



Adverse Events and Their Contributors Among Older Adults During Skilled Nursing Stays for Rehabilitation: A Scoping Review

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Purpose: To identify factors that contribute to adverse events among older adults during short stays at skilled nursing facilities (SNFs) for rehabilitation (ie, up to 100 resident days). Adults aged 65 years and older are at serious risk for adverse events throughout their continuum of care. Over 33% of older adults admitted to SNFs experienced an adverse event (eg, falls) within the first 35 days of their stay.

Design: A scoping review.

Setting and Participants: Older adults admitted for short stays in SNFs.

Methods: Eligibility criteria were peer-reviewed original articles published between 1 January 2015 and 30 May 2021, written in English, and containing any of the following key terms and synonyms: “skilled nursing facilities”, “adverse events”, and “older adults”. These terms were searched in PubMed, MEDLINE, CINAHL, EBSCOHost, and the ProQuest Nursing and Allied Health Database. We summarized the findings using the Joanna Briggs Institute and PRISMA-ScR reporting guidelines. We also used the Capability-Opportunity-Motivation-Behavior (COM-B) model of health behavioral change as a framework to guide the content, thematic, and descriptive analyses of the results.

Results: Eleven articles were included in this scoping review. Intrinsic and extrinsic contributors to adverse events (ie, falls, medication errors, pressure ulcers, and acute infections) varied for each COM-B domain. The most frequently mentioned capacity-related intrinsic contributors to adverse events were frailty and reduced muscle strength due to advancing age. Inappropriate medication usage and polypharmacy were the most common capacity-related extrinsic factors. Opportunity-related extrinsic factors contributing to adverse events included environmental hazards, poor communication among SNF staff, lack of individualized resident safety plans, and overall poor care quality owing to racial bias and organizational and administrative issues.

Conclusion: These findings shed light on areas that warrant further research and may aid in developing interventional strategies for adverse events during short SNF stays.

Keywords: older adults, adverse events, skilled nursing facilities, rehabilitation, short stays, risk factors

Introduction

The US Department of Health and Human Services and the Agency for Healthcare Research and Quality (AHRQ) acknowledge that adults aged 65 years and older are at serious risk for adverse events throughout their continuum of care.^{1,2} In 2014, the Office of the Inspector General reported that more than 33% of skilled nursing facility (SNF) beneficiaries experienced an adverse event or temporary-harm event

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within the first 35 days of their stay.¹ In this context, “adverse event” describes any medical care-related harm or injury, including the failure to provide needed care.^{1–3} Adverse events, such as falls, falls with injuries, medical errors, and substandard care, are common among older adults. Adverse events can result in preventable harms (eg, healthcare-acquired infections, adverse drug events, malnutrition, pressure ulcers, and medication errors) during care delivery to older adults.^{1,3,4}

Adverse events among older adults occur most often in the immediate post-hospitalization period,^{1,3} owing to several factors that can be classified as either intrinsic or extrinsic.^{5,6} Intrinsic factors are individual-related factors such as age, fear of falling, cognition, health condition, and medications.^{6,7} Extrinsic factors are external to the individual, including influences from outside the individual, such as the environment and social and cultural influences.^{6,7} Although older adults in SNFs are considered the most vulnerable to adverse events,¹ insufficient evidence exists to support the degree of vulnerability or determine the reasons for this pattern. Additionally, because more research focuses on older adults in acute hospital settings compared with SNFs which have been shown in research to admit more acute older adults for rehabilitative care;^{3,8–10} it is therefore plausible that the frequency of adverse events occurrence in SNFs may be higher than recorded in the literature.

According to the United States Center for Disease Control and Prevention, 14% of adults aged 65 years and over experience a repeat fall within 1-month post-hospitalization or visit the emergency room for a fall-related issue.¹¹ Milat et al reported that 40% of older adults fall within 6 months post-discharge and thus require continued assistance for up to 6 months post-discharge.¹² In an epidemiological study, Kapoor et al found that 40% of older adults admitted to long-term care facilities post-hospitalization experience adverse events such as falls and infections within 45 days after admission.³ Given the frequency of adverse events in SNFs, we explored the risk factors associated with adverse events in SNFs and analyzed the relationships between these risk factors and adverse events among older adults admitted for short stays in SNFs. This scoping review explores the evidence in the literature reporting extrinsic and intrinsic risk factors that contribute to adverse events among older adults admitted to SNFs for short-stay rehabilitation. In this study, we defined short stays as SNF stays up to 100 resident days for rehabilitative care.

Study Rationale and Objectives

We conducted a scoping review of the peer-reviewed published journal literature to (1) identify the extent, range, and quantity of evidence available regarding short-stay rehabilitative care for older adults in SNFs (up to 100 days) and factors that contribute to related adverse events (ie, fall/fall injuries, pressure ulcers, medication errors, and acute infections); (2) map and describe these factors (intrinsic and extrinsic) using the Capability-Opportunity-Motivation-Behavior (COM-B) model of health behavioral changes¹³ as a framework, and (3) determine existing gaps in the research. The COM-B model categorizes behavioral change strategies into three groups: capability (eg, physical or psychological-related changes), opportunity (eg, physical opportunities afforded by the environment or social opportunities afforded by cultural milieu), and motivation (eg, reflective-related or planned changes, as well as automatic-related or impulse changes). This model could support intervention designs and improve intervention evaluation and theory development.¹³ The overarching research question was What are the intrinsic and extrinsic factors contributing to adverse events (ie, falls/fall injuries, pressure ulcers, medication errors, and acute infections) among older adults during short SNF stays for rehabilitation?

Materials and Methods

We systematically searched and reviewed articles within the disciplines of nursing, medicine, and geriatrics, using the Joanna Briggs Institute (JBI) guideline for scoping reviews¹⁴ based on the Arksey and O’Malley methodological framework.¹⁵ Our search strategy focused on both primary and secondary sources (including systematic reviews) that described adverse events among older adult residents in nursing homes. The major adverse events we focused on were falls, falls with injuries, pressure ulcers, medication errors, and acute infections. We followed the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-SCR).¹⁶

Protocol and Registration

No published or registered protocol was in place before the study commenced.

Eligibility Criteria

Articles were included if they met the following criteria: 1) were peer-reviewed, 2) reported associations, predictors,

correlations, associations, and/or relationships between falls/fall injuries (or other adverse events such as medication errors, infections, and pressure ulcers) and older adults' characteristics, 3) included older adults admitted to SNFs for short-stay rehabilitative care, and 4) were published between 01 January 2015 and 30 May 2021 and were written in English.

Information Sources and Search Strategy

We worked with a librarian to identify three conceptual groups of combined and individually adapted terms for each database-specific search. These terms included “skilled nursing facilities” (including synonyms), “adverse events” (including falls, pressure ulcers, medication errors, and acute infections as synonyms), and older adults (including synonyms). Table 1 shows the search syntax generated and modified to each electronic database. Studies were identified by searching these databases and hand-searching reference lists of the included articles.

The following databases were searched: Medline-Ovid (1 January 2015 to 30 May 2021), PubMed (1 January 2015 to 30 May 2021), Cumulative Index to Nursing and Allied Health Literature (CINAHL; 1 January 2015 to 30 May 2021), EBSCOHost (1 January 2015 to 30 May 2021), and the ProQuest Nursing and Allied Health Database (1 January 2015 to 30 May 2021). The initial search was performed between 10 November 2020 and 15 December 2020, with two updated searches on 30 January 2021 and 30 May 2021. We hand-searched references of the included articles and used the snowballing method to identify relevant papers. No gray literature was included in the complimentary searches.

Selection of Evidence Sources

Both authors screened the citations and articles against the preset inclusion criteria described in the section titled “Eligibility criteria”. We applied two iterations of the same approach to identify articles for inclusion. First, we screened the titles and abstracts of all articles collated from the library databases and removed the duplicates. Next, we retrieved the full texts of the remaining articles and reviewed them for relevance (according to the study's research question), assigning a score of either 0 (not relevant to the research question) or 1 (relevant to the research question). We then discussed conflicts and discrepancies between inter-rater scores and resolved them by discussion. The overall inter-rater reliability Kappa score was

Table 1 Keyword Search Syntax and Search Strategy for the Five Library Databases (PubMed, MEDLINE, CINAHL, EBSCOHost, and ProQuest Nursing and Allied Health Database)

| |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.Older adult\$/ |
| 2.Older adj1 adult\$ or senior\$ or the adj2 elderly or the adj2 aged or geriatr\$.ti.ab |
| 3.Falls |
| 4.Fall\$ or accidental adj2 fall\$ or fall adj2 injur\$ or fall adj2 fracture\$ or adverse adj3 event\$ or pressure adj1 sore\$ or medication adj1 error\$ or infection\$.ti.ab |
| 5.Skilled nursing facilities |
| 6.Skilled adj1 nursing adj1 hom\$ or nursing adj2 hom\$ or nursing adj2 facilit\$ or sub-acute adj3 care or post-acute adj3 care or chronic adj1 care adj1 facilit\$ or skilled adj1 nursing adj1 facilit\$ or short adj1 stay or respite adj1 care or convalescent adj3 care.ti.ab |
| 7.#2 AND #6 |
| 8.#4 AND #7 |

Notes: The search items in Table 1 uses truncation (eg, \$) at the end of a word to facilitate finding the word in its several endings or spelling styles. For example, geriatr\$ would find geriatrics, geriatric, geriatrician, etc., without entering them manually. Same for facility\$ for facility, or facilities where necessary. Adj operators in our table were used to find two or more terms adjacent to each other. For example, adj1 would find terms right next to each other, adj2 would find terms in any other with one word between them, and adj3 will find terms in any order with one to two words between them. For instance, older Adj1 adults would find the word older adults, and nursing adj2 home will find the word nursing home or nursing “care” home (assuming the word care was included in between them). These codes were put together with the help of a professional librarian to ensure a comprehensive search of keywords and Mesh terms.

0.846 (standard error = 0.147, $p = 0.001$). All citations were imported or manually entered using the reference manager, Endnote X9.¹⁷

Data Charting and Data Items

We extracted the following preidentified data from the final selected articles: author names, title and date of publication, study type, design, data collection methods, study setting and country, adverse event types, length of stay in SNF, intrinsic and extrinsic factors that contributed to each adverse event among older adults during rehabilitation or respite care, study gaps, and lessons learned. For each selected study, both authors extracted and coded the data for intrinsic and extrinsic factors as described from each included article, using the COM-B model of health behavioral change as a framework.¹³ Using this framework, we characterized the intrinsic and extrinsic factors related to specified adverse events among older adults during short stays in SNFs to determine behavioral strategies that could

mitigate these factors.¹³ All data were compiled into a spreadsheet using Microsoft Excel 2016.¹⁸

Critical Appraisal of Individual Evidence Sources

We appraised each included article's characteristics and methodological quality using the JBI critical appraisal tool for quantitative studies (eg, randomized clinical, prospective, retrospective, and cross-sectional studies).¹⁹ The JBI critical appraisal tool enables evaluating the rigor, trustworthiness, relevance, and potential for bias in study designs, conduct, and analysis.¹⁹ Please see the [Supplementary Materials Tables 1–4](#) for the critical appraisal data of the included studies using the JBI critical appraisal tools for study designs.

Synthesis of Results

We used the COM-B model of health behavioral change to analyze the data and descriptive results of this scoping review. The COM-B model categorizes behavioral change strategies into one of three groups: capability, opportunity, or motivation.¹³ Using this model may help design interventions and improve intervention evaluation and theory development.¹³ We characterized the behavioral change strategies related to preventing the predefined adverse events among older adults during short SNF stays for rehabilitation. Both authors met weekly via the internet to review codes and themes from the data analyses. Conflicting themes were resolved by discussion.

Results

Selection of Evidence Sources

We identified 325 articles from five databases (n=311) and by hand-searching/snowballing (n=14). Of these 325 articles, 78 were duplicates, resulting in 247 articles to be further screened. After screening the title and abstracts, we excluded 121 articles, leaving 126 articles for which we retrieved and assessed the full texts for eligibility. After screening the full texts, we excluded 115 articles, leaving 11 articles for data extraction and final review. Full-text articles were excluded from final screening for the following reasons: 1) no indication of a subacute or post-acute rehabilitation stay in a nursing home or SNF, 2) no indication of adverse events during the nursing home or SNF stay, 3) article was not written in English, or 4) article was not an original study (ie, discussion paper, commentary, essay, or dissertation) (Figure 1).

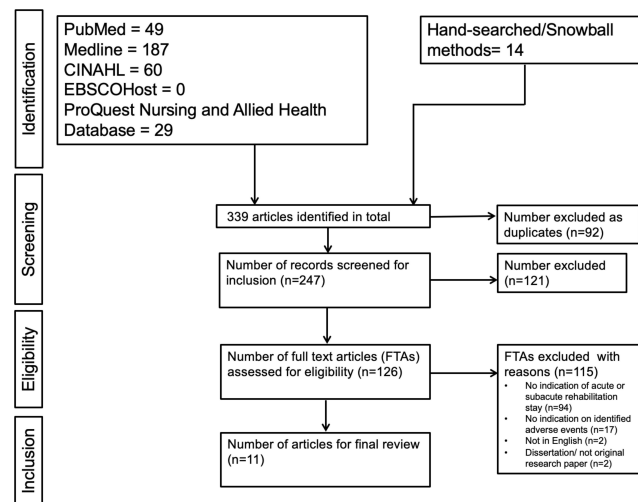


Figure 1 PRISMA flowchart showing the article selection process for the scoping review.

Note: Adapted from Tricco AC, Lillie E, Zarin W, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med.* 2018;169(7):467–473. doi:10.7326/M18-0850.¹⁶

Characteristics of Evidence Sources

Table 2 summarizes the general and methodological characteristics of the 11 reviewed articles. Of these, three were published in 2015, two in 2016, three in 2017, two in 2018, and one in 2019. We found no articles published in 2020 or 2021. Ten (90.9%) were quantitative studies, and one (9.9%) used a mixed method. Four (36.4%) used a cross-sectional design, three (27.3%) were prospective, and four (36.4%) were retrospective. Six studies (54.5%) were conducted in the United States, and three were conducted in the Netherlands. One study mentioned multiple adverse events. Falls and fall injuries were the most common adverse events (10 studies, 90.9%), followed by two studies reporting medication errors, one reporting pressure ulcers, and one reporting acute infections. Six (54.5%) of the included studies indicated length of stay; five (45.5%) did not. We contacted the corresponding authors of these studies to confirm the participants' length of stay. Table 3 summarizes the characteristics of the included studies.

Synthesis of Results

Table 4 describes the intrinsic factors (left column) and extrinsic factors (right column) that contributed to adverse events among older adults during short SNF stays for rehabilitation as reported in all included studies. We coded them with identifiers corresponding to the COM-B framework¹³ where “C” indicates capability, “O” indicates

Table 2 General and Methodological Characteristics of the 11 Included Quantitative Articles Published Between 2015 and 2021

| Publication Year | n (%) | Article Citations |
|-----------------------------------------------------------------------------|-----------|-------------------|
| 2015 | 3 (27.3) | [21,24,27] |
| 2016 | 2 (18.2) | [23,25] |
| 2017 | 3 (27.3) | [22,26,29] |
| 2018 | 2 (18.2) | [6,28] |
| 2019 | 1 (9.1) | [20] |
| Study type | n (%) | Article citations |
| Quantitative | 10 (90.9) | [6,20–24,26–29] |
| Mixed method (including both qualitative and quantitative data collections) | 1 (9.1) | [25] |
| Study design | n (%) | Article citations |
| Cross-sectional | 4 (36.4) | [21,22,25,29] |
| Prospective | 3 (27.3) | [6,26,27] |
| Retrospective | 4 (36.4) | [20,23,24,28] |
| Data collection methods | n (%) | Article citations |
| Structured survey questionnaires | 6 (54.5) | [6,21,22,26–28] |
| Semi-structured questionnaire | 1 (9.1) | [25] |
| Retrospective data collection | 4 (36.4) | [20,23,24,29] |
| Country | n (%) | Article citations |
| Canada | 1 (9.1) | [28] |
| Norway | 1 (9.1) | [29] |
| The Netherlands | 3 (27.3) | [23,26,27] |
| United States | 6 (54.5) | [6,20–22,24,25] |
| Adverse event type | n (%) | Article citations |
| Falls/fall injuries | 10 (90.9) | [6,20–28] |
| Pressure ulcers | 1 (9.1) | [25] |
| Medication errors | 2 (18.2) | [21,29] |
| Acute infections | 1 (9.1) | [25] |
| Length of stay in the skilled nursing facilities | n (%) | Article citations |
| Up to 100 days (short stay) | 4 (36.4) | [20,21,25,28] |
| More than 100 days (long days) | 0 (0.0) | – |
| Variable (mix of short and long stays) | 2 (18.2) | [23,29] |
| Not specified | 5 (45.5) | [6,22,24,26,27] |

opportunity and “M” indicates motivation for the respective intrinsic (coded with the prefix “In”) or extrinsic (coded with the prefix “Ex”) factors for each theme. Subthemes were similarly categorized under major themes using the same coding strategy.

Intrinsic Factors

We identified the following themes as capacity-related intrinsic factors: a) frailty and reduced muscle strength due to advancing age,^{20–25} b) sex,^{6,23,25} c) fall history,^{20–22,24,25} d) cognitive impairment^{20,21,24,26,27}

and e) comorbidities^{24–27} (Table 4). These capacity-related intrinsic factors were reported to contribute to falls, pressure ulcers, and medication errors. The most frequently mentioned capacity-related contributors to adverse events were frailty and reduced muscle strength due to advancing age (6 articles, 54.5%).^{20–25} Fall history^{20–22,24,25} and cognitive impairment^{20,21,24,26,27} were the next most common contributors (5 articles each, 45.5% each) (fall and fall injuries, specifically) during short stays. The most recurring subthemes implicated as contributors to falls, medication errors, and

Table 3 Summary of Each Included Study (n=11)

| Author(s) [Citation] | Study Objective(s) | Adverse Event(s) | Study Design, Settings Participants, and Methods | Findings |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 Aspinal et al., 2015. ²¹ | 1) To describe the factors associated with drug-disease interactions among older adults admitted into skilled nursing facilities for rehabilitative care. 2) To determine the prevalence of medications exacerbating falls/hip fractures from drug-disease interactions. | Falls /Medication errors | Design and setting: Cross-sectional study at 15 Veterans Affairs Community Living Centers, USA. Participants: 1270 adults aged ≥65 years diagnosed with dementia/cognitive impairment, history of falls/hip fractures, heart failure, history of peptic ulcer disease, or stage IV or stage V chronic kidney disease. | 1) Drug-disease interactions in older adults were associated with an increased risk of functional status decline and adverse drug events during short-stay rehabilitation care. 2) Residents with dementia/cognitive impairment or a history of falls/hip fractures were most likely to receive a potentially inappropriate medication during short-stay rehabilitation care. 3) Selective serotonin receptor inhibitors, antipsychotics, and anticonvulsants were the most often involved in drug-disease interactions among older adults with falls/hip fractures. 4) In older adults with dementia/cognitive impairment, older age (≥75 years) was independently associated with a lower risk of a drug-disease interaction causing falls/hip fractures. 5) Older adults who were either a long-stay or hospice/palliative care resident or taking ≥5 chronic medications had increased odds for drug-disease interactions exacerbating falls/hip fractures compared with those with a short-stay status and taking ≤4 chronic medications, respectively. |
| 2 Aspinal et al., 2019. ²⁰ | To examine the association between central nervous system medication burden (categorized as standardized daily doses), and the risk of severe falls and hip fractures among older adults with a history of falls or hip fractures admitted to skilled nursing facilities for respite care. | Falls/fall with injuries | Design and setting: Nested case-control study at the Veterans Health Administration Community Living Centers, USA. Participants: 1264 adults aged ≥65 years with a history of a falls or hip fractures in the year before skilled nursing facility admission. Procedure: central nervous system standardized daily doses were calculated and categorized as 0, 1 to 2, and ≥3 standardized daily doses for opioids, benzodiazepines, antidepressants, antiepileptics, and antipsychotics against the outcome of recurrent serious falls. | Older adult residents receiving ≥3 central nervous system standardized daily doses (for opioids, benzodiazepines, antidepressants, antiepileptics, and antipsychotics) were more likely to have a severe recurrent fall than those taking no central nervous system medications. |

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|---|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 | Bell et al., 2016. ²⁵ | To quantify the prevalence of nine geriatric syndromes among older adults admitted to a skilled nursing facility for rehabilitation/respite care. | Falls/pressure ulcers (as part of geriatric syndromes) | Design and setting: Quality improvement project set in an acute care academic medical center and 23 regional partner skilled nursing facilities in the USA. Procedures: Nine geriatric syndromes, including falls and pressure ulcers, were measured to estimate prevalence and risk factors. | 1) The most prevalent geriatric syndrome was falling. 2) Men with histories of falls were more likely to have recurrent falls and pressure ulcers than were women with no history of falls during short-stay rehabilitation care. |
| 4 | Bronskill et al., 2018. ²⁸ | To evaluate the difference in fall risk between skill nursing facility-living older adults given low-dose trazodone and newly dispensed benzodiazepines during rehabilitation/respite care. | Falls/fall injuries | Design and setting: retrospective, matched cohort study from linked population-based administrative data for all skilled nursing facilities in Ontario, Canada. Participants: 7791 adults ≥66 years who were assessed in an skilled nursing facility between 1 April 2010 and 31 March 2015. Procedures: data on falls and fall-related injury within 90 days from admission were analyzed. | No differences were found between new use of low-dose trazodone and new benzodiazepines to increase the risk of acquiring falls and fall-related injuries during short stays (≤90 days) in skilled nursing facilities in Ontario. |
| 5 | Colon-Emeric et al., 2017. ²² | To examine how specific fall-prevention activities are impacted by resident and staff characteristics. | Falls/fall injuries | Design and setting: Randomized factorial clinical vignette survey conducted in 16 skilled nursing facilities in North Carolina, USA. Participants: 433 nursing, rehabilitation, and social services staff. Procedures: All participants completed at least four randomly assigned vignettes (from a total of 1615) describing hypothetical residents' lived experiences regarding falls/fall injuries. | 1) Skilled nursing facility staff tended to use a standardized approach to fall prevention for all residents regardless of their specific clinical characteristics, which may have accounted for an increase in fall/fall injuries. 2) Lack of information flow between staff (nurses, rehabilitation, and social service staff) increased risks for falls/fall injuries for short-stay residents. 3) Nursing staff licensure or clinical experience influences the frequency of identification and reporting of falls. 4) The roles of registered nurses in skilled nursing facilities (being more regulatory or supervisory) influence the quality of resident care delivered regarding fall prevention. 5) Implicit racial bias from nursing staff on fall-prevention strategies negatively influenced resident-centeredness and quality of delivery. 6) Understaffing increases falls incidence rates among adults admitted for rehabilitation. |

(Continued)

Table 3 (Continued).

| Author(s) [Citation] | Study Objective(s) | Adverse Event(s) | Study Design, Settings Participants, and Methods | Findings |
|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6 Cox et al., 2016. ²³ | To assess the association between the prescription of psychotropic drugs and falls in a general nursing home population (short or long stays). | Falls/fall injuries | Design and setting: A retrospective observational study. Data collected from nine nursing homes in Eindhoven, the Netherlands. Participants: 2368 nursing home residents aged ≥ 65 years. | 1) The prescription of psychotropic drugs was associated with an increased fall risk during short stays. 2) Antipsychotics and antidepressants were associated with a higher risk of falling during short stays. |
| 7 Datta et al., 2018. ⁶ | To examine the relationship between falls and multiple factors during a short stay in a skilled nursing facility. | Falls/fall injuries | Design and setting: Cross-sectional pilot study set across nursing homes in the Czech Republic. Participants: Sixteen adults aged ≥ 65 years who met the eligibility criteria for recruitment. | 1) No significant relationship was found between falls and independent variables such as age, sex, gait speed, mobility device, fear of falls, cognitive function, and medication. 2) Environmental causes were 64 times more likely to cause falls in nursing home participants. |
| 8 Hall et al., 2015. ²⁴ | To investigate the association of chronic kidney diseases with recurrent falls among older adults with a history of falls in the skilled nursing facilities. | Falls/fall injuries | Design and setting: A retrospective cohort study set in the skilled nursing facilities in North Carolina, USA. Participants: 510 older adults aged ≥ 50 years with at least one fall within 6 months in the skilled nursing facilities. | 1) Chronic kidney diseases and other chronic comorbidities (eg, history of stroke, Parkinson's disease) were not significantly associated with falls during short stays. 2) Orthostatic hypotension, prior history of falls, and impaired mobility were independently associated with recurrent falls among participants. |
| 9 Hartog et al., 2015. ²⁷ | To identify the impact of orthostatic hypotension on previous falls among nursing home residents. | Falls/fall injuries | Design and setting: prospective observational study in the Netherlands. Participants: 290 adults aged ≥ 60 years; 128 were admitted for short-stay rehabilitation owing to orthostatic hypotension. | No significant associations or correlation were found between reported previous falling and orthostatic hypotension or orthostatic complaints. |
| 10 Hartog et al., 2017. ²⁶ | To investigate the relationship between orthostatic hypotension and fall incidents among nursing home residents. | Falls/fall injuries | Design and setting: prospective observational study in the Netherlands. Participants and procedures: 249 adults aged ≥ 60 years; 127 were admitted for short-stay rehabilitation due to orthostatic hypotension. Fall incidents were prospectively registered. | No significant associations were found between orthostatic hypotension and the first fall incident, although falling and orthostatic hypotension were highly prevalent in nursing homes. |

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|----|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11 | Nyborg et al., 2017. ²⁹ | To investigate the extent of potentially inappropriate medication, use among nursing home short- or long-stay residents and explore possible associated factors. | Medication errors/Falls | Design and setting: a cross-sectional observational study in Vestfold, Norway. Participants: 881 adults aged ≥65 years from 30 skilled nursing facilities. Procedures: The Norwegian General Practice Nursing Home criteria list was used to investigate inappropriate medication use. | 1) 43.8% of older adult residents were prescribed at least one potentially inappropriate regular medication during a short stay 2) 9.9% regularly received three or more potentially inappropriate medications. 3) Female residents received at least one potentially inappropriate regular medication more often than did male residents during short stays. 4) Use of multiple psychoactive drugs increased the risk of falls during acute episodes of infection or dehydration. |
|----|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

pressure ulcers were ambulation difficulties (eg, being bedbound or using supports such as a cane, walker, or wheelchair) (5 articles, 45.5%).^{20–22,24,25} We identified no opportunity-related or motivation-related intrinsic factors contributing to adverse events in older adults during short SNF stays (Table 4).

Extrinsic Factors

We identified and categorized inappropriate medications and issues related to polypharmacy as capacity-related extrinsic factors contributing to adverse events during short SNF stays. These capacity-related extrinsic factors were reported to contribute to falls and medication errors. Inappropriate administration of central nervous system (CNS) medications (eg, selective serotonin receptor inhibitors, opioids, benzodiazepines, antidepressants, anticonvulsants, and antipsychotics) was the most commonly identified capacity-related (extrinsic) subtheme contributing to most fall and fall injury incidences among older adults during short stays in SNFs (4 articles, 36.4%).^{20,21,23,28} Polypharmacy (taking ≥3 medications) was also a capacity-related extrinsic factor contributing to medication errors and drug-disease interactions leading to fall and fall injuries during short stays (3 articles, 27.3%).^{21,23,29}

Six themes were identified and categorized as opportunity-related extrinsic factors contributing to falls and fall injuries during SNF short stays.²² The themes included 1) environmental safety factors⁶ (eg, clutter, lack of stair railings, lack of grab bars in the bathroom, poor lighting, loose rugs or other tripping hazards), 2) poor communication among SNF staff, 3) lack of older adult engagement in prevention care plans during short SNF stays, 4) lack of an individualized adverse event prevention plan, 5) organizational and administrative issues (eg, staff shortages, lack of delineation of roles for staff), and 6) care disparity related to racial bias (Table 4).²² We identified no motivation-related extrinsic factors contributing to adverse events in older adults during short SNF stays.

Discussion

In this scoping review, we synthesized peer-reviewed evidence on intrinsic and extrinsic factors that contribute to adverse events (ie, falls, medication errors, pressure ulcers, and acute infections) among older adults admitted to SNFs for rehabilitation. We used the COM-B framework¹³ to categorize the intrinsic and extrinsic factors identified in 11 articles to determine behavioral modifications and gaps to address in future research. Grouping the intrinsic and

Table 4 Identified Intrinsic and Extrinsic Risk Factors Contributing to Adverse Events (Ie, Fall/Fall Injuries, Pressure Ulcers, Medication Errors, and Acute Infections) Among Older Adults During Skilled Nursing Facility (SNF) Stays for Rehabilitation; These Factors Were Identified from 11 Articles Using the Capability-Opportunity-Motivation Behavioral Model.¹³

| Intrinsic Risk Factor | | Extrinsic Risk Factors | | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------|
| Capability-Related Themes | Frequency (%) [*] | Article Citation | Capability-Related Themes | Frequency (%) [*] | Article Citation |
| InC1: Frailty and reduced muscle strength due to advancing age | 6 (54.5%) | [20–25] | ExC1: Potential inappropriate medications and issues related to polypharmacy | 5 (45.5%) | [20,21,23,28,29] |
| InC1.1: Frailty and reduced muscle strength from advancing age was associated with more falls during SNF stays. | 2 (18.2%) | [23,24] | ExC1.1: Older adults on central nervous system (CNS) medications such as selective serotonin receptor inhibitors, opioids, benzodiazepines, antidepressants, anticonvulsants, and antipsychotics were more likely to fall during short-term stays in SNFs. | 4 (36.4%) | [20,21,23,28] |
| InC1.2: Adults aged ≥75 years were at lower risk for falls and fall injuries during SNF stays. | 1 (9.1%) | [21] | ExC1.2: Older adults taking CNS medications at higher standardized daily doses (ie, at ≥3.0 SDDs) were independently at greater risk for falls/fall injuries than were older adults taking lower SDD doses (≤1.0). | 1 (9.1%) | [20] |
| InC1.3: Older adults with ambulatory dysfunction (bedbound) or used a cane, walker, or wheelchair were at higher risk for falls during SNF stays. | 5 (45.5%) | [20–22,24,25] | ExC1.3: Taking ≥3 medications increased the risk factor for medication errors, drug-disease interactions, and fall/fall injuries during short SNF stays. | 3 (27.3%) | [21,23,29] |
| InC1.4: Long-stay residents (> 100 days) were at greater risk of medication errors and drug-disease interactions from taking multiple drugs for chronic conditions compared with shorter-stay (up to 100 days) residents. | 1 (9.1%) | [21] | | | |
| InC2: Residents' gender | 3 (27.3%) | [6,23,25] | | | |
| InC2.1: Older men were more likely to have higher fall risks and acquire pressure ulcers during SNF convalescence admission (explained by a higher prevalence of CNS medications). | 2 (18.2%) | [23,25] | | | |
| InC2.2: Older women were more likely to fall during SNF stays, than were men. | 1 (9.1%) | [6] | | | |
| InC3: History of fall | 5 (45.5%) | [20–22,24,25] | | | |
| InC3.1: Older adults with a history of previous falls were at higher risk for falls during SNF stays. | 5 (45.5%) | [20–22,24,25] | – | – | – |

| | | | | | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------------|---|
| InC4: Cognitive impairment | 5 (45.5%) | [20,21,24,26,27] | | | | |
| InC4.1: Older adults with cognitive impairment (eg, Parkinson's disease, dementia, or stroke) were at greater risk for falls/fall injuries during SNF stays. | 5 (45.5%) | [20,21,24,26,27] | | | | - |
| InC5: Comorbidities | 4 (36.4%) | [24-27] | | | | |
| InC5.1: Older adults with orthostatic hypotension and chronic kidney disease were at greater risk for falls/fall injuries during SNF stays. | 4 (36.4%) | [24-27] | | | | - |
| Opportunity-related themes | Frequency (%) | Article citation | Opportunity-related themes | Frequency (%) | Article citation | |
| No theme identified | - | - | ExO1: Environmental safety | 1 (9.1%) | [6] | |
| | | | ExO1.1: SNF environmental factors such as clutter, lack of stair railings, loose rugs or other tripping hazards, lack of grab bars in the bathroom, and poor lighting, increased the likelihood of falls among older adults admitted for rehabilitative care. | 1 (9.1%) | [6] | |
| | | | ExO2: Communication among the SNF health care team | 1 (9.1%) | [22] | |
| | | | ExO2.1: Lack of or weakened information flow among staff (nurses, physicians, occupational therapists, physical therapists) increased the risks for increased adverse events and poor care quality during SNF stays. | 1 (9.1%) | [22] | |
| | | | ExO2.2: Nursing staff licensure and clinical experience influenced the frequency of identifying and reporting falls during SNF stays. For example, licensed rehabilitation staff (physical, occupational, and speech therapy) and social work staff consistently reported a substantially lower likelihood of all fall prevention activities. | 1 (9.1%) | [22] | |
| | | | ExO3: Lack of SNF residents' involvement in adverse event prevention care | 1 (9.1%) | [22] | |

(Continued)

Table 4 (Continued).

| Intrinsic Risk Factor | | Extrinsic Risk Factors | | | |
|---------------------------|----------------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------|
| Capability-Related Themes | Frequency (%) [*] | Article Citation | Capability-Related Themes | Frequency (%) [*] | Article Citation |
| - | - | - | ExO3.1: A lack of involvement in older adult care planning by licensed rehabilitation staff (eg, physical, occupational, and speech therapists) due to a lack of awareness of interventions and clarity regarding their scope of practice. These two possible reasons may have affected the quality of fall-prevention care provided to older adults admitted for respite care. | I (9.1%) | [22] |
| - | - | - | ExO3.2: Nursing staff underappreciation of residents' common fall risk factors (eg, cognitive status and other comorbidities) challenge fall-prevention strategies and increase the risk for falls/fall injuries. | I (9.1%) | [22] |
| - | - | - | ExO4: Lack of individualized adverse event prevention care plans | I (9.1%) | [22] |
| - | - | - | ExO4.1: Failure by nursing staff to individualize fall-prevention strategies to most resident characteristics enabled more fall incidents during SNF stays. | I (9.1%) | [22] |
| - | - | - | ExO5: Organizational and administrative issues | I (9.1%) | [22] |
| - | - | - | ExO5.1: Understaffing leading to time constraints increased residents' risk for adverse events. | I (9.1%) | [22] |
| - | - | - | ExO5.2: The roles of registered nurses (RNs) in SNFs being more regulatory or supervisory may influence the quality of resident care delivered. For example, significant gaps exist in RN-developed individual-resident-centered fall-prevention plans, and the actual fall-prevention plan implemented at bedside by non-RNs in SNFs. Non-RN nursing staff may have difficulty connecting specific tasks to fall prevention or understanding what fall-prevention activities fall outside their roles. | I (9.1%) | [22] |
| - | - | - | ExO6: Care disparity related to racial bias | I (9.1%) | [22] |

| | | | | | | |
|---------------------------|---------------|------------------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------------|
| - | - | - | - | ExO6.1: Presence of implicit racial bias from nursing staff on fall-prevention strategies shown to influence resident-centeredness of care for older adults admitted for rehabilitation care. | I (9.1%) | [22] |
| Motivation-related themes | Frequency (%) | Article citation | Motivation-related themes | Motivation-related themes | Frequency (%) | Article citation |
| No theme identified. | - | - | No theme identified. | No theme identified. | - | - |

Notes: -Coding identifiers corresponding to the COM-B framework where "C" indicates capability, "O" indicates opportunity and "M" indicates motivation for the respective intrinsic (coded with the prefix "in") or extrinsic (coded with the prefix "Ex") factors for each theme. -Subthemes were similarly categorized under major themes using the same coding strategy. -Intrinsic factors refer to individual-related elements that could be unmodifiable or modifiable. -Extrinsic factors refer to those factors external to the individual. *The frequency is the number of cited articles per category. The percentage is the percentage of the 11 articles included in the review.

extrinsic contributors to adverse events in SNFs may help guide interventional strategies (capability-related elements) and opportunities for change (opportunity- and motivation-related elements) as health professionals navigate older adult care along the care continuum.

The contributors to adverse events among short-stay SNF residents identified herein were similar to those found for older adults participating in fall-prevention strategies after transitioning home from acute hospitalization.³⁰ The present study validates the importance of identifying individualized resident care plans during short SNF stays for rehabilitation. These intrinsic factors were inevitably related and thus contributed to singular adverse event incidents, such as falls and medication errors, and contributed additively and synergistically to other adverse events. For example, capacity-related intrinsic factors, such as advancing age, coexisted with physical and cognitive disabilities in most articles on falls and fall injuries.^{6,20-28}

This scoping review identified the risks of major medication classes, especially CNS-related drugs, to adverse events during short stays.^{20,21,23,28,29} The adverse effects of these medications (eg, sedation, impaired balance, delirium, and discoordination), as well as the drug interactions from taking multiple medications (polypharmacy), were identified as modifiable capacity-related extrinsic contributors to adverse events such as falls and fall injuries during short stays in SNFs.^{20,21,23,28,29} Studies substantiating polypharmacy and inappropriate medications as significant contributors to frequent falls in SNFs^{20,21,23,28,29} recommended medication reviews and modifications combined with continued nursing staff education as a valuable strategy to mitigate medication errors and drug-drug interactions causing adverse events in SNFs.^{31,32}

This study identified only one article²² that provided several opportunity-related extrinsic factors that contributed to adverse events during older adults' short stays in SNFs. Notably, these organizational and administrative challenges spanned the older adults' continuum of care.²² Previous studies supported the importance of addressing communication and older adults' engagement in individualized care to improve their safety, prevent falls at home, enhance health quality, and promote self-care among community-dwelling older adults.^{10,30,33,34}

Practical Implications

The findings of this scoping review may guide interventional strategies for mitigating adverse events among older adults during short SNF stays by addressing the intrinsic and

extrinsic contributors. SNF administrators play vital roles in leading the efforts to decrease adverse events. The capacity-related and opportunity-related extrinsic contributors identified herein (ie, poor communication among SNF staff regarding residents, lack of individualized care plans or resident engagement in the care plans, resident discrimination, and lack of institutional support for staff in SNFs) shed light on areas that warrant further research and interventions.

Study Strengths and Limitations

The main strength of this scoping review was that we applied the COM-B model of health behavioral change¹³ as a framework to identify and categorize contributing factors. By differentiating intrinsic versus extrinsic contributors, the COM-B model provided a novel approach to pursuing our study's research objectives and facilitating future interventional strategy development and evaluation. The COM-B behavioral change wheel program planning model³⁵ guides matching various intervention components with specific elements of the COM-B model.¹³

The study had some limitations. First, few peer-reviewed sources met the eligibility criteria to enable us to develop our findings across all the domains of the COM-B framework. Second, the authors could not overtly ascertain whether all studies addressed only short-stay older adult residents. We repeatedly reached out to the corresponding authors of these studies but received responses from only two of them.

Conclusion

We reviewed the main findings of 11 original peer-reviewed articles to present an overview of intrinsic and extrinsic contributors to adverse events among older adults admitted to SNFs for short stays. The review used the COM-B model of health behavioral change¹³ to identify the contributors to adverse events (ie, falls, medication errors, pressure ulcers, and acute infections). Intrinsic and extrinsic factors leading to adverse events were grouped across each capability-opportunity-motivation domain related to health behavioral changes among older adults during short stays for rehabilitation. Capacity-related intrinsic contributors to adverse events were frailty, reduced muscle strength due to advancing age and history of falls. Capacity-related extrinsic factors identified were inappropriate medications and issues related to polypharmacy, and opportunity-related extrinsic contributors identified included environmental hazards, poor

communication among SNF staff, lack of individualized care plans, lack of resident engagement in the care plans, resident discrimination, and lack of institutional support for staff in SNFs. We believe our findings could help shed light on areas that would warrant further research and guide interventional strategies for mitigating adverse events among older adults during short SNF stays.

Disclosure

The authors report no conflicts of interest in this work.

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