Appropriate Nurse Staffing Levels for U.S. Nursing Homes

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ABSTRACT: US nursing homes are required to have sufficient nursing staff with the appropriate competencies to assure resident safety and attain or maintain the highest practicable level of physical, mental, and psychosocial well-being of each resident. Minimum nurse staffing levels have been identified in research studies and recommended by experts. Beyond the minimum levels, nursing homes must take into account the resident acuity to assure they have adequate staffing levels to meet the needs of residents. This paper presents a guide for determining whether a nursing home has adequate and appropriate nurse staffing. We propose five basic steps to: (1) determine the collective resident acuity and care needs, (2) determine the actual nurse staffing levels, (3) identify appropriate nurse staffing levels to meet residents care needs, (4) examine evidence regarding the adequacy of staffing, and (5) identify gaps between the actual staffing and the appropriate nursing staffing levels based on resident acuity. Data sources and specific methodologies are analyzed, compared, and recommended. The goal is to assist nursing home nurses and administrators to ensure adequate nursing home staffing levels that protect resident health, safety, and well-being.

KEYWORDS: Nursing homes, nurse staffing, quality, safety

Insufficient nursing staff can negatively impact all residents in a nursing home. Numerous studies of nursing homes reveal a strong positive relationship between the number of nursing home staff who provide direct care to residents on a daily basis and the quality of care and quality of life of residents. The dangers of understaffing have been common knowledge in the U.S. nursing home industry since the 1980s and culminated with the findings from the 2001 study of Appropriateness of Minimum Nurse Staffing Ratios published by Centers for Medicare & Medicaid Services (CMS).[1,2]

On the whole, higher nurse staffing improves both the process and outcome measures of nursing home quality. The impact of registered nurses (RNs) is particularly positive, but total nursing staff including licensed vocational nurses or licensed practical nurses (LVNs/LPNs) and certified nursing assistants (CNAs) is also important.[2-4] 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 (ADLs) independence; less weight loss, dehydration, and insufficient morning care; less improper and overuse of antipsychotics; and lower mortality rates.[2-17] There is also a strong relationship between higher nurse staffing levels in nursing homes and reduced emergency room use and rehospitalizations from nursing homes.[18-20] The strongest relationships are found between higher nurse staffing levels and lower deficiencies (violations of federal regulations) for poor quality issued by state surveyors.[2-4,9,21,22]

Unfortunately, most nursing homes do not provide sufficient staffing to ensure basic quality. More than half of U.S. nursing homes were found to have lower RN, CNA, and total nurse staffing levels than those recommended by experts and one quarter of nursing homes had dangerously low staffing (below 3.53 total nursing hours) in 2014.[23] Overall, 75% of nursing homes almost never met the CMS expected RN staffing levels based on resident acuity in the 2017 to 2018 period.[24] During the coronavirus pandemic in 2020, the importance of adequate nursing home staffing has become even more critical in protecting the health and safety of residents.[25-27]

Aims

The purpose of this article is to present a guide for determining whether a facility has adequate and appropriate nurse staffing. For background, we review the current federal and state nurse staffing requirements. This article describes 5 basic steps for determining staffing levels.

The first step is to determine the collective resident acuity and care needs using resident assessment data and overall resident care plans. Data are available from (1) facility assessments of the staffing resources needed to provide care,[28] (2) data from aggregate Minimum Data Set (MDS) resident assessments,[29] (3) Resource Utilization Group (RUG) scores,[8,30] (4) CMS Form 672 summary of resident needs and cost reports,[31] (5) resident ADL summaries, and (6) the new Patient-Driven Payment Model (PDPM) scores.[32]

The second step is to determine the actual staffing levels for RNs, LVNs/LPNs, and CNAs. This step involves analyzing data from facility internal staffing reports and payroll data, payroll-based journal (PBJ) data[33] that facilities submit to CMS (since 2017 to replace CMS Form 671 data), and Medicare and Medicaid cost report data.

The third step is to determine appropriate nurse staffing levels based on resident acuity. Sources of information include (1) research studies, expert opinions, and professional recommendations on the minimum staffing levels; (2) CMS 1995 to 1997 staff time measurement (STM) study[34]; (3) CMS expected staffing based on resident acuity and staffing time[35]; and (4) new research to calculate minimum CNA staffing.[36]

The fourth step is to examine the empirical evidence regarding whether the facility staffing is adequate including federal and state deficiencies and complaints; accurate quality measures such as hospital readmission rates; missed or omitted care and staff turnover rates; adverse events/sentinel events; and other care problems.

The final step is to compare the actual facility staffing to the appropriate nursing staffing levels based on acuity for each facility to identify gaps. The goal of the guide is to assist directors of nursing and administrators in nursing homes to ensure adequate nursing home staffing levels to protect resident health, safety, and well-being.

Federal Nursing Home Staffing Requirements

Federal regulations specify that each nursing home must provide nursing services to meet the care needs of its residents[28]:

> The facility must have sufficient nursing staff with the appropriate competencies and skills sets to provide nursing and related services to assure resident safety and attain or maintain the highest practicable level of physical, mental, and psychosocial well-being of each resident, as determined by resident assessments and individual plans of care and considering the number, acuity and diagnoses of the facility's resident population in accordance with the facility assessment . . . (see 42 C.F.R. § 483.70(e)).[37]

The facility must have sufficient numbers of RNs, LVNs/LPNs, and 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.[37] The director of nursing may serve as a charge nurse only when the facility has an average daily occupancy of 60 or fewer residents (§483.35(b)(3)).[37] Nursing homes are required to post daily nurse staffing data on the total number and type of staff and the actual hours worked by nursing staff by shift.[28,37] In addition, facilities must ensure that nursing staff have the competency and skill sets to care for residents.[33]

A majority of states have established their own minimum staffing requirements for nursing homes.[38] For example, California law requires all nursing homes to provide at least 3.5 nursing hours per resident day (hprd), although some waivers are allowed (California Health & Safety Code §1276.5). State minimum standards are generally well below the levels recommended by researchers and experts to consistently meet the needs of each resident.

Step 1. Determine the Collective Resident Acuity and Care Needs

Resident care needs differ depending on the acuity level (or casemix) of the facility residents. Higher acuity rates require higher staffing levels.

Facility assessments of resident needs and facility resources

Federal regulations established in 2016 require nursing homes to conduct a facility self-assessment regarding what resources and qualified staff are needed to meet patient needs and to carry out all functions at the facility level.[28] This analysis must consider the following: "the number, acuity and diagnoses of the facility's resident population" and must be updated at least annually (42 C.F.R. §483.70(e)).[37] The facility assessment is similar to strategic and capital budget planning and should define the facility's strategy and resource allocation decisions. While corporate input may be included, the assessment must be conducted at the facility using many sources of information such as the residents, families, councils, and representatives (§483.35).[37] Although the requirement began in November 2017 and no standard forms or tools are prescribed, facility assessment is meant to be a thorough process and surveyors may issue a deficiency if the assessment is generic or designed to justify a preexisting or budgeted staffing levels and not based on resident acuity. While the quality of assessment information will vary by facility, it may be useful for determining necessary resident care services and nursing resources.

Resident assessments and care plans

The collective resident acuity and care needs are based on an aggregation of individual resident assessments and care needs. Federal law requires nursing homes to conduct a comprehensive resident assessment of each individual resident on admission, annually, and when a significant change in status occurs.[39] Centers for Medicare & Medicaid Services developed a standardized resident assessment instrument using the MDS form, revised and updated,[29] to document resident's needs, strengths, goals, functional and health status, life history, and preferences. The MDS data are reported electronically by each facility to CMS and are used by facilities to develop a comprehensive care plan that determines appropriate resident services, needs, and preferences.[37]

Resource Utilization Group classification

Beginning in 1998, CMS used the summary RUG score (from MDS Section Z) to adjust its Medicare nursing home

Table 1. Comparison of methods for rating case-mix for activities of daily living for CNAs.

ASSISTANCE ITEMS	SCORING SYSTEM	AVERAGE FACILITY SCORE[A]
RUGS IV	0 = Independent	Lightest care = Score 0-1
Bed mobility	1 = Independent/supervision	Light care = Score 2-5
Toileting	2 = Limited assistance	Moderate = Score 6-10
Transferring	3 = Extensive assistance or total dependence (1 person)	Extensive = Score 11-14
Eating	4 = Extensive assistance or total dependence (2 persons)	Most Extensive = Score 15-16
Schnelle et al[36,a]	1 = Yes; 0 = No	
Exercise/range of motion	1. Exercise/ROM	1. Lightest care (yes on 1)
Dressing/hygiene	2. Exercise/ROM and dressing/hygiene	2. Light care (yes on 2)
Incontinent toileting	3. Exercise/ROM and incontinent toileting	3. Moderate (yes on 3)
Repositioning	4. Exercise/ROM, dressing/hygiene, eating	4. Moderate (yes on 4)
Eating	5. Exercise/ROM, dressing/hygiene, toileting, repositioning	5. Heavy (yes on 5)
	6. Exercise/ROM, dressing/hygiene, toileting, repositioning, eating	6. Heaviest (bedbound; yes on 6)
	7. Exercise/ROM, dressing/hygiene, toileting, repositioning, eating	7. Heaviest (not bedbound; yes on 7)
CMS Form 672[a]		
Dressing/hygiene	1 = Independent/Supervision	Light care = Score 1-4
Toileting	2 = Moderate (Assist of 1 or 2 staff)	Moderate = Score 5-7
Transferring	3 = Dependent	Extensive = Score 8-10
Eating		Most extensive = Score 11-12
PDPM		
Bed mobility (average)	4 = Independent/setup/cleanup	1. Heaviest = Score 0-5
a. Sit to lying	3 = Supervision	2. Heavy = Score 0-14
b. Lying to sit	2 = Partial/moderate	3. Moderate = Score 6-14
Toileting	1 = Substantial/maximal	4. Light = Score 11-16
Transfer (average)	0 = Dependent	5. Lightest = Score 15-16
a. Sit to Stand		
b. Chair/bed to chair		
c. Toilet transfer		
Eating		

Abbreviations: CNA, certified nursing assistants; CMS, Centers for Medicare & Medicaid Services; PDPM, Patient-Driven Payment Model; ROM, range of motion; RUGS IV, Resource Utilization Groups IV.
For each method, each resident is given a score on each activity item based on the amount of assistance needed and an average is calculated for each resident. Then, the average score can be calculated for all residents.
[a]Average facility score suggested by authors.

prospective payment to give higher payments for higher resident acuity because more nursing and therapy time was required to provide care.[29,30,40] The RUG classification system was updated over time until RUG IV was adopted in 2010 with 66 groups.[41,42] RUGs used 7 overall hierarchical categories: Rehabilitation Extensive, Rehabilitation, Extensive, Special, Clinically Complex, Behavioral and Impaired Cognition, and Physically Functioning, but the latter 2 categories were not paid by

Medicare. Each RUG group was based on a CMS STM study that identified the amount of nursing time provided for the resident groups.[34]

The assessment of ADL was one component of the RUG scores.[29,30] Table 1 shows the 4 assessment items under RUGS IV: bed mobility, toilet use, transferring, and eating with scores ranging from 1 to 4. ADL summary scores ranged from 0 to 1 for lightest care to the most extensive care (scores

15-16; the scoring system and facility scores are proposed by the article authors).

Schnelle et al classification system for activities of daily living

Using data from the MDS physical functioning section (GG), Schnelle and colleagues divided residents into workload categories based on 5 ADL activities: (1) exercise or range of motion; (2) dressing and hygiene; (3) incontinent toileting, (4) repositioning; and (5) eating[36] (see Table 1). These items were given a score of 1 for yes for needing any assistance or zero for no assistance. Overall workload scores were categorized into 7 groups from lightest care to heaviest.[36]

Centers for Medicare & Medicaid Services Form 672 and cost report data

Earlier approaches used resident acuity data from the CMS Form 672 at the time of each facility's annual state survey (see Table 1).[31] These self-reported data show the number of residents who need assistance or are dependent in 4 ADLs with scores from 1 to 3 for the lightest to heaviest level of care needs.[31] These summary scores ranged from 1 to 12 for the 4 activities. Form 672 provided data at one point in time and was not as accurate or complete as the RUG scores.

Medicare cost report data show the payer mix of residents, available on-line from CMS. Medicaid cost report data from state agencies also show the payer mix for each facility. Medicare pays for short-term residents with high nursing and therapy needs compared with long-term residents paid by state-federal Medicaid who may have lower acuity levels.[40]

PDPM Classification of Residents

In October 2019, CMS changed its Medicare PPS reimbursement rate methodology.[32] Rather than using the RUG IV scores, nursing homes must calculate PDPM scores for nursing and other services.[32] The PDPM system has casemix-adjusted components for therapies, nontherapy ancillary (NTA), and nursing. PDPM classifies Medicare residents into only 25 nursing groups in 4 categories: (1) Extensive Services, (2) Special Care High, (3) Special Care Low, and (4) Clinically Complex (excluding the Behavioral and Impaired Cognition and Physical Functioning categories not paid by Medicare).[32] PDPM separates nursing care needs and co-morbidities from therapy time, while truncating the range of licensed nursing groups and nursing times. The PDPM uses 4 ADL activities[32] (see Table 1). The scores are inverted from all other methods and the summary scores are categorized into 2 groups: low acuity and high acuity.[32] Because 2 PDPM groups do not distinguish among the wide range of ADL acuity levels, the authors recommend subdividing the summary scores into 5 groups that range from the lightest to the heaviest care needs, comparable to the RUGs and Schnelle et al. ADL categories (see Table 1).

The CMS PDPM payment methodology was primarily designed for Medicare reimbursement and not specifically to promote high-quality staffing nor to assure that nursing homes meet the federal regulatory requirements.[32] Although the change from the RUGs system to PDPM for short-term Medicare residents may have an impact on payment, it is beyond the scope of this article to speculate on the financial impact. The impact of the Medicare PDPM changes on state Medicaid payment systems for longer stay residents is also not clear at this time.

Summary

The aggregate care needs of facility residents are the basis for determining staffing needs for each facility. To simplify the acuity classifications, we recommend that facilities use 6 basic nursing acuity levels consistent with the Medicare PDPM categories from highest to lowest: (1) Extensive Services, (2) Special Care High, (3) Special Care Low, (4) Clinically Complex, and the non-Medicare groups: (5) Behavioral Symptoms and (6) Reduced Physical Functioning.[32] These categories identify both the licensed nursing care needs and the CNA care needs.[36] Based on a summary of individual resident assessments, each facility should determine its aggregate resident acuity level.

Step 2. Determine the Facility's Actual Per Resident Per Day Staffing Levels

Nursing homes are required to maintain records documenting staffing levels on a per-resident-day basis.[37] This information is maintained, reported, and summarized in daily posted staffing reports, staff time cards, amended staff time cards, facility payroll data, and summary staff reports. These reports provide hours per resident day (hprd) calculations of nursing hours provided by types of nursing staff (RNs, LVNs/LPNs, and CNAs) for all regular, temporary, contract, or agency staff.

Payroll–Based Journal data

Since the 1990s, unaudited nurse staffing data were submitted by facilities to CMS on Form 671 for the 2-week period prior to the annual state survey.[33,35] Form 671 staffing data were used for Medicare Nursing Home Compare website between 2009 and 2018, but these data were not considered accurate because they were not validated. Facilities often increased staffing just prior to the annual survey to improve their survey results and inflate their staffing ratings on Medicare Nursing Home Compare.[43]

Since 2017, nursing homes have been required to submit daily staffing to CMS on the PBJ reporting system on a quarterly basis.[33] The PBJ data (if submitted on a timely basis according to CMS protocols) are reported on the CMS website (data. Medicare.gov) and summary data are shown on the Medicare Nursing Home Compare website beginning in 2018.

After the PBJ reporting was implemented, 7 out of 10 nursing homes reported 12% lower staffing on average than reported on CMS Form 671.[43] Overall, 70% of nursing homes reported higher total direct staffing time prior to reporting PBJ data in 2017 to 2018.[24] The PBJ data, however, are not always audited by CMS, so there may be errors when compared with audited facility payroll records. Therefore, an audit of original facility payroll data (rather than the electronically reported PBJ data) verifying the names and types of staff that worked in direct care is the most accurate way to determine actual staffing levels. In addition, PBJ data can be compared with the staffing data on each facility's Medicare cost reports (which are not audited by CMS and include all paid staffing hours rather than the actual productive staffing hours provided to residents). Some state Medicaid cost reports provide productive or actual nursing hours (rather than paid hours) and are more accurate than the staffing data on CMS Form 671.[44]

Inadequate staffing levels in most nursing homes

According to the PBJ data, nursing home staffing levels are highly variable and much lower on weekends than during the week.[43] RN levels were 42% lower, LVN/LPN levels were 17% lower, and CNA levels were 9% lower on weekends in 2017 to 2018.[24] Based on resident acuity, 54% of nursing homes did not meet the total CMS expected staffing level 80%of the time. About 75% of nursing homes almost never met the CMS expected RN staffing level based on resident acuity in 2017 to 2018.[24] These findings show that most nursing homes are not taking resident acuity data into full account to determine sufficient staffing levels. In 2019, based on PBJ data, the average nursing home reported total nurse staffing levels of 3.89 hours per resident day (hprd; which included 0.68 RN hprd, 0.88 LVN/LPN hprd, and 2.33 CNA hprd including all administrative nurses).[45]

Step 3. Determine Appropriate Nurse Staffing Levels Based on Resident Acuity

The next step is to determine the appropriate staffing levels for each nursing home, by considering the research on the minimum staffing levels as well as the CMS expected staffing hours using the STM studies.

Research studies on minimum staffing levels

A CMS study in 2001 established the importance of having a minimum of 0.75 RN hours per resident day (hprd), 0.55 licensed nurse (LVN/LPN) hprd, and 2.8 (to 3.0) CNA hprd, for a total of 4.1 nursing hprd to prevent harm or jeopardy to residents.[1] As part of this study, a simulation model of direct care workers (CNAs) established the minimum number of staff necessary to provide 5 basic aspects of daily care in a facility with different levels of resident acuity. An increase in CNA staffing resulted in an increased frequency of care provided to

residents and reduced the missed or delayed care episodes. The results indicated that the minimum threshold for CNA staffing was 2.8 hprd to ensure consistent, timely care to residents and that the CNA staffing levels should be the same on the day shifts as on the evening shifts because the resident care needs are essentially the same.[1]

A number of organizations have endorsed the minimum of 4.1 hprd standard and have suggested that at least 30% of hours should be provided by RNs and LVNs/LPNs and facilities should have 24 hour RN care.[46-48] Some experts have recommended even higher staffing standards (a total of 4.55 hprd) to improve the quality of nursing home care, with higher adjustments for higher resident acuity.[49]

It should be noted that there is a wide range of actual staffing levels in U.S. nursing homes. In addition, skilled nursing homes in hospital-based facilities with distinct parts and subacute facilities tend to have substantially higher staffing levels. For example, California established higher Medicaid payment rates for these types of facilities, where adult free-standing subacute and hospital-based distinct part are required 3.8 to 4.0 RN and LVN/LPN hrpd combined and a total of 5.8 to 6.0 nursing hprd.[50]

Centers for Medicare & Medicaid Services staff time measurement study

The 1995 to 1997 STM study determined the amount of nursing time for each RUG group.[34] The STM included data on 3,933 Medicare, Medicaid, and self-pay residents in 150 Medicare-certified SNF units in 12 States (Kansas, Maine, Mississippi, Ohio, South Dakota, Texas, Washington, California, Florida, Maryland, Colorado, and New York). Medicare residents were 34% of the sample. Nursing staff used electronic wands over a period of 48 hours to record episodes of direct resident care lasting 30 seconds or more. Nonresident-specific nursing time (such as meetings, administration, breaks, and unit maintenance) was allocated equally across all unit residents.[34,40]

Table 2 shows the results of the STM staff times for each RUG category (converted from minutes to hprd), which were used to set Medicare prospective rates from 1998 through 2010.[28,30,40] STM was also used by the CMS Medicare Nursing Home Compare website for determining expected staffing levels based on the RUG scores from 2009 through March 31, 2018.[35] The RN hprd were found to be 2.78 and total nursing were 7.44 hprd for the highest RUG category (see Table 2).

The STM times are considered too low for RNs and LVNs/LPNs providing care for residents in the Behavioral Symptoms and the Reduced Physical Functioning groups compared with minimum estimates by the CMS 2001 study and experts.[1,36,46-49] This could have occurred because of over sampling the highest Medicaid RUG groups and under sampling the low RUG categories. The STM study was based on the typical care provided to nursing home residents rather than the care that should have been provided. In the absence of a new and

Table 2. Comparison of nursing time in the staff time measurement (STM) study and the Staff Time and Resource Intensity Verification (STRIVE) time study for different resident classification systems in hours per resident day.

CLASSIFICATION SYSTEM			STM				STRIVE			
	RUG III	RUG IV	RN	LPN	AIDE	TOTAL	RN	LPN	AIDE	TOTAL
Rehab extensive	RUX	RUX	2.68	1.41	3.34	7.44	1.14	1.86	2.19	5.18
	RUL	RUL	2.13	0.99	2.24	5.36	1.82	1.06	3.33	6.21
	RVX	RVX	2.29	0.97	2.79	6.05	0.49	1.60	2.43	4.52
	RVL	RVL	2.15	0.80	2.07	5.02	1.13	1.62	2.33	5.09
	RHX	RHX	2.17	0.81	2.59	5.58	2.15	0.87	2.59	5.60
	RHL	RHL	1.95	1.15	2.12	5.22	1.12	0.81	2.26	4.18
	RMX	RMX	2.73	1.52	3.26	7.52	1.63	1.24	2.47	5.34
	RML	RML	2.78	1.04	2.45	6.27	2.23	1.40	2.55	6.18
	RLX	RLX	1.95	0.92	2.21	5.08	2.23	1.40	2.55	6.18
Rehab	RUC	RUC	1.68	0.77	2.91	5.36	0.46	1.11	2.48	4.05
	RUB	RUB	1.40	0.58	2.05	4.04	0.75	1.18	2.35	4.29
	RUA	RUA	1.08	0.66	1.63	3.37	0.59	0.91	1.68	3.18
	RVC	RVC	1.56	0.84	2.73	5.12	0.57	1.14	2.61	4.32
	RVB	RVB	1.43	0.71	2.31	4.45	0.48	0.94	2.00	3.42
	RVA	RVA	1.20	0.44	1.72	3.37	0.52	0.99	1.90	3.41
	RHC	RHC	1.58	0.75	2.77	5.11	0.61	0.91	2.60	4.13
	RHB	RHB	1.68	0.58	2.17	4.43	0.61	0.80	1.99	3.40
	RHA	RHA	1.50	0.46	1.71	3.66	0.45	0.86	1.66	2.98
	RMC	RMC	1.30	0.82	2.87	4.99	0.54	0.93	2.48	3.96
	RMB	RMB	1.48	0.63	2.34	4.45	0.54	0.92	2.25	3.71
	RMA	RMA	1.57	0.57	1.94	4.09	0.43	0.81	1.65	2.89
	RLB	RLB	1.16	0.78	3.27	5.20	0.56	0.74	3.10	4.40
	RLA	RLA	1.01	0.55	2.07	3.64	0.26	0.73	1.98	2.97
Extensive	SE3	ES3	2.39	1.69	3.23	7.31	2.17	0.97	2.54	5.69
	SE2	ES2	1.81	1.43	2.73	5.97	1.09	1.25	2.44	4.78
	SE1	ES1	1.35	0.96	3.20	5.50	1.21	0.82	2.13	4.17
Special	SSC	HE2	1.22	1.07	3.07	5.36	0.35	1.13	3.17	4.66
	SSB	HD2	1.18	0.92	2.87	4.97	0.70	1.18	2.56	4.44
	SSA	HC2	1.53	0.70	2.17	4.40	0.59	0.89	2.58	4.06
		HB2					1.01	1.13	2.23	4.37
		HE1					0.32	1.13	2.49	3.94
		HD1					0.28	0.91	2.36	3.55
		HC1					0.37	0.90	2.26	3.53
		HB1					0.36	0.84	1.78	2.98

Table 2. (Continued)

CLASSIFICATION SYSTEM			STM				STRIVE			
	RUG III	RUG IV	RN	LPN	AIDE	TOTAL	RN	LPN	AIDE	TOTAL
		LE2					0.37	0.98	2.94	4.29
		LD2					0.33	0.97	2.55	3.85
		LC2					0.46	0.80	1.94	3.19
		LB2					0.49	0.85	2.14	3.48
		LE1					0.37	0.87	2.39	3.63
		LD1					0.20	0.73	2.18	3.11
		LC1					0.26	0.78	2.08	3.12
		LB1					0.32	0.81	1.77	2.90
Clinically complex	CC2	CE2	1.42	0.71	3.19	5.31	0.35	0.74	2.71	3.80
	CB2	CD2	1.03	0.70	2.65	4.37	0.33	0.75	2.93	4.01
	CA2	CC2	0.98	0.72	2.17	3.87	0.33	0.62	2.22	3.16
		CB2					0.39	0.61	1.92	2.92
		CA2					0.34	0.74	1.35	2.44
	CC1	CE1	0.93	0.96	2.95	4.84	0.35	0.56	2.65	3.57
	CB1	CD1	0.98	0.60	2.46	4.04	0.26	0.70	2.52	3.48
	CA1	CC1	1.00	0.63	1.72	3.34	0.27	0.59	2.12	2.97
		CB1					0.27	0.58	1.97	2.83
		CA1					0.37	0.67	1.21	2.26
Behavioral and impaired cognition	IB2	BB2	0.67	0.53	2.29	3.49	0.19	0.55	1.97	2.71
	IB1	BB1	0.65	0.53	2.17	3.35	0.31	0.69	1.69	2.68
	IA2	BA2	0.63	0.45	1.67	2.75	0.25	0.55	1.91	2.70
	IA1	BA1	0.55	0.43	1.60	2.58	0.23	0.53	1.43	2.19
Physical function	PE2	PE2	0.62	0.53	3.08	4.23	0.25	0.66	2.73	3.64
	PE1	PE1	0.62	0.49	3.03	4.13	0.20	0.63	2.72	3.56
	PD2	PD2	0.60	0.42	2.83	3.85	0.14	0.56	2.08	2.78
	PD1	PD1	0.60	0.46	2.67	3.73	0.26	0.65	1.98	2.89
	PC2	PC2	0.43	0.55	2.57	3.55	0.09	0.60	1.22	1.91
	PC1	PC1	0.75	0.34	2.07	3.17	0.33	0.60	2.69	3.62
	PB2	PB2	0.47	0.61	1.34	2.42	0.27	0.56	2.46	3.28
	PB1	PB1	0.46	0.46	1.57	2.49	0.23	0.62	2.06	2.91
	PA2	PA2	0.53	0.51	1.22	2.26	0.21	0.53	1.59	2.33
	PA1	PA1	0.47	0.50	1.21	2.18	0.24	0.54	1.18	1.96
M			1.31	0.75	2.39	4.45	0.59	0.87	2.23	3.70
Median			1.18	0.63	2.29	4.10	0.35	0.78	1.86	3.00
Strive mean as a percent of STM mean							45%	117%	93%	83%

Source: Centers for Medicare & Medicaid Services. Design for Nursing Home Compare Five Star Quality Rating System Technical Users' Guide, April, 2019 and February, 2015.
Abbreviations: LPN, licensed practical nurses; RN, registered nurses; RUG, resource utilization group.
For RUGs IV, the Impaired Cognition and Behavioral categories were combined.

more accurate time study, we recommended that STM be used as a guide for RN and LVN/LPN time for all categories except the Behavioral Symptoms and Reduced Physical Functioning groups and also not for CNA staffing hours.

The average CNA times in the STM study were 2.35 hprd compared with the minimum level found necessary to prevent harm and jeopardy in simulation models of 2.8 CNA hprd.[1,36] The time estimates for CNAs in the STM study were inadequate because time study documentation of ADL care is often inaccurate and the time studies do not take into account omitted care needed to meet regulatory requirements.[36] Moreover, residents who need the assistance of 2 persons are more likely to have care omissions or longer wait times for care.[13] Therefore, we conclude that the Schnelle and colleague's CNA methodology should be used to replace the CNA hours from the STM study.

Centers for Medicare & Medicaid Services expected staffing for Medicare Nursing Home Compare website

Centers for Medicare & Medicaid Services' Medicare Nursing Home Compare five-star rating system[35] developed a method to calculate the expected nurse staffing levels needed for each nursing home based on its RUGs acuity scores. The CMS STM for each RUG group were published on CMS's Medicare Nursing Home Compare website from 2009 to March 31, 2018.[35,40] The CMS expected staffing calculation took into account the facility's resident casemix based on the daily distribution of residents in each RUG-IV group in each quarter.[30,35] Total nursing and RN hours were calculated by multiplying the STM nursing times by the number of residents in each RUG-IV group. Aggregate total staffing and RN hours were summing across all days and RUG-IV groups as the numerators with the total number of resident-days as the denominator.[35]

Staff Time and Resource Intensity Verification time study

The STRIVE time study, conducted in 2006 to 2007 to refine the RUG-IV classification system and to develop casemix indices for the Medicare SNF payment system, was flawed in several ways.[51] First, the study included a sample of nursing homes located in 15 states that excluded some large states like California and Pennsylvania. Sample targets were set within each state and based on (1) the number of facilities that each state's data monitors could visit, (2) the number of facilities available within each state's strata, and (3) the number of cases needed within each stratum for the sample as a whole.[51] The use of probability proportional to size sampling favored the selection of larger, higher volume facilities. The sample focused on Medicare residents in the high RUG groups who needed higher intensity of care (oversampling) so that lower RUG group samples were smaller and appear to inaccurate. Although the STM time study selected facilities that were considered to

have a reputation for delivering high quality of care,[42] the STRIVE sample facilities were not required to provide "high quality of care," although a few homes with low quality were removed from the sample.[32] Importantly, both STM and the STRIVE studies only measured time that was actually provided by the facilities and did not measure the nurse staffing levels necessary to provide the quality of care specifically required by federal regulations, namely that each resident attain or maintain their "highest" practicable level of well-being.

Table 2 shows that the average STRIVE RN times were only 45% of the STM RN time, LVN/LPN hours were 117%, CNA hours were 93%, and total nursing hours were 83% of STM hours. This substantial decrease in the STRIVE nursing hours lacks face validity compared with the STM study. The only STRIVE RN hours that met the expert minimum levels (of 0.75) were in the very highest Rehabilitation category, the Extensive category, and only one RUG in the Special category. STRIVE total nursing hours that were above the 4.1 level recommended by experts were in the Rehab category, the Extensive category, only 5 RUGs in Special category, and 1 RUG in the Clinically Complex Category. All other STRIVE nursing times were lower than the lowest staffing minimums recommended by experts.[1,46-49] We conclude that the STRIVE study should not be used for estimating "expected" staffing levels. By contrast, the STM study times have not been disavowed by CMS and remain appropriate for estimating "expected" staffing levels for licensed nurses in the highest RUG and PDPM categories.

In 2008, the CMS Medicare Nursing Home Compare Technical Expert Panel rejected using the STRIVE time data because it lacked face validity for all staffing types due to the sampling limitations in the study design (White AJ, Abt Associates, personal correspondence, October 15, 2019). In spite of these obvious problems, in 2018, the CMS Medicare Nursing Home Compare website began using the STRIVE data rather than the STM study data.[52] The CMS website uses the STRIVE times solely to adjust nursing home staffing data for comparison purposes, but no longer calculates "expected times." Rather, the data are called "casemix times."

Recommended staffing levels for 5 levels of resident acuity

To develop a simple guide for recommended staffing levels for 6 levels of acuity, the authors have drawn on the existing research and the STM time study for the RUGs system as well as actual PBJ staffing distributions in subacute facilities.[1,34,46-50] Table 3 shows a crosswalk of the RUG-IV classification to the new PDPM groups and the authors' recommended nurse staffing levels in hours per resident day. Table 3 substitutes the STM staff time scores for the STRIVE scores for RNs and LVNs/LPNs for the Extensive, Special Care High, Special Care Low, and Clinically Complex categories. Because the STM scores for RNs and LVNs/LPNs are too low for the

Table 3. Recommended nurse staffing hours per resident day for RUG-IV and PDPM group resident acuity.

	RUG-IV	PDPM GROUP	RN	LVN/LPN	AIDE	TOTAL STAFFING
Extensive services	ES3	ES3	2.39	1.69	3.60	7.68
	ES2	ES2	1.81	1.43	3.60	6.84
	ES1	ES1	1.35	0.96	3.60	5.91
		Average	1.85	1.36	3.60	6.81
Special care high	HE2/HD2	HDE2	1.20	0.99	3.60	5.79
	HE1/HD1	HDE1	1.20	0.99	3.60	5.79
	HC2/HB2	HBC2	1.53	0.70	3.20	5.42
	HC1/HB1	HBC1	1.53	0.70	3.20	5.42
		Average	1.36	0.84	3.40	5.61
Special care low	LE2/LD2	LDE2	1.20	0.99	3.60	5.79
	LE1/LD1	LDE1	1.20	0.99	3.60	5.79
	LC2/LB2	LBC2	1.53	0.70	3.20	5.42
	LC1/LB1	LBC1	1.53	0.70	3.20	5.42
		Average	1.36	0.84	3.40	5.61
Clinically complex	CE2/CD2	CDE2	1.22	0.70	3.60	5.53
	CE1/CD1	CDE1	0.96	0.78	3.60	5.34
	CC2/CB2	CBC2	0.99	0.67	3.20	4.86
	CA2	CA2	1.00	0.63	2.80	4.42
	CC1/CB1	CBC1	1.00	0.63	3.20	4.82
	CA1	CA1	1.00	0.63	2.80	4.42
		Average	1.03	0.67	3.20	4.90
Behavioral symptoms	BB2/BA2	BAB2	0.75	0.55	3.00	4.30
	BB1/BA1	BAB1	0.75	0.55	3.00	4.30
		Average	0.75	0.55	3.00	4.30
Reduced physical function	PE2/PD2	PDE2	0.75	0.55	3.60	4.90
	PE1/PD1	PDE1	0.75	0.55	3.60	4.90
	PC2/PB2	PBC2	0.75	0.58	3.20	4.53
	PA2	PA2	0.75	0.55	2.80	4.10
	PC1/PB1	PBC1	0.75	0.55	3.20	4.50
	PA1	PA1	0.75	0.55	2.80	4.10
		Average	0.75	0.56	3.20	4.51

Abbreviations: CMS, Centers for Medicare & Medicaid Services; LPN, licensed practical nurses; LVN, licensed vocational nurses; MDS, Minimum Data Set; PDPM, Patient Driven Payment Model; RN, registered nurses; RUGS IV, Resource Utilization Groups IV.
Source: RUG IV to PDPM Crosswalk from CMS *Patient Driven Payment Model, Fact Sheet: PDPM Patient* Classification (Revised 8-27-2019): see also MDS 3.0 RAI Manual v. 1.17.1 October 2019, Chapter 6.
RN and LPN Hours for Extensive, Special Care High, and Special Care Low are from the Staff Time Measurement Study (STM). ES1, ES2, and ES3 are assumed to have PDPM Nursing Function Scores between 0 and 6. RN and LPN Hours for Behavioral Symptoms & Cognitive Performance are adjusted to the minimum hours from the CMS 2001 study. CNA hours are based Schnelle et al[36] estimates of 2.8 hprd for PDPM Nursing Function Score of 15-16, 3.0 hprd for Score of 11-16, 3.2 hprd for Score of 6-14, 3.3 hprd for Score of 0-14, and 3.6 hprd for Score of 0-5.

Behavioral Symptoms and Reduced Physical Functioning groups, we use 0.75 RN hprd and 0.55 LPN hprd, recommended in the CMS 2001 study for the lowest acuity long stay residents.[1,46-49] The estimates include all administrative nurses. For the Aide category, we used Schnelle and colleagues[36] hours which vary from 2.8 hprd for the lowest level of resident acuity to 3.6 hprd for the highest acuity.

Table 4 shows the average recommended hours per resident day in Table 3 converted to a ratio of residents to staff, including administrative nurses. Each nursing home would summarize its individual resident assessments to determine the facility's aggregate acuity and then would use the staffing recommendations on Table 3 to determine its overall staffing needs.

Step 4. Identify Evidence Regarding the Adequacy of Staffing

Federal and state deficiencies and complaints

Low staffing may be reflected in consumer complaints about poor quality both substantiated and unsubstantiated by state agency surveyors.[53] Federal and state regulations for nursing homes are detailed for residents' rights, quality of care, and the major components of nursing home care.[37] Deficiencies and citations given by state surveyors for violations of quality regulations show clear evidence of quality problems which are often directly related to understaffing. Some states issue their own deficiencies and citations for violations of state laws. Complaints and reports by families or resident councils may also show understaffing and poor quality.

Nursing home deficiencies and complaints, however, are frequently under-identified and serious deficiencies are under-rated by state surveyors in terms of their scope and severity.[54-57] Moreover, deficiencies for understaffing have rarely been given.[23] Contributing to the under-reporting of deficiencies, many state survey agencies have had difficulty meeting CMS requirements for timely complaint investigations.[54-56] Moreover, state survey agencies often fail to report some substantiated abuse cases to local law enforcement and CMS does not record and track many incidents in its automated tracking system.[57] State surveyors often do not examine resident acuity and staffing levels, especially as the amount of time available for the surveys and the frequency of surveys is generally limited because of budgetary constraints.

Centers for Medicare & Medicaid Services quality measures

Centers for Medicare & Medicaid Services developed resident quality measures using data from the MDS assessments submitted by nursing homes to CMS and reported on the Medicare Nursing Home Compare website that are related to staffing levels.[58] These quality measures currently include pressure ulcers, urinary tract infections, decline in physical functioning,

decline in mobility, overuse of antipsychotics, and falls with injuries.[52] Most quality measures are self-reported and are not audited and may be inaccurate.[59] For example, only 57.5% of major injury falls were reported on MDS data compared with actual claims data.[60] Nursing homes have an incentive to under-report indicators of poor quality to receive higher quality ratings and to avoid scrutiny from state surveyors, consumers, advocates, journalists, and managed care payers with whom nursing homes are contracted to provide short-stay care.

Centers for Medicare & Medicaid Services added new quality measures based on claims data to improve the accuracy of the quality measures. These include the percent of residents who were readmitted to the hospital; were successfully discharged to the community; and had outpatient emergency department visits.[35,52] Poor outcomes on rehospitalization and emergency visits are related to low nurse staffing levels.[18-20]

Missed or omitted care and staff turnover rates

Another important source of information about the adequacy of staffing may come directly from reports by facility nursing staff about their workload and inability to complete their assignments including basic care, communications, and timeliness of care.[61-63] Missed or omitted care has been found to be associated with adverse events including pressure ulcers, medication errors, new infections, and IVs running dry or leaking.[61-64] Missed nursing care has also been found to be associated with poor patient safety culture and patient falls, a patient safety indicator.[63,64] Staffing levels, not surprisingly, predict missed nursing care and can explain the relationship between staffing levels and patient outcomes.[61-64]

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 lack of time or resources.[65] The missed care often included care planning, comforting/talking with residents, providing adequate resident surveillance, and resident/family teaching. Missed care was found to be related to high levels of RNs burnout and job dissatisfaction.[65] High nurse turnover rates are also related to inadequate staffing levels and poor quality.[7,66]

Adverse events and quality problems

Nursing homes are required to develop program feedback, data systems, and monitoring of quality of care (§483.75(c)(a)).[37] Each facility must (1) obtain and use feedback and input from staff, residents, and others to identify problems and opportunities for improvement; (2) identify, collect, and use data and information from all departments to develop and monitor performance indicators; (3) develop, monitor, and evaluate performance indicators; and (4) monitor adverse events.[37] Facility reports on problems with quality of care, quality of life, and safety problems may be useful in determining the adequacy of staffing levels.

Table 4. Average recommended nurse staffing hours per resident day converted to staffing ratios.

ACUITY	AVERAGE HOURS PER RESIDENT DAY				RATIO OF RESIDENTS TO STAFF AND HOURS PER RESIDENT DAY							
	RN	LVN/LPN	AIDE	TOTAL		RN RATIO TO RESIDENTS	RN HPRD	LVN/LPN RATIO TO RESIDENTS	LPN HPRD	AIDE RATIO TO RESIDENTS	AIDE HPRD	TOTAL NURSING HPRD
Extensive services	1.85	1.36	3.60	6.81	Day	9	0.89	14	0.57	5.5	1.45	
					Evening	14	0.57	18	0.44	5.5	1.45	
					Night	20	0.40	25	0.32	12.0	0.67	
					Total		1.86		1.34		3.58	6.77
Special care high	1.36	0.84	3.40	5.61	Day	14	0.57	24	0.33	5.5	1.45	
					Evening	17	0.47	28	0.29	6.0	1.33	
					Night	25	0.32	36	0.22	13.0	0.62	
					Total		1.36		0.84		3.40	5.61
Special care low	1.36	0.84	3.40	5.61	Day	14	0.57	24	0.33	5.5	1.45	
					Evening	17	0.47	28	0.29	6.0	1.33	
					Night	25	0.32	36	0.22	13.0	0.62	
					Total		1.36		0.84		3.40	5.61
Clinically complex	1.03	0.67	3.20	4.90	Day	18	0.44	30	0.27	6.0	1.33	
					Evening	22	0.36	34	0.24	6.5	1.23	
					Night	36	0.22	42	0.19	13.0	0.62	
					Total		1.03		0.69		3.18	4.90
Behavioral symptoms	0.75	0.55	3.00	4.30	Day	28	0.29	38	0.21	7.0	1.14	
					Evening	30	0.27	40	0.20	7.0	1.14	
					Night	40	0.20	56	0.14	11.5	0.70	
					Total		0.75		0.55		2.98	4.29
Reduced physical function	0.75	0.56	3.20	4.51	Day	28	0.29	38	0.21	6.0	1.33	
					Evening	30	0.27	40	0.20	6.5	1.23	
					Night	40	0.20	56	0.14	13.0	0.62	
					Total		0.75		0.55		3.18	4.49

Abbreviations: LPN, licensed practical nurses; LVN, licensed vocational nurses; RN, registered nurses.
Estimates include administrative care nurses (Director of Nursing, Assistant Director of Nursing, Director of Staff Development or about 0.24 hprd for 100 residents), the MDS Coordinator, supervisors, direct care nurses, plus an RN on duty of 24 hours per day.

Each facility must set priorities for its performance improvement activities that focus on high-risk, high-volume, or problem-prone areas; consider the incidence, prevalence, and severity of problems in those areas; and assure health outcomes, resident safety, resident autonomy, resident choice, and quality of care (§483.75(e)(1)). Each facility must also establish a quality assurance and performance improvement (QAPI) program and develop and implement appropriate plans of correction (§483.75(g)(2)).[37] Where nursing homes are not able to reduce errors, adverse incidents, and improve quality, inadequate staffing levels may be the fundamental underlying problem.

Step 5. Analyze the Adequacy of Facility Staffing

The final step is to compare the actual staffing levels with the appropriate staffing levels based on the resident acuity to determine the adequacy of facility nurse staffing. Nursing homes need to meet the minimum levels of staffing identified in the CMS 2001 study and the levels recommended by experts. Beyond the minimum standards, nursing homes must adjust for the acuity and care needs of residents. As noted above, the RUG IV categories are converted to the PDPM categories and the STM time studies are used as the accurate method for calculating licensed nursing hours for residents in the 4 highest acuity groups. This guide incorporates Schnelle and colleagues' methodology for calculating CNA staffing as it has the most accurate time estimates.[36] Other evidence may indicate inadequate staffing including federal and staff deficiencies and complaints, claims-based quality measures, missed and omitted care reports, staff turnover rates, adverse events\sentinel events, and other quality problems.

Any gaps between actual and appropriate staffing levels should be identified. If a facility's staffing meets levels recommended by experts and expected staffing time for resident acuity but still has quality problems based on quality indicators, then the types of nursing staff, staff competency levels, turnover rates, types of patients admitted, facility resources, and management practices should be examined and improved as necessary. Facilities must meet the basic federal quality regulatory requirements that assure adequate staffing to meet the needs of each resident.

Discussion

This article has developed a methodology for determining whether nurse staffing in a nursing home is sufficient. This approach is designed to assist nursing homes in proactively determining and providing appropriate staffing to meet the needs of their residents. Research studies provide clear evidence that most nursing homes do not have adequate nurse staffing levels particularly for RNs.[23,24] As nursing staffing (levels and wages) is one of the primary cost components for nursing homes, many nursing homes keep staffing costs as low as possible to maximize profits.[67,68] Inadequate staffing levels can have devasting consequences as found in California nursing homes with COVID-19 that had 25% lower RN staffing

levels than homes without non-COVID-19 residents.[26] Lower staffing levels in facilities before the pandemic made these facilities more vulnerable to the coronavirus, resulting in more than 28 000 U.S. nursing home resident and worker deaths by May 11, 2020.[25-27,69]

Keeping nurse staffing levels low results in serious quality problems in many nursing homes across the country and is not consistent with the 2016 federal regulations that require sufficient nursing staff with the appropriate competencies to assure resident safety and attain or maintain the highest practicable level of resident well-being. Nursing homes are responsible for assuring adequate nurse staffing levels and for complying with federal nursing home requirements.

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The first draft was completed by the first author and then subsequent drafts and edits were made by all the co-authors. All co-authors contributed to the content, text, tables, and references.

The lead author wrote the first draft of the manuscript. All authors contributed to the writing and editing of the manuscript and agreed with the text and conclusions of the article. All authors reviewed and approved the final version of the manuscript.

Disclaimer

The content of this manuscript is the responsibility of the authors alone and does not necessarily reflect the view or policies of the Department of Veterans Affairs or the University of California.

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REFERENCES

1. Centers for Medicare & Medicaid Services (CMS). *Report to Congress: Appropriateness of Minimum Nurse Staffing Ratios in Nursing Homes Phase II Final Report*. Baltimore, MD: CMS; 2001. (See The relationship between nurse staffing levels and the quality of nursing home care, by Kramer AM and Fish R.

Chapter 2, and Minimum nurse aide staffing required to implement best practice care in nursing facilities, by Schnelle JF, Simmons SF, and Cretin S, Chapter 3.)

2. Bostick JE, Rantz MJ, Flesner MK, Riggs CJ. Systematic review of studies of staffing and quality in nursing homes. *JAMDA*. 2006;7:366-376.

3. Castle N. Nursing home caregiver staffing levels and quality of care: a literature review. *J Appl Gerontol*. 2008;27:375-405.

4. Dellefield ME, Castle NG, McGilton KS, Spilsbury K. The relationship between registered nurses and nursing home quality: an integrative review (2008-2014). *Nurs Econ*. 2015;33:95-108, 116.

5. Castle NG, Anderson RA. Caregiver staffing in nursing homes and their influence on quality of care. *Med Care*. 2011;49:545-552.

6. Castle N, Engberg J. The influence of staffing characteristics on quality of care in nursing homes. *Health Serv Res*. 2007;42:1822-1847.

7. Castle NG, Engberg J, Men A. Nursing home staff turnover: impact on nursing home compare quality measures. *Gerontologist*. 2007;47:650-661.

8. Horn SD, Buerhaus P, Bergstrom N, Smout RJ. RN staffing time and outcomes of long-stay nursing home residents: pressure ulcers and other adverse outcomes are less likely as RNs spend more time on direct patient care. *Am J Nurs*. 2005;105:58-70, quiz 71.

9. Kim H, Harrington C, Greene W. Registered nurse staffing mix and quality of care in nursing homes: a longitudinal analysis. *Gerontologist*. 2009;49:81-90.

10. Konetzka RT, Stearns SC, Park J. The staffing–outcomes relationship in nursing homes. *Health Serv Res*. 2008;43:1025-1042.

11. Phillips LJ, Birtley NM, Petroski GF, Siem C, Rantz M. An observational study of antipsychotic medication use among long-stay residents without qualifying diagnoses. *J. Psych Mental Health Nurs*. 2018;25:463-474.

12. Schnelle JF, Simmons SF, Harrington C, Cadogan M, Garcia E, Bates-Jensen BM. Relationship of nursing home staffing to quality of care. *Health Serv Res*. 2004;39:225-250.

13. Simmons SF, Durkin DW, Rahman AN, Choi L, Beuscher L, Schnelle JF. Resident characteristics related to the lack of morning care provision in long-term care. *Gerontologist*. 2013;53:151-161.

14. Simmons SF, Keeler E, Zhuo X, Hickey KA, Sato HW, Schnelle JF. Prevention of unintentional weight loss in nursing home residents: a controlled trial of feeding assistance. *J Am Geriatr Soc*. 2008;56:1466-1473.

15. Simmons SF, Schnelle JF. Individualized feeding assistance care for nursing home residents: staffing requirements to implement two interventions. *J Gerontol A Biol Sci Med Sci*. 2004;59:M966-M973.

16. Tong PK. The effects of California minimum nurse staffing laws on nurse labor and patient mortality in skilled nursing facilities. *Health Econ*. 2011;20:802-816.

17. Zimmerman S, Gruber-Baldini AL, Hebel JR, Sloane PD, Magaziner J. Nursing home facility risk factors for infection and hospitalization: importance of registered nurse turnover, administration, and social factors. *J Am Geriatr Soc*. 2002;50:1987-1995.

18. Grabowski DC, Stewart KA, Broderick SM, Coots LA. Predictors of nursing home hospitalization: a review of the literature. *Med Care Res Rev*. 2008;65:3-39.

19. Konetzka RT, Spector W, Limcangco MR. Reducing hospitalizations from long-term care settings. *Med Care Res Rev*. 2007;65:40-66.

20. Spector WD, Limcangco R, Williams C, Rhodes W, Hurd D. Potentially avoidable hospitalizations for elderly long-stay residents in nursing homes. *Med Care*. 2013;51:673-681. doi:10.1097/MLR.0b013e3182984bff.

21. Castle NG, Wagner LM, Ferguson JC, Handler SM. Nursing home deficiency citations for safety. *J Aging Soc Policy*. 2011;23:34-57.

22. Lin H. Revisiting the relationship between nurse staffing and quality of care in nursing homes: an instrumental variables approach. *J Health Econ*. 2014;37:13-24.

23. Harrington C, Schnelle JF, McGregor M, Simmons SF. The need for minimum staffing standards in nursing homes. *Health Serv Insights*. 2016;9:13-19.

24. Geng F, Stevenson DG, Grabowski DC. Daily nursing home staffing levels highly variable, often below CMS expectations. *Health Aff (Millwood)*. 2019;38:1095-1100.

25. Stockman F, Richtel M, Ivory D, Smith M. "They're death pits": virus claims at least 7,000 lives in U.S. nursing homes. *The New York Times*. April 17, 2020. https://www.nytimes.com/2020/04/17/us/coronavirus-nursing-homes.html.

26. Rau J, Almendrala A. COVID-plagued California nursing home often had problems in past. *Kaiser Health News*. May 4, 2020. https://khn.org/news/covid-plagued-california-nursing-homes-often-had-problems-in-past/.

27. Mathews AW, Fuller A, De Avila J. Thinly-staffed nursing homes face challenges in pandemic. *Wall Street Journal*. May 1, 2020. https://www.wsj.com/articles/thinly-staffed-nursing-homes-face-challenges-in-pandemic-11588343407.

28. U.S. Department of Health and Human Services, Centers for Medicare & Medicaid Services (CMS). Medicare and Medicaid programs: reform of requirements for long-term care facilities (Final Rule). *Fed Regis*. 2016;81:68688-68872.

29. Centers for Medicare & Medicaid Services (CMS). Minimum data set 3.0 RAI manual. https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/NursingHomeQualityInits/MDS30RAIManual.html. Accessed February, 2020.

30. Centers for Medicare & Medicaid Services (CMS). CMS RUGS refinement. RUGS III/RUGS IV 2008 distribution. RUG-IV grouper overview: logic version 1.03 and code version 1.03.0. https://www.aanac.org/docs/reference-documents/rugiv-grouper-overview-v1.pdf. Updated July 18, 2013. Accessed February, 2020.

31. Centers for Medicare & Medicaid Services (CMS). *Form 672*. Baltimore, MD: CMS. https://www.cms.gov/Medicare/CMS-Forms/CMS-Forms/CMS-Forms-Items/CMS006583.

32. Acumen. *Skilled Nursing Facilities Patient-Driven Payment Model Technical Report*. Burlingame, CA: Acumen; 2018. (See also U.S. Department of Health and Human Services, Centers for Medicare & Medicaid Services. Medicare program; prospective payment system and consolidated billing for skilled nursing facilities; updates to the quality reporting program and value-based purchasing program for federal fiscal year 2020. *Federal Register*. Proposed Rule 4/25/2019, 2019. https://www.federalregister.gov/documents/2019/04/25/2019-08108/medicare-program-prospective-payment-system-and-consolidated-billing-for-skilled-nursing-facilities. See the new MDS 3.0 Final Item Sets and the PDPM Grouper DLL Package for October 1, 2020).

33. Centers for Medicare & Medicaid Services (CMS). *Staffing Data Submission PBJ*. Baltimore, MD: CMS; 2017. https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/NursingHomeQualityInits/Staffing-Data-Submission-PBJ.html.

34. White C, Pizer SD, White AJ. Assessing the RUG-III resident classification system for skilled nursing facilities. *Health Care Financ Rev*. 2002;24:7-15.

35. Centers for Medicare & Medicaid Services (CMS). *Design for Nursing Home Compare: Five-Star Quality Rating System: Users Guide*. Baltimore, MD: CMS; 2017.

36. Schnelle JF, Schroyer LD, Saraf AA, Simmons SF. Determining nurse aide staffing requirements to provide care based on resident workload: a discrete event simulation model. *JAMDA*. 2016;17:970-977.

37. Centers for Medicare & Medicaid Services (CMS). State operations manual appendix PP – guidance to surveyors for long term care facilities (Rev. 11-22-17). https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/GuidanceforLawsAndRegulations/Nursing-Homes.html.

38. Harrington C, Choiniere J, Goldmann M, et al. Nursing home staffing standards and levels in six countries. *J Nurs Scholarship*. 2012;44:88-98.

39. Omnibus Budget Reconciliation Act of 1987 (OBRA, 1987). *Public Law 100-203. Subtitle C: nursing home reform*. Signed by President, Washington, DC, December 22, 1987.

40. U.S. Department of Health and Human Services, Centers for Medicare & Medicaid Services (CMS). Medicare program: prospective payment system and consolidated billing for skilled nursing facilities. *Fed Regis*. 2000;65:446769-446796.

41. Centers for Medicare & Medicaid Services (CMS). Archived Minimum data set 2.0 for nursing homes. https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/NursingHomeQualityInits/NHQIMDS20.html. Accessed November 10, 2019.

42. Fries BE, Schneider DP, Foley WJ, Gavazzi M, Burke R, Cornelius E. Refining a case-mix measure nursing homes: resource utilization groups (RUG-III). *Med Care*. 1994;32:668-685.

43. Rau J. 'It's almost like a ghost town.' Most nursing homes overstated staffing for years. *The New York Times*. July 8, 2018. https://www.nytimes.com/2018/07/07/health/nursing-homes-staffing-medicare.html.

44. Kash BA, Hawes C, Phillips CD. Comparing staffing levels in the Online Survey Certification and Reporting (OSCAR) system with the Medicaid Cost Report data: are differences systematic. *Gerontologist*. 2007;47:480-489.

45. Centers for Medicare & Medicaid Services (CMS). Medicare nursing home compare. http://www.medicare.gov/NursingHomeCompare/search.aspx?bhcp=1. Accessed July 15, 2019. (See website data on www.Medicare.data.gov. Accessed June 13, 2019).

46. Institute of Medicine. *Keeping Patients Safe: Transforming the Work Environment of Nurses*. Washington, DC: National Academy of Medicine; 2004.

47. American Nurses' Association. Nursing staffing requirements to meet the demands of today's long term care consumer recommendations from the Coalition of Geriatric Nursing Organizations (CGNO). Position Statement 11/12/14. www.nursingworld.org.

48. Coalition of Geriatric Nursing Organizations (CGNO). Nursing staffing requirements to meet the demands of today's long-term care consumer recommendations. https://www.nursingworld.org/practice-policy/nursing-excellence/official-position-statements/id/nursing-staffing-requirements-to-meet-the-demands-of-todays-long-term-care-consumer. Updated 2013.

49. Harrington C, Kovner C, Kayser-Jones J, et al. Experts recommend minimum nurse staffing standards for nursing facilities in the United States. *Gerontologist*. 2000;40:5-16.

50. California Department of Health Care Services. Policies and guidelines for sub-acute care. https://www.dhcs.ca.gov/provgovpart/Pages/PoliciesandGuidelines.aspx. Updated 2019.

51. Centers for Medicare & Medicaid Services (CMS). Time Study (STRIVE) project. https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/SNF-PPS/TimeStudy.

52. Centers for Medicare & Medicaid Services (CMS). *Design for Nursing Home Compare: Five Star Quality Rating System: Users Guide*. Baltimore, MD: CMS; 2019.

53. Stevenson DG. Nursing home consumer complaints and quality of care: a national view. *Med Care Res Rev*. 2006;63:347-368.

54. U.S. Government Accountability Office. *Nursing Homes: Addressing the Factors Underlying Understatement of Serious Care Problems Requires Sustained CMS and State Commitment* (GAO-10-70). Washington, DC: U.S. Government Accountability Office; 2009.

55. U.S. Office of the Inspector General. Adverse events in skilled nursing facilities: national incidence among Medicare beneficiaries (OEI-06-11-00370). https://oig.hhs.gov/oei/reports/oei-06-11-00370.asp. Updated February, 2014.

56. U.S. Office of the Inspector General. Trends in deficiencies at nursing homes show that improvements are needed to ensure the health and safety of residents. https://oig.hhs.gov/oas/reports/region9/91802010.asp. HHS Data Brief (09-18-02010). Published April, 2019.

57. U.S. Office of Inspector General. Incidents of potential abuse and neglect at skilled nursing facilities were not always reported and investigated. https://oig.hhs.gov/oas/reports/region1/11600509.asp. HHS Brief (A-01-16-00509). Published June, 2019.

58. Abt Associates. Nursing home compare five-star quality rating system: year three report. https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/CertificationandComplianc/Downloads/FSQRS-Report.pdf. Report prepared for the Centers for Medicare & Medicaid Services. Published June 7, 2013.

59. Han X, Yaraghi N, Gopal R. Five-star ratings for sub-par service: evidence of inflation in nursing home ratings (Government Studies at Brookings). https://www.brookings.edu/research/five-star-ratings-for-sub-par-service-evidence-of-inflation-in-nursing-home-ratings/. Updated December, 2016.

60. Sanghavi P, Pan S, Caudry D. Assessment of nursing home reporting of major injury falls for quality measurement on nursing home compare. *Health Serv Res*. 2020;55:201-210. doi:10.1111/1475-6773.13247.

61. Kalisch BJ, Xie B, Dabney BW. Patient-reported missed nursing care correlated with adverse events. *Am J Med Qual*. 2014;29:415-422.

62. Dabney BW, Kalisch BJ. Nurse staffing levels and patient-reported missed nursing care. *J Nurs Care Qual*. 2015;30:306-312.

63. Hessels AJ, Paliwal M, Weaver SH, Siddiqui D, Wurmser T. Impact of patient safety culture on missed nursing care and adverse patient events. *J Nurs Care Qual*. 2019;34:287-294.

64. Kalisch BJ, Tschannen D, Lee KH. Do staffing levels predict missed nursing care? *Int J Qual Health Care*. 2011;23:302-308.

65. White EM, Aiken LH, McHugh MD. Registered nurse burnout, job satisfaction and missed care in nursing homes. *J Am Geriatr Soc*. 2019;67:2065-2071.

66. Harrington C, Swan JH. Nurse home staffing, turnover, and casemix. *Med Care Res Rev*. 2003;60:366-392.

67. Grabowski DC, Feng Z, Hirth R, Rahman M, Mor V. Effect of nursing home ownership on the quality of post-acute care: an instrumental variables approach. *J Health Econ*. 2013;32:12-21.

68. Harrington C, Olney B, Carrillo H, Kang T. Nurse staffing and deficiencies in the largest for-profit chains and chains owned by private equity companies. *Health Serv Res*. 2012;47:106-128.

69. Yourish K, Lai KKR, Ivory D, Smith M. One-third of all U.S. coronavirus deaths are nursing home residents or workers. *The New York Times*. https://www.nytimes.com/interactive/2020/05/09/us/coronavirus-cases-nursing-homes-us.html?referringSource=articleShare. Updated May 11, 2020.