Feature Article

Effect of nurse staffing on rehospitalizations and emergency department visits among short-stay nursing home residents: A Cross-sectional study using the US Nursing Home Compare database

Ari Min, PhD, RN, Hye Chong Hong, PhD, RN*

Chung-Ang University Red Cross College of Nursing, 84 Heukseok-ro, Bldg 106, Dongjak-gu, Seoul 06974, South Korea

A R T I C L E   I N F O

A B S T R A C T

The aim of this study was to examine the effect of nurse staffing on both rehospitalizations and emergency department emergency department visits among short-stay nursing home residents in the United States. Data for 11,132 US nursing homes were drawn from the 2016 Nursing Home Compare. We found that the Five-Star Quality Rating System's staffing rating is a significant predictor for the rates of rehospitalization and emergency department visit among short-stay nursing home residents. The results also showed the importance of registered nurse staffing in nursing home caring for short-stay residents. Administrators and policy-makers can employ the findings to formulate management strategies that will reduce rehospitalizations and emergency department visits among nursing home residents.

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Introduction

In 1998, the Center for Medicaid and Medicare Services (CMS) launched an online report card called Nursing Home Compare (NHC) that was intended to provide residents and providers with information on every Medicare- and Medicaid-certified nursing home in the United States.[1] In 2008, the CMS implemented the Five-Star Quality Rating System on NHC to provide residents and their families with nursing home quality information in order to help them make better-informed decisions about their healthcare services; the system was also intended to encourage nursing homes to improve their quality of care. The rating system includes three domains of nursing home quality: health inspection results, staffing, and quality measures. A one-star rating designates the poorest performance and a five-star rating the highest.[2] Recently, the CMS supplemented the rating system with new claims-based quality measures for short-stay nursing home residents to promote their successful discharge; these measures included rehospitalizations within 30 days after an original nursing home admission and an outpatient emergency department (ED) visit within 30 days after an original nursing home admission.[3] Short-stay

residents were defined as those who are discharged from nursing homes within 100 days of their admission. Inclusion of the new measures was significant because it marked the first time the CMS had included quality measures that were not based on self-reporting by nursing homes. These new measures may more accurately represent nursing home quality of care than did earlier measure versions, as the data for earlier measures included in the facility-reported Minimum Data Set (MDS) may have over-reported nursing home quality.[4]

Preventable rehospitalizations and frequent ED visits among residents of nursing homes, especially skilled nursing facilities, are gaining substantial attention, as they are associated with increased expense, patient complications, and healthcare-associated infections.[5-7] In the United States, approximately one in five hospital patients discharged to a nursing home is readmitted to an acute care hospital within 30 days of discharge and approximately 90% of such readmissions are unplanned.[8] In addition, nursing home residents are frequent users of EDs, accounting for more than 2.2 million ED visits annually, and are more likely to be admitted to acute care hospitals than are non-residents.[9] The cost of readmissions to acute care hospitals is massive. In 2011, for example, approximately $41.3 billion was spent on rehospitalizations in the United States; 58.2% of this cost was shared by Medicare, 18.4% by Medicaid, and 19.6% by private insurance.[10]

As part of the Patient Protection and Affordable Care Act, the Hospital Readmission Reduction Program (HRRP) was established to reduce prospective payment system reimbursements to hospitals with excessive

30-day readmission rates and promote a more efficient mixture of acute and post-acute care services.[8,11,12] In 2011, over 25% of Medicare patients admitted to an acute care hospital were discharged to a skilled nursing home or rehabilitation facility.[13] Nursing homes (skilled nursing facilities and nursing homes with rehabilitation services) play a critical role in post-acute care for patients who are discharged from acute care hospitals but are either limited or unable to care for themselves at home. The goal of post-acute care is to prepare patients to fully or nearly return to their premorbid condition at lower costs and to prevent unnecessary readmission to acute care hospitals.[11,14] However, the rehospitalization rate has been on a constant rise over the years, as have its associated costs.[14,15]

Researchers have reported that higher nurse staffing increased the capability of nursing homes to care for clinically complex residents.[16,17] Licensed nurses working in nursing homes, generally registered nurses (RN) and licensed practical nurses (LPN), are vital in preventing resident rehospitalization, as they conduct resident assessments, monitor changes in health status, communicate with family members, and contact physicians if there are any significant changes in residents' health.[18,19] Based on resident acuity, the average CMS recommended staffing levels are 1.08 RN hours, 0.66 LPN hours, and 2.43 certified nurse aide (CNA) hours per resident day.[2] Despite a large body of research demonstrating a relationship between nurse staffing levels and nursing home care quality and outcomes, overall staffing levels are still below recommendations and the staffs primarily consist of unlicensed nurses.[4,20] Moreover, previous research has not determined the impact of RN staffing levels on resident rehospitalizations and ED visits, even though they are important indicators of nursing home quality.

Because the earlier NHC version did not include short-stay resident rehospitalizations and outpatient ED visits as quality measures for nursing homes, few studies have examined both these variables for short-stay residents admitted to nursing homes for post-acute care. As a result, little is known about how nurse staffing levels simultaneously impact rehospitalizations and ED visits. Previous studies indicated that rehospitalizations and ED visits were significantly related[7] and that high rates of these quality measures may reflect deficiencies in the healthcare delivery system.[21] Therefore, we examined the effect of nurse staffing on both rehospitalizations and ED visits among short-stay nursing home residents based on the newly adopted NHC.

The specific aims of this study were to examine the effect of nurse staffing on both rehospitalizations and ED visits among short-stay nursing home residents in the United States. We hypothesized that higher nurse staffing levels would simultaneously reduce the rates of rehospitalizations and ED visits for short-stay residents. This study was the first to comprehensively examine how nurse staffing levels in nursing homes impact both rehospitalizations and ED visits among short-stay residents based on the new NHC.

Material and methods

Data and sample

Data for this study were obtained from NHC, a national database that includes a health inspection database, the MDS, and Medicare claims data from the CMS. NHC also includes a set of five-star ratings (e.g., health inspection, staffing, RN staffing, quality, and overall ratings) for each nursing home that participates in Medicare and Medicaid. The Five-Star Quality Rating System was developed to help residents and their families distinguish between higher- and lower-performing nursing homes in terms of quality of care.

We used the 2016 NHC dataset for short-stay residents of nursing homes, which included new quality measures such as rehospitalizations and ED visits (data for 2017 had not yet been released). The data were downloaded in January 2018 from the CMS NHC website and included records for 15,655 nursing home facilities. However, we found that in 2016, 4523 of the nursing homes (28.9%) had not reported both rehospitalizations and ED visits to the CMS, so we could not include those facilities in our analysis. A notable difference between the included and excluded nursing homes was their total number of beds: on average, the nursing homes included in this study had a larger number of beds than the excluded nursing homes, meaning that nursing homes with a relatively small number of beds tended not to report both quality measures. Of the excluded nursing homes, approximately 30% had 50 beds or fewer and close to 47% had 51 to 100 beds. Finally, 11,132 nursing homes with complete data were included in this study.

Measures

Dependent variables: quality measures

Two measures were employed to represent the quality of nursing home care for short-stay residents: the percentage of residents rehospitalized after nursing home admission and the percentage of residents who had an outpatient ED visit. Data for these quality measures were drawn from Medicare claims and were updated every 6 months.[22] The short-stay resident quality measures indicate the average quality of resident care in a nursing home for individuals who stayed in a nursing home for less than 101 days. Specifically, the rehospitalization measure reports "the percentage of all new admissions or readmissions to a nursing home from a hospital where the resident was re-admitted to a hospital for an inpatient or observation stay within 30 days of entry or reentry" and the ED visit measure reports "the percentage of all new admissions or readmissions to a nursing home from a hospital where the resident had an outpatient ED visit (i.e., an ED visit not resulting in an inpatient hospital admission) within 30 days of entry or reentry" (p.13).[22] Lower percentages of these two measures reflect better quality of care.

Key independent variables: nurse staffing measures

In this study, we used two nurse staffing measures in the Five-Star Quality Rating System: the total nurse staffing rating and the RN staffing rating. The rating system, which was implemented in 2008,[22] is based on a five-point scale with 1 representing "much below average" and 5 representing "much above average"; a percentile-based method is used to assign the 1–5 rating. The total nurse staffing rating was based on the hours worked by RNs, LPNs, and CNAs whereas the RN staffing rating was based on the hours worked by RNs only.

The CMS determined the percentile cut points for staffing ratings using nursing hours per resident day (HPRD) data reported through December 2011 (Table 1). The HPRD was calculated by dividing the total number of productive hours provided by all nursing staff (RN, LPN, and CNA) with direct care responsibilities by resident days.[22] In this study, three case-mix adjusted nurse staffing measures were employed: RN HPRD, LPN HPRD, and CNA HPRD. The RN HPRD included RNs, RN directors of nursing, and nurses with administrative duties; the LPN HPRD included licensed practical and licensed vocational nurses; the CNA HPRD included CNAs, aides in training, and medication aides/technicians. The staffing data from the CMS included both facility employees (full and part time) and individuals employed under an organization (agency) contract or an individual contract for Medicare- and/or Medicaid-certified beds only. The case-mix adjustment for the staffing data was based on MDS assessment data for the residents of each nursing home on the last day of the quarter in which the staffing data were collected. CMS adjusted the reported nurse staffing levels using the Resource Utilization Group (RUG-III) case-mix system. The case-mix adjusted HPRD for each nursing home was calculated using the formula,

$$\text{Hours}_{\text{adjusted}} = (\text{Hours}_{\text{Reported}}/\text{Hours}_{\text{Expected}}) * \text{Hours}_{\text{National Average}} \quad (1)$$

Table 1
Descriptive summary of short-stay nursing home characteristics.

Variable	Mean (SD)	Median (IQR)	*n* (%)
Quality measures			
Rehospitalizations (%)	22.46 (5.48)	22.38 (19−26)	
Emergency department visits (%)	11.87 (4.93)	11.31 (8−15)	
Nurse staffing levels			
Total nurse staffing rating (cut points)			
1 star (<3.262)			1225 (11.39)
2 stars (3.262−3.660)			1518 (14.12)
3 stars (3.661−4.172)			3304 (30.72)
4 stars (4.173−4.417)			3499 (32.54)
5 stars (≥4.418)			1208 (11.23)
RN staffing rating (cut points)			
1 star (<0.283)			891 (8.29)
2 stars (0.283−0.378)			1676 (15.58)
3 stars (0.379−0.512)			2963 (27.55)
4 stars (0.513−0.709)			2981 (27.72)
5 stars (≥0.710)			2243 (20.86)
Total HPRD	3.99 (0.96)	3.85 (3.43−4.37)	
RN HPRD	0.57 (0.29)	0.51 (0.39−0.68)	
LPN HPRD	1.09 (0.50)	1.07 (0.82−1.32)	
CNA HPRD	2.46 (0.67)	2.38 (2.08−2.76)	
Facility characteristics			
Ownership			
For-profit			2601 (23.37)
Nonprofit			8022 (72.06)
Government			509 (4.57)
Total beds			
≤50			793 (7.12)
51−100			3706 (33.29)
101−150			4329 (38.89)
≥151			2304 (20.70)
Hospital affiliation			
Hospital-based			410 (3.68)
Nonhospital-based			10,722 (96.32)
Occupancy rate (%)	0.82 (0.17)	0.85 (0.74−0.92)	

Note. SD, standard deviation; IQR, interquartile range; *n*, number of nursing homes; RN HPRD, registered nurse hours per resident day; LPN HPRD, licensed practical nurse hours per resident day; CNA HPRD, certified nurse aide hours per resident day. The rating cut points were updated in April 2012 by the Center for Medicaid and Medicare Services (CMS, 2017).

where the national average HPRD is the mean across all nursing homes of the reported HPRD for each nurse staff type and the expected HPRDs are based on the distribution of residents by the RUG-III in the quarter closest to the date of the most recent survey.[22]

Covariates: facility characteristics

We employed facility characteristics as control variables that potentially affect the dependent variables (i.e., quality measures). Ownership was measured as a categorical variable representing three categories: for-profit, nonprofit, and government-owned nursing homes. Total beds represented the total number of beds in each nursing home and this variable was categorized as 50 or fewer, between 51 and 100, between 101 and 150, and 151 or more beds. Hospital affiliation was used as a dichotomous variable coded as 1 for hospital-based and 0 for nonhospital-based nursing homes. Occupancy rate was quantified as the total number of residents divided by the total number of federally certified beds. These control variables were drawn from previous studies in which they were shown to affect rehospitalizations and ED visits among nursing home residents. In addition, cutoff values used to determine how variables would be divided or dichotomized were based on previous research.[11,15,16,23,24]

Data analysis

Descriptive statistics were used to express nurse staffing levels, quality outcomes, and facility characteristics. Multivariate regression analyses were performed to examine associations between nurse staffing and rehospitalizations and ED visits among short-stay residents of nursing homes while controlling for facility characteristics. Those facility characteristics that showed potentially confounding relationships between nurse staffing and rehospitalizations and between nurse staffing and ED visits were included in the final multivariate models based on their correlations ($p < .05$). All analyses were performed using Stata Version 13 (StataCorp., TX) and a level of significance of $p < .05$. The multivariate regression was performed using the "mvreg" command in Stata 13.

Results

Our sample included 11,132 nursing homes in the United States. As shown in Table 1, the overall rates of rehospitalizations and ED visits were approximately 23% (median = 22.4) and 12% (median = 11.3), respectively. The rehospitalization rate was 0% in 5 nursing homes and the ED visit rate was 0% in 37 nursing homes. For the total nurse staffing ratings, approximately 11% of nursing homes were rated with 1 star, 30% with 3 stars, and 11% with 5 stars; for the RN staffing ratings, close to 8% of nursing homes were rated with 1 star and 21% with 5 stars. The average RN, LPN, and CNA hours were 0.57, 1.09, and 2.46 HPRD, respectively. Most nursing homes (72%) were nonprofit, while 23% were for-profit. More than half (59%) of the nursing homes had over 100 beds. Most nursing homes (96%) were nonhospital-based, and the average nursing home occupancy rate was 81.67%.

Bivariate analyses were conducted to examine associations between nurse staffing measures, facility characteristics, and quality measures (Table 2). The total nurse staffing ratings and RN staffing ratings were significantly related to both rehospitalization and ED visit rates ($p < .001$). Among facility characteristics, ownership status, total beds, and hospital affiliation were also significantly associated with both rehospitalization and ED visit rates ($p < .001$). Small but significant relationships were identified between the percentage of rehospitalizations and RN HPRD ($r = -0.089$, $p < .001$) and LPN HPRD ($r = 0.068$, $p < .001$). Similarly, small but significant relationships were identified between the percentage of ED visits and RN HPRD ($r = -0.094$, $p < .001$), LPN HPRD ($r = 0.034$, $p < .001$), CNA HPRD ($r = -0.027$, $p = .005$), and occupancy rate ($r = -0.082$, $p < .001$). The percentages of rehospitalizations and ED visits were significantly correlated ($r = 0.243$, $p < .001$). Effects of facility characteristics were controlled for in the multivariate regression models.

The results of the multivariate regression models are shown in Table 3. We examined the effects of five-star staffing ratings (total nurse and RN) on the percentages of rehospitalizations and ED visits while controlling for covariates; the rehospitalization and ED visit rates were significantly correlated ($r = 0.238$, $p < .001$) in this model. The results revealed that nursing homes with higher total nurse staffing ratings calculated based on the RNs, LPNs, and CNAs HPRD were more likely to have higher rehospitalization rates ($B = 0.307$, $p < .001$) and that nursing homes with lower RN staffing ratings calculated based on only RNs HPRD were more likely to have higher rehospitalization rates ($B = -0.608$, $p < .001$). Moreover, nursing homes with lower RN staffing ratings were more likely to have higher ED visits ($B = -0.394$, $p < .001$). Nonprofit nursing homes were more likely to have higher rehospitalization rates ($B = 0.585$, $p < .001$) than for-profit facilities and government owned nursing homes were more likely to have lower rehospitalization rates ($B = -1.041$, $p < .001$) compared to for-profit facilities. In addition,

Table 2
Associations between nurse staffing ratings, facility characteristics, and quality measures.

Variable	Percent of rehospitalizations		Percent of emergency department visits	
	Mean (SD)	p-value	Mean (SD)	p-value
Nurse staffing (five-star rating)				
Total nurse staffing rating				
1 star	22.85 (5.25)	<0.001	12.61 (4.98)	<0.001
2 stars	22.79 (5.38)		12.06 (4.85)	
3 stars	22.75 (5.43)		12.04 (4.96)	
4 stars	22.22 (5.42)		11.63 (4.84)	
5 stars	21.54 (5.88)		11.06 (4.80)	
RN staffing rating				
1 star	23.20 (5.40)	<0.001	12.85 (5.22)	<0.001
2 stars	23.17 (5.38)		12.32 (4.95)	
3 stars	22.76 (5.29)		11.93 (4.86)	
4 stars	22.23 (5.44)		11.81 (4.87)	
5 stars	21.54 (5.68)		11.12 (4.76)	
Facility characteristics				
Ownership				
For-profit	21.89 (5.73)	<0.001	11.23 (4.90)	<0.001
Nonprofit	22.74 (5.37)		12.10 (4.89)	
Government	21.05 (5.29)		11.55 (5.50)	
Total beds				
≤50	21.59 (6.51)	<0.001	11.23 (5.65)	<0.001
51−100	22.29 (5.91)		12.27 (5.25)	
101−150	22.69 (5.22)		12.15 (4.83)	
≥151	22.61 (4.76)		10.94 (4.13)	
Hospital affiliation				
Hospital-based	21.05 (5.74)	<0.001	10.73 (5.15)	<0.001
Nonhospital-based	22.52 (5.46)		11.92 (4.92)	

Note. RN, registered nurse.

Table 3
Results of multivariate linear regression models estimating effects of nurse staffing and facility characteristics on rehospitalizations and emergency department visits.

Variable	Percent of rehospitalizations		Percent of emergency department visits	
	B	SE	B	SE
Nurse staffing levels				
Total nurse staffing rating	0.307*	0.077	−0.046	0.069
RN staffing rating	−0.608*	0.073	−0.394*	0.065
Facility characteristics				
Ownership				
For-profit (reference)				
Nonprofit	0.585*	0.133	0.441*	0.069
Government	−1.041*	0.269	0.122	0.240
Total beds				
≤50 (reference)				
51−100	0.245	0.241	0.391	0.215
101−150	0.496	0.243	0.056	0.217
≥151	0.408	0.257	−1.160*	0.229
Hospital affiliation				
Hospital-based	−0.495	0.322	−0.296	0.286
Nonhospital-based (reference)				
Occupancy rate	−0.130	0.316	−2.819*	0.282

Note. RN, registered nurse.
* $p < .001$.

nonprofit nursing homes were more likely to have higher ED visits ($B = 0.441$, $p < .001$) that for-profit facilities. Nursing homes were less likely to have ED visits if nursing homes had 151 or more beds, compared to facilities with 50 beds or fewer ($B = -1.160$, $p < .001$), and more likely to have ED visits if nursing homes had a lower occupancy rate ($B = -2.819$, $p < .001$). Further evaluation revealed that the RN staffing ratings simultaneously influenced the percentages of rehospitalizations and ED visits, ($F = 43.28$, $p < .001$). The assumption of lack of multicollinearity was met, as the variance inflation factor (VIF) values of all independent variables were less than 10 (mean VIF = 2.71).

Discussion

The aims of this study were to examine the effects of nurse staffing on both rehospitalizations and ED visits among short-stay nursing home residents in the United States. Preventable rehospitalizations and frequent ED visits among post-acute care nursing home residents are significant healthcare issues in the United States. Previous studies have reported that nearly one in five nursing home residents, especially those in skilled nursing facilities, were rehospitalized within 30 days.[14−16,25] Consistent with those studies, we found that the overall rehospitalization rate was approximately 23%. However, while

previous studies have reported ED visit rates ranging from 1.2% to 1.9%, we observed an ED visit rate of about 12%. These divergent findings are likely attributable to differences in the studies themselves: previous researchers reported annual ED visits among nursing home residents aged 65 years or more, whereas our study focused on ED visits within a 30-day window among short-stay residents of any age in Medicare- and Medicaid-certified nursing homes. In addition, we found that rehospitalization and ED visit rates were significantly correlated. There is a dearth of research on the relationships between ED visits within 30 days and readmissions to acute care hospitals within 30 days. Thus, further research is needed to confirm the correlation that we observed.

Compared to the CMS-recommended minimum staffing levels of 0.75 RN HPRD, 0.55 LPN HPRD, and 2.80 CNA HPRD,[26] our staffing results showed 0.57 RN HPRD, 1.09 LPN HPRD, and 2.46 CNA HPRD, indicating that RN staffing levels are still low. Numerous studies, including systematic reviews of the literature, have shown a strong relationship between nurse staffing levels and quality outcomes. In particular, previous research has identified the strongest positive relationship between RN staffing levels (as compared to LPN and CNA levels) and nursing home quality.[15,17,27−29] However, few previous studies have addressed the relationship between nurse staffing levels and rates for rehospitalization and ED visits and no previous study has examined the simultaneous effect of nurse staffing on these variables. Supporting the findings of Thomas et al,[15] we observed that lower RN staffing levels strongly predicted higher percentages of rehospitalizations and ED visits within 30 days of nursing home admission. Because our study is one of very few that have examined this relationship, further research is needed to verify our findings. Finally, our study expanded on previous knowledge of the relationship between rehospitalization and ED visit rates by demonstrating that they were positively correlated. ED visits often provide a pathway for hospital admission.[9] Therefore, reducing rates of preventable ED visits is vital to reducing rehospitalization rates.

Nearly 96% of all US nursing homes receive at least some funds from Medicaid and Medicare for resident services and must be inspected and certified annually. The CMS summarizes data from the inspections and makes the information available to patients and their families. Under the Five-Star Quality Rating System, one of the factors inspected is nurse staffing. Our study results showed that only the RN staffing ratings were significantly associated with lower rehospitalization rates and that the total nurse staffing ratings were significantly associated with higher rehospitalization rates. In other words, the higher total nursing staffing ratings did not guarantee the better quality of care, but the RN staffing ratings were a significant factor for the better quality of care which was indicated by lower rehospitalization rates. Contrary to our findings, Pandolfi et al,[11] reported that total nurse and RN staffing ratings were both significantly associated with lower rehospitalization rates within 30 days of nursing home admission. The difference in the results may be explained by the characteristics of the nursing home residents in the study by Pandolfi et al,[11] which was limited to nursing home residents with acute myocardial infarction, heart failure, or pneumonia, and who may have required a level and mixture of nursing staff different from those of the nursing homes in our study. In addition, studies by Neuman et al and Unroe et al found no significant relationship between the total nurse staffing rate and rehospitalizations after controlling for facility characteristics.[16,30] Neuman et al and Unroe et al included both short-stay and long-stay residents in their studies,[16,30] whereas we included only short-stay residents (those spending 100 days or less in nursing homes). Short-stay residents recently admitted to nursing homes might be more fragile and require more rehabilitation and thus need more care from nurses, making them more sensitive to nurse staffing and particularly to RN staffing. Based on our study findings, nursing home administrators and policy-makers should consider increasing the proportion of RNs on staff rather than the total number of nursing staff to reduce rehospitalization rates in nursing homes.

Limitations

Our study has some limitations that should be noted. First, although we controlled for significant facility characteristics in our analysis, we did not account for resident-level variables such as demographic characteristics, diagnoses, functional impairments, and mental impairments that may contribute to differences in the rates of rehospitalizations and ED visits. As another limitation of our study, we did not take the locations of nursing homes into account. Previous researchers have reported that state or county characteristics are associated with rehospitalization rates of nursing home residents.[31] Thus, further research is necessary to examine the influence of resident-level characteristics and state- or county-level characteristics on rehospitalizations and ED visits. In addition, we could not compare predictors of ED visits within 30 days of nursing home admission to previous research because studies of ED visits within the 30-day window are scarce in the literature. Thus, further research is also needed to confirm our findings in this regard. Finally, because approximately 29% of nursing homes that had not reported both rehospitalizations and ED visits were excluded from the study using listwise deletion, the results of this study cannot be generalized to all US nursing homes and should be interpreted with caution, especially with regard to nursing homes with relatively small numbers of beds.

These limitations notwithstanding, our study expands knowledge of nursing home care in the United States by analyzing recent national-level data for both Medicaid- and Medicare-certified nursing homes and short-stay residents. Notably, our study results revealed that the RN staffing level remains low in US nursing homes, even though a higher level could play a major role in reducing rates of rehospitalizations and ED visits for short-stay nursing home residents. The Protecting Access to Medicare Act of 2014 includes rehospitalization-related penalties for nursing homes beginning in 2018,[32] thus policies for minimum RN staffing, as well as total nurse staffing in nursing homes should be examined in future studies. We believe that nursing home administrators and policy-makers should consider our findings when developing management strategies for reducing rehospitalizations and ED visits among nursing home residents.

Conclusions

Using a 2016 NHC dataset, we found that nurse staffing ratings in the Five-Star Quality Rating System are significant predictors for rates of rehospitalizations and ED visits among short-stay nursing home residents. Moreover, rates of rehospitalizations and ED visits were positively correlated and nurse staffing levels simultaneously predicted rehospitalization and ED visit rates. As our study is one of the first to examine the relationship between nurse staffing and rehospitalizations and ED visits among short-stay nursing home residents, further research is needed to confirm our findings.

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Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.gerinurse.2018.09.010.

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