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4-2023

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# Relationships Between Residence Characteristics and Nursing Home Compare Database Quality Measures

Brian J. Puckett, BA, Erica E. Ryherd, PhD, Natalie A. Manley, MD, MPH, and Carey S. Ryan, PhD

## ABSTRACT

**Objective:** This study evaluated relationships between physical characteristics of nursing home residences and quality-of-care measures.

**Design:** This was a cross-sectional ecologic study. The dependent variables were 5 Centers for Medicare & Medicaid Services (CMS) Nursing Home Compare database long-stay quality measures (QMs) during 2019: percentage of residents who displayed depressive symptoms, percentage of residents who were physically restrained, percentage of residents who experienced 1 or more falls resulting in injury, percentage of residents who received antipsychotic medication, and percentage of residents who received anti-anxiety medication. The independent variables were 4 residence characteristics: ownership type, size, occupancy, and region within the United States. We explored how different types of each residence characteristic compare for each QM.

**Setting, participants, and measurements:** Quality measure values from 15,420 CMS-supported nursing homes across the United States averaged over the 4 quarters of 2019 reporting were used. Welch's analysis of variance was performed to examine whether the mean QM values for groups within each residential characteristic were statistically different.

**Results:** Publicly owned and low-occupancy residences had the highest mean QM values, indicating the poorest performance. Nonprofit and high-occupancy residences generally had the lowest (ie, best) mean QM values. There were significant differences in mean QM values among nursing home sizes and regions.

**Conclusion:** This study suggests that residence characteristics are related to 5 nursing home QMs. Results suggest that physical characteristics may be related to overall quality of life in nursing homes.

**Keywords:** quality of care, quality measures, residence characteristics, Alzheimer's disease and related dementias.

More than 55 million people worldwide are living with Alzheimer's disease and related dementias (ADRD).<sup>1</sup> With the aging of the Baby Boomer population, this number is expected to rise to more than 78 million worldwide by 2030.<sup>1</sup> Given the growing number of cognitively impaired older adults, there is an increased need for residences designed for the specialized care of this population. Although there are dozens of living options for the elderly, and although most specialized establishments have the resources to meet the immediate needs of their residents, many facilities lack universal design features that support a high quality of life for someone with ADRD or mild cognitive impairment. Previous research has shown relationships between behavioral and psy-

chological symptoms of dementia (BPSD) and environmental characteristics such as acoustics, lighting, and indoor air temperature.<sup>2,3</sup> Physical behaviors of BPSD, including aggression and wandering, and psychological symptoms, such as depression, anxiety, and delusions, put residents at risk of injury.<sup>4</sup> Additionally, BPSD is correlated with caregiver burden and stress.<sup>5-8</sup> Patients with dementia may also experience a lower stress threshold, changes in perception of space, and decreased

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short-term memory, creating environmental difficulties for those with ADRD<sup>9</sup> that lead them to exhibit BPSD due to poor environmental design. Thus, there is a need to learn more about design features that minimize BPSD and promote a high quality of life for those with ADRD.<sup>10</sup>

Although research has shown relationships between physical environmental characteristics and BPSD, in this work we study relationships between possible BPSD indicators and 4 residence-level characteristics: ownership type, size, occupancy, and region in the United States (determined by location of the Centers for Medicare & Medicaid Services [CMS] regional offices). We analyzed data from the CMS Nursing Home Compare database for the year 2019.<sup>11</sup> This database publishes quarterly data and star ratings for quality-of-care measures (QMs), staffing levels, and health inspections for every nursing home supported by CMS. Previous research has investigated the accuracy of QM reporting for resident falls, the impact of residential characteristics on administration of antipsychotic medication, the influence of profit status on resident outcomes and quality of care, and the effect of nursing home size on quality of life.<sup>12-16</sup> Additionally, research suggests that residential characteristics such as size and location could be associated with infection control in nursing homes.<sup>17</sup>

Certain QMs, such as psychotropic drug administration, resident falls, and physical restraint, provide indicators of agitation, disorientation, or aggression, which are often signals of BPSD episodes. We hypothesized that residence types are associated with different QM scores, which could indicate different occurrences of BPSD. We selected 5 QMs for long-stay residents that could potentially be used as indicators of BPSD. Short-stay resident data were not included in this work to control for BPSD that could be a result of sheer unfamiliarity with the environment and confusion from being in a new home.

## Methods

### *Design and Data Collection*

This was a cross-sectional ecologic study aimed at exploring relationships between aggregate residential characteristics and QMs. Data were retrieved from the 2019 annual archives found in the CMS provider data catalog on nursing homes, including rehabilitation services.<sup>11</sup>

The dataset provides general residence information, such as ownership, number of beds, number of residents, and location, as well as residence quality metrics, such as QMs, staffing data, and inspection data. Residence characteristics and 4-quarter averages of QMs were retrieved and used as cross-sectional data. The data used are from 15,420 residences across the United States. Nursing homes located in Guam, the US Pacific Territories, Puerto Rico, and the US Virgin Islands, while supported by CMS and included in the dataset, were excluded from the study due to a severe absence of QM data.

### *Dependent Variables*

We investigated 5 QMs that were averaged across the 4 quarters of 2019. The QMs used as dependent variables were percentage of residents who displayed depressive symptoms (depression), percentage of residents who were physically restrained (restraint), percentage of residents who experienced 1 or more falls resulting in a major injury (falls), percentage of residents who received antipsychotic medication (antipsychotic medication), and percentage of residents who received anti-anxiety or hypnotic medication (anti-anxiety medication).

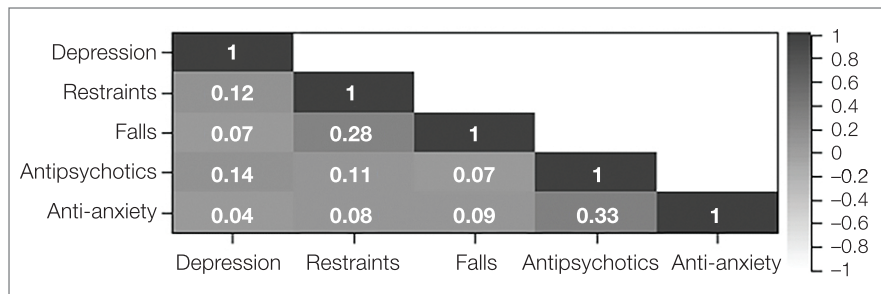
A total of 2471 QM values were unreported across the 5 QM analyzed: 501 residences did not report depression data; 479 did not report restraint data; 477 did not report falls data; 508 did not report antipsychotic medication data; and 506 did not report anti-anxiety medication data. A residence with a missing QM value was excluded from that respective analysis.

To assess the relationships among the different QMs, a Pearson correlation coefficient  $r$  was computed for each unique pair of QMs (**Figure**). All QMs studied were found to be very weakly or weakly correlated with one another using the Evans classification for very weak and weak correlations ( $r < 0.20$  and  $0.20 < r < 0.39$ , respectively).<sup>18</sup>

### *Independent Variables*

A total of 15,420 residences were included in the study. Seventy-nine residences did not report occupancy data, however, so those residences were excluded from the occupancy analyses. We categorized the ownership of each nursing home as for-profit, nonprofit, or public. We categorized nursing home size, based on quartiles of

## Residence Characteristics and Quality Measures



**Figure.** Pearson correlation coefficients between the 5 quality measures studied.

nursing home occupancy as high (>92% occupancy), medium (73% to 91% occupancy), and low (<73% occupancy) based on quartiles of the occupancy distribution. For the regional analysis, we grouped states together based on the CMS regional offices: Atlanta, Georgia;

the size distribution, as large (>127 beds), medium (64 to 126 beds), and small (<64 beds). This method for categorizing the residential characteristics was similar to that used in previous work.<sup>19</sup> Similarly, we categorized

Boston, Massachusetts; Chicago, Illinois; Dallas, Texas; Denver, Colorado; Kansas City, Missouri; New York, New York; Philadelphia, Pennsylvania; San Francisco, California; and Seattle, Washington.<sup>20</sup>

**Table 1. Mean Quality Measure Scores per Residence Characteristic**

Characteristic	No.	Depression	Restraint	Falls	Antipsychotic medication	Anti-anxiety medication
No. of nursing homes reported		14,919	14,941	14,943	14,912	14,914
Ownership		<b>Mean (SD) quality measure scores, %</b>				
For profit	10,813	5.74 (12.86)	0.28 (2.14)	3.22 (2.79)	14.49 (10.17)	20.37 (10.21)
Nonprofit	3614	4.00 (8.03)	0.30 (2.59)	3.81 (2.69)	13.27 (8.14)	17.52 (9.55)
Public	993	5.28 (9.20)	0.54 (3.57)	3.92 (3.29)	15.18 (10.84)	20.44 (10.23)
Size						
Small	3766	5.11 (9.78)	0.33 (2.28)	3.78 (3.27)	14.39 (11.06)	19.15 (11.26)
Medium	7785	5.12 (11.48)	0.30 (2.48)	3.42 (2.88)	14.13 (9.72)	20.28 (10.01)
Large	3869	5.87 (13.64)	0.27 (2.20)	3.01 (2.13)	14.40 (8.75)	19.11 (9.25)
Occupancy						
Low	3835	6.03 (12.78)	0.26 (1.65)	3.63 (2.80)	14.79 (10.34)	20.94 (10.46)
Medium	7660	5.40 (11.90)	0.34 (3.00)	3.39 (3.02)	14.28 (9.77)	19.59 (10.10)
High	3846	4.45 (10.25)	0.25 (1.32)	3.15 (2.36)	13.69 (9.31)	18.76 (9.76)
Region						
Atlanta, GA	2712	2.37 (5.67)	0.36 (2.41)	3.24 (2.28)	15.05 (8.88)	24.42 (10.25)
Boston, MA	873	2.99 (4.88)	0.20 (1.11)	3.59 (2.02)	16.93 (9.18)	18.07 (8.46)
Chicago, IL	3374	12.11 (19.04)	0.29 (2.94)	3.68 (3.78)	14.53 (10.26)	18.71 (9.75)
Dallas, TX	2092	3.17 (8.15)	0.25 (1.75)	3.65 (2.55)	13.66 (8.57)	23.31 (9.86)
Denver, CO	618	4.80 (6.52)	0.17 (0.69)	4.22 (2.88)	14.97 (9.62)	15.57 (7.99)
Kansas City, MO	1488	4.25 (5.72)	0.19 (1.01)	4.24 (2.81)	16.68 (12.75)	21.29 (10.67)
New York, NY	982	5.40 (11.09)	0.33 (1.31)	2.79 (2.02)	10.50 (6.21)	15.18 (8.41)
Philadelphia, PA	1395	3.08 (5.89)	0.24 (2.28)	3.27 (2.28)	14.42 (7.66)	19.36 (8.80)
San Francisco, CA	1450	2.10 (9.14)	0.50 (3.31)	1.97 (2.14)	10.56 (10.85)	14.51 (8.99)
Seattle, WA	436	7.44 (11.99)	0.47 (4.12)	2.97 (2.38)	15.12 (10.23)	13.44 (7.70)

Table 2. Mean Differences for Ownership, Size, and Occupancy Pairwise Comparisons

Characteristic comparisons	Quality measures, %				
	Depression	Restraint	Falls	Antipsychotic medication	Anti-anxiety medication
	Mean difference (95% CI)				
Ownership					
Nonprofit–for profit	–1.74 <sup>a</sup> (–2.17 to –1.30)	0.02 (–0.09 to 0.14)	0.59 <sup>a</sup> (0.47–0.72)	–1.22 <sup>a</sup> (–1.62 to –0.82)	–2.85 <sup>a</sup> (–3.29 to –2.39)
Public–for profit	–0.46 (–1.12 to 0.30)	0.26 (–0.01 to 0.54)	0.70 <sup>a</sup> (0.45–0.99)	0.69 (–0.16 to 1.54)	0.07 (–0.74 to 0.88)
Public–nonprofit	1.28 <sup>a</sup> (0.51–2.04)	0.24 (–0.05 to 0.53)	0.11 (–0.17 to 0.38)	1.91 <sup>a</sup> (1.03–2.79)	2.92 <sup>a</sup> (2.05–3.78)
Size					
Small–medium	–0.01 (–0.51 to 0.49)	0.03 (–0.09 to 0.14)	0.36 <sup>a</sup> (0.21–0.51)	0.26 (–0.25 to 0.77)	–1.13 <sup>a</sup> (–1.67 to –0.61)
Small–large	–0.76 <sup>b</sup> (–1.40 to –0.10)	0.06 (–0.06 to 0.18)	0.77 <sup>a</sup> (0.61–0.92)	–0.01 (–0.56 to 0.54)	0.04 (–0.54 to 0.61)
Medium–large	–0.75 <sup>c</sup> (–1.34 to –0.15)	0.03 (–0.07 to 0.14)	0.41 <sup>a</sup> (0.30–0.52)	–0.27 (–0.68 to 0.16)	1.17 <sup>a</sup> (0.73–1.61)
Occupancy					
Low–high	1.58 <sup>a</sup> (0.95–2.21)	0.01 (–0.07 to 0.09)	0.48 <sup>a</sup> (0.34–0.62)	1.10 <sup>a</sup> (0.56–1.63)	2.18 <sup>a</sup> (1.63–2.73)
Medium–high	0.95 <sup>a</sup> (0.44–1.46)	0.09 (–0.01 to 0.19)	0.24 <sup>a</sup> (0.12–0.36)	0.59 <sup>b</sup> (0.15–1.04)	0.83 <sup>a</sup> (0.37–1.30)
Medium–low	–0.63 <sup>c</sup> (–1.22 to –0.04)	0.08 (–0.02 to 0.18)	–0.24 <sup>a</sup> (–0.37 to –0.10)	–0.51 <sup>c</sup> (–0.98 to –0.03)	–1.35 <sup>a</sup> (–1.83 to –0.86)

<sup>a</sup>Significance at  $P < .001$ .<sup>b</sup>Significance at  $P < .01$ .<sup>c</sup>Significance at  $P < .05$ .

## Analyses

We used Levene's test to determine whether variances among the residential groups were equal for each QM, using an a priori  $\alpha = 0.05$ . For all 20 tests conducted (4 residential characteristics for all 5 QMs), the resulting  $F$ -statistics were significant, indicating that the assumption of homogeneity of variance was not met.

We therefore used Welch's analysis of variance (ANOVA) to evaluate whether the groups within each residential characteristic were the same on their QM means. For example, we tested whether for-profit, nonprofit, and public residences had significantly different mean depression rates. For statistically significant differences, a Games-Howell post-hoc test was conducted to test the difference between all unique pairwise comparisons. An a priori  $\alpha = 0.05$  was used for both Welch's ANOVA and post-hoc testing. All analyses were conducted in RStudio Version 1.2.5033 (Posit Software, PBC).

## Results

### Mean Differences

Mean QM scores for the 5 QMs investigated, grouped by residential characteristic for the 2019 year of reporting, are shown in **Table 1**. It should be noted that the number of residences that reported occupancy data ( $n = 15,341$ ) does not equal the total number of residences included in the study ( $N = 15,420$ ) because 79 residences did not report occupancy data. For all QMs reported in Table 1, lower scores are better. **Table 2** and **Table 3** show results from pairwise comparisons of mean differences for the different residential characteristic and QM groupings. Mean differences and 95% CI are presented along with an indication of statistical significance (when applicable).

### Ownership

Nonprofit residences had significantly lower (ie, better) mean scores than for-profit and public residences for 3 QMs:

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Table 3. Mean Differences for Region Pairwise Comparisons

Regions	Quality measures, %				
	Depression	Restraint	Falls	Antipsychotic medication	Anti-anxiety medication
BOS-ATL	0.62 (-0.02 to 1.25)	-0.16 (-0.35 to 0.03)	0.35 <sup>a</sup> (0.09-0.61)	1.88 <sup>a</sup> (0.74-3.01)	-6.35 <sup>a</sup> (-7.46 to -5.24)
CHI-ATL	9.74 <sup>a</sup> (8.64-10.85)	-0.07 (-0.28 to 0.16)	0.44 <sup>a</sup> (0.19-0.69)	-0.52 (-1.31 to 0.27)	-5.72 <sup>a</sup> (-6.54 to -4.87)
DAL-ATL	0.80 <sup>b</sup> (0.13-1.47)	-0.11 (-0.30 to 0.09)	0.41 <sup>a</sup> (0.18-0.64)	-1.39 <sup>a</sup> (-2.21 to 0.58)	-1.11 <sup>b</sup> (-2.05 to -0.17)
DEN-ATL	2.43 <sup>a</sup> (1.51-3.36)	-0.19 <sup>c</sup> (-0.36 to -0.02)	0.98 <sup>a</sup> (0.58-1.38)	-0.08 (-1.45 to -1.29)	-8.85 <sup>a</sup> (-10.1 to -7.63)
KC-ATL	1.88 <sup>a</sup> (1.29-2.47)	-0.17 (-0.34 to 0.003)	1.00 <sup>a</sup> (0.73-1.28)	1.63 <sup>a</sup> (0.44-2.82)	-3.13 <sup>a</sup> (-4.22 to -2.04)
NY-ATL	3.03 <sup>a</sup> (1.84-4.23)	-0.03 (-0.23 to 0.18)	-0.45 <sup>a</sup> (-0.70 to -0.20)	-4.55 <sup>a</sup> (-5.39 to -3.71)	-9.24 <sup>a</sup> (-10.3 to -8.17)
PHI-ATL	0.71 <sup>c</sup> (0.09-1.33)	-0.12 (-0.37 to 0.13)	0.03 (-0.21 to 0.28)	-0.63 (-1.49 to 0.23)	-5.06 <sup>a</sup> (-6.05 to -4.07)
SF-ATL	-0.27 (-1.13 to 0.59)	0.14 (-0.17 to 0.46)	-1.27 <sup>a</sup> (-1.50 to -1.04)	-4.49 <sup>a</sup> (-5.57 to -3.41)	-9.91 <sup>a</sup> (-10.9 to -8.91)
SEA-ATL	5.07 <sup>a</sup> (3.18-6.99)	0.11 (-0.54 to 0.77)	-0.27 (-0.67 to 0.12)	0.07 (-1.61 to 1.74)	-10.98 <sup>a</sup> (-12.3 to -9.62)
CHI-BOS	9.12 <sup>a</sup> (7.95-10.30)	0.09 (-0.11 to 0.29)	0.09 (-0.21 to 0.39)	-2.40 <sup>a</sup> (-3.53 to -1.25)	0.64 (-0.42 to 1.70)
DAL-BOS	0.18 (-0.60 to 0.96)	0.05 (-0.12 to 0.23)	0.06 (-0.22 to 0.34)	-3.27 <sup>a</sup> (-4.43 to -2.11)	5.24 <sup>a</sup> (4.10-6.39)
DEN-BOS	1.81 <sup>a</sup> (0.81-2.82)	-0.03 (-0.18 to 0.12)	0.63 <sup>a</sup> (0.19-1.06)	-1.96 <sup>b</sup> (-3.56 to -0.35)	-2.50 <sup>a</sup> (-3.89 to -1.11)
KC-BOS	1.26 <sup>a</sup> (0.55-1.97)	-0.01 (-0.16 to 0.14)	0.65 <sup>a</sup> (0.33-0.97)	-0.25 (-1.70 to 1.20)	3.22 <sup>a</sup> (1.95-4.49)
NY-BOS	2.41 <sup>a</sup> (1.16-3.67)	0.13 (-0.05 to 0.31)	-0.80 <sup>a</sup> (-1.11 to -0.50)	-6.43 <sup>a</sup> (-7.60 to -5.25)	-2.89 <sup>a</sup> (-4.15 to -1.64)
PHI-BOS	0.09 (-0.64 to 0.82)	0.04 (-0.19 to 0.27)	-0.32 <sup>c</sup> (-0.61 to -0.02)	-2.51 <sup>a</sup> (-3.70 to -1.32)	1.29 <sup>c</sup> (0.10-2.48)
SF-BOS	-0.89 (-1.83 to 0.06)	0.30 (-0.004 to 0.61)	-1.62 <sup>a</sup> (-1.90 to -1.34)	-6.37 <sup>a</sup> (-7.73 to -5.01)	-3.56 <sup>a</sup> (-4.75 to -2.37)
SEA-BOS	4.45 <sup>a</sup> (2.52-6.38)	0.27 (-0.38 to 0.92)	-0.62 <sup>a</sup> (-1.05 to -0.20)	-1.81 (-3.67 to 0.06)	-4.63 <sup>a</sup> (-6.12 to -3.12)
DAL-CHI	-8.94 <sup>a</sup> (-10.2 to -7.75)	-0.04 (-0.24 to 0.17)	-0.03 (-0.30 to 0.25)	-0.87 <sup>c</sup> (-1.70 to -0.05)	4.60 <sup>a</sup> (3.72-5.48)
DEN-CHI	-7.31 <sup>a</sup> (-8.66 to -5.96)	-0.12 (-0.31 to 0.06)	0.54 <sup>b</sup> (0.11-0.97)	0.44 (-0.94 to 1.82)	-3.14 <sup>a</sup> (-4.32 to -1.97)
KC-CHI	-7.86 <sup>a</sup> (-9.02 to -6.71)	-0.10 (-0.29 to 0.08)	0.56 <sup>a</sup> (0.25-0.88)	2.15 <sup>a</sup> (0.95-3.35)	2.58 <sup>a</sup> (1.54-3.61)
NY-CHI	-6.71 <sup>a</sup> (-8.26 to -5.16)	0.04 (-0.17 to 0.25)	-0.89 <sup>a</sup> (-1.19 to -0.60)	-4.03 <sup>a</sup> (-4.89 to -3.18)	-3.53 <sup>a</sup> (-4.56 to -2.52)
PHI-CHI	-9.03 <sup>a</sup> (-10.2 to -7.87)	-0.05 (-0.31 to 0.20)	-0.41 <sup>a</sup> (-0.69 to -0.12)	-0.11 (-0.98 to 0.76)	0.65 (-0.28 to 1.58)
SF-CHI	-10.01 <sup>a</sup> (-11.3 to -8.70)	0.21 (-0.12 to 0.54)	-1.71 <sup>a</sup> (-1.99 to -1.43)	-3.97 <sup>a</sup> (-5.06 to -2.88)	-4.20 <sup>a</sup> (-5.14 to -3.27)

Regions	Quality measures, %				
	Depression	Restraint	Falls	Antipsychotic medication	Anti-anxiety medication
SEA-CHI	-4.67 <sup>a</sup> (-6.81 to -2.54)	0.18 (-0.48 to 0.84)	-0.71 <sup>a</sup> (-1.14 to -0.29)	0.59 (-1.10 to 2.27)	-5.27 <sup>a</sup> (-6.58 to -3.96)
DEN-DAL	1.63 <sup>a</sup> (0.61-2.66)	-0.08 (-0.24 to 0.07)	0.57 <sup>a</sup> (0.15-0.98)	1.31 (-0.08 to 2.70)	-7.74 <sup>a</sup> (-9.00 to -6.49)
KC-DAL	1.08 <sup>a</sup> (0.34-1.82)	-0.06 (-0.21 to 0.08)	0.59 <sup>a</sup> (0.30-0.88)	3.02 <sup>a</sup> (1.80-4.24)	-2.02 <sup>a</sup> (-3.15 to -0.90)
NY-DAL	2.23 <sup>a</sup> (0.95-3.51)	0.08 (-0.11 to 0.26)	-0.86 <sup>a</sup> (-1.14 to -0.59)	-3.16 <sup>a</sup> (-4.04 to -2.28)	-8.13 <sup>a</sup> (-9.24 to -7.03)
PHI-DAL	-0.09 (-0.86 to 0.67)	-0.01 (-0.25 to 0.21)	-0.38 <sup>a</sup> (-0.64 to -0.11)	0.76 (0.13-1.65)	-3.95 <sup>a</sup> (-4.98 to -2.92)
SF-DAL	-1.07 <sup>c</sup> (-2.04 to -0.10)	0.25 (-0.06 to 0.56)	-1.68 <sup>a</sup> (-1.94 to -1.42)	-3.10 <sup>a</sup> (-4.21 to -1.99)	-8.80 <sup>a</sup> (-9.84 to -7.77)
SEA-DAL	4.27 <sup>a</sup> (2.32-6.21)	0.22 (-0.43 to 0.87)	-0.68 <sup>a</sup> (-1.09 to -0.27)	1.46 (-0.24 to 3.15)	-9.87 <sup>a</sup> (-11.3 to -8.49)
KC-DEN	-0.55 (-1.53 to 0.42)	0.02 (-0.10 to 0.15)	0.02 (-0.42 to 0.46)	1.71 <sup>c</sup> (0.07-3.35)	5.72 <sup>a</sup> (4.35-7.09)
NY-DEN	0.60 (-0.83 to 2.02)	0.16 <sup>c</sup> (0.002-0.33)	-1.43 <sup>a</sup> (-1.86 to -1.00)	-4.47 <sup>a</sup> (-5.88 to -3.06)	-0.39 (-1.75 to 0.96)
PHI-DEN	-1.72 <sup>a</sup> (-2.72 to -0.73)	0.07 (-0.15 to 0.29)	-0.95 <sup>a</sup> (-1.37 to -0.52)	-0.55 (-1.97 to 0.87)	3.79 <sup>a</sup> (2.50-5.09)
SF-DEN	-2.70 <sup>a</sup> (-3.86 to -1.55)	0.33 <sup>c</sup> (0.04-0.63)	-2.25 <sup>a</sup> (-2.67 to -1.83)	-4.41 <sup>a</sup> (-5.98 to 2.85)	-1.06 (-2.35 to 0.24)
SEA-DEN	2.64 <sup>b</sup> (0.59-4.68)	0.30 (-0.34 to 0.95)	-1.25 <sup>a</sup> (-1.78 to -0.72)	0.15 (-1.87 to 2.17)	-2.13 <sup>b</sup> (-3.71 to -0.54)
NY-KC	1.15 (-0.08 to 2.39)	0.14 (-0.02 to 0.30)	-1.45 <sup>a</sup> (-1.77 to -1.15)	-6.18 <sup>a</sup> (-7.42 to -4.94)	-6.11 <sup>a</sup> (-7.35 to -4.87)
PHI-KC	-1.17 <sup>a</sup> (-1.87 to -0.48)	0.05 (-0.17 to 0.26)	-0.97 <sup>a</sup> (-1.28 to -0.66)	-2.26 <sup>a</sup> (-3.51 to -1.01)	-1.93 <sup>a</sup> (-3.09 to -0.76)
SF-KC	-2.15 <sup>a</sup> (-3.06 to -1.23)	0.31 <sup>c</sup> (0.02-0.61)	-2.27 <sup>a</sup> (-2.57 to -1.97)	-6.12 <sup>a</sup> (-7.53 to -4.71)	-6.78 <sup>a</sup> (-7.95 to -5.61)
SEA-KC	3.19 <sup>a</sup> (1.27-5.11)	0.28 (-0.36 to 0.92)	-1.27 <sup>a</sup> (-1.71 to -0.83)	-1.56 (-3.46 to 0.34)	-7.85 <sup>a</sup> (-9.33 to -6.36)
PHI-NY	-2.32 <sup>a</sup> (-3.57 to -1.08)	-0.09 (-0.33 to 0.14)	0.48 <sup>a</sup> (0.20-0.77)	3.92 <sup>a</sup> (3.00-4.84)	4.18 <sup>a</sup> (3.03-5.34)
SF-NY	-3.30 <sup>a</sup> (-4.68 to -1.92)	0.17 (-0.14 to 0.48)	-0.82 <sup>a</sup> (-1.09 to -0.54)	0.06 (-1.07 to 1.19)	-0.67 (-1.82 to 0.49)
SEA-NY	2.04 (-0.14 to 4.21)	0.14 (-0.51 to 0.79)	0.18 (-0.24 to 0.60)	4.62 <sup>a</sup> (2.91-6.32)	-1.74 <sup>b</sup> (-3.20 to -0.26)
SF-PHI	-0.98 <sup>c</sup> (-1.91 to -0.04)	0.26 (-0.8 to 0.61)	-1.30 <sup>a</sup> (-1.57 to -1.03)	-3.86 <sup>a</sup> (-5.00 to -2.72)	-4.85 <sup>a</sup> (-5.93 to -3.77)
SEA-PHI	4.36 <sup>a</sup> (2.43-6.29)	0.23 (-0.44 to 0.90)	-0.30 (-0.73 to 0.11)	0.70 (-1.02 to 2.41)	-5.92 <sup>a</sup> (-7.33 to -4.50)
SEA-SF	5.34 <sup>a</sup> (3.32-7.35)	-0.03 (-0.73 to 0.66)	1.00 <sup>a</sup> (0.58-1.41)	4.56 <sup>a</sup> (2.72-6.39)	-1.07 (-2.48 to 0.35)

ATL, Atlanta, Georgia; BOS, Boston, Massachusetts; CHI, Chicago, Illinois; DAL, Dallas, Texas; DEN, Denver, Colorado; KC, Kansas City, Missouri; NY, New York, New York; PHI, Philadelphia, Pennsylvania; SEA, Seattle, Washington; SF, San Francisco, California.

<sup>a</sup>Significance at  $P < .001$ .

<sup>b</sup>Significance at  $P < .01$ .

<sup>c</sup>Significance at  $P < .05$ .



## Residence Characteristics and Quality Measures

resident depression, antipsychotic medication use, and anti-anxiety medication use. For-profit and public residences did not significantly differ in their mean values for these QMs. For-profit residences had a significantly lower mean score for resident falls than both nonprofit and public residences, but no significant difference existed between scores for nonprofit and public residence falls. There were no statistically significant differences between mean restraint scores among the ownership types.

### Size

Large (ie, high-capacity) residences had a significantly higher mean depression score than both medium and small residences, but there was not a significant difference between medium and small residences. Large residences had the significantly lowest mean score for resident falls, and medium residences scored significantly lower than small residences. Medium residences had a significantly higher mean score for anti-anxiety medication use than both small and large residences, but there was no significant difference between small and large residences. There were no statistically significant differences between mean scores for restraint and antipsychotic medication use among the nursing home sizes.

### Occupancy

The mean scores for 4 out of the 5 QMs exhibited similar relationships with occupancy rates: resident depression, falls, and antipsychotic and anti-anxiety medication use. Low-occupancy residences consistently scored significantly higher than both medium- and high-occupancy residences, and medium-occupancy residences consistently scored significantly higher than high-occupancy residences. On average, high-occupancy ( $\geq 92\%$ ) residences reported better QM scores than low-occupancy ( $< 73\%$ ) and medium-occupancy (73% to 91%) residences for all the QMs studied except physical restraint, which yielded no significant results. These findings indicate a possible inverse relationship between building occupancy rate and these 4 QMs.

### Region

Pairwise comparisons of mean QM scores by region are shown in Table 3. The Chicago region had a significantly

higher mean depression score than all other regions, while the San Francisco region's score was significantly lower than all other regions, except Atlanta and Boston. The Kansas City region had a significantly higher mean score for resident falls than all other regions, with the exception of Denver, and the San Francisco region scored significantly lower than all other regions in falls. The Boston region had a significantly higher mean score for administering antipsychotic medication than all other regions, except for Kansas City and Seattle, and the New York and San Francisco regions both had significantly lower scores than all other regions except for each other. The Atlanta region reported a significantly higher mean score for administering anti-anxiety medication than all other regions, and the Seattle region's score for anti-anxiety medication use was significantly lower than all other regions except for San Francisco.

### Discussion

This study presented mean percentages for 5 QMs reported in the Nursing Home Compare database for the year 2019: depression, restraint, falls, antipsychotic medication use, and anti-anxiety medication use. We investigated these scores by 4 residential characteristics: ownership type, size, occupancy, and region. In general, publicly owned and low-occupancy residences had the highest scores, and thus the poorest performances, for the 5 chosen QMs during 2019. Nonprofit and high-occupancy residences generally had the lowest (ie, better) scores, and this result agrees with previous findings on long-stay nursing home residents.<sup>21</sup> One possible explanation for better performance by high-occupancy buildings could be that increased social interaction is beneficial to nursing home residents as compared with low-occupancy buildings, where less social interaction is probable. It is difficult to draw conclusions regarding nursing home size and region; however, there are significant differences among sizes for 3 out of the 5 QMs and significant differences among regions for all 5 QMs. The analyses suggest that residence-level characteristics are related to QM scores. Although reported QMs are not a direct representation of resident quality of life, this work agrees with previous research that residential characteristics have some impact on the lives of nursing home residents.<sup>13-17</sup> Improvements in QM reporting and changes in quality improvement goals since the formation



of Nursing Home Compare exist, suggesting that nursing homes' awareness of their reporting duties may impact quality of care or reporting tendencies.<sup>21,22</sup> Future research should consider investigating the impacts of the COVID-19 pandemic on quality-reporting trends and QM scores.

Other physical characteristics of nursing homes, such as noise, lighting levels, and air quality, may also have an impact on QMs and possibly nursing home residents themselves. This type of data exploration could be included in future research. Additionally, future research could include a similar analysis over a longer period, rather than the 1-year period examined here, to investigate which types of residences consistently have high or low scores or how different types of residences have evolved over the years, particularly considering the impact of the COVID-19 pandemic. Information such as staffing levels, building renovations, and inspection data could be accounted for in future studies. Different QMs could also be investigated to better understand the influence of residential characteristics on quality of care.

## Conclusion

This study suggests that residence-level characteristics are related to 5 reported nursing home QMs. Overall, non-profit and high-occupancy residences had the lowest QM scores, indicating the highest performance. Although the results do not necessarily suggest that residence-level characteristics impact individual nursing home residents' quality of life, they suggest that physical characteristics affect overall quality of life in nursing homes. Future research is needed to determine the specific physical characteristics of these residences that affect QM scores.

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Disclosures: None reported.

doi:10.12788/jcom.0123

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