
Effects of Nurse Staffing on Processes of Care and Resident Outcomes in Nursing Homes: A Systematic Review

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The findings and conclusions in this document are those of the author(s) who are responsible for its contents and do not necessarily represent the views of the Department of Veterans Affairs or the United States government. Therefore, no statement in this article should be construed as an official position of the Department of Veterans Affairs. No investigators have any affiliations or financial involvement (eg, employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties) that conflict with material presented in the report.

PREFACE

The VA Evidence Synthesis Program (ESP) was established in 2007 to provide timely and accurate syntheses of targeted health care topics of importance to clinicians, managers, and policymakers as they work to improve the health and health care of Veterans. These reports help:

- Develop clinical policies informed by evidence;
- Implement effective services to improve patient outcomes and to support VA clinical practice guidelines and performance measures; and
- Set the direction for future research to address gaps in clinical knowledge.

The program comprises four ESP Centers across the US and a Coordinating Center located in Portland, Oregon. Center Directors are VA clinicians and recognized leaders in the field of evidence synthesis with close ties to the AHRQ Evidence-based Practice Center Program. The Coordinating Center was created to manage program operations, ensure methodological consistency and quality of products, interface with stakeholders, and address urgent evidence needs. To ensure responsiveness to the needs of decision-makers, the program is governed by a Steering Committee composed of health system leadership and researchers. The program solicits nominations for review topics several times a year via the [program website](#).

The present report was developed in response to a request from the Office of Nursing Services. The scope was further developed with input from Operational Partners (below), the ESP Coordinating Center, the review team, and the technical expert panel (TEP). The ESP consulted several technical and content experts in designing the research questions and review methodology. In seeking broad expertise and perspectives, divergent and conflicting opinions are common and perceived as healthy scientific discourse that results in a thoughtful, relevant systematic review. Ultimately, however, research questions, design, methodologic approaches, and/or conclusions of the review may not necessarily represent the views of individual technical and content experts.

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Operational Partners

Operational partners are system-level stakeholders who help ensure relevance of the review topic to the VA, contribute to the development of and approve final project scope and timeframe for completion, provide feedback on the draft report, and provide consultation on strategies for dissemination of the report to the field and relevant groups.

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Technical Expert Panel

To ensure robust, scientifically relevant work, the TEP guides topic refinement; provides input on key questions and eligibility criteria, advising on substantive issues or possibly overlooked areas of research; assures VA relevance; and provides feedback on work in progress. TEP members are listed below:

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The Coordinating Center sought input from external peer reviewers to review the draft report and provide feedback on the objectives, scope, methods used, perception of bias, and omitted evidence (see Appendix E for disposition of comments). Peer reviewers must disclose any relevant financial or non-financial conflicts of interest. Because of their unique clinical or content expertise, individuals with potential conflicts may be retained. The Coordinating Center works to balance, manage, or mitigate any potential nonfinancial conflicts of interest identified.

EXECUTIVE SUMMARY

INTRODUCTION

There are more than 1.3 million residents in over 15,000 US nursing homes. Nursing homes are complex environments serving a variety of resident needs, including rehabilitative post-acute, end-of-life, or custodial long-term care. Facilities may be stand-alone (independently owned or belonging to a network of facilities) or part of integrated care networks that include hospitals and clinics or continuing care communities. Nursing home residents have diverse care needs and diagnoses that vary within and across facilities. Within nursing homes, direct care nursing staff (*ie*, registered nurses [RN], licensed vocational or practical nurses [LPN], and nursing assistants [NA]) are the primary caregivers for residents; thus, the level and characteristics of nursing staff are likely to impact resident well-being, health, safety, and quality of life.

US nursing homes are governed by a complex regulatory and payment environment. While the Institute of Medicine recommends that there is at least 1 RN on duty 24 hours a day, federal regulations only require 1 RN on duty 8 hours a day and sufficient staff to provide nursing care to all residents. States can impose more stringent regulations but they also do not currently require that each nursing home has an RN on duty 24 hours per day. State regulations typically require specific nursing hours per resident per day (HPRD). There may be large daily variations in staffing levels in some facilities, and some evidence indicates that facilities may increase staffing to coincide with annual inspections.

The Department of Veterans Affairs (VA) operates 134 nursing homes, called Community Living Centers (CLCs), that together currently provide a total of 8,480 beds.¹ CLCs are often attached to VA medical centers or hospitals but may also be stand-alone facilities. Due to VA nurse staffing requirements, CLCs have higher levels of nurse staffing than non-VA community nursing homes. CLCs serve a variety of resident populations, which may have higher acuity and complexity of needs than residents in most non-VA community nursing homes. There is also a set of State Veterans Homes that are independently run by state governments. These State Veterans Homes must meet federal and state regulations for nursing homes, but do not follow the same VA nurse staffing requirements as CLCs. VA certifies that these State Veterans Homes meet certain standards and conducts annual surveys to make these determinations.

The VA Office of Nursing Services, in collaboration with Geriatrics and Extended Care, requested an evidence review on the effects of nurse staffing and skill mix on process of care and resident outcomes in nursing homes. The main goal of this review is to assist these VA partners with recommendations for nurse staffing at VA CLCs and State Veterans Homes. Here, we summarize evidence on effects of nurse staffing levels and skill mix, beginning with high-priority outcomes: pressure ulcers, nursing home-associated infections, and pain outcomes. For these outcomes, we also provide certainty of evidence for the summary findings. We then describe results for additional outcomes. Finally, we discuss implications of these results for VA policy and recommendations for future research.

METHODS

Key Questions

In collaboration with our VA stakeholders, we developed the following key questions (KQ):

KQ1: What are the effects of nursing home nurse staffing levels and staff mix on:

- a) Processes of care in nursing homes (*eg*, use of antipsychotics)?
- b) Resident outcomes in nursing homes (*eg*, falls)?

KQ2: Which nurse staffing levels and staff mix have demonstrated cost-effectiveness for improving resident outcomes?

Data Sources and Searches

We searched for peer-reviewed English language articles from January 2000 to May 2021 in the following databases: MEDLINE, Embase, CINAHL, and the Cochrane Database of Systematic Reviews. We used Medical Subject Headings (MeSH) and title/abstract terms for nurse staffing and nursing homes. We also hand-searched bibliographies of relevant systematic reviews, identified from searches of the above databases, VA ESP, and AHRQ Evidence-based Practice Centers. We conducted a grey literature search of websites of organizations that may produce potentially relevant reports or white papers.

Study Selection

After removal of duplicates and conference abstracts, citations were uploaded into DistillerSR. Eligible populations were adults (≥ 18 years of age) living in US nursing homes. Studies were excluded if evaluating other types of congregate settings (*eg*, homes for those with developmental disabilities or transitional housing for addiction treatment). Eligible articles addressed the effects of nurse staffing levels (*eg*, nurse hours per patient) or skill mix (*eg*, ratio of RN to other nursing staff) on processes of care (*eg*, receipt of antipsychotics and receipt or duration of urinary catheter) and/or resident outcomes (*eg*, pressure ulcers, nursing home-associated infections, and pain). Using these prespecified inclusion and exclusion criteria, titles and abstracts were screened by 2 reviewers. Articles included by either reviewer underwent full-text review. At full-text review, 2 individuals decided on inclusion/exclusion by consensus (input from a third reviewer was requested as needed).

Data Abstraction and Quality Assessment

Abstracted data from all eligible studies included the following: study design, setting and population characteristics, data sources, definitions of nurse staffing and/or skill mix, and processes of care or resident outcomes evaluated. For studies rated as moderate or high methodological quality, we also abstracted detailed results on the characteristics of staffing (amount and different types of nurse staffing, including total staffing [RN, LPN, and NA]); effects or associations between nurse staffing (or skill mix) and processes of care or resident outcomes; and detailed analytic methods (*eg*, consideration of confounders and analytic models). Data were abstracted by 1 person and over-read by a second. If needed to resolve conflicts, a third reviewer also evaluated the study.

Quality was independently assessed by 2 reviewers using a modified version of the Joanna Briggs Institute Critical Appraisal Tool Checklist for Analytical Cross-Sectional Studies. Generally, a study rated as having methodological concerns in 2 or more domains was considered low quality overall. Quality assessments were completed by 2 reviewers independently, and if needed, a third reviewer assisted with reaching consensus.

Synthesis and Certainty of Evidence

Due to heterogeneity in populations, methods, and outcomes of included studies, we performed qualitative synthesis of the results. We summarized key study findings categorized by the processes of care and/or resident outcomes being evaluated. For the 3 high-priority outcomes (pressure ulcers, nursing home-associated infections, and pain), we also rated overall certainty of evidence using a GRADE approach.

RESULTS

Overview of Eligible Studies

Of 9,152 unique titles and abstracts screened, 378 articles underwent full-text review, and 44 eligible studies were identified. We also searched 14 websites for grey literature but found no eligible reports for inclusion.

The outcomes most commonly evaluated by eligible studies were pressure ulcers (k=15), nursing home-associated infections (k=12), hospitalizations (k=9), residents with moderate to severe pain (k=7), and urinary catheters (k=7). Fourteen studies addressed multiple processes of care or resident outcomes. None of the eligible studies addressed cost effectiveness (KQ2). Nearly half of the studies used national US samples of NH (k=21) and were cross-sectional (k=24). Only 1 study addressed nurse staffing and resident outcomes in VA CLCs. Ten studies were high quality, 26 were moderate quality, and the remaining 8 were low quality. Methodological concerns across many studies included: accuracy of outcomes and staffing data (most were reported by nursing home staff or administrators); timing of outcomes assessment with respect to staffing measures (*eg*, outcomes may have been assessed before data collection on staffing levels); and adequate consideration of confounders. From the 36 high and moderate-quality studies, we abstracted detailed results on associations between nurse staffing and processes of care or resident outcomes.

First, we present results for key outcomes that were both high priority for our stakeholders and addressed by a sufficient number of studies: pressure ulcers, nursing home-associated infections, and pain (moderate to severe). We describe effects separately by different nurse staffing (*eg*, RN, LPN, or NA) or skill mix variables. We also present overall certainty of evidence for these results (using GRADE, see Methods). Then, we summarize results for the remaining outcomes.

Pressure Ulcers

Twelve moderate- and high-quality studies evaluated the association of pressure ulcers with nurse staffing. Nine studies were cross-sectional and 3 were longitudinal analyses. Though all 12 studies used data derived from the Minimum Data Set (MDS), measures of pressure sores and populations varied. One study specifically evaluated the number of residents with dementia who died with pressure ulcers (defined as having pressure ulcers on the last MDS before death). Most studies used data from years within 1999-2008. Six evaluated national samples of nursing homes, while the remaining used data from selected states. Sample sizes ranged from 63 to 14,618 nursing homes. Five studies were conducted by the same research team led by Castle, NG.

RN Staffing

Higher RN staffing is probably associated with fewer pressure ulcers among residents of nursing homes (moderate confidence). Among 11 studies addressing the relationship between RN staffing and pressure ulcers, 9 found that higher RN staffing was associated with fewer pressure ulcers. The remaining 2 studies found no association between RN staffing levels and the outcome of interest. Eight studies included conceptual models to inform their study design. Six studies conducted analyses adjusting for case mix and all studies adjusted for confounders such as environment, policy, and other staffing metrics. Five studies were conducted by Castle et al and all included conceptual models. The primary methodological limitation among all studies was uncertainty about whether measures of RN staffing had preceded assessment of the pressure ulcer outcomes. The magnitude of the association between RN staffing and pressure ulcers in nursing home residents is not clear.

LPN Staffing

Higher LPN staffing may be associated with fewer pressure ulcers (low certainty). Five moderate- and high-quality studies evaluated associations between LPN staffing and pressure ulcers. Four of these were from the same lead author (Castle, NG) and showed that higher LPN staffing was associated with fewer pressure ulcers. The fifth study found no association between measures of staffing and resident outcomes.

NA Staffing

Higher NA staffing may be associated with fewer pressure ulcers (low certainty). Seven studies examined associations between NA staffing and pressure ulcers. Four of these found that higher NA staffing was associated with a decrease in pressure ulcer presence. The remaining 3 studies found no association between NA staffing levels and the outcome of interest.

Total Staffing

Total staffing is probably not associated with pressure ulcers in nursing home residents (moderate certainty). Two moderate-quality studies evaluated total staffing and pressure ulcers in residents. One study examined pressure ulcers among high-risk patients in 162 nursing homes in New York, while the second study evaluated all residents of 1,142 nursing homes (national sample). The first study found no association between total staffing and the likelihood of pressure ulcers in high-risk residents (OR 1.11, $p=0.62$). The second study also did not find an association between total staffing and pressure ulcers (OR 1.01 [0.56, 1.82] among high-risk residents, OR 1.21 [0.58, 2.53] among low-risk residents).

Nurse Skill Mix

Higher skill mix may be associated with less pressure ulcers among residents (low confidence). Six studies evaluated skill mix as the ratio of RN staffing to total staffing. Three of the studies included a conceptual model to inform their study and analytic design. Four of the studies adjusted for case mix, and all studies included other confounders such as environment, policy, and other nursing home characteristics. Three studies reported no significant association, and the other 3 reported significant associations between nurse skill mix and pressure ulcers.

Nursing Home-associated Infections

Ten moderate- and high-quality studies examined nursing home associated infections. We first present results for COVID-19 outcomes, followed by other infections (*eg*, urinary tract infection [UTI]).

COVID-19 Cases and Mortality

Three high-quality studies and 1 moderate-quality study evaluated the association between nurse staffing and COVID-19 cases and/or mortality. Three studies were cross-sectional and 1 used repeated time series analyses. Two studies evaluated nursing homes within a single state, while 1 study looked at nursing homes in 17 states, and the fourth looked at national data. All the studies obtained staffing data from the CMS Payroll-Based Journal. COVID-19 outcome data were obtained from a variety of federal, state, county and news organization sources. Methodological concerns for all of these studies were mainly regarding accuracy of data for COVID-19 outcomes reporting, timing of nursing home staffing data versus COVID-19 outcomes, and possible staff shortages due to COVID-19 outbreaks.

Across the 4 studies, RN HPRD ranged from 0.49 to 0.75. Total staffing was evaluated in 2 studies, with mean HPRD 3.9 in one, and 55% of nursing homes < 4.1 total nurse HPRD in the other.^{13,14} Only 1 study examined relationships between NA staffing (mean HPRD 2.3) or LPN staffing (mean HPRD 0.9) and COVID-19.

RN Staffing

Higher RN staffing may be associated with lower resident COVID-19 infection and mortality (low confidence). Four studies investigated the relationship between RN staffing and COVID-19 cases or mortality. The 2 state-level studies and 1 regional study all found that higher RN staffing was significantly associated with fewer COVID-19 cases and/or mortality. However, 1 national study found higher RN staffing was significantly associated with higher likelihood of nursing home having any COVID-19 cases (OR 1.34, $p < 0.01$).

LPN and NA Staffing

LPN staffing may not be associated with COVID-19 infection or mortality, while NA staffing may be associated with lower infection and mortality (low confidence for both). A single national study examined the relationship between LPN or NA staffing and COVID-19 outcomes. It found no statistical association between LPN staffing and COVID-19 cases and low LPN staffing relative to medium LPN staffing was associated with fewer COVID-19 deaths. High LPN staffing relative to medium LPN staffing was not associated with COVID-19 mortality. Among nursing homes with at least 1 COVID-19 case, those with high NA staffing (compared with middle tertile) had a lower likelihood of having an outbreak and fewer COVID-19 resident and staff deaths.

Total Staffing

It is unknown if total staffing is associated with COVID-19 infections or mortality (very low confidence). One national study and 1 state-level study examined associations between total nurse staffing and COVID-19 outcomes. The national study found that nursing homes with both

low and high total staffing (compared to middle tertile) had fewer COVID-19 deaths. The state-level study found no association between nursing hours and COVID-19 cases.

Nurse Skill Mix

Higher nursing skill mix may be associated with higher resident COVID-19 infection (low confidence). The same national study described above also examined the relationship between nurse skill mix COVID-19 outcomes. Skill mix was measured as RN to total nurse staffing. This study found that lower staff skill mix was significantly associated with lower likelihood of having any COVID-19 cases, while higher skill mix was associated with greater likelihood. The study found no association between staff skill mix and COVID-19 mortality.

Other Infections

Six articles evaluated the association between nursing home staffing and infections. Four studies evaluated UTI, another study examined a composite measure of UTI, pneumonia, and pressure ulcers, and the sixth study addressed increased hospitalizations and mortality during norovirus outbreaks. Two of these were high quality and used longitudinal design, while 3 moderate-quality studies were cross-sectional and 1 moderate-quality study was also longitudinal. Two studies used an instrumental variable approach.

One study focused specifically on VA CLCs, evaluating the composite measure noted above. Three studies focused on nursing homes in a single state or a small number of states. The remaining 2 studies focused on a national sample of US nursing homes. Staffing measures were obtained from study-specific survey data, OSCAR, or VA payroll data. Outcome data were obtained from the MDS and Nursing Home Compare. Across these studies of non-VA US nursing homes, RN HPRD ranged from 0.1 to 0.6. In the VA CLC study, average total nurse staffing was 4.6 HPRD (SD 1.2), with 31% being RN, 26% LPN, and 42% NA.

RN Staffing

Higher RN staffing may be associated with fewer UTI among residents (low confidence). Three studies addressed the relationship between RN staffing and urinary tract infections. One high-quality study using an instrumental variable approach found greater RN staffing was significantly associated with lower UTI. Another instrumental variable study of moderate quality found no significant association between RN staffing and UTI. A national study of moderate quality found that higher RN staffing was significantly associated with higher rates of UTI. Lower RN staffing may also be associated with worse outcomes (hospitalizations and mortality) for nursing home residents during norovirus outbreaks.

LPN and NA Staffing

LPN and NA staffing may not be associated with UTI among nursing home residents (low confidence). One study of a national sample of nursing homes found no significant association between LPN staffing and rates of UTI, but showed that higher NA staffing was associated with lower rates.

Total Staffing

Total staffing may not be associated with UTI (low confidence). The study of VA CLCs found no significant association between total nurse HPRD and a composite measure of UTI, pneumonia, and pressure ulcers. A national study of non-VA US nursing homes categorized total nurse staffing as ≥ 5.0 HPRD or < 5.0 HPRD, with 88% being in the latter category; this study found no association between total staffing and UTI.

Nurse Skill Mix

Higher skill mix staffing may be associated with fewer UTI in nursing home residents (low confidence). Three studies investigated the relationship between nurse skill mix and infections, and there was variation in the direction of effects across the studies. One study defined skill mix as total licensed nurse FTE (RN and LPN) to total nurse staffing, finding that it was not significantly associated with UTI. One study using an instrumental variable approach found that higher skill mix (RN to total) was associated with fewer UTI. The VA CLC study examined both percent RN staffing (of total) and percent NA staffing; it found no significant associations between either and the composite outcome of UTI, pneumonia, and pressure ulcers.

Pain (Moderate-Severe)

Six moderate-quality studies examined associations between nurse staffing and moderate-severe pain in nursing home residents, all using MDS 2.0 data for outcomes. MDS 2.0 data on residents with moderate-severe pain relied on reports by nursing home staff (beginning in 2010, pain outcomes in MDS 3.0 have been assessed by resident interviews). Five studies used data for national nursing home samples, and 1 study evaluated nursing homes in 6 states (Missouri, Texas, Pennsylvania, New York, Connecticut, and New Jersey).

RN, LPN, and NA Staffing

Five studies evaluated associations between nurse staffing (measured as RN, LPN, or NA FTE per 100 residents) and rates of residents with moderate-severe pain. All 5 studies were conducted by the same lead author, and all used study-specific surveys of nursing home administrators to assess nurse staffing. Across these studies, NA FTE made up more than half of total nurse staffing, ranging from 26-33 FTE per 100 residents. RN staffing ranged from 12-15 FTE and LPN staffing was 11-17 FTE. Higher RN staffing may be associated with lower rates of moderate-severe pain among nursing home residents (low confidence). Significant results were reported by 3 studies; for example, 1 of these found 0.5% fewer residents with moderate-severe pain (per nursing home) for every 1 FTE higher RN staffing (per 100 residents). However, 2 studies did not find significant associations between RN staffing and rates of moderate-severe pain in residents.

It was unclear if LPN and NA staffing were also associated with rates of moderate-severe pain among NH residents (very low confidence for both). Two studies reported that higher LPN and NA staffing were both associated with lower rates of moderate-severe pain among long-stay patients. Two studies found no significant associations for LPN staffing, while 1 of these showed a significant association for NA staffing. The last 2 studies found inconsistent results for LPN and NA staffing for pain in long-stay and short-stay residents.

Total Staffing

It was unclear if total nurse staffing is associated with moderate-severe pain in nursing home residents (very low confidence). One study examined data for a national nursing home sample and found that total nurse staffing was not associated with the likelihood of a nursing home being in highest 75th percentile for rates of residents with moderate to severe pain. This study did not report whether long-stay or short-stay residents (or both) were included in assessment of pain outcomes.

Nurse Skill Mix

Higher skill mix may be associated with lower rates of moderate-severe pain among nursing home residents (low confidence). Four studies evaluated associations between skill mix and rates of moderate-severe pain. Three studies were conducted by the same lead author, defined skill mix as the ratio of RN FTE to total non-RN FTE (LPN and NA), and found that higher ratios were associated with lower rates of moderate-severe pain among long-stay residents. For example, 1 of these studies reported that 1% higher RN ratio was associated with 0.2% lower rates of moderate-severe pain. One of these studies also evaluated moderate-severe pain among short-stay residents but found no significant association with skill mix. Finally, 1 study found no association between skill mix (RN and LPN to total nurse staffing) and likelihood of the nursing home being in highest 75th percentile for residents with moderate-severe pain.

Urinary Catheters

Seven studies addressed the use of urinary catheters and all used MDS data for outcome data. All were moderate quality and conducted between 2000 and 2008. Five of the studies were from the same research group, Castle et al. Six of studies were cross-sectional, while the seventh used a longitudinal design. Five studies evaluated data for national samples of nursing homes, 1 looked at nursing homes only in Colorado, and the seventh examined nursing homes in 6 states (Missouri, Texas, Pennsylvania, New York, Connecticut, and New Jersey).

Results regarding nurse staffing and use of urinary catheters in nursing homes were inconsistent, with some studies finding significant associations and others finding none. All 7 studies evaluated RN staffing, with 4 showing a significant association between higher RN staffing and lower use of catheters, and the other 3 studies finding no significant associations. Four studies found a significant association between higher NA staffing and lower catheter use, and 1 study found no association. Two studies showed a significant association between higher skill mix and lower catheter use, while the third study found no association. None of the studies addressed total nurse staffing.

Functioning

Three studies addressed functioning in nursing home residents and all used MDS data on worsening in activities of daily living (ADL, including bed mobility, transfer, eating, and toileting) or basic mobility (able to move around the room). One high-quality study measured nurse staffing hours by observation and detailed self-reports from staff at 105 nursing homes in 4 states (Colorado, Indiana, Mississippi, and Minnesota), specifying resident-specific time (attributed by staff to individual residents) out of total direct care HPRD by RN, LPN, or NA. Higher resident-specific time was associated with greater likelihood of ADL decline for RN (coefficient 0.09, OR 1.09, $p < 0.05$), LPN (coefficient 0.13, OR 1.14, $p < 0.05$), and NA

(coefficient 0.42, OR 1.52, $p < 0.001$). Higher total RN HPRD was associated with lower likelihood of decline in ADL at 90 days (coefficient -0.27, OR 0.76, $p < 0.05$), but LPN HPRD was associated with higher likelihood of decline (coefficient 0.25, OR 1.28, $p < 0.05$); NA HPRD did not have a significant association (coefficient not reported). Notably, baseline data for ADL came from the MDS assessments closest to the time period during which nurse staffing hours were assessed (ADL assessments could have been before or after staffing measurement); there was also substantial variation in the gap between MDS assessment and nurse staffing measurement (mean 0.2 days, SD 24.2 days).

The 2 remaining moderate-quality studies were conducted by the same group and both examined worsening ADL and mobility. One evaluated a national sample of 2,840 nursing homes, finding that higher RN, LPN, and NA staffing were all associated with lower proportions of residents with ADL decline (coefficients -0.06 to -0.09, $p \leq 0.05$).^{6 6} For mobility, higher RN and LPN staffing were associated with lower proportion of residents with decline (coefficients -0.06 and -0.05, $p \leq 0.05$), but NA staffing was associated with higher proportion with decline (coefficient 0.27, $p \leq 0.05$). The other study examined data for 1,071 nursing homes from 6 states (Missouri, Texas, Pennsylvania, New York, Connecticut, and New Jersey), showing that higher RN staffing, modeled as log(FTE per 100 residents), was associated with lower proportions of residents with declines in ADL (coefficient 0.76, $p < 0.01$) and mobility (coefficient 0.83, $p < 0.01$). LPN and NA staffing were not significantly associated with declines in ADL or mobility.

Quality of Life

Three moderate-quality studies reported on the association between nurse staffing and quality of life; 2 examined outcomes for Minnesota nursing homes, and 1 study evaluated nursing homes in western New York. All 3 studies used in-person resident interviews to assess quality of life across broad domains. Results were inconsistent across studies, with 1 study finding that only RN HPRD was associated with quality of life, another study showing that only NA HPRD was associated with quality of life, and the third study not finding any significant associations for nurse staffing levels or skill mix.

Hospitalizations

One high-quality and 4 moderate-quality studies examined hospitalizations among nursing home residents. Three studies were longitudinal, and the remaining 2 were cross-sectional.^{8,15 8,15} Four studies evaluated national samples of nursing homes, using CMS claims data to determine hospitalizations for nursing home residents. The fifth study used state agency data on hospitalizations for nursing homes in New York. Two studies focused specifically on potentially avoidable hospitalizations (PAH) among nursing home residents before death.

Three studies evaluated effects of total nurse staffing levels, with 2 showing no associations with PAH within 90 days of death or overall hospitalization rates. The third study showed a significant association between higher total staffing and a slightly lower odds of PAH within 1 year of death (OR 0.94 [0.90, 0.99], $p = 0.02$). Two studies examined effects of RN staffing; 1 showed that higher RN staffing was associated with a small decrease in probability of 30-day readmissions, and the other did not find significant associations between RN staffing and time to first hospitalization (or time between repeat hospitalizations). Only 1 study examined LPN and NA staffing and found no associations between these staffing levels and probability of 30-day

readmission. Three studies evaluated skill mix and all 3 found an association between higher skill mix and fewer hospitalizations.

Deficiency Citations for Quality of Care

One high-quality and 4 moderate-quality studies addressed associations between nurse staffing and citations for a range of deficiencies. All studies used deficiency citations captured in OSCAR data; citations were for concerns related to resident safety or quality of care. Four studies included national samples of nursing homes, while 1 study focused on nursing homes in New York. Three studies were conducted by the same group, used national samples of nursing homes, and evaluated separate associations with RN, LPN, and NA staffing. One of these found that higher RN, LPN, and NA staffing were all associated with somewhat lower odds of having a citation (OR 0.89-0.91, $p < 0.05$ or $p < 0.001$). Another study found no associations between nurse staffing and deficiency citations (OR 0.77-1.01 for RN, LPN, and NA; $p > 0.05$ for all), while the third study showed lower likelihood of citations with higher RN staffing (OR 0.95, $p < 0.01$) but higher likelihood with higher LPN staffing (OR 1.02, $p < 0.05$), and no association with NA staffing (OR 1.01, $p > 0.05$). The fourth national study examined associations between total nurse staffing (RN, LPN, and NA; dichotomized at < 5.0 or ≥ 5.0 HPRD) and the likelihood of being in the highest 75% percentile in number of citations (out of the set of citations for quality of care), finding no significant association (OR 1.03, 95% CI [0.63, 1.69]). This study also evaluated association with skill mix, measured as proportion of licensed nurse staffing (RN and LPN) out of total nurse staffing; there was no significant association (OR 0.99, 95% CI [0.97, 1.01]). The final study evaluated associations between nurse staffing (RN, LPN, or NA) and receiving citations for quality of care for 162 nursing homes in New York. Only higher RN staffing was associated with nursing homes having lower counts of citations (coefficient -0.25, $p = 0.005$); there were no significant associations for LPN or NA staffing. This study also examined associations with likelihood of receiving more serious quality of care citations but found no significant effects for any nurse staffing variable.

Other Outcomes

Only 1-2 high- and moderate-quality studies addressed each of the following outcomes: use of antipsychotic medications, falls with major injury, discharge to home or community and all-cause mortality. Both studies examining antipsychotic medications used OSCAR and Medicaid data. One included nursing homes in Colorado, while the second study used data from a national sample of nursing homes. Both studies found no significant association between RN HPRD and antipsychotic medications. The second study found that higher LPN and NA HPRD were associated with slightly higher rates of antipsychotics use (coefficients 0.1-0.3, $p < 0.05$).

Two studies addressed resident falls. Both evaluated national samples of nursing homes, using data on nurse staffing from CASPER/OSCAR and falls data from MDS. These 2 studies found inconsistent results; 1 showed that higher RN HPRD, but not LPN or NA, was associated with a lower rates of falls. In contrast, the other study showed that higher NA HPRD, but not licensed nurses (RN and LPN), was associated with significantly fewer resident falls. Inconsistent results may have been due to different analytic decisions due to varying primary goals; 1 was mainly focused on impact of occupational and physical therapy staffing (with nurse staffing included as covariates), whereas the other study aimed to address organizational factors of nursing homes.

One study examined resident discharge to the community from 68 nursing homes who had contracted with a private company (aimed at improving outcomes for Medicare Advantage). Outcomes were assessed for residents who were at the nursing homes for 100 days or less; nursing homes with ≥ 3.5 HPRD were more likely have residents discharged to the community (OR 1.53 [1.29–1.80]).

One addressed mortality rates at 612 California nursing homes in response to new state regulations in 2000 that mandated 3.2 HPRD. Using an instrumental approach, this study found that among nursing homes which had fewer HPRD than required (pre-2000), those that increased their HPRD had fewer resident deaths (6 deaths per 1 HPRD).

DISCUSSION

Summary of Key Findings

We identified 44 eligible studies addressing processes of care and resident outcomes in nursing homes (KQ 1). We did not find any eligible studies that addressed KQ 2. All eligible studies were observational in design, with the vast majority using CMS datasets. Only 1 study focused on outcomes in VA CLCs; no studies compared outcomes across VA CLCs and non-VA community nursing homes. The most frequently addressed outcomes were pressure ulcers and nursing home-associated infections, with one-third of the latter group evaluating COVID-19. Key findings include the following:

- Higher RN staffing is probably associated with fewer pressure ulcers among residents of nursing homes (moderate confidence); LPN and NA staffing may also be associated with fewer pressure ulcers (low confidence)
- Total nurse staffing is probably not associated with pressure ulcers in residents (moderate confidence), but higher skill mix may be associated with fewer pressure ulcers (low confidence)
- Higher RN and NA staffing, and higher skill mix, may be associated with lower resident COVID-19 infection and mortality in nursing homes, while LPN staffing may not be associated with COVID-19 outcomes (low confidence for all findings)
- Higher RN staffing and skill mix may be associated with fewer UTI among nursing home residents, while LPN, NA, and total staffing may not be associated with rates of UTI (low confidence for all findings)
- Higher RN staffing and skill mix may be associated with lower rates of moderate-severe pain among nursing home residents (low confidence), but it is unclear if LPN, NA, and total staffing are associated with pain outcomes (very low confidence)
- Only 1-2 studies addressed effects of nurse staffing on use of antipsychotics medications, falls with major injury, discharge to community, and all-cause mortality
- Results for other resident outcomes and processes of care were largely inconsistent across studies, and sometimes within the same study

The use of CMS-mandated data to study nursing home outcomes is powerful and practical but presents several concerns. CMS data were not collected for research purposes, but to meet federal requirements for nursing homes. As these data directly inform payment or ability to operate, and most are reported by nursing home staff, there may be under-reporting of certain outcomes and over-reporting of staffing levels. In 2016, CMS started to require that staffing data be based on payroll (or other auditable information), but most eligible studies used CMS staffing data collected before this change. Additionally, in many studies, outcomes data were not clearly collected after nurse staffing data, which may change over time. CMS data captures nurse staffing at a certain time or averaged over some time period. This presents challenges for understanding the potential impact of fluctuations in nurse staffing (eg, over intervening weeks or differences between weekdays and weekends). Timing of CMS data collection is likely also not ideal for capturing rates of acute outcomes such as nursing home-associated infections. These methodological concerns limit the ability to detect true associations, and may contribute to counter-intuitive results, such as when insufficient nurse staffing leads to under-detection of pressure ulcers or pain among residents. Staffing assessment of patient-centered outcomes (eg, pain) may also substantially differ from resident or family reports. This concern has been addressed by changes in MDS 3.0 data collection (beginning in 2010) that now incorporate resident interviews, but none of the eligible studies examining pain used MDS 3.0 data.

Notably, studies for 2 outcomes (COVID-19 infections and quality of life) often used data sources outside of these CMS datasets. COVID-19 studies used a variety of sources including state agency data and reports from news organizations to capture COVID-19 cases and mortality. However, these studies still used CMS data on nurse staffing, which are collected once a year; although studies selected the timepoint for staffing data before the time period when COVID-19 infections occurred, these studies would not have captured any fluctuations in staffing during the early stages of the pandemic. Several studies on quality of life used in-person interviews with nursing home residents, but these were limited to data for nursing homes in a single state.

Variation across studies in analytic approaches, definitions of nurse staffing, and outcomes measures presented substantial challenges for interpretation and synthesis of results. In particular, nurse staffing measures varied for RN, LPN, or NA, and also total nurse staffing or total licensed nursing (RN and LPN). Similarly, there was different measures of skill mix, with some focusing on RN effort or time. Because these staffing measures are related and these relationships may vary depending on state-level regulations regarding specific types of nurse staffing, analytic modeling decisions likely impacted ability to detect separate effects due to RN, LPN, and NA staffing.

Some studies used instrumental variables approaches, in particular using data before and after policy changes regarding nursing home regulations (*ie*, taking advantage of a natural experiment). However, there remains substantial challenges to observational analyses of the relationship between nurse staffing and resident outcomes. Nursing homes are complex, heterogenous environments. They are regulated by multiple federal, state, and other agencies. Even high-quality observational studies may not be able to account for all resident population and facility confounders. Nurse staffing may play a key role in resident outcomes, but it is not the only factor. Other healthcare staff (*eg*, physician and non-physician providers, and allied health professionals), the physical environment, and other staff within a nursing home may also affect resident outcomes. The number of these other factors and their complex interplay were considered in conceptual models employed in multiple eligible studies. Accurate data were

generally not available for all of these confounding factors. Thus, it is difficult to distinguish causal effects of nurse staffing apart from higher nurse staffing (or skill mix) being an indicator of generally positive environments or higher resources in nursing homes.

Implications for VA Policy

We found only 1 eligible study that evaluated outcomes for VA CLCs. There are substantial concerns in generalizability of results from studies of non-VA community nursing homes to VA CLCs. VA CLC residents are likely very different from the average community nursing home resident. Federal law and VA policies require VA to treat any qualifying Veteran, regardless of ability to pay and especially if care needs reflect injuries or conditions related to past military service (*ie*, service-connected conditions). This requirement, along with being hospital-based facilities, contribute to some demographic differences, more health conditions and care needs, and overall greater acuity, compared with community nursing home residents. For example, most CLC residents are male, younger, and have higher rates of certain conditions (*eg*, PTSD). These differences may contribute to higher rates of certain outcomes in VA CLC residents. Furthermore, by VA policies, VA CLCs must have higher levels of nurse staffing (particularly RN staffing), compared to community nursing homes. For example, the single eligible study on outcomes in VA CLCs showed that the average total nurse staffing in CLCs was 4.6 HPRD, with 31% being RN staffing (*ie*, 1.4 RN HPRD for each CLC). Community nursing homes generally had much less RN HPRD. Beyond staffing levels, there are likely other important differences in the nursing workforce and work environment between VA CLCs and community nursing homes. Therefore, the results showing better resident outcomes with higher RN staffing in community nursing homes may be less applicable to VA CLCs.

Aside from these concerns regarding applicability, larger environmental factors (*eg*, nursing shortages) may present substantial challenges to increasing nurse staffing. Nursing homes may also be less desirable employers compared with other facilities (*eg*, hospitals) that also need nursing staff, due to differences in salary and benefits, or other factors in the work environment. Additionally, our results suggest very small potential differences in resident outcomes associated with nurse staffing. For example, 1 study showed that 1 FTE higher of RN staffing per 100 residents reduced the rate of moderate-severe pain in residents by 0.5%; this indicates that 2 additional FTE of RN staffing in a nursing home with 100 residents are needed to prevent 1 case of pain. Using an estimated \$75,000 for salary and benefits for RN, it would take \$150,000 to prevent 1 resident from having moderate-severe pain. VA salaries for RNs are often higher, leading to even greater costs for VA. While data are not available for cost-effectiveness calculations, higher RN staffing is also likely to reduce the costs associated with other outcomes including pressure ulcers, urinary tract infections, and COVID-19 infections.

Although outside the scope of this current review, VA CLCs may wish to consider changes beyond nurse staffing in order to improve specific resident outcomes. Other potential options include modifications to the nursing home environment and processes (*eg*, engaging all nurse staffing in care planning), and greater resources for other allied health professionals (*eg*, social workers and mental health staff). Some of these measures have been implemented by certain VA CLCs, including specialized teams to address behavioral symptoms among residents with dementia.

Research Gaps/Future Research

We identified only 1 eligible study on nurse staffing and resident outcomes in VA CLCs; this focused on a composite outcome of pressure ulcers, pneumonia, and UTI. Due to concerns noted above regarding applicability of results from non-VA community nursing homes, we recommend conducting future studies that examine other high-priority outcomes in VA CLC residents.

Additionally, dedicated assessments of nurse staffing and resident outcomes in observational studies may provide more accurate evaluations of the effects of nurse staffing. It would also be valuable to include data on organizational culture and other structural characteristics of nursing homes that are not usually reflected in CMS datasets. Although CMS has recently started to require reporting of nurse turnover and weekend nurse staffing, there remain other aspects of staffing and work environment that are likely important but not captured by CMS data.

Finally, all eligible studies used observational designs. Randomized evaluations of nurse staffing may be logistically challenging and also may engender substantial ethical concerns (*eg*, lowering nurse staffing below currently accepted levels may create unacceptable risks for resident safety). However, the complex relationships between nurse staffing, nursing home facility characteristics, and resident factors make it very difficult to understand causal effects of nurse staffing from observational studies alone. One possible avenue to address these concerns is to consider an implementation science approach and study designs that incorporate randomization in real-world setting (*eg*, stepped wedge). For example, a new initiative could offer more resources for nurse staffing to participating nursing homes, with different facilities randomly selected to increase staffing over different time periods. If such a study were conducted within a large integrated health system, such as the VA, there may be additional opportunities to use existing health information technology infrastructure to capture resident outcomes.

Limitations

This review focused on nursing home staffing, and not on other organizational or structural factors of nursing homes that may be important for resident outcomes. We also prioritized resident outcomes and processes of care based on the needs of our VA stakeholders. Because our goal was to inform current policy and decision-making within the VA, we also limited eligibility to studies of US nursing homes using data from 2000 or later. Nursing homes are governed by a complex set of national (and state) regulations, which have substantially changed since 2000 and likely very different in other countries. Training and experience for nursing staff may also vary across different countries. There may also be differences in resident characteristics, related to varying national regulations and financial policies for nursing home benefits. Therefore, our results are likely not applicable to outcomes in non-US nursing homes.

Conclusions

Evidence on nurse staffing and resident outcomes and processes of care from observational studies indicate that higher RN staffing and skill mix were associated with fewer pressure ulcers, fewer nursing home-associated infections, and lower rates of moderate-severe pain. Effects of LPN, NA, and total staffing were mixed or unclear for these outcomes. Relationships between nurse staffing and a variety of other outcomes were inconsistent, or only evaluated by 1-2 studies. These findings may not generalize to VA CLCs, which have different resident characteristics and higher staffing levels than non-VA community nursing homes. More accurate

and randomized study designs may be required to definitely evaluate the effects of nurse staffing on resident outcomes and processes of care.