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Factors involved in the development of hospital-acquired conditions in older patients in acute care settings: a scoping review

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Abstract

Background Older patients hospitalized in acute care settings are at significant risk of presenting hospital-acquired conditions. Healthcare professionals should consider many factors involved in the development of such conditions, including factors related to the patients, as well as those related to the processes of care and the structure of hospitals. The aim of this study was to describe and identify the factors involved in the development of hospital-acquired conditions in older patients in acute care settings.

Methods A scoping review was performed based on a structured search in eight databases in September 2022. Data were extracted with an extraction tool and classified into categories. Mapping and a narrative summary were used to synthetize data.

Results A total of 237 articles were included in the scoping review. Functional decline and delirium were the most frequent hospital-acquired conditions studied. Among all categories, factors related to the patients provided most of the data, whereas factors related to the processes of care and the structure of hospitals were less frequently explored. In most articles, one or two categories of factors were retrieved; fewer articles examined factors among three categories. Personal factors, medications, and the human and work environment were the most frequent subcategories of factors retrieved, whereas social factors, hydration and nutrition, and organizational factors were less common.

Conclusions The development of hospital-acquired conditions in older patients in acute care settings involves many factors related to the patients, as well as to the processes of care and the structure of hospitals. Prevention of hospital-acquired conditions must involve to consider the complexities of older patients and of acute care hospitals. Not considering all categories of factors might affect the implementation of new practices of care and interventions.

Keywords Acute care settings, Hospital-acquired conditions, Older patients, Scoping review, Health services delivery

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Introduction

Aging of the population increases hospital use, as almost 35–40% of inpatients are over 65 years old [1, 2]. However, acute care hospitals are not well adapted to older people and expose them to many hazards [3]. During their stay, older patients are at significant risk of presenting untoward events and hospital-acquired conditions [4, 5]. The prevalence of such conditions can typically reach 30% in acute care settings [6], with more than 80% of them potentially being preventable [7]. To respond to older patients' needs and to prevent hospital-acquired conditions, healthcare professionals must have knowledge and awareness of the nature of these conditions.

A variety of terms are used to report on conditions acquired during the hospitalization of older patients. Some authors approach the topic by using the terms iatrogenic illness [8], iatrogenic disability [9], hospitalization-associated disability (HAD) [10], or adverse event [4], among others. These terms often refer to functional decline during hospitalization [8–10], as well as to geriatric syndromes, adverse drug events, hospital-acquired infections, and procedure-related complications [4]. A common aspect of these terms is that they highlight the role of hospitalization and its procedures in the development of consequences in older patients that are not attributable to the acute condition or the natural course of their disease.

Another concept described by several authors revolves around the term geriatric syndromes. These syndromes are clinical conditions that do not fit into a discrete disease categories [11] and that correspond to highly prevalent atypical clinical presentations among older patients [12]. For instance, these conditions include urinary incontinence, pressure ulcers, delirium, and functional decline [11]. However, the term geriatric syndromes remains a poorly defined concept [11, 12]. Because it is used to describe both preexisting problems and those that occur during hospitalization, some authors propose using the term hospital-associated complications of older people to better distinguish between preexisting and acquired problems [13].

In addition to clarification of the taxonomy and mapping out of existing concepts encompassed in hospital-acquired conditions, categories of factors that contribute to the development of these conditions need to be explored. The first category is related to older patients themselves. Their baseline conditions and the acute conditions associated with the acute care hospital environment can interact and induce a cascade of deterioration [3]. Factors related to older patients include the aging process and normal age-related changes, with decreasing reserves and mechanisms to cope with stressors [5]. Comorbidities, atypical non-disease-specific presentations, and abnormal presentations of the aging process complicate the detection of older patients' needs and problems [14]. In addition, hospital-acquired conditions are complex, distinct, and share risk factors such as older age, impaired mobility, and baseline cognitive and functional impairments [11]. A second category of factors is how these conditions relate to in-hospital processes and activities in the provision of daily care [7]. Nursing staff represent the largest group of healthcare professionals [15] and play an important role in patient quality of care and security, as they are on the front line in providing evidence-based care and daily coordination of overall patient care [16]. However, geriatric knowledge is lacking among nurses [17]. In addition, nurses' attitudes are both negative and positive toward older patients and their care [18]. A third category of contributing factors is inappropriate care related to processes and structure [5]. Because hospitals are focused on efficiency and productivity, they are structured to address and treat acute illness in a limited time frame. Complex and time-consuming multiple health conditions of older patients are not compatible with economic constraints. The care needs of older patients could be considered as obstacles to hospital functioning [19].

Geriatric acute care models exist such as Acute Care for Elders (ACE), Hospital Elder Life Program (HELP), and Nurses Improving Care for Healthsystem Elders (NICHE) among others. These models address the needs of older patients and the hospital institutional factors contributing to iatrogenic complications [20]. The aim of the ACE units is the prevention of HAD and other serious complications in older patients exposed to hostile environments and procedures during hospitalization [21]. In contrast, HELP primarily focuses on the prevention of delirium but also functional decline [22]. The NICHE program emphasizes enhancing nurses' knowledge and skills in order to incorporate changes in clinical practice [23]. Despite the advantages of these models of care, their implementation is limited by available resources and reimbursement for care [20]. Some policies advocate for a reorientation and redesign of older patient care by redeploying existing resources in existing care [24]. Older patients account for a significant proportion of hospitalizations, but are cared for throughout the hospital and not in a few specialized units. Consequently, hospitals have to adapt and find hospital-wide-level policies and interventions to respond to older patients' needs [25].

We therefore conducted a scoping review to address the factors involved in the development of hospital-acquired conditions in older patients in acute care settings. The research question was to describe the factors related to patients, processes, and structure as well as interventions

that address the prevention of hospital-acquired conditions. A preliminary search of PROSPERO, Embase, Epistemonikos, and the *JBI Database of Systematic Reviews and Implementation Reports* conducted in June 2020 retrieved no planned, ongoing, or completed systematic or scoping reviews on this exact topic. Two systematic reviews were identified about hospital-acquired conditions, but they mainly focused on incidence and prevalence [4, 6]. Among four ongoing systematic reviews, one is set to examine the prevalence and course of various geriatric syndromes in acutely hospitalized older patients at admission, during hospitalization, and after discharge [26]. A second systematic review will study the impact of interventions in hospitalized older non-orthopedic surgical patients [27], a third the prevention and reduction of hospital-associated deconditioning [28] and a fourth walking interventions [29].

The aim of this study was to perform a scoping review to describe and identify the factors involved in the development of hospital-acquired conditions in older patients in acute care settings.

Methods

A scoping review approach was used to structure the review because it addressed a broad question. The proposed scoping review was conducted and reported in accordance with the JBI methodology for scoping reviews [30] and the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews [31]. The protocol was registered on Open Science Framework (2021, May 17; osf.io/4ycfn/).

Inclusion and exclusion criteria

This scoping review included all studies concerning older patients in acute care settings. Older patients are defined as patients who are 65 years and over. All hospital-acquired conditions that developed between admission and discharge were included. The factors involved in the development of hospital-acquired conditions were those related to older patients' characteristics, the processes and activities (such as delivery of care and procedures), and the structure (such as organizational aspects and resources).

Search strategy

We used a search strategy intended to locate both published and unpublished studies. An initial search was undertaken in Embase.com to identify keywords in the titles, abstracts and index terms of relevant articles. The strategies were then adapted to each selected literature sources. We search MEDLINE ALL Ovid, CINAHL with Full text, Web of Science Core Collection, Embase.com, Cochrane Central Register of Controlled Trials Wiley and ProQuest Dissertations and Theses on October 10, 2020 with an update on September 13, 2022. Additional searches were conducted in OpenGrey and Google Scholar on January 05, 2021. The combination of search terms used for databases is displayed in Additional file 1. The strategies were developed with the assistance of a medical librarian using index and free-terms and peer-reviewed by another librarian according to the Peer Review of Electronic Search Strategies (PRESS) checklist [32]. The search had no language or time frame restrictions, except for conference abstracts. The full strategies are displayed in Additional file 1. References were imported into EndNote 20 (Clarivate Analytics, USA) and deduplicated.

Data screening

Titles and abstracts were screened into Rayyan [33] by two independent reviewers (MV; SP) for assessment against the inclusion criteria for the review. The full text of selected citations was assessed in detail against the inclusion criteria by the same two independent reviewers. Any disagreements that arose between the reviewers at each stage of the study selection process were resolved through discussion or with a third reviewer (CM). The results of the search and reasons for exclusion are reported in a flow diagram. During the process, the lower age limit was extended from 65 to 55 years and interventions were extended from hospital level to unit or department level.

Data extraction and presentation of the results

Data were extracted with an extraction tool developed by the reviewers. Resulting tables included general characteristics about the studies, as well as specific details about the population, concept, context, study methods, and key findings relevant to the objectives. After the extraction was completed, a first overview was produced and data were classified into categories and subcategories. Accompanied by a narrative summary, diagrams or tables presented extracted data in a manner that aligned with the objective of this scoping review. In accordance with the scoping review methodology, the review process involved no assessment of the quality of the included studies.

Results

Article inclusion and description of included studies

The search of eight databases yielded 15,975 records. After duplicates were removed, the titles and abstracts of 9,224 records were screened and 8,459 records were excluded. Of the 765 reports sought for retrieval, 16 were not retrieved or there was no response from the first author. The full texts of 749 reports were assessed for eligibility, and 508 reports were excluded. After

three reports were removed, the remaining 237 studies were included in the review. A flow diagram that presents the search and selection process [34], including the number of studies at each step and the reasons for exclusion, is presented in Fig. 1.

Of the 237 articles published from 1982 to 2022, most were performed in North America (46.0%) and Europe (27.0%) and were mainly primary articles (67%). Details about the characteristics of the included studies are provided in Additional file 2. Several articles included older patients with a specific surgical [35–74], mainly orthopedic or trauma surgery [36–38, 40–49, 51–56, 58, 59, 61, 63, 64, 67–69, 74], or with a specific medical diagnosis [75–95]. Interventions were studied in randomized controlled trials, non-randomized studies, and systematic reviews of interventions [39, 42, 57, 66, 69, 70, 73, 79, 94–119].

Hospital-acquired conditions, terms, and definitions

Of the included articles, 131 (55.3%) examined one hospital-acquired condition and the remaining examined multiple hospital-acquired conditions (Additional file 2).

In the articles investigating one hospital-acquired condition, the most frequently studied hospital-acquired conditions were functional decline [10, 62, 65, 77, 82–84, 91, 94, 98, 102, 103, 105, 107, 109–112, 118, 120–145] and delirium [40, 45, 48, 50, 53–55, 58, 64, 67, 68, 79, 81, 85, 89, 113, 146–161]. In studies of functional decline, various terms were used to describe decline in ADLs or instrumental activities of daily living (IADLs), mainly functional decline [65, 91, 102, 112, 120, 122, 124, 126, 128, 131–133, 136–139, 141–143] and hospital-acquired decline in different variations: hospital-associated, hospitalization-associated, hospital-acquired, hospital-associated ADL disability, IADL decline during hospitalization,

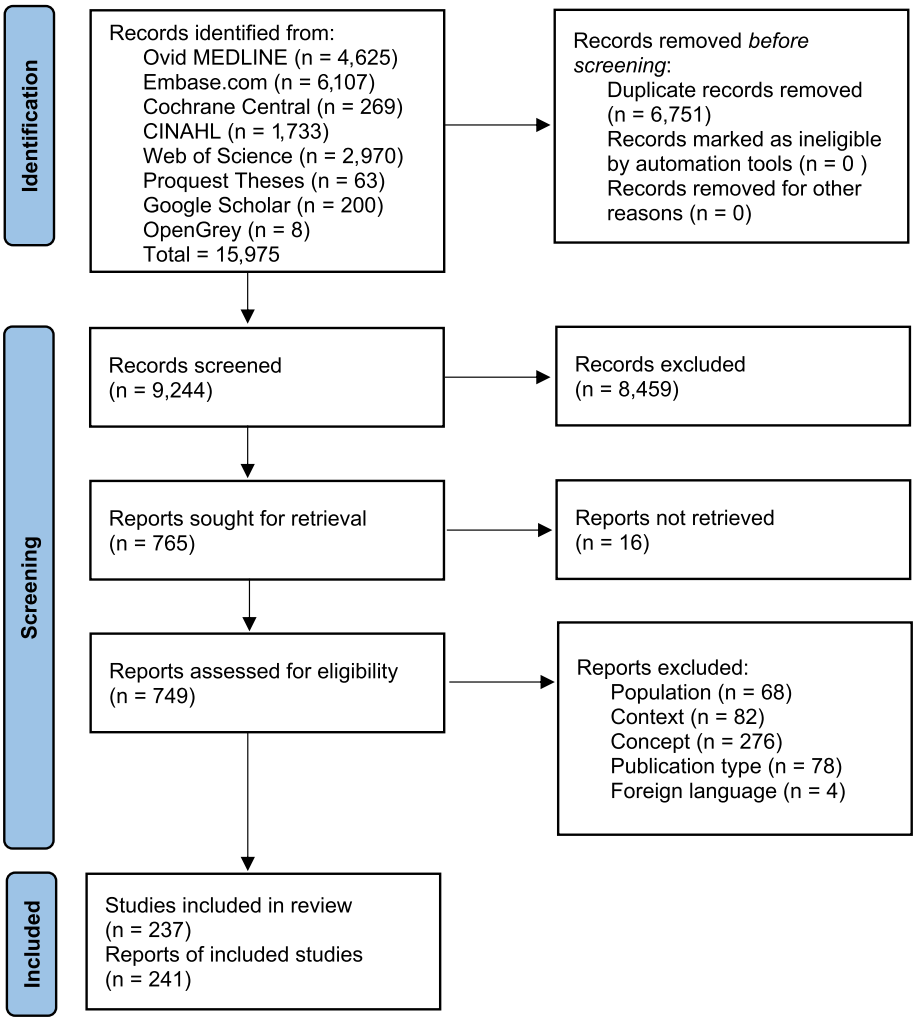

Fig. 1 Flowchart of the study selection process according to the PRISMA statement

and hospital-associated deconditioning [10, 62, 82–84, 94, 105, 110, 111, 118, 123, 127, 129, 130, 134, 140, 144, 145].

In most of the articles investigating multiple hospital-acquired conditions, between two and nine conditions were included [5, 7–9, 11, 13, 36–38, 41–44, 47, 52, 56, 57, 59, 61, 63, 66, 70–75, 80, 86, 87, 92, 93, 95–97, 100, 101, 104, 106, 115–117, 119, 162–220], with only a few investigating more than 10 conditions [35, 221–223].

When generic terms were used (62.3%) [5, 8, 11, 13, 35–38, 41, 43, 47, 52, 59, 61, 63, 66, 70–74, 80, 86, 92, 93, 97, 100, 101, 106, 115–117, 119, 164, 170, 172, 177, 178, 182–184, 188, 191, 192, 194, 196–200, 203–207, 209, 210, 212, 213, 216–219, 221–223], the most frequent were those related to events and risks during hospitalization, such as "hospital-acquired," "iatrogenic," "preventable," "harm," "adverse events," "incidents," "injuries," "complications," and "hazards of hospitalization," among others [5, 8, 13, 35–38, 41, 43, 47, 52, 59, 61, 63, 66, 74, 80, 86, 92, 97, 100, 101, 115, 117, 119, 172, 177, 178, 182, 184, 188, 194, 200, 203–206, 210, 213, 217–219, 221–223]. The generic term "geriatric syndromes" was also found [11, 70–73, 93, 106, 116, 191, 196–199, 216].

Categories of retrieved factors

Factors related to the patients and to the processes of care were identified in 67.9% and 61.2% of the articles, respectively. Factors related to the structure were less frequent and retrieved in 35.4% of the articles. Overall, only 24.9% of the articles considered the three categories of factors. Figure 2 presents an overview. The mapping of the factors in the different categories and domains is presented in Fig. 3 and completed by showing the details of the citations in Table 1. Additional file 3 presents details of retrieved risk factors for hospital-acquired conditions.

Individual factors related to the patients

Individual factors were extracted and classified into four domains: personal, physical-physiological, psychological-psychiatric-cognitive, and social (Fig. 3; Table 1).

Regarding age, some articles detailed age groups such as ≥70 years old (≥70; 65–74; 70–75 years) [9, 125, 180], ≥75 years old (≥75; 75–84) [13, 37, 125, 194, 202], ≥80 years old [91, 223], and ≥85 years old (≥85; 85–89; ≥90) [126, 163, 199, 222, 225]. For functioning at admission and in addition to ADLs, some articles specified IADLs [120, 127, 128, 134, 141, 183, 202, 221] or the number of dependences in activities [13, 141, 199, 202, 235].

In the articles that allowed the extraction of physical-physiological factors, some studies specified the level of frailty, such as frailty and prefrailty [5, 8, 10, 35, 36, 40, 43, 48, 50, 60, 61, 72, 129, 133, 135, 137, 168, 182, 191, 193, 195, 198, 206, 208, 213, 215, 225, 246], or mentioned

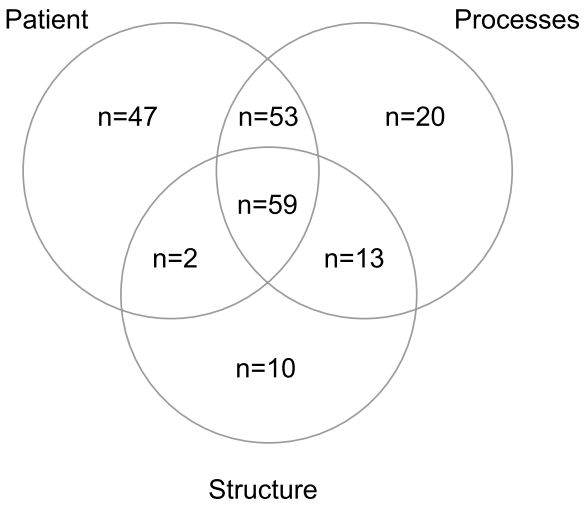

Fig. 2 Overview of data extraction in each category of factors (values correspond to the number of articles in which the factors were found)

deconditioning [75, 130, 132, 133, 172, 183], sarcopenia [74, 134, 242, 244], and immunosenescence [43]. For physiological changes, the details showed that they were mostly associated with age [3, 8, 36, 38, 43, 48, 75, 137, 163, 179, 182, 183, 191, 204–206, 221, 227, 231, 242], diminished physiological reserves [5, 8, 36, 134, 139, 182, 183, 187, 201, 226], and age-related changes in pharmacokinetics and pharmacodynamics [8, 168, 172, 179, 204, 221, 245] or physiological stress of the acute illness [75, 206, 242]. Regarding sensory impairment, the most predominant factors were visual impairment [5, 9, 43, 53, 55, 67, 146, 148, 150, 151, 153, 159, 183, 203, 221, 228] and hearing impairment [9, 43, 55, 85, 125, 144, 146, 148, 151, 220, 221], or sensory losses or deficits that included visual and hearing impairments [37, 38, 40, 48, 137, 154, 168, 182, 191, 205, 206]. For physical impairment and mobility, the factors found were difficulties in access [206], unsafe and unsteady gait [9, 163, 194, 228], and muscle mass and muscle strength [82, 137].

For psychological-psychiatric-cognitive factors, more specifically for cognition, some articles mentioned the level of severity of the cognitive impairment [8, 9, 53, 120] or specified the severity through specific scores on scales [68, 141, 159, 174, 183, 202, 203, 250]. The type of cognitive activities, such as reading books, using e-mail, and playing computer games, predicted the incidence of delirium. Cognitive activities such as computer games and singing predicted lower delirium severity [58]. Regarding depression, one article specified mood disorders [146] and another reported whether, on the Geriatric Depression Scale, individuals answered "yes" to the question, "Have you dropped many of your activities

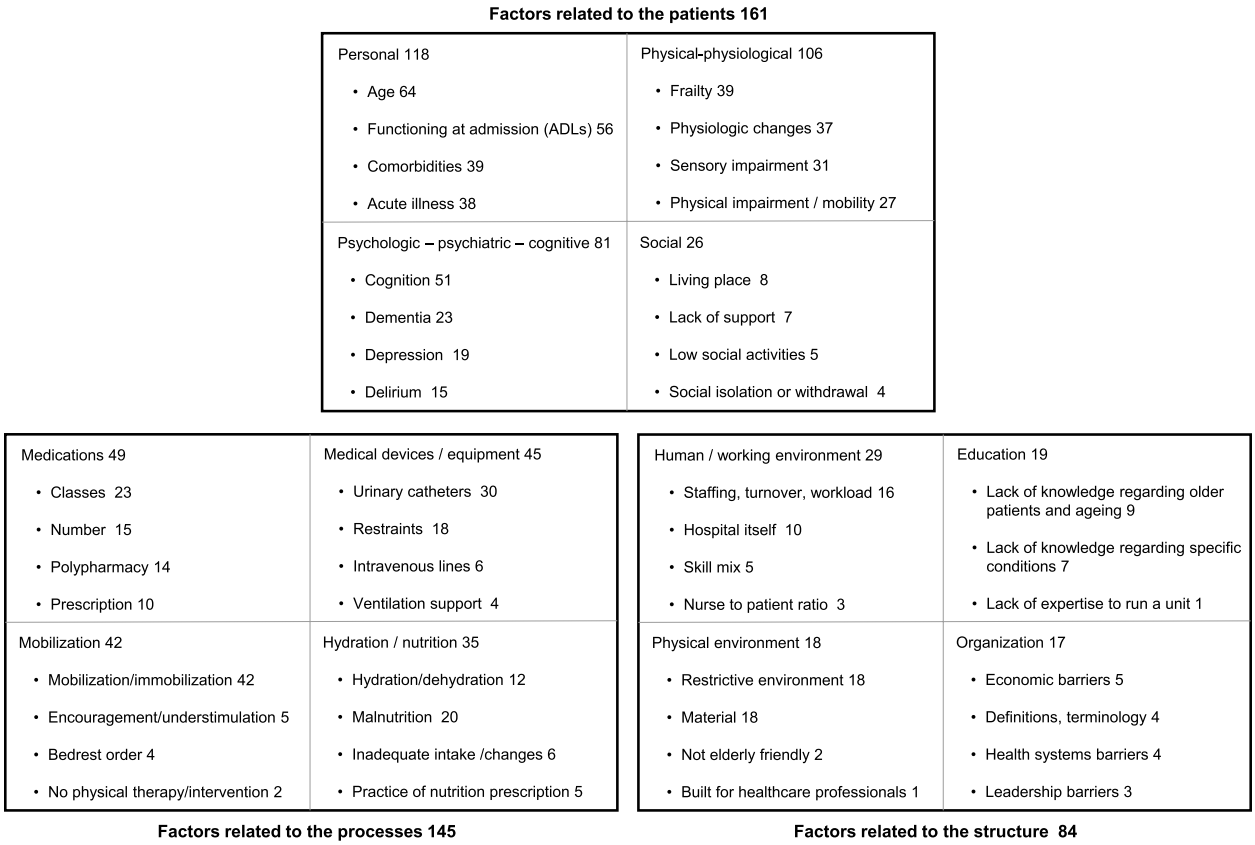

Fig. 3 Mapping of factors (values correspond to the number of articles in which the factors were found on a total of 237 articles)

and interests?" [60]. One article found no clear evidence of the influence of affective disorders [120]. Concerning delirium, details specified preoperative delirium [55], or reported the relation between the subtypes of delirium and the development of hospital-acquired conditions [86].

For social factors, more specifically for living place, factors retrieved included nursing home or long-term facility [9, 48, 51, 93, 138, 180], living situation [160], previous institutionalization [127], poor accommodation, or living in a rented accommodation [9].

Factors related to the processes of care

The most frequent factors related to the processes of care were medications, medical devices/equipment, mobilization, and hydration/nutrition (Fig. 3; Table 1).

For medications, details were collected about classes of medications such as psychoactive, hypnotic, benzodiazepines, narcotic, or anticholinergic, among others [5, 8, 38, 43, 76, 89, 129, 132, 141, 146, 151, 154, 156, 157, 182, 199, 203, 204, 206, 221, 224, 227, 248, 250], as well as high-risk medications [157, 179, 183]. Regarding practices of medical prescription, modification factors were also found, such as the start, cessation, modification, or withdrawal of medications [5, 37, 132, 146, 147, 182, 221].

For medical devices/equipment, their role in limiting mobilization was retrieved [8, 37, 75, 122, 129, 154, 201, 207, 208, 221, 254].

Regarding mobilization, all articles mentioned mobilization, immobilization, or bed rest. More specifically, factors such as little encouragement, discouragement, under-stimulation [7, 10, 123, 127, 207], bed rest order (routine or without indications) [124, 127, 156, 208], no physical therapy, lack of physical therapist intervention, lack of mobilization with nursing staff [7, 8], lower activity time per day and fewer step counts per day [140], and postoperative ambulation start day [62] were also found to be related to hospital-acquired conditions.

For nutrition, some articles detailed malnutrition during hospitalization (nutrition, malnutrition, undernutrition, starvation) [8, 10, 38, 48, 81, 120, 123, 132, 146, 149, 151, 153, 154, 156, 201–203, 206, 221, 254], reduced or inadequate intake and a change in normal routine intake [38, 44, 129, 134, 183, 206], the practice of nutrition prescription such as dietary restriction or

Table 1 Mapping of factors (values correspond to the number of articles in which the factors were found of 237 articles in total)

FACTORS RELATED TO THE PATIENTS	Retrieved factors	Citations
PERSONAL	Personal 118	[4, 5, 8–11, 13, 35–38, 40, 41, 43, 45, 48, 49, 51, 53, 55, 57, 59, 60, 62, 63, 74, 75, 81, 82, 85, 86, 88, 90, 91, 93, 97, 112, 120, 123, 125–130, 132–139, 141, 142, 144–148, 150, 151, 153, 154, 157, 159, 160, 163, 165–168, 171–173, 176, 177, 179, 180, 182, 183, 187, 188, 191, 194, 196–199, 201–204, 206, 209, 217, 220–240]
	Age 64	[5, 8–11, 13, 37, 38, 40, 43, 45, 48, 55, 62, 63, 74, 85, 91, 93, 120, 123, 125–127, 129, 133–135, 137, 138, 141, 142, 144, 146, 148, 150, 151, 163, 166, 168, 171–173, 177, 180, 182, 183, 187, 188, 191, 194, 199, 202, 204, 206, 221–225, 227, 228, 231, 239]
	Functioning at admission (activities of the daily living) 56	[4, 5, 8–11, 13, 36, 37, 45, 48, 51, 55, 57, 59, 60, 62, 74, 85, 97, 120, 123, 127–129, 133, 134, 137, 138, 141, 142, 146–148, 150, 151, 163, 167, 168, 172, 173, 182, 183, 187, 191, 197, 199, 202, 206, 221, 228, 231, 233, 235, 237, 240]
	Comorbidities 39	[4, 5, 8, 9, 36–38, 40, 43, 49, 74, 90, 127, 133, 134, 142, 146, 148, 154, 166, 168, 182, 183, 187, 190, 199, 201–203, 206, 221, 224, 226–228, 236, 238, 239, 241]
	Acute illness 38	[4, 8, 10, 36, 37, 43, 55, 75, 86, 88, 112, 123, 127, 130, 132, 133, 137, 139, 141, 142, 146, 151, 153, 154, 157, 163, 168, 172, 182, 183, 201–203, 206, 209, 221, 226, 238]
PHYSICAL-PHYSIOLOGICAL	Physical-physiological 106	[3, 5, 8–11, 35–38, 40, 43, 45, 46, 48, 50, 53–55, 57, 60, 61, 63–65, 67, 72, 74, 75, 82, 84, 85, 91, 112, 120, 122, 124, 125, 129, 130, 132–137, 139, 141, 144, 146, 148, 150, 151, 153, 154, 159, 160, 163, 168, 172–174, 177, 179, 180, 182, 183, 187, 189, 191, 193–195, 198, 199, 201–208, 213, 215–218, 220, 221, 225–229, 231, 237, 238, 242–249]
	Frailty 39	[5, 8, 10, 35, 36, 40, 43, 48, 50, 54, 60, 61, 72, 74, 75, 129, 130, 132–135, 137, 168, 172, 182, 183, 189, 191, 193, 195, 198, 206, 208, 213, 215, 225, 242, 244, 246]
	Physiological changes 37	[3, 5, 8, 36, 38, 43, 48, 63, 129, 130, 132–134, 137, 139, 172, 174, 179, 182, 183, 187, 191, 198, 201, 204–206, 218, 221, 227, 231, 242, 245]
	Sensory impairment 31	[5, 9, 37, 38, 40, 43, 48, 53, 55, 67, 85, 125, 137, 144, 148, 150, 151, 153, 154, 159, 168, 182, 183, 191, 203, 205, 206, 221, 228]
	Physical impairment/mobility 27	[5, 9–11, 38, 60, 63, 65, 74, 82, 85, 91, 112, 122, 124, 137, 163, 168, 182, 183, 194, 206, 217, 221, 228, 238, 244]
PSYCHOLOGICAL-PSYCHIATRIC-COGNITIVE	Psychological – psychiatric – cognitive 72	[5, 8–11, 13, 36–38, 40, 46–48, 51–56, 58, 60, 61, 63, 68, 74, 76, 80, 85, 86, 90, 91, 112, 120, 122, 123, 127, 129, 133, 134, 136–138, 141, 145–148, 150, 151, 153, 154, 157, 159, 161, 163, 168, 172, 174, 176, 177, 179, 182, 183, 191, 194, 199, 200, 202–204, 206–208, 215, 216, 221, 228, 231, 233, 250, 251]
	Cognition 51	[5, 8–11, 13, 36, 40, 47, 48, 53–56, 58, 60, 68, 85, 90, 112, 120, 123, 127, 129, 133, 134, 137, 141, 146, 148, 151, 154, 157, 159, 161, 163, 168, 172, 174, 179, 182, 183, 191, 199, 202, 203, 206, 221, 228, 233, 250]
	Dementia 23	[8, 9, 37, 38, 46, 48, 52, 55, 61, 74, 76, 80, 91, 136, 146, 147, 151, 161, 168, 182, 202, 221, 231]
	Depression 19	[8–10, 46, 48, 60, 90, 122, 134, 137, 146, 148, 151, 162, 163, 183, 206, 216, 221]
	Delirium 15	[8, 9, 38, 55, 63, 86, 127, 137, 168, 183, 191, 200, 215, 228, 231]

Table 1 (continued)

FACTORS RELATED TO THE PATIENTS	Retrieved factors	Citations
SOCIAL	Social 26	[5, 8, 9, 48, 51, 90, 93, 112, 120, 122, 126, 127, 137, 138, 141, 150, 160, 176, 180, 182, 183, 202, 208, 221, 228, 233]
	Living place 8	[9, 48, 51, 93, 127, 138, 160, 180]
	Lack of social or family support 7	[5, 112, 127, 137, 160, 183, 233]
	Low social activities 5	[8, 10, 141, 160, 202]
	Social isolation or withdrawal 4	[8, 9, 182, 221]
FACTORS RELATED TO THE PROCESSES	Retrieved factors	Citations
MEDICATIONS	Medications 47	[5, 8–10, 37, 38, 43, 48, 53, 55, 57, 75, 76, 81, 89, 120, 129, 132, 141, 146, 147, 151, 153, 154, 156, 157, 173, 179, 182, 183, 187, 194, 199, 202–204, 206, 221, 224, 227, 230, 235, 236, 245, 248, 250, 252–254]
	Classes 23	[5, 8, 38, 43, 76, 89, 129, 132, 141, 146, 151, 154, 156, 157, 182, 199, 203, 204, 206, 221, 224, 227, 248, 250]
	Number 15	[8, 9, 53, 57, 81, 89, 153, 156, 182, 202–204, 230, 235, 252]
	Polypharmacy 14	[9, 10, 43, 48, 55, 120, 146, 151, 157, 179, 183, 204, 206, 245]
	Prescription 10	[8, 76, 132, 141, 156, 182, 194, 204, 206, 250]
MEDICAL DEVICES/EQUIPMENT	Medical devices/equipment 45	[3, 5, 7, 8, 37, 40, 43, 45, 63, 75, 81, 83, 85, 112, 120, 122, 127, 129, 138, 144, 146, 149, 151, 153, 154, 156, 157, 182, 201–204, 206–208, 220, 221, 228, 240, 247, 254–258]
	Urinary catheters 30	[5, 7, 40, 43, 45, 81, 83, 85, 120, 127, 129, 138, 146, 149, 151, 153, 156, 157, 182, 202–204, 206, 208, 221, 228, 240, 255–257]
	Restraints 18	[8, 63, 81, 83, 85, 144, 146, 151, 153, 156, 157, 201–203, 221, 228, 247, 258]
	Intravenous lines 6	[5, 112, 129, 204, 208, 228]
	Ventilation support 4	[85, 182, 204, 220]
MOBILIZATION	Mobilization/immobilization 42	[3, 7, 8, 10, 37, 38, 48, 62, 75, 85, 120, 121, 123, 124, 127, 129, 130, 132–134, 137, 140, 141, 143, 145, 147, 156, 163, 168, 172, 179, 182, 187, 201, 202, 206–208, 221, 254, 259]
	Encouragement/understimulation 5	[7, 10, 123, 127, 207]
	Bed rest order 4	[124, 127, 156, 208]
	No physical therapy/intervention 2	[7, 8]
HYDRATION/NUTRITION	Hydration/nutrition 35	[3, 8, 10, 37, 38, 40, 44, 48, 55, 81, 85, 120, 123, 129, 132, 134, 146, 149, 151, 153, 154, 156, 168, 172, 183, 201–204, 206, 221, 227, 249, 253, 254]
	Hydration/dehydration 12	[3, 37, 38, 40, 48, 55, 146, 149, 156, 201, 204, 221, 227]
	Malnutrition during hospitalization 20	[8, 10, 38, 48, 81, 120, 123, 132, 146, 149, 151, 153, 154, 156, 201–203, 206, 221, 254]
	Inadequate intake/changes 6	[38, 44, 129, 134, 183, 206]
	Practice of nutrition prescription 5	[3, 168, 172, 221, 254]
FACTORS RELATED TO THE STRUCTURE	Retrieved factors	Citations
HUMAN/WORK ENVIRONMENT	Human/work environment 29	[3, 5, 8, 10, 11, 76, 78, 112, 127, 132, 138, 141, 148, 154, 156, 158, 165, 175, 182, 183, 187, 194, 206, 208, 226, 239, 249, 256, 258]
	Staffing/turnover/workload 16	[8, 11, 76, 112, 127, 132, 148, 158, 165, 175, 194, 208, 239, 249, 256, 258]
	Hospital itself 10	[3, 10, 78, 127, 141, 175, 183, 187, 206, 226]
	Skill mix 5	[138, 165, 194, 208, 239]
	Nurse-to-patient ratio 3	[5, 156, 208]

Table 1 (continued)

FACTORS RELATED TO THE PATIENTS	Retrieved factors	Citations
EDUCATION	Education 19	[11, 78, 112, 120, 127, 129, 132, 145, 148, 151, 158, 161, 165, 175, 182, 206, 231, 249, 258]
	Lack of knowledge regarding older patients and aging 9	[112, 120, 127, 148, 165, 182, 206, 231, 258]
	Lack of knowledge regarding specific conditions 7	[11, 78, 132, 145, 151, 158, 175]
	Lack of expertise to run a unit 1	[129]
PHYSICAL ENVIRONMENT	Physical environment 18	[5, 8, 75, 78, 87, 112, 120, 122, 145, 161, 182, 183, 194, 206, 207, 228, 231, 256]
	Restrictive environment 18	[5, 8, 75, 78, 87, 112, 120, 122, 145, 161, 182, 183, 194, 206, 207, 228, 231, 256]
	Material 18	[5, 8, 75, 78, 87, 112, 120, 122, 145, 161, 182, 183, 194, 206, 207, 228, 231, 256]
	Not elderly-friendly 2	[78, 231]
	Built for healthcare professionals 1	[8]
ORGANIZATION	Organization 17	[4, 9, 11, 76, 112, 129, 134, 149, 156, 158, 161, 175, 182, 203, 210, 213, 249]
	Economic barriers 5	[129, 149, 156, 161, 182]
	Definitions/terminology 4	[4, 9, 134, 161]
	Health systems barriers 4	[11, 158, 203, 210]
	Leadership barriers 3	[11, 76, 210]

Legends: Values correspond to the number of articles in which the factors were found of 237 articles in total)

nihil per os order, and lack of attention [3, 168, 172, 221, 254].

Factors related to the structure

In extracted factors related to the structure, the human environment, education, the physical environment, and organization demonstrated the highest frequencies (Fig. 3; Table 1).

For the human and work environment, details revealed that the hospital environment was full of hazards and environmental triggers [187, 206] and was not adapted to the needs and safety of older people [3, 78, 141, 175]. The composition of the staff, especially the skill mix [138, 165, 194, 208, 239], the reduction of skilled nurses with substitution by less skilled assistive personnel [154, 156], and the use of agency staff [76], managed care [154], and fragmented uncoordinated care [11] were also found.

Factors related to education included global lack of education and knowledge regarding older patients and aging [112, 120, 127, 148, 165, 182, 206, 231, 258], as well as lack of specific knowledge regarding specific conditions concerning restraints, falls, mobility, dementia, delirium, pharmacology, and safe patient handling and mobility activities [11, 78, 132, 145, 151, 158, 175].

Regarding the physical environment, all studies reported restrictive environmental configurations such as floors, lighting, bathrooms, corridors, cluttered environments, space, and location, including material resources such as beds, chairs, or assistive devices [5, 8, 75, 78, 87, 112, 120, 122, 145, 161, 182, 183, 194, 206, 207, 228, 231, 256]. Two articles mentioned that the hospital environment was not elderly- or dementia-friendly [78, 231]. One article added that the hospital environment is built to meet the needs of healthcare professionals [8].

For the factors related to organization, economic barriers were found, especially costs of specialized units, financial disincentives and demands from payers, obtaining funding for programs, and the reimbursement system [129, 149, 156, 161, 182]. Details of leadership and support barriers showed the need for organizational support to promote a culture of change and effective leadership [11, 76, 210]. Some articles mentioned variations in the use of definitions, terminology, criteria/measurement, or the nomenclature and codification system [4, 9, 134, 161]. In another article, legal liability, hospital and manager policies, and punishment regarding falls reduced patients' mobility and activities [175].

Programs, models of care, and interventions

The most mentioned programs and models of care were ACE [5, 9, 10, 129, 139, 142, 163, 168, 178, 201, 202, 208, 221, 231, 238, 242, 246], HELP [9–11, 132, 153, 155, 185, 186, 191, 201, 208, 215, 242]; and NICHE [9, 36, 132, 149, 242]. Various interventions were investigated [39, 42, 57, 66, 69, 70, 73, 79, 94–119] on one [39, 69, 79, 94,

98, 99, 102, 103, 105, 107–114, 118] or multiple hospital-acquired conditions [42, 57, 66, 70, 73, 95–97, 100, 101, 104, 106, 115–117, 119].

Interventions were consultation teams [42, 96, 97, 101, 103, 107], co-management programs [66, 70, 95, 104], based on or derived from HELP [39, 79], derived from the ACE model [98, 100], Enhanced Recovery After Surgery (ERAS) [73], implementation of geriatric or age-friendly principles [108, 117], and various physical or exercise interventions [69, 94, 105, 109, 112, 116, 118]. Remaining studies examined various interventions [57, 99, 102, 106, 110, 111, 113–115, 119], included a volunteer companion observer intervention [99], an interdisciplinary huddle intervention [106], a comprehensive geriatric assessment-based care plan intervention [57], a structured sleep promotion intervention [113], an intervention for the maintenance of ADLs [102], a game-based intervention [110], a functional eating rehabilitation intervention [114], an intervention to reduce complications associated with indwelling urethral catheters [115], a deprescribing intervention [119], and interventions targeting fundamental care [111].

Studies reported various benefits. Studies reported a significant reduction in the incidence [57, 70, 73, 79, 95, 113, 117] and severity of delirium [79], nosocomial infections [66, 69, 95, 106], adverse events [100, 119] or adverse drug events [106], geriatric syndromes [57, 70] or more geriatric syndromes identified [117]. Moreover studies showed a significant reduction of functional decline [95, 104, 110, 114, 115], a decreased risk of HAD [105, 109] or decline in IADLs [94], and a significant difference in functional mobility [118], However, a systematic review of interventions targeting fundamental care to reduce hospital-associated decline concluded that the strength of evidence was low to moderate [111]. Improvements were also found in reduced falls [99, 106], frailty by discharge [39], fluid overload [66], obstipation [95], noninfectious complications [115], a lower proportion of restraint use, lower pressure ulcers, more therapist and dietician interventions [108], use of diapers and mechanical restraints [102], and a decreased daily oral intake [114]. A systematic review identified types of physical activity interventions and facilitators to enhancing physical activity during an acute hospital stay and reported improvements in clinical outcomes [112].

Discussion

This scoping review identified and described the factors involved in the development of hospital-acquired conditions among older patients in acute care settings. Our results showed that most articles focused primarily on functional decline and delirium. Our analysis reveals three key insights: the predominance of patient-related factors in research compared to organizational factors, the challenges of implementing care models, and the importance of considering all categories of factors in prevention strategies.

The predominance of patient-related factors in our results (67.9% of articles) compared to process (61.2%) and structural factors (35.4%) suggests a potential bias in current research approaches. This imbalance aligns with previous observations that hospitals are not well adapted to older people and expose them to many hazards [3]. The limited number of studies (24.9%) examining all three categories of factors simultaneously indicates a fragmented understanding of hospital-acquired conditions. This fragmentation is particularly problematic given the established interdependence between patient vulnerabilities and institutional factors [11]. For instance, while cognitive impairment (a patient factor) increases vulnerability to delirium, its impact is significantly modulated by environmental factors and care processes. This interconnection demands a more integrated approach to both research and intervention design.

The implementation of care models faces significant challenges in practice. While ACE units, HELP, and NICHE programs provide valuable frameworks [20], their implementation is often limited by available resources [201]. Our findings suggest that the dissemination of geriatric principles to non-specialized units shows promise but requires careful consideration of implementation strategies. For instance, studies have demonstrated improvement in standardized geriatric assessments after dissemination of ACE principles to non-ACE units [260]. However, the question remains regarding the extent of training needed, as no increase in geriatric nursing knowledge was found following NICHE implementation in some cases [261].

The category of factors related to the structure was the least frequently identified in this scoping review. Results showed that the human and work environment, physical environment, education, and organization were involved in hospital-acquired conditions. In a senior-friendly approach, these factors are included in two domains which are organizational support and physical environment [211, 262].

Organizational support emphases the strong leadership and commitment to improve care for older patients [262, 263]. The development of this organizational priority involves suitable financial resources, policies and procedures, processes, monitoring, and trained staff level and expertise [262]. Considering patient care practices and the development of complications during hospital stays, staffing level and expertise emerge as an important concern [264]. Models of

care describe the dedicated staff [22, 23, 265], the team composition [265], and the pivotal role played by the team in coordinating intervention in an interdisciplinary approach [22, 265]. But required staffing levels are rarely explicitly specified. Although some ratio suggestions have been identified [266–268], interpreting these ratios is challenging in the absence of clear staffing level recommendations. Despite the model of care recommendations on the roles and profiles, there is a noticeable absence of studies providing insights into staffing. Furthermore, it does not appear that staffing can be dissociated from education and training.

The education and training of the interdisciplinary team are included in the geriatric models of care [22, 23, 269]. Geriatric knowledge and skills are crucial to provide best practice standards, and to achieve positive patient outcomes [269]. Moreover the education of the geriatric resource nurses is essential due to their fundamental role in educating, training, and leading nurses in the standards of geriatric care [23]. However, the question remains regarding the extend of training needed. Dissemination of ACE principles to non-ACE units without the daily participation of geriatricians and specialists [260, 270] demonstrated improvement in standardized geriatric assessments [260] after a short training in terms of duration and number of sessions [260, 270]. In addition, geriatric resource nurses had difficulties and barriers to the implementation of their new knowledge and skills due to lack of collaboration and resistance [271]. Moreover, no increase in geriatric nursing knowledge in acute care registered nurses in direct care positions with older adults was found following NICHE implementation [261].

Physical environment is central to programs aimed at addressing older patients' needs plays a crucial role in minimizing harm and enhancing their safety and well-being [169, 272]. That includes interior design, equipment, and furnishing [211, 262] but also accessibility [262], to minimize the vulnerability and promote safety, functional independence, and well-being of older adults [211, 263]. Physical environment plays a crucial role in minimizing harm and enhancing the safety and well-being of older patients. To achieve positive patient outcomes, however, considerations about the physical environment must be applied in combination with clinical practice and adapted to specific patient populations and settings [272]. Models of care include the hospital environment adaptation and equipment considerations [22, 23, 267, 273]. The benefits and value of the geographic concentration of resources in a dedicated unit were suggested [274]. In contrast, other studies demonstrated the dissemination of geriatric principles to non-dedicated units [260, 270] with improvement in standardized geriatric assessments [260]. Although many units implemented physical environment adaptations [246], these factors were rarely reported in this the scoping review.

Senior-friendly approach and geriatric models of care represent a challenge and cultural and organizational changes. Support and involvement of the stakeholders [201, 275, 276], and a commitment and a policy at an organizational level are required [211, 262]. The leaders' effectiveness is essential for implementing and sustaining the program [271, 275]. However, this scoping review showed that the factors related to the structure were poorly reported. Studies rarely include the preparation process before implementing a new approach or model.

In this scoping review, we considered two other categories of factors. The category of factors related to the patients provided the most factors identified, including personal, psychological or cognitive, physical, or social factors. In the category of factors related to the processes of care, the results showed that medications, medical devices and equipment, mobilization, and hydration/nutrition were involved in hospital-acquired conditions. In a senior-friendly approach, these factors related to the patients and to the processes are considered in two domains which are processes of care, but also social climate and service or emotional and behavioral environment [262, 263].

Processes of care and climate/environment are patient-centered to address unique individual needs [262, 263], especially the physical, psychological, functional, and social needs identified through a holistic assessment [263]. As mentioned before, screening of factors related to the patients can allow detection of patients at risk of developing hospital-acquired conditions, and subsequently to plan cares addressing the older patients' needs.

In the scoping review, factors related to the patients had the highest frequencies because of the inclusion in the studies of data collected describing patients at admission and because of the significant results of the studies. As the models of care are centered on older patients, age of the patients is a consubstantial factor. Age is the criterion for admission in units or programs [21, 22], and the older population is the focus of education and training for healthcare professionals in the NICHE program [277]. Several other patient-related factors identified in the scoping review are part of the inclusion criteria in units or programs, such as impairment in ADLs/IADLs, presence of preexisting geriatric syndromes [269], cognitive or functional ability, frailty status, or certain medical diagnoses [266]. Cognition and mental health are also assessed [273]. Regarding the social factors, psychosocial assessments and identification of the patients' social supports are recommended [273], and living alone or having limited social support is included in the inclusion criteria [269].

Care and interventions protocols are guided by evidence and best practices [211, 262, 263]. Several protocols are included in models of care, including for medication, mobilization, and nutrition [22, 23, 273]. For medications, protocols of care contained recommendations for reviewing of medication [273] or a daily review of medications by a pharmacist [21], screening of psychoactive medications [22], or reducing potentially inappropriate medications [23]. The presence of pharmacists in the units [266, 278] allow modifications of prescribing practices and medication changes, especially after identification of potentially inappropriate medications [278, 279], and reduce prescriptions for antipsychotics or benzodiazepines [280]. For medical devices, a daily discussion about the presence or removal of catheters are included in protocols in order to minimize the use of immobilizing equipment and prevent infection [22, 273]. Recommendations for mobilization and for nutrition and hydration can also be found [22, 273]. Moreover, mobilization activities were performed primarily by volunteers [281, 282].

Factors related to the patients and processes of are included in models of care through inclusion criteria or protocols. Adherence to the established guidelines played a critical role [283]. However, despite these considerations, the presence of multidisciplinary team members at the rounds and compliance to recommendations remain suboptimal and vary [266, 283, 284]. Some healthcare professionals, such as physiotherapists and dietitians, are often not present during rounds, highlighting a gap in multidisciplinary care [266]. Involvement of family members is effective in reducing postoperative delirium and the decline of cognitive and physical functioning in older patients [285], but this involvement is encouraged but varies [23].

Although those factors are included in care protocols, understanding the barriers and facilitators to their implementation is essential. However, results of your scoping review showed that factors related to the structure are poorly reported. In contrast, research on senior-friendly approach focuses mainly on development and implementation rather than outcomes [286]. Consequently, an in-depth knowledge of the context is required for implementing and adapting practice changes or new practices. Organizational support included trained staff, suitable resources, leadership, and commitment seems to be a prerequisite.

This scoping review identified numerous factors related to the patients, the processes of care, and the structure of hospitals. Geriatric acute care models share the common goals of addressing the needs of older patients and preventing iatrogenic complications. These models include to some extent all of the categories and factors with varying emphasis on specific hospital-acquired conditions or factors. Notably, structural factors were less reported, highlighting the need for strong organizational as reflected in senior-friendly approaches. Combining existing acute care geriatric models of care with a hospital-wide strategy could enhance care for older patients. This integration may offer both specialized care in dedicated units for older patients with the greatest needs and the dissemination geriatric principles throughout an acute care hospital. Such a dual approach may open perspectives for improving older patients care.

Strengths and limitations

To our knowledge, this scoping review is the first mapping to consider factors related to the patients, the processes of care, and the structure of hospitals. In doing so, this scoping review provides a comprehensive overview of the factors involved in the development of hospital-acquired conditions and highlights the fact that the factors are not only related to the patients and their health situation. The limitations of this scoping review are related to our objective and the methodology chosen for this purpose. The difficulties encountered were mainly the result of our ambitious research question and objective to identify all categories of factors involved in the development of any hospital-acquired condition. We included a broad range of source types without evaluating the quality, and the volume of extracted data was extensive. The heterogeneity in definitions and terms used for hospital-acquired conditions across studies may have led to missing some relevant publications, despite our comprehensive search strategy. The classification of factors into categories was based on our interpretation and other researchers might propose different categorization schemes, particularly given the complex interplay between factors. Moreover, the predominance of studies from North America and Europe may limit the generalizability of our findings to other healthcare contexts with different resources, organizational structures, and care delivery models. Additionally, the complexity and breadth of the topic may have led to oversimplification in factor categorization, potentially masking some of the nuances in how these factors interact and influence hospital-acquired conditions in older patients. Some factors could potentially be classified into multiple categories, highlighting the challenge of creating distinct categorizations in such a complex healthcare issue.

Conclusion

The development of hospital-acquired conditions in older patients in acute care settings emerges from a complex interplay of patient-related, process-related, and structural factors. Our findings highlight that while patient characteristics are well-documented, the

processes of care and structural factors remain underexplored despite their potential for modification. As the population ages and healthcare systems face increasing pressure, preventing hospital-acquired conditions requires moving beyond individual patient factors to embrace system-wide approaches. The challenge ahead lies in transforming acute care hospitals to better serve older adults while acknowledging both the complexities of aging and the intricacies of modern healthcare organizations. Success in this endeavor requires not only understanding the various contributing factors but also developing and implementing integrated solutions that address all three dimensions of care. This comprehensive approach, though challenging, offers promising pathways for improving the quality and safety of hospital care for older adults.

Abbreviations

ADLs	Activities of Daily Living
ACE	Acute Care for Elders
ERAS	Enhanced Recovery After Surgery
HAD	Hospitalization-Associated Disability
HELP	Hospital Elder Life Program
IADLs	Instrumental Activities of Daily Living
NICHE	Nurses Improving Care for Healthsystem Elders
PRESS	Peer Review of Electronic Search Strategies
PRISMA-ScR	PRISMA Extension for Scoping Reviews

Supplementary Information

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Additional file 1. Data searching combination used on databases.

Additional file 2. Characteristics and results of individual sources.

Additional file 3. Risk factors for hospital-acquired conditions.

Authors' contributions

MV conceptualized the review and design. CJ developed the search strategy. MV, SP, and CM conducted the review. MV prepared the original draft of the manuscript. CM and TA contributed to revising and finalizing the manuscript by providing critical feedback to drafts. All authors have reviewed and approved the final manuscript.

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Data availability

All data relevant to the study are included in the article or uploaded as online supplementary materials.

Declarations

Ethics approval and consent to participate

All methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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