



# Effective Health Care Program

---

Technical Brief  
Number 24

## Resident Safety Practices in Nursing Home Settings



Agency for Healthcare Research and Quality  
Advancing Excellence in Health Care • [www.ahrq.gov](http://www.ahrq.gov)

# ***Technical Brief***

---

**Number 24**

## **Resident Safety Practices in Nursing Home Settings**

**Prepared for:**

Agency for Healthcare Research and Quality  
U.S. Department of Health and Human Services  
5600 Fishers Lane  
Rockville, MD 20857  
[www.ahrq.gov](http://www.ahrq.gov)

**Contract No. 290-2015-00003-I**

**Prepared by:**

Vanderbilt Evidence-based Practice Center  
Nashville, TN

**Investigators:**

Sandra Simmons, Ph.D.  
John Schnelle, Ph.D.  
Jason Slagle, Ph.D.  
Nila A. Sathe, M.A., M.L.I.S.  
David Stevenson, Ph.D.  
Marius Carlo, M.D.  
Melissa L. McPheeters, Ph.D., M.P.H.

**AHRQ Publication No. 16-EHC022-EF**  
**May 2016**

This report is based on research conducted by the Vanderbilt Evidence-based Practice Center (EPC) under contract to the Agency for Healthcare Research and Quality (AHRQ), Rockville, MD (Contract No. 290-2015-00003-I). The findings and conclusions in this document are those of the authors, who are responsible for its contents; the findings and conclusions do not necessarily represent the views of AHRQ. Therefore, no statement in this report should be construed as an official position of AHRQ or of the U.S. Department of Health and Human Services.

**None of the investigators have any affiliations or financial involvement that conflicts with the material presented in this report.**

The information in this report is intended to help health care decisionmakers—patients and clinicians, health system leaders, and policymakers, among others—make well-informed decisions and thereby improve the quality of health care services. This report is not intended to be a substitute for the application of clinical judgment. Anyone who makes decisions concerning the provision of clinical care should consider this report in the same way as any medical reference and in conjunction with all other pertinent information, i.e., in the context of available resources and circumstances presented by individual patients.

This report is made available to the public under the terms of a licensing agreement between the author and the Agency for Healthcare Research and Quality. This report may be used and reprinted without permission except those copyrighted materials that are clearly noted in the report. Further reproduction of those copyrighted materials is prohibited without the express permission of copyright holders.

AHRQ or U.S. Department of Health and Human Services endorsement of any derivative products that may be developed from this report, such as clinical practice guidelines, other quality enhancement tools, or reimbursement or coverage policies, may not be stated or implied.

Persons using assistive technology may not be able to fully access information in this report. For assistance contact [EffectiveHealthCare@ahrq.hhs.gov](mailto:EffectiveHealthCare@ahrq.hhs.gov).

**Suggested citation:** Simmons S, Schnelle J, Slagle J, Sathe NA, Stevenson D, Carlo M, McPheeters ML. Resident Safety Practices in Nursing Home Settings. Technical Brief No. 24 (Prepared by the Vanderbilt Evidence-based Practice Center under Contract No. 290-2015-00003-I.) AHRQ Publication No. 16-EHC022-EF. Rockville, MD: Agency for Healthcare Research and Quality; May 2016. [www.effectivehealthcare.ahrq.gov/reports/final.cfm](http://www.effectivehealthcare.ahrq.gov/reports/final.cfm).

## Preface

The Agency for Healthcare Research and Quality (AHRQ), through its Evidence-based Practice Centers (EPCs), sponsors the development of evidence reports and technology assessments to assist public- and private-sector organizations in their efforts to improve the quality of health care in the United States. The reports and assessments provide organizations with comprehensive, science-based information on common, costly medical conditions and new health care technologies and strategies. The EPCs systematically review the relevant scientific literature on topics assigned to them by AHRQ and conduct additional analyses when appropriate prior to developing their reports and assessments.

This EPC evidence report is a Technical Brief. A Technical Brief is a rapid report, typically on an emerging medical technology, strategy or intervention. It provides an overview of key issues related to the intervention—for example, current indications, relevant patient populations and subgroups of interest, outcomes measured, and contextual factors that may affect decisions regarding the intervention. Although Technical Briefs generally focus on interventions for which there are limited published data and too few completed protocol-driven studies to support definitive conclusions, the decision to request a Technical Brief is not solely based on the availability of clinical studies. The goals of the Technical Brief are to provide an early objective description of the state of the science, a potential framework for assessing the applications and implications of the intervention, a summary of ongoing research, and information on future research needs. In particular, through the Technical Brief, AHRQ hopes to gain insight on the appropriate conceptual framework and critical issues that will inform future research.

AHRQ expects that the EPC evidence reports and technology assessments will inform individual health plans, providers, and purchasers as well as the health care system as a whole by providing important information to help improve health care quality.

If you have comments on this Technical Brief, they may be sent by mail to the Task Order Officer named below at: Agency for Healthcare Research and Quality, 5600 Fishers Lane, Rockville, MD 20857, or by email to [epc@ahrq.hhs.gov](mailto:epc@ahrq.hhs.gov).

Sharon B. Arnold, Ph.D.  
Acting Director  
Agency for Healthcare Research and Quality

Arlene S. Bierman, M.D., M.S.  
Director  
Center for Evidence and Practice Improvement  
Agency for Healthcare Research and Quality

Stephanie Chang, M.D., M.P.H.  
Director  
Evidence-based Practice Center Program  
Center for Evidence and Practice Improvement  
Agency for Healthcare Research and Quality

Linda Bergofsky, M.S.W., M.B.A, P.M.P.  
Task Order Officer  
Center for Delivery, Organization, and Markets  
Agency for Healthcare Research and Quality

## Acknowledgments

The authors gratefully acknowledge the following individuals for their contributions to this project. Ms. Katie Worley managed the project and helped with data collection and analysis. Drs. Shanthi Krishnaswami and Mamata Raj assessed reviews. Ms. Jessica Kimber and Ms. Sanura Latham helped with retrieving studies and creating tables. We also thank our Task Order Officer for her invaluable input throughout the project.

## Key Informants

In designing the study questions, the EPC consulted several Key Informants who represent the end-users of research. The EPC sought the Key Informant input on the priority areas for research and synthesis. Key Informants are not involved in the analysis of the evidence or the writing of the report. Therefore, in the end, study questions, design, methodological approaches, and/or conclusions do not necessarily represent the views of individual Key Informants.

Key Informants must disclose any financial conflicts of interest greater than \$10,000 and any other relevant business or professional conflicts of interest. Because of their role as end-users, individuals with potential conflicts may be retained. The TOO and the EPC work to balance, manage, or mitigate any conflicts of interest.

The list of Key Informants who provided input to this report follows:

Barbara J. Bowers, R.N., Ph.D., FAAN\*  
School of Nursing  
University of Wisconsin–Madison  
Madison, WI

Charlene A. Harrington, R.N., Ph.D.\*  
Professor Emeritus, Sociology and Nursing  
University of California  
San Francisco, CA

Vincent Mor, Ph.D.  
Brown University  
Providence Veterans Administration Medical Center  
Providence, RI

Ed Mortimore, Ph.D.  
Centers for Medicare & Medicaid Services  
Division of Nursing Homes  
Baltimore, MD

Beverly Sanborn  
Belmont Village Senior Living  
Nashville, TN

Thomas Talbot, M.D., M.P.H.\*  
Vanderbilt University School of Medicine  
Nashville, TN

Jane Tilly, Dr.P.H., M.P.A.\*  
United States Administration for Community Living/Administration on Aging  
Washington, DC

\*Provided input on draft report.

## Peer Reviewers

Prior to publication of the final evidence report, EPCs sought input from independent Peer Reviewers without financial conflicts of interest. However, the conclusions and synthesis of the scientific literature presented in this report do not necessarily represent the views of individual reviewers.

Peer Reviewers must disclose any financial conflicts of interest greater than \$10,000 and any other relevant business or professional conflicts of interest. Because of their unique clinical or content expertise, individuals with potential nonfinancial conflicts may be retained. The TOO and the EPC work to balance, manage, or mitigate any potential nonfinancial conflicts of interest identified.

The list of Peer Reviewers follows:

Mary Ellen Dellefield, Ph.D., R.N.  
University of San Diego  
Veterans Administration San Diego Healthcare  
System  
San Diego, CA

Steven Handler, M.D., Ph.D., CMD  
University of Pittsburgh  
Pittsburgh, PA

Robert Kane, M.D.  
University of Minnesota  
Minneapolis, MN

Joseph G. Ouslander, M.D.  
Florida Atlantic University  
Boca Raton, FL

William Spector, Ph.D.  
Agency for Healthcare Research and Quality  
Center for Delivery, Organization, and  
Markets  
Rockville, MD

# Resident Safety Practices in Nursing Home Settings

## Structured Abstract

**Background.** Resident safety issues are common in nursing homes. Relevant literature reports a range of poor clinical outcomes thought to be preventable if specific care processes were consistently implemented.

**Purpose.** To describe the state of the science around nursing home safety in order to establish a research agenda for moving the field forward.

**Methods.** We developed Guiding Questions (GQs) broadly encompassing issues related to resident safety via discussions with Key Informants representing multiple stakeholder groups and expert clinicians and researchers. To address GQs related to identifying and characterizing contextual factors potentially affecting safety issues in the nursing home setting, applicability of hospital-based safety interventions to the nursing home, uptake of safety interventions, and future research areas related to safety in this setting and the overall long-term care landscape (GQs 1, 2, 4), we used input from conversations with Key Informants and conducted targeted literature searches to inform our discussion. To develop a high-level map of relevant evidence (GQ3), we conducted searches of the literature published between 2005 and October 2015 to identify systematic reviews of interventions addressing safety areas in nursing homes. We also searched the published literature for studies of interventions published after the completion of systematic reviews discussed in this brief.

**Findings.** Key safety issues as defined by Agency for Healthcare Research and Quality Common Format criteria are adverse events such as falls, pressure ulcers, infection, and medication errors/adverse drug events, including inappropriate use. Thirty-six recent systematic reviews evaluated nursing home safety-related interventions to address these issues. Evidence is lacking on the degree to which national uptake of efficacious interventions targeting adverse events or factors that may lead to adverse events has occurred, with barriers including staffing costs needed to implement the interventions and low-quality evidence. Little evidence suggests that hospitals have significantly improved safety in many domains that are important to care of nursing home residents, whose vulnerability and complexity make them markedly different from most hospital patients. Future research needs include defining safety in the nursing home context, which differs considerably from that of hospitals. Defining safety must take into account the context of care and the interplay of resident characteristics and needs within the context of staffing and programmatic decisions that are influenced by various payment and regulatory models. Future research should also address understanding the relationship between adherence to quality-of-life and person-centered care standards and incidence of some types of adverse events, overcoming barriers to implementing proven interventions, and improving safety event reporting. Nursing homes must find the balance between preserving person-centeredness and resident autonomy while ensuring safety, quality of care, and quality of life for residents. Overall, safety outcomes per se have not been well studied in nursing homes; however, outcomes associated with quality of care and, in some cases, quality of life have been studied, and those outcomes may be inexorably linked to safety outcomes. These negative outcomes related to (and potentially contributing to) negative safety outcomes include catheter left in bladder and physical

restraints, as well as documented conditions, including unintentional weight loss, decline in activities of daily living, fecal/urinary incontinence, depressive symptoms, and pain.

# Contents

<b>Background</b> .....	<b>1</b>
Nursing Home Safety.....	1
Technical Brief Objectives .....	2
Report Organization.....	2
Scope.....	3
<b>Methods</b> .....	<b>4</b>
Data Collection .....	4
Discussions with Key Informants .....	4
Published Literature Search .....	4
Screening of Studies for GQ3 .....	5
Quality Assessment for GQ3 .....	5
Data Organization and Presentation.....	5
Peer Review .....	6
<b>Findings</b> .....	<b>6</b>
Guiding Question (GQ) 1a. What are the safety issues of particular concern in the nursing home setting? .....	6
GQ1b. Are there important differences in safety issues for short-stay versus long-stay residents?.....	7
Care Transitions and Safety .....	7
Rehabilitation Services and Safety .....	8
GQ1c. Are there specific interventions that have improved patient safety in the hospital setting that could transfer to the nursing home setting, but have yet to be tested as such? .....	8
Falls.....	9
Medication Errors .....	9
Pressure Ulcers.....	9
Infection .....	9
GQ2a. What characteristics and qualities of nursing homes and nursing home residents create unique settings for assessing safety and may affect choice of intervention and success rates? .....	11
GQ3. Current literature assessing interventions for improving safety practices in nursing home settings .....	12
Overview of All Systematic Reviews.....	12
Primary Studies Published Since the Publication of the Included Systematic Reviews.....	16
GQ4a. What is the uptake of evidence-based nursing home interventions beyond individual test sites? What are the most important barriers/facilitators to uptake of successful interventions? .....	17
Research Evidence .....	17
Barriers to Uptake .....	17
GQ4b. What major areas for future research remain regarding resident safety in nursing homes? .....	18
Refine Our Understanding of Safety Within the Nursing Home Context .....	18
Encourage Implementation Research Specific to Nursing Home Safety .....	19
Develop Consensus Around Common Outcomes.....	20
Empirically Assess the Role of Performance Monitoring Approaches in Nursing Home Settings.....	20

Rigorously Study the Role of Staffing Models, Levels, and Types of Staff in Achieving Safe Nursing Home Environments .....	20
Better Understand What Works for Staff Training and Management and Organizational Culture.....	21
Understand the Effects of Care Omissions on Safety .....	22
Rigorously Evaluate Person-Centered Care.....	23
Study Approaches to Managing Polypharmacy.....	24
Establish What Lessons Can Be Learned From Hospital Safety for Older Patients .....	24
GQ4c. In what ways is the field of long-term care changing such that resident safety interventions may need to adapt to a new environment, and what additional challenges do these changing conditions bring to increasing long-term care patient safety? .....	25
Population Shifts and Clinical Challenges.....	25
ALFs and Dementia Care Within ALFs .....	25
<b>Summary and Conclusions .....</b>	<b>26</b>
Summary of Patient Populations and/or Safety Issues Not Addressed in This Technical Brief .....	26
Conclusions .....	26
<b>References .....</b>	<b>27</b>

## Tables

Table 1. Facility characteristics .....	2
Table 2. Inclusion criteria for evaluation studies.....	5
Table 3. Nursing home resident adverse events represented across reporting systems.....	6
Table 4. Outcomes addressed in systematic reviews for falls prevention .....	13
Table 5. Frequently reported components of falls prevention intervention studies.....	13
Table 6. Frequently reported components of interventions described in reviews of pressure ulcer prevention and treatment .....	14
Table 7. Frequently reported components of interventions described in reviews of infection prevention .....	15
Table 8. Frequently reported components of interventions described in reviews of medication errors and adverse drug events.....	16
Table 9. Overview of estimated new studies of nursing home safety interventions.....	16
Table 10. Common contributing factors to safety events in nursing homes.....	19

## Appendixes

Appendix A. Summary of Key Informant Calls

Appendix B. Literature Search Strategies

Appendix C. Summary Tables of Recent Systematic Reviews Addressing Interventions for Common Format Safety Events

Appendix D. Comparative Studies of Interventions Addressing Common Format Safety Events in the Nursing Home Published After the Publication of Systematic Reviews Included in This Technical Brief

# Background

## Nursing Home Safety

The Agency for Healthcare Research and Quality (AHRQ) defines safety as “a type of process or structure that reduces the probability of an adverse event.”<sup>1</sup> An adverse event is defined as harm to a resident as a result of medical care or in a health care setting.<sup>2</sup> Studying adverse events and interventions that may prevent them and/or promote safety is an important but complex undertaking, particularly in settings with vulnerable populations (typically, but not exclusively, defined as elders, people with economic disadvantages, the uninsured, low-income children, the homeless, racial and ethnic minorities, and those with chronic health conditions).<sup>3-5</sup>

Nursing home residents are susceptible to adverse outcomes, including patient safety events, for a number of reasons. These reasons include a highly vulnerable population that is chronically frail and cognitively and/or physically impaired. They often arrive debilitated and deconditioned after hospitalization for acute illness. This level of debilitation and impairment makes residents particularly vulnerable during transitions in care between providers and settings. Because of the uniqueness of the nursing home setting and its population, studying the effectiveness of safety interventions in the nursing home is critically important.

Deficiencies in care provided in nursing homes are reported through programs, including the Centers for Medicare & Medicaid Services (CMS) Nursing Home Compare system, a publicly accessible database of quality of care-related information that compiles data from Medicaid- and Medicare-certified nursing homes. In 2014, an average of 7.96 deficiencies in care per nursing home was reported in State surveys. The most common deficiencies were for failures in infection control, environmental safety, food sanitation, quality of care, and unnecessary medication use. Not all deficiencies are associated with safety issues; however, over 20 percent of facilities had a deficiency for actual harm or jeopardy, which would constitute a safety issue. An estimated mean 1.5 falls/bed/year occur in long-term care facilities, with 4 percent of these resulting in fracture and 11 percent resulting in serious injuries such as lacerations and head trauma.<sup>6,7</sup> Additionally, Federal deficiency data from 2012 (Table 1) demonstrate an average of 6.1 deficiency citations per facility. These data may include both short and long-term care residents (Table 1). Specific to short-stay residents, one in five older adults admitted to skilled nursing facilities (SNFs) after hospitalization experiences adverse events, and 60 percent of these are preventable.<sup>2</sup> Per the 2014 Office of the Inspector General (OIG) report, *Adverse Events in Skilled Nursing Facilities: National Incidence Among Medicare Beneficiaries*, among the 10 percent of residents harmed by adverse events, half were readmitted to the hospital for treatment, resulting in \$2.8 billion in Medicare spending.<sup>2</sup>

**Table 1. Facility characteristics**

<b>Facility Characteristics* (n=15,683 Nursing Homes)</b>	<b>Proportion Nationwide</b>
Percent dually certified (Medicare and Medicaid)	91.4%
Average occupancy rate	82.7%
Percent 50-99 beds	36.5%
Percent 100-199 beds	44.1%
Percent for-profit status	69.0%
Average total staffing hours per resident per day (HPRD)	4.12
Average licensed nurse staffing (HPRD)	1.67
Average nurse aide staffing Level (HPRD)	2.45
Average number of health deficiency citations per facility	6.1
Percent with citations for immediate jeopardy or actual harm	3.4%
Percent with citations for substandard quality of care	3.4%
Percent with citation for use of restraints	6.0%
Percent with deficiency for failure to treat/prevent pressure ulcers	14.6%

\*Based on Centers for Medicare & Medicaid Services data for 15,683 nursing homes, Nursing Home Data Compendium 2012 Edition.<sup>8</sup> Staffing Data reflect 2015 national average based on medicare.gov/nursinghomecompare. Licensed Staff comprises Licensed Vocational Nurse (LVN), Licensed Practical Nurse (LPN), and Registered Nurse (RN). HPRD=Hours per resident per day.

## Technical Brief Objectives

The goals of this Technical Brief are to describe the state of the literature focusing on interventions that address safety in the nursing home setting, to identify gaps and in so doing, to provide a research agenda for future work. A Technical Brief is not intended to be a systematic review and thus does not summarize results or conclusions of existing research. Rather, it should provide the reader with an overview of available data and perspective around a given clinical intervention or issues in an area of care.

Because of the breadth of literature on this topic, we describe the availability of systematic reviews rather than primary studies. In addition, we provide an estimate of the number of new studies addressing nursing home safety practices in key areas of interest published after these systematic reviews that could potentially be available for an update. Finally, we also engaged stakeholders to augment the findings from the literature and inform the summary of contextual issues unique to the nursing home setting, barriers to implementation and/or broad uptake of safety-related interventions, and future areas of research.

## Report Organization

We have organized the report by Guiding Questions (GQs) and summarized relevant literature and Key Informant perspectives. GQ1, GQ2, and GQ4 reflect information found in published and unpublished literature, including opinion pieces and general materials. They also include the perspectives of our Key Informants.

GQ3 is limited to a high-level evidence map of systematic reviews and empirical studies. Thus, GQ1 and GQ2 describe issues of relevance, while GQ3 identifies empirical literature on those issues. GQ4 then addresses areas in which future research is needed based on the current state of the science.

The following GQs provide the structure for this Technical Brief.

### GQ1. Describe interventions for resident safety practices in nursing home settings

GQ1a. What are the safety issues of particular concern in the nursing home setting?

- GQ1b. Are there important differences in safety issues for short-stay versus long-stay residents?  
GQ1c. Are there specific interventions that have improved patient safety in the hospital setting that could transfer to the nursing home setting, but have yet to be tested as such?

## GQ2. Describe the context in which interventions are used for safety practices in nursing home settings

- GQ2a. What characteristics and qualities of nursing homes and nursing home residents create unique settings for assessing safety and may affect choice of intervention and success rates? Considerations include:
- Staffing – type, education, numbers, turnover
  - Particular vulnerability of the residents
  - Resident mix, including short and long stay

## GQ3. Describe current literature assessing interventions for improving safety practices in nursing home settings

- GQ3a. What is the state of the current research based on the following criteria:
- Indication/resident inclusion criteria
  - Type of intervention
  - Study design/size
  - Comparator
  - Outcomes

## GQ4. Identify the important issues raised by interventions for safety practices in nursing home settings

- GQ4a. What is the uptake of evidence-based nursing home interventions beyond individual test sites? What are the most important barriers/facilitators to uptake of successful interventions?  
GQ4b. What major areas for future research remain regarding resident safety in nursing homes?  
GQ4c. In what ways is the field of long-term care changing such that resident safety interventions may need to adapt to a new environment, and what additional challenges do these changing conditions bring to increasing long-term care resident safety?

## Scope

AHRQ has developed a Common Format for reporting safety events in nursing homes that focuses on four safety issues that served as the starting point for this report. Those events are: falls with injury, infection, pressure ulcers, and medication errors. However, studies of other undesired outcomes or lapses in care beyond these safety events (e.g., health and safety deficiencies identified by surveyors) point to the link between adverse events and what we term “potentially contributing events” (see GQ4).<sup>9-16</sup> In practice, interventions to prevent the safety events identified in the Common Format are likely to prevent other negative outcomes as well since many interventions focused on the common format events are multifaceted. For example, pressure ulcer interventions often address incontinence care and nutrition since these are primary risk factors for pressure ulcer development. We also note that weight loss in nursing homes has been recently endorsed by the National Quality Forum as a long-term care safety indicator.<sup>17</sup>

While the presumptive link between the four safety events and other negative outcomes has some face validity, the mechanism of causality is not well understood. We address this gap in understanding in our discussion of future research needs (GQ4).

## **Methods**

We used discussions with Key Informants and targeted searches of the published literature to identify resident safety issues and contextual factors related to safety in this setting. We used published systematic reviews, narrative reviews, meta-analyses, and primary and secondary research studies to address Guiding Questions (GQs) 1, 2, and 4.

For GQ3, we identified existing systematic reviews via literature searches described below and supplemented the studies presented in each selected review with a tabulation of new prospective comparative intervention studies published since the most recent review's conduct.

## **Data Collection**

### **Discussions With Key Informants**

In consultation with the investigative team and the Agency for Healthcare Research and Quality (AHRQ), we assembled a list of individuals representing perspectives including nursing home safety, hospital safety, quality of care, assisted living administration, health services research, advocacy, policy, medication safety, and risk management. Seven of 20 invited individuals agreed to participate in three calls (details in Appendix A). Participants included a representative from the Centers for Medicare & Medicaid Services (CMS); the Administration for Community Living, academic researchers; the long-term care industry; and clinicians with expertise in nursing home staffing, nursing home and long-term care, organizational culture and workforce development, quality of care, patient-reported outcomes in nursing homes, outcomes in the frail older adults, and health care epidemiology and infection control.

### **Published Literature Search**

We used a combination of controlled vocabulary terms and keywords to search the published literature for systematic reviews and studies that specifically evaluated interventions addressing the key safety areas identified above. Thus, other types of studies (e.g., descriptive, cross-sectional) were excluded from our review even if focused on the key safety areas. We used two primary search strategies for GQ3:

1. We searched MEDLINE and the Cumulative Index of Nursing and Allied Health Literature (CINAHL) using controlled and key terms for concepts including nursing home, long-term care, older adults, and the outcome areas (e.g., pressure ulcers, falls, infection) of interest, as well as related broad terms and descriptors. Our search strategies for this GQ focused specifically on the nursing home setting and the outcome areas of interest. We sought to identify recent existing systematic reviews and newly published literature. We searched these databases from 2005 to October 2015. We selected the 2005 start date to capture more recent literature published since the implementation of Nursing Home Compare in 1998 and the introduction of the CMS Five-Star quality rating in 2008.

2. We also updated the searches used in a sample of the systematic reviews we identified for GQ3 from the end search date of each selected review forward in order to identify newly published literature.

We present the literature search details in Appendix B.

## Screening of Studies for GQ3

We screened the included literature for systematic reviews and publications that addressed one or more GQs. Two investigators independently screened the full text of each publication identified in the literature search using the criteria outlined in Table 2. Any discrepancies between investigators were resolved via discussion to reach consensus or via a senior investigator. We used a simple categorization scheme to code the reasons for exclusion from GQ3. We used EndNote® to record and track the disposition of references identified.

**Table 2. Inclusion criteria for evaluation studies**

Category	Criteria
Study Population	Residents in nursing home facilities (short stay and long stay)
Publication Languages	English only
Timeframe	2005 to the present
Admissible Evidence	<p><b>Study Design</b> Systematic Reviews, Meta-analyses, Randomized controlled trials, Prospective intervention studies, including cohorts with comparison groups, and Pre-post studies</p> <p><b>Safety Outcomes Per Agency for Healthcare Research and Quality Common Format</b> Falls with injury Pressure ulcers Infection, including healthcare-associated infection, urinary tract infection, and antibiotic stewardship Medication errors and adverse drug events (e.g., delirium), including inappropriate medication use and polypharmacy</p>

## Quality Assessment for GQ3

We used the Risk of Bias in Systematic Reviews (ROBIS) tool<sup>18</sup> to assess the overall risk of bias of the included systematic reviews. As noted previously, we outlined reviews but we did not assess individual studies. The ROBIS tool is designed to assess relevance, potential for bias in the study eligibility criteria, identification and selection of studies, data collection and study appraisal, and synthesis and findings. One reviewer completed an assessment for each review after all reviewers initially completed scoring of the same set of test reviews in order to compare ratings and discuss any areas of discrepancy.

## Data Organization and Presentation

We summarize information extracted from the published literature in the results and discussion sections of this report. We identified resident safety themes and contextual issues from expert input and the published literature and Key Informant discussions for GQ1 and GQ2. For GQ3, we provide an overview of existing systematic reviews and original research published since the end date of the systematic reviews. In addition to describing the available systematic reviews, we catalogued the numbers and designs of newer studies that could potentially inform the assessment of interventions for each of the resident safety outcomes identified in Table 3.

## Peer Review

A draft of this Technical Brief was posted to the AHRQ Web site for 4 weeks for public comments. During this time, the Scientific Resource Center (SRC) distributed the draft report to individuals who agreed to serve as peer reviewers. The SRC collected the feedback from peer reviewers and forwarded the compiled comments to report authors. We reviewed the comments and made appropriate changes to the final report. We documented the report revisions and provided a summary of responses to the individual comments received from public and peer reviewers in a disposition of comments table. The disposition of comments table will be available on the AHRQ Web site after publication of the final Technical Brief Report.

## Findings

### Guiding Question (GQ) 1a. What are the safety issues of particular concern in the nursing home setting?

Current discourse and methods of capturing information on safety and adverse events in nursing homes have a strong basis in the study of patient safety in the hospital, and the four areas currently identified by the Agency for Healthcare Research and Quality (AHRQ) for measuring nursing home safety are taken directly from hospital-based concerns; Table 3 outlines the Patient Safety Organization Privacy Protection Center (PSOPPC) Common Formats for Event Reporting on Nursing Home Safety Version 0.1 Beta (PSOPPC Common Formats). In GQ4, we describe why these are likely inadequate and what additional measures might be considered safety issues as well in the development of a future research agenda on safety issues in the nursing home setting.

**Table 3. Nursing home resident adverse events represented across reporting systems**

Nursing Home Resident Safety Issue	AHRQ Common Formats for Event Reporting –Nursing Home Version 0.1 Beta <sup>19</sup>	MDS Quality Measure/ Indicator <sup>20</sup>	CMS Nursing Home Compare Quality Indicators –Long Stay <sup>21</sup>	CMS Nursing Home Compare Quality Indicators –Short Stay <sup>21</sup>	Top Litigated Issues in Nursing Homes <sup>22</sup>
Falls with injury	✓	✓	✓		✓
Pressure ulcers	✓	✓	✓	✓	✓
Infections, including healthcare-associated infection , urinary tract infection , and antibiotic stewardship	✓	✓	✓		
Medication errors and adverse drug events (e.g., delirium), including inappropriate medication use and polypharmacy	✓				

AHRQ=Agency for Healthcare Research and Quality; MDS=Minimum Data Set; CMS=Centers for Medicaid & Medicare Services

## GQ1b. Are there important differences in safety issues for short-stay versus long-stay residents?

Skilled nursing beds for short-term stays located within long-term care facilities represent the fastest growing segment of post-acute care, with 91 percent of nursing home beds dually certified for Medicare and Medicaid (Table 1).<sup>8</sup> Both short- and long-stay populations experience falls and hospital readmissions thought to be preventable,<sup>2, 23</sup> and both populations often require assistance with multiple activities of daily living (e.g., transfer out of bed, toileting, eating, walking), which increases their risk for care omissions (e.g., not receiving incontinence care in a frequent or timely manner) and functional decline. There are, however, at least two related aspects of care that differentiate short- and long-stay residents: (1) management of the care transitions from post-acute care to home since more (although not all) short stay residents transition home than is the case for long term stay residents and (2) the delivery of rehabilitation services in preparation for discharge home.

### Care Transitions and Safety

Transitions between care settings (acute to post-acute care to home, long-term care to home, or transition to and from the emergency department) create vulnerability for multiple adverse outcomes. Older, hospitalized patients discharged to skilled nursing facilities (SNFs) are more impaired than those discharged home, and this population may experience an exacerbation of their clinical conditions (e.g., unintentional weight loss, depression, pain) as a result of the hospitalization event. In recent studies, the transition from acute to post-acute care has been shown to be fragmented with incomplete clinical information necessary to provide care safely.<sup>24, 25</sup> Recent data also suggest that at least some older adults are discharged from the hospital too soon with conditions that could be best treated by remaining in the hospital for a longer period of time<sup>26</sup>; however, the scope and severity of this problem is unknown.

In short, the probability of adverse events during the transition from hospital to SNFs increases due to the stress of the hospitalization event and the care transition process, a lack of timely, accurate clinical information necessary to care for this complex patient population in the nursing home setting, and the possibility that some patients may not be ready to leave the hospital. For example, adverse events related to medication errors in the SNF cited in the OIG report<sup>2</sup> may be associated with multiple medications, particularly new medications, being prescribed for older patients discharged from the hospital to this care setting. In a recent study, hospitalized patients discharged to SNFs had an average of 13 medications on their hospital discharge list.<sup>27</sup> Thus, SNF providers face the challenge of starting complex new medication regimens with little knowledge of the patient or their medication history upon admission. These same safety issues exist for long-stay residents but to a lesser degree due to fewer care transitions and increased staff knowledge of the resident.

In view of evidence that many hospital readmissions may be avoidable, CMS is currently developing new quality indicators to monitor 30-day readmissions from the SNF as well as successful discharge from SNF to home. In addition, other evidence suggests that many emergency room visits from both the SNF and long-stay nursing home segments may be avoidable, even without hospitalization.<sup>28</sup> Thus, separate measures of emergency room visits are also being planned for public reporting and quality monitoring in the nursing home setting.

## Rehabilitation Services and Safety

Another primary difference between short- and long-stay residents is the differential focus on rehabilitation services in preparation for discharge home. A major goal of skilled nursing care is to effectively rehabilitate residents to allow discharge to the least restrictive care environment possible which, in most cases, is a return to a community setting (e.g., own home residence or assisted living). Very few long-stay residents are expected to be discharged home or to another community setting. In contrast, 69 percent of SNF residents who were living at home prior to admission return home after their SNF stay.<sup>29</sup> Similar to the acute care to post-acute care transition, safety concerns relate to the transition from skilled nursing care to home and include the need for comprehensive care planning; effective, timely communication with outpatient provider(s), scheduled followup visits within less than 30 days of SNF discharge, persons' ability to safely manage their new medication regimen at home, and an accurate assessment of the need for other support services at home such as transportation, meals and home health).<sup>30</sup>

Although short-stay residents are generally expected to return to community settings, one recent study reported that 33 percent of short-stay residents discharged home suffered an adverse medication-related event within 45 days of discharge, and only 28 percent of this group remained living at home 90 days after discharge.<sup>31,32</sup> Ten percent experienced a hospital readmission within 30 days.<sup>29</sup> Based on these findings, new quality indicators are being developed by CMS and others for short-stay residents discharged home related to hospital readmission rates, with the rationale that this measure reflects the quality of the SNF discharge process.

**GQ1c. Are there specific interventions that have improved patient safety in the hospital setting that could transfer to the nursing home setting, but have yet to be tested as such?**

Although individual studies have been conducted and published on interventions to improve safety in hospitals, neither nationally representative data nor broad implementations of hospital-based interventions to address safety issues are easily available. While prior systematic reviews have addressed safety interventions in hospitals,<sup>33-49</sup> most of the literature describes single hospital implementations under tightly controlled conditions. Sparse data are available on the potential for wider implementation, and even less for considering implementation across types of settings, such as nursing homes or the populations served by nursing homes. Such data would be required to correctly estimate the potential for these interventions to achieve target safety goals in nursing homes. A full review of hospital-based safety interventions is inappropriate for this Technical Brief, and without evidence of broader implementation or data on what is needed for implementation, it would be difficult to draw direct links to their potential for effectiveness in nursing homes.

Nonetheless, we provide *selected examples* of interventions that have been studied in hospital settings as potential approaches below, while stressing that evidence is lacking specifically on generalizability of these interventions to the nursing home. We have no evidence of widespread adoption of these hospital-based interventions, and thus implementation data necessary to evaluate their potential for the nursing home setting are not presented. Furthermore, these studies do not focus on a population that matches that in the long-term care setting. We describe a selection of interventions here only to suggest approaches that might be studied further. This is followed by an assessment of national estimates that may be more representative.

## Falls

Multifaceted and individualized falls prevention programs that have demonstrated effectiveness in hospital studies include a focused patient history and physical; educational programs for patients and staff; toileting programs; providing walking aids and making sure they are accessible and used sufficiently; and/or supervised exercise programs, especially those that combine balance, strength and power training. These appear to be most effective when designed and delivered by multidisciplinary teams.<sup>49-53</sup>

## Medication Errors

Medication review, either by pharmacists during the prescribing phase and/or by patients upon admission to the hospital and/or at discharge, has been associated with reduction in medication errors, including prescribing and dispensing errors; preventable adverse drug events; and adverse drug events (ADEs).<sup>54-60</sup> Clinician engagement, multidisciplinary communication, and the review of medication lists and related risks for risk prevention and patient education, especially with older patients who are at risk due to higher acuity and/or actively take several medications, has also been shown to be effective and increase patient safety in the acute hospital setting.<sup>61-64</sup> It would seem that these types of interventions may be useful in the nursing home setting, particularly among short-stay residents who will be discharged home, and several systematic reviews (GQ3) have addressed medication review in the nursing home.

It is unclear whether technology intensive interventions, which are commonly seen in hospitals, could translate to the nursing home. Some nursing homes have implemented technologies including electronic medication administration systems, with outcomes including reduced errors and identification of key times or situations in which medication errors may occur.<sup>65-68</sup>

Health information technology (HIT), such as computerized physician order entry (CPOE) and electronic health records (EHR) and databases that provide decision support (e.g., drug-drug interaction alerts, evidence-based guidelines, dosing alerts, etc.) have been shown to be effective and increase quality and medication safety as well as being more conducive and efficient for medication and chart reviews in the hospital setting.<sup>69-76</sup> It is important to note that hospital resources for intervention implementation included an emphasis on bioinformatics and technological solutions, which may lessen the applicability of many of these interventions in the nursing home setting, or at least limit their generalizability, unless nursing homes also have active and rich informatics systems for health records and management.

## Pressure Ulcers

Most individually reported studies regarding pressure ulcers in hospitals assess treatment of ulcers; however, quality indicators for nursing homes are related to the prevention of pressure ulcers. Therefore, a robust body of evidence on wound healing in hospitals provides limited guidance for long-term care beyond care practice guidelines to inform treatment of existing wounds.<sup>77-81</sup>

## Infection

Catheter-associated UTIs (CAUTIs) may be the most avoidable type of hospital-associated infection (HAI).<sup>82</sup> A variety of strategies and guidelines for prevention and reduction in catheter-associated infections have been produced<sup>83-89</sup> as well as some AHRQ evidence

reports/technology assessments on all healthcare-associated infections. These reports may provide some approaches applicable to use in nursing homes.<sup>90, 91</sup> Strategies for CAUTI prevention include proper techniques for urinary catheter insertion, which is reinforced by staff training; minimizing urinary catheter usage; using a closed urinary drainage system; avoiding catheter usage for incontinent patients; using external catheters instead of indwelling catheters, if possible; documentation of key information related to urinary catheters; and stop orders or reminders to remove such catheters. These safety issues related to catheter use provide the rationale for the current quality indicator “catheter left in bladder” publicly reported by nursing homes via the CMS website.

Other common infection control approaches in hospitals with applicability to the nursing home include hand washing, environmental cleaning, and antibiotic stewardship. A recent review of antibiotic stewardship interventions in the intensive care unit, which typically seek to optimize appropriate treatment with antibiotics and minimize inappropriate use and antimicrobial resistance, reported reductions in rates of antibiotic use and antimicrobial resistance but no benefits on survival.<sup>92</sup> A 2013 Cochrane review evaluating clinical trials of interventions for antibiotic stewardship in inpatients similarly reported reductions in antibiotic prescribing and reductions in hospital-acquired *Clostridium difficile*, Methicillin-resistant *Staphylococcus aureus* (MRSA), and *Enterococcus faecalis* infections. Interventions also reduced pneumonia-associated mortality.<sup>93</sup> Multiple reviews have reported on the effectiveness of hand hygiene approaches such as chlorhexidine bathing and alcohol rubs at reducing rates of infections or microbial activity,<sup>94-98</sup> but sustained adherence to such approaches is challenging. Reviews of environmental cleaning have discussed the need for thoughtful cleaning practices, especially of high touch sites and sites near the patient, to control potential outbreaks.<sup>99</sup> Overall, reviews addressing hospital infection control practices commented on a need for multifaceted interventions that combine elements of cleaning, hand hygiene, appropriate control of contacts, and behavioral and system approaches to promote adherence to infection control measures. These elements are equally applicable to nursing home settings, where infection control processes are variable and staff may not be adequately trained in prevention and control measures.<sup>100, 101</sup>

Finally, in addition to individual studies, another and potentially more informative data source is national data available before and after large-scale payment reform. Specifically, in 2008, Medicare implemented a no-payment policy for specific conditions thought to reflect safety problems with hospital care including new pressure ulcers, falls, and catheter-related infections. Each of these adverse events is also a significant safety issue of concern in the nursing home setting. If scalable interventions are available in the hospital setting, one could reasonably expect that rates should decrease as hospitals strove to implement services to prevent loss of income due to this policy. This should signal the true availability and potential scalability of purported positive intervention effects. In reality, data are mixed or negative on the degree to which improvements were seen after implementation of the no-payment policy in 2008.

Contradictory results reported by studies of pressure ulcer incidence may serve as a good example of issues related to data sources and collection. One retrospective, observational study reported significant reductions but acknowledged that the approach to data collection, which did not necessarily include all diagnosis codes in a given discharge, had high specificity for stage II and IV health care acquired pressure ulcers (HAPUs), but low sensitivity.<sup>102</sup> On the other hand, a quasi-experimental study of 1,381 hospitals participating in the National Database of Nursing Quality Indicators (NDNQI), which relied on trained nurses to assess HAPU prevalence,

reported no effect of the payment policy on HAPU incidence. The NDNQI pressure ulcer indicator used in this study is, in fact, that endorsed by the National Quality Forum (NQF).<sup>17</sup>

A second study using a non-claims database reported no improvement in injurious falls when measured before and after the introduction of the no payment policy. Data on hospital-acquired infections were similarly mixed with some studies reporting improvements and others reporting no change. National data<sup>103</sup> suggest substantial decreases since 2008 in many infections but not CAUTI, which have increased by about 6 percent.

Some recent data suggest that this trend is reversing, and the increase in CAUTI is contrary to clearly evidenced reductions in other infections, including central line associated bloodstream infections and hospital-onset MRSA and *C. difficile* infections. In studies specifically intended to provide data before and after implementation of the policy, conclusions are mixed.<sup>104-107</sup> Indeed, some studies suggest that analyses based on hospital coding data, intended for billing purposes and reported for quality may not provide objective or optimal sources of information.

In general, hospitals have invested considerable resources in improving safety. Hospital safety has improved in many areas that were not the focus of this review (e.g., surgical adverse events). However, in our brief review for the purposed of this Technical Brief, we could not ascertain that hospital safety has improved for the areas of most relevance to long-term care, with the possible exception of medication errors. Mixed evidence about hospital-based improvements in falls, pressure ulcers and catheter-related infections, even after a “no payment” policy was implemented, suggest that interventions to improve safety that have specific relevance to the nursing home population may not be consistently implemented in the hospital.

## **GQ2a. What characteristics and qualities of nursing homes and nursing home residents create unique settings for assessing safety and may affect choice of intervention and success rates?**

Individuals residing in nursing homes may be residents in the facility for a number of years, so safety issues occur in the context of their prolonged nursing home stay, not just during an acute hospitalization event. The goals of nursing homes in caring for residents are also not the same as that of a hospital, in which stabilization or treatment of an acute illness are typically the focus of care. Instead, nursing homes try to balance providing maximum independence with ensuring safety of an increasingly frail population. The fact that the population includes people aging in their fulltime place of residence, rather than patients who present for short term or targeted care means that the commonly accepted, narrow foci of hospital-based safety measures are likely insufficient to comprehensively address safety in the nursing home setting. Both short and long-stay nursing home residents are vulnerable populations for multiple reasons including advanced age (70.4 percent aged 70 or older), medical complexity, the prevalence of activities of daily living (ADL) impairments (66.6 percent with three or more ADL impairments) and dementia (64.8 percent moderate to severe impairment). Nursing home residents also need frequent, labor-intensive care (e.g., assistance getting in/out of bed, dressing, toileting, eating, walking) due to physical and cognitive deficits. Importantly, because nursing home residents remain in the facility for a prolonged period of time, the care environment must have adequate staffing and organizational management over time to ensure that all aspects of care are provided 24-hours/day, seven days/week to all residents in need even as those needs change. The intensity of daily care needs and the prolonged length of stay of nursing home residents place this population at risk for care omissions which, in turn, may contribute to adverse events.

## GQ3. Current literature assessing interventions for improving safety practices in nursing home settings

### Overview of All Systematic Reviews

As a technical brief, the purpose of this report is not to describe outcomes, but to enumerate the number and types of studies available to contribute to an evidence base. We captured this information from existing systematic reviews, supplemented with newly published studies. Studies of interventions intended to improve safety outcomes among the nursing home population may be targeted interventions to change specific outcomes, or more general or multifaceted interventions with multiple outcomes. In this section, we provide an overview of literature on the safety outcomes noted in Table 3. The reviews meeting our inclusion criteria regarding the four safety targets outlined by AHRQ may have addressed multiple outcomes but typically focused on a primary outcome such as falls prevention.

Some reviews also broadly targeted older adults and may only include a small number of studies that were conducted in nursing homes, but also include hospital-based or community based settings. We elected to include these reviews in the Technical Brief to provide a comprehensive picture of the literature potentially relevant to older adults rather than eliminating reviews with mixed care settings. All reviews included nursing home studies. Whenever possible, we focused on data from nursing home or long-term care settings (Appendix C). We also provide an estimate of new comparative studies of interventions published since the ending search date of the reviews addressed in each section and identified in our screening of the primary literature (Appendix D). The purpose of this estimate is to begin to identify areas of research that might warrant an updated or new review. We classified studies as randomized controlled trials (RCTs); prospective intervention studies, which included cohort studies with comparison groups and non-randomized trials; or pre-post studies with comparison groups.

### Interventions To Prevent Falls

A wide range of interventions may be associated with falls prevention, including those interventions aimed at toileting, preventing delirium, ensuring appropriate medication use and use of physical restraints. Thus, the reviews included here, which focus specifically on falls prevention interventions represent a subset of potential studies on this topic. Tables 4 and 5 outline the outcomes and intervention components addressed in studies included in the 14 reviews of falls prevention approaches.<sup>51, 108-120</sup>

Several reviews assessed multiple interventions or multimodal approaches.<sup>51, 108, 111, 112, 114, 117, 120</sup> Among those with low risk of bias, the most recent was published in 2015 and included 13 RCTs published through 2013.<sup>108</sup> Interventions assessed in the review included staff training, written materials, informatics tools for appropriate medication use, vitamin D supplementation, exercise programs, modifications to the environment, management of urinary incontinence and nutrition therapy. Outcomes included numbers of falls, numbers of fallers and numbers of recurrent fallers (individuals who had prior falls). A 2012 Cochrane review included 60 RCTs, also with a diverse set of interventions that were implemented in nursing homes and in hospitals.<sup>111</sup> This review also examined number of falls and fallers, as well as fractures, complications and economic outcomes. A 2010 review addressing multiple interventions including Vitamin D, exercise, pharmacologic therapies, and hip protectors included 20 RCTs, most assessing Vitamin D or hip protectors.<sup>117</sup> A 2007 review of 43 studies assessed multiple

interventions including Vitamin D supplementation and hip protectors to prevent fractures in the nursing home.<sup>51</sup>

Other reviews specifically examined a single category of intervention such as exercise,<sup>109, 119</sup> environmental modification,<sup>113</sup> hip protectors,<sup>115, 116, 118</sup> and vitamin D supplementation.<sup>110</sup> The most common outcomes studied in these systematic reviews were the number and rate of fractures and the number and frequency of falls (Table 4).

**Table 4. Outcomes addressed in systematic reviews for falls prevention**

Outcomes Assessed	Risk of Fracture or Fall	Falls and Fracture Prevention	Frequency of Patient Injuries Due to All Falls/ Falls out of Bed /From Their Beds	Number/ Rate /Frequency of Falls/ Fallers; Change In % of Falls; Incidence of Falls	Number/ Rate of Fractures/Hip Fractures	Number of Recurrent Fallers	Complications/Harms of Falls Interventions	Economic Outcomes
Vlaeyen et al. 2015 <sup>108</sup>				✓		✓		
Santesso et al, 2014 <sup>118</sup>	✓			✓	✓			
Cameron et al. 2012 <sup>111*</sup>				✓	✓		✓	✓
Anderson et al. 2011 <sup>113</sup>			✓	✓			✓	
Howe et al. 2011 <sup>119**</sup>								✓
Sawka et al. 2010 <sup>117</sup>					✓			
Sawka et al. 2007 <sup>115</sup>					✓			
Sawka et al. 2005 <sup>116</sup>					✓			
Silva et al, 2013 <sup>109</sup>		✓						
Balzer et al, 2012 <sup>112*</sup>	✓	✓	✓		✓		✓	✓
Chua et al. 2011 <sup>110</sup>				✓				
Cusimano et al. 2008 <sup>114</sup>			✓	✓		✓		
Oliver et al. 2007 <sup>51</sup>				✓	✓			

\*Balzer et al. 2012<sup>112</sup> also assesses legal, ethical, and social aspects of interventions

\*\*Howe et al. 2011<sup>119</sup> also assessed measures of balance and walking speed.

Table 5 outlines the most frequently evaluated interventions included in unique studies across reviews (individual studies were typically included in multiple reviews). Interventions evaluated in studies typically included multiple components, and we classified components of interventions broadly. We recognize that some elements could be categorized in multiple ways, but the table is intended to present a broad estimate of the approaches addressed in studies. We note also that residents frequently received elements of usual care that are not reflected in the tables reporting components.

**Table 5. Frequently reported components of falls prevention intervention studies**

Intervention Component	Estimated Number of Studies Including Component*
Exercise	22
Hip protectors/protective aids	20
Staff training/education	19

Intervention Component	Estimated Number of Studies Including Component*
Falls/safety risk assessment	12
Vitamin D supplementation	13
Environmental modification, including physical alerts to identify fallers (e.g., wristband, etc.)	7
Guidelines/treatment recommendations	6
Medication review	6

\*72 unique studies set in nursing homes were included in the 14 systematic reviews; studies could include more than one component

## Pressure Ulcers

Eight systematic reviews specifically focused on preventing and treating pressure ulcers.<sup>47, 80, 121-126</sup> One low risk of bias review focused on repositioning and included only three RCTs, with a final search date in 2013.<sup>121</sup> Two low risk of bias reviews conducted by AHRQ EPCs addressed multiple interventions for pressure ulcer prevention<sup>125</sup> and treatment.<sup>124</sup> The prevention-focused review included roughly 20 comparative studies (including an intervention and comparison group) in nursing home or long-term care settings. The treatment-focused review included approximately 45 randomized or observational studies in nursing home or long-term care facilities.

Two additional reviews (both high risk of bias) assessed multiple interventions.<sup>123, 126</sup> Three other reviews with high risk of bias largely focused on education and process of care. Table 6 outlines components frequently addressed in studies included in the reviews.

**Table 6. Frequently reported components of interventions described in reviews of pressure ulcer prevention and treatment**

Component	Estimated N Studies Including Component*
Support surfaces including overlays and specialized mattresses or beds	26
Wound dressings	19
Repositioning/turning	12
Topical wound treatments	11
Nutrition/nutritional supplementation	11
Risk assessment	8
Staff education/training	7
Guidelines/protocols	7
Wheelchair cushions/pads/protective cushions	7
External consultants	6
Biologic agents/growth factors	4
Skin champion	4
Skin examinations	4

\*97 unique studies set in nursing homes were included in the 8 systematic reviews; studies could include more than one component

## Infections, Including Healthcare-Associated Infection, Urinary Tract Infection, and Antibiotic Stewardship

Three reviews addressed infection prevention.<sup>127-129</sup> In one Cochrane review of methods to prevent transmission of MRSA in nursing homes, only one study, a cluster randomized trial of 32 sites (16 matched pairs), was included. The intervention included providing baseline data and infection control education to the staff as well as infection control audits.<sup>127</sup> Another review evaluated evidence for infection prevention interventions from 24 studies (16 RCTs)<sup>129</sup> addressing therapeutic or educational interventions including oral hygiene education, antifungal medications, hand sanitizer, vitamin E or other supplements, chlorhexidine bathing, and pneumococcal vaccine across multiple infection sites. The final systematic review addressed the preventive effect of oral hygiene on pneumonia and respiratory tract infection (RTI) in older adults in nursing homes and hospitals. Table 7 lists components frequently included in interventions for infection control in the nursing home.

**Table 7. Frequently reported components of interventions described in reviews of infection prevention**

Component	Estimated N Studies Including Component*
Professional oral care (dental hygienist, nurse, or dentist delivered)	7
Dental/oral cleaning tools/rinses and self-delivered oral care	7
Staff education and training	4
Vitamin/mineral or herbal supplements	3
Antibiotic	2

\*25 unique studies set in nursing homes were included in the 14 systematic reviews; studies could include more than one component

## Medication Errors and Adverse Drug Events (e.g., Delirium), Including Inappropriate Medication Use and Polypharmacy

Eleven systematic reviews focused on identifying interventions to prevent medication errors and adverse drug events through approaches to improve prescribing and reduce inappropriate use of drugs. Five reviews focused broadly on optimizing prescribing or medication safety.<sup>76, 130-134</sup> One addressed antibiotic prescribing specifically,<sup>135</sup> two evaluated medication reconciliation or communication of medication regimens in care transitions,<sup>130, 136</sup> and a third evaluated specific effects of medication reviews on mortality and hospitalization.<sup>137</sup> A final review examined a computer-based approach to identify medications that may contribute to delirium.<sup>138</sup> To categorize approaches addressed in studies in these reviews further, Table 8 outlines frequently studied components of the interventions.

One Cochrane review on polypharmacy included three studies conducted in the nursing home setting.<sup>76</sup> Most studies evaluated multicomponent interventions (including education and medication review components) intended to promote appropriate medication use. Another review focused on medication reconciliation during transition to and from long-term care.<sup>130</sup> A second review addressing communication of medication regimens in transitions between hospitals and nursing homes included three studies of medication reconciliation or transfer documentation/summaries.<sup>136</sup> One review of third party medication reviews in nursing home residents to reduce mortality and hospitalization included seven RCTs and five non-RCTs.<sup>137</sup> Another review focused specifically on clinical decision support systems to improve medication safety in long-term care settings<sup>134</sup> and included seven studies (5 RCTs).<sup>134</sup> One Cochrane review identified two trials that focused on non-pharmacologic delirium prevention approaches.<sup>138</sup>

Across systematic reviews, medication review and clinician or pharmacist education were frequently the focus of interventions. Table 8 provides an estimated count of the intervention components frequently addressed across the nursing home studies included in the reviews. We note that reviews also included studies conducted in hospital or other non-nursing home settings. In addition, we classified components of interventions broadly. We recognize that elements could be categorized in multiple ways, but the table is intended to present a broad assessment of approaches addressed in studies.

**Table 8. Frequently reported components of interventions described in reviews of medication errors and adverse drug events\***

Intervention Component	Estimated Number of Studies Evaluating Intervention Component
Clinician/pharmacist education	19
Pharmacist review of medications (care facility- or home-based)	13
Information technology (CPOE, CDS, etc.)	7
Academic detailing	5
Multidisciplinary case conferences	4
Interdisciplinary care/rounding team (typically including clinical pharmacist)	3
Clinician/multidisciplinary medication review or medication reconciliation	4
Guidelines	3
Transition coordination/documentation	3

\*52 unique studies set in nursing homes were described in 11 systematic reviews; studies could include more than one component; CPOE=Computerized physician order entry; CDS=Clinical decision support

## Primary Studies Published Since the Publication of the Included Systematic Reviews

We identified an estimated 90 unique new comparative studies evaluating safety-related interventions in the nursing home (Table 9). A reasonable number of RCTs suggests a growing evidence base of potentially high quality studies.

**Table 9. Overview of estimated new studies of nursing home safety interventions**

Safety Area Addressed	Randomized Controlled Trial (RCT)	Prospective Intervention Studies, Including Cohorts With Comparison Groups	Pre-Post Studies With Comparison Groups
Falls with injury	33	2	3
Pressure ulcers	22	5	2
Infection, including healthcare-associated infection, urinary tract infection, and antibiotic stewardship	11	0	0
Medication errors and adverse drug events (e.g., delirium), including inappropriate medication use and polypharmacy	7	5	0

GQ4a. What is the uptake of evidence-based nursing home interventions beyond individual test sites? What are the most important barriers/facilitators to uptake of successful interventions?

## **Research Evidence**

Perhaps due to mixed results and lack of consensus in the literature, uptake of specific interventions to enhance safety in the nursing home appears to be limited. That said, a fairly large body of primary literature published after the latest systematic reviews addressed in GQ3 is available, and this new literature could inform an update of existing findings for many safety areas in the nursing home care setting, such as the staffing resources necessary for intervention delivery.

## **Barriers to Uptake**

Three primary barriers to uptake appear to be a) a lack of consensus related to the level of adverse events that may be acceptable and thus a target for interventions; b) lack of evidence that Federally-collected quality measures accurately reflect quality in the nursing home setting, and c) lack of implementation data from effective interventions that would support uptake, such as the staffing resources necessary for intervention delivery.

First, limited “natural history” evidence exists to provide expected levels of different safety outcomes absent intervention, given that some degree of decline and associated clinical events will certainly occur in this vulnerable and complex population. It is possible that nursing homes could more confidently adopt evidence-based care practices with realistic targets for achievable outcomes.

Second, the current practice of comparing nursing homes on quality measures to identify variability (e.g., which homes are in top 10<sup>th</sup> percentile for falls) assumes that the variability in rates between homes is a true reflection of differences in the quality of care or safety practices within the facility. Empirically, however, the connection between quality measures and facility practices has not been well established for many quality measures and, thus, warrants further consideration.

Third, most intervention studies that have demonstrated positive outcomes do not report either the resource needs or the specific care processes involved in the intervention. This lack of information makes it difficult to achieve the uptake of even successful safety interventions with any fidelity. In the few studies wherein the necessary resources, particularly staffing, have been reported, resources often exceed the typical operating capacity of the facility, suggesting that modifications of effective interventions may be necessary to support uptake in daily care practice in most nursing homes.<sup>139-141</sup>

GQ4b. What major areas for future research remain regarding resident safety in nursing homes?

## **Refine Our Understanding of Safety Within the Nursing Home Context**

This report is based on the core measures already identified by AHRQ as safety indicators in the nursing home setting. However, team experts and key informants felt that this small set of four indicators, which were largely informed by hospital practices, did not fully capture the safety issues for nursing home residents.

In reality, there are a number of contributing factors to pressure ulcers, falls, infections and medication errors that may also lead to events that cause injury and adverse events outside of these four safety domains, which are the focus of this report. These conditions and associated adverse events may also be improved with interventions, which suggests that they meet the AHRQ safety definition of a “process or structure that prevents adverse events.” Thus, these domains may provide amenable targets for intervention.

Potential domains that meet these criteria include unintentional weight loss (now a safety quality measure endorsed by the NQF<sup>17</sup>); dehydration; decline in ADLs, typically defined as basic tasks of everyday life (eating, bathing, dressing, toileting, transferring to different locations such as chair to bed ); functional independence; fecal and urinary incontinence, including constipation, depressive symptoms, moderate to severe pain, influenza vaccine; pneumococcal vaccine; physical restraints; and catheter left in bladder.<sup>111, 142-145</sup> It is important to note that these factors may not be possible to mitigate or avoid entirely in the nursing home setting, particular for some segments of the population (e.g., reductions in ADL in severely impaired individuals).

Many of these known factors are commonly referred to in the context of quality of care or quality of life, including those indicators that are tracked via the federally-required Minimum Data Set (MDS), described in Nursing Home Compare, captured through the annual survey and certification process, or identified through complaints. By comparing these sources as well as common litigation targets<sup>22</sup> and consulting with key informants, we identified ten conditions (Table 10) that, if not addressed, have substantial potential to result in a safety issue. For example, decline in ADLs could lead to an increased likelihood of falling, and a catheter left in too long could lead to infection. Indeed, increasing support is coalescing around an expanded consideration of safety in this setting, including the recent addition to the NQF safety indicators of specific measures on weight loss and decline in ADLs.<sup>17</sup>

Our research team and key informants have proposed that, to best understand and address safety in the nursing home setting writ large, the elements in Table 10 should also be targets for intervention and thus added to future research agendas. A central component of this research would be to identify and explicate any empirical link between these potentially contributing factors and clinical safety outcomes. We recognize that additional factors such as dementia also represent important factors to consider in future research; however, we focused in this brief on potentially preventable issues. Issues such as dementia or physical dependency are also prevalent among nursing home residents and therefore may set the stage for issues described in Table 10 to lead to safety events over time. In sum, future research efforts should consider which measures constitute the body of target outcomes relevant to nursing home safety – both final clinical outcomes and contributing factors. These research efforts should also include understanding

what areas or factors are addressed in existing studies and the extent to which these studies offer insights into understanding safety in the nursing home and potential safety-related interventions.

**Table 10. Common contributing factors to safety events in nursing homes**

Nursing Home Resident Safety Issue	AHRQ Common Formats for Event Reporting – Nursing Home Version 0.1 Beta <sup>19</sup>	MDS Quality Measure/ Indicator <sup>20</sup>	CMS Nursing Home Compare Quality Indicators –Long Stay <sup>21</sup>	CMS Nursing Home Compare Quality Indicators –Short Stay <sup>21</sup>	Top Litigated Issues in Nursing Homes <sup>22</sup>
Unintentional weight loss, including dehydration		✓	✓		✓
Decline in activities of daily living – functional independence		✓	✓		
Fecal and urinary incontinence, including constipation		✓	✓		
Depressive symptoms		✓	✓		
Overuse or inappropriate use of antipsychotic medications		✓	✓	✓	
Moderate to severe pain		✓	✓	✓	
Influenza vaccine			✓	✓	
Pneumococcal vaccine			✓	✓	
Physical restraints			✓		
Catheter left in bladder			✓		

AHRQ=Agency for Healthcare Research and Quality; MDS=Minimum Data Set; CMS=Centers for Medicaid and Medicare Services

## Encourage Implementation Research Specific to Nursing Home Safety

Many studies in this field, to date, have not included standardized, independent measures of safety outcomes, complete information on the care processes thought to be related to those outcomes, details about the staffing resources (number, time, equipment) necessary to provide the interventions, or leadership, regulatory, and payment characteristics that may affect implementation. Because these components are so often lacking in the literature, it is difficult to determine to what extent mixed results in prior systematic reviews for various outcomes are attributable to a lack of an intervention effect or lack of intervention fidelity or lack of resources to support the intervention. It is noteworthy that many of these same implementation issues were discussed in a recent AHRQ-sponsored report on non-pharmacological interventions for behavioral disturbance in long-term care settings.<sup>146</sup> The weaknesses in implementation contribute to the weak/mixed evidence base, a dearth of incentives to change care practice, and questions about staffing resource requirements necessary to improve outcomes as well as what outcomes are even achievable in the nursing home setting. These are inter-related, important issues that should be addressed in future studies, and we provide more specific discussion of some of these implementation research issues in the remainder of this section. In addition, understanding of the sustainability of effects of intervention is lacking; future research should consider how to maximize durability of positive outcomes of interventions.

## **Develop Consensus Around Common Outcomes**

As noted above, specific outcome performance standards (e.g., absolute rather than relative performance) for acceptable quality of care and safety in nursing homes are absent and this likely impedes the uptake of interventions with demonstrated effectiveness. One way to achieve performance standards is to actively develop consensus among experts in the field. Another approach is to encourage the conduct of implementation science to help identify what is achievable under controlled conditions, and, in this context, describe fully the resources and circumstances needed to achieve those outcomes. Finally, better characterization of implementation research also could provide important clinical information about the resident characteristics that may modify the effectiveness of specific interventions.

Specific research questions include:

- What are the maximum achievable outcomes (e.g., fall or pressure ulcer incidence rate reduction) when specific care processes thought to be related to the outcomes are implemented with high fidelity?
- What are the resources required to consistently implement the intervention to all residents in need within a given facility (e.g., number of staff, training, equipment)?
- What resident characteristics modify intervention effectiveness such that clinically meaningful criteria can be used to best target interventions, especially in the context of limited staffing resources?

## **Empirically Assess the Role of Performance Monitoring Approaches in Nursing Home Settings**

Outside of the Federal and State inspection process and recent targeted chart review protocols used in OIG studies,<sup>2</sup> most research to date has relied solely on self-reported information from nursing facilities. Because discrepancies have been noted between self-reported and externally collected data, validation research as well as direct observation studies would be informative.<sup>2, 147-149</sup>

In particular, questions that have arisen about the accuracy of self-reported staffing information that is part of the current 5-Star reporting systems, staffing data submitted to CMS will soon be based on nursing home payroll data in lieu of facility self-report. As an example of changes in practice that may improve available data, CMS has now instructed survey staff to increase their audits during the survey process.<sup>150, 151</sup>

Research questions include:

- What auditing approaches are most efficacious and effective more broadly for verifying the accuracy of adverse event reporting in nursing homes?
- Does the effectiveness of such auditing differ based on the frequency of the audits?
- What are the most accurate information sources to identify safety issues in the nursing home setting?

## **Rigorously Study the Role of Staffing Models, Levels, and Types of Staff in Achieving Safe Nursing Home Environments**

In contrast to hospitals and hospital care, nursing homes rely on many non-licensed personnel (e.g., nurse aides) who are responsible for the majority of labor-intensive and non-clinical ADL care (e.g., helping residents get in/out of bed, dressing, bathing, feeding, toileting, walking

assistance) delivered to residents over a longer period of time. Also in contrast to hospitals, nursing homes rely more on Licensed Practical Nurses or Licensed Vocational Nurses (LPNs/LVNs) as opposed to Registered Nurses (RNs), which may have implications for medication errors as well as overall clinical management. A mixed body of research has explicitly explored the association of staffing levels and quality of care issues that may contribute to safety, with most studies reporting positive outcomes and others not demonstrating any effect. Systematic and narrative reviews have identified substantial variation in the study methods and measurement of staffing interventions. Studies overall were considered methodologically flawed in the reviews that reported study quality, and reviews generally commented on variation in methods to measure staffing.<sup>152-156</sup>

The largest and most standardized database on this topic is perhaps the five-star nursing home rating system, which catalogues staffing, survey deficiency and quality outcome data for all nursing home facilities in the U.S. on a routine basis using a standardized reporting format. Data from these reports also suggest positive associations between total staffing (i.e., licensed nurses plus nurse aides), survey deficiencies, 30-day hospital readmissions from SNF and successful community discharge from SNF.<sup>157-159</sup> However, the mechanism through which staffing may be affecting care quality in these five star reports is unclear.

Future studies should be used to determine the effects of specific staffing models on care processes related to safety outcomes. Concurrently, effectiveness studies should report details about staffing that can be used to assess this potential modifier of effectiveness.<sup>139-141</sup> An increased focus on a more rigorous application of implementation science in the evaluation of nursing home interventions could provide a basis for understanding the role of staffing models in the future and would, in fact, reduce the need for minimum staffing standards in nursing homes by providing more nuanced information about models and staffing types that affect outcomes. Many nursing homes nationwide currently report total staffing levels that are consistent with expert consensus recommendations (Table 1). However, staffing levels and types of staff still vary significantly among facilities, with little evidence to suggest that any particular model is optimal for improving quality and safety.<sup>152, 160</sup> A potential reason for the current variability in staffing levels is the absence of reliable and empirically established models describing an optimal level and mix of staffing resources based on resident acuity.

Research questions include:

- What are the staff-time requirements and type(s) of staff associated with interventions known to prevent adverse events?
- Given staff time requirements and staffing skill mix, are any staffing models more efficient and effective than others in practice for preventing adverse events?
- How can labor resource data be converted into an information system useful for planning the number and skill mix of staff necessary to prevent adverse events?

## **Better Understand What Works for Staff Training and Management and Organizational Culture**

At a very practical level, methods of training and managing staff should be studied and reported, including operational research and rigorously conducted qualitative research to understand contextual factors with the nursing home setting and staff perspectives. It is conceivable that managers may not be cognizant of safety lapses in their facilities or the best approaches to training staff, documenting care, or implementing programs to improve safety. Recent studies from multiple hospital systems have shown that both nurses and patients report

frequent omitted care, particularly care related to pressure ulcer and fall prevention (e.g. repositioning and mobility assistance). Hospital nurse staffing levels have been shown to be the primary predictor of care omissions and there is no reason to believe that this is not also a potential issue in nursing homes<sup>161, 162</sup>. Rigorous evaluations of both staff training and management models would provide needed information for broader implementation. Potential examples include web-based approaches that would be continually available to new staff. Programs that do exist, including the Quality Assessment and Performance Improvement (QAPI) framework, should be rigorously evaluated.

An intervention that currently lacks rigorous evaluation is the use of point of care documentation systems, which are commercially available, that may provide timely methods to identify care frequency and care omissions. A second solution that does not require technology is the use of standardized observational tools by managers to intermittently monitor daily care processes related to adverse events. Recent studies have demonstrated that standardized observations can be used by both nursing home staff and federal surveyors to monitor nutritional care quality and resident-centered care practices<sup>147, 163-168</sup> but both technological and non-technological approaches to management improvement need to be rigorously evaluated in future studies.

Further, understanding of how management and leadership practices and work processes affect care and the safety-related climate of nursing homes is also needed, and some literature from the hospital setting may guide efforts in this area.<sup>169-171</sup>

Research questions include:

- What is the effectiveness of various staff training and management models for improving staff ability to provide optimal care consistently?
- What is the role of direct observation in multicomponent approaches to staff management of clinical care?
- What is the effectiveness of point-of-care documentation systems for reducing adverse events?
- What is the role of care process information (collected either through technology or standardized observations) for improving staff performance?
- What are the costs of implementing new care process documentation systems or the staff training and management models based on the data generated by these systems?
- How do leadership style, management practices, and work organization affect care and safety?
- How do organizational and management factors contribute to a culture of safety?

## **Understand the Effects of Care Omissions on Safety**

A number of researchers have suggested that the basis for safety issues may be identifiable omissions of care, and thus that omissions of care may be a focus of study. Care omissions can be defined as (1) care documented in a resident's medical record but not actually provided by staff; and, (2) the presence of a clinical condition not identified by staff and thus not reflected in the care plan and/or treatment decisions. Finally, prolonged delays in care delivery wherein care is provided but not in a timely manner may occur (e.g., delayed incontinence care or repositioning).

Care omissions may reflect a discrepancy between medical record documentation and direct observations of care delivery in the nursing home setting for incontinence care (e.g., toileting assistance and changing), feeding assistance during meals, nutritional supplement and snack

delivery between meals, repositioning and mobility exercise.<sup>148</sup> Separate studies have shown that many clinical conditions go unrecognized and untreated by staff including depression, moderate to severe pain, inadequate food and fluid intake and unintentional weight loss.<sup>147, 172-175</sup> Similarly, other clinical conditions may be recognized by staff but not adequately addressed in resident care plans (e.g., incontinence and a toileting program). A recent Government Accounting Office (GAO) report indicated that fall risk, nutritional problems and incontinence are commonly experienced by nursing home residents but are not addressed in care plans.<sup>78, 159</sup> Prolonged and/or excessive omissions of care may increase a resident's risk for harm and subsequently be deemed as neglect/abuse in litigation (e.g., recurrent episodes of inadequate feeding assistance can lead to weight loss/dehydration).

Research questions include:

- How can omissions of care be captured and measured?
- How do omissions of care contribute to adverse events?
- How do omissions of care for risk factors related to pressure ulcers and falls (e.g., exercise and incontinence care) affect these outcomes?

## **Rigorously Evaluate Person-Centered Care**

Key Informants added one additional concept to key safety and quality issues, that of person-centered care as a way of supporting an environment less susceptible to safety lapses. A central tenet of person-centered care is staff compliance with residents' preferences and/or the ability of residents to make choices about aspects of their daily care and lives. Person-centered care approaches may have a potential impact on resident wellbeing and quality of life, and anecdotal evidence suggests that some approaches (e.g., Eden Alternative, Greenhouses) may produce both clinical and quality of life benefits. However, the research literature is fairly limited, and most often does not explicitly describe the key components of person-centered care in a way that is measurable, and thus replicable, by other facilities.

Given potential trade-offs between personal freedom (a common tenet of these approaches) and safety, good evaluations are needed to better understand the role and optimal implementation of person-centered care. Conversely, studies to evaluate clinical interventions to improve resident health status and other clinical outcomes also should consider the potential risks and benefits related to residents' quality of life and wellbeing. Future studies also should define the specific daily care processes related to person-centered care and objectively measure associated outcomes to allow such models to be replicated in other facilities. Understanding the impact of the physical structure of the home, such as providing a more homelike environment, is also lacking. Research in this area may also include rigorously conducted qualitative research to better inform our understanding of contextual factors related to care as well as staff, family, and resident perspectives.

Research questions include:

- How does daily care differ between facilities based on person-centered care models and other models (e.g. are residents offered more choices in their daily lives?)
- What are the key, measurable daily care processes that define the person-centered care model, and how can these be replicated more broadly?
- How do daily care differences relate to adverse events?
- How does the physical environment of the nursing home affect care outcomes and safety of care?

## **Study Approaches to Managing Polypharmacy**

Polypharmacy is common in both hospitalized older patients and nursing home residents and can be associated with a number of adverse events and other poor clinical outcomes. We do not know, however, to what extent it can be improved for this medically complex population, while managing challenging clinical conditions. For example, older adults discharged from the hospital to post-acute care (SNFs) have an average of more than 13 medications and new medications are prescribed during their hospital stay.<sup>27, 176</sup> This high number of medications per patient may increase the probability of adverse medication-related events and also is related to multiple geriatric syndromes associated with safety outcomes (e.g., falls, urinary incontinence, weight loss, delirium, depression).<sup>27, 177-180</sup> Literature on medication-related adverse events alludes to some of these issues. However, evidence that medications can be safely reduced for this frail older population or if improved health outcomes related to safety can be achieved with medication reductions is lacking for older hospitalized patients discharged to SNF but also for those discharged to home.<sup>76</sup> Future research should evaluate interventions related to polypharmacy and medication reductions and should assess appropriate medication management to optimally balance reducing unnecessary prescriptions while also effectively managing clinical needs.

Research questions include:

- Is there evidence that polypharmacy is associated with adverse events in the nursing home population?
- What interventions, including technology-based approaches, may safely reduce the number of prescribed medications for hospitalized older adults discharged to SNF and subsequently to the nursing home or home demonstrate promise?

## **Establish What Lessons Can Be Learned From Hospital Safety for Older Patients**

The assumption that effective hospital safety interventions are transferrable to the nursing home setting is untested, as noted in this report. Furthermore, analyses of hospital discharge records highlight a lack of documentation for problems related to safety and experienced by geriatric patients in the hospital.<sup>25, 27, 31</sup> A separate comprehensive literature review of hospital-based safety practices specifically as they relate to older patients could identify aspects of hospital care and the discharge process that warrant improvement.

Research questions include:

- What is the evidence that hospital-based interventions to improve safety are transferrable to the nursing home population?
- What barriers to generalizability exist?
- What modifiers of effectiveness exist in the nursing home setting that are the same or different than those in the hospital?

GQ4c. In what ways is the field of long-term care changing such that resident safety interventions may need to adapt to a new environment, and what additional challenges do these changing conditions bring to increasing long-term care patient safety?

## **Population Shifts and Clinical Challenges**

Our Key Informants suggested that several shifts in the target population are occurring rapidly and require that safety interventions and related research adapt as part of future efforts to improve safety outcomes. These include increases in the psychiatric needs of nursing home residents, individuals with HIV-AIDS living longer lives and moving to nursing home care, and the care of aging prisoners. Perhaps most significantly, a greater proportion of older adults who are higher functioning with fewer care needs are moving into assisted-living facilities (ALFs), rather than nursing homes, which changes the population still moving into nursing homes to be of significantly higher acuity. Thus, the nursing home population is becoming more medically complex with higher care needs. As this shift occurs, the dominant paradigm may shift to palliative care, which has the potential to affect definitions of target safety outcomes as well. Also inherent in this shift is a need to focus increasingly on educating families and residents to make informed treatment decisions such that a resident's life expectancy and quality of life are strongly considered.

## **ALFs and Dementia Care Within ALFs**

ALFs are not only the fastest growing segment of older adult congregate living but ALFs also house residents with multiple ADL and cognitive impairments.<sup>181, 182</sup> Some State-level regulations govern ALF staffing, but these vary by State and are less restrictive than those for nursing homes. In particular, the significant growth in dementia care services within ALFs makes this segment of the ALF population similar to those with dementia in nursing homes.<sup>182, 183</sup> This similarity suggests that safety issues for those with dementia in the ALF care setting may be comparable. One of the biggest challenges in ALFs is the lack of standardized quality or safety data; thus, the extent of care quality and/or safety problems in this care setting is largely unknown, with only a few studies examining ALF care quality.<sup>182-185</sup> Future research in this area is needed for multiple reasons.

First, the number of ALFs is growing with an estimated 36,000 facilities serving over one million older adults nationwide.<sup>181</sup> A recent nationwide survey of 31,100 ALFs revealed dementia as one of the most prevalent chronic conditions.<sup>182</sup> At least partially due to the prevalence of dementia, 74 percent of ALF residents require caregiver assistance with one or more ADLs, such as bathing (72 percent), dressing (52 percent), and toileting (36 percent).<sup>182</sup> Moreover, a longitudinal study showed that ALF residents and long-stay nursing home residents both experienced significant and comparable decline in their ability to independently perform ADLs.<sup>184</sup> Functional decline is a quality indicator for both short- and long-stay nursing home residents, and evidence suggests that optimal care can prevent decline.<sup>141</sup> Thus, safety issues related to functional decline may be similar in both the nursing home and ALF care settings. Because the ALF industry began as a hospitality industry, it is also likely that measures related to person-centered care and quality of life are also equally applicable across settings.

One Key Informant who represented the ALF industry noted that resident acuity is increasing in this population, and current ALF staffing, both in terms of number and skill set, may be

inadequate to meet future needs. Some of the safety concerns raised by Key Informants included medication errors, at least partially due to the skill set of the staff responsible for medication management (e.g., use of medication aides as opposed to licensed nurses); falls; and accurate assessments of clinical conditions (e.g., delirium, dehydration, depression) in the absence of licensed nurses with this skill set to support timely treatment.

## **Summary and Conclusions**

### **Summary of Patient Populations and/or Safety Issues Not Addressed in This Technical Brief**

Several areas are notably not included in this report. We did not review safety issues associated with home health care services, although these services are growing rapidly. We also did not review data on hospice and palliative care services, although we note the need for attention here. Issues related to staff-to-resident aggression or altercations or resident-to-resident aggression, especially in individuals with dementia, pose important potential safety concerns but were not in scope for this report. We also excluded transitional care units in hospitals and inpatient hospital rehabilitation facilities, as well as Veterans Administration (VA) community living centers (although some of the cited research may have included VA sites, we did not examine this setting specifically). Finally, as noted, assisted living facilities may be the fastest growing setting for the care of increasingly vulnerable residents but these were not the focus of our report. That said, it was challenging to determine which studies in the systematic review literature were truly conducted in nursing homes or may have taken place in residential care settings, given inadequate descriptions of settings as well as different terminology used, especially internationally.

### **Conclusions**

Current discourse about safety and adverse events in nursing homes is largely based on the study of patient safety in the hospital. The four areas currently identified by the Agency for Healthcare Research and Quality for measuring nursing home safety (falls, pressure ulcers, infections, medication errors and adverse drug events) are taken directly from hospital-based concerns. As described here, these four areas alone are likely inadequate to capture the breadth of safety concerns in the nursing home as well as additional measures that might be considered safety issues in the development of a research agenda in this space. Nursing homes differ from hospitals in many ways, including individuals' resident status and the complexity of their care needs. A large and growing body of literature related to nursing home safety exists, as evidenced by the available literature in this brief. As noted, however, the quality of that research is mixed. In a number of areas that have existing systematic reviews, enough new studies are available that new systematic reviews may be warranted. In terms of primary research, we have laid out not only the current state of the literature, but recommendations for future research. Those recommendations, available in Guiding Question 4, should be taken up by the research community and the funders should consider them as priorities for funding research.

## References

1. Shojania KG, Duncan BW, McDonald KM, et al. Making health care safer: a critical analysis of patient safety practices. *Evid Rep Technol Assess (Summ)* 2001(43):i-x, 1-668. PMID: 11510252.
2. Levinson D. Adverse Events in Skilled Nursing Facilities: National Incidence Among Medicare Beneficiaries. OEI-06-11-00370, February 2014. <http://oig.hhs.gov/oei/reports/oei-06-11-00370.pdf>.
3. Vulnerable populations: who are they? *Am J Manag Care* 2006 Nov;12(13 Suppl):S348-52. PMID: 17112321.
4. Department of Health and Human Services. Vulnerable Populations. Washington DC: Department of Health and Human Services. <http://www.hhs.gov/ohrp/policy/populations/index.html>.
5. Centers for Disease Control and Prevention. About CDC's Office of Minority Health & Health Equity. Atlanta: Centers for Disease Control and Prevention. <http://www.cdc.gov/minorityhealth/omhhe.html>
6. Rubenstein LZ, Josephson KR, Robbins AS. Falls in the nursing home. *Ann Intern Med* 1994 Sep 15;121(6):442-51. PMID: 8053619.
7. Centers for Disease Control and Prevention. Falls in Nursing Homes. Atlanta: Centers for Disease Control and Prevention, 2015. <http://www.cdc.gov/HomeandRecreationalSafety/Falls/nursing.html>
8. Center for Medicare & Medicaid Services. Nursing Home Data Compendium 2012 Edition. Centers for Medicare & Medicaid Services Baltimore MD: 2012. <https://www.cms.gov/medicare/provider-enrollment-and-certification/certificationandcompliance/nhs.html>.
9. Werner RM, Konetzka RT, Kim MM. Quality improvement under nursing home compare: the association between changes in process and outcome measures. *Med Care* 2013 Jul;51(7):582-8. PMID: 23756645.
10. Castle NG, Engberg J. The health consequences of using physical restraints in nursing homes. *Med Care* 2009 Nov;47(11):1164-73. PMID: 19786918.
11. Castle NG, Ferguson JC. What is nursing home quality and how is it measured? *Gerontologist* 2010 Aug;50(4):426-42. PMID: 20631035.
12. Chiu Y, Bero L, Hessol NA, et al. A literature review of clinical outcomes associated with antipsychotic medication use in North American nursing home residents. *Health Policy* 2015 Jun;119(6):802-13. PMID: 25791166.
13. Gruneir A, Mor V. Nursing home safety: current issues and barriers to improvement. *Annu Rev Public Health* 2008;29:369-82. PMID: 18173385.
14. Kapp MB. "At least Mom will be safe there": the role of resident safety in nursing home quality. *Qual Saf Health Care* 2003 Jun;12(3):201-4. PMID: 12792010.
15. Thomas KS, Hyer K, Castle NG, et al. Patient safety culture and the association with safe resident care in nursing homes. *Gerontologist* 2012 Dec;52(6):802-11. PMID: 22383542.
16. An HM, Baek EH, Jang S, et al. Efficacy of Lactic Acid Bacteria (LAB) supplement in management of constipation among nursing home residents. *Nutr J* 2010;9:5. PMID: 20137076.
17. National Quality Forum. Patient Safety 2015: Final Technical Report. Washington DC: National Quality Forum, February 2016. [http://www.qualityforum.org/Publications/2016/02/Patient\\_Safety\\_2015\\_Final\\_Report.aspx](http://www.qualityforum.org/Publications/2016/02/Patient_Safety_2015_Final_Report.aspx).
18. Whiting P, Savović J, Higgins J, et al. ROBIS: A new tool to assess risk of bias in systematic reviews was developed. *Jnl Clin Epi* 2016; 69, 1-39.
19. PSO Privacy Protection Center. Common Formats for Event Reporting - Nursing Home Version 0.1 Beta Vienna, Virginia. [https://www.psoppc.org/psoppc\\_web/public/pages/nursinghome](https://www.psoppc.org/psoppc_web/public/pages/nursinghome)

20. Centers for Medicare & Medicaid Services. Minimum Data Set, Version 3.0 (MDS 3.0). Baltimore MD: Centers for Medicare and Medicaid Services; 2010.  
[https://www.cms.gov/NursingHomeQuality/nits/45\\_NHQIMDS30TrainingMaterials.asp#TopOPage](https://www.cms.gov/NursingHomeQuality/nits/45_NHQIMDS30TrainingMaterials.asp#TopOPage)
21. Centers for Medicare & Medicaid Services. CMS Nursing Home Compare Quality Measures. Baltimore MD: Centers for Medicare and Medicaid Services.  
<https://www.medicare.gov/NursingHomeCompare/About/Quality-Measures-Info.html>
22. Studdert DM, Spittal MJ, Mello MM, et al. Relationship between quality of care and negligence litigation in nursing homes. *N Engl J Med* 2011 Mar 31;364(13):1243-50. PMID: 21449787.
23. Handler SM, Wright RM, Ruby CM, et al. Epidemiology of medication-related adverse events in nursing homes. *Am J Geriatr Pharmacother* 2006 Sep;4(3):264-72. PMID: 17062328.
24. Kind AJH, Smith MA. Documentation of Mandated Discharge Summary Components in Transitions from Acute to Subacute Care. In: Henriksen K, Battles JB, Keyes MA, Grady ML, editors. *Advances in Patient Safety: New Directions and Alternative Approaches (Vol. 2: Culture and Redesign)*. Rockville (MD): Agency for Healthcare Research and Quality (US); 2008 Aug.
25. Kind AJ, Thorpe CT, Sattin JA, et al. Provider characteristics, clinical-work processes and their relationship to discharge summary quality for sub-acute care patients. *J Gen Intern Med* 2012 Jan;27(1):78-84. PMID: 21901489.
26. Bartel A, Chan C, Kim S. Should hospitals keep their patients longer? The role of inpatient and outpatient care in reducing readmissions. Cambridge MA: National Bureau of Economic Research; 2014.  
<http://www.nber.org/papers/w20499>
27. Bell S, Vasilevskis E, Saraf A, et al. Geriatric syndromes in patients transferred to skilled nursing facilities. *J Am Geriatr Soc* 2016 (*In press*).
28. Burke RE, Rooks SP, Levy C, et al. Identifying Potentially Preventable Emergency Department Visits by Nursing Home Residents in the United States. *J Am Med Dir Assoc* 2015 May 1;16(5):395-9. PMID: 25703449.
29. Kramer A, Fish R, Min S. Community Discharge and Rehospitalization Outcome Measures (Fiscal Year 2011). MedPAC. Washington, DC: Providigm, LLC; 2013.  
[http://www.medpac.gov/documents/contract-or-reports/apr13\\_communitydischarge\\_contract-or.pdf](http://www.medpac.gov/documents/contract-or-reports/apr13_communitydischarge_contract-or.pdf).
30. Office of Inspector General. Skilled Nursing Facilities Often Fail to Meet Care Planning and Discharge Planning Requirements. OEI-02-09-00201. 27 Feb. 2013. Available from <http://oig.hhs.gov/oei/reports/oei-02-09-00201.asp>
31. King BJ, Gilmore-Bykovskyi AL, Roiland RA, et al. The consequences of poor communication during transitions from hospital to skilled nursing facility: a qualitative study. *J Am Geriatr Soc* 2013 Jul;61(7):1095-102. PMID: 23731003.
32. Donovan JL, Kanaan AO, Gurwitz JH, Tjia J, Cutrona SL, Garber L, Preusse P, Field TS. A Pilot Health Information Technology-Based Effort to Increase the Quality of Transitions From Skilled Nursing Facility to Home: Compelling Evidence of High Rate of Adverse Outcomes. *J Am Med Dir Assoc*. 2015 Dec 23. pii: S1525-8610(15)00708-2.
33. Hempel S, Maggard-Gibbons M, Nguyen DK, et al. Wrong-Site Surgery, Retained Surgical Items, and Surgical Fires : A Systematic Review of Surgical Never Events. *JAMA Surg* 2015 Aug;150(8):796-805. PMID: 26061125.
34. Maaskant JM, Vermeulen H, Apampa B, et al. Interventions for reducing medication errors in children in hospital. *Cochrane Database Syst Rev* 2015;3:Cd006208. PMID: 25756542.
35. Charles K, Cannon M, Hall R, et al. Can utilizing a computerized provider order entry (CPOE) system prevent hospital medical errors and adverse drug events? *Perspect Health Inf Manag* 2014;11:1b. PMID: 25593568.

36. Acheampong F, Anto BP, Koffuor GA. Medication safety strategies in hospitals--a systematic review. *Int J Risk Saf Med* 2014;26(3):117-31. PMID: 25214157.
37. Clay-Williams R, Nosrati H, Cunningham FC, et al. Do large-scale hospital- and system-wide interventions improve patient outcomes: a systematic review. *BMC Health Serv Res* 2014;14:369. PMID: 25187292.
38. Manias E, Kinney S, Cranswick N, et al. Interventions to reduce medication errors in pediatric intensive care. *Ann Pharmacother* 2014 Oct;48(10):1313-31. PMID: 25059205.
39. Rinke ML, Bundy DG, Velasquez CA, et al. Interventions to reduce pediatric medication errors: a systematic review. *Pediatrics* 2014 Aug;134(2):338-60. PMID: 25022737.
40. Keers RN, Williams SD, Cooke J, et al. Impact of interventions designed to reduce medication administration errors in hospitals: a systematic review. *Drug Saf* 2014 May;37(5):317-32. PMID: 24760475.
41. Berger Z, Flickinger TE, Pfoh E, et al. Promoting engagement by patients and families to reduce adverse events in acute care settings: a systematic review. *BMJ Qual Saf* 2014 Jul;23(7):548-55. PMID: 24336575.
42. Ojeleye O, Avery A, Gupta V, et al. The evidence for the effectiveness of safety alerts in electronic patient medication record systems at the point of pharmacy order entry: a systematic review. *BMC Med Inform Decis Mak* 2013;13:69. PMID: 23816138.
43. Shekelle PG. Nurse-patient ratios as a patient safety strategy: a systematic review. *Ann Intern Med* 2013 Mar 5;158(5 Pt 2):404-9. PMID: 23460097.
44. Weaver SJ, Lubomksi LH, Wilson RF, et al. Promoting a culture of safety as a patient safety strategy: a systematic review. *Ann Intern Med* 2013 Mar 5;158(5 Pt 2):369-74. PMID: 23460092.
45. Shekelle PG, Wachter RM, Pronovost PJ, et al. Making health care safer II: an updated critical analysis of the evidence for patient safety practices. *Evid Rep Technol Assess (Full Rep)* 2013 Mar(211):1-945. PMID: 24423049.
46. Shekelle PG, Pronovost PJ, Wachter RM, et al. Advancing the science of patient safety. *Ann Intern Med* 2011 May 17;154(10):693-6. PMID: 21576538.
47. Sullivan N, Schoelles KM. Preventing in-facility pressure ulcers as a patient safety strategy: a systematic review. *Ann Intern Med* 2013 Mar 5;158(5 Pt 2):410-6. PMID: 23460098.
48. Reston JT, Schoelles KM. In-facility delirium prevention programs as a patient safety strategy: a systematic review. *Ann Intern Med* 2013 Mar 5;158(5 Pt 2):375-80. PMID: 23460093.
49. Miake-Lye IM, Hempel S, Ganz DA, et al. Inpatient Fall Prevention Programs as a Patient Safety Strategy A Systematic Review. *Annals of Internal Medicine* 2013;158(5\_Part\_2):390-6.
50. DiBardino D, Cohen ER, Didwania A. Meta-analysis: Multidisciplinary fall prevention strategies in the acute care inpatient population. *Journal of Hospital Medicine* 2012;7(6):497-503.
51. Oliver D, Connelly JB, Victor CR, et al. Strategies to prevent falls and fractures in hospitals and care homes and effect of cognitive impairment: systematic review and meta-analyses. *Bmj* 2007 Jan 13;334(7584):82. PMID: 17158580.
52. Gschwind YJ, Kressig RW, Lacroix A, et al. A best practice fall prevention exercise program to improve balance, strength/power, and psychosocial health in older adults: study protocol for a randomized controlled trial. *BMC geriatrics* 2013;13(1):105.
53. Luk JK, Chiu PK, Chu LW. Factors affecting institutionalization in older Hong Kong Chinese patients after recovery from acute medical illnesses. *Arch Gerontol Geriatr* 2009 Sep-Oct;49(2):e110-4. PMID: 19095312.
54. Eginger KH, Yarborough LL, Inge LD, et al. Medication Errors in HIV-Infected Hospitalized Patients: A Pharmacist's Impact. *Annals of Pharmacotherapy* 2013 July 1, 2013;47(7-8):953-60.

55. Klopotoska J, Kuiper R, van Kan H, et al. Onward participation of a hospital pharmacist in a Dutch intensive care unit reduces prescribing errors and related patient harm: an intervention study. *Critical Care* 2010 2010/10/04;14(5):1-11.
56. Midlöv P, Holmdahl L, Eriksson T, et al. Medication report reduces number of medication errors when elderly patients are discharged from hospital. *Pharmacy World & Science* 2008 2008/01/01;30(1):92-8.
57. Shulman R, McKenzie CA, Landa J, et al. Pharmacist's review and outcomes: Treatment-enhancing contributions tallied, evaluated, and documented (PROTECTED-UK). *Journal of Critical Care* 2015 8//;30(4):808-13.
58. Gurwitz JH, Field TS, Harrold LR, et al. INcidence and preventability of adverse drug events among older persons in the ambulatory setting. *JAMA* 2003;289(9):1107-16.
59. Mueller SK, Sponsler K, Kripalani S, et al. Hospital-based medication reconciliation practices: A systematic review. *Archives of Internal Medicine* 2012;172(14):1057-69.
60. Leape LL, Cullen DJ, Clapp M, et al. PHarmacist participation on physician rounds and adverse drug events in the intensive care unit. *JAMA* 1999;282(3):267-70.
61. Gazarian M, Graudins LV. Long-term Reduction in Adverse Drug Events: An Evidence-Based Improvement Model. *Pediatrics* 2012 May 1, 2012;129(5):e1334-e42.
62. Blank FSJ, Tobin J, Macomber S, et al. A "Back to Basics" Approach to Reduce ED Medication Errors. *Journal of Emergency Nursing* 2011 3//;37(2):141-7.
63. Pham CB, Dickman RL. Minimizing adverse drug events in older patients. *Am Fam Physician* 2007;76(12):1837-44.
64. Spinewine A, Claeys C, Foulon V, et al. Approaches for improving continuity of care in medication management: a systematic review. *Int J Qual Health Care*. 2013 Sep;25(4):403-17. PMID: 23639854
65. Szczepura A, Wild D, Nelson S. Medication administration errors for older people in long-term residential care. *BMC Geriatr* 2011;11:82. PMID: 22151472.
66. Scott-Cawiezell J, Madsen RW, Pepper GA, et al. Medication safety teams' guided implementation of electronic medication administration records in five nursing homes. *Jt Comm J Qual Patient Saf* 2009 Jan;35(1):29-35. PMID: 19213298.
67. Qian S, Yu P, Hailey DM. The impact of electronic medication administration records in a residential aged care home. *Int J Med Inform* 2015 Nov;84(11):966-73. PMID: 26358850.
68. Wild D, Szczepura A, Nelson S. New barcode checks help reduce drug round errors in care homes. *Nurs Manag (Harrow)* 2011 Sep;18(5):26-30. PMID: 21977895.
69. Bates D, Boyle D, Vliet MV, et al. Relationship between medication errors and adverse drug events. *Journal of General Internal Medicine* 1995 1995/04/01;10(4):199-205.
70. Classen DC, Metzger J. Improving medication safety: the measurement conundrum and where to start. *Int J Qual Health Care*. 2003 Dec;15 Suppl 1:i41-7. PMID:14660522
71. Conroy S, Sweis D, Planner C, et al. Interventions to Reduce Dosing Errors in Children. *Drug Safety* 2007 2007/12/01;30(12):1111-25.
72. Kaushal R, Shojania KG, Bates DW. Effects of computerized physician order entry and clinical decision support systems on medication safety: A systematic review. *Archives of Internal Medicine* 2003;163(12):1409-16.
73. Hug B, Witkowski D, Sox C, et al. Adverse Drug Event Rates in Six Community Hospitals and the Potential Impact of Computerized Physician Order Entry for Prevention. *Journal of General Internal Medicine* 2010 2010/01/01;25(1):31-8.
74. Merandi J, Morvay S, Lewe D, et al. Improvement of medication event interventions through use of an electronic database. *American Journal of Health-System Pharmacy* 2013 October 1, 2013;70(19):1708-14.
75. Natali BJ, Varkey AC, Garey KW, et al. Impact of a pharmacotherapy alerting system on medication errors. *American Journal of Health-System Pharmacy*. January 1, 2013;70(1):48-52.

76. Patterson Susan M, Cadogan Cathal A, Kerse N, et al. Interventions to improve the appropriate use of polypharmacy for older people. *Cochrane Database of Systematic Reviews* 2014(10)PMID: CD008165.
77. Whitney J, Phillips L, Aslam R, et al. Guidelines for the treatment of pressure ulcers. *Wound Repair and Regeneration* 2006;14(6):663-79.
78. US Government Accountability Office. Nursing Homes : Federal Monitoring Surveys Demonstrate Continued Understatement of Serious Care Problems and CMS Oversight Weakness. GAO-08-517, May 2008. <http://www.gao.gov/new.items/d08517.pdf>.
79. Health Quality Ontario. Management of Chronic Pressure Ulcers: An Evidence-Based Analysis. Ontario Health Technology Assessment Series 2009 07/01;9(3):1-203. PMID: 23074533
80. Pressure ulcer prevention: an evidence-based analysis. *Ont Health Technol Assess Ser* 2009;9(2):1-104. PMID: 23074524.
81. Smith ME, Totten A, Hickam DH, et al. Pressure ulcer treatment strategies: a systematic comparative effectiveness review. *Ann Intern Med* 2013 Jul 2;159(1):39-50. PMID: 23817703.
82. Umscheid C, Mitchell M, Doshi J, et al. Estimating the Proportion of Healthcare-Associated Infections That Are Reasonably Preventable and the Related Mortality and Costs. *Infection Control and Hospital Epidemiology* 2011;32(2):101-14.
83. Gould CV, Umscheid CA, Agarwal RK, et al. Guideline for prevention of catheter-associated urinary tract infections 2009. *Infection Control* 2010;31(04):319-20.
84. Lo E, Nicolle L, Classen D, et al. Strategies to Prevent Catheter-Associated Urinary Tract Infections in Acute Care Hospitals. *Infection Control & Hospital Epidemiology* 2008;29(SupplementS1):S41-S50.
85. Lo E, Nicolle LE, Coffin SE, et al. Strategies to Prevent Catheter-Associated Urinary Tract Infections in Acute Care Hospitals: 2014 Update. *Infection Control & Hospital Epidemiology* 2014;35(05):464-79.
86. Meddings J, Rogers MAM, Krein SL, et al. Reducing unnecessary urinary catheter use and other strategies to prevent catheter-associated urinary tract infection: an integrative review. *BMJ Quality & Safety* 2014 09/27 PMID: PMC3960353.
87. Meddings J, Rogers MAM, Macy M, et al. Systematic Review and Meta-Analysis: Reminder Systems to Reduce Catheter-Associated Urinary Tract Infections and Urinary Catheter Use in Hospitalized Patients. *Clinical Infectious Diseases* 2010 September 1, 2010;51(5):550-60.
88. Safdar N, Abad C. Educational interventions for prevention of healthcare-associated infection: A systematic review. *Critical Care Medicine* 2008;36(3):933-40.
89. Yokoe DS, Anderson DJ, Berenholtz SM, et al. A Compendium of Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals: 2014 Updates. *American Journal of Infection Control* 2014 8//;42(8):820-8.
90. Rothenberg M, Marbella A, Pines E, et al. Prevention of Healthcare-Associated Infections. Closing the Quality Gap: Revisiting the State of the Science. *Evidence Report/Technology Assessment* 2012(208).
91. Ranji SR, Shetty K, Posley KA, et al. Prevention of Healthcare-Associated Infections. Prepared by Stanford University-UCSF Evidence-based Practice Center under Contract No. 290-02-0017). AHRQ Publication No. 04(07)-0051-6. Rockville, MD: AHRQ; January 2007. <http://www.ncbi.nlm.nih.gov/books/NBK43982/pdf/TOC.pdf>.
92. Zhang YZ, Singh S. Antibiotic stewardship programmes in intensive care units: Why, how, and where are they leading us. *World J Crit Care Med* 2015 Feb 4;4(1):13-28. PMID: 25685719.
93. Davey P, Brown E, Charani E, et al. Interventions to improve antibiotic prescribing practices for hospital inpatients. *Cochrane Database Syst Rev* 2013;4:Cd003543. PMID: 23633313.

94. Stout A, Ritchie K, Macpherson K. Clinical effectiveness of alcohol-based products in increasing hand hygiene compliance and reducing infection rates: a systematic review. *J Hosp Infect* 2007 Aug;66(4):308-12. PMID: 17655977.
95. Larmer PJ, Tillson TM, Scown FM, et al. Evidence-based recommendations for hand hygiene for health care workers in New Zealand. *N Z Med J* 2008 Apr 18;121(1272):69-81. PMID: 18425156.
96. Pincock T, Bernstein P, Warthman S, et al. Bundling hand hygiene interventions and measurement to decrease health care-associated infections. *Am J Infect Control* 2012 May;40(4 Suppl 1):S18-27. PMID: 22546269.
97. Cherry MG, Brown JM, Bethell GS, et al. Features of educational interventions that lead to compliance with hand hygiene in healthcare professionals within a hospital care setting. A BEME systematic review: BEME Guide No. 22. *Med Teach* 2012;34(6):e406-20. PMID: 22578050.
98. Gould DJ, Moralejo D, Drey N, et al. Interventions to improve hand hygiene compliance in patient care. *Cochrane Database of Systematic Reviews* 2010(9).
99. Dancer SJ. The role of environmental cleaning in the control of hospital-acquired infection. *J Hosp Infect* 2009 Dec;73(4):378-85. PMID: 19726106.
100. Herzig CT, Stone PW, Castle N, et al. Infection Prevention and Control Programs in US Nursing Homes: Results of a National Survey. *J Am Med Dir Assoc* 2016 Jan 1;17(1):85-8. PMID: 26712489.
101. Cohen CC, Engberg J, Herzig CT, et al. Nursing Homes in States with Infection Control Training or Infection Reporting Have Reduced Infection Control Deficiency Citations. *Infect Control Hosp Epidemiol* 2015 Dec;36(12):1475-6. PMID: 26350287.
102. Padula WV, Makic MB, Wald HL, et al. Hospital-Acquired Pressure Ulcers at Academic Medical Centers in the United States, 2008-2012: Tracking Changes Since the CMS Nonpayment Policy. *Jt Comm J Qual Patient Saf* 2015 Jun;41(6):257-63. PMID: 25990891.
103. Centers for Disease Control and Prevention. Healthcare-associated Infections (HAI) Progress Report. Atlanta, GA: Centers for Disease Control and Prevention. <http://www.cdc.gov/hai/progress-report/index.html>.
104. Waters TM, Daniels MJ, Bazzoli GJ, et al. Effect of Medicare's nonpayment for Hospital-Acquired Conditions: lessons for future policy. *JAMA Intern Med* 2015 Mar;175(3):347-54. PMID: 25559166.
105. Peasah SK, McKay NL, Harman JS, et al. Medicare non-payment of hospital-acquired infections: infection rates three years post implementation. *Medicare Medicaid Res Rev* 2013;3(3) PMID: 24753974.
106. Schuller K, Probst J, Hardin J, et al. Initial impact of Medicare's nonpayment policy on catheter-associated urinary tract infections by hospital characteristics. *Health Policy* 2014 Apr;115(2-3):165-71. PMID: 24361201.
107. Lee GM, Hartmann CW, Graham D, et al. Perceived impact of the Medicare policy to adjust payment for health care-associated infections. *Am J Infect Control* 2012 May;40(4):314-9. PMID: 22541855.
108. Vlaeyen E, Coussement J, Leysens G, et al. Characteristics and effectiveness of fall prevention programs in nursing homes: a systematic review and meta-analysis of randomized controlled trials. *J Am Geriatr Soc* 2015 Feb;63(2):211-21. PMID: 25641225.
109. Silva RB, Eslick GD, Duque G. Exercise for falls and fracture prevention in long term care facilities: a systematic review and meta-analysis. *J Am Med Dir Assoc* 2013 Sep;14(9):685-9.e2. PMID: 23860265.
110. Chua GT, Wong RY. Association Between Vitamin D Dosing Regimen and Fall Prevention in Long-term Care Seniors. *Can Geriatr J* 2011 Dec;14(4):93-9. PMID: 23251320.
111. Cameron ID, Gillespie LD, Robertson MC, et al. Interventions for preventing falls in older people in care facilities and hospitals. *Cochrane Database Syst Rev* 2012;12: Cd005465. PMID: 23235623.

112. Balzer K, Bremer M, Schramm S, et al. Falls prevention for the elderly. *GMS Health Technol Assess* 2012;8:Doc01. PMID: 22536299.
113. Anderson O, Boshier PR, Hanna GB. Interventions designed to prevent healthcare bed-related injuries in patients. *Cochrane Database Syst Rev* 2011(11):Cd008931. PMID: 22071860.
114. Cusimano MD, Kwok J, Spadafora K. Effectiveness of multifaceted fall-prevention programs for the elderly in residential care. *Inj Prev* 2008 Apr;14(2):113-22. PMID: 18388232.
115. Sawka AM, Boulos P, Beattie K, et al. Hip protectors decrease hip fracture risk in elderly nursing home residents: a Bayesian meta-analysis. *Journal of clinical epidemiology* 2007 2007/04/23;60(4):336-44.
116. Sawka AM, Boulos P, Beattie K, et al. Do hip protectors decrease the risk of hip fracture in institutional and community-dwelling elderly? A systematic review and meta-analysis of randomized controlled trials. *Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA* 2005 2005/12/01;16(12):1461-74.
117. Sawka AM, Ismaila N, Cranney A, et al. A scoping review of strategies for the prevention of hip fracture in elderly nursing home residents. *PloS one* 2010 2010/03/03;5(3):e9515.
118. Santesso N, Carrasco-Labra A, Brignardello-Petersen R. Hip protectors for preventing hip fractures in older people. *Cochrane Database of Systematic Reviews* 2014;3:CD001255. PMID: 24687239.
119. Howe Tracey E, Rochester L, Neil F, et al. Exercise for improving balance in older people. *Cochrane Database of Systematic Reviews* 2011(11).
120. Choi M, Hector M. Effectiveness of intervention programs in preventing falls: a systematic review of recent 10 years and meta-analysis. *Journal of the American Medical Directors Association* 2012;13(2):188.e13-21. PMID: 21680249.
121. Gillespie BM, Chaboyer WP, McInnes E, et al. Repositioning for pressure ulcer prevention in adults. *Cochrane Database Syst Rev* 2014;4:Cd009958. PMID: 24700291.
122. Niederhauser A, VanDeusen Lukas C, Parker V, et al. Comprehensive programs for preventing pressure ulcers: a review of the literature. *Adv Skin Wound Care* 2012 Apr;25(4):167-88; quiz 89-90. PMID: 22441049.
123. Cullum N, Petherick E. Pressure ulcers. *BMJ Clin Evid* 2008;2008PMID: 19450317.
124. Saha S, Smith MEB, Totten A, et al. Pressure Ulcer Treatment Strategies: Comparative Effectiveness. 2013 May. PMID: 23785727.
125. Chou R, Dana T, Bougatsos C, et al. Pressure Ulcer Risk Assessment and Prevention: Comparative Effectiveness. 2013 May PMID: 23762918.
126. Reddy M, Gill SS, Kalkar SR, et al. Treatment of pressure ulcers: a systematic review. *JAMA* 2008 Dec 10;300(22):2647-62. PMID: 19066385.
127. Hughes C, Tunney M, Bradley Marie C. Infection control strategies for preventing the transmission of meticillin-resistant *Staphylococcus aureus* (MRSA) in nursing homes for older people. *Cochrane Database of Systematic Reviews* 2013(11) PMID: CD006354.
128. Sjögren P, Nilsson E, Forsell M, et al. A systematic review of the preventive effect of oral hygiene on pneumonia and respiratory tract infection in elderly people in hospitals and nursing homes: effect estimates and methodological quality of randomized controlled trials. *Journal of the American Geriatrics Society* 2008 2008/11/15;56(11):2124-30.
129. Uchida M, Pogorzelska-Maziarz M, Smith PW, et al. Infection prevention in long-term care: a systematic review of randomized and nonrandomized trials. *Journal of the American Geriatrics Society* 2013;61(4):602-14. PMID: 23581914.
130. Tjia J, Velten SJ, Parsons C, et al. Studies to reduce unnecessary medication use in frail older adults: a systematic review. *Drugs Aging* 2013 May;30(5):285-307. PMID: 23475597.

131. Alldred DP, Raynor DK, Hughes C, et al. Interventions to optimise prescribing for older people in care homes. *Cochrane Database Syst Rev* 2013;2:CD009095. PMID: 23450597.
132. Forsetlund L, Eike MC, Gjerberg E, et al. Effect of interventions to reduce potentially inappropriate use of drugs in nursing homes: a systematic review of randomised controlled trials. *BMC Geriatr* 2011;11:16. PMID: 21496345.
133. Loganathan M, Singh S, Franklin BD, et al. Interventions to optimise prescribing in care homes: systematic review. *Age Ageing* 2011 Mar;40(2):150-62. PMID: 21262782.
134. Marasinghe KM. Computerised clinical decision support systems to improve medication safety in long-term care homes: a systematic review. *BMJ Open* 2015;5(5):e006539. PMID: 25967986.
135. Fleming A, Browne J, Byrne S. The effect of interventions to reduce potentially inappropriate antibiotic prescribing in long-term care facilities: a systematic review of randomised controlled trials. *Drugs Aging* 2013 Jun;30(6):401-8. PMID: 23444263.
136. LaMantia MA, Scheunemann LP, Viera AJ, et al. Interventions to improve transitional care between nursing homes and hospitals: a systematic review. *J Am Geriatr Soc* 2010 Apr;58(4):777-82. PMID: 20398162.
137. Wallerstedt SM, Kindblom JM, Nylén K, et al. Medication reviews for nursing home residents to reduce mortality and hospitalization: systematic review and meta-analysis. *Br J Clin Pharmacol* 2014 2014/02/18;78(3):488-97.
138. Clegg A, Siddiqi N, Heaven A, et al. Interventions for preventing delirium in older people in institutional long-term care. *Cochrane Database Syst Rev* 2014;1:CD009537. PMID: 24488526.
139. Simmons SF, Schnelle JF. Individualized feeding assistance care for nursing home residents: staffing requirements to implement two interventions. *J Gerontol A Biol Sci Med Sci* 2004 Sep;59(9):M966-73. PMID: 15472163.
140. Simmons SF, Osterweil D, Schnelle JF. Improving food intake in nursing home residents with feeding assistance: a staffing analysis. *J Gerontol A Biol Sci Med Sci* 2001 Dec;56(12):M790-4. PMID: 11723156.
141. Schnelle JF, Alessi CA, Simmons SF, et al. Translating clinical research into practice: a randomized controlled trial of exercise and incontinence care with nursing home residents. *J Am Geriatr Soc* 2002 Sep;50(9):1476-83. PMID: 12383143.
142. Simmons SF, Keeler E, Zhuo X, et al. Prevention of unintentional weight loss in nursing home residents: a controlled trial of feeding assistance. *J Am Geriatr Soc* 2008 Aug;56(8):1466-73. PMID: 18637983.
143. Bunn D, Jimoh F, Wilsher SH, et al. Increasing fluid intake and reducing dehydration risk in older people living in long-term care: a systematic review. *J Am Med Dir Assoc* 2015 Feb;16(2):101-13. PMID: 25499399.
144. Sollins HL. Office of inspector general report finds skilled nursing facilities "often" fail to meet care planning and discharge planning requirements. *Geriatr Nurs* 2013 May-Jun;34(3):233-4. PMID: 23639913.
145. Reddy M, Gill SS, Rochon PA. Preventing pressure ulcers: a systematic review. *JAMA* 2006 Aug 23;296(8):974-84. PMID: 16926357.
146. Kane R, et al. Non-pharmacologic Interventions for Agitation and Aggression in Dementia (in press). 2016.
147. Simmons SF, Babineau S, Garcia E, et al. Quality assessment in nursing homes by systematic direct observation: feeding assistance. *J Gerontol A Biol Sci Med Sci* 2002 Oct;57(10):M665-71. PMID: 12242322.
148. Schnelle JF, Bates-Jensen BM, Chu L, et al. Accuracy of nursing home medical record information about care-process delivery: implications for staff management and improvement. *J Am Geriatr Soc* 2004 Aug;52(8):1378-83. PMID: 15271130.
149. Thomas K. Medicare star ratings allow nursing homes to game the system. *New York Times*. August 24, 2014.

150. Munley E. CMS will expand MDS 3.0 Focused Surveys in 2015. *Leading Age*, 2014. [http://www.leadingage.org/CMS\\_Will\\_Expand\\_MDS\\_3\\_0\\_Focused\\_Surveys\\_in\\_2015.aspx](http://www.leadingage.org/CMS_Will_Expand_MDS_3_0_Focused_Surveys_in_2015.aspx).
151. Centers for Medicare & Medicaid Services. CMS Announces Two Medicare Quality Improvement Initiatives. Centers for Medicare & Medicaid Services Baltimore MD. October 6, 2014. <https://www.cms.gov/Newsroom/MediaReleaseDatabase/Press-releases/2014-Press-releases-items/2014-10-06.html>.
152. Bostick JE, Rantz MJ, Flesner MK, et al. Systematic review of studies of staffing and quality in nursing homes. *J Am Med Dir Assoc* 2006 Jul;7(6):366-76. PMID: 16843237.
153. Castle NG. Nursing Home Caregiver Staffing Levels and Quality of Care: A Literature Review. *Journal of Applied Gerontology* 2008 August 1, 2008;27(4):375-405.
154. Spilsbury K, Hewitt C, Stirk L, et al. The relationship between nurse staffing and quality of care in nursing homes: a systematic review. *Int J Nurs Stud* 2011 Jun;48(6):732-50. PMID: 21397229.
155. Backhaus R, Verbeek H, van Rossum E, et al. Nurse staffing impact on quality of care in nursing homes: a systematic review of longitudinal studies. *J Am Med Dir Assoc* 2014 Jun;15(6):383-93. PMID: 24529872.
156. Dellefield ME, Castle NG, McGilton KS, et al. The Relationship Between Registered Nurses and Nursing Home Quality: An Integrative Review (2008-2014). *Nurs Econ* 2015 Mar-Apr;33(2):95-108, 16. PMID: 26281280.
157. Breunig I WA, Ribar D. . Developing a Community Discharge Measure for Medicare Nursing Home Residents. *Academy Health*; 2015.
158. Centers for Medicare & Medicaid Services. Nursing Home Compare Five-Star Quality Rating System: Year Five Report. 2014. <https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/CertificationandCompliance/Downloads/NHC-Year-Five-Report.pdf>
159. Levinson D. Medicare Nursing Home Resident Hospitalization Rates Merit Additional Monitoring. OEI-06-11-00040. Centers for Medicare & Medicaid Services Baltimore MD, November 2013. <http://oig.hhs.gov/oei/reports/oei-06-11-00040.pdf>.
160. Centers for Medicare & Medicaid Services. Medicare nursing home compare Technical Users Guide on Staffing. Centers for Medicare & Medicaid Services Baltimore MD. <https://www.medicare.gov/NursingHomeCompare/About/Staffing-Info.html>
161. Dabney BW, Kalisch BJ. Nurse Staffing Levels and Patient-Reported Missed Nursing Care. *J Nurs Care Qual* 2015 Oct-Dec;30(4):306-12. PMID: 25929314.
162. Kalisch BJ. Missed nursing care: a qualitative study. *J Nurs Care Qual* 2006 Oct-Dec;21(4):306-13; quiz 14-5. PMID: 16985399.
163. Simmons SF, Durkin DW, Rahman AN, et al. Resident characteristics related to the lack of morning care provision in long-term care. *Gerontologist* 2013 Feb;53(1):151-61. PMID: 22565494.
164. Schnelle JF, Osterweil D, Simmons SF. Improving the quality of nursing home care and medical-record accuracy with direct observational technologies. *Gerontologist* 2005 Oct;45(5):576-82. PMID: 16199391.
165. Simmons SF, Schnelle JF. A continuous quality improvement pilot study: impact on nutritional care quality. *J Am Med Dir Assoc* 2006 Oct;7(8):480-5. PMID: 17027624.
166. Schnelle JF, Bertrand R, Hurd D, et al. Resident choice and the survey process: the need for standardized observation and transparency. *Gerontologist* 2009 Aug;49(4):517-24. PMID: 19435928.
167. Schnelle JF, Bertrand R, Hurd D, et al. The importance of standardized observations to evaluate nutritional care quality in the survey process. *J Am Med Dir Assoc* 2009 Oct;10(8):568-74. PMID: 19808155.

168. Simmons SF, Durkin DW, Shotwell MS, et al. A staff training and management intervention in VA long-term care: impact on feeding assistance care quality. *Transl Behav Med* 2013 Jun;3(2):189-99. PMID: 24073169.
169. Goldenhar LM, Brady PW, Sutcliffe KM, et al. Huddling for high reliability and situation awareness. *BMJ Qual Saf* 2013 Nov;22(11):899-906. PMID: 23744537.
170. Wilson KA, Burke CS, Priest HA, et al. Promoting health care safety through training high reliability teams. *Qual Saf Health Care* 2005 Aug;14(4):303-9. PMID: 16076797.
171. Madsen P, Desai, V., Roberts, K., Wong D. Mitigating hazards through continuing design: The birth and evolution of a pediatric intensive care unit. *Organization Science* 2006;17(2):239-48.
172. Simmons SF, Lim B, Schnelle JF. Accuracy of minimum data set in identifying residents at risk for undernutrition: oral intake and food complaints. *J Am Med Dir Assoc* 2002 May-Jun;3(3):140-5. PMID: 12807657.
173. Simmons SF, Peterson EN, You C. The accuracy of monthly weight assessments in nursing homes: implications for the identification of weight loss. *J Nutr Health Aging* 2009 Mar;13(3):284-8. PMID: 19262969.
174. Cadogan MP, Schnelle JF, Yamamoto-Mitani N, et al. A minimum data set prevalence of pain quality indicator: is it accurate and does it reflect differences in care processes? *J Gerontol A Biol Sci Med Sci* 2004 Mar;59(3):281-5. PMID: 15031314.
175. Simmons SF, Cadogan MP, Cabrera GR, et al. The minimum data set depression quality indicator: does it reflect differences in care processes? *Gerontologist* 2004 Aug;44(4):554-64. PMID: 15331813.
176. Lund BC, Schroeder MC, Middendorff G, et al. Effect of hospitalization on inappropriate prescribing in elderly Medicare beneficiaries. *J Am Geriatr Soc* 2015 Apr;63(4):699-707. PMID: 25855518.
177. Oyarzun-Gonzalez XA, Taylor KC, Myers SR, et al. Cognitive decline and polypharmacy in an elderly population. *J Am Geriatr Soc* 2015 Feb;63(2):397-9. PMID: 25688619.
178. Hein C, Forgues A, Piau A, et al. Impact of polypharmacy on occurrence of delirium in elderly emergency patients. *J Am Med Dir Assoc* 2014;15(11):850 e11-5. PMID: 25405712.
179. Kashyap M, Tu le M, Tannenbaum C. Prevalence of commonly prescribed medications potentially contributing to urinary symptoms in a cohort of older patients seeking care for incontinence. *BMC Geriatr* 2013;13:57. PMID: 23758756.
180. Jyrkka J, Enlund H, Lavikainen P, et al. Association of polypharmacy with nutritional status, functional ability and cognitive capacity over a three-year period in an elderly population. *Pharmacoepidemiol Drug Saf* 2011 May;20(5):514-22. PMID: 21308855.
181. MetLife Market Institute. *MetLife Market Survey of Nursing Homes, Assisted Living, Adult Day Services and Home Care Costs*. Westport, CT: 2011. <https://www.metlife.com/assets/cao/mmi/publications/studies/2011/mmi-market-survey-nursing-home-assisted-living-adult-day-services-costs.pdf>
182. National Center for Health Statistics. *Residents Living in Residential Care Facilities: United States, 2010* National Center for Health Statistics. 2012. <http://www.cdc.gov/nchs/data/databriefs/db91.htm>
183. Sloane PD, Zimmerman S, Gruber-Baldini AL, et al. Health and functional outcomes and health care utilization of persons with dementia in residential care and assisted living facilities: comparison with nursing homes. *Gerontologist* 2005 Oct;45 Spec No 1(1):124-32. PMID: 16230759.
184. Zimmerman S, Sloane PD, Williams CS, et al. Dementia care and quality of life in assisted living and nursing homes. *Gerontologist* 2005 Oct;45 Spec No 1(1):133-46. PMID: 16230760.
185. Frytak JR, Kane RA, Finch MD, et al. Outcome trajectories for assisted living and nursing facility residents in Oregon. *Health Serv Res* 2001 Apr;36(1 Pt 1):91-111. PMID: 11324746.

# Appendix A. Summary of Key Informant Calls

## Technical Brief Key Informant Discussion Call #1 Vanderbilt Evidence-based Practice Center Technical Brief: Critical Analysis of the Evidence for Patient Safety Practices in Nursing Home Settings

### Patient Safety Technical Brief Discussion

\*Participant names have been redacted from these summaries

#### Introduction to Guiding Questions (GQs)

**EPC** began the discussion by introducing the first guiding question (GQ) and soliciting for general feedback from the key informants (KIs).

**EPC** mentioned that the GQs help guide the discussion and would like the KI's perspective on patient safety issues in the nursing home (NH) setting.

#### Definition of patient safety discussion

**EPC** inquired how broadly the patient safety construct should be defined. AHRQ defines patient safety broadly and asked the KIs to think about all the potential safety issues in NH settings across the CMS derived quality indicators: staffing, care omission, elder abuse and neglect. She solicited insight from the KIs on what the most silent issues are for NH patient safety.

**KI** responded that some view patient safety very narrowly and need actual, measurable harm demonstrated rather than missed opportunities and wanted to be really careful about how patient safety is defined in the NH setting and **KI** agreed.

#### Quality of life (QOL) and person centered care discussion

**KI** advised the group to not let patient safety issues overwhelm quality of life (QOL) issues and would like to see important QOL issues included under the patient safety definition.

**EPC** inquired if the KIs are speaking to issues like omitted care or missed care that may not result in an adverse event, but effects QOL, dignity, etc. and **KIs** agreed that this is extremely important.

**KI** stated that there are some person-centered measures that capture QOL. Edvardsson, from Norway has done work on developing patient-centered measures, looking at the tradeoff between patient-centered care and safety or adverse events.

**EPC** mentioned that Rosalie Kane has also written about person-centered care.

**EPC** stated that one part of the technical brief is to summarize the gaps and point out areas for future research. There is a paucity of quality of life interventions, or person centered interventions so this would be a gap in the literature to highlight for future research.

**KI** added that NH resident's subjective experience should be counted here. Research in the NH setting needs to accommodate the experience of the residents in long-term care settings rather than defining quality of life formulaically and the **EPC Team** agreed.

#### Staff educational training/changing staff behavior discussion

**KI** added educational programs in long-term care settings as a potential patient safety issue and noted that there is intervention research on educational programs and sustainability of those programs over time and will email some references to the team.

**EPC** inquired if **KI** meant there needs to be a different approach to staff training and education that is much more evidence-based in the education or training literature and she agreed.

**EPC** asked the KIs what they see as some of the significant challenges in changing staff behavior?

**KI** noted that NH leadership (e.g., director of nursing) is generally inadequately trained in management and is a common problem across NHs. She also noted that nurses who work in NH units also lack management skills (e.g., managing the unit or managing people). There's a paucity of staff education in managing people.

**KIs** also noted that frontline staff are generally poorly trained, poorly resourced, and left out of decision making. Another key issue is the trend to hire more LPNs, fewer RNS and even fewer BSNs. If you look at the hospital literature, it suggests that there is a direct correlation to increased mortality, morbidity and costs. LPNs are not trained to assess and, by law in most states, shouldn't be assessing.

**KIs** also pointed out that the real patient safety issues are with staff skill mix (e.g., staff skills matched with the skills that are needed in different NH settings with different resident mixes).

**KI** stated that Nurse Aides have very little training (state's minimum number of hours, annual infection control, fire safety, compliance training).

### **Overall staff mix/skill levels**

**KI** acknowledged that NH upper level management doesn't differentiate between CNAs and RNs due to the lack of understanding of differences in skill training and scope of practice between the CNAs and RNs or BSNs.

**EPC** agreed and added that the scope of practice in NHs is changing. More and more tasks that used to be done by licensed nurses that are now done by nurse aides.

**KI** would like to see an intervention looking at staff mix in the NH setting. Linda Atkins conducted a staff mix study in hospital settings and those credentials (RN vs. LPN/CAN) actually made a big difference in patient outcomes.

### **Staff turnover/staff to resident ratio issues**

**KI** brought up the issue of inadequate onboarding of staff with minimal orientation.

**KI** suggested that one possible outcome measure would be employee turnover.

**EPC** noted that patient to nurse aide ratio is between 10-15 residents to 1 nurse aid and suggested that increasing staffing numbers, education, training, and management of residents are key issues and the **KIs** agreed.

### **Systems level issues**

**KI** suggested adding systems level issues as a patient safety issue.

**EPC Team** agreed that when identifying intervention studies in this care setting they are often focused on an isolated aspect of care with one or two key outcomes and that a multifaceted, systems-level intervention is warranted.

**EPC** agreed that a multicomponent intervention would need to go into a NH and change everything at the same time and implement it.

**KI** reiterated the key issues are organizational change, including resident case mix changes and staff training.

**KI** mentioned that the Robert Johnson Foundation funded 5 research groups to conduct a series of nested studies on the Greenhouse program that asked similar questions from different vantage points including large data sets, interviews, MDS and field work. She noted that an article was published in HSR last year on the mixed methods process and challenges, and a special issue that the WJ purchased in Health Services Research that is coming out in early 2016.

### **White House Conference on Aging Brief**

**The EPC Team** inquired if the **KIs** were familiar with the White House Conference on Aging brief about the changes to improve care and safety in NHs by HHS secretary Sylvia Burwell,

specifically the change to ensure that NHs take into consideration the health of residents when making decisions on the kinds of levels of staffing.

**KIs** mentioned that the federal register report on staffing in NHs actually alluded to that as well.

### **Patient Safety as a broader issue**

**EPC** inquired if the existing measures (e.g., falls, pressures ulcers, weight loss) are not adequate measures of quality or safety in the NH.

**KI** agreed that the existing patient safety measures should take into consideration quality of life issues (e.g., restraining a resident so that he doesn't fall and limiting his quality of life/dignity versus letting the resident have the freedom to move around and potentially fall but have quality of life).

### **Hospital care of elderly**

**KI** stated that elderly patient safety is worse in the hospital (e.g., delirium, falls, pressure ulcers), due to hospital staff treating the condition without regard to the age of the patient.

**EPC** agreed that the hospital treat patients based on the diagnostic codes.

**KI** added that nurses and physicians tend to see the patient when they're first admitted as their baseline status instead of how they were functioning two weeks prior to the admission. She also added that most of the infections come from hospitals which are a very different situation than in a nursing home. There's an infectious disease specialist who is looking at how to keep other residents safe while not completely isolating a resident.

### **Admissions/Transfers to NHs**

**KI** suggested that we look at admissions. Admissions to nursing homes are a huge issue. The transfer of care to NH setting is typically lacking in the information you get, who gets it, how that leads to a care plan, and if there was family involvement in the care planning process.

### **Resident mix changing over time (patient acuity level is higher)**

**KIs** brought up the issue of changing resident mix and the increasing proportion of short and long stay residents. One of the challenges NHs face is how to effectively implement interventions and proper staff training/levels if you have a resident mix with different care needs. The issue of changing resident mix extends to new types of resident populations (e.g., ex-prisoners and parolees, psych patients, AIDS and HIV patients, more trauma patients) leading to higher levels of patient acuity.

**The EPC Team** agreed and added that this issue underscores the need for higher skilled workforce in NHs and the need for higher staff to resident ratios.

**KI** added that even among short stay residents, the nature of the population is changing. Residents with hip or knees conditions are being replaced by more medically complex care residents even in the short stay NH settings.

## **Technical Brief Key Informant Discussion Call #2**

### **Vanderbilt Evidence-based Practice Center Technical Brief: Critical Analysis of the Evidence for Patient Safety Practices in Nursing Home Settings**

#### **Patient Safety Technical Brief Discussion**

##### **Introduction to Guiding Questions (GQs)**

**EPC** introduced the GQs to the Key Informants (KIs) and solicited their input based on their experiences and perspectives in the field.

##### **Scope/definitions of GQs**

**KI** pointed out that the term *patient* should be replaced with *resident* since that is the accepted term in the nursing home (NH) and assisted living communities. She also brought to the team's attention that the GQs were medically oriented in scope rather than including person-centered quality of life issues.

**KI** also inquired about dementia in the GQs and stated that roughly half of NH residents have some form of cognitive impairment, many of them with dementia and the comparative figure in assisted living is 40%. She also added that we should be inclusive of the broader category of *cognitive impairment*, not solely *dementia* residents in NHs and assisted living facilities.

**EPC** solicited input from the KIs on how to handle the definition of patient safety for issues that are not measured by adverse events (e.g., quality of life issues for dementia care).

**KI** inquired if the EPC team was aware of the dementia report that the National Quality Forum did recently? The report provides a conceptual framework for measurements and a literature review on quality measures and the measures that they went through cover the assisted living and NH environments.

##### **Gaps in the literature discussion**

**EPC** asked the KIs for input on other salient issues, gaps in the literature or issues for future research that are important to capture in this report.

**The KIs** suggested that outcomes related to dementia: falls, wandering, use of antipsychotics, and inappropriate medication use that affect cognition should be included.

##### **Patient Safety issues in Assisted Living facilities discussion**

**The EPC team** inquired if safety problems for dementia residents are worse in assisted living than they are in NHs.

**KI** was unsure, but reiterated that NHs are far more sophisticated in tracking patient safety issues (e.g., falls) than assisted living facilities.

**KI** added that mild cognitive impairment is not the same as early stage dementia and there are many different types of dementia, many of which are diagnosed in error.

**EPC** agreed that assisted living facilities have a lot of cognitively impaired people and creates additional safety issues.

**EPC** inquired if there were other safety concerns dementia residents in either assisted living or nursing homes that the EPC team needed to include in the report

**KI** added swallowing disorders as a significant patient safety issue for Parkinson's and dementia residents.

##### **Dementia**

**EPC** inquired if the issue of medically focused definitions of safety from AHRQ needs to be expanded to include quality of life issues.

**KI** agreed that resident safety isn't about medical approaches all of the time. For example, a person with dementia who wanders (as many as 60-80 percent of people with dementia will wander) isn't particularly a medical issue, but it's a safety issue. Protocols need to be implemented to address unaccompanied wandering off property or into other resident's room. **EPC** suggested starting the discussion in the area of safety issues for dementia care that are medically related or a central concern for that group of residents in both NHs and assisted living settings.

### **Delirium**

**KI** added delirium as an important patient safety issue. Delirium, knowing whether or not someone has delirium is important. Pain is another clinical measure that is important with delirium residents and their ability to communicate their condition

**The EPC team** agreed and noted that there's literature that has repeatedly demonstrated that those with dementia or any type of cognitive impairment are at much higher risk and have poorer clinical outcomes. Accurate treatment of pain, depression, delirium, medication appropriateness, or medication errors should all be considered patient safety issues for the cognitively impaired population and they are going to be at higher risk.

### **Medication errors**

**EPC** inquired if medication error is significant safety concern for assisted living facilities since there is such a low level of licensed nurses.

**KI** agreed and stated that most of the assisted living facilities used medication aids (not CNAs). Her facilities use LBNs and LPNs, but even then LPNs and LBNs have minimal training. Safety is really a huge issue and it's getting kind of alarming because the acuity levels are just so high.

### **Regulating assisted living facilities**

**KI** noted that more states including California are looking into regulating assisted living facilities. The Assisted Living Association is trying to be proactive and develop regulations. The CALA association (California Assisted Living Association) has been collecting data precisely to track some of these safety issues. Other organizations are TALA (Texas Assisted Living Association) and the Alpha Group.

### **Grey literature resources discussion**

**EPC** asked the KIs where they look to find interventions to implement on site.

**KI** mentioned that The Alzheimer's Association has a series of dementia care practice recommendations that have been around since the 2000's in the grey literature that you wouldn't necessarily find in a PubMed search. Dementia care practice recommendations provide an outline on how people can best take care of people with dementia, but how does the facility take that and translate it into an educational program for their staff and how did they implement it during the care planning process? That is where I think the most work probably needs to be done at least in the area of dementia.

**KI** agreed and suggested looking at the assisted living trade associations (annual meeting, educational conferences). Look at the list of lectures and seminars and sessions they have devoted to safety issues as an indicator of what the trade itself is identifying as problems. And you'd also identify through those trade associations identify their own experts.

### **Change in resident mix for assisted living facilities discussion**

**The KIs** brought up the resident mix is changing for assisted living facilities. NHs used to have residents with more complex medical needs, but now assisted living facilities are seeing an increase in this type of resident and the assisted living industry is aware it is happening, but just beginning to try to set up some regulations to help better deal with this type of complex resident.

### **Staffing mix/ratio/skill level in assisted living facilities and NHs discussion**

**KI** stated that her expertise is mostly with assisted living and the quality of the staff skills is an issue. One of the problems is that assisted living facilities are taking on higher and higher acuity residents that used to be handled in NHs almost exclusively. The assisted living facilities are not staffed with the skill level of a NH or a hospital. The highest skilled staff is the director who might be an RN. Staff mix is mostly LPNs with no skill/competence in assessment, CNAs or aides. Outcomes- in assisted living the outcomes are not tracked- there's no effort in assisted living to track these outcome measures as a way to improve quality. Assisted living is very primitive when compared to a NH setting.

**The KIs** added that there is staffing difference between the NHs and assisted living facilities in terms of skill level (e.g., less RNS, aids). Care providers in assisted living don't have to be certified nursing assistants and it's unclear how they are trained.

**EPC** also added that in nursing homes there are some regulations and consensus about what staffing levels should be, but there are little to no regulations in assisted living leading to a lot of assisted living facilities with very poor staff to resident ratios/mix.

**KI** agreed and noted that the staff ratio varies by state (e.g., the state of California requires assisted living facilities to have one staff for 15 residents) and not all states regulate this.

**KI** pointed out that assisted living was supposed to be more of a hospitality model for residents to have a gracious life with a little bit of assisted care.

**EPC** reiterated that in terms of interventions to improve patient safety, everything comes back to staffing (training, staff mix/ratio) and the **KIs** agreed.

**KI** added emphasis to the staff skill level and the staffing ratios are just not adequate for the levels of acuity in the NH or assisted living.

### **Person-centered care in assisted living facilities**

**KI** stated that assisted living facilities tend to handle person centered care/dignity/quality of life issues better than NHs because assisted living started out as a hospitality model. Assisted living is an adjunct to independent living and that person-centered model of care has always been imbedded in the programs. The NH model is a nurse dominated model whereas assisted living really isn't

**EPC** inquired about the issues that might impede resident safety, including resident assessment and clinical information.

**KI** responded that assisted living has care plans required in most states, but care plans are loosely put together and not at the level of sophistication found in NHs where monitoring and tracking takes place. The issue with NHs is that they are over regimented (over structured).

**KI** reiterated that person-centered care is critical to the success of providing good quality of life for residents without or without dementia in assisted living (e.g., if someone likes to sleep late they are able to wake up at 10 in the morning instead of 6 in the morning when the shift changes). Knowing the person's background can help improve their quality of life and quality of care for other residents.

### **End of life care/Hospice**

**EPC** also inquired about quality of end of life care at assisted living facilities and do you view that as a safety issue?

**KI** stated that the majority of assisted living facilities partner with hospice services. Hospice has its own model, its own rules and expectations

**EPC** inquired as to when the hospice service is initiated for a resident.

**KI** stated that the person is typically in a state of decline and will have physician involvement to place the order for hospice services. The family is also involved at this point. Hospice has social workers and grief counselors, and other services for the family. The safety issue would be the

staff not having adequate skills. Moving forward, all of our aids need to be CNAs, which would be a new staffing model for assisted living.

## **Technical Brief Key Informant Discussion Call #3**

### **Vanderbilt Evidence-based Practice Center Technical Brief: Critical Analysis of the Evidence for Patient Safety Practices in Nursing Home Settings**

#### **Patient safety definition and overview of Guiding Questions (GQs)**

**The EPC team** started out the discussion by introducing the Agency for Healthcare Research and Quality's (AHRQ) broad definition of patient safety soliciting feedback from the KIs on their views of patient safety in the context of nursing home (NH) settings.

**KI** stated that it would be challenging to cover every potential patient safety issue in one technical brief.

**KI** added that *safety* is not a *thing*, but a *result* and it would be hard to imagine safety as a *structure*.

**The EPC team** inquired if limiting the report to *adverse events* is the right course of action. Adverse events discussed in the literature include patient safety issues like falls, pressure sores, weight loss, and medication errors.

**EPC** reiterated that this report is looking at adverse events as outcomes.

**KI** added that from a hospital perspective, dealing with infections and reporting infection outcomes (e.g., surgical site infections), that we really don't know preventability. We know what our rate should be compared to our peer hospitals and can examine process failures and adherence, but we may not know direct causality or preventability. Several patient safety issues of concern in a post-acute care facility (e.g., NH, skilled nursing facility [SNF], assisted living) would be the acquired urinary tract infection (UTI), respiratory tract infection, and gastroenteritis, level of vaccinated workers, hand washing practices, and safe injection practice. Some of these are measurable (e.g., process, outcome measures).

**EPC** also inquired if preventability can be done in a nursing home not just in a hospital setting and **KI** stated that there's pretty good evidence in hospitals that depending on the kind of anesthesia used during an operation it reduces or increases the likelihood that specific types of patients have delirium post-surgically. Now what are the causes of delirium and do they arise while people are in nursing homes and can they be addressed and prevented? It's likely that it's possible to the extent that it's actually defined and documented.

**EPC** inquired if hospitalizations and burdensome transitional care should be encompassed under patient safety?

**KI** replied that there are a certain strata of patients with re-hospitalizations for hip fracture rehab which is a very different issue than re-hospitalizations of a NH resident with multiple chronic comorbidities and multiple medications. Those patients present a different set of clinical problems and a different set of clinical rates. Both can potentially be prevented and it depends of how you want to do that.

#### **Scope of patient safety Issues covered in the report**

**KI** stated that patient quality is a big issue and is subset of patient safety and need to define it in advance and focus on some of the most important patient safety areas because you can't cover everything and the **EPC team** agreed. She also pointed out that the literature on even one of these patient safety issues could be a whole technical brief in itself.

**EPC** inquired what salient issues are the most important to focus on in this report and **KI** stated that pressure ulcers, infection, psychotropic drug use, weight loss, activities of daily living (ADL) decline, incontinence, and pain are the main patient safety issues. Re-hospitalization could be included, but really should be in a separate report and the other **KIs** agreed.

**EPC** stated that some of the issues that have come up in our previous KI calls were aspects of safety and quality that have not been traditionally captured by the Nursing Home compare quality measures. She inquired if there other measures that are not necessarily clinical outcomes, but other types of outcomes that we should include in this report?

**KI** suggested adding the issue of staffing (e.g., low staffing levels lead to bad safety practice) and the **EPC team** noted that this is an issue that is cross-cutting over all patient safety issues. **The EPC team** inquired if it is important to include quality of life or resident-centered care issues in the report (e.g., non-clinical events, hospital readmissions).

**KI** suggested to not include quality of life under the concept of patient safety to help narrow the scope of how we are defining patient safety and the other **KIs** agreed that it would broaden the scope too far for this report.

**KI** also suggested limiting the report by not taking on assisted living and just point out the issues around assisted living and **KI** agreed that the report needs to focus on the medical safety issues where there's some institutional and societal obligation to keep people safe and the **EPC team** agreed.

### **Antimicrobial stewardship and infection control**

**KI** noted that particularly in long-term care facilities, there is a need for antimicrobial stewardship for all uses of drug resistant organism infections (e.g., C. Diff.) and **KI** agreed that antimicrobial stewardship is a significant patient safety issue. The complications associated with antibiotic use in the face of infection whether they're asymptomatic or even marginally symptomatic implies for the overall burden in the facility and its risk of increase in population rates of multi-organ resistant bacteria. There is reasonably good evidence to suggest that some hospitals and NHs, as they transfer patients back and forth, became pretty significant reservoirs of drug resistant organism infections that have the adverse effect on everyone else that passes through those hospitals and NHs in terms of their increased risk of a drug resistant organism diagnosis subsequently and the role of antibiotic use on the context of that is a significant issue. They might be viewed as medication errors but they are actually not a classic medication error.

**EPC** inquired if hospitals are better at infection control and prevention than NHs and **KI** responded that hospital programs exist around the appropriateness of antimicrobials, in terms of indication (e.g., ensuring narrow spectrum antibiotics or treating colonization and appropriate diagnostic testing upfront) so there is not unnecessary use of antibiotics. The science is just starting as far as what interventions work, what is effective and that's just in acute care settings.

### **Short and long stay resident safety issues**

**KI** inquired about patient safety issues in short and long stay NH populations. He noted that there is rising pressure surrounding preferred provider selection due to penalties from Medicare Advantage and the insurer's role in the contracting process. The differentiation between short and long stay is probably going to only be further differentiated in time and the safety issues for e.g., Alzheimer's care unit in assisted living. There are increasingly more post-acute settings that are more like extensions of hospitals and there is an expectation that those people going to post-acute are intending to go home. The long stay patients, they live there. It does become a

quality of life issue in terms of whether they have more autonomy and control and are willing to take the risk of some adverse events. It will never be 100% clear but to the extent that quality or safety, it is multifactorial and those factors are not correlated. It's even more so as you looked at that across short stay and long stay populations.

**EPC** reiterated that he was referring to as quality of life for long-term stay residents that the patient safety issues might not be accurately measure quality and the **KIs** agreed.

### **Increasing number of impaired assisted living residents**

**EPC** stated that assisted living is seeing an increase in more impaired residents, but the staff skill level and staff ratios in assisted living facilities are lower than NHs. He inquired if that poses bigger safety issues/problems in assisted living than in NHs?

**KI** agreed and stated that the general trend has been that people in assisted living are more impaired than they were 10 years ago and people who are in assisted living now are people who were in NHs 10 or 15 years ago.

**The KIs** also noted that outcomes aren't tracked in assisted living facilities like they are in NHs and added that the median tenure in assisted living is only like 9-12 months before either dying or graduating to the NH.

### **Palliative Care and Hospice**

**KI** noted another issue for both short term and long term care is the issue of residents in the facility for palliative care or hospice. When do you stop aggressive treatment and preventing infections during end of life care and questioned if the EPC team thought that would be considered a safety issue.

**EPC** agreed that this could be a safety issue for end of life residents that may get excessive treatment that could lead to adverse events and **KI** added that people who come directly from hospital units to hospice units (in NHs and SNFs) across the country is a very high and fast growing number and that it's an issue. He also added that Medicare Advantage (MA) patients typically enter hospice services about 5 days earlier than other patients.

### **Polypharmacy and medication reconciliation issues**

**KI** brought up polypharmacy as a patient safety issue and stated that, for example, SNF patients take 15 medications on average. He also noted that some NH residents are treated for multiple comorbid conditions that require 3-4 medications per each condition resulting in high medication counts.

**EPC** agreed and noted that there are long-term residents taking medications for indications that no longer exist because due to lack of medication reconciliation would be considered a patient safety issue.

### **Staffing**

**KI** brought up the issue of regarding quality improvement programs and intervention studies on staffing that are conducted in facilities that don't have adequate staffing so you don't see the results and suggested that a clinical trial on RN staffing was needed to demonstrate that almost all these patient safety outcomes might be better if you had RN staffing and **EPC** agreed that there are muted effects on any intervention because of staffing limitations.

**KI** suggested looking at staffing in the context of these outcomes and **EPC** agreed and mentioned that the issue of staffing, both in terms of number and kind of skill set, has come up several times as like an overarching issue that impacts all patient safety issues.

**KI** agreed and stated that the majority of staffing studies in hospital settings show that higher RN staffing makes a bigger difference in patient safety than higher total staffing.

### **Future Research Needs**

**EPC** inquired if the KIs had any topics for potential future research in the NH setting.

**KI** suggested three future research topics:

1. What's the benefit of an extra hour of therapy?
2. Antibiotic stewardship affects both the short stay and the long stay in terms of the proclivity of a facility to actually engage in antimicrobial prescription and there is little evidence in the NH setting about how that's used what the positive effects of reducing or more rationalizing the use of antimicrobials might be.
3. What's the effect of more rationalized medication prescription and de-prescribing medications in very elderly or very frail NH residents?

### **Gray Literature**

**KI** suggested that there's one area of evidence to look at which is the Quality Improvement Organizations (QIO) initiative about quality improvement which often does not lead to publications, but sometimes leads to reports and the **EPC team** agreed that this would be a good source for gray literature. **KI** also suggested reaching out to individuals in Denver who run the CMS QIO program across nursing homes.

## Appendix B. Literature Search Strategies

Table B-1. PubMed literature search strings for nursing home patient safety categories

Falls		Results
#1	"Nursing Homes"[Mesh] OR "Long-Term Care"[Mesh] OR "Homes for the Aged"[Mesh]	54,850
#2	"nursing home"[tiab] OR "long-term care"[tiab] OR "residential aged care"[tiab] OR "skilled nursing facility"[tiab] OR "aged care facility"[tiab] OR "aged care facilities"[tiab] NOT medline[sb]	2,683
#3	#1 OR #2	57,529
#4	"Accidental Falls"[Mesh]	16,283
#5	"fall prevention"[tiab] OR "preventing falls"[tiab] NOT medline[sb]	313
#6	#4 OR #5	16,596
#7	#3 AND #6	858
#8	(((((("Controlled Clinical Trial" [Publication Type]) OR "Multicenter Study" [Publication Type]) OR "Randomized Controlled Trial" [Publication Type])) OR (((("randomized"[tiab] OR "cluster-randomized"[tiab] OR "RCT"[tiab]) OR (("trial"[tiab]) AND ("controlled"[tiab] OR "clinical"[tiab]))) OR ("systematic review"[tiab] OR "systematic literature review" [tiab])))	879,376
#9	#7 AND #8	148
#10	#9 AND ("2005/01/01"[Date - Publication] : "3000"[Date - Publication])	106
Pressure Ulcer		Results
#1	"Nursing Homes"[Mesh] OR "Long-Term Care"[Mesh] OR "Homes for the Aged"[Mesh]	54,850
#2	"nursing home"[tiab] OR "long-term care"[tiab] OR "residential aged care"[tiab] OR "skilled nursing facility"[tiab] OR "aged care facility"[tiab] OR "aged care facilities"[tiab] NOT medline[sb]	2,683
#3	#1 OR #2	57,529
#4	"Pressure Ulcer"[Mesh]	9,954
#5	"pressure ulcer"[tiab] OR "decubitus ulcer"[tiab] OR "bedsore"[tiab] OR "pressure sore"[tiab] NOT medline[sb]	442
#6	#4 OR #5	10,394
#7	#3 AND #6	764
#8	(((((("Controlled Clinical Trial" [Publication Type]) OR "Multicenter Study" [Publication Type]) OR "Randomized Controlled Trial" [Publication Type])) OR (((("randomized"[tiab] OR "cluster-randomized"[tiab] OR "RCT"[tiab]) OR (("trial"[tiab]) AND ("controlled"[tiab] OR "clinical"[tiab]))) OR ("systematic review"[tiab] OR "systematic literature review" [tiab])))	879,376
#9	#7 AND #8	92
#10	#9 AND ("2005/01/01"[Date - Publication] : "3000"[Date - Publication])	69
#10	#9 AND ("2005/01/01"[Date - Publication] : "3000"[Date - Publication])	30
#9	#7 AND #8	9
#10	#9 AND ("2005/01/01"[Date - Publication] : "3000"[Date - Publication])	6
Urinary Tract Infection		Results
#1	"Nursing Homes"[Mesh] OR "Long-Term Care"[Mesh] OR "Homes for the Aged"[Mesh]	54,870
#2	"nursing home"[tiab] OR "long-term care"[tiab] OR "residential aged care"[tiab] OR "skilled nursing facility"[tiab] OR "aged care facility"[tiab] OR "aged care facilities"[tiab] NOT medline[sb]	2,670
#3	#1 OR #2	57,536
#4	("Catheter-Related Infections"[Mesh] AND urin*) OR "urinary tract infections"[mesh:NoExp]	32,703
#5	"catheter-associated urinary tract infection"[tiab] OR "CAUTI"[tiab] or "UTI"[tiab] or "urinary tract infection"[tiab] NOT medline[sb]	1,870
#6	#4 OR #5	34,573

#7	#3 AND #6	359
#8	((((("Controlled Clinical Trial" [Publication Type]) OR "Multicenter Study" [Publication Type]) OR "Randomized Controlled Trial" [Publication Type])) OR (((("randomized"[tiab] OR "cluster-randomized"[tiab] OR "RCT"[tiab]) OR (("trial"[tiab]) AND ("controlled"[tiab] OR "clinical"[tiab]))) OR ("systematic review"[tiab] OR "systematic literature review" [tiab])))	879,613
#9	#7 AND #8	41
#10	#9 AND ("2005/01/01"[Date - Publication] : "3000"[Date - Publication])	26
<b>Medication error</b>		<b>Results</b>
#1	"Nursing Homes"[Mesh] OR "Long-Term Care"[Mesh] OR "Homes for the Aged"[Mesh]	54,870
#2	"nursing home"[tiab] OR "long-term care"[tiab] OR "residential aged care"[tiab] OR "skilled nursing facility"[tiab] OR "aged care facility"[tiab] OR "aged care facilities"[tiab] NOT medline[sb]	2,670
#3	#1 OR #2	57,536
#4	"Medication Errors"[Mesh]	11,859
#5	"medication reconciliation"[tiab] OR "medication error"[tiab] NOT medline[sb]	279
#6	#4 OR #5	12,138
#7	#3 AND #6	302
#8	((((("Controlled Clinical Trial" [Publication Type]) OR "Multicenter Study" [Publication Type]) OR "Randomized Controlled Trial" [Publication Type])) OR (((("randomized"[tiab] OR "cluster-randomized"[tiab] OR "RCT"[tiab]) OR (("trial"[tiab]) AND ("controlled"[tiab] OR "clinical"[tiab]))) OR ("systematic review"[tiab] OR "systematic literature review" [tiab])))	879,613
#9	#7 AND #8	44
#10	#9 AND ("2005/01/01"[Date - Publication] : "3000"[Date - Publication])	41
<b>Infection</b>		<b>Results</b>
#1	"Nursing Homes"[Mesh] OR "Long-Term Care"[Mesh] OR "Homes for the Aged"[Mesh]	54,870
#2	"nursing home"[tiab] OR "long-term care"[tiab] OR "residential aged care"[tiab] OR "skilled nursing facility"[tiab] OR "aged care facility"[tiab] OR "aged care facilities"[tiab] NOT medline[sb]	2,670
#3	#1 OR #2	57,536
#4	"Infectious Disease Transmission, Professional-to-Patient"[Mesh]	1,555
#5	"healthcare associated infection"[tiab] OR HAI[tiab] NOT medline[sb]	327
#6	#4 OR #5	1,882
#7	#3 AND #6	37
#8	((((("Controlled Clinical Trial" [Publication Type]) OR "Multicenter Study" [Publication Type]) OR "Randomized Controlled Trial" [Publication Type])) OR (((("randomized"[tiab] OR "cluster-randomized"[tiab] OR "RCT"[tiab]) OR (("trial"[tiab]) AND ("controlled"[tiab] OR "clinical"[tiab]))) OR ("systematic review"[tiab] OR "systematic literature review" [tiab])))	879,613
#9	#7 AND #8	7
#10	#9 AND ("2005/01/01"[Date - Publication] : "3000"[Date - Publication])	6
<b>Quality Improvement (system level)</b>		<b>Results</b>
#1	"Nursing Homes"[Mesh] OR "Long-Term Care"[Mesh] OR "Homes for the Aged"[Mesh]	54,870
#2	"nursing home"[tiab] OR "long-term care"[tiab] OR "residential aged care"[tiab] OR "skilled nursing facility"[tiab] OR "aged care facility"[tiab] OR "aged care facilities"[tiab] NOT medline[sb]	2,670
#3	#1 OR #2	57,536
#4	"Quality Improvement"[Mesh] OR "Quality Indicators, Health Care"[Mesh] OR "Standard of Care"[Mesh]	21,433
#5	"workforce training"[tiab] OR "public reporting"[tiab] OR "patient hand-off"[tiab] OR "quality improvement"[tiab] OR "reducing error"[tiab] NOT medline[sb]	2,721
#6	#4 OR #5	24,154
#7	#3 AND #6	790
#8	((((("Controlled Clinical Trial" [Publication Type]) OR "Multicenter Study" [Publication Type]) OR "Randomized Controlled Trial" [Publication Type])) OR (((("randomized"[tiab] OR "cluster-randomized"[tiab] OR "RCT"[tiab]) OR (("trial"[tiab]) AND ("controlled"[tiab] OR "clinical"[tiab]))) OR ("systematic review"[tiab] OR "systematic literature review" [tiab])))	879,613
#9	#7 AND #8	71
#10	#9 AND ("2005/01/01"[Date - Publication] : "3000"[Date - Publication])	64

<b>Medication polypharmacy/inappropriate prescribing</b>		<b>Results</b>
#1	"Nursing Homes"[Mesh] OR "Long-Term Care"[Mesh] OR "Homes for the Aged"[Mesh]	55,088
#2	"nursing home"[tiab] OR "long-term care"[tiab] OR "residential aged care"[tiab] OR "skilled nursing facility"[tiab] OR "aged care facility"[tiab] OR "aged care facilities"[tiab] NOT medline[sb]	2,901
#3	#1 OR #2	57,985
#4	("Inappropriate Prescribing"[Mesh] OR "Polypharmacy"[Mesh] OR "Prescription Drugs"[Mesh] OR "Prescriptions"[Mesh] OR "Drug Utilization"[Mesh])	47,840
#5	Polypharmacy[tiab] OR "over-prescribe"[tiab] OR "over prescribe"[tiab] "overmedicate"[tiab] OR "over medicated"[tiab] OR "overmedicated"[tiab] OR "overprescribe"[tiab] OR "medication appropriateness"[tiab] OR "multi-drug"[tiab] OR "inappropriate drug"[tiab] OR "inappropriate medication"[tiab] OR "inappropriate prescription"[tiab] OR "drug overuse"[tiab] OR "zhan criteria"[tiab] OR "beers criteria"[tiab] NOT medline[sb]	1,148
#6	#4 OR #5	48,988
#7	#3 AND #6	1,322
#8	(((((("Controlled Clinical Trial" [Publication Type]) OR "Multicenter Study" [Publication Type]) OR "Randomized Controlled Trial" [Publication Type])) OR (((("randomized"[tiab] OR "cluster-randomized"[tiab] OR "RCT"[tiab]) OR (("trial"[tiab] AND ("controlled"[tiab] OR "clinical"[tiab]))) OR ("systematic review"[tiab] OR "systematic literature review" [tiab])))	891,435
#9	#7 AND #8	147
#10	#9 AND ("2005/01/01"[Date - Publication] : "3000"[Date - Publication])	109
<b>Resident Centered Care</b>		<b>Results</b>
#1	"Nursing Homes"[Mesh] OR "Long-Term Care"[Mesh] OR "Homes for the Aged"[Mesh]	55,089
#2	"nursing home"[tiab] OR "long-term care"[tiab] OR "residential aged care"[tiab] OR "skilled nursing facility"[tiab] OR "aged care facility"[tiab] OR "aged care facilities"[tiab] NOT medline[sb]	2,902
#3	#1 OR #2	57,987
#4	"patient-centered care"[Mesh] OR "Green House"[tiab] OR "Eden Alternative"[tiab] OR "Wellspring Innovative Solutions"[tiab] OR "Planetree"[tiab]	12432
#5	"Culture change"[tiab] OR "individualized care"[tiab] OR "resident centered"[tiab] OR "person-directed"[tiab] OR "resident-directed"[tiab] OR "Person-centered"[tiab] OR "Resident-centered"[tiab] OR "Person-centered"[tiab] NOT medline[sb]	530
#6	#4 OR #5	12,962
#7	#3 AND #6	470
#8	(((((("Controlled Clinical Trial" [Publication Type]) OR "Multicenter Study" [Publication Type]) OR "Randomized Controlled Trial" [Publication Type])) OR (((("randomized"[tiab] OR "cluster-randomized"[tiab] OR "RCT"[tiab]) OR (("trial"[tiab] AND ("controlled"[tiab] OR "clinical"[tiab]))) OR ("systematic review"[tiab] OR "systematic literature review" [tiab])))	891,706
#9	#7 AND #8	46
#10	#9 AND ("2005/01/01"[Date - Publication] : "3000"[Date - Publication])	40

Note: Searches conducted in June 2015

**Table B-2. CINAHL literature search strings for nursing home patient safety categories**

1	"nursing home" OR "long-term care" OR "residential aged care" OR "skilled nursing facility" OR "aged care facility" OR "aged care facilities"	(33,522)
2	"randomized" OR "cluster-randomized" OR "RCT" OR "trial" OR "systematic review" OR "systematic literature review" OR "cochrane" OR "meta-analysis" OR "comparative effectiveness"	(147,681)
3	#1 AND #2	(1,358)
4	#2 <b>Limited to</b> - Published Date: 2005-2015; Exclude MEDLINE records	(216)

8	("nursing home" OR "long-term care" OR "residential aged care" OR "skilled nursing facility" OR "aged care facility" OR "aged care facilities") AND ("Accidental Falls" OR "fall prevention" OR "preventing falls") AND ("randomized" OR "cluster-randomized" OR "RCT" OR "trial" OR "systematic review" OR "systematic literature review" OR "cochrane" OR "meta-analysis" OR "comparative effectiveness") <b>Limiters</b> - Published Date: 2005-2015; Exclude MEDLINE records	(10)
9	("nursing home" OR "long-term care" OR "residential aged care" OR "skilled nursing facility" OR "aged care facility" OR "aged care facilities") AND "pain" AND ("randomized" OR "cluster-randomized" OR "RCT" OR "trial" OR "systematic review" OR "systematic literature review" OR "cochrane" OR "meta-analysis" OR "comparative effectiveness") <b>Limiters</b> - Published Date: 2005-2015; Exclude MEDLINE records	(12)
10	("nursing home" OR "long-term care" OR "residential aged care" OR "skilled nursing facility" OR "aged care facility" OR "aged care facilities") AND ("randomized" OR "cluster-randomized" OR "RCT" OR "trial" OR "systematic review" OR "systematic literature review" OR "cochrane" OR "meta-analysis" OR "comparative effectiveness") AND ("pressure ulcer" OR "decubitus ulcer" OR "bedsore" OR "pressure sore") <b>Limiters</b> - Published Date: 2005-2015; Exclude MEDLINE records	(15)
11	("nursing home" OR "long-term care" OR "residential aged care" OR "skilled nursing facility" OR "aged care facility" OR "aged care facilities") AND ("randomized" OR "cluster-randomized" OR "RCT" OR "trial" OR "systematic review" OR "systematic literature review" OR "cochrane" OR "meta-analysis" OR "comparative effectiveness") AND ("Catheter-Related Infections" OR "urinary tract infections" OR "catheter-associated urinary tract infection" OR "CAUTI" OR "UTI" OR "urinary tract infection") <b>Limiters</b> - Published Date: 2005-2015; Exclude MEDLINE records	(2)
12	("nursing home" OR "long-term care" OR "residential aged care" OR "skilled nursing facility" OR "aged care facility" OR "aged care facilities") AND ("randomized" OR "cluster-randomized" OR "RCT" OR "trial" OR "systematic review" OR "systematic literature review" OR "cochrane" OR "meta-analysis" OR "comparative effectiveness") AND ("Medication Error" OR "medication reconciliation" OR "reducing error") <b>Limiters</b> - Published Date: 2005-2015; Exclude MEDLINE records	(0)
13	("nursing home" OR "long-term care" OR "residential aged care" OR "skilled nursing facility" OR "aged care facility" OR "aged care facilities") AND ("randomized" OR "cluster-randomized" OR "RCT" OR "trial" OR "systematic review" OR "systematic literature review" OR "cochrane" OR "meta-analysis" OR "comparative effectiveness") AND ("Infectious Disease Transmission" OR "healthcare associated infection" OR "HAI" OR "infection control") <b>Limiters</b> - Published Date: 2005-2015; Exclude MEDLINE records	(4)
14	("nursing home" OR "long-term care" OR "residential aged care" OR "skilled nursing facility" OR "aged care facility" OR "aged care facilities") AND ("randomized" OR "cluster-randomized" OR "RCT" OR "trial" OR "systematic review" OR "systematic literature review" OR "cochrane" OR "meta-analysis" OR "comparative effectiveness") AND ("Quality Improvement" OR "Quality Indicator" OR "public reporting" OR "patient safety" OR "resident safety") <b>Limiters</b> - Published Date: 2005-2015; Exclude MEDLINE records	(14)

## Cochrane Search String

((“nursing home” OR “aged care” OR “elderly care” OR “long-term care” OR “long term care” OR elderly OR “older people” OR “older adults”) AND (falls OR “pressure ulcer” OR “pressure ulcers” OR “infection” OR “HAI” OR “healthcare-associated infection” OR “urinary tract infection” OR “UTI” OR “medication error” OR “adverse drug event” OR “ADE” OR polypharmacy OR “weight loss” OR dehydration OR “activities of daily living” OR “ADL” OR “fecal incontinence” OR “urinary incontinence” OR incontinence OR “depressive symptoms” OR “antipsychotic medication” OR pain OR “influenza vaccine” OR “pneumococcal vaccine” OR “physical restraint” OR “physical restraints” OR (catheter AND bladder) )) AND limit to Cochrane Review =173  
Conducted July 30,2015

## Appendix C. Summary Tables of Recent Systematic Reviews Addressing Interventions for Common Format Safety Events

**Table C-1. Overview of systematic reviews for falls**

Title, Author, Year of publication <b>ROBIS score</b>	Population, Setting, Search Dates, Included study type/counts	Interventions Included	Outcomes Assessed	Conclusions Reported in the Review
<p>Characteristics and effectiveness of fall prevention programs in nursing homes: a systematic review and meta-analysis of randomized controlled trials (Vlaeyen et al. 2015)<sup>1</sup></p> <p>ROBIS: Low</p>	<p>Population: Nursing home residents</p> <p>Setting: Nursing home</p> <p>Search dates: Up to September 2013</p> <p>Included study type/ counts: 13 RCTs (2 individual RCTs; 12 cluster RCTs)</p>	<p>Single intervention:</p> <ol style="list-style-type: none"> <li>1. Staff training</li> <li>2. Staff Knowledge</li> <li>3. Medication Informatics tool to analyze and review medication use</li> <li>4. Assessment of medication needs</li> <li>5. Vitamin D supplementation</li> <li>6. Exercise</li> <li>7.Environmental: Furnishings and Adaptations</li> <li>Body-worn aids; protection</li> <li>Aids for personal mobility</li> <li>8.Other: Management of urinary incontinence; Fluid or nutrition therapy; Advice on correction of orthostatic hypotension; Optician referral</li> </ol> <p>Multiple interventions: Incontinence care and a low-intensity, functionally oriented exercise program</p> <p>Multifactorial intervention:</p>	<p>Number of falls, fallers and recurrent fallers</p>	<p>Fall prevention programs did not reduce the number of falls or fallers, but significantly reduced the number of recurrent fallers by 21%.</p>
<p>Hip protectors for preventing hip fractures in older people (Santesso et al. 2014)<sup>2</sup></p> <p>ROBIS: Low</p>	<p>Population: older age (&gt;65)</p> <p>Setting: Living in community or residential care</p> <p>Search Dates: Up to 2012</p> <p>Included study type/counts: 19 RCTs and non-randomized comparative trials</p>	<p>Hip protector</p>	<p>Risk of hip or pelvic fracture; Rate of fracture; Rate of falls</p>	<p>For nursing home resident hip protectors were associated with a small reduction in hip fracture risk and a slight increase in pelvic fracture risk. There was no significant effect on other fracture or falls. The strength of evidence was moderate quality.</p>

<b>Title, Author, Year of publication</b>	<b>Population, Setting, Search Dates, Included study type/counts</b>	<b>Interventions Included</b>	<b>Outcomes Assessed</b>	<b>Conclusions Reported in the Review</b>
<b>ROBIS score</b> Interventions for preventing falls in older people in care facilities and hospitals (Cameron et al. 2012) <sup>3</sup>  ROBIS: Low	Population: Older patients  Setting: Long-term care and hospitals  Search dates: 1946 to August 2012  Included study type/ counts: 60 RCTs	1. Exercises 2. Physiotherapy 3. Medication review by a pharmacist 4. Vitamin D supplementation 5. Environment/assistive technology 6. Social environment (staff training and service model change) 7. Resident education	Rate of falls; Number of fallers; Number of participants sustaining fall-related fractures; Complications of the interventions; Economic outcomes	Vitamin D supplements reduced the rate of falls. Exercise interventions showed inconsistent results. The evidence for multifactorial interventions was also inconclusive.
Interventions designed to prevent healthcare bed-related injuries in patients (Anderson et al. 2011) <sup>4</sup>  ROBIS: Low	Population: Patients in residential healthcare  Setting: Residential healthcare setting  Search dates: Up to December 2010  Included study type/ counts: 2 RCTs	1. Low height beds 2. Bed exit alarms	Frequency of patient injuries from their beds; Frequency of patient falls out of bed Frequency of patient injuries due to falls out of bed Frequency of patient injuries due to the intervention; Frequency of all falls Frequency of patient injuries due to all falls	No effectiveness of low height beds or bed alarms in reducing injuries or falls from beds. Evidence was limited.
Exercise for improving balance in older people (Howe et al. 2011) <sup>5</sup>  ROBIS: Low	Population: Adults age 60 or older  Setting: Community or institutional settings  Search dates: Up to 2011  Included study type/counts: 94 RCTs	Exercise programs, including gait and balance, strengthening exercises, 3 dimensional exercise programs, general physical activity, computerized balance training, vibration platform	Balance	Limited evidence that exercise programs are effective in improving balance outcomes.
A scoping review of strategies for the prevention of hip fracture in elderly nursing home residents (Sawka et al.2010) <sup>6</sup>  ROBIS: Low	Population: Elderly (≥ 65 years) nursing home residents  Setting: Long-term care setting  Search dates: 1975 to 2009)	1. Vitamin D or calcium 2. Non-hormonal pharmacologic therapies for osteoporosis 3. Hormonal therapies (or hormone analogues) 4. Oral or parenteral alternative	Number of hip fractures; Fracture risk	Vitamin D supplementation reduced hip fracture risk. More research is needed on other interventions including pharmacologic treatment, exercise, multi-modal strategies and hip protectors.

Title, Author, Year of publication ROBIS score	Population, Setting, Search Dates, Included study type/counts	Interventions Included	Outcomes Assessed	Conclusions Reported in the Review
	Included study type/ counts: 20 RCTs	medicines 5. Exercise, behavioral interventions, physiotherapy, education, or multimodal interventions 6. Hip protectors		
Hip protectors decrease hip fracture risk in elderly nursing home residents: a Bayesian meta-analysis (Sawka et al. 2007) <sup>7</sup>  ROBIS: Low	Population: Elderly (≥ 65 years) nursing home residents  Setting: Nursing home  Search dates: 1996 to 2006  Included study type/ counts: 4 RCTs (including 3 cluster RCTs)	Hip protectors	Hip fractures	Hip protectors decreased the risk of hip fractures.
Do hip protectors decrease the risk of hip fracture in institutional and community-dwelling elderly? A systematic review and meta-analysis of randomized controlled trials (Sawka et al, 2005) <sup>8</sup>  ROBIS: Low	Population: Elderly (≥ 50 years)  Setting: Institutional and community-dwelling  Search dates: 1998 to 2004  Included study type/ counts: 7 RCTs	Hip protectors Educational co-interventions	Hip fractures	More research needed to assess effectiveness of hip protectors in reducing hip fractures in nursing home residents.
Exercise for falls and fracture prevention in long term care facilities: a systematic review and meta-analysis (Silva et al. 2013) <sup>9</sup>  ROBIS: High	Population: Older adults  Setting: Long-term care  Search dates: January 1974 to June 2012  Included study type/ counts: RCTs = 12	Physical exercise regime: Balance and resistance training exercises	Falls and fracture prevention	Exercise programs work for fall prevention but were not effective in preventing fractures.
Falls prevention for the elderly (Balzer et al. 2012) <sup>10</sup>  ROBIS: High	Population: 60 years or older  Setting: Home or long-term care settings	Exercise, instruments and assessments for fall risk, assessment and correction of visual acuity, surgical	Prevention of falls and fall-related injuries	Lack of evidence to support fall prevention recommendations.

Title, Author, Year of publication ROBIS score	Population, Setting, Search Dates, Included study type/counts	Interventions Included	Outcomes Assessed	Conclusions Reported in the Review
	Search dates: January 2003 to January 2010 Included study type/ counts: 184 studies	interventions, educational, hip protectors, gait stabilizing footwear, Vitamin D, dietary supplements, multiple and multifactorial interventions		
Effectiveness of intervention programs in preventing falls: a systematic review of recent 10 years and meta-analysis (Choi et al. 2012) <sup>11</sup>  ROBIS: High	Population: Older adults  Setting: Nursing home and community settings  Search Dates: 2000 to 2009  Included study type/counts: 17 RCTs	Interventions with a goal of Ffall prevention including components such as comprehensive medical exam, occupational therapy assessment, home environmental and behavioral assessment, cognition assessment, gait stability, medication review, staff training, and education for residents	Number of falls and fall rate	Fall-prevention programs effective in reducing fall rates by 14%. There was a 54% fall reduction in nursing homes (3 studies)
Association Between Vitamin D Dosing Regimen and Fall Prevention in Long-term Care Seniors (Chua et al. 2011) <sup>12</sup>  ROBIS: High	Population: 75 years or older  Setting: Long-term care settings  Search dates: 2000 to 2010  Included study type/ counts: 4 RCTs	Vitamin D	Rate of falls and number of fallers	Vitamin D supplementation reduced the rate of falls but not the number of fallers.
Effectiveness of multifaceted fall-prevention programs for the elderly in residential care (Cusimano et al. 2008) <sup>13</sup>  ROBIS: High	Population: 60 and older  Setting: Residential care  Search dates: Up to 2007  Included study type/ counts: 5 RCTs	Multifaceted fall programs (included more than 1 intervention such as staff/resident education on falls prevention, environmental modification, exercise programs, medication review, hip protectors, and mobility-related aids such as wheelchairs) with at least 6 month follow-up	Number of residents sustaining a fall; Number of falls; Number of injuries resulting from falls; Number of recurrent fallers	Multifaceted programs have shown some evidence of efficacy (three studies report significant reductions in number of recurrent fallers, two reported significant reductions in number of falls)

Title, Author, Year of publication <b>ROBIS score</b>	Population, Setting, Search Dates, Included study type/counts	Interventions Included	Outcomes Assessed	Conclusions Reported in the Review
<p>Strategies to prevent falls and fractures in hospitals and care homes and effect of cognitive impairment: systematic review and meta-analyses (Oliver et al. 2007)<sup>14</sup></p> <p>ROBIS: Unclear</p>	<p>Population: Nursing home patients with cognitive impairment and depression</p> <p>Setting: Nursing home</p> <p>Search dates: Up to January 2005</p> <p>Included study type/ counts: 16 RCTs; 12 cluster RCTs; 2 prospective; 2 retrospective observational cohort; 2 prospective observational cohort; 1 prospective case-control study; 1 quasi-experimental</p>	<p>Single interventions:</p> <ol style="list-style-type: none"> <li>1.Hip protectors</li> <li>2.Removal of physical restraint</li> <li>3.Fall alarm devices</li> <li>4.Exercise</li> <li>5.Environment</li> <li>6.Calcium and Vitamin D</li> <li>7.Medication review</li> </ol>	<p>Number or rate of falls; Number or rate of fallers; Number or rate of fractures</p>	<p>Hip protectors in care homes reduced hip fractures. There was insufficient evidence to evaluate other single or multifaceted interventions.</p>

ROBIS=Risk of Bias in Systematic Reviews; RCT=Randomized controlled trial

**Table C-2. Overview of systematic reviews for pressure ulcers**

Title, Author, Year of publication	Population, Setting, Search Dates, Included study type/counts	Interventions Included	Outcomes Assessed	Conclusions Reported in the Review
<p><b>ROBIS score</b></p>				
<p>Repositioning for pressure ulcer prevention in adults (Gillespie et al. 2014)<sup>15</sup></p>	<p>Population: Older patients</p> <p>Setting: Acute &amp; long-term care</p> <p>Search dates: 1948 to September 2013</p> <p>Included study type/ counts: 1 RCT; 2 cluster RCTs</p>	<p>1. 30 degree vs. 90 degree tilt positions</p> <p>2. Two-hourly and 3-hourly repositioning on standard hospital mattresses and 4 hourly and 6 hourly repositioning on viscoelastic foam mattresses</p>	<p>Proportion of participants with a new pressure ulcer of any stage, grade, or category; HRQoL; Procedural pain; Patient satisfaction; Cost of ulcer prevention and cost per event avoided</p>	<p>No benefits associated with mattress tilt angles or increased repositioning frequency. Limited and low quality evidence.</p>
<p>Pressure Ulcer Risk Assessment and Prevention: Comparative Effectiveness (Chou et al. 2013)<sup>16</sup></p>	<p>Population: Adults</p> <p>Setting: Any</p> <p>Search Dates: Up to 2012</p> <p>Included study type/counts: 120 studies</p>	<p>Risk assessment scales to identify high risk and prevention interventions (including support surfaces and overlays, bed systems, cushions, nutritional supplementation, repositioning, and cleansers) to decrease incidence or severity</p>	<p>Pressure ulcers</p>	<p>Some evidence supports the use of risk assessment scales to identify individuals at risk for ulcers but effects on incidence of ulcers are not clear. Advanced static support surfaces were more effective in ulcer prevention compared to standard mattresses in higher risk populations. Evidence was unclear for other prevention interventions.</p>
<p>Pressure Ulcer Treatment Strategies: Comparative Effectiveness (Saha et al. 2013)<sup>17</sup></p>	<p>Population: Adults 18 and older treated for existing pressure ulcers</p> <p>Setting: Any</p> <p>Search Dates: 1985 to 2012</p> <p>Included study type/counts: 143 trials, 31 observational studies including cohort studies, case-control, case series, and cross-sectional studies</p>	<p>Surface supports, nutrition supplementation, wound dressings, topical therapies, biologic agents, surgical repair</p>	<p>Effectiveness and safety of pressure ulcer treatment strategies</p>	<p>Moderate strength evidence that air-fluidized beds, protein containing nutritional supplements, radiant heat dressings, and electrical stimulation associated with wound improvement. Limited evidence regarding best treatment for pressure ulcers.</p>
<p>Preventing in-facility pressure ulcers as a patient safety</p>	<p>Population: Hospital patients (acute &amp; long-term care)</p>	<p>Multicomponent initiatives including education,</p>	<p>Improvement in pressure ulcer rates;</p>	<p>Multicomponent interventions improved care and reduced</p>

<b>Title, Author, Year of publication</b>	<b>Population, Setting, Search Dates, Included study type/counts</b>	<b>Interventions Included</b>	<b>Outcomes Assessed</b>	<b>Conclusions Reported in the Review</b>
<b>ROBIS score</b> strategy: a systematic review (Sullivan et al. 2013) <sup>18</sup> ROBIS: High	Setting: Hospital (acute and long-term) Search dates: 2000 to 2012 Included study type/ counts: 26 studies (including 3 RCTs)	documentation, audit and feedback, protocols, use of risk assessment tools, support surfaces, repositioning, moisture management, nutrition and hydration	Process of care quality measures	rates of pressure ulcers. Few studies addressed effectiveness of individual components of prevention programs but most included elements of risk assessment, skin examination, support surfaces, moisture control, repositioning/mobility, nutrition, and hydration.
Comprehensive programs for preventing pressure ulcers: a review of the literature (Niederhauser et al. 2012) <sup>19</sup> ROBIS: High	Population: Patients in acute care and long-term care Setting: Acute care and long-term care Search dates: January 1995 to December 2010 Included study type/ counts: 24 case series (1 longitudinal group pretest-posttest design)	Multifaceted, multidisciplinary interventions (Pressure Ulcer prevention best practices, staff education, clinical monitoring and evaluation, skin care champions, other campaign elements, and strategies to ensure sustainability)	Pressure Ulcer prevalence or incidence rates; Care process measures	Multi-disciplinary, bundled approaches can reduce pressure ulcer prevalence or incidence rates.
Pressure ulcer prevention: an evidence-based analysis (Ontario, 2009) <sup>20</sup> ROBIS: High	Population: 60 to 80 year olds Setting: Long-term care homes Search dates: Up to 2003 Included study type/ counts: 2 RCTs; 3 Non-RCTs	Risk assessment Distribution devices Nutritional supplements Repositioning Incontinence management	Incidence of pressure ulcers	Moderate evidence of effectiveness of alternative foam mattress compared to standard hospital foam mattress for preventing PU. Lack of evidence to support most other preventive interventions.
Pressure ulcers (Cullum et al. 2008) <sup>21</sup> ROBIS: High	Population: NR Setting: NR Search Dates: Up to 2007 Included study type/counts: 60 studies including systematic reviews, RCTs	Interventions including alternative mattresses, low-air-loss beds, overlays, alternating pressure surfaces, cushions, heel supports, nutritional supplements, repositioning, skin conditioning	Incidence and severity of pressure ulcers; Time to heal; Adverse effects of treatment	Alternative foam mattresses reduce incidence of pressure ulcers. Air-fluidized supports and hydrocolloid dressings may improve healing

Title, Author, Year of publication ROBIS score	Population, Setting, Search Dates, Included study type/counts	Interventions Included	Outcomes Assessed	Conclusions Reported in the Review
	and observational studies			
Treatment of pressure ulcers: a systematic review (Reddy et al. 2008) <sup>22</sup>  ROBIS: High	Population: Adults  Setting: Any  Search Dates: Up to 2008  Included study type/counts: 103 RCTs	Treatments for pressure ulcers including support surfaces, nutritional supplements, wound dressings, biological agents, and adjunctive therapies such as ultrasound and light therapy	Pressure ulcers	No evidence favored one support system over another. One study found protein supplementation improved healing. No benefits shown in 21 RCTS evaluating adjunctive therapies

ROBIS=Risk of Bias in Systematic Reviews; RCT=Randomized controlled trial; NR=Not reported

**Table C-3. Overview of systematic reviews for infections, including healthcare-associated infection, urinary tract infection, and antibiotic stewardship**

Title, Author, Year of publication ROBIS score	Population, Setting, Search Dates, Included study type/counts	Interventions Included	Outcomes Assessed	Conclusions Reported in the Review
Infection control strategies for preventing the transmission of methicillin-resistant Staphylococcus aureus (MRSA) in nursing homes for older people (Hughes, 2013) <sup>23</sup>  ROBIS: Low	Population: Nursing home residents  Setting: Nursing home  Search dates: Up to 2013  Included study type/ counts: 1 RCT (cluster in 32 homes)	Infection prevention and control, including staff education, audit and feedback, and infection control champions	MRSA prevalence	No change in MRSA prevalence between intervention and control sites reported in a single study.
Infection prevention in long-term care: a systematic review of randomized and nonrandomized trials (Uchida et al. 2013) <sup>24</sup>  ROBIS: High	Population: Elderly (≥ 65)  Setting: Nursing homes  Search Dates: 2001 to 2011  Included study type/counts: 24 studies (16 RCTs; 8 non randomized comparative studies)	Non pharmacological infection-prevention interventions, including antimicrobial soaps or ointments, cleaning agents, oral care/hygiene, hand sanitizers, vitamin or herbal supplements, ultraviolet light, and staff education	Infection rates and reduction in risk factors related to infections	Primary purpose for most RCTs was to reduce pneumonia. 13 out of 24 (54%) reported statistically significant results for at least one outcome. No standardized definition to examine infection rates
A systematic review of the preventive effect of oral hygiene on pneumonia and respiratory tract infection in	Population: Elderly population  Setting: Hospitals and nursing homes	Oral hygiene	Frequency of pneumonia or lower respiratory tract infection	RCTs showed positive preventive effects of oral hygiene on pneumonia and RTI

<b>Title, Author, Year of publication</b> <b>ROBIS score</b>	<b>Population, Setting, Search Dates, Included study type/counts</b>	<b>Interventions Included</b>	<b>Outcomes Assessed</b>	<b>Conclusions Reported in the Review</b>
elderly people in hospitals and nursing homes: effect estimates and methodological quality of randomized controlled trials (Sjogren, 2008) <sup>25</sup>  ROBIS: High	Search dates: 1996 to 2006  Included study type/ counts: 5 RCTs; 10 other including: case-control, cross sectional, retrospective longitudinal			

ROBIS=Risk of Bias in Systematic Reviews; RCT=Randomized controlled trial; MRSA=Methicillin-resistant Staphylococcus aureus; RTI=Respiratory tract infection

**Table C-4. Overview of systematic reviews for medication errors and adverse drug events**

<b>Title, Author, Year of publication</b> <b>ROBIS score</b>	<b>Population, Setting, Search Dates, Included study type/counts</b>	<b>Interventions Included</b>	<b>Outcomes Assessed</b>	<b>Conclusions Reported in the Review</b>
Interventions for preventing delirium in older people in institutional long-term care (Clegg et al. 2014) <sup>26</sup>  ROBIS: Low	Population: Older patients  Setting: Long-term care  Search dates: Up to April 2013  Included study type/ counts: 2 cluster RCTs	1.Hydration-based intervention Intervention to assess hydration needs and provide adequate fluids  2.Computer program which searched prescriptions for medications that might increase the chance of developing delirium	Prevalence, incidence, and severity of delirium	Very limited evidence (only 2 studies) Computerized system to identify medications and trigger pharmacist review reported a reduction in delirium incidence in a single study. A small hydration study was negative.
Interventions to improve the appropriate use of polypharmacy for older people (Patterson et al. 2014) <sup>27</sup>  ROBIS: Low	Population: Adults > age 65 with more than one long-term medical condition  Setting: Any  Search dates: Up to Nov 2013  Included study type/counts: 12 RCTs	Interventions to improve polypharmacy, including professional/educational, organizational, financial and regulatory	Primary Outcomes: Appropriateness of prescribed medications; Prevalence of appropriate medication; Hospital admissions  Secondary outcomes: Medication-related problems (adverse drug reactions, drug-drug interactions, medication errors); Medication adherence; Quality of life	Interventions helped reduce inappropriate prescribing, but no evidence of corresponding clinical improvement
Medication reviews for	Population: Nursing home	Medication reviews conducted	Mortality; Hospitalization	Medication reviews for

<b>Title, Author, Year of publication</b>	<b>Population, Setting, Search Dates, Included study type/counts</b>	<b>Interventions Included</b>	<b>Outcomes Assessed</b>	<b>Conclusions Reported in the Review</b>
<b>ROBIS score</b>				
nursing home residents to reduce mortality and hospitalization: systematic review and meta-analysis (Wallerstedt et al. 2014) <sup>28</sup>  ROBIS: Low	residents  Setting: Nursing home  Search dates: January 1990 to June 2012  Included study type/ counts: 7 RCTs; 5 non-RCTs	by pharmacists, physicians, geriatricians and geriatric nurses, or multidisciplinary teams		nursing home residents were not effective in decreasing mortality or hospitalization
Interventions to optimise prescribing for older people in care homes (Allred et al. 2013) <sup>29</sup>  ROBIS: Low	Population: Older patients in care homes  Setting: Care homes  Search dates: 1966 to November 2012  Included study type/ counts: 2 RCTs; 6 Cluster RCTs	1. Professional interventions (educational programs aimed at prescribers) 2. Organizational interventions (medication review services or specialist clinics, case conferencing, information and communication technology interventions)	Adverse drug events; Hospital admissions; Mortality; Quality of life; Medication related problems; Medication appropriateness; Medicine costs	No evidence of effect of interventions on adverse drug effects, hospital admissions, and mortality.
The effect of interventions to reduce potentially inappropriate antibiotic prescribing in long-term care facilities: a systematic review of randomised controlled trials (Fleming et al. 2013) <sup>30</sup>  ROBIS: Low	Population: Older patients in care homes  Setting: Care homes  Search dates: Up to August 2012  Included study type/ counts: 4 RCTs	1. Educational material and sessions for physicians and nurses 2. Prescribing feedback	Rate or proportion of antibiotics prescribed; Rate of antibiotics prescribed that were in accordance with recommended guidelines.	Education for medical staff may improve antibiotic prescribing but evidence was limited in this review.
Medication reconciliation during the transition to and from long-term care settings: a systematic review (Chhabra et al. 2012) <sup>31</sup>  ROBIS: Low	Population: Older patients transferred to and from long-term care settings  Setting: Long-term care  Search dates: 1950 to August 2010  Included study type/ counts: 4	Medication reconciliation interventions	Drug discrepancies; Discrepancy related ADEs; Potential drug related Problems Within 60 days of Discharge (Mortality, Rehospitalizations, Ambulatory clinic Visits, ED visit, Length of stay, Unspecified Medications,	All studies reported improvement associated with the intervention. However, methodological flaws limited the ability to draw conclusions about the effectiveness of these interventions.

Title, Author, Year of publication ROBIS score	Population, Setting, Search Dates, Included study type/counts	Interventions Included	Outcomes Assessed	Conclusions Reported in the Review
	quasi experimental design; 2 RCTs; 1 observational study		Medication errors, Quality of prescribing, Falls, Worsening mobility, Worsening behaviors, Increased confusion, Worsening pain)	
Effect of interventions to reduce potentially inappropriate use of drugs in nursing homes: a systematic review of randomised controlled trials (Forsetlund et al. 2011) <sup>32</sup>  ROBIS: Low	Population: Nursing home patients  Setting: Nursing home  Search dates: Up to April 2010  Included study type/ counts: 20 RCTs	1.Educational outreach initiatives 2.Educational meetings 3.Educational meetings with at least one additional intervention 4.Medication review 5.Geriatric assessment and care teams 6.Early psychiatric intervention 7.Activity program interventions for residents	Proportion of residents with at least one fall in the past 12 months; Use of physical restraint; 'Interactional' physical restraint (force or pressure in medical examination, treatment or in activities of daily living); Mortality; Number of admissions to hospital; Number of days alive; Number of falls; Number of patients that fell	Educational interventions, alone or in conjunction with pharmacist review, may reduce inappropriate drug use. Evidence quality is low.
Computerised clinical decision support systems to improve medication safety in long-term care homes: a systematic review (Marasinghe et al. 2015) <sup>33</sup>  ROBIS: High	Population: Residents of long-term care  Setting: Long-term care homes  Search Dates: Up to 2014  Included study type/counts: 7 studies (5 RCTs; 2 pre-post)	Computerized clinical decision support systems	Medication safety	Five studies reported improved medication safety and 2 found no improvement
Studies to reduce unnecessary medication use in frail older adults: a systematic review (Tjia et al. 2013) <sup>34</sup>  ROBIS: High	Population: Frail older adults  Setting: Long-term care, nursing homes and hospitals, home care, hospice and community  Search dates: January 1966 to September 2012  Included study type/ counts: 15 RCTs; 4 Non RCTs; 6 Pre-	1. Pharmacist review of drug list and diagnoses and discontinuation processes 2. Academic detailing to physicians 3. Staff education 4. Audit and feedback reports about medication overuse 5. Physician-led medication reviews	Reductions in explicitly defined unnecessary medications; Number of recommendations to discontinue unnecessary medications; Reductions in composite measures of inappropriate medications that include unnecessary medications	Majority of controlled studies reported significant reductions in unnecessary medications with an intervention

Title, Author, Year of publication ROBIS score	Population, Setting, Search Dates, Included study type/counts	Interventions Included	Outcomes Assessed	Conclusions Reported in the Review
Interventions to optimise prescribing in care homes: systematic review (Loganathan et al. 2011) <sup>35</sup>  ROBIS: Unclear	post; 11 Case series  Population: Older patients in long-term care  Setting: Long-term care  Search dates: 1990 to April 2010  Included study type/ counts: 11 cluster RCTs; 2 RCTs; 2 controlled before-after; 1 before-after	1. Staff education, 2. Multi-disciplinary team meetings 3. Pharmacist medication reviews 4. Computerized clinical decision support systems	Proportion, number and total drug use; Composite behavioral disorders; Change in percentage of falls	Limited evidence for effectiveness, but education intervention showed the most promise.
Interventions to Improve Transitional Care Between Nursing Homes and Hospitals: A Systematic Review (LaMantia et al. 2010) <sup>36</sup>  ROBIS: High	Population: Patients aged 65 years or older  Setting: Transitioning between nursing homes and hospitals in either direction  Search dates: Inception to June 2008  Included study type/counts: 1 RCT; 2 pre/post studies; 2 descriptive	Interventions to improve communication of medication lists, including transfer summaries and standardized documentation and medication reconciliation	Appropriate use of medications (by using Medication Appropriateness Index), adverse drug effects	Standardized patient transfer documentation assists in the successful communication of medication lists; pharmacist-developed review of medication lists help identify omitted or indicated medications on patient transfer

ROBIS=Risk of Bias in Systematic Reviews; RCT=Randomized controlled trial; QOL=Quality of life

# Appendix D. Comparative Studies of Interventions Addressing Common Format Safety Events in the Nursing Home Published After the Publication of Systematic Reviews Included in This Technical Brief

## Falls

1. C. C. Kennedy, G. Ioannidis, L. Thabane, J. D. Adachi, S. Marr, L. M. Giangregorio, S. N. Morin, R. G. Crilly, R. G. Josse, L. Lohfeld, L. E. Pickard, M. L. van der Horst, G. Campbell, J. Stroud, L. Dolovich, A. M. Sawka, R. Jain, L. Nash, A. Papaioannou (2015). Successful knowledge translation intervention in long-term care: final results from the vitamin D and osteoporosis study (ViDOS) pilot cluster randomized controlled trial. *Trials*, 16, 214-24
2. C. M. Sackley, M. F. Walker, C. R. Burton, C. L. Watkins, J. Mant, A. K. Roalfe, K. Wheatley, B. Sheehan, L. Sharp, K. E. Stant, J. Fletcher-Smith, K. Steel, K. Wilde, L. Irvine, G. Peryer (2015). An occupational therapy intervention for residents with stroke related disabilities in UK care homes (OTCH): cluster randomised controlled trial. *BMJ*, 350, h468
3. S. L. Greenspan, S. Perera, M. A. Ferchak, D. A. Nace, N. M. Resnick. Efficacy and safety of single-dose zoledronic Acid for osteoporosis in frail elderly women: a randomized clinical trial. *JAMA Internal Medicine*. 2015. 175:913-21
4. M. Gregersen, L. C. Borris and E. M. Damsgaard. Postoperative blood transfusion strategy in frail, anemic elderly patients with hip fracture: the TRIFE randomized controlled trial. *Acta Orthop*. 2015. 86:363-72
5. B. S. Husebo, R. Ostelo, L. I. Strand (2014). The MOBID-2 pain scale: reliability and responsiveness to pain in patients with dementia. *European journal of pain*, 18(10), 1419-30
6. D. Frankenthal, Y. Lerman, E. Kalendaryev, Y. Lerman (2014). Intervention with the screening tool of older persons potentially inappropriate prescriptions/screening tool to alert doctors to right treatment criteria in elderly residents of a chronic geriatric facility: a randomized clinical trial. *Journal of the American Geriatrics Society*, 62(9), 1658-65
7. E. G. da Silva Borges, R. G. de Souza Vale, S. A. Cader, S. Leal, F. Miguel, C. S. Pernambuco, E. H. Dantas (2014). Postural balance and falls in elderly nursing home residents enrolled in a ballroom dancing program. *Archives of gerontology and geriatrics*, 59(2), 312-6
8. E. Galik, B. Resnick, M. Hammersla, J. Brightwater (2014). Optimizing function and physical activity among nursing home residents with dementia: testing the impact of function-focused care. *Gerontologist*, 54(6), 930-43
9. F. Alvarez-Barbosa, J. del Pozo-Cruz, B. del Pozo-Cruz, R. M. Alfonso-Rosa, M. E. Rogers, Y. Zhang (2014). Effects of supervised whole body vibration exercise on fall risk factors, functional dependence and health-related quality of life in nursing home residents aged 80+. *Maturitas*, 79(4), 456-63
10. F. Buckinx, C. Beaudart, D. Maquet, M. Demonceau, J. M. Crielaard, J. Y. Reginster, O. Bruyere (2014). Evaluation of the impact of 6-month training by whole body vibration on the risk of falls among nursing home residents, observed over a 12-month period: a single blind, randomized controlled trial. *Aging clinical and experimental research*, 26(4), 369-76
11. G. van de Ven, I. Draskovic, E. van Herpen, R. T. Koopmans, R. Donders, S. U. Zuidema, E. M. Adang, M. J. Vernooij-Dassen (2014). The economics of dementia-care mapping in nursing homes: a cluster-randomised controlled trial *PLoS ONE [Electronic Resource]*, 9(1), e86662

12. K. Meguro, Y. Ouchi, K. Akanuma, M. Meguro, M. Kasai (2014). Donepezil can improve daily activities and promote rehabilitation for severe Alzheimer's patients in long-term care health facilities. *BMC Neurology*, 14, 243
13. F. Buckinx, C. Beaudart, D. Maquet, M. Demonceau, J. M. Crielaard, J. Y. Reginster and O. Bruyere. Evaluation of the impact of 6-month training by whole body vibration on the risk of falls among nursing home residents, observed over a 12-month period: a single blind, randomized controlled trial. *Aging Clin Exp Res*. 2014. 26:369-76
14. C. Beaudart, D. Maquet, M. Mannarino, F. Buckinx, M. Demonceau, J. M. Crielaard, J. Y. Reginster, O. Bruyere (2013). Effects of 3 months of short sessions of controlled whole body vibrations on the risk of falls among nursing home residents. *BMC Geriatrics*, 13, 42
15. C. S. Colon-Emeric, E. McConnell, S. O. Pinheiro, K. Corazzini, K. Porter, K. M. Earp, L. Landerman, J. Beales, J. Lipscomb, K. Hancock, R. A. Anderson (2013). CONNECT for better fall prevention in nursing homes: results from a pilot intervention study. *Journal of the American Geriatrics Society*, 61(12), 2150-9
16. E. Kovacs, I. Sztruhar Jonasne, C. K. Karoczi, A. Korpos, T. Gondos (2013). Effects of a multimodal exercise program on balance, functional mobility and fall risk in older adults with cognitive impairment: a randomized controlled single-blind study. *European journal of physical and rehabilitation medicine*, 49(5), 639-48
17. E. Tuunainen, J. Rasku, P. Jantti, P. Moisio-Vilenius, E. Makinen, E. Toppila, I. Pyykko (2013). Postural stability and quality of life after guided and self-training among older adults residing in an institutional setting. *Clinical interventions in aging*, 8, 1237-46
18. J. A. Teresi, M. Ramirez, D. Remler, J. Ellis, G. Boratgis, S. Silver, M. Lindsey, J. Kong, J. P. Eimicke, E. Dichter (2013). Comparative effectiveness of implementing evidence-based education and best practices in nursing homes: effects on falls, quality-of-life and societal costs. *International journal of nursing studies*, 50(4), 448-63
19. M. Underwood, S. E. Lamb, S. Eldridge, B. Sheehan, A. Slowther, A. Spencer, M. Thorogood, N. Atherton, S. A. Bremner, A. Devine, K. Diaz-Ordaz, D. R. Ellard, R. Potter, K. Spanjers, S. J. Taylor (2013). Exercise for depression in care home residents: a randomised controlled trial with cost-effectiveness analysis (OPERA). *Health technology assessment*, 17(18), 1-281
20. K. T. Snider, E. J. Snider, J. C. Johnson, C. Hagan, C. Schoenwald (2012). Preventative osteopathic manipulative treatment and the elderly nursing home resident: a pilot study. *Journal of the American Osteopathic Association*, 112(8), 489-501
21. N. Gusi, J. Carmelo Adsuar, H. Corzo, B. Del Pozo-Cruz, P. R. Olivares, J. A. Parraca (2012). Balance training reduces fear of falling and improves dynamic balance and isometric strength in institutionalised older people: a randomised trial. *Journal of physiotherapy*, 58(2), 97-104
22. S. Kopke, I. Muhlhauser, A. Gerlach, A. Haut, B. Haastert, R. Mohler, G. Meyer (2012). Effect of a guideline-based multicomponent intervention on use of physical restraints in nursing homes: a randomized controlled trial. *JAMA*, 307(20), 2177-84
23. L. Gruber-Baldini, B. Resnick, J. R. Hebel, E. Galik, S. Zimmerman (2011). Adverse events associated with the Res-Care Intervention. *Journal of the American Medical Directors Association*, 12(8), 584-9
24. K. Klages, A. Zecevic, J. B. Orange, S. Hobson (2011). Potential of Snoezelen room multisensory stimulation to improve balance in individuals with dementia: a feasibility randomized controlled trial. *Clinical Rehabilitation*, 25(7), 607-16
25. M. J. Gulpers, M. H. Bleijlevens, T. Ambergen, E. Capezuti, E. van Rossum, J. P. Hamers (2011). Belt restraint reduction in nursing homes: effects of a multicomponent intervention program. *Journal of the American Geriatrics Society*, 59(11), 2029-36

26. P. Koczy, C. Becker, K. Rapp, T. Klie, D. Beische, G. Buchele, A. Kleiner, V. Guerra, U. Rissmann, S. Kurrle, D. Bredthauer (2011). Effectiveness of a multifactorial intervention to reduce physical restraints in nursing home residents. *Journal of the American Geriatrics Society*, 59(2), 333-9
27. E. Cakar, U. Dincer, M. Z. Kiralp, D. B. Cakar, O. Durmus, H. Kilac, F. C. Soydan, S. Sevinc, C. Alper (2010). Jumping combined exercise programs reduce fall risk and improve balance and life quality of elderly people who live in a long-term care facility. *European journal of physical and rehabilitation medicine*, 46(1), 59-67
28. K. Rapp, S. E. Lamb, L. Erhardt-Ber, U. Lindemann, U. Rissmann, J. Klenk, C. Becker (2010). Effect of a statewide fall prevention program on incidence of femoral fractures in residents of long-term care facilities. *Journal of the American Geriatrics Society*, 58(1), 70-5
29. T. G. Fitzgerald, T. Hadjistavropoulos, Y. C. MacNab (2009). Caregiver fear of falling and functional ability among seniors residing in long-term care facilities. *Gerontology*, 55(4), 460-7
30. Bouwen, J. De Lepeleire, F. Buntinx (2008). Rate of accidental falls in institutionalised older people with and without cognitive impairment halved as a result of a staff-oriented intervention. *Age and ageing*, 37(3), 306-10
31. Uy, S. E. Kurrle, I. D. Cameron (2008). Inpatient multidisciplinary rehabilitation after hip fracture for residents of nursing homes: a randomised trial. *Australasian journal on ageing*, 27(1), 43-4
32. H. Bentzen, A. Bergland, L. Forsen. Risk of hip fractures in soft protected, hard protected, and unprotected falls. *Injury prevention* 2008, 14(5):306-10
33. H. Bentzen, L. Forsen, C. Becker, A. Bergland. Uptake and adherence with soft- and hard-shelled hip protectors in Norwegian nursing homes: a cluster randomised trial. *Osteoporosis international*. 2008. 19:101-11
34. D. Holmes, J. A. Teresi, M. Ramirez, J. Ellis, J. Eimicke, Kong Jian, L. Orzechowska, S. Silver (2007). An evaluation of a monitoring system intervention: falls, injuries, and affect in nursing homes. *Clinical nursing research*, 16(4), 317-35
35. E. Capezuti, L. M. Wagner, B. L. Brush, M. Boltz, S. Renz, K. A. Talerico (2007). Consequences of an intervention to reduce restrictive side rail use in nursing homes. *Journal of the American Geriatrics Society*, 55(3), 334-41
36. L. M. Wagner, E. Capezuti, J. A. Taylor, R. W. Sattin, J. G. Ouslander (2005). Impact of a falls menu-driven incident-reporting system on documentation and quality improvement in nursing homes. *Gerontologist*, 45(6), 835-42
37. P. D. O'Halloran, L. J. Murray, G. W. Cran, L. Dunlop, G. Kernohan, T. R. Beringer. The effect of type of hip protector and resident characteristics on adherence to use of hip protectors in nursing and residential homes--an exploratory study. *International journal of nursing studies*. 2005. 42(4):387-97
38. T. T. Hien le, R. G. Cumming, I. D. Cameron, J. S. Chen, S. R. Lord, L. M. March, J. Schwarz, D. G. Le Couteur, P. N. Sambrook (2005). Atypical antipsychotic medications and risk of falls in residents of aged care facilities. *Journal of the American Geriatrics Society*, 53(8), 1290-5

## **Pressure Ulcers**

1. E. Cereda, C. Klersy, M. Seriola, A. Crespi, F. D'Andrea, Group OligoElement Sore Trial Study (2015). A nutritional formula enriched with arginine, zinc, and antioxidants for the healing of pressure ulcers: a randomized trial. *Annals of Internal Medicine*, 162(3), 167-74
2. V. Pouyssegur, P. Brocker, S. M. Schneider, J. L. Philip, P. Barat, E. Reichert, F. Breugnon, D. Brunet, B. Civalieri, J. P. Solere, L. Bensussan, L. Lupi-Pegurier (2015). An innovative solid oral nutritional supplement to fight weight loss and anorexia: open, randomised controlled trial of efficacy in institutionalised, malnourished older adults. *Age & Ageing*, 44(2), 245-51

3. Stern, N. Mitsakakis, M. Paulden, S. Alibhai, J. Wong, G. Tomlinson, A. S. Brooker, M. Krahn, M. Zwarenstein (2014). Pressure ulcer multidisciplinary teams via telemedicine: a pragmatic cluster randomized stepped wedge trial in long term care. *BMC Health Services Research*, 14, 83
4. N. Bergstrom, S. D. Horn, M. Rapp, A. Stern, R. Barrett, M. Watkiss and M. Krahn. Preventing Pressure Ulcers: A Multisite Randomized Controlled Trial in Nursing Homes. *Ont Health Technol Assess Ser.* 2014. 14:1-32
5. D. Beeckman, E. Clays, A. Van Hecke, K. Vanderwee, L. Schoonhoven, S. Verhaeghe (2013). A multi-faceted tailored strategy to implement an electronic clinical decision support system for pressure ulcer prevention in nursing homes: a two-armed randomized controlled trial. *International journal of nursing studies*, 50(4), 475-86
6. K. Sakae, T. Agata, R. Kamide, H. Yanagisawa (2013). Effects of L-carnosine and its zinc complex (Polaprezinc) on pressure ulcer healing. *Nutrition in clinical practice*, 28(5), 609-16
7. M. van Leen, S. Hovius, R. Halfens, J. Neyens, J. Schols (2013). Pressure relief with visco-elastic foam or with combined static air overlay? A prospective, crossover randomized clinical trial in a dutch nursing home. *Wounds*, 25(10), 287-92
8. N. Bergstrom, S. D. Horn, M. P. Rapp, A. Stern, R. Barrett, M. Watkiss (2013). Turning for Ulcer ReductioN: a multisite randomized clinical trial in nursing homes. *Journal of the American Geriatrics Society*, 61(10), 1705-13
9. T. L. Yap, S. M. Kennerly, M. R. Simmons, C. R. Buncher, E. Miller, J. Kim, W. Y. Yap (2013). Multidimensional team-based intervention using musical cues to reduce odds of facility-acquired pressure ulcers in long-term care: a paired randomized intervention study. *Journal of the American Geriatrics Society*, 61(9), 1552-9
10. Z. Moore, S. Cowman, J. Posnett (2013). An economic analysis of repositioning for the prevention of pressure ulcers. *Journal of Clinical Nursing*, 22(15-16), 2354-60
11. D. Beeckman, E. Clays, A. Van Hecke, K. Vanderwee, L. Schoonhoven and S. Verhaeghe. A multi-faceted tailored strategy to implement an electronic clinical decision support system for pressure ulcer prevention in nursing homes: a two-armed randomized controlled trial. *Int J Nurs Stud.* 2013. 50:475-86
12. M. Fossum, M. Ehnfors, E. Svensson, L. M. Hansen and A. Ehrenberg. Effects of a computerized decision support system on care planning for pressure ulcers and malnutrition in nursing homes: an intervention study. *Int J Med Inform.* 2013. 82:911-21
13. N. Bergstrom, S. D. Horn, M. P. Rapp, A. Stern, R. Barrett and M. Watkiss. Turning for Ulcer ReductioN: a multisite randomized clinical trial in nursing homes. *J Am Geriatr Soc.* 2013. 61:1705-13
14. J. Twersky, T. Montgomery, R. Sloane, M. Weiner, S. Doyle, K. Mathur, M. Francis, K. Schmader (2012). A randomized, controlled study to assess the effect of silk-like textiles and high-absorbency adult incontinence briefs on pressure ulcer prevention. *Ostomy Wound Management*, 58(12), 18-24
15. K. Lam, K. K. Lau, K. K. So, C. K. Tam, Y. M. Wu, G. Cheung, K. S. Liang, K. M. Yeung, K. Y. Lam, S. Yui, C. Leung (2012). Can botulinum toxin decrease carer burden in long term care residents with upper limb spasticity? A randomized controlled study. *Journal of the American Medical Directors Association*, 13(5), 477-84
16. M. J. Rantz, M. Zwygart-Stauffacher, L. Hicks, D. Mehr, M. Flesner, G. F. Petroski, R. W. Madsen, J. Scott-Cawiezell (2012). Randomized multilevel intervention to improve outcomes of residents in nursing homes in need of improvement. *Journal of the American Medical Directors Association*, 13(1), 60-8
17. R. J. Shannon, L. Brown, D. Chakravarthy (2012). Pressure Ulcer Prevention Program Study: a randomized, controlled prospective comparative value evaluation of 2 pressure ulcer prevention

- strategies in nursing and rehabilitation centers. *Advances in Skin and Wound Care*, 25(10), 450-64
18. E. W. Kwong, A. T. Lau, R. L. Lee, R. Y. Kwan (2011). A pressure ulcer prevention programme specially designed for nursing homes: does it work? *Journal of Clinical Nursing*, 20(19-20), 2777-86
  19. M. van Leen, S. Hovius, J. Neyens, R. Halfens, J. Schols (2011). Pressure relief, cold foam or static air? A single center, prospective, controlled randomized clinical trial in a Dutch nursing home. *Journal of Tissue Viability*, 20(1), 30-4
  20. D. Brienza, S. Kelsey, P. Karg, A. Allegretti, M. Olson, M. Schmeler, J. Zanca, M. J. Geyer, M. Kusturiss, M. Holm (2010). A randomized clinical trial on preventing pressure ulcers with wheelchair seat cushions. *Journal of the American Geriatrics Society*, 58(12), 2308-14
  21. P. Mistiaen, W. Achterberg, A. Ament, R. Halfens, J. Huizinga, K. Montgomery, H. Post, P. Spreeuwenberg, A. L. Francke (2010). The effectiveness of the Australian Medical Sheepskin for the prevention of pressure ulcers in somatic nursing home patients: a prospective multicenter randomized-controlled trial. *Wound repair and regeneration*, 18(6), 572-9
  22. N. A. Stotts, H. W. Hopf, J. Kayser-Jones, G. M. Chertow, B. A. Cooper, H. S. Wu (2009). Increased fluid intake does not augment capacity to lay down new collagen in nursing home residents at risk for pressure ulcers: a randomized, controlled clinical trial. *Wound repair and regeneration*, 17(6), 780-8
  23. G. Duimel-Peeters, J. G. Halfens R, A. W. Ambergen, R. H. Houwing, P. F. Berger M, L. H. Snoeckx (2007). The effectiveness of massage with and without dimethyl sulfoxide in preventing pressure ulcers: a randomized, double-blind cross-over trial in patients prone to pressure ulcers. *International journal of nursing studies*, 44(8), 1285-95
  24. J. Lynn, J. West, S. Hausmann, D. Gifford, R. Nelson, P. McGann, N. Bergstrom, J. A. Ryan (2007). Collaborative clinical quality improvement for pressure ulcers in nursing homes. *Journal of the American Geriatrics Society*, 55(10), 1663-9
  25. K. Vanderwee, M. H. Grypdonck, D. De Bacquer, T. Defloor (2007). Effectiveness of turning with unequal time intervals on the incidence of pressure ulcer lesions. *Journal of advanced nursing*, 57(1), 59-68
  26. N. R. Al-Samarrai, G. C. Uman, T. Al-Samarrai, C. A. Alessi (2007). Introducing a new incontinence management system for nursing home residents. *Journal of the American Medical Directors Association*, 8(4), 253-61
  27. R. Buckland (2007). Evaluating two dynamic mattresses in a nursing home setting. *British Journal of Nursing*, 16(11), S28-32
  28. D. R. Thomas, M. R. Diebold, L. M. Eggemeyer (2005). A controlled, randomized, comparative study of a radiant heat bandage on the healing of stage 3-4 pressure ulcers: a pilot study. *Journal of the American Medical Directors Association*, 6(1), 46-9
  29. J. K. Stechmiller, B. Langkamp-Henken, B. Childress, K. A. Herrlinger-Garcia, J. Hudgens, L. Tian, S. S. Percival, R. Steele (2005). Arginine supplementation does not enhance serum nitric oxide levels in elderly nursing home residents with pressure ulcers. *Biological research for nursing*, 6(4), 289-99

## **Infection**

1. L. Mody, S. L. Krein, S. K. Saint, L. C. Min, A. Montoya, B. Lansing, S. E. McNamara, K. Symons, J. Fisch, E. Koo, R. A. Rye, A. Galecki, M. U. Kabeto, J. T. Fitzgerald, R. N. Olmsted, C. A. Kauffman, S. F. Bradley (2015). A targeted infection prevention intervention in nursing home residents

- with indwelling devices: a randomized clinical trial. *JAMA International Medicine*, 175(5), 714-23
2. M. Gregersen, E. M. Damsgaard, L. C. Borris (2015). Blood transfusion and risk of infection in frail elderly after hip fracture surgery: the TRIFE randomized controlled trial. *European journal of orthopaedic surgery & traumatology*, 25(6), 1031-8
  3. D. M. Schora, S. Boehm, S. Das, P. A. Patel, J. O'Brien, C. Hines, D. Burdsall, J. Beaumont, K. Peterson, M. Fausone, L. R. Peterson (2014). Impact of Detection, Education, Research and Decolonization without Isolation in Long-term care (DERAIL) on methicillin-resistant *Staphylococcus aureus* colonization and transmission at 3 long-term care facilities. *American Journal of Infection Control*, 42(10 Suppl), S269-73
  4. M. A. Caljouw, W. B. van den Hout, H. Putter, W. P. Achterberg, H. J. Cools, J. Gussekloo (2014). Effectiveness of cranberry capsules to prevent urinary tract infections in vulnerable older persons: a double-blind randomized placebo-controlled trial in long-term care facilities. *Journal of the American Geriatrics Society*, 62(1), 103-10
  5. M. Handeland, N. Grude, T. Torp, R. Slimestad (2014). Black chokeberry juice (*Aronia melanocarpa*) reduces incidences of urinary tract infection among nursing home residents in the long term--a pilot study. *Nutrition research*, 34(6), 518-25
  6. W. B. van den Hout, M. A. Caljouw, H. Putter, H. J. Cools, J. Gussekloo (2014). Cost-effectiveness of cranberry capsules to prevent urinary tract infection in long-term care facilities: economic evaluation with a randomized controlled trial. *Journal of the American Geriatrics Society*, 62(1), 111-6
  7. S. Y. Lin (2013). A pilot study: fluid intake and bacteriuria in nursing home residents in southern Taiwan. *Nursing Research*, 62(1), 66-72
  8. K. T. Snider, E. J. Snider, J. C. Johnson, C. Hagan, C. Schoenwald (2012). Preventative osteopathic manipulative treatment and the elderly nursing home resident: a pilot study. *Journal of the American Osteopathic Association*, 112(8), 489-501
  9. K. Van Puyenbroeck, N. Hens, S. Coenen, B. Michiels, C. Beunckens, G. Molenberghs, P. Van Royen, V. Verhoeven (2012). Efficacy of daily intake of *Lactobacillus casei* Shirota on respiratory symptoms and influenza vaccination immune response: a randomized, double-blind, placebo-controlled trial in healthy elderly nursing home residents. *American journal of clinical nutrition*, 95(5), 1165-71
  10. M. L. Ho, W. H. Seto, L. C. Wong, T. Y. Wong (2012). Effectiveness of multifaceted hand hygiene interventions in long-term care facilities in Hong Kong: a cluster-randomized controlled trial. *Infection Control & Hospital Epidemiology*, 33(8), 761-7
  11. M. Laffan, R. McKenzie, J. Forti, D. Conklin, R. Marcinko, R. Shrestha, M. Bellantoni, W. B. Greenough (2011). Lactoferrin for the prevention of post-antibiotic diarrhea. *Journal of health, population, and nutrition*, 29(6), 547-51

### **Medication Error/Adverse Drug Events**

1. F. Konner, A. Budnick, R. Kuhnert, I. Wulff, S. Kalinowski, P. Martus, D. Drager, R. Kreutz (2015). Interventions to address deficits of pharmacological pain management in nursing home residents - A cluster-randomized trial. *European Journal of Pain*, 19(9), 1331-41
2. D. Frankenthal, Y. Lerman, E. Kalendaryev, Y. Lerman (2014). Intervention with the screening tool of older persons potentially inappropriate prescriptions/screening tool to alert doctors to right treatment criteria in elderly residents of a chronic geriatric facility: a randomized clinical trial. *Journal of the American Geriatrics Society*, 62(9), 1658-65

3. E. Fleet, G. Gopal Rao, B. Patel, B. Cookson, A. Charlett, C. Bowman, P. Davey. Impact of implementation of a novel antimicrobial stewardship tool on antibiotic use in nursing homes: a prospective cluster randomized control pilot study. *Journal of Antimicrobial Chemotherapy*. 2014. 69:2265-73
4. F. Garcia-Gollarte, J. Baleriola-Julvez, I. Ferrero-Lopez, A. Cuenllas-Diaz, A. J. Cruz-Jentoft (2014). An educational intervention on drug use in nursing homes improves health outcomes resource utilization and reduces inappropriate drug prescription. *Journal of the American Medical Directors Association*, 15(12), 885-91
5. F. Jodar-Sanchez, J. J. Martin, M. P. Lopez del Amo, L. Garcia, J. M. Araujo-Santos, D. Epstein (2014). Cost-utility analysis of a pharmacotherapy follow-up for elderly nursing home residents in Spain. *Journal of the American Geriatrics Society*, 62(7), 1272-80
6. S. Zimmerman, P. D. Sloane, R. Bertrand, L. E. Olsho, A. Beeber, C. Kistler, L. Hadden, A. Edwards, D. J. Weber, C. M. Mitchell (2014). Successfully reducing antibiotic prescribing in nursing homes. *Journal of the American Geriatrics Society*, 62(5), 907-12
7. F. Toscani, P. Di Giulio, D. Villani, F. Giunco, C. Brunelli, S. Gentile, S. Finetti, L. Charrier, M. Monti, J. T. van der Steen (2013). Treatments and prescriptions in advanced dementia patients residing in long-term care institutions and at home. *Journal of palliative medicine*, 16(1), 31-7
8. C. Verrue, E. Mehuys, K. Boussery, E. Adriaens, J. P. Remon, M. Petrovic (2012). A pharmacist-conducted medication review in nursing home residents: impact on the appropriateness of prescribing. *Acta clinica Belgica*, 67(6), 423-9
9. M. Laffan, R. McKenzie, J. Forti, D. Conklin, R. Marcinko, R. Shrestha, M. Bellantoni, W. B. Greenough (2011). Lactoferrin for the prevention of post-antibiotic diarrhea. *Journal of health, population, and nutrition*, 29(6), 547-51
10. Boockvar KS, Carlson LaCorte H, Giambanco V, et al. Medication reconciliation for reducing drug-discrepancy adverse events. *Am J Geriatr Pharmacother*. 2006; 4(3):236–243. [PubMed: 17062324]
11. E. Hutt, G. A. Pepper, C. Vojir, R. Fink, K. R. Jones (2006). Assessing the appropriateness of pain medication prescribing practices in nursing homes. *Journal of the American Geriatrics Society*, 54(2), 231-9
12. Madden C, Garrett J, Busby-Whitehead J. The interface between nursing homes and emergency departments: A community effort to improve transfer of information. *Acad Emerg Med*. 1998; 5:1123–1126. [PubMed: 9835479]

## References

1. Vlaeyen E, Coussement J, Leysens G, et al. Characteristics and effectiveness of fall prevention programs in nursing homes: a systematic review and meta-analysis of randomized controlled trials. *J Am Geriatr Soc* 2015 Feb;63(2):211-21. PMID: 25641225.
2. Santesso N, Carrasco-Labra A, Brignardello-Petersen R. Hip protectors for preventing hip fractures in older people. *Cochrane Database of Systematic Reviews* 2014;3:CD001255. PMID: 24687239.
3. Cameron ID, Gillespie LD, Robertson MC, et al. Interventions for preventing falls in older people in care facilities and hospitals. *Cochrane Database Syst Rev* 2012;12:CD005465. PMID: 23235623.
4. Anderson O, Boshier PR, Hanna GB. Interventions designed to prevent healthcare bed-related injuries in patients. *Cochrane Database Syst Rev* 2011(11):Cd008931. PMID: 22071860.
5. Howe Tracey E, Rochester L, Neil F, et al. Exercise for improving balance in older people. *Cochrane Database of Systematic Reviews* 2011(11)PMID: CD004963.
6. Sawka AM, Ismaila N, Cranney A, et al. A scoping review of strategies for the prevention of hip fracture in elderly nursing home residents. *PloS one* 2010 2010/03/03;5(3):e9515.
7. Sawka AM, Boulos P, Beattie K, et al. Hip protectors decrease hip fracture risk in elderly nursing home residents: a Bayesian meta-analysis. *Journal of clinical epidemiology* 2007 2007/04/23;60(4):336-44.
8. Sawka AM, Boulos P, Beattie K, et al. Do hip protectors decrease the risk of hip fracture in institutional and community-dwelling elderly? A systematic review and meta-analysis of randomized controlled trials. *Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA* 2005 2005/12/01;16(12):1461-74.
9. Silva RB, Eslick GD, Duque G. Exercise for falls and fracture prevention in long term care facilities: a systematic review and meta-analysis. *J Am Med Dir Assoc* 2013 Sep;14(9):685-9.e2. PMID: 23860265.
10. Balzer K, Bremer M, Schramm S, et al. Falls prevention for the elderly. *GMS Health Technol Assess* 2012;8:Doc01. PMID: 22536299.
11. Choi M, Hector M. Effectiveness of intervention programs in preventing falls: a systematic review of recent 10 years and meta-analysis. *Journal of the American Medical Directors Association* 2012;13(2):188.e13-21. PMID: 21680249.
12. Chua GT, Wong RY. Association Between Vitamin D Dosing Regimen and Fall Prevention in Long-term Care Seniors. *Can Geriatr J* 2011 Dec;14(4):93-9. PMID: 23251320.
13. Cusimano MD, Kwok J, Spadafora K. Effectiveness of multifaceted fall-prevention programs for the elderly in residential care. *Inj Prev* 2008 Apr;14(2):113-22. PMID: 18388232.
14. Oliver D, Connolly JB, Victor CR, et al. Strategies to prevent falls and fractures in hospitals and care homes and effect of cognitive impairment: systematic review and meta-analyses. *Bmj* 2007 Jan 13;334(7584):82. PMID: 17158580.
15. Gillespie BM, Chaboyer WP, McInnes E, et al. Repositioning for pressure ulcer prevention in adults. *Cochrane Database Syst Rev* 2014;4:CD009958. PMID: 24700291.
16. Chou R, Dana T, Bougatsos C, et al. Pressure Ulcer Risk Assessment and Prevention: Comparative Effectiveness. 2013 May PMID: 23762918.
17. Saha S, Smith MEB, Totten A, et al. Pressure Ulcer Treatment Strategies: Comparative Effectiveness. 2013 May PMID: 23785727.
18. Sullivan N, Schoelles KM. Preventing in-facility pressure ulcers as a patient safety strategy: a systematic review. *Ann Intern Med* 2013 Mar 5;158(5 Pt 2):410-6. PMID: 23460098.
19. Niederhauser A, VanDeusen Lukas C, Parker V, et al. Comprehensive programs for preventing pressure ulcers: a review of the literature. *Adv Skin Wound Care* 2012 Apr;25(4):167-88; quiz 89-90. PMID: 22441049.

20. . Pressure ulcer prevention: an evidence-based analysis. *Ont Health Technol Assess Ser* 2009;9(2):1-104. PMID: 23074524.
21. Cullum N, Petherick E. Pressure ulcers. *BMJ Clin Evid* 2008;2008PMID: 19450317.
22. Reddy M, Gill SS, Kalkar SR, et al. Treatment of pressure ulcers: a systematic review. *JAMA* 2008 Dec 10;300(22):2647-62. PMID: 19066385.
23. Hughes C, Tunney M, Bradley Marie C. Infection control strategies for preventing the transmission of methicillin-resistant *Staphylococcus aureus* (MRSA) in nursing homes for older people. *Cochrane Database of Systematic Reviews* 2013(11)PMID: CD006354.
24. Uchida M, Pogorzelska-Maziarz M, Smith PW, et al. Infection prevention in long-term care: a systematic review of randomized and nonrandomized trials. *Journal of the American Geriatrics Society* 2013;61(4):602-14. PMID: 23581914.
25. Sjögren P, Nilsson E, Forsell M, et al. A systematic review of the preventive effect of oral hygiene on pneumonia and respiratory tract infection in elderly people in hospitals and nursing homes: effect estimates and methodological quality of randomized controlled trials. *Journal of the American Geriatrics Society* 2008 2008/11/15;56(11):2124-30.
26. Clegg A, Siddiqi N, Heaven A, et al. Interventions for preventing delirium in older people in institutional long-term care. *Cochrane Database Syst Rev* 2014;1:CD009537. PMID: 24488526.
27. Patterson Susan M, Cadogan Cathal A, Kerse N, et al. Interventions to improve the appropriate use of polypharmacy for older people. *Cochrane Database of Systematic Reviews* 2014(10)PMID: CD008165.
28. Wallerstedt SM, Kindblom JM, Nylén K, et al. Medication reviews for nursing home residents to reduce mortality and hospitalization: systematic review and meta-analysis. *British journal of clinical pharmacology* 2014 2014/02/18;78(3):488-97.
29. Alldred DP, Raynor DK, Hughes C, et al. Interventions to optimise prescribing for older people in care homes. *Cochrane Database Syst Rev* 2013;2:CD009095. PMID: 23450597.
30. Fleming A, Browne J, Byrne S. The effect of interventions to reduce potentially inappropriate antibiotic prescribing in long-term care facilities: a systematic review of randomised controlled trials. *Drugs Aging* 2013 Jun;30(6):401-8. PMID: 23444263.
31. Chhabra PT, Rattinger GB, Dutcher SK, et al. Medication reconciliation during the transition to and from long-term care settings: a systematic review. *Res Social Adm Pharm* 2012 Jan-Feb;8(1):60-75. PMID: 21511543.
32. Forsetlund L, Eike MC, Gjerberg E, et al. Effect of interventions to reduce potentially inappropriate use of drugs in nursing homes: a systematic review of randomised controlled trials. *BMC Geriatr* 2011;11:16. PMID: 21496345.
33. Marasinghe KM. Computerised clinical decision support systems to improve medication safety in long-term care homes: a systematic review. *BMJ Open* 2015;5(5):e006539. PMID: 25967986.
34. Tjia J, Velten SJ, Parsons C, et al. Studies to reduce unnecessary medication use in frail older adults: a systematic review. *Drugs Aging* 2013 May;30(5):285-307. PMID: 23475597.
35. Loganathan M, Singh S, Franklin BD, et al. Interventions to optimise prescribing in care homes: systematic review. *Age Ageing* 2011 Mar;40(2):150-62. PMID: 21262782.
36. LaMantia MA, Scheunemann LP, Viera AJ, et al. Interventions to improve transitional care between nursing homes and hospitals: a systematic review. *J Am Geriatr Soc* 2010 Apr;58(4):777-82. PMID: 20398162.