JAMDA 25 (2024) 105261

JAMDA

journal homepage: www.jamda.com

Review Article

# Impact of Quality Improvement Interventions on Hospital Admissions from Nursing Homes: A Systematic Review and Meta-Analysis

Ines Basso PhD [a,*], Silvia Gonella RN, PhD [b], Erika Bassi PhD [a], Silvia Caristia PhD [c], Sara Campagna PhD [d], Alberto Dal Molin PhD [a]

[a] Department of Translational Medicine, University of Piemonte Orientale, Novara, Italy
[b] Azienda Ospedaliero Universitaria Città della Salute e della Scienza di Torino, Torino, Italy
[c] Department of Sustainable Development and Ecological Transition, University of Piemonte Orientale, Vercelli, Italy
[d] Department of Public Health and Pediatric Sciences, University of Torino, Torino, Italy

*Keywords:*
Quality improvement
hospitalizations
nursing homes
systematic review

A B S T R A C T

*Objective:* To synthesize evidence assessing the effectiveness of quality improvement (QI) interventions in reducing hospital service use from nursing homes (NHs).
*Design:* Systematic review and meta-analysis of randomized controlled trials (RCTs), controlled before-after (CBA), uncontrolled before-after (UBA), and interrupted time series studies. Searches were conducted in MEDLINE, CINAHL, The Cochrane Library, Embase, and Web of Science from 2000 to August 2023 (PROSPERO: CRD42022364195).
*Setting and Participants:* Long-stay NH residents (>30 days).
*Methods:* Included QI interventions using a continuous and data-driven approach to assess solutions aimed at reducing hospital service use. Risk of bias was assessed using JBI tools. Delivery arrangements and implementation strategies were categorized through EPOC taxonomy.
*Results:* Screening of 14,076 records led to the inclusion of 22 studies describing 29 QI interventions from 6 countries across 964 NHs. Ten studies, comprising 4 of 5 RCTs, 3 of 4 CBAs, and 1 of 12 UBAs were deemed to have a low risk of bias. All but 3 QI interventions used multiple component delivery arrangements (median 6; IQR 3-8), focusing on the "coordination of care and management of care processes" alone or combined with "changes in how, when, where, and by whom health care is delivered." The most frequently used implementation strategies were educational meetings (n = 25) and materials (n = 20). The meta-analysis of 11 studies showed a significant reduction in "all-cause hospital admissions" for QI interventions compared with standard care (rate ratio, 0.60; 95% CI, 0.41-0.87; $I^2 = 99.3\%$), with heterogeneity due to study design, QI intervention duration, type of delivery arrangements, and number of implementation strategies. No significant effects were found for emergency department (ED) visits or potentially avoidable hospitalizations.
*Conclusions and Implications:* The study provides preliminary evidence supporting the implementation of QI interventions seeking to reduce hospital admissions from NHs. However, these findings require confirmation through future experimental research.


Nursing homes (NHs) are among the primary providers of long-term care services across both the United States and Europe.[1,2] Approximately 25% to 50% of NH residents are hospitalized every year,[3-5] with 4% to 55% of these hospitalizations considered potentially avoidable.[6,7] Although distinguishing between avoidable and non-avoidable admissions can be challenging because of complex health conditions prevalent among NH residents, there is a general

S.C. and A.D.M. should be considered co-last authors.
This study was partially funded by the Italian Ministry of University and Research (MUR) program "Departments of Excellence 2023–2027," AGING Project – Department of Translational Medicine, Università del Piemonte Orientale.
* Address correspondence to Ines Basso, PhD, Department of Translational Medicine, University of Piemonte Orientale, Via Solaroli 17, 28100 Novara, Italy.
*E-mail address:* ines.basso@uniupo.it (I. Basso).

https://doi.org/10.1016/j.jamda.2024.105261

consensus that certain acute conditions, could be prevented or managed in a way that would not require hospitalization.[8-11] Hospitalizations among this fragile population often lead to an increased risk of adverse events.[6] In addition, communication breakdowns between health care settings can result in care that is misaligned with the wishes of the residents or their families, causing distress, discomfort, and higher costs.[12]

In the past decades, there has been significant investment in quality improvement (QI) interventions aimed at reducing hospitalizations among NH residents.[13-17] QIs are structured as complex interventions that progress through phases, each informed by the previous one, specifically designed to implement and continuously improve care delivery.[18] The core premise of a QI intervention is to organize the improvement process using an iterative and customized approach to evaluate the changes introduced.[19,20] For QI intervention to be effective, full engagement from all organizational members, including management, is essential. This involves a clear acknowledgement and understanding of the issue at hand and empowerment to develop innovative solutions.[21]

QI interventions typically facilitate the translation of research evidence into clinical practice through multiple delivery arrangements, which refer to the changes implemented to achieve improvements.[22] Such changes in delivery arrangements may include transformative adjustments in the organizational structure, including modifications to the logistics of service provision, the personnel providing care, advancements in information and communication technology (ICT) resources, as well as strategies to ameliorate the coordination of the care process.[23]

In addition to delivery arrangements, recent advancements in implementation science have evidenced the importance of strategies that favor sustainable changes in real-world settings.[24] In this regard, a wide range of activities, including education programs or local consensus processes, have been shown to improve project implementation outcomes (ie, project fidelity and acceptability), thereby directly influencing the effectiveness of the intervention itself.[25]

This study used an adapted version of the implementation research conceptual model to guide the research question.[26] According to the model, delivery arrangements and implementation strategies are interconnected aspects that affect different and interrelated outcomes, including implementation (eg, fidelity measures) and resident outcomes (eg, hospitalization rates).

Our preliminary search has failed to identify any registered or published protocols specifically addressing this topic. Indeed, previous systematic reviews have either focused on the rate of avoidable 30-day readmissions from skilled nursing facilities or analyzed the quality of QI interventions in NHs, including descriptions of staff training initiatives.[27,28]

Given the existing lack of evidence summarizing the effectiveness of QI interventions in preventing hospitalizations from NHs, this systematic review and meta-analysis aims to evaluate the effectiveness of QI interventions in reducing hospitalizations among NH residents, analyzing the contribution of their delivery arrangements and implementation strategies.

## Methods

A systematic review with meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement.[29] The protocol for this review is registered in the PROSPERO database and described in detail elsewhere.[30]

### *Search Strategy*

The literature search spanned MEDLINE, CINAHL, Cochrane Library, Embase, and Web of Science databases, targeting publications from January 1, 2000, to August 31, 2023. This timeframe was chosen based on a previous review that had not retrieved QI interventions in NH settings before that date.[31] No language restrictions were imposed.

After an initial search conducted on MEDLINE via PubMed, we collaborated with an expert librarian to devise a comprehensive search strategy that used a combination of controlled and free-text terms using Boolean operators AND/OR. The search focused exclusively on peer-reviewed publications; gray literature was excluded. Finally, we manually screened the reference lists of included studies to identify additional papers. Zotero software was used to remove duplicates. The complete search strategy is detailed in the published protocol.[30]

### *Selection Criteria*

We selected studies based on predefined eligibility criteria, considering the PICO elements.[32]

- Population: we included studies focusing on long-stay NH residents, defined as individuals who had resided in the facility for at least 30 days. We excluded studies on short-term stay individuals, such as those receiving rehabilitation services or respite care. NHs in this context refer to facilities providing accommodation and nursing care services to individuals who are no longer independent or have disabilities.[33]
- Intervention: QI interventions were defined as dynamic approaches that design, test, and implement changes in clinical practice, using real-time measurement to improve safety and quality of care.[34] Eligible studies needed to describe at least 1 implementation strategy among those included in the EPOC taxonomy of health system interventions.[23] It was not mandatory to employ a formal model for improvement [eg, plan-do-study-act (PDSA) or Lean]. QI collaboratives (QICs), involving multiple institutions, were also considered eligible.[35]
- Comparison: eligible studies were required to compare the effects of the QI interventions with the standard care.
- Outcomes: the primary outcome of the review was hospital admissions for any cause, and the secondary outcomes included emergency department (ED) visits, potentially avoidable hospitalizations—as defined by the authors using all the existing metrics—hospital readmissions, end-of-life hospitalizations, ambulance calls, and conveyances to hospital. We considered both self-reported and data extracted from a database.[6]
- Study design: we included randomized controlled trials (RCTs), controlled before-after trials (CBAs), uncontrolled before-and-after trials (UBAs), or interrupted time series (ITSs) with at least 3 data points before and 3 after the intervention.

Two reviewers (I.B. and S.G.) independently screened the titles and abstracts of the studies. Full texts of selected studies were then thoroughly assessed according to PICO criteria. In case of doubt, a consensus was reached through discussion.

### *Risk of Bias and Quality Assessment of the QI Intervention*

The risk of bias in the included studies was independently assessed by 2 reviewers (I.B. and S.G.) using the Joanna Briggs Institute Critical Appraisal Tools tailored for RCTs and quasi-experimental studies.[36] These tools offer a range of criteria to score based on whether they are fulfilled (Yes = 2), unclear (= 1), not fulfilled (No = 0), or not applicable. For RCTs, the highest possible score is 22. Because of the nature of the studies, items assessing the blindness of participants and those administering the intervention were excluded. The maximum score for quasi-experimental studies is 18.

Studies were classified as high quality if the specified criteria were present in more than 80% of responses, moderate quality for percentages between 60% and 80%, and low quality when less than 60%. All studies were included in the review regardless of their methodological quality outcomes.

In addition to the risk of bias, the quality of the QI interventions themselves was assessed using the QI Minimum Quality Criteria Set (QI-MQCS).[37] This tool comprises 16 items, each requiring a dichotomous response to determine whether the study meets the minimum quality standards.

### *Data Extraction*

Data extraction was performed independently by 2 authors (I.B. and S.G.). The changes for improvement and implementation strategies were classified according to the "Delivery Arrangements" and "Implementation Strategies" domains of EPOC taxonomy of health system interventions, respectively.[23] Delivery arrangements were organized into the 5 categories of the domain:

- How and when care is delivered (5 subcategories)
- Where care is delivered and changes to the health care environment (5 subcategories)
- Who provides care and how the health care workforce is managed (9 subcategories)
- Coordination of care and management of care processes (16 subcategories)
- ICT (4 subcategories)

Implementation strategies were framed into 3 broad areas:

- Interventions targeted at health care organizations
- Interventions targeted at health care workers
- Interventions targeted at specific types of practice, conditions, or settings

### *Data Synthesis*

Data from included studies were aggregated for meta-analysis using Stata/SE V.17 software. Given that the outcome measures were different across studies, the rate ratios (RRs) along with their 95% CIs were calculated. A random-effects model was used to pool the data.

Statistical heterogeneity in the metanalysis was evaluated using the $I^2$ statistic, which is considered high if values exceed 75%. In cases in which fewer than 10 studies were included, the $H^2$ statistics were used, with values less than 1.88 deemed acceptable.[38] The authors were asked to supply missing data.

To further examine sources of heterogeneity, subgroup analyses were performed based on the following factors: (1) the duration of the QI (<6 months, between 7 and 12 months, or > 12 months); (2) the type of delivery arrangements; and (3) the number of implementation strategies ($\leq$5 or $\geq$ 6). These analyses were stratified by study design (ie, RCT, CBA, and UBA).[39]

Delivery arrangements were dichotomized into 2 groups: (1) those focusing solely on the coordination and management of care processes, and (2) those that combined coordination and management of care processes with at least 1 of the following EPOC categories: (1) changes in how and when care is delivered, (2) where care is delivered and changes to the health care environment, (3) modifications in who provides care and how the health care workforce is managed, and (4) adjustments in ICT. The second group, which combined more EPOC categories, was described as "changes in how, when, and where health care is organized and delivered, and who delivers health care." Because of the limited number of retrieved studies, we chose not to perform a sensitivity analysis based on quality appraisal.

## Results

### *Selection Process*

After duplicate removal, a total of 14,076 citations were identified (Supplementary Figure 1). A total of 206 citations were assessed in full text. From these, most were excluded for various reasons: they focused on other populations (n = 27), used approaches other than QI interventions (n = 49), measured different outcomes (n = 25), or used alternative study designs (n = 83) (Supplementary Table 1). Finally, 22 studies were included in the systematic review.

### *Study Characteristics*

Of the 22 studies included, 5 (23%) were RCTs,[14,16,40-42] 4 were CBAs (18%),[17,43-45] 12 (55%) were UBAs,[15,46-56] and 1 (4%) was an ITS (Table 1).[57] These studies were conducted between 2000 and 2021 and reflected a wide geographic distribution: 6 studies (27%) each from the United Kingdom and the United States,[15-17,41,42,45,48,51,54-57] 4 (19%) from Canada,[47,50,52,53] 3 (14%) from New Zealand,[14,40,46] 2 (9%) from Australia,[43,49] and 1 (4%) from Europe.[44]

As summarized in Table 1, most studies described a single QI intervention using a single set of implementation strategies, although there were exceptions. Vadnais et al reported on 7 QI interventions led by 7 organizations across various US states.[45] Lisk et al presented a 2-phase project (part 1-2), with each phase testing different QI interventions, and Rask et al compared 3 different sets (A, B, C) of implementation strategies to deliver a single QI intervention.[51,54] Overall, the 22 studies assessed 29 QI interventions, using 32 sets of implementation strategies.

## Participants

A total of 964 NHs were recruited (median 20, range 1–175), with a pre-intervention hospitalization rate ranging from 0.88[14] to 7.32 per 1000 resident/bed-days.[56] In terms of participation, 238,487 NH residents were involved across 12 studies that provided this information.[14,16,40-42,44,45,47-50,55]

### *QI Intervention Characteristics*

Of the 29 QI interventions assessed, 11 (38%) were based on a theoretical framework or used the PDSA model for improvement.[14,15,41,42,47,48,(part 1-2)51-53,57] The median QI intervention duration was 12 months (IQR 6–18).

Another 12 of 290 QIs (41%) were QIC interventions, which facilitated the collaborations between NHs and primary care providers or acute hospital settings.[14,40,43,44,46,48,49,57,(part 1-2)51,55,56]

Overall, the 29 QI interventions used 161 delivery arrangements (Table 1). Although most QI interventions primarily implemented multicomponent delivery arrangements (median 6, IQR 3–8), 3 were based on a single-component delivery arrangement.[15,47,53]

All QI interventions used delivery arrangements related to the coordination of care and management of care processes. These arrangements were implemented exclusively (n = 11)[15-17,41,42,44,47,48,53,54,56] or in combination with changes in others. For those that integrated additional strategies, changes included adjustments in "how and when care is delivered" (n = 10),[14,43, (Alabama, Indiana, Missouri, Nebraska, Nevada, NewYork, Pennsylvania)45,49] "where care is delivered and changes to the health care environment" (n = 10),[14,40,46,50,(part 1-2)51,52,(Nebraska)45,55,57] "who provided care and how the health care workforce is managed" (n = 5), (Indiana, Missouri, Nebraska, Nevada, Pennsylvania) or envisaged "changes in ICT" (n = 9).[14,43,49, (part 1-2)51,57, (Missouri, New York, Pennsylvania) 45]

**Table 1**
Delivery Arrangements and Implementation Strategies Employed by QI Intervention

| Delivery Arrangements | N = 29 QI* (%) | Implementation Strategies | N = 32 Set (%) |
|---|---|---|---|
| Coordination of care and management of the care process† | *29* | *Interventions targeted at health care workers*† | 32 |
| Case management[16,17,40-43, (AL,IN,MO,NE,NV,PA,NY)45-47,49,54-56] | 19 | Educational meetings[14-17,40,41,43,(AL,IN,MO,NE,NV,NY,PA)45-49,52,53, (A,B,C,)54,55,57] | 25 |
| Continuity of care[16,17, (AL,IN,MO,NE,NV,PA,NY)45,50,(part1-2)51,54,56] | 14 | Educational materials[16,17,42,44,47,48,50,52,53,(AL,IN,MO,NE,NV,NY,PA)45,(A,B,C,)54,55] | 20 |
| Shared decision-making[16,17,40,46,(IN,NY,PA,NV)45,50,52-56] | 14 | Continuous QI[15-17,41,42,(AL,MO,NV,PA)45,48,49,(part1-2)51,52,(A)54-57] | 18 |
| Care pathways[14,16,17,42,43,(AL,IN,NV,NY,PA)45,49,54,56,57] | 14 | Audit and feedback[15,17,41,44,(AL,MO,NV,NY)45,47,48,(part1-2)51-53,(A)54,55,57] | 17 |
| Communication between providers[16,17,42,(AL,IN,MO,NE,NV,NY,PA)45,48,49,54,56] | 14 | Local consensus processes[14-17,41,42,44,47,(IN)45,48,50,(A,C)54,56] | 14 |
| Disease management[15,16,44,(AL,IN,MO,NE,NV,NY,PA)40,41,45,46] | 13 | Local opinion leaders[14-17,41,(AL,IN)45,48,(A,B)54-56] | 12 |
| Transition of care[16,17,43,(AL,IN,MO,NE,NV,NY,PA)45,49,54,56] | 13 | Communities of practice[16,17,40,42,(AL,MO)45,46,50,53,56,57] | 11 |
| Integration[14,40,43,44,46,48,49,(part1-2)51,55-57] | 12 | Reminders[16,17,(AL,MO,NV,NY)45,56,(A,B,C)54] | 10 |
| Teams[40,46,(part1-2)51,55,57] | 6 | Educational outreach visits, or academic detailing[15,41,(AL,NY)45,48,50,(C)54] | 7 |
| Comprehensive geriatric assessment[14,43,49,(IN)45] | 4 | Tailored interventions[40,41,44,(PA)45,46,50] | 6 |
| How and when care is delivered† | *10* | Patient-mediated interventions(IN)45,50,52,53,55] | 5 |
| Coordination of care among different providers[14,43,(AL,IN,MO,NE,NV,NY,PA)45,49] | 10 | Inter-professional education[14,44,56] | 3 |
| Triage[43,49] | 2 | Monitoring the performance of the delivery of healthcare[40,44,56] | 3 |
| Quality and safety system(NV)45] | 1 | Routine patient-reported outcome measures(NV)45,55] | 2 |
| Where care is provided and changes to the healthcare environment† | | Managerial supervision(A,B)54] | 2 |
| Outreach services[14,40,(NE)45,46,50,(part1-2)51,52,55,57] | 10 | Clinical incident reporting[15] | 1 |
| Site of service delivery(part2)51] | 1 | *Interventions targeted at health care organizations* | 10 |
| Who provides care and how the health care workforce is managed | | Organizational culture[15,44,(AL,IN,MO,NE,NV,NY,PA)45,48] | 10 |
| Role expansion or task shifting(IN,MO,NE,NV,PA)45] | 5 | | |
| ICT | | | |
| The use of ICT[14,43,(MO,NY)45,46,(Part1-2)51] | 7 | | |
| Telemedicine(PA)45,57] | 2 | | |

AL, Alabama; IN, Indiana; MO, Missouri; NE, Nebraska; NV, Nevada; NY, New York; PA, Pennsylvania.
*Number of QI interventions that have adopted the delivery arrangement.
†The total for the categories is lower than the sum of the individual subcategories because a QI intervention could adopt multiple strategies within the same category.

Among the delivery arrangements related to the "coordination of care and management of care processes," the most common subcategories involved case management (n = 19) (eg, improving the skills of clinical staff in recognizing and managing acute deterioration), continuity of care (n = 14) (eg, promoting transition toward palliative-oriented care), shared decision-making (n = 14) (eg, emphasizing advance care planning), care pathways (n = 14) (eg, care paths for residents with common geriatric problems), and communication between providers (n = 14) (eg, establishment of communication protocols or introduction of communication tools). Table 1 presents the details of delivery arrangements and implementation strategies in individual QI, and Supplementary Table 2 reports the detailed classification according to the EPOC taxonomy.

The QI interventions used a median of 5 (IQR 4–7) implementation strategies, among which the most frequent were education meetings (n = 25), educational materials (n = 20), or continuous QI measures (n = 18). All QI interventions used strategies targeted at health care workers, with 10 of them targeting health care organizations.[15,44,(Alabama, Indiana, Missouri, Nebraska, Nevada, New York, Pennsylvania)45,48] No QI interventions used implementation strategies targeted at specific types of practice, conditions, or settings.

### *Type of Comparison*

All included studies compared the QI intervention with standard care. Boyd et al implemented care pathways in the control group as well.[14]

## Outcomes

The included studies collected data using national or hospital databases,[14,40,41,43,46,49,57] Medicare claims,[16,54] medical records,[44,50] or self-reported data by NH staff.[15,17,42,45,48,56] Five studies did not report the source of data collection.[47,51-53,55]

### *All-Cause Hospital Admissions*

Of 22 studies, 13 provided data on all-cause hospital admissions (Figure 1). Eleven of these studies, comprising 12 QI interventions, were included in the meta-analysis,[14-17,40-43,49, (part 1 and 2)51] whereas 2 studies did not report or provide sufficient data to be included.[55,56]

Figure 1 shows a significant overall reduction in all-cause hospital admissions in the group receiving the QI interventions compared with those treated with standard care (RR, 0.60; 95% CI, 0.41–0.87), but the heterogeneity was considerable ($I^2$ = 99.3%).

When pooling by study design, RCT subgroup estimate showed a borderline significant effect in favor of intervention with moderate heterogeneity (RR, 0.83; 95% CI, 0.69–1.00; $I^2$ = 51.6%),[14,16,40-42] whereas estimates from the CBA and UBA subgroups did not show any significant effects[15,17,43,45,49, (part 1-2)51].

## ED Visits

Of the 22 studies, 10 (45.4%) measured ED visits.[15,40,43-49,55] Seven were included in the meta-analysis, whereas 3 studies were excluded because of insufficient data.[47,48,55]

The overall estimate shows a borderline significant effect in favor of the intervention group in reducing ED visits, although the heterogeneity remains high (RR, 0.60; 95% CI, 0.36–1.00; $H^2 > 1.88$) (Figure 2).

Combining by study design, results from 1 RCT failed to show a significant effect.[42] Similarly, pooled results from 3 CBAs also showed no significant effect.[43-45] In contrast, the combined results from 3 UBAs indicated a significant reduction in ED visits for the QI intervention group compared with standard care (RR, 0.66; 95% CI, 0.49–0.90; $H^2 > 1.88$).[15,46,49]

### *Potentially Avoidable Admissions*

Four out of 5 studies assessing potentially avoidable admissions were included in the meta-analysis.[14,16,40,45] One study was excluded

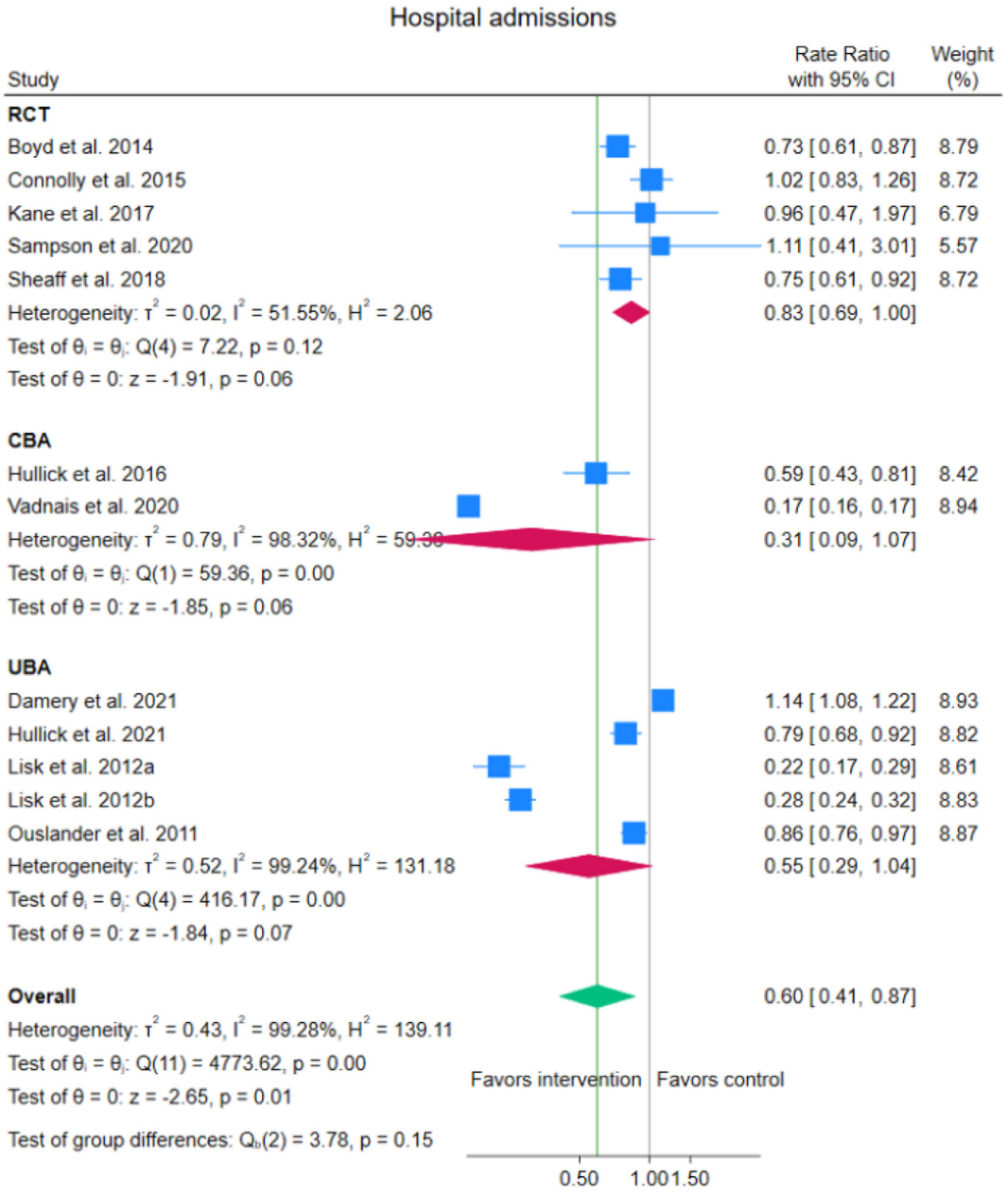


**Fig. 1.** Forest plot for a meta-analysis assessing the effectiveness of QI interventions in reducing all-cause hospital admissions, stratified by study design.

because of insufficient data.[42] Potentially avoidable hospitalizations were defined using different metrics.

The combined analysis of 3 RCTs and 1 CBA showed no significant effect of the QI intervention in reducing potentially avoidable admissions (Figure 3).[14,16,40,45]

## Subgroup Analysis

Supplementary Table 3 provides a detailed subgroup analysis by outcome and study design. The heterogeneity observed in the overall estimates (Figures 1–3) may be attributed to differences in the duration of the QI interventions, types of delivery arrangements employed, and number of implementation strategies used. Specifically, in the RCT subgroup evaluating all-cause hospital admission—the largest study group—combining the studies lasting 7 to 12 months resulted in acceptable levels of heterogeneity (RR, 0.74; 95% CI, 0.65–0.85; $H^2 = 1$).[14,16,41] Likewise, RCTs focusing solely on "coordination of care and management of care processes" or those that combined "coordination of care and management of care" and "changes in how, when, and where health care is organized and delivered, and who delivers health care" demonstrated positive outcomes (RR, 0.78; 95% CI, 0.64–0.94; $H^2 > 1$ and RR, 0.76; 95% CI, 0.63–0.93; $H^2 = 1$, respectively).[14,16,41-43] Furthermore, when RCTs using more than 6 strategies to prevent all-cause hospitalizations were pooled, the heterogeneity was similarly acceptable (RR, 0.76; 95% CI, 0.63–0.93; $H^2 = 1$).[16,41] Heterogeneity remained substantial for CBA and UBA subgroup analysis.

### *Hospital Readmissions*

Four studies provided data on hospital readmissions, measuring outcomes at either 28 or 30 days.[16,43,49,54] No meta-analysis was

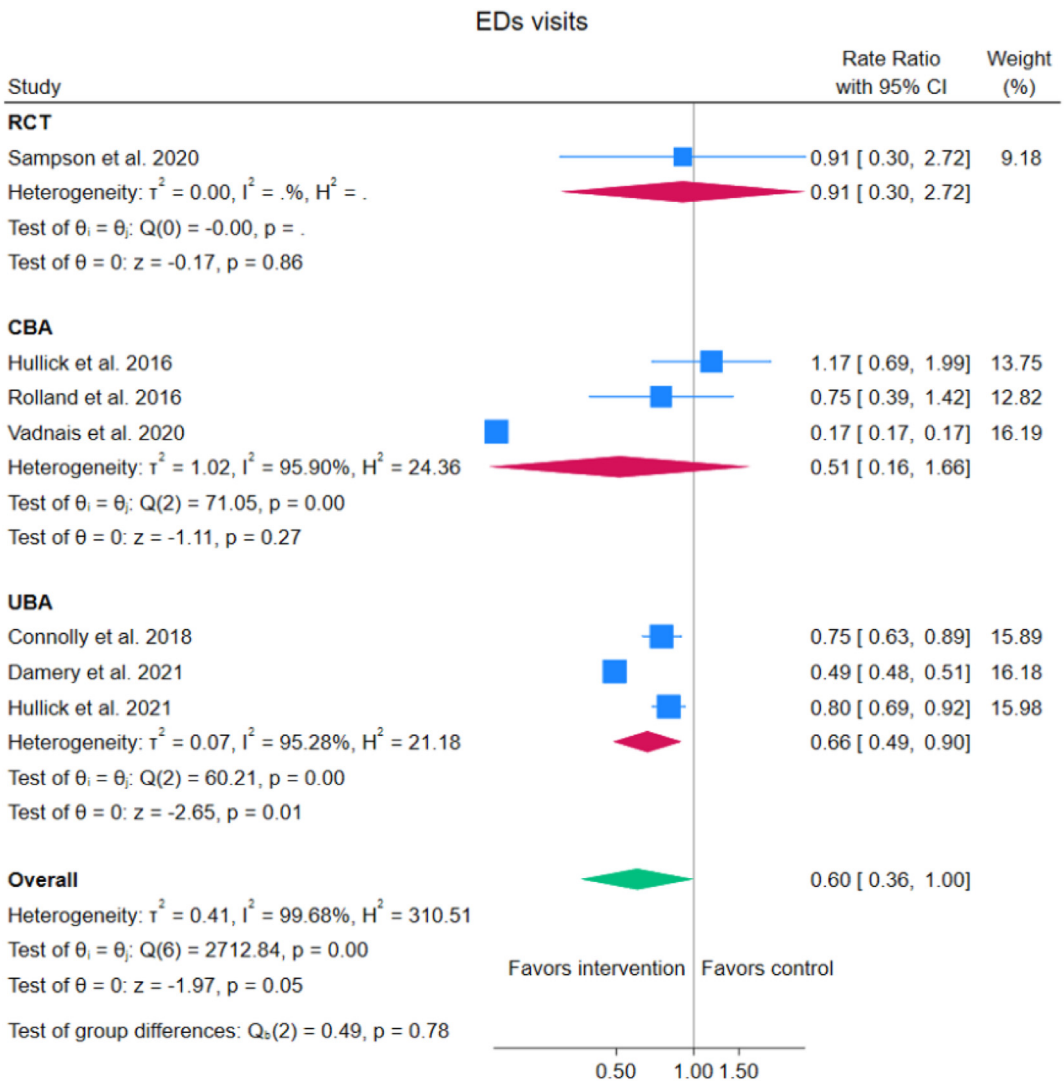


**Fig. 2.** Forest plot for a meta-analysis assessing the effectiveness of QI interventions in reducing ED visits, stratified by study design.

performed because of the heterogeneity of the data formats and measures. In these studies, no significant differences were found in a cluster RCT and a CBA study.[16,43] However, a slight reduction in readmission rates was observed in 1 UBA.[49] A significant positive effect was documented in 2 of 3 initiatives in a UBA comparing different sets of implementation strategies for the same QI intervention.[54]

## Hospitalizations at the End of Life

Three UBAs assessed end-of-life hospitalizations, considering the last 2 months or the final year of life.[50,52,53] No meta-analysis was performed. One study reported no significant changes following a 6-month QI intervention that focused on educating and supporting clinical NH staff and residents' families.[52] In contrast, the same authors reported a decrease in end-of-life hospitalizations in a subsequent study that used a tool to gather information about residents at risk of hospital transfer.[53] Last, a study by Kaasalainen et al documented a reduction in end-of-life hospitalizations through the implementation of a palliative care program.[50]

### *Ambulance Calls*

Three studies evaluated the frequency of ambulance calls.[41,42,57] Two RCTs found no significant differences between the QI intervention and control groups,[41,42] whereas an ITS implementing a QIC demonstrated a 15.1% reduction in ambulance calls over a 3-year period.[57]

## Conveyances to Hospital

One ITS study showed an 18.7% decrease in hospital conveyances during the implementation period of a QI intervention.[57]

### *Risk of Bias and Appraisal Quality of the Intervention*

Supplementary Tables 4 and 5 detail the risk of bias assessments for the included studies. Among the RCTs, 4 of 5 were considered high-quality studies,[14,16,40,42] whereas 1 was classified as moderate quality.[41] On the other hand, among the quasi-experimental studies, almost one-third (6 of 17) were deemed high quality,[43-46,49,57]

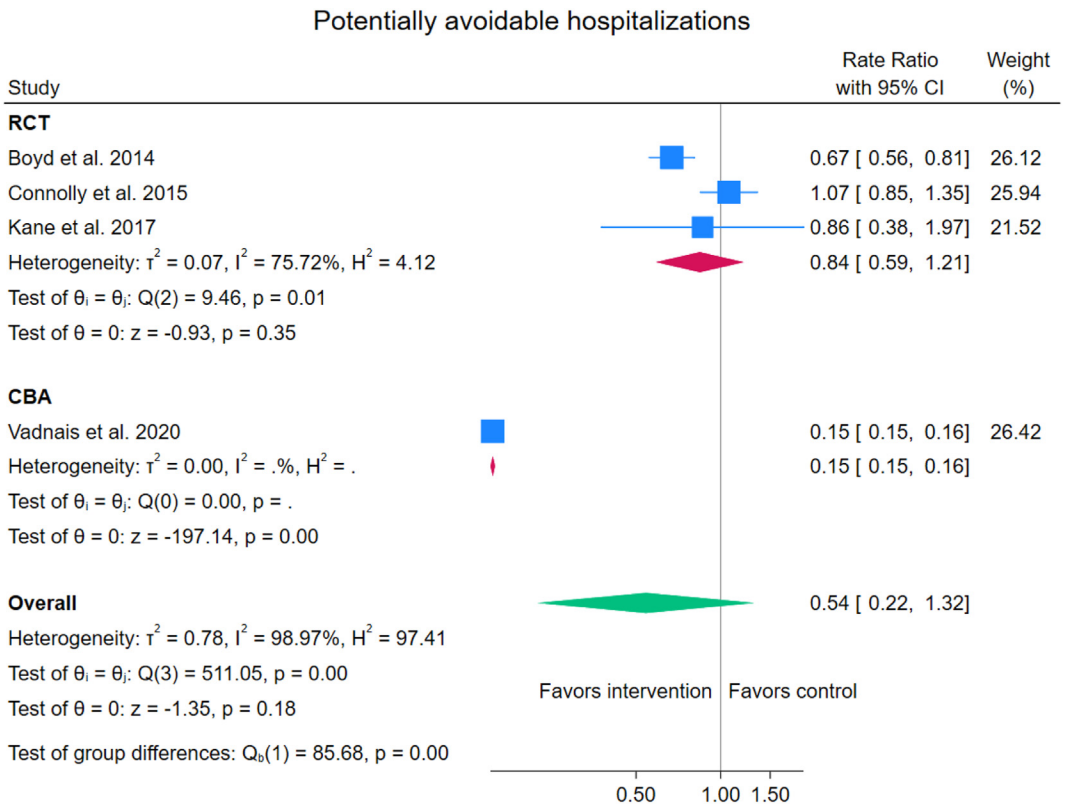


**Fig. 3.** Forest plot for a meta-analysis assessing the effectiveness of QI interventions in reducing potentially avoidable hospitalizations, stratified by study design.

6 of moderate quality,[15,17,50,54-56] and the remaining 5 of low quality.[47,48,51-53]

Supplementary Table 6 presents the overall quality of the QI interventions assessed. Three studies (14%) fully met the quality criteria, achieving the maximum score of 16.[16,42,44] Most studies (59%) were considered to have good quality, scoring from 12 to 15.[14,15,17,40,41,43,45,46,49,50,54,56,57] The most critical domains were those related to the discussion of sustainability and the necessary adjustments required to uphold the intervention post-study, which were adequately addressed by 55% of the studies. Similarly, the measurement of penetration was successfully achieved by 55% of the studies.

### *Funnel Plots*

The subgroup of RCTs exhibits discrete asymmetry, suggesting potential publication bias. Funnel plots within each study design are presented in Supplementary Figures 2–4.

## Discussion

This systematic review synthetized data from 22 studies, evaluating 29 QI interventions, and observed a potential positive impact on all-cause hospital admissions. However, it found no effects on ED visits and potentially avoidable hospitalizations. The overall estimates for each outcome were significantly influenced by substantial heterogeneity, which was due to both methodological diversity, such as variations in study designs, and clinical diversity, including differences in the duration of QI interventions, types of delivery arrangements utilized, and number of implementation strategies employed. Although these factors effectively addressed the heterogeneity within the RCT subgroup, the CBA and UBA subsets displayed substantial heterogeneity likely due to methodological weaknesses and the magnitude of bias.[39]

Our results confirm and expand on those of a recent systematic review, which acknowledges QI interventions as a potentially useful strategy to support NHs in reducing unplanned hospitalizations.[58] To better understand the effectiveness of these strategies and to uncover the characteristics they require, future research should use experimental designs that effectively address and reduce potential threats to internal validity.

Regarding the secondary outcomes, no effects were observed concerning ED visits. Considering the limited number of the studies addressing this endpoint, it is noteworthy to point out that the leading causes of ED visits among NH residents are falls and trauma,[6,59-61] often requiring follow-up x-ray examinations and diagnostic testing to determine the treatment course. The lack of mobile imaging services, and consequently, the inability to conduct these assessments in-house, makes these transfers inevitable, regardless of efforts to enhance the quality of care. Furthermore, the different metrics used to define potentially avoidable hospitalizations may have significantly affected both the overall estimate and high heterogeneity observed in our meta-analysis. A post hoc analysis conducted by Connolly and colleagues demonstrated that focusing on diseases commonly responsible for unplanned transfers, such as heart failure, ischemic heart disease, stroke, chronic obstructive pulmonary disease, and pneumonia, rather than a broader spectrum of diagnoses, could reverse the results of their study.[62] Potentially avoidable hospitalizations are considered an important quality performance health care indicator.[10,63] Therefore, achieving a universal consensus on which unplanned transfers are unnecessary or preventable is essential to clearly differentiate this phenomenon and effectively target improvement initiatives.

We observed that only slightly more than half of the studies (12 of 22) provided data on the level of engagement of facilities or health

care providers with the proposed adjustments. This lack of focus prevents the possibility of evaluating and comparing the impact of engagement levels across studies. Given the close interconnection between process and resident outcomes,[26] the continuous measurement of factors such as fidelity, penetration, acceptability, and sustainability of the intervention is as important as evaluating the effect of the QI intervention itself. In addition, to ensure a successful intervention, it is crucial to account for contextual factors, such as organizational maturity, stability in leadership, and managerial support for the project.[54] With this regard, human factors also play a key role.[64] Because a QI intervention often demands that employees go beyond their job requirements, it is important to leverage individual and team motivation, as well as to foster social cohesion and effective cooperation among staff members.[64] All these elements can be significantly enhanced through transformational leadership, a managerial approach that narrows the distance between the leaders and their subordinates.[65]

The median duration of QI interventions examined was 1 year. Given that most evaluated interventions were complex and multifaceted, this timeframe represents the minimum necessary period to ensure the sustainability of the intervention.[66] It is noteworthy that only 3 primary studies measured the impact of QI interventions after a follow-up period,[46,48,49] which limits the ability to assess long-term effects. Moreover, few authors discussed strategies for sustaining improvements after the conclusion of their studies. Sustaining success may require as much effort as initiating positive change, as deviation from the iterative cycle methodology could lead to the collapse of the initiative.[18,67]

The studies included addressed a range of delivery arrangements, mainly related to the coordination of care and management of care processes. Most of these measures have already been proven to induce beneficial changes in clinical practice. Among these is advanced care planning, which consists of shared decision-making processes that help residents, and their family carers understand and express their beliefs and values, enabling meaningful discussions about future medical decisions.[68] Clear and honest information from health care professionals to family members about the condition of their loved ones often leads to a preference for comfort care, which avoids aggressive treatments with unsure benefits.[69] Furthermore, providing palliative care services in NH settings is crucial to deliver high-quality end-of-life care and maintaining continuity of care among residents.[70] By integrating palliative care into NH settings, health care providers can better meet residents' preferences and goals, uphold their dignity, and support their families during challenging times.[71] Effective communication between providers also plays a crucial role in improving patient safety during hand-offs, which are vital in preventing adverse events,[72] especially when residents are transferred to different health care settings. Timely and accurate communication during these transitions helps maintain continuity of care by ensuring proper medication reconciliation and the development of a cohesive care plan.[73,74] All these strategies are integral components of the US QI program INTERACT, which is designed to manage acute deterioration in NH residents. This program was implemented in 4 studies included in this review.[16,17,54,56]

Nearly all the QI interventions described in the included studies incorporated multiple implementation strategies, with educational meetings (n = 25) and materials (n = 20) being the most frequently employed. A prior comprehensive review indicated that strategies targeting health care professionals, such as educational outreach visits, educational meetings, and performance audit and feedback, were the most effective in achieving improvements, with effects ranging from low to moderate.[75] However, the effectiveness of staff training elements in facilitating or hindering organizational change remains under scrutiny. Elements such as external cooperation, provision of rewards, continuous training—as opposed to 1-time training—and referral to clinical guidelines as training sources have been identified as potential influencers.[27] Nevertheless, there is no consensus regarding the optimal number of implementation strategies. Although some studies suggest that a greater number of implementation strategies may improve the likelihood of implementation success, others have found no difference between multicomponent and single strategies.[75]

Despite its rigorous and transparent methodology, this review has several limitations. First, it is important to recognize that significant differences exist among international health services. Indeed, many publications in this review are based on the US and UK health care systems, which differ considerably from those in Australia or continental Europe. This disparity calls for caution when generalizing the results. Second, although raw data were obtained from the original studies, the conversion of original outcome measures into RRs may have introduced some inaccuracies into the estimates included in the meta-analysis. Last, because of the extensive volume of peer-reviewed literature retrieved, gray literature was excluded. The incorporation of unpublished studies offers invaluable insights frequently overlooked in commercial publications, thereby mitigating publication bias.[76]

## Conclusion and Implications

Preventing hospitalizations among NH residents plays a key role in maintaining continuity of care and ensuring that these guests receive treatment aligned with their preferences, alongside those of their family caregivers.

Although no definitive conclusion can be drawn because of the limited number of primary studies, this review shows a borderline significant effect of QI interventions in preventing all-cause hospital admissions. Additional research using rigorous experimental designs is warranted to better estimate the effectiveness of this promising approach, potentially advancing strategies that reduce hospitalizations and improve overall care quality in NHs.

## Disclosures

The authors declare no conflicts of interest.

## Supplementary Data

Supplementary data related to this article can be found online at https://doi.org/10.1016/j.jamda.2024.105261.

## References

1. Sengupta M, Lendon JP, Caffrey C, Melekin A, Singh P. Post-acute and long-term care providers and services users in the United States, 2017-2018. *Vital Health Stat*. 2022;3:1–93.
2. European Commission, Directorate-General for Employment. *Social Affairs and Inclusion, Long-term Care Report – Trends, Challenges and Opportunities in an Ageing Society*, I. Publications Office; 2021.
3. Albanesi B, Conti A, Politano G, Dimonte V, Gianino MM, Campagna S. Emergency department visits by nursing home residents. A retrospective Italian study of administrative databases from 2015 to 2019. *BMC Geriatr*. 2024;24:295.
4. Haute Autorité de Santé (HAS). Comment réduire les hospitalizations non programmées des résidents des Ehpad. 2015. Accessed February 18, 2024. https://www.has-sante.fr/jcms/c_2049096/fr/comment-reduire-les-hospitalisations-non-programmees-des-residents-des-ehpad
5. Gaines J, Xu L. Evaluation of the Initiative to Reduce Avoidable Hospitalizations Among Nursing Facility Residents-Payment Reform, Final Report. 2021. Accessed February 3, 2024. https://www.cms.gov/priorities/innovation/data-and-reports/2021/pah2-nfi2-ar4-main-report
6. Lemoyne SE, Herbots HH, De Blick D, Remmen R, Monsieurs KG, Van Bogaert P. Appropriateness of transferring nursing home residents to emergency departments: a systematic review. *BMC Geriatr*. 2019;19:17.
7. Renom-Guiteras A, Uhrenfeldt L, Meyer G, Mann E. Assessment tools for determining appropriateness of admission to acute care of persons transferred from long-term care facilities: a systematic review. *BMC Geriatr*. 2014;14:80.

8. 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.
9. Muench U, Simon M, Guerbaai RA, et al. INTERCARE Research Group. Preventable hospitalizations from ambulatory care sensitive conditions in nursing homes: evidence from Switzerland. *Int J Publ Health*. 2019;64:1273–1281.
10. Ouslander JG, Lamb G, Perloe M, et al. Potentially avoidable hospitalizations of nursing home residents: frequency, causes, and costs [see editorial comments by Drs. Jean F. Wyman and William R. Hazzard. *J Am Geriatr Soc*. 2010;58: 627–635. 760-761].
11. Walsh EG, Wiener JM, Haber S, Bragg A, Freiman M, Ouslander JG. Potentially avoidable hospitalizations of dually eligible Medicare and Medicaid beneficiaries from nursing facility and Home- and Community-Based Services waiver programs. *J Am Geriatr Soc*. 2012;60:821–829.
12. Hanson LC, Zimmerman S, Song MK, et al. Effect of the goals of care intervention for advanced dementia: a randomized clinical trial. *JAMA Intern Med*. 2017;177:24–31.
13. Ingber MJ, Feng Z, Khatutsky G, et al. Initiative to reduce avoidable hospitalizations among nursing facility residents shows promising results. *Health Aff*. 2017;36:441–450.
14. Boyd M, Armstrong D, Parker J, et al. Do gerontology nurse specialists make a difference in hospitalization of long-term care residents? Results of a randomized comparison trial. *J Am Geriatr Soc*. 2014;62:1962–1967.
15. Damery S, Flanagan S, Jones J, Jolly K. The effect of providing staff training and enhanced support to care homes on care processes, safety climate and avoidable harms: evaluation of a care home quality improvement programme in england. *Int J Environ Res Publ Health*. 2021;18:7581.
16. Kane RL, Huckfeldt P, Tappen R, et al. Effects of an intervention to reduce hospitalizations from nursing homes: a randomized implementation trial of the INTERACT program. *JAMA Intern Med*. 2017;177:1257–1264.
17. Ouslander JG, Lamb G, Tappen R, et al. Interventions to reduce hospitalizations from nursing homes: evaluation of the INTERACT II collaborative quality improvement project. *J Am Geriatr Soc*. 2011;59:745–753.
18. Taylor MJ, McNicholas C, Nicolay C, Darzi A, Bell D, Reed JE. Systematic review of the application of the plan-do-study-act method to improve quality in healthcare. *BMJ Qual Saf*. 2014;23:290–298.
19. Girdler SJ, Glezos CD, Link TM, Sharan A. The science of quality improvement. *JBJS Rev*. 2016;4:e2.
20. Marshall M, de Silva D, Cruickshank L, Shand J, Wei L, Anderson J. What we know about designing an effective improvement intervention (but too often fail to put into practice). *BMJ Qual Saf*. 2017;26:578–582.
21. Jones B, Vaux E, Olsson-Brown A. How to get started in quality improvement. *BMJ*. 2019;364:k5408.
22. Backhouse A, Ogunlayi F. Quality improvement into practice. *BMJ*. 2020;368: m865.
23. Effective Practice and Organisation of Care (EPOC). EPOC Taxonomy. 2015. Accessed April 20, 2024. https://epoc.cochrane.org/epoc-taxonomy
24. Peters DH, Adam T, Alonge O, Agyepong IA, Tran N. Republished research: implementation research: what it is and how to do it: implementation research is a growing but not well understood field of health research that can contribute to more effective public health and clinical policies and programmes. This article provides a broad definition of implementation research and outlines key principles for how to do it. *Br J Sports Med*. 2014;48:731–736.
25. Proctor E, Silmere H, Raghavan R, et al. Outcomes for implementation research: conceptual distinctions, measurement challenges, and research agenda. *Adm Policy Ment Health*. 2011;38:65–76.
26. Proctor EK, Landsverk J, Aarons G, Chambers D, Glisson C, Mittman B. Implementation research in mental health services: an emerging science with conceptual, methodological, and training challenges. *Adm Policy Ment Health*. 2009;36:24–34.
27. Mileski M, Topinka JB, Lee K, Brooks M, McNeil C, Jackson J. An investigation of quality improvement initiatives in decreasing the rate of avoidable 30-day, skilled nursing facility-to-hospital readmissions: a systematic review. *Clin Interv Aging*. 2017;12:213–222.
28. Chen H, Feng H, Liao L, et al. Evaluation of quality improvement intervention with nurse training in nursing homes: a systematic review. *J Clin Nurs*. 2020; 29:2788–2800.
29. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71.
30. Basso I, Gonella S, Bassi E, Caristia S, Campagna S, Dal Molin A. Quality improvement interventions to prevent the use of hospital services among nursing home residents: protocol for a systematic review and meta-analysis. *BMJ Open*. 2023;13:e074684.
31. Kaplan HC, Brady PW, Dritz MC, et al. The influence of context on quality improvement success in health care: a systematic review of the literature. *Milbank Q*. 2010;88:500–559.
32. Richardson WS, Wilson MC, Nishikawa J, Hayward RS. The well-built clinical question: a key to evidence-based decisions. *ACP J Club*. 1995; 123:A12–A13.
33. Sanford AM, Orrell M, Tolson D, et al. An international definition for "nursing home". *J Am Med Dir Assoc*. 2015;16:181–184.
34. Academy of Medical Royal Collages. Training for better outcomes Developing quality improvement into practice. 2019. Accessed September 27, 2024. https://www.aomrc.org.uk/wp-content/uploads/2019/06/Developing_QI_into_practice_0619.pdf
35. Kilo CM. A framework for collaborative improvement: lessons from the Institute for Healthcare Improvement's Breakthrough Series. *Qual Manag Health Care*. 1998;6:1–13.
36. Tufanaru C, Munn Z, Aromataris E, Campbell J, Hopp L. Chapter 3: systematic reviews of effectiveness. In: Aromataris E, Munn Z, eds. *JBI Manual for Evidence Synthesis*. JBI; 2020.
37. Hempel S, Shekelle PG, Liu JL, et al. Development of the Quality Improvement Minimum Quality Criteria Set (QI-MQCS): a tool for critical appraisal of quality improvement intervention publications. *BMJ Qual Saf*. 2015;24:796–804.
38. Mona P, Sada Nand D, SVS D, V Sreenivas, Bhaskar T. Which is the preferred measure of heterogeneity in meta-analysis and why? A revisit. *Biostat Biometrics Open Acc J*. 2017;1:555555.
39. Reeves BC, Deeks JJ, Higgins JPT, Shea B, Tugwell P, Wells GA. Chapter 24: including non-randomized studies on intervention effects. In: Higgins JPT, Thomas J, Chandler J, et al, eds. *Cochrane Handbook for Systematic Reviews of Interventions*. Cochrane, version 6.4. .
40. Connolly MJ, Boyd M, Broad JB, et al. The Aged Residential Care Healthcare Utilization Study (ARCHUS): a multidisciplinary, cluster randomized controlled trial designed to reduce acute avoidable hospitalizations from long-term care facilities. *J Am Med Dir Assoc*. 2015;16:49–55.
41. Sheaff R, Sherriff I, Hennessy CH. Evaluating a dementia learning community: exploratory study and research implications. *BMC Health Serv Res*. 2018;18:83.
42. Sampson EL, Feast A, Blighe A, et al. Pilot cluster randomised trial of an evidence-based intervention to reduce avoidable hospital admissions in nursing home residents (Better Health in Residents of Care Homes with Nursing-BHiRCH-NH Study). *BMJ Open*. 2020;10:e040732.
43. Hullick C, Conway J, Higgins I, et al. Emergency department transfers and hospital admissions from residential aged care facilities: a controlled pre-post design study. *BMC Geriatr*. 2016;16:102.
44. Rolland Y, Mathieu C, Piau C, et al. Improving the quality of care of long-stay nursing home residents in France. *J Am Geriatr Soc*. 2016;64:193–199.
45. Vadnais AJ, Vreeland E, Coomer NM, Feng Z, Ingber MJ. Reducing transfers among long-stay nursing facility residents to acute care settings: effect of the 2013–2016 centers for Medicare and medicaid services initiative. *J Am Med Dir Assoc*. 2020;21:1341–1345.
46. Connolly MJ, Broad JB, Bish T, et al. Reducing emergency presentations from long-term care: a before-and-after study of a multidisciplinary team intervention. *Maturitas*. 2018;117:45–50.
47. ElBestawi MR, Kohm C. Decreasing preventable emergency department transfers for long-term care residents using PREVIEW-ED. *Healthc Manag Forum*. 2018;31:137–141.
48. Graham E, Campbell S. Reducing avoidable emergency department attendances through bespoke education. *Nurs Older People*. 2017;29:32–38.
49. Hullick CJ, Hall AE, Conway JF, et al. Reducing hospital transfers from aged care facilities: a large-scale stepped wedge evaluation. *J Am Geriatr Soc*. 2021;69:201–209.
50. Kaasalainen S, Sussman T, Thompson G, et al. SPA-LTC team. A pilot evaluation of the strengthening a palliative approach in long-term care (SPA-LTC) program. *BMC Palliat Care*. 2020;19:107.
51. Lisk R, Yeong K, Nasim A, et al. Geriatrician input into nursing homes reduces emergency hospital admissions. *Arch Gerontol Geriatr*. 2012;55:331–337.
52. Oliver J, Chidwick P. Transfers of LTC residents to hospital EDs: an ethics quality improvement project to minimize non-beneficial and unwanted hospital transfers and maximize system efficiency. *Healthc Q*. 2014;17:54–59.
53. Oliver J, Chidwick P. The PoET (prevention of error-based transfers) project. *Healthc Q*. 2017;20:40–44.
54. Rask KJ, Hodge J, Kluge L. Impact of contextual factors on interventions to reduce acute care transfers II implementation and hospital readmission rates. *J Am Med Dir Assoc*. 2017;18:991.e11–991.e15.
55. Stadler DS, Oliver BJ, Raymond JG, et al. Reducing avoidable facility transfers (RAFT): outcomes of a team model to minimize unwarranted emergency care at skilled nursing facilities. *J Am Med Dir Assoc*. 2019;20:929–934.
56. Tena-Nelson R, Santos K, Weingast E, Amrhein S, Ouslander J, Boockvar K. Reducing potentially preventable hospital transfers: results from a thirty nursing home collaborative. *J Am Med Dir Assoc*. 2012;13:651–656.
57. Giebel C, Harvey D, Akpan A, Chamberlain P. Reducing hospital admissions in older care home residents: a 4-year evaluation of the care home innovation Programme (CHIP). *BMC Health Serv Res*. 2020;20:94.
58. Chambers D, Cantrell A, Preston L, et al. Reducing unplanned hospital admissions from care homes: a systematic review. *Health Soc Care Deliv Res*. 2023;11:1–130.
59. Dubucs X, Balen F, Charpentier S, et al. Factors associated with emergency medical dispatcher request and residents' inappropriate transfers from nursing homes to emergency department. *Eur Geriatr Med*. 2022;13:351–357.
60. Tian Y, Ayyappan V, Hemmert K, Myers J, Gitelman Y, Ryskina K. Potentially avoidable emergency department use by patients discharged to skilled nursing facilities. *J Hosp Med*. 2023;18:524–527.
61. Unroe KT, Caterino JM, Stump TE, et al. Long-stay nursing facility resident transfers: who gets admitted to the hospital? *J Am Geriatr Soc*. 2020;68: 2082–2089.
62. Connolly MJ, Broad JB, Boyd M, et al. The 'Big Five'. Hypothesis generation: a multidisciplinary intervention package reduces disease-specific hospitalisations from long-term care: a post hoc analysis of the ARCHUS cluster-randomised controlled trial. *Age Ageing*. 2016;45:415–420.
63. Mcandrew RM, Grabowski DC, Dangi A, Young GJ. Prevalence and patterns of potentially avoidable hospitalizations in the US long-term care setting. *Int J Qual Health Care*. 2016;28:104–109.

64. Fischer S, Patterson K, Marr C. Enabling clinician engagement in safety and quality improvement. *Aust Health Rev*. 2021;45:455–462.
65. Lindert L, Zeike S, Choi KA, Pfaff H. Transformational leadership and employees' psychological wellbeing: a longitudinal study. *Int J Environ Res Publ Health*. 2022;20:676.
66. Fan E, Laupacis A, Pronovost PJ, Guyatt GH, Needham DM. How to use an article about quality improvement. *JAMA*. 2010;304:2279–2287.
67. Silver SA, McQuillan R, Harel Z, et al. How to sustain change and support continuous quality improvement. *Clin J Am Soc Nephrol*. 2016;11:916–924.
68. Sudore RL, Lum HD, You JJ, et al. Defining advance care planning for adults: a consensus definition from a multidisciplinary delphi panel. *J Pain Symptom Manag*. 2017;53:821–832.e1.
69. Gonella S, Basso I, Dimonte V, et al. Association between end-of-life conversations in nursing homes and end-of-life care outcomes: a systematic review and meta-analysis. *J Am Med Dir Assoc*. 2019;20:249–261.
70. Carpenter JG, Lam K, Ritter AZ, Ersek M. A systematic review of nursing home palliative care interventions: characteristics and outcomes. *J Am Med Dir Assoc*. 2020;21:583–596.e2.
71. Ersek M, Unroe KT, Carpenter JG, Cagle JG, Stephens CE, Stevenson DG. High-quality nursing home and palliative care-one and the same. *J Am Med Dir Assoc*. 2022;23:247–252.
72. The Joint Commssion. Sentinel event data 2022 annual review the joint commission. 2023. Accessed May 12, 2024. http://www.jointcommission.org/Sentinel_Event_Policy_and_Procedures/
73. LaMantia MA, Scheunemann LP, Viera AJ, Busby-Whitehead J, Hanson LC. Interventions to improve transitional care between nursing homes and hospitals: a systematic review. *J Am Geriatr Soc*. 2010;58:777–782.
74. O'Neill BJ, Dwyer T, Reid-Searl K, Parkinson L. Nursing staff intentions towards managing deteriorating health in nursing homes: a convergent parallel mixed-methods study using the theory of planned behaviour. *J Clin Nurs*. 2018;27:e992–e1003.
75. Lau R, Stevenson F, Ong BN, et al. Achieving change in primary care–effectiveness of strategies for improving implementation of complex interventions: systematic review of reviews. *BMJ Open*. 2015;5:e009993.
76. Paez A. Gray literature: an important resource in systematic reviews. *J Evid Base Med*. 2017;10:233–240.