QUERI

Emergency Department Interventions for Older Adults

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PREFACE

The VA Evidence-based Synthesis Program (ESP) was established in 2007 to provide timely and accurate syntheses of targeted healthcare topics of particular importance to clinicians, managers, and policymakers as they work to improve the health and healthcare of Veterans. QUERI provides funding for four ESP Centers, and each Center has an active University affiliation. Center Directors are recognized leaders in the field of evidence synthesis with close ties to the AHRQ Evidence-based Practice Centers. The ESP is governed by a Steering Committee comprised of participants from VHA Policy, Program, and Operations Offices, VISN leadership, field-based investigators, and others as designated appropriate by QUERI/HSR&D.

The ESP Centers generate evidence syntheses on important clinical practice topics. These reports help:

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

The ESP disseminates these reports throughout VA and in the published literature; some evidence syntheses have informed the clinical guidelines of large professional organizations.

The ESP Coordinating Center (ESP CC), located in Portland, Oregon, was created in 2009 to expand the capacity of QUERI/HSR&D and is charged with oversight of national ESP program operations, program development and evaluation, and dissemination efforts. The ESP CC establishes standard operating procedures for the production of evidence synthesis reports; facilitates a national topic nomination, prioritization, and selection process; manages the research portfolio of each Center; facilitates editorial review processes; ensures methodological consistency and quality of products; produces “rapid response evidence briefs” at the request of VHA senior leadership; collaborates with HSR&D Center for Information Dissemination and Education Resources (CIDER) to develop a national dissemination strategy for all ESP products; and interfaces with stakeholders to effectively engage the program.

Comments on this evidence report are welcome and can be sent to Nicole Floyd, ESP CC Program Manager, at Nicole.Floyd@va.gov.

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This topic was developed in response to a nomination by Dr. Thomas Edes, Executive Director, VHA Geriatrics and Extended Care Operations, and Dr. Chad Kessler, Director, VHA Emergency Medicine, for the purpose of identifying and evaluating intervention strategies in emergency care for older adults and with the goal of implementation across 141 VA emergency departments (EDs) and urgent care centers (UCCs). The scope was further developed with input from the topic nominators (*ie*, operational partners), the ESP Coordinating Center, the review team, and the technical expert panel (TEP).

In designing the study questions and methodology at the outset of this report, the ESP consulted several technical and content experts. Broad expertise and perspectives were sought. Divergent and conflicting opinions are common and perceived as healthy scientific discourse that results in a thoughtful, relevant systematic review. Therefore, in the end, study questions, design, methodologic approaches, and/or conclusions do not necessarily represent the views of individual technical and content experts.

The authors gratefully acknowledge the following individuals for their contributions to this project:

Operational Partners

Operational partners are system-level stakeholders who have requested the report to inform decision-making. They recommend TEP participants; assure VA relevance; help develop and approve final project scope and timeframe for completion; provide feedback on draft report; and provide consultation on strategies for dissemination of the report to field and relevant groups.

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Technical Expert Panel (TEP)

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

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

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EXECUTIVE SUMMARY

INTRODUCTION

Older adults, particularly those 75 years of age and older, visit the emergency department (ED) with nearly twice the frequency of their younger counterparts. Within VA, older Veterans account for 40 percent of 2.4 million annual ED visits. This figure will continue to rise as the number of older Veterans is expected to increase significantly over the next decade.

Older adults presenting to the ED can experience challenges that make care more difficult, such as multiple morbidities, polypharmacy, atypical symptoms, functional disabilities, impaired cognition, and reduced social support. To address these challenges, a range of interventions designed to improve clinical outcomes and decrease healthcare utilization in older adult ED users have been evaluated in prior studies. These include care delivery, case management, and transitional care or discharge planning. Systems-level attention to these challenges is also evident through the 2014 publication of the Geriatric Emergency Department Guidelines (hereafter referred to as the 2014 Geriatric ED Guidelines). These collaborative guidelines provide a template for staffing, equipment, education, policies and procedures, follow-up care, and performance-improvement measures, but do not include evidence-based recommendations on specific ED interventions.

Our review aims to fill gaps in the literature by synthesizing evidence about ED interventions for clinical outcomes such as functional status and quality of life and utilization outcomes including hospital admission and ED readmission. Additionally, our review carefully classifies individual intervention components and uses rigorous analytic techniques to compare the effectiveness of selected interventions on outcomes of interest.

At the request of the VHA Offices of Geriatrics and Extended Care Operations and Emergency Medicine, we conducted a systematic review and meta-analysis to address the following key question (KQ):

> How effective are emergency department (ED) interventions in improving clinical, patient experience, and utilization outcomes in older adults (age ≥65)?

METHODS

We developed and followed a standard protocol for this review in collaboration with operational partners and a technical expert panel (PROSPERO registration number CRD42018087660).

Data Sources and Searches

We searched MEDLINE (via PubMed), Embase, and CINAHL through December 4, 2017. We also identified studies by reviewing the bibliographies of relevant review articles. Additionally, we performed a search of ClinicalTrials.gov and a targeted search of Scopus for publications citing the 2014 Geriatric ED Guidelines.

Study Selection

In brief, the major eligibility criteria were studies conducted in EDs that enrolled older adults (age ≥65); evaluation of case management, discharge planning, medication management, and/or geriatric guideline-based intervention strategies; randomized or quasi-experimental study designs; and a clinical, patient experience, or utilization outcome. Using these prespecified inclusion/exclusion criteria, 2 reviewers independently evaluated titles and abstracts to identify potentially eligible studies. Studies that met all eligibility criteria at full-text review were included for data abstraction.

Data Abstraction and Quality Assessment

Key characteristics, abstracted by 1 reviewer and over-read by another, included patient descriptors, intervention structure (*ie*, overall strategy and core components) and characteristics (*ie*, mode, dose), comparator, and outcomes. Based on abstracted data, we evaluated each study for the presence, or absence, of 3 key intervention components: assessment, referral plus follow-up, and bridge design (*ie*, planned contacts occurring both before and after ED discharge). Study risk of bias (ROB) was assessed independently by 2 reviewers using the Effective Practice and Organisation of Care (EPOC) guidance. We assigned a summary ROB score separately for non–patient-reported outcomes, hereafter referred to as objective outcomes (*eg*, mortality, ED readmission), and patient-reported outcomes (*eg*, quality of life).

Data Synthesis and Analysis

We summarized the literature using relevant data abstracted from the eligible studies. Feasibility of completing meta-analyses to estimate summary effects depended on the volume of relevant literature, conceptual homogeneity of the studies, and completeness of results reporting. We aggregated outcomes when there were at least 3 studies with the same outcome, reported at similar time points; for nonrandomized studies, we required adequately adjusted analyses to be reported. All analyses were stratified by randomized versus nonrandomized study designs.

When meta-analysis was possible, dichotomous outcomes (*eg*, mortality) were combined using risk ratios in the random-effects analyses. Continuous outcomes (*eg*, quality of life) were summarized using the mean difference. When quantitative synthesis was not feasible, we analyzed the data qualitatively, giving more weight to larger, lower ROB studies. Strength of evidence (SOE) was assessed for outcomes critical to decision making using the approach described by the Grading of Recommendations Assessment, Development and Evaluation working group (GRADE).

RESULTS

Key Points

- The literature addressing intervention strategies for older adults presenting to EDs is diverse, with varying approaches to selecting patients for services and an array of intervention strategies that typically incorporate geriatric care and/or chronic care principles that have been effective in other settings.

- ED interventions showed a mixed pattern of effects on clinical outcomes. Evidence suggested a small benefit for functional status (very low strength of evidence [SOE]), but no effects on quality of life (QOL). However, only 2 studies reported effects on QOL.
- ED interventions did not show a reduction in mortality, but no study identified mortality as a primary outcome. This finding was based on few events, and confidence intervals do not exclude an important effect.
- Overall, there were no effects of ED interventions on hospitalization at the index visit (very low SOE), subsequent hospitalizations (low SOE), or ED readmission (high SOE).
- Studies with the greatest effects on clinical and healthcare utilization outcomes employed more comprehensive interventions, but this pattern was not consistent across all effective interventions:
    - Multi-strategy interventions, defined as those using more than 1 intervention strategy (*eg*, discharge planning, case management, medication management), may be associated with less decline in functional independence.
    - More intensive, or higher touch, interventions, as indicated by the presence of 3 key intervention components (*ie*, assessment, referral plus follow-up, and bridge design), may be associated with less decline in functional independence, and decreased hospitalization after the ED index visit and/or ED readmissions.
    - Single-contact interventions, whether delivered in the ED or after discharge, do not improve utilization outcomes.

Results of Literature Search

We reviewed a total of 1,878 references, of which 100 were reviewed at the full-text stage. Of these, 17 references describing 15 unique studies (9 randomized and 6 nonrandomized) were included for data abstraction. All were conducted in the United States, Canada, Europe, or Australia. More than 16,000 older adults were enrolled in these studies, but no study explicitly enrolled Veterans.

Study and Intervention Characteristics

The 15 studies recruited a broad patient population (*ie*, not limited to a specific diagnosis or condition). Just over one-half of studies enrolled older adults at higher risk for poor health outcomes as determined by either a risk-assessment tool or clinical criteria (*eg*, dependent in 1 or more activities of daily living [ADLs]). Interventions were delivered during the index ED visit, post-ED discharge, or across settings (*ie*, bridge). Case management was the most common intervention strategy (n=12), followed by discharge planning (n=7), and medication management/medication safety (n=3). Roughly one-half of studies (n=7) used more than 1 of these intervention strategies and thus were classified as multi-strategy. The most common combinations were discharge planning plus case management (n=5) and case management plus medication safety (n=2). Across the strategies, interventions included the components of risk assessment (n=12, including 8 that specified use of a comprehensive geriatric assessment), referral plus follow-up (n=6), and bridge designs (n=5). Intervention strategies typically incorporated geriatric care and/or chronic care principles that have been effective in other settings, but studies did not describe an overall conceptual model that motivated the intervention.

Measures of healthcare utilization, such as ED readmission, were the most commonly reported outcomes. The ROB for objective outcomes was judged low for 4 studies, unclear for 3 studies, and high for 7; 1 study did not report an objective outcome.

Summary of Intervention Effects

Randomized studies showed a pattern of positive effects on functional status (4 studies, low SOE), but no effect on mortality. Effects on QOL were reported infrequently. There was no effect noted in the limited number of studies that reported this outcome. Although ED interventions did not show a reduction in mortality, there were few events, and confidence intervals do not exclude an important effect.

Five studies reported effects on patient experience, but this outcome was often measured by unvalidated scales. Overall, these studies show a mixed pattern, with 2 studies reporting higher satisfaction with care or greater patient knowledge of community resources.

Overall, interventions did not show a reduction in hospitalization at index ED visit (3 studies, very low SOE). Meta-analyses of randomized studies did not show an overall effect on subsequent hospitalizations (3 studies; relative risk [RR] 0.96; 95% CI 0.51 to 1.83; low SOE), or ED readmission (6 studies; RR 1.13; 95% CI 0.94 to 1.36; high SOE). However, a qualitative analysis that included nonrandomized studies suggested that interventions that included points of contact before and after ED discharge decreased hospital and ED readmission rates.

Multi-strategy interventions (*eg*, discharge planning and case management) may be associated with benefit on functional status and some utilization outcomes. Similarly, more intensive interventions with multiple planned contacts across settings (*ie*, both before and after ED discharge) may be associated with beneficial effects on functional status and some utilization outcomes.

Key Findings and Strength of Evidence

In order to evaluate strategies to improve ED care for older adults, we examined intervention effects on a range of outcomes of importance to patients, clinicians, and policymakers. We used a unique approach to classifying intervention strategies and specific components, assessed ROB carefully, and included only randomized or stronger nonrandomized studies. Although the intervention approaches varied widely across studies, we were particularly interested in determining if specific intervention strategies or components were associated with greater benefit to older adults. Studies most often evaluated case management or multiple intervention strategies. Two strategies were evaluated infrequently (medication management) or not at all (guideline-informed). We found a pattern of small benefit for functional status but, overall, no benefit on ED readmission or subsequent hospitalization. Intervention effects for other outcomes were uncertain because of infrequent or incomplete reporting. Most interventions evaluated were relatively low intensity, and thus our findings are applicable only to low-intensity geriatric management strategies in the ED.

We evaluated strategies applicable to a broad range of older adults rather than focusing narrowly on condition-specific interventions. Just over half of the 15 studies enrolled high-risk older adults—patients who are similar clinically to Veterans presenting to VA EDs. The SOE was

rated high for effects on ED readmission but low, or very low, for other outcomes. This was due to concerns of high ROB, inconsistent effects, and imprecision.

Strength of Evidence for Effects of Interventions to Improve Outcomes for Older Adults in Emergency Departments

Outcome	Studies (Patients)	Findings	Strength of Evidence (Rationale by Domain)
Physical function	Randomized: 5 (2233)	3 of 5 showed benefit; beneficial interventions were multi-strategy	Very low SOE (Serious ROB, inconsistent, imprecise)
	Nonrandomized: 1 (687)	No effect	
ED readmission	Randomized: 7 (4629)	Relative risk 1.13 (0.94 to 1.36) (9 fewer to 53 more per 1,000)	High SOE (No serious ROB, consistent, precise)
	Nonrandomized: 5 (6432)	2 of 5 showed lower readmission; beneficial interventions were multi-strategy or case management	
Hospital admission after index	Randomized: 3 (3338)	Relative risk 0.96 (0.51 to 1.83) (59 fewer to 100 more per 1,000)	Low SOE (No serious ROB, inconsistent, imprecise)
	Nonrandomized: 3 (5346)	No consistent effects on readmission	
Patient experience	Randomized: 4 (1889)	2 of 4 showed benefit for satisfaction, helpfulness, or self-esteem; beneficial interventions were multi-strategy or case management	Low SOE (No serious ROB, consistent, indirect, imprecise)
	Nonrandomized: 1 (199)	No usable data	

Abbreviations: ROB=risk of bias; SOE=strength of evidence

Implications and Applicability to Veterans

Similar to prior reviews and the 2014 Geriatric ED Guidelines, our review suggests that ED visits should not be considered in isolation, but as an integral part of the geriatric patient's continuum of care. The diversity of interventions and outcome measures across included studies limits our ability to determine clinical utility of any 1 intervention strategy and highlights the need for interventions rooted in a conceptual model. Our structured analysis of these heterogeneous findings suggests that single-strategy interventions are less effective at improving outcomes compared with more comprehensive and more intensive interventions (*ie*, interventions including assessment, referral plus follow-up, contacts both pre- and post-ED discharge). Although none of the studies included Veteran populations, all studies were conducted in economically developed countries with community-dwelling, mostly high-risk older adults without cognitive impairment, and with broadly similar ED and geriatric staff training.

Research Gaps/Future Research

The primary gaps in the current evidence are studies that actively recruit Veterans, studies that examine optimal dose of ED intervention strategies (number of contacts and duration) or optimal timing and setting (both within ED and after discharge), and studies that evaluate interventions

informed by the 2014 Geriatric ED Guidelines. Although 8 studies targeted high-risk patients, few studies have examined which subpopulations of older adults benefit most from ED strategies. Similarly, the existing literature often lacks complete descriptions of intervention strategies and components.

Future research may benefit from using conceptual models to guide selection of intervention strategies and hypothesize the relationship, or mechanisms of action, between such strategies and outcomes of interest. Conceptual models may also enable researchers to explore ED use through a more holistic lens, expanding beyond clinical and medical characteristics that influence use to also consider sociodemographic factors, individual preferences, and access to services. Future research should consider using innovative intervention and evaluation designs to achieve a balance between interventions that are broadly applicable to diverse, heterogeneous populations and patient-centered interventions tailored to meet the needs of high-risk subgroups. This may include adaptive intervention designs to optimize dose and content of interventions and innovative study designs, including factorial designs and hybrid designs, that allow researchers to isolate intervention components for assessing individual and interactive effects of intervention strategies and components and/or evaluate interventions in pragmatic settings. Lastly, future research should address challenges in outcome measures, including the selection of outcome measures that apply to older adults with a range medical conditions and that are responsive to change. There is substantial opportunity for patient- and stakeholder-engaged research, as well as research informed by the 2014 Geriatric ED Guidelines.

Conclusions

We focused only on studies recruiting general patient populations as opposed to focusing on interventions for specific presenting conditions or diagnoses upon ED discharge (*eg*, falls, heart failure). Our results indicate mixed effects of ED intervention strategies on select clinical and utilization outcomes. The small number of studies using any single intervention strategy makes it difficult to draw definitive conclusions because of imprecise estimates of effect and variability in study populations, intervention strategies, and intervention components. However, we found evidence that studies evaluating multi-strategy interventions and those with a more intensive structure, as indicated by the presence of 3 key intervention components (*ie*, assessment, referral plus follow-up, and planned contacts both pre- and post-ED discharge) may be associated with a small benefit in functional status, decreased hospitalization after the ED index visit, and/or lower likelihood of ED readmission. Future research should be informed by a comprehensive conceptual model, consider emerging intervention approaches (*eg*, adaptive, or dynamic, treatment designs), employ rigorous evaluation strategies, adhere to more thorough reporting of intervention structure, and engage patients and relevant policymakers in selecting outcomes of interest.

ABBREVIATIONS TABLE

ACEP	American College of Emergency Physicians
ADL	Activity of daily living
CI	Confidence interval
CINAHL	Cumulative Index to Nursing and Allied Health Literature database
ED	Emergency department
ESP	Evidence-based Synthesis Program
HSR&D	Health Services Research & Development
IADL	Independent activity of daily living
KQ	Key Question
MD	Mean difference
MeSH	Medical Subject Heading
OARS	Older Americans Resources and Services
OECD	Organisation for Economic Cooperation and Development
PICOTS	Population, intervention, comparator, outcome, timing, and setting
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta Analyses
QOL	Quality of life
QUERI	Quality Enhancement Research Initiative
ROB	Risk of bias
SF-36	Short-Form Health Survey
SMD	Standardized mean difference
SOE	Strength of evidence
VA	Veterans Affairs
VHA	Veterans Health Administration

EVIDENCE REPORT

INTRODUCTION

Older adults, especially those 75 years of age and over, have some of the highest rates of emergency department (ED) visits. In the United States, older adults make 64 ED visits per 100 persons annually, nearly twice the frequency of their younger counterparts.[1] Within VA, older Veterans account for 40 percent of 2.4 million annual ED visits. This number will continue to rise, as the number of older Veterans is expected to increase significantly over the next decade.[2]

Older adults presenting to the ED can have a myriad of challenges that make care more difficult compared with younger adults. Such challenges include extensive medical histories with multiple morbidities, atypical symptoms or disease states, polypharmacy and adverse drug-drug interactions, and misunderstandings or misuse of prescription and over-the-counter medications.[3,4] Additionally, older adults have different physiology compared with younger patients and may be challenged by functional disabilities, impaired cognition, communication problems, and reduced social support.[5,6] These factors can make it difficult both for the older patient to navigate the hurried pace of the ED and for the health care provider to obtain a complete and accurate history, evaluate symptoms, make appropriate diagnoses, and optimize treatment.[3,7,8] Any of these challenges can complicate assessment, diagnosis, treatment, and discharge, thereby negatively impacting care received while in the ED, transitions to home or other setting, and postdischarge health outcomes.[9,10] In fact, older adults aged 75 and over are 3 times more likely to be admitted to the hospital from the ED.[1]

In addition to the factors noted above, optimal care for older adults visiting the ED may be difficult due to the physical space or design of the ED[11] and decreased comfort of providers and staff in the care of older adults.[3] However, individual and systems-level interventions may help address some of these challenges and improve both care processes and patient-related outcomes.

A broad range of interventions have been designed to improve clinical and utilization outcomes in older adult ED users. Broadly speaking, these interventions can be grouped into several categories including staffing, physical infrastructure, care delivery (including functional and geriatric assessments, and risk-prediction tools), case management, and transitional care or discharge planning.[7,12-15]

There has been growing attention to systems-level changes in geriatric emergency medicine practice and education, including the publication of the 2014 Geriatric Emergency Department Guidelines.[16-18] These guidelines were a joint effort by the American College of Emergency Physicians, American Geriatrics Society, Emergency Nurses Association, and Society for Academic Emergency Medicine. These consensus guidelines offer a standard set of guidelines that are designed to be implemented in both general EDs and standalone geriatric EDs. More specifically, these guidelines provide a template for staffing, equipment, education, policies and procedures, follow-up care, and performance-improvement measures. They were the first multidisciplinary geriatric guidelines not aimed at addressing a specific condition or barrier, but rather addressing known challenges in caring for the elderly population at a systems level. The guidelines offer recommendations about important principles and processes in the care of older adults in the ED but do not recommend specific interventions or programs, acknowledging

uncertainty in effectiveness. This gap highlights the need for a systematic review of ED intervention strategies.

The American College of Emergency Physicians (ACEP) has established an accreditation process for geriatric ED recognition. The standards to gain accreditation are meant to be applied across all settings, from rural to academic, within a regular ED or in a separate area. While there is not sufficient evidence that geriatric accreditation leads to improved clinical outcomes in ED settings, improved outcomes have been shown with accreditation for specific disease processes such as stroke.[19]

A 2017 scoping review to identify evidence addressing the identification and management of frail older people in the ED identified substantial literature and called for a careful synthesis to inform policy and clinical practice.[7] Most prior studies of geriatric ED practices have focused on systems-level utilization outcomes, including length of stay, hospital admission, and repeat ED visits; few prior reviews have focused on patient-centered outcomes. Further, these reviews often classified interventions simply, potentially obscuring relationships between intervention components and outcomes, and no review has comprehensively evaluated a broad range of strategies. Our review aims to fill this gap by synthesizing evidence and including functional status and quality of life—2 clinical outcomes prioritized by VHA providers committed to preserving functional independence as critical to supporting older Veterans' ability to age in place. Additionally, our review carefully classifies individual intervention components and uses rigorous analytic techniques to compare the effectiveness of selected interventions on outcomes of interest.

This review is intended to be used by the VHA Offices of Geriatrics and Extended Care Operations and Emergency Medicine to identify and evaluate intervention strategies in emergency care for older adults, with the goal of implementation across 141 VA EDs and urgent care centers. The review is also intended to provide guidance and establish priorities for an update of the Geriatric Emergency Medicine section of the ED Handbook to inform the future research agenda in VA geriatric emergency medicine.

METHODS

We followed a standard protocol for this review. Each step was pilot-tested to train and calibrate study investigators. The PROSPERO registration number is CRD42018087660. We adhered to the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guidelines, including the PRISMA Harms extension.[20]

TOPIC DEVELOPMENT

This topic was nominated by the VHA Offices of Geriatrics and Extended Care Operations and Emergency Medicine. The Key Question (KQ) and protocol, including the identification of intervention strategies and components, were developed *a priori* by the Durham Evidence-based Synthesis Program team in consultation with the operational partners and a technical expert panel. Topic development was informed by a search for recent systematic reviews, scoping reviews, or evidence maps. We rated the quality and retained those judged moderate[3,21-25] or good[12-15] to inform the final KQ and methods. We did not include studies that addressed the development of risk-assessment tools, as these have been reviewed recently and were not a priority for VHA.[22]

Key Question

The KQ for this report was: How effective are emergency department (ED) interventions in improving clinical, patient experience, and utilization outcomes in older adults (age ≥65)?

Emergency Department Intervention Strategies

For this review, ED interventions included the 4 major strategies described in Table 1. These strategies were identified before data abstraction and were based on prior reviews, existing literature, and consultation with our technical expert panel. We classified each study by its primary intervention strategy. Although 4 potentially distinct strategies are described, some studies evaluated multiple strategies (*eg*, discharge planning followed by case management, or case management that includes strategies for medication safety), and in these instances, we classified the intervention as "multi-strategy."

Table 1. Emergency Department Intervention Strategies

Intervention Strategy	Definition
Discharge planning	Discharge planning is time-limited, taking place fully within the ED, and encompassing the process of thinking about and formalizing a plan of care prior to a patient's discharge from the ED. Discharge planning may incorporate 1 or more of the following: geriatric consultation or geriatric assessment in the ED[a], patient/caregiver education, or a follow-up plan. Although the initial assessment and discharge planning take place within the ED, the responsibility for coordinating and obtaining follow-up care rests with the patient or caregiver.

Intervention Strategy	Definition
Case management	Case management takes place over time and across settings, initially beginning within the ED and continuing after discharge, and includes the activities that a physician or other health care professional performs to ensure coordination of medical services needed by the patient[b]. The ultimate goal of case management is to help support successful transition from the ED to post-ED settings. Unlike discharge planning, in which the patient or caregiver may be responsible for identifying and securing services, in case management the major responsibility and coordination rests with 1 or more providers.
Medication safety or management	Interventions that assist patients or caregivers in managing and monitoring drug therapy for older adults with chronic conditions[c].
Geriatric EDs	EDs designed or guided by the 2014 Geriatric ED Guidelines.[16-18]

[a] The geriatric assessment is a multidimensional, multidisciplinary assessment designed to evaluate an older person's functional ability, physical health, cognition and mental health, and socio-environmental circumstances. It must include a geriatrician or geriatric-trained nurse practitioner or physician assistant and may be a focused assessment that is customized for ED settings.
[b] We define case management narrowly to require a non-physician, either onsite in the ED or offsite, who is involved in coordinating follow-up care related to an ED visit. This may include home-based services.
[c] Interventions may incorporate a clinical pharmacist or other expert in drug therapy, or computerized interventions if they are conducted in real time (during patients' ED admission). Interventions may be targeted to the clinician, patient, or family if they focus on the proper selection of medications, reduction in polypharmacy or medication errors, or use of medications. These interventions do not include shared decision-making approaches to choosing 1 treatment versus another.
Abbreviation: ED=emergency department

Emergency Department Intervention Components

In addition to the major ED intervention strategies, we abstracted detailed information about the intervention structure. This included the timing and setting (*eg*, before ED discharge, after ED discharge, or both); target of intervention (*eg*, patient, caregiver/family member, provider); mode of delivery (*eg*, telephone, in-person); number and type of providers; number of planned contacts; and number of actual contacts. We also abstracted details about patient-focused intervention components (*eg*, assessment/screening, patient and/or caregiver education or support) and provider- or service-driven components (*eg*, referral to provider and/or community resources, follow-up call or visit, continuity of care/care coordination, environmental or procedural changes in response to 2014 Geriatric ED guidelines). An in-depth description of intervention strategies and components is in Appendix A.

Informed by prior literature,[26] and using information from the detailed intervention abstractions, we hypothesized that 3 key intervention components would be associated with positive outcomes, as described in Table 2.

Table 2. Definitions of Key Emergency Department Intervention Components

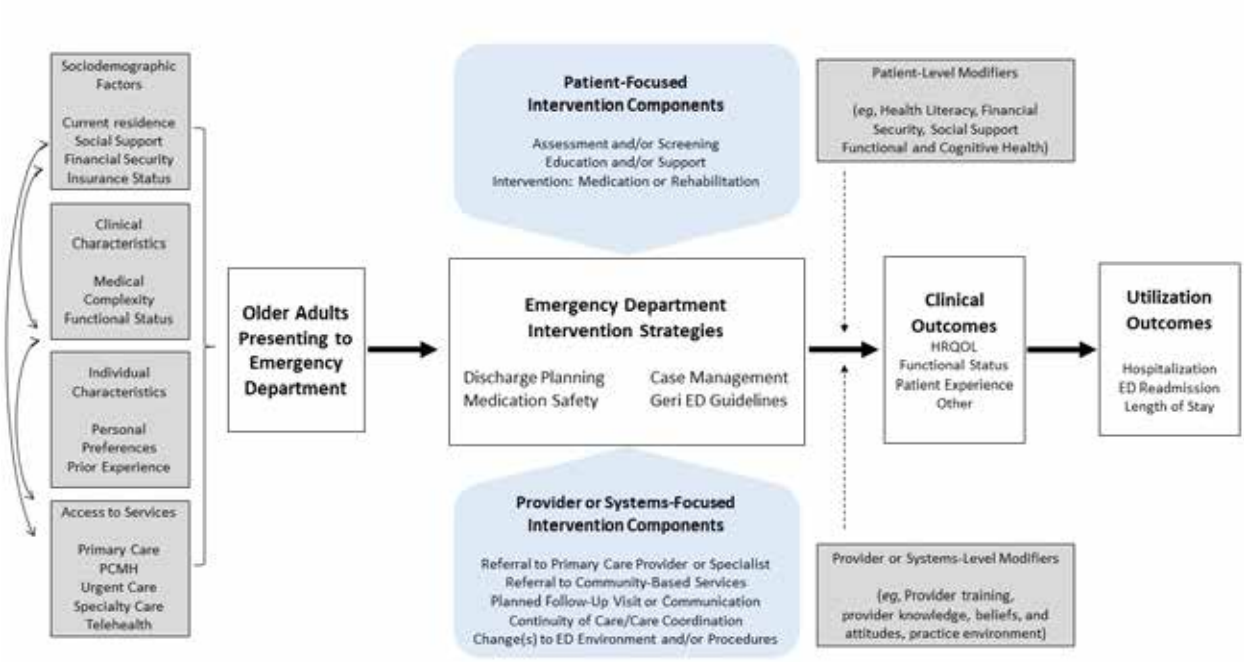
Intervention Component	Definition
Assessment	A structured and/or targeted assessment performed as a part of the intervention. A structured assessment may include a comprehensive geriatric assessment or biopsychosocial assessment covering common domains including cognitive performance, functional status, social status and living environment, health behaviors, and psychosocial factors. Brief or targeted assessments may include 1 or more specific domains, such as cognitive performance or functional status.
Referral plus follow-up	Referral to 1 or more of the following: primary care provider, specialty provider, or community resource or services plus planned communication or visit(s) with intent of following up on referral.
Bridge	An intervention that takes place across settings, including 1 or more planned contacts before discharge from the ED and again after discharge.

Abbreviation: ED=emergency department

Conceptual Framework

Conceptual frameworks are theory-driven and depict the hypothesized, or causal, relationships between behavioral determinants, intervention strategies, and key outcomes. Models also examine potential mediators and moderators of causal processes. In collaboration with our stakeholders and technical expert panel, and prior to the start of our review, we developed a conceptual framework (Figure 1) informed by existing research in geriatric emergency medicine. Existing literature suggests that, for older adults, the process of accessing and utilizing ED care results from an interaction between sociodemographic factors, clinical characteristics, personal preferences and prior experiences, and access to services.[27,28] Although prior reviews have evaluated the effect of common ED interventions such as geriatric assessment and/or discharge planning, to our knowledge no reviews to date have mapped specific components of these interventions to a conceptual model, nor have any reviews examined interventions that use multiple strategies. In addition to evaluating the effect of the different ED intervention strategies described in the above, we collected additional details of the interventions. As depicted below, we grouped the intervention components into 2 main categories: (1) patient-focused intervention components (*ie*, intervention processes that gathered information from, or provided information to, the patient and/or caregiver) and (2) provider- or systems-focused components (*ie*, intervention processes that involve a provider, service, resource, or workflow in the larger healthcare system). Note that boxes shaded in gray depict constructs believed to influence initial need for ED care and modify the effect of the intervention. However, information depicted in these boxes was rarely included in the studies and was not abstracted or analyzed as a part of this report. Also not shown in the model are aspects of the intervention structure, described above (*eg*, setting, target, providers, number of planned contacts).

Figure 1. Conceptual Framework



Abbreviations: ED=emergency department; Geri=geriatric; HRQOL=health-related quality of life; PCMH=patient-centered medical home

SEARCH STRATEGY

In collaboration with an expert reference librarian, we employed a 2-stage search strategy, searching first for recent systematic reviews (SRs) or scoping reviews, and then conducting a search for primary literature not identified in these reviews. We searched MEDLINE® (via PubMed®) and the Cochrane Library for high-quality SRs published from inception through October 17, 2017. We identified 7 relevant reviews, with the most recent being a high-quality scoping review whose search was conducted in Fall 2016.[7] We searched MEDLINE (via PubMed), Embase, and CINAHL for primary literature published from January 1, 2016 through December 4, 2017. Overall, our approach was to utilize existing moderate- to high-quality SRs and scoping reviews to identify literature up to the most recent comprehensive search date, supplemented by a new literature search to the current date, and perform a *de novo* literature synthesis.

Our search strategy was informed by the Cochrane Effective Practice and Organization of Care (EPOC) Group.[29] EPOC criteria were developed to capture both randomized and nonrandomized study designs. We used a combination of medical subject headings (MeSH), keywords, and selected free-text terms for the eligible interventions, geriatrics or older adults, and EDs (Appendix B). All citations were imported into 2 electronic databases (for referencing, EndNote® Version X7, Thomson Reuters, Philadelphia, PA; for data abstraction, DistillerSR; Evidence Partners Inc., Manotick, ON, Canada).

STUDY SELECTION

Using prespecified inclusion/exclusion criteria (Appendix C), 2 reviewers independently evaluated titles and abstracts to identify potentially eligible primary studies. Studies then advanced to the full-text review stage. To be eligible for inclusion at the full-text review stage, studies had to meet all eligibility criteria. Disagreements were resolved by consensus between the 2 investigators or by a third investigator. Articles meeting all eligibility criteria were included for data abstraction. Eligibility criteria included (1) older adults ≥65 of age presenting to the ED, (2) an eligible intervention (see Table 1), (3) a randomized or quasi-experimental study,[29] and (4) conducted in an Organisation for Economic Cooperation and Development (OECD) country.

DATA ABSTRACTION

Data from published reports were abstracted into a customized DistillerSR database by 1 reviewer and over-read by a second reviewer. Disagreements were resolved by consensus or by obtaining a third reviewer's opinion when consensus was not reached. Key characteristics abstracted included patient descriptors, intervention characteristics, comparator, and outcomes. Multiple reports from a single study were treated as a single data point; we prioritized results based on the most complete and appropriately analyzed data. When critical data were missing or unclear in published reports, we requested supplemental data from the study authors. Key features relevant to applicability included the match between the sample and target populations (*eg*, age and Veteran status).

RISK OF BIAS ASSESSMENT

Study risk of bias (ROB) was assessed independently by 2 investigators. Disagreements were resolved by consensus between the investigators or, when needed, by arbitration by a third investigator. We used the key ROB criteria described in the EPOC guidance.[29] These criteria are adequacy of randomization and allocation concealment; comparability of groups at baseline; blinded outcomes assessment; completeness of follow-up and differential loss to follow-up; whether incomplete data were addressed appropriately; protection against contamination; and selective outcomes reporting (Appendix D). We assigned a summary ROB score (low, unclear, or high) separately to non-patient reported outcomes, hereafter referred to as objective outcomes (*eg*, mortality, ED readmission), and patient-reported outcomes (*eg*, quality of life).[29] Summary ROB ratings were defined as follows:

- Low ROB: Bias, if present, is unlikely to alter the results seriously.
- Unclear ROB: A risk of bias that raises some doubts about the results.
- High ROB: Bias may alter the results seriously.

DATA SYNTHESIS

We summarized the primary literature using relevant data abstracted from the eligible studies. Summary tables describe the key study characteristics of the primary studies: study design, patient demographics, and details of the intervention and comparator. We then determined the feasibility of completing a quantitative synthesis (*ie*, meta-analysis) to estimate summary effects. Feasibility depended on the volume of relevant literature, conceptual homogeneity of the studies,

and completeness of results reporting. All analyses were stratified by randomized versus nonrandomized study designs.

We aggregated outcomes when there were at least 3 studies with the same outcome, reported at similar time points; for nonrandomized studies, we required adequately adjusted analyses to be reported. When quantitative synthesis was possible, dichotomous outcomes (*ie*, mortality, hospitalization after the ED visit, ED readmission) were combined using risk ratios random-effects. Continuous outcomes (*eg*, quality of life) were summarized using the mean difference. We used the Knapp Hartung approach to adjust the standard errors of the estimated coefficients in the random effects analyses.[30,31] We evaluated statistical heterogeneity using visual inspection and Cochran's Q and I^2 statistics. We planned to assess publication bias using funnel plots but there were too few studies for these analyses to be meaningful. We planned subgroup analyses of moderator variables (*eg*, intervention strategy, intervention components), but there were too few studies to conduct these analyses.

When quantitative synthesis was not feasible, we analyzed the data qualitatively (*ie*, functional status, QOL, patient experience, hospitalization at the ED index visit). We gave more weight to the evidence from studies with a lower ROB and more precise estimates of effect. Qualitative synthesis focused on documenting and identifying patterns in efficacy and safety of the interventions across conditions and outcome categories. We analyzed potential reasons for inconsistency in treatment effects across studies by evaluating differences in the study population, intervention, comparator, and outcome definitions.

STRENGTH OF THE BODY OF EVIDENCE

The strength of evidence (SOE) was assessed using the Grading of Recommendations Assessment, Development and Evaluation working group (GRADE) approach.[32] In brief, this approach requires assessment of 4 domains: risk of bias, consistency, directness, and precision. These domains were considered qualitatively for the primary outcomes, and a summary rating of high, moderate, low, or very low SOE was assigned after evaluation in the GRADEpro software[33] and discussion by 2 reviewers. SOE was assessed only for outcomes considered critical to decision making: functional status, ED readmission, hospital readmission, and patient experience.

PEER REVIEW

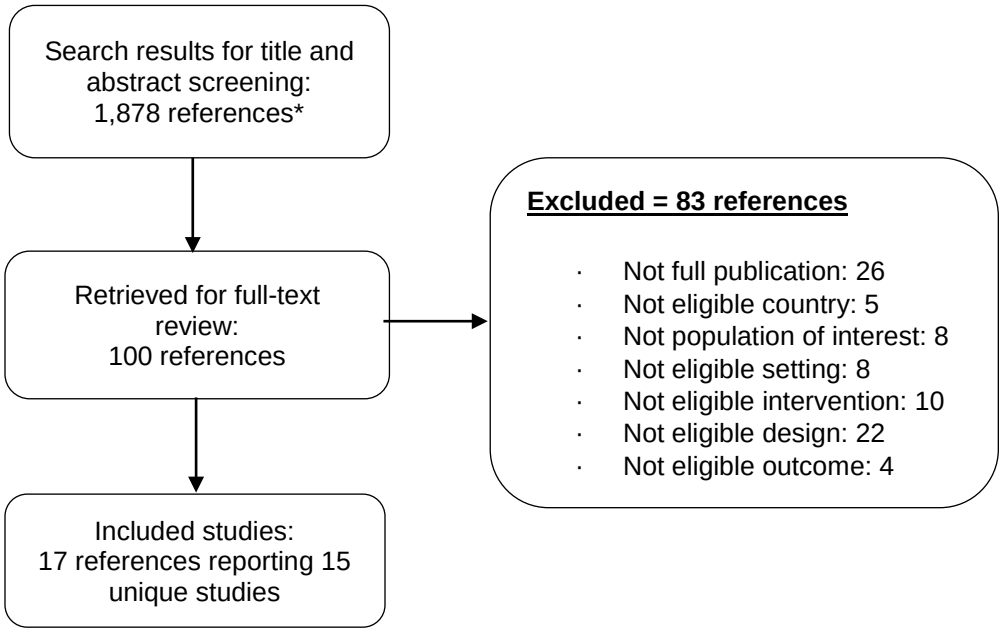
A draft version of this report was reviewed by technical experts and clinical leadership. A transcript of their comments and our responses is in Appendix E.

RESULTS

LITERATURE FLOW

We identified 1,799 studies through searches of MEDLINE® (via PubMed®), Embase®, and CINAHL. An additional 79 articles were identified by reviewing the bibliographies of relevant review articles,[7,12-15] a search of ClinicalTrials.gov, and a targeted search of Scopus for publications citing the 2014 Geriatric ED Guidelines,[18] for a total of 1,878 unique citations (Figure 2). After applying inclusion and exclusion criteria to titles and abstracts, 100 articles remained. Seventeen articles, describing 15 unique studies, met eligibility criteria and were retained for data abstraction. Of the 15 studies, 9 were randomized and 6 were nonrandomized. All were conducted in the United States, Canada, Europe, or Australia.

Figure 2. Literature Flow Chart



* Unique citations after combining all searches and manual bibliography review

Key Question: How effective are emergency department (ED) interventions in improving clinical, patient experience, and utilization outcomes in older adults (age ≥65)?

KEY POINTS

- The literature addressing intervention strategies for older adults presenting to EDs is diverse, with varying approaches to selecting patients for services and an array of intervention strategies that typically incorporate geriatric care and/or chronic care principles that have been effective in other settings.
- ED interventions showed a mixed pattern of effects on clinical outcomes. Evidence suggested a small benefit for functional status (very low SOE), but no effects on quality of life (QOL). However, only 2 studies reported effects on QOL.
- ED interventions did not show a reduction in mortality, but no study identified mortality as a primary outcome. This finding was based on few events, and confidence intervals do not exclude an important effect.
- Overall, there were no effects of ED interventions on hospitalization at the index visit (very low SOE), subsequent hospitalizations (low SOE), or ED readmission (high SOE).
- Studies with the greatest effects on clinical and health care utilization outcomes employed more comprehensive interventions, but this pattern was not consistent across all effective interventions:
  - Multi-strategy interventions, defined as those using more than 1 intervention strategy (*eg*, discharge planning, case management, medication management), may be associated with less decline in functional independence.
  - More intensive, or higher touch, interventions, as indicated by the presence of 3 key intervention components (*ie*, assessment, referral plus follow-up, and bridge design), may be associated with less decline in functional independence, and decreased hospitalization after the ED index visit and/or ED readmissions.
  - Single-contact interventions, whether delivered in the ED or after discharge, do not improve utilization outcomes.

DETAILED FINDINGS

Description of Included Studies for ED Interventions for Older Adults

We identified 9 randomized studies[34-42] and 6 nonrandomized studies[43-48] that evaluated interventions to improve the outcomes of older adults who present for care in an ED. Studies recruited a broad patient population (*ie*, not limited to a specific diagnosis or condition). No studies enrolled mixed samples of younger and older patients. Just over one-half of the studies enrolled older adults at higher risk for poor health outcomes as determined by either a risk-assessment tool or clinical criteria (*eg*, dependent in 1 or more activities of daily living [ADLs]). The remainder of the studies included unselected older adults. No studies specified enrollment of Veterans. All studies compared an intervention to usual care or attention control. Interventions were delivered during the index ED visit, post-ED discharge, or across settings (*ie*, bridge). Case management was the most common intervention strategy (n=12), followed by discharge planning

(n=7), and medication management/medication safety (n=3). Roughly one-half of studies (n=7) used more than 1 intervention strategy and thus were classified as "multi-strategy." The most common combinations were discharge planning plus case management (n=5) and case management plus medication safety (n=2). Tables 3 and 4 show the pattern of interventions, classified by strategy and components.

Table 3. Randomized Studies (n=9)

Intervention Strategy (# Studies)	Components		
	Assessment	Referral Plus Follow-up	Bridge
Discharge planning (n=0)	–	–	–
Case management (n=4)	4	1	1
Medication safety (n=0)	–	–	–
Geriatric EDs (n=0)	–	–	–
Multi-strategy (n=5)	3	4	3

Table 4. Nonrandomized Studies (n=6)

Intervention Strategy (# Studies)	Components		
	Assessment	Referral Plus Follow-up	Bridge
Discharge planning (n=2)	2	0	0
Case management (n=1)	1	1	0
Medication safety (n=1)	0	0	0
Geriatric EDs (n=0)	–	–	–
Multi-strategy (n=2)	2	0	1

Across the strategies, interventions included the components of risk assessment (n=12, including 8 that specified use of a comprehensive geriatric assessment), referral plus follow-up (n=6), and bridge designs (n=5). All 3 of these intervention components were present in 4 of the randomized studies. The number of team members involved in a single intervention ranged from 1 to 4, and included physicians, nurses, social workers or case managers, and physical or occupational therapists. Eight studies used a geriatrician, geriatric nurse provider, or other provider with geriatrics training. The number of planned contacts was reported in only 8 of the 15 studies, with 6 of these reporting 1 planned contact.

Measures of healthcare utilization, such as ED readmission, were the most commonly reported outcomes. Effects on physical functioning were reported in almost half the studies; QOL was reported in only 2 studies. The ROB for objective outcomes was judged low for 4 studies,[37,40,41,48] unclear for 3,[36,39,42] and high for 7 [34,35,43-47]; 1[38] study did not report an objective outcome. The ROB for patient-reported outcomes was judged low for 2 studies,[40,41] unclear for 3,[37,39,42] and high for 6[34-36,38,46,47]; 4 studies[43-45,48] did not report patient-reported outcomes. Demographic factors were reported infrequently, including race, socioeconomic status, and insurance status. Seven randomized and 5 nonrandomized studies described the most common presenting condition or discharge diagnosis, but used variable methods for classifying them. All

studies were conducted in the United States, Canada, Europe, or Australia between 1996 and 2017. The comparators for all studies were treatment as usual.

Table 5 shows the evidence profile for the included studies.

Table 5. Evidence Profile for Emergency Department Interventions for Older Adults

	Randomized (n=9)	Nonrandomized (n=6)
Study designs	8 randomized studies 1 cluster-randomized study	5 nonrandomized studies 1 controlled before-after study
Number of patients	4,561	11,580
Patient eligibility	4 high-risk patients only 5 unselected older adults	4 high-risk patients only 2 unselected older adults
Exclusion criteria	3 need for immediate treatment 6 long-term care facility 5 cognitive impairment	3 need for immediate treatment 0 long-term care facility 1 cognitive impairment
Median patient age (range)	79 (74-82) (1 study NR)	78.5 (75-86)
Patient sex (%)	59% women	59% women
Race (%)	64% white (6 studies NR) 25% black	67% white (5 studies NR) 32% black
Patients with cognitive impairment[a]	27.3% (5 studies NR)	8.5% (5 studies NR)
Patients' living status (%)	789/4688 (16.8%) living alone (5 studies NR)	3072/11580 (26.5%) living alone (2 studies NR)
Patient has primary care[b]	88% (8 studies NR)	NR
Intervention strategy[c]	3 discharge planning 9 case management 2 medication safety 0 geriatric EDs	4 discharge planning 3 care management 1 medication management 0 geriatric EDs
Multi-strategy interventions	5 studies	2 studies
Major intervention components[c]	7 assessment 5 referral plus follow-up 4 bridge design[d]	5 assessment 1 referral plus follow-up 1 bridge design[d]
Outcomes reported	7 ED readmission 6 functional status 5 hospitalization after ED discharge 4 patient experience 2 quality of life 3 mortality 2 hospitalization at ED index	5 ED readmission 1 functional status 3 mortality 3 hospitalization after ED discharge 1 patient experience 2 hospitalization at ED index 1 quality of life
Risk of bias for objective and patient-reported outcomes	Objective: 2 high risk 3 unclear risk 3 low risk 1 NA Patient-reported: 4 high risk 3 unclear risk 2 low risk	Objective: 5 high risk 1 low risk Patient-reported: 2 high risk 4 NA

[a] Definitions of impairment varied from abnormal cognitive screen to dementia to delirium/confusion.
[b] 6 randomized and 5 nonrandomized studies were conducted in countries with National Health Service.
[c] Numbers sum to more than 15 because studies employed more than 1 intervention type.

[d] Design refers to interventions that include contact both within the ED and after discharge.
Abbreviations: ED=emergency department; NA=not applicable; NR=not reported

Summary of Findings

Next, we organize the findings from the 15 ED intervention studies by effects on (1) clinical outcomes of functional status, QOL, and mortality; (2) patient experience outcomes; and (3) utilization outcomes. We describe results from randomized studies first, as these are more likely to report valid estimates of intervention effects. Because of the small number of studies reporting outcomes that used comparable measures, we conducted meta-analyses only for randomized studies reporting hospitalization after the index visit and ED readmission. Other outcomes are synthesized qualitatively, giving more weight to larger studies with a lower ROB. In some cases, results are grouped by how outcomes were measured (*eg*, hospitalization as dichotomous outcome followed by hospitalization length of stay).

Appendix F presents detailed study characteristics; Appendix G provides detailed intervention characteristics; Appendix H lists the excluded studies and reasons for exclusion; and Appendix I contains a glossary of terms.

EFFECTS ON CLINICAL OUTCOMES

Functional Status

A total of 6 studies, of which were 5 randomized, evaluated the effect of ED interventions on functional status using a variety of outcome measures and analysis approaches.[37-40,42,46] Functional status was a primary outcome in all but 1 study[37] and was evaluated using measures of ADLs or independent ADLs (IADLs), reported categorically (*eg*, dependent ADLs) or using a continuous scale. Three randomized studies evaluated single-strategy interventions of case management.[37,39,42] Three studies, including 2 randomized[38,40] and 1 nonrandomized,[46] evaluated multi-strategy interventions, all using discharge planning plus case management. Positive intervention effects were observed in 4 of the 5 randomized studies,[37,38,40,42] and of these, 2 focused on high-risk older adults and included all 3 intervention components of interest (*ie*, assessment, referral plus follow-up, and bridge).[38,40] Two other randomized studies recruited unselected older adults; 1 included all 3 intervention components and also followed participants for up to 4 weeks,[37] while the second included only 1 intervention component (assessment).[42] Findings of individual randomized studies are described below, focusing first on those reporting categorical changes in function, then those reporting functional status as a continuous outcome.

Three randomized studies defined functional status as changes in dependence in ADLs/IADLs; all found positive effects.[38,40,42] One moderate-sized, low ROB study evaluating a multi-strategy intervention (*ie*, discharge planning plus case management) found a statistically significant lower odds of clinically important functional dependency, defined as less decline in ADLs/IADLs (odds ratio [OR] 0.53; 95% CI 0.31 to 0.91) at 3 and 4 months, respectively.[40] A second small, high ROB study evaluating discharge planning plus case management found a significantly greater odds of functional improvement, as defined by improvement in ADL performance on the staircase measured at 3 months (OR 2.37; 95% CI 1.20 to 4.68) and 12 months (OR 2.04; 95% CI 1.03 to 4.06).[38] Both studies recruited high-risk populations and evaluated interventions with all 3 intervention components present. A third moderate-sized study with unclear ROB evaluated case management and found that intervention participants reported higher levels of functional

independence in IADLs compared with the control group (p=0.027), but there were no significant differences in ADL independence (p=0.47).[42]

Two randomized studies evaluated change in functional status, reporting the Barthel Index of ADLs and Older Americans Resources and Services (OARS) as a continuous outcome.[37,39] One study with a relatively small sample size (N=427) and unclear ROB recruited a high-risk population of older adults who were admitted to the hospital in the prior 12 months and evaluated case management (*ie*, referral to community services) delivered after ED discharge.[39] There were no differences in ADL or IADL mean scores between intervention and control groups. A second study with moderate sample size (N=739) and unclear ROB evaluated case management delivered pre- and post-ED discharge, and found that intervention participants reported less functional decline at 6 months compared with control (-0.25 intervention vs -0.75 decline; p<0.001).[37] At 18 months, there were no significant differences in the rate of functional decline between intervention and control groups. This intervention included all 3 components including follow-up by intervention staff for up to 4 weeks after study enrollment.

One nonrandomized study with a moderate sample size and high ROB evaluated a multi-strategy intervention (*ie,* discharge planning plus case management) and examined the number of older adults reporting basic and intermediate dependency in ADLs based on the Katz scale.[46] The number of participants reporting each level of dependency at 3 months was similar for intervention and control groups, although no statistical tests were presented.

Quality of Life

Three studies[39,41,46] (2 randomized) evaluated the effects of ED interventions on QOL—1 of multiple primary outcomes in 2 studies.[39,46] One study evaluated case management[39] while 2 studies[41,46] (1 randomized) evaluated multi-strategy interventions (*ie*, discharge plus case management). The 2 studies evaluating multi-strategy interventions included all 3 intervention components.[41,46] Results are sparse for this outcome, but based on limited data do not suggest an intervention effect.

Two randomized studies reported physical and mental health-related QOL using the SF-36 physical function and mental health component scores.[39,41] One study, judged unclear ROB, recruited high-risk older adults and evaluated a case management intervention with assessment only.[39] The second, judged low ROB, recruited unselected older adults and evaluated a discharge plus case management intervention with all 3 intervention components.[41] Assessment time points included 30 and 120 days[41] and 10 months.[39] There were no statistically significant effects of the ED interventions on either physical or mental health-related QOL at any time point. Although there was no significant effect on QOL, results favored the intervention.

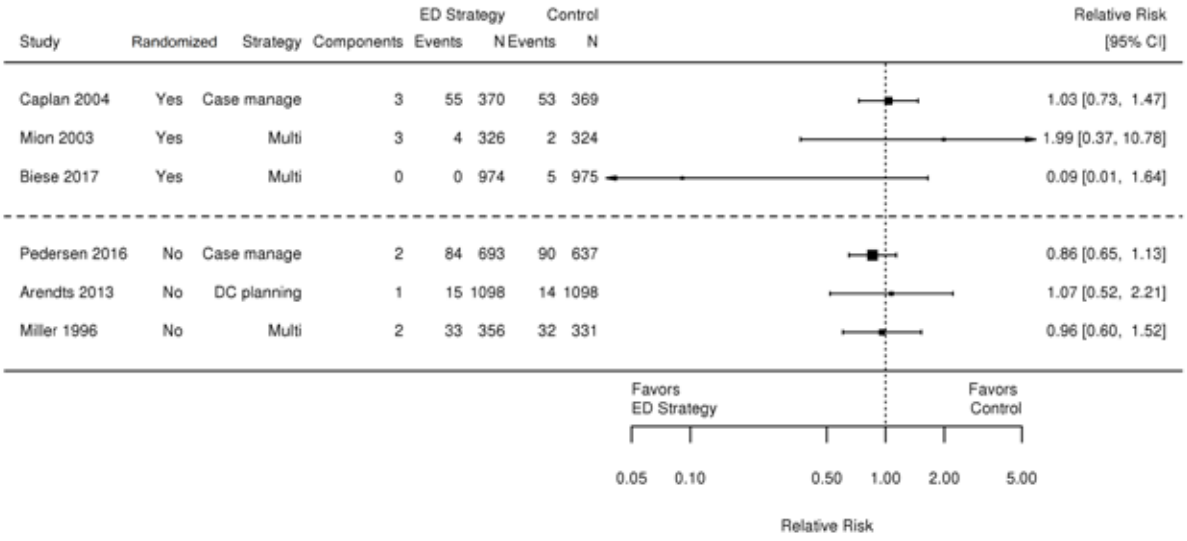
One nonrandomized study reported an unadjusted analysis of QOL at 3 months using a single item drawn from a validated scale.[46] Scores were similar for intervention and control participants, yet there was not sufficient information reported to conduct an analysis.

Mortality

Six studies evaluated the effect of ED interventions on mortality based on data in the electronic health record (EHR).[36,37,41,44,46,48] Mortality was a primary outcome in 3 nonrandomized studies[44,46,48]; no randomized studies included mortality as a primary outcome. Two studies evaluated single intervention types, including discharge planning (n=1, nonrandomized)[44] and case management (n=2, including 1 randomized).[37,48] Four studies evaluated multi-strategy interventions, 3 consisting of discharge planning plus case management[40,41,46] and 1 case management plus medication safety.[36] Two randomized studies and 1 nonrandomized study included all 3 intervention components.[37,41,46] The overall pattern of results suggests no effect on mortality, but no studies had a large enough sample and number of events to exclude a clinically important effect.

Three randomized studies evaluated the effect of ED interventions on mortality (Figure 3).[36,37,41] Two were judged low ROB[37,41] and 1 high ROB.[36] All 3 studies recruited unselected older adults. The studies varied in their assessment time points, ranging from 30 days[36,37,41] to 180 days.[37] There was no significant effect of the ED interventions on mortality. Two of the 3 studies had few deaths (proportion of deaths in intervention and control groups: 0% to 1%), with resulting imprecise estimates indicated by wide confidence intervals (CIs).

Figure 3. Forest Plot of Effect of ED Interventions on Mortality[a]



[a] No summary estimate of effect is reported for the randomized studies due to the highly variable timing of the assessment, and for nonrandomized studies due to the small number of studies and high ROB.
Abbreviations: CI=confidence interval; DC=discharge; ED=emergency department

Three nonrandomized studies evaluated the effect of ED interventions on mortality.[44,46,48] Two recruited high-risk older adults. Only 1 study, judged low ROB, reported an adequately adjusted analysis.[48] The studies varied in their assessment time points, ranging from 28 days[44] to 30 days[46] to 3 months.[48] There were no significant effects of the ED interventions on relative risk of mortality.

EFFECTS ON PATIENT EXPERIENCE OUTCOMES

Five studies evaluated the effect of ED interventions on patient experience based on a range of outcome measures, including the Client Satisfaction Questionnaire, Satisfaction with Care Scale, and 2 unnamed scales in which items were drawn from existing instruments.[39-42,47] Patient experience was not included as a primary outcome in any studies. The randomized studies were judged low ROB (n=2)[40,41] and unclear ROB (n=2),[39,42] while the single nonrandomized study was judged high ROB.[47] Interventions assessed were case management (n=2, both randomized[39,42]) and medication safety (n=1, nonrandomized[47]). Two studies evaluated multi-strategy interventions consisting of discharge planning plus case management.[40,41] Overall, these studies show a mixed pattern, with 2 of the 5 studies reporting higher satisfaction with care or greater patient knowledge of community resources. Findings of individual studies are described below.

Two randomized studies evaluated patient satisfaction with care using continuous outcome measures, Client Satisfaction Questionnaire and Satisfaction with Care Scale.[39,40] Both studies had small to moderate sample sizes and were judged unclear and low ROB. Assessment time points occurred at 1 month and 10 months. There were no statistically significant effects of the ED interventions on patient experience in either study, although results favored the intervention. A third study of moderate sample size (N=650) and low ROB evaluated multi-strategy interventions and included all 3 intervention components.[41] This study reported mean satisfaction values from a single item that assessed satisfaction with the information received about agencies or organizations to help with needs after leaving the ED, and was included as part of routine ED care. Using a 5-point Likert Scale (1=poor to 5=excellent), this study found a significant difference between intervention and control participants in level of satisfaction regarding information received while in the ED (3.42 vs 3.03; MD 0.37; 95% CI 0.13 to 0.62). A fourth randomized study with a small sample size and unclear ROB evaluated satisfaction with care 4 weeks after the intervention utilizing an unnamed instrument and found that 40% of intervention participants recalled helpful interventions while 28% reported benefits of improved confidence and self-esteem.[42]

One nonrandomized study with a small sample size and high ROB evaluated patient satisfaction with a care provider using a 13-item survey drawn from a validated questionnaire.[47] However, no summary or average scores were reported; thus no conclusions could be drawn from this outcome.

EFFECTS ON UTILIZATION OUTCOMES

Hospitalization at the ED Index Visit

Four studies (2 randomized) examined the effect of hospitalization at the index ED visit,[34,40,43,45] 3 of which included this as a primary outcome.[34,43,45] All 4 studies reported hospitalization at the index visit as a dichotomous variable. Data regarding admission versus discharge disposition were collected prospectively. Interventions included discharge planning (n=1),[43] case management (n=1),[34] and 2 multi-strategy interventions consisting of discharge planning plus case management (n=2).[40,45] All interventions were delivered in the ED prior to discharge. Only 1 study included all 3 intervention components.[40] Overall, only 1 nonrandomized study showed a benefit of ED interventions on hospitalization at the index visit.[43]

The 2 randomized studies recruited high-risk older adults and used intervention components that included geriatric assessments[34] and risk assessments plus referrals and follow-up.[40] In 1 study, anticipated admission was an exclusion criteria, and therefore this study had a very small number of admitted participants, 14 of 178 in the intervention group and 26 of 210 in the control group.[40] The second study had a very high admission rate of 76%.[34] Participants in this study were specifically referred to an "aged care" nurse, and randomization occurred after a detailed baseline assessment.

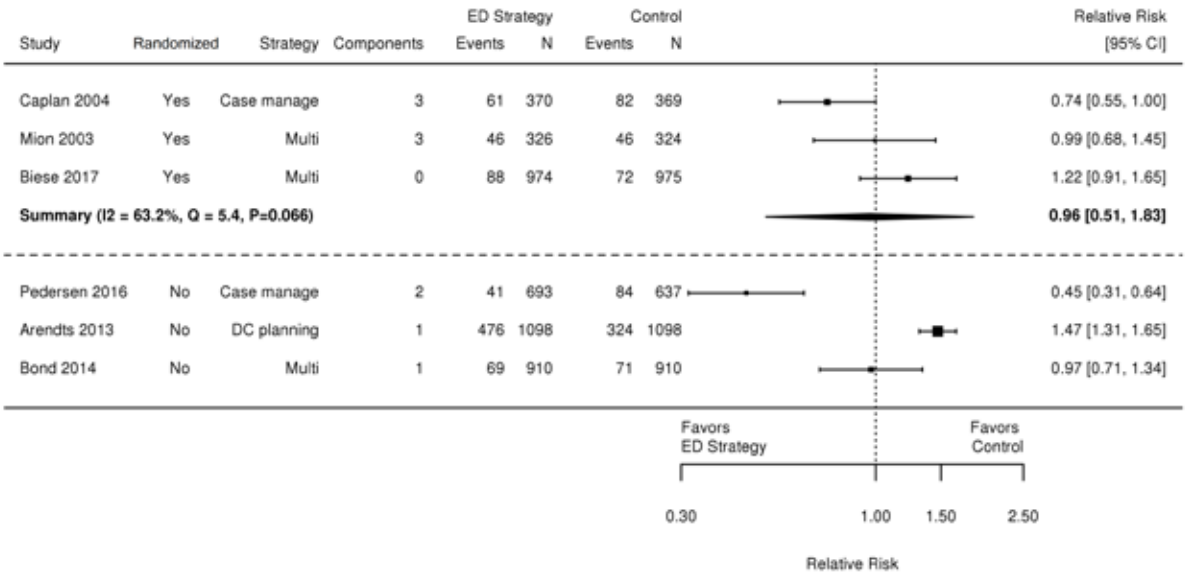
Two large nonrandomized studies were both judged high ROB.[43,45] Both enrolled high-risk older adults. Both included an assessment, but only 1 also included referral to community services.[45] One included older adults who resided in nursing homes, although these patients made up <20% of the sample.[45] One study used propensity scores to appropriately adjust for nonrandomization and found a lower admission rate in older adults receiving discharge planning (OR 0.88; 95% CI 0.76 to 1.0).[43] However, admission to the ED observation unit and deaths in the ED were also categorized as admissions. In a subgroup analysis, older adults whose presenting problem was musculoskeletal symptoms or angina had lower admission rates. However, those subgroup analyses were performed *post hoc* and should be considered exploratory. The second nonrandomized study had poor matching between the intervention and control groups.[45] There were no effects on admission rates overall, or when comparing only those cases with high matching.

Hospitalization after the ED Index Visit

Eight studies reported effects of ED interventions on hospitalization after the index ED visit,[36,37,39,41,42,44-46] including 5 randomized studies.[35-37,39,41] Three studies evaluated single intervention strategies including discharge planning (n=1)[44] and case management (n=2).[37,39] Five studies evaluated multi-strategy interventions including discharge planning plus case management (n=3)[41,45,46] and case management plus medication management (n=2).[35,36] Three randomized studies included all 3 intervention components.[37,41,46]

Three moderate to large randomized studies reported hospitalization as a dichotomous outcome.[36,37,41] It was a primary outcome for 2 of these studies, both of which had a low ROB.[37,41] All 3 studies targeted unselected older adults. One study evaluated case management[37] while 2 studies evaluated multi-strategy interventions, including case managing plus discharge planning[41] and case management plus medication safety.[36] Outcomes were assessed by patient report, with confirmation via EHR.[36,37,41] Overall, there was no intervention effect (RR 0.96; 95% CI 0.51 to 1.83, Figure 4), but the confidence interval was wide and intervention effects varied significantly (Q=5.4, p=0.07; I^2=63%). When looking at the effects reported by individual studies, 2 found no impact on hospitalization at 30 days.[36,41] One of these studies included all 3 intervention components.[41] The other had none of the intervention components hypothesized to be important.[36] Two studies had prolonged follow-up periods of 120 days and 18 months.[37,41] One found a decreased risk of hospitalization at each of the follow-up time points, with a reported number needed to treat of 18 to prevent 1 hospitalization at 30 days, and a number needed to treat of 10 to prevent 1 hospital admission at 18 months.[37] An analysis of time-to-first-emergency hospitalization as a continuous variable also showed an intervention benefit. This study included all 3 intervention components and had the most intensive intervention of the included studies, with presentation of each case at a weekly interdisciplinary conference and ongoing involvement of the intervention team for up to 4 weeks after the index ED visit.

Figure 4. Forest Plot of Effect of ED Interventions on Hospitalization After the Index Visit[a]



[a] No summary estimate of effect is reported for nonrandomized studies because of the small number of studies and high ROB.
Abbreviations: CI=confidence interval; DC=discharge; ED=emergency department

Three randomized studies also reported hospitalization after the ED index visit using a variety of continuous outcome measures.[37,39,41] One was judged unclear ROB[39] and 2 low ROB.[37,41] Two studies evaluated case management.[37,39] One study evaluated a multi-strategy intervention consisting of discharge planning plus case management.[41] Only 1 study, which used all 3 intervention components, found a significant effect of the intervention on hospitalization after the ED index, detailed in the above section.[37] Another study, which also included all 3 intervention components, reported the number of subsequent hospital days at follow-up time points of 30 and 120 days.[41] There was no difference between the intervention and control groups. The last study reported the mean number of admissions at 10 months' follow-up, with no difference between groups.[39] Only 1 intervention component, a comprehensive assessment, was used in this study. Participants were initially enrolled in the study if they had been discharged from the ED in the previous 12 months. This study aimed to enroll high-risk older adults,[39] while the other 2 enrolled unselected older adults.[37,41]

Four nonrandomized studies reported hospitalization after the index visit: 3 using a dichotomous outcome[44,45,48] and 1 using a continuous measure.[46] A low ROB study that enrolled high-risk older adults evaluated case management and included all 3 intervention components.[48] This study found a lower likelihood of hospitalization at 30 days (RR 0.55; 95% CI 0.36 to 0.82). In this study, a statistically significant higher percentage of participants in the intervention group were discharged to home at the index ED visit and had a longer length of sustained contact with the geriatric ED team than did those in the control group (14 days as opposed to 1 day). A high ROB study that evaluated discharge planning and included only 1 intervention component, assessment, found that intervention participants had a higher risk of hospitalization at 1 year.[44] The matching used for this study involved matching a high-risk intervention participant with a

low-risk control participant. Risk was determined using a 4-question screening tool, and a positive answer to any question led to a high-risk designation. The last 2 studies evaluated case management plus discharge planning. Another study also used pair matching that was not robust; it found no effect on hospitalization.[45] This study included only 1 intervention component, assessment.[45] A final study reported hospitalization after the index visit as a continuous measure.[46] This prospective cohort study matched pairs only by age and gender and over one-half were admitted to the hospital at the index visit. There was no difference in number of nights spent in the hospital between the intervention and control groups. This held true even when performing subanalysis on participants who were discharged to home at the index visit. Only 1 intervention component, *assessment*, was used in this study.

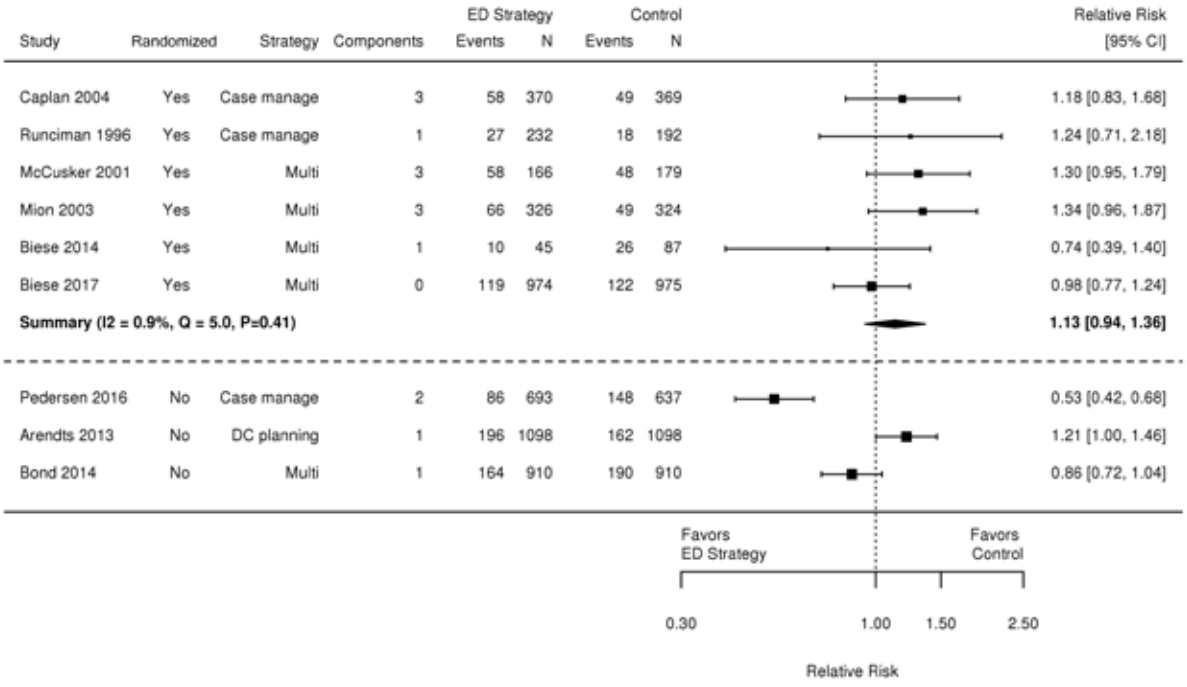
Emergency Department Readmission

Twelve studies (7 randomized) reported ED readmission after the index ED visit using a variety of methods and data sources including patient report and EHR data.[35-37,39-42,44-48] Six randomized studies reported ED readmission as a dichotomous outcome,[35-37,40-42] but this was a primary outcome in just 2 studies.[36,41] One study reported a composite outcome of ED readmission and hospitalization after the index visit.[35] When queried, the author reported that a majority of these visits were ED readmissions, although a breakdown of numbers could not be provided. Six studies evaluated single-type intervention strategies including case management (n=4; 3 randomized[37,39,42,48]), discharge planning (n=1; nonrandomized[44]), and medication safety (n=1; nonrandomized[47]). Six studies evaluated multi-strategy interventions including discharge planning plus case management (n=4)[40,41,45,46] and case management plus medication management (n=2).[35,36] All 3 intervention components were present in 3 randomized studies[37,40,41] and 1 nonrandomized study.[46] Overall, these interventions did not decrease ED readmission.

When considered altogether, the randomized studies that reported ED readmission as a dichotomous outcome found no effect on ED readmission (RR 1.13; 95% CI 0.94 to 1.36, Figure 5).[35-37,41,42] As described above, 2 studies evaluated single-strategy interventions of case management[37,42] while 3 studies evaluated multi-strategy interventions of case management plus medication safety and discharge planning plus case management.[35,36,41] However, patients in the case management plus medication management studies were identified days after ED discharge and the interventions were delivered via a single phone call.[35,36] A single low ROB study (n=345) found that intervention patients had an increased risk of ED readmission at 30 days.[40] This was a multi-strategy intervention that included discharge planning and case management. It also included all 3 intervention components of interest. In a *post hoc* stratified analysis, this effect was seen only in patients who had not visited their primary care physician in the month prior to the ED index visit.

Another randomized study reported ED readmission, a primary outcome, as a continuous variable, measuring both number of hospitalizations and mean length of stay at 10 months' follow-up.[39] This study evaluated case management and included only 1 intervention component, assessment. There were no differences between the intervention and control groups.

Figure 5. Forest Plot of Effect of ED Interventions on Readmission[a]



[a] No summary estimate of effect is reported for nonrandomized studies because of the small number of studies and high ROB.
Abbreviations: CI=confidence interval; DC=discharge; ED=emergency department

Four nonrandomized studies reported ED readmission as a dichotomous variable.[44,45,47,48] Three of these involved a single intervention strategy; discharge planning,[44] case management,[48] and medication management.[47] One evaluated case management plus discharge planning.[45] Two studies failed to find a difference in ED readmission rates between groups.[45,47] One study included no intervention components of interest,[47] while the other included assessment only.[45] All participants admitted to the hospital in 1 study received the medication management intervention that had been provided only to the intervention group in the ED, decreasing the potential to observe an intervention effect.[47] One study found that risk of ED readmission following an intervention was decreased (hazard ratio [HR] 0.49; 95% CI 0.33 to 0.72).[48] Two intervention components, assessment and referral plus follow-up, were included in this study. However, the assessment was part of the standard of care in this study. In this study, a higher percentage of participants in the intervention group were discharged to home at the index ED visit and had a longer length of sustained contact with the geriatric team. It was shown that a majority of ED readmission occurred in the first week following the index ED visit. A majority of participants (73%) in the intervention group received a follow-up visit within the first 24 hours following the index ED visit. One study, whose only intervention component of interest was an assessment, found the risk of ED readmission to be increased (risk difference 3%, p=0.05) following receipt of the intervention.[44] In this study, control case matches were low-risk participants while those in the intervention group were deemed to be high risk, meaning they had positively answered at least 1 of the 4 screening questions that gauge ability to care for self at home.

A final nonrandomized study reported ED readmission as a continuous outcome.[46] This study evaluation discharge planning plus case management and included 1 intervention component of interest, referral plus follow-up. The number of visits to the ED within the 3 month follow-up period did not differ between groups.

Quality of Evidence

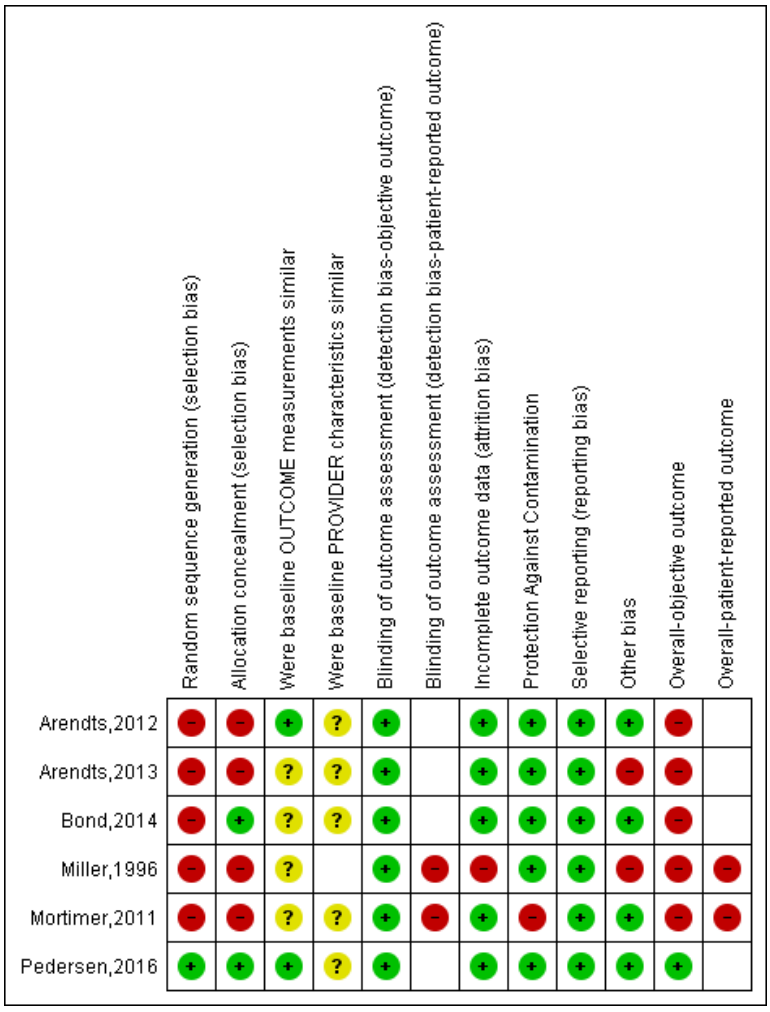
Risk of bias is described for randomized studies in Figure 6. We separately evaluated objective outcomes (*eg*, mortality, ED readmission) and patient-reported outcomes (*eg*, QOL). For objective outcomes, 6 of the 9 studies were judged low or unclear ROB. Five studies were judged low or unclear ROB for patient-reported outcomes. Factors that led to higher ROB judgments included unclear randomization and allocation concealment, detection bias (patient-reported outcomes), and differences in baseline patient characteristics.

Figure 6. Risk of Bias Ratings for Randomized Studies[a]

[a] White indicates items that were not applicable. Green/positive indicates items that were judged low ROB. Yellow/question mark indicates items that were judged unclear ROB. Red/negative indicates items that were judged high ROB.

Nonrandomized studies (Figure 7) were judged high ROB for objective outcomes, with 1 exception that was judged low ROB.[48] Because the EPOC quality criteria consider random sequence generation even for nonrandomized designs, this was a major factor in the high ROB ratings. Other concerns were lack of proof that baseline provider characteristics (*eg*, experience) were similar, and lack of proof that baseline outcome measurements were similar. Also, many studies had fundamental differences in baseline patient characteristics, which may affect outcomes.

Figure 7. Risk of Bias Ratings for Nonrandomized Studies[a]



[a] White indicates items that were not applicable. Green/positive indicates items that were judged low ROB. Yellow/question mark indicates items that were judged unclear ROB. Red/negative indicates items that were judged high ROB.

SUMMARY AND DISCUSSION

We evaluated interventions to improve ED care for older adults, examining effects on a range of outcomes of importance to patients, clinicians, and policymakers. Our review is unique in the approach to classifying intervention strategies and specific components, careful ROB assessment, and the inclusion of randomized and stronger nonrandomized designs. We identified 9 randomized and 6 nonrandomized studies, all conducted in economically developed countries. Just over half of these enrolled high-risk older adults—patients that are medically similar to Veterans presenting to VA EDs. The interventions most commonly used case management or multiple intervention strategies. No studies were informed by an explicit conceptual model. When considering the interventions collectively, we found a small benefit on functional outcomes but no overall effect on ED readmission or subsequent hospitalizations. Although there was no overall effect on healthcare utilization, 2 studies with a more comprehensive intervention and longer duration of follow-up were associated with decreased healthcare utilization.[37,48] Other outcomes were reported less frequently, and intervention effects could not be determined definitively.

We evaluated interventions applicable to a broad range of older adults, rather than focusing narrowly on condition-specific interventions. We were particularly interested in determining if specific strategies or intervention components were associated with greater benefit to older adults. Two strategies were evaluated infrequently (medication management) or not at all (guideline informed). Interventions evaluated were relatively low intensity (*ie*, short duration and limited number of planned patient contacts), and thus our findings are applicable only to low-intensity geriatric management interventions in the ED.

Strength of evidence (SOE) was rated for outcomes judged critical to decision making on the basis of study design, risk of bias (ROB), consistency, directness, and precision (Table 6). The SOE was rated high for effects on ED readmission. SOE was low or very low for all other outcomes. Concerns that contributed to the lower SOE were high ROB, inconsistent effects, and imprecision that was attributed to the 95% CI not excluding a small or small-to-moderate effect.

Table 6. Strength of Evidence for Effects of Interventions to Improve Outcomes for Older Adults in Emergency Departments

Outcome	Studies (Patients)	Findings	Strength of Evidence (Rationale by Domain)
Physical function	Randomized: 5 (2233)	3 of 5 showed benefit; beneficial interventions were multi-strategy	Very low SOE (Serious ROB, inconsistent, imprecise)
	Nonrandomized: 1 (687)	No effect	
ED readmission	Randomized: 7 (4629)	Relative risk 1.13 (0.94 to 1.36) (9 fewer to 53 more per 1,000)	High SOE (No serious ROB, consistent, precise)
	Nonrandomized: 5 (6432)	2 of 5 showed lower readmission; beneficial interventions were multi-strategy or case management	
Hospital admission after index	Randomized: 3 (3338)	Relative risk 0.96 (0.51 to 1.83) (59 fewer to 100 more per 1,000)	Low SOE (No serious ROB, inconsistent, imprecise)
	Nonrandomized: 3 (5346)	No consistent effects on readmission	

Outcome	Studies (Patients)	Findings	Strength of Evidence (Rationale by Domain)
Patient experience	Randomized: 4 (1889)	2 of 4 showed benefit for satisfaction, helpfulness, or self-esteem; beneficial interventions were multi-strategy or case management	Low SOE (No serious ROB, consistent, indirect, imprecise)
	Nonrandomized: 1 (199)	No usable data	

Abbreviations: ROB=risk of bias; SOE=strength of evidence

FINDINGS IN THE CONTEXT OF PRIOR REVIEWS

Most prior reviews focused on single strategies including case management,[3] comprehensive geriatric consultation,[12] nursing interventions,[13] discharge planning,[15] or risk-assessment tools.[22] In contrast, our review included a broad range of intervention strategies as well as studies that used 1 or more intervention strategies. Only 1 of the prior reviews was published in the past 5 years (search date 2013) and judged of good quality.[15] This review evaluated "community transition planning," described as discharge planning in our review, and identified 9 studies. Consistent with our findings, they found no effect of discharge planning on utilization outcomes or mortality and found the evidence too limited to draw conclusions about effects on functional status.

An older systematic review of case management found that these interventions did not impact quality of life, but the evidence for this outcome was sparse.[3] That review also carefully classified interventions and used qualitative case analyses to identify patterns but included studies at higher ROB, such as program descriptions and noncomparative observational studies. The review found that case management strategies utilizing multiple elements had a positive effect (defined inclusively as a positive effect on any outcome). The review was limited by the inclusion of study designs with high ROB and the lack of any careful quality or ROB assessment of the included studies. Across these reviews, general themes are that more comprehensive interventions are associated with greater effects, but that interventions tested to date do not show a consistent effect on utilization outcomes.

A recent good-quality evidence mapping review described a broad literature of studies examining risk-assessment tools and ED interventions for older adults.[7] Evidence maps do not assess the quality of included studies, focusing instead on a description of the quantity and type of evidence, interventions, and outcomes reported. The authors found an extensive literature—much of it published only in meeting abstracts—and recommended formal literature syntheses.

CLINICAL AND POLICY IMPLICATIONS

The diversity of interventions and outcome measures among included studies limits the ability to determine definitively the clinical utility of any single intervention strategy or set of intervention components. However, our structured approach to analyzing these heterogeneous findings, including careful examination of intervention components, suggests that future research could benefit from using a conceptual model to both guide a more comprehensive reporting of intervention components and enable researchers to analyze mechanisms of action. Some studies selected patients at higher risk for poor outcomes, but there was no clear relationship between intervention effects and selection of high-risk patients. Our findings suggest that multi-strategy,

longitudinal interventions may be more effective than single-touch interventions isolated to the ED on improving clinical outcomes. ED interventions that bridge into more intensive outpatient management tended to reduce ED and hospital readmission rates as well as functional decline. From a clinical and policy perspective, these finding suggests that future research in this area may benefit from working across settings and disciplines. Furthermore, incorporating input from patients, family members, clinical staff, and policymakers representing both ED and post-ED community settings and services may help to identify and prioritize key outcomes.

Similar to previous reviews[23] and the 2014 Geriatric Emergency Department Guidelines,[16-18] our findings suggest that ED visits should not be considered in isolation, but rather as an integral part of the geriatric patient's continuum of care, bridging inpatient and outpatient management. The patient's functional status, access to community resources, and capacity for follow-up should be considered when planning their disposition. However, the relative benefit of individual interventions is unclear and requires further studies to elucidate.

LIMITATIONS

Our protocol-driven review has several strengths, including input from an expert panel, a conceptual model, rigorous methods, and a structured approach to describing the key components of the tested interventions. This approach allowed for a theory-driven, standardized classification of the study interventions. A significant limitation of this approach is that intervention descriptions were not always detailed enough to describe some components with confidence. We limited our review to English-language publications, which may have excluded potentially informative evidence. Other limitations are described below.

Publication Bias

Given the small number of studies, statistical methods to detect publication bias are not useful. We searched ClinicalTrials.gov for completed but unpublished studies, but this is not a particularly effective way to identify publication bias.[49] Thus, although no publication bias was detected, tools for detection are poor.

Study Quality

We were also limited by the existing literature. Of the 9 randomized studies, only 3 were evaluated as low ROB for objective outcomes. The most common limitation was lack of blinded outcome assessment. Almost all nonrandomized studies were judged high ROB for patient-reported outcomes and for objective outcomes. The basic study design, differences between intervention and control participants, and lack of analyses that adjusted for potential confounders were common problems. In addition, some key outcomes, such as quality of life, were infrequently reported. No studies reported adverse effects.

Heterogeneity and Sparse Information

There was substantial diversity in study designs, including the choice to randomize and the intervention approaches. This made coherent synthesis and identification of themes difficult. Interventions typically did not specify a conceptual framework, and interventions differed substantially in goals, components, delivery, and intensity. Specifically, few studies reported detailed information on intervention strategies and components. This limited amount of

information prevented us from conducting further analyses on patient- and provider-level intervention components. A lack of detail around patient characteristics, including medical history and presenting condition, further prevented us from mapping outcomes back to intervention strategies and predisposing characteristics, as depicted in our conceptual model. No studies used the 2014 Geriatric ED Guidelines[16-18] to inform intervention development, and few studies explicitly addressed medication management.

Applicability of Findings to the VA Population

None of the studies included Veteran samples. Seven studies were conducted in North America, and the others were conducted in economically developed countries. Thus, the staffing and training of ED staff and geriatric specialists should be broadly similar to VA EDs. Almost all Veterans have an assigned primary care provider, similar to studies conducted in countries with a national health service, and a health system that facilitates post-ED care. However, it is uncertain if the community and specialty care referral resources available to study patients were similar to those available to Veterans. Studies had a representative mix of men and women, but only 4 studies reported race; these studies had a representative mix of white and black patients. Few studies reported participants' sociodemographic characteristics (*ie*, income, education), preventing us from abstracting this information, and further limiting the ability to evaluate the degree of sociodemographic similarities compared to Veteran populations. Most randomized studies excluded patients from long-term care facilities or individuals with important cognitive impairment. Therefore, results are most applicable to community-dwelling older adults without important cognitive impairment.

RESEARCH GAPS/FUTURE RESEARCH

We structured our analysis of gaps in evidence by considering each element of the PICOTS framework (Table 7).[50] Although it would be possible to generate an extensive list of gaps in evidence, we restricted this list to the areas judged to be highest priority, given the current state of evidence. To facilitate future literature syntheses, we encourage investigators conducting clinical trials to include these studies in trial registries.

Table 7. Highest Priority Evidence Gaps

PICOTS Domain	Evidence Gap
Population	● No studies actively recruited Veterans. ● Few studies report clinical and sociodemographic characteristics of older adults using the ED, or subgroup (interaction) effects, limiting the ability to examine whether effects of interventions may vary across different clinical or demographic subgroups. ● Although some studies recruited high-risk older adults, it is unclear which subgroups of older adults are most likely to benefit from geriatric ED interventions.
Interventions	● No studies included a conceptual model to guide selection of intervention strategies and components or propose relationships between intervention strategies and study outcomes. Most interventions did not explicitly address domains such as unmet biopsychosocial and/or psychological needs. ● Limited reporting around intervention strategies and components make it difficult to identify the relationship between intervention structure and outcomes. ● Few studies included elements of caregiver education or support. ● Limited information makes it difficult to identify the optimal dose of ED interventions (*eg*, number of contacts, frequency and duration of contacts, overall length of intervention). ● To date, no studies have evaluated interventions guided by the 2014 Geriatric ED Guidelines.
Comparators	● Additional research is needed to identify effective intervention strategies and components before undertaking head-to-head comparison of different intervention types, doses, or modalities.
Outcomes	● Lack of a uniform, core set of patient/stakeholder prioritized outcomes limits comparisons across studies.
Timing	● The optimal time to assess significant changes in clinical and utilization outcomes for ED-based interventions is unknown.
Setting	● Interventions that "bridge" pre- and post-ED care, meaning those that include contacts both before and after discharge, may be most effective. However, additional information is needed around the timing and coordination of care within these interventions. ● There is limited information on interventions taking place in large, integrated healthcare systems similar to VA healthcare system.

Abbreviations: ED=emergency department; VA=Veterans Affairs

Given its integrated structure, including presence of a primary care medical home (*ie*, patient-aligned care team, or PACT), high proportion of complex patients, and continuum of available Geriatrics and Extended Care services (*ie*, ambulatory care, inpatient care, home and community-based long-term services and supports, and facility-based care), VA is an ideal setting to pursue additional research in geriatric emergency medicine and address some of the evidence gaps noted above. In considering future research, we recommend considerations across several major domains as follows.

Conceptual Model/Framework

A more holistic model describing multilevel factors that influence older ED use and resulting clinical and utilization outcomes may help to guide the selection of intervention strategies and explore how particular strategies do or do not address unmet needs and other determinants of ED use. A conceptual model can also be used to hypothesize and evaluate relationships between determinants of ED use, intervention strategies, and outcomes of interest. Further, the conceptual model should expand beyond medical/clinical factors influencing ED use to also acknowledge social determinants of health, personal preferences, and access to care. Interventions guided by a conceptual model may help researchers better identify subgroups of high-risk patients who may benefit the most from ED interventions. The use of a conceptual model also may motivate more complete data collection and reporting, including details on participant characteristics (*ie*, sociodemographics) as well as intervention strategies and components. The availability of such data, combined with hypothesized relationships outlined in a conceptual model, may allow researchers to better understand the mechanisms through which selected intervention strategies influence key outcomes.

Innovation in Intervention and Study Design

An inherent challenge in developing and evaluating ED intervention strategies is to balance the need for broad interventions that are applicable for a diverse patient population while also recognizing that patient-centered interventions or those designed for high-risk subgroups may be most effective. Adaptive interventions, including those that optimize delivery by tailoring the dose and content of an intervention to each individual, may help to maximize intervention effects. Research methods and study designs must be appropriate for these emerging intervention designs. Traditional randomized trials prevent researchers from isolating intervention components and identifying which individual components may be associated with intervention effects. Incorporating alternative frameworks, including factorial designs, to the intervention development process may enable researchers to not only examine average treatment effects but also disentangle the relative contribution of individual intervention strategies and combinations of intervention components. Hybrid designs enable researchers to simultaneously explore intervention and implementation effects.

Outcomes and Measurement

Several measurement challenges should be resolved before conducting additional research. First, utilization outcomes, including hospitalization and ED readmission, have been studied most frequently in prior ED studies. However, important clinical and utilization outcomes may have been overlooked. For example, clinical outcomes such as functional status, psychological health, and improved chronic disease self-management may impact health status while access to or use of primary care and specialty services may impact both health and acute care utilization. Second, the heterogeneity of older ED users requires use of more general, compared to disease-specific, outcome measures. However, their responsiveness to ED strategies may be limited and may not fully capture important states or concerns related to an ED visit. Third, it is essential to select measures, particularly those related to physical function, that lack floor or ceiling effects and are sufficiently responsive to changes in older, complex patient populations. Given these considerations, there is a substantial opportunity for patient- and stakeholder-engaged research, such as that prioritized by VA and the Patient-Centered Outcomes Research Institute.

Geriatric Emergency Department Guidelines

As noted, no studies were guided by the 2014 Geriatric ED Guidelines. However, this is not unexpected given the time needed to gain awareness of such guidelines, implement changes, evaluate results, and disseminate findings. These guidelines provide a template for developing geriatric-friendly EDs, giving particular emphasis to elements that may enhance the care experience and improve outcomes for older adults. Although not reported in our results, we identified many of these elements as being present in the included studies, including the use of a geriatric-trained physician or nurse, interdisciplinary team, referrals or partnerships with community services, and care coordination strategies (*eg*, interdisciplinary team meeting). Future research may consider these guidelines to inform conceptual models and/or research interventions.

CONCLUSIONS

We focused only on studies recruiting general patient populations as opposed to focusing on interventions for specific presenting conditions or diagnoses upon ED discharge (*eg*, falls, heart failure). Our results indicate mixed effects of ED intervention strategies on select clinical and utilization outcomes. The small number of studies using any single intervention strategy makes it difficult to draw definitive conclusions because of imprecise estimates of effect and variability in study populations, intervention strategies, and intervention components. However, we found evidence that studies evaluating multi-strategy interventions and those with a more intensive structure, as indicated by the presence of three key intervention components (*ie*, assessment, referral plus follow-up, and planned contacts both pre- and post-ED discharge) may be associated with a small benefit in functional status, decreased hospitalization after the ED index visit, and/or lower likelihood of ED readmission. Future research should be informed by a comprehensive conceptual model, consider emerging intervention approaches (*eg*, adaptive, or dynamic, treatment designs), employ rigorous evaluation strategies, adhere to more thorough reporting of intervention structure, and engage patients and relevant policymakers in selecting outcomes of interest.

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APPENDIX A. INTERVENTION STRATEGIES AND COMPONENTS

For full study citations in this appendix, please refer to the report's main reference list.

INTERVENTION STRATEGIES

Strategy	Description
Discharge planning	Discharge planning involves the process of thinking about and formalizing a plan of care prior to a patient's discharge from the ED. In this instance, discharge planning is defined as being *time-limited, taking place fully within the ED (prior to discharge*). Discharge planning may incorporate 1 or more of the following: geriatric consultation or geriatric assessment in the ED, written information provided to the patient/caregiver, patient/caregiver education, and/or a follow-up plan. Although not required for discharge planning, the geriatric assessment is a multidimensional, multidisciplinary assessment designed to evaluate an older person's functional ability, physical health, cognition and mental health, and socioenvironmental circumstances. The geriatric assessment may include a geriatrician or geriatric trained nurse practitioner or physician assistant and may be a focused assessment that is customized for ED settings. Although 1 or more providers may conduct an assessment and make recommendations, the responsibility to initiate, coordinate, and secure any post-ED services or recommendations typically rests with the patient and/or caregiver.
Case management	Case management *occurs over time* and helps to support successful transition of care from the ED to the post-ED settings. *Case management activities often take place across settings*, initially beginning in the ED and continuing after discharge. Case management may incorporate all the activities which a physician or other health care professional performs to insure the coordination of the medical services required by a patient to successfully transition from the ED setting to home (or other residential facility). In this instance, we defined case management more narrowly to require a non-physician, either onsite in the ED or offsite, who is involved in coordinating follow-up care that is related to an ED visit. This may include home-based services and/or referral to primary care providers, specialists, or other community-based resources and services. Unlike discharge planning in which the patient or caregiver may be responsible for identifying and securing services, in case management, the *major responsibility and coordination rests with the provider* (*eg*, an order for physical therapy).
Medication safety or management	These are interventions that assist patients or caregivers in reviewing, managing, and monitoring drug therapy for older adults with chronic conditions. More basic interventions may include a simple review or reconciliation of medications. More involved interventions may incorporate a clinical pharmacist or other expert in drug therapy, and/or computerized interventions so long as they are conducted in real time (during patient's ED admission). Interventions may be targeted to the clinician, patient and/or the family as long as they focus on the proper selection of medications, reduction in polypharmacy or medication errors, or use of medications. These interventions would not include shared decision-making approaches to choosing 1 treatment versus another.
Geriatric Emergency Departments	These are EDs designed or adapted to conform to 2014 American College of Emergency Physicians Guidelines.[18]

PATIENT-FOCUSED INTERVENTION COMPONENTS

PATIENT-FOCUSED INTERVENTION COMPONENTS ***(Information is collected from or provided to the patient or caregiver)***	
Assessment and screening	
Geriatric assessment	A multidimensional interdisciplinary evaluation to ensure that problems are identified, quantified, and managed appropriately. Common elements include assessment of medical, psychological, biopsychosocial, functional, cognitive, and environmental capacity. Results from the assessment may be used to inform other elements of discharge planning.
High-risk screening	Use of 1 or more risk-screening tool(s) to evaluate a specific risk factor, condition, or potential outcome. Risk screening tools are typically brief and shorter in nature than a comprehensive, multidimensional assessment.
Patient and/or caregiver education or support	
Patient education	Key information provided in writing or explained to patient and/or caregiver. The information provided is related to diagnosis or treatment but does not encourage specific behavior change.
Self-management	Patient-directed education or coaching that focuses on enhancing the patient's ability to self-manage care needs. This may include education or coaching around specific behavior(s) (*eg*, weight control action plan) and/or disease specific information (*eg*, congestive heart failure action plan).
Caregiver education	Education directed toward the caregiver, which may include any of the following: basic disease education, behavior management strategies, guidance on how to support the patient in self-care, or information on how to provide direct care, including information related to condition, symptoms, treatment, or medication management.
Caregiver support	Supportive counseling or guidance focused on self-care, coping skills to manage caregiver burden and expectations, tips on identifying local resources, communication skills, etc.
Shared decision-making	Decision-making around testing, treatment, and/or discharge are shared between different individuals, potentially including the patient and/or caregiver. May include use of a decision aid.[29]

Intervention	
Medication intervention	Medication reconciliation or special education aimed at improving medication understanding or adherence.[26]
Rehabilitation intervention	Patient receives occupational and/or physical therapy aimed at improving functional status.
Telemonitoring	Use of remote technology designed for the patient to transmit objective measures of health status with or without connected subjective assessment (*eg*, health buddy).[26]

PROVIDER- OR SERVICE-FOCUSED INTERVENTION COMPONENTS

PROVIDER AND/OR SYSTEM-FOCUSED INTERVENTION COMPONENTS ***(related to care delivery or care process)***	
Follow-up call or visit	
Patient hotline and/or patient-initiated appointment systems	An open line for patient-initiated communication.[26] Systems that enable patients to make urgent appointments when they feel they cannot manage their condition or where something has changed unexpectedly.[29]
Follow-up visit scheduled	A follow-up visit is scheduled prior to discharge from ED and/or prior to the end of the intervention period.
Follow-up communication	ED provider or intervention staff initiate telephone follow-up communication after discharge from the ED.
Follow-up visit completed	In-person follow-up visit completed during the course of the intervention period.
Home visit	In-person visit to patient's place of residence by 1 or more intervention providers.
Referral to services	
Referral(s) to primary care	ED provider initiates and/or recommends referral to primary care.
Referral(s) to medical specialist(s)	ED provider initiatives and/or recommends referral to medical specialist(s).
Referral(s) to home or community-based services	ED provider initiates and/or recommends referral to 1 or more home or community-based services. Examples include physical/occupational therapy, meal delivery, home-based primary care, or adult day health care.
Continuity of care/care coordination	
Communication between providers ("clinician continuity")	Processes that ensure the responsibility of care is passed from 1 provider to another. This may include increased provider presence before and after ED discharge, verbal or written communication between providers, strategic follow-up with primary clinician after discharge, or the involvement of a "bridging" clinician. Increased provider presence before and after ED discharge; may include involvement of PCP in patient care or strategic follow-up with inpatient clinician after discharge or "bridging" clinician.[26]
Interdisciplinary care team meeting	Team meeting as part of discharge planning or ongoing case management.

EMERGENCY DEPARTMENT STRUCTURE AND PROCEDURES

EMERGENCY DEPARTMENT STRUCTURE AND PROCEDURES ***Components designed and delivered to be in accordance with 2014 Geriatric Emergency Department Guidelines[18]***	
Staffing/administration	Presence of Geriatric Emergency Department Medical Director or Nurse Manager.
Follow-up and transition of care	Detailed procedures on how to provide age-friendly discharge planning within ED and appropriate referrals to post-ED services in the community.
Provider education	A formal, competency-based educational program designed to educate staff on the needs of older adults.
Quality improvement	Implementation of a formal quality improvement (QI) program designed to collect and monitor data related to program success.
Equipment and supplies	Structural and/or physical modifications to best support unique functional, clinical, and behavioral needs of older adults.

EMERGENCY DEPARTMENT STRUCTURE AND PROCEDURES *Components designed and delivered to be in accordance with 2014 Geriatric Emergency Department Guidelines*[18]	
	Improvements may include furniture, special equipment, visual orientation improvements, lighting, acoustic orientation.
Policies, procedures, and protocols	Changes to local policies and procedures.

OTHER CHARACTERISTICS OF THE INTERVENTION STRUCTURE

Timing and setting	
Pre-discharge (within ED)	Intervention is intentionally designed to be initiated and completed within the ED, prior to patient's discharge.
Post-discharge (after leaving ED)	Patient is identified while in the ED (or immediately after discharge) but intervention is initiated and completed after patient is discharged from ED. Patient may or may not have face-to-face contact with the provider or interventionist.
Both pre- and post-discharge ("bridge")	The intervention is intentionally designed so that elements take place both before *and* after discharge from the ED. The intervention is designed to have multiple points of contact.

Target of the intervention	
Patient	The patient is the main recipient of any assessment or intervention.
Caregiver/family member	One or more caregivers are actively addressed in the intervention as a part of specified caregiver education or support.
Provider	Intervention is focused on training the provider and/or making adjustments to provider's workflow or responsibilities. This does NOT refer to simply involving provider(s) to deliver intervention components.

How were intervention sessions delivered?	
Mode of delivery	Intervention sessions were delivered via phone or in-person.
Planned contacts/sessions	The number of contacts/sessions the authors planned, or intended to happen, in the study.
Actual contacts/sessions	The number of contacts/sessions actually delivered in the study.
Type(s) of providers	The type(s) of provider(s) to deliver the intervention (*eg*, physician, nurse, social worker, case manager, physical or occupational therapist)

APPENDIX B. SEARCH STRATEGIES

Search date: December 4, 2017

#1	"Geriatrics"[Mesh] OR "Geriatric Nursing"[Mesh] OR "Geriatricians"[Mesh] OR "Geriatric Assessment"[Mesh] OR "Health Services for the Aged"[Mesh] OR gerontology[tiab] OR geriatric[tiab] OR geriatrics[tiab] OR gerontologist[tiab] OR gerontologists[tiab] OR geriatrician[tiab] OR geriatricians[tiab] OR elderly[tiab] OR elder[tiab] OR elders[tiab] OR "older adult"[tiab] OR "older adults"[tiab] OR "older patient"[tiab] OR "older patients"[tiab] OR senior[tiab] OR seniors[tiab] OR senium[tiab] OR "aged care"[tiab] OR "Aged"[Mesh]	2,871,510
#2	"Emergency Service, Hospital"[Mesh] OR "Emergency Medicine"[Mesh] OR "Emergency Nursing"[Mesh] OR "emergency medicine"[tiab] OR "emergency nursing"[tiab] OR "Hospital Emergency Service"[tiab] OR "Hospital Emergency Services"[tiab] OR "Emergency Hospital Service"[tiab] OR "Emergency Hospital Services"[tiab] OR "Emergency Department"[ti] OR "Emergency Departments"[ti] OR "Emergency Unit"[ti] OR "Emergency Units"[ti] OR "Emergency Ward"[ti] OR "Emergency Wards"[ti] OR "Emergency Room"[ti] OR "Emergency Rooms"[ti] OR "trauma center"[ti] OR "trauma centers"[ti] OR "trauma unit"[ti] OR "trauma units"[ti] OR (emergency[ti] AND hospital[ti])	91,901
#3	(#1 AND #2) AND English[lang]	17,218
#4	#3 NOT (("Adolescent"[Mesh] OR "Child"[Mesh] OR "Infant"[Mesh]) NOT "Adult"[Mesh])	17,142
#5	#4 AND ("Patient Care Management"[Mesh] OR "Medication Errors"[Mesh] OR "Polypharmacy"[Mesh] OR "transitional care"[tiab] OR "transition care"[tiab] OR "case management"[tiab] OR "critical pathway"[tiab] OR "critical pathways"[tiab] OR "clinical pathway"[tiab] OR "clinical pathways"[tiab] OR "critical path"[tiab] OR "critical paths"[tiab] OR "clinical path"[tiab] OR "clinical paths"[tiab] OR "healthcare team"[tiab] OR "patient care team"[tiab] OR "patient management"[tiab] OR "medication management"[tiab] OR "drug therapy management"[tiab] OR "discharge planning"[tiab] OR "patient discharge"[tiab] OR "Outcome and Process Assessment (Health Care)"[Mesh] OR "Treatment Outcome"[Mesh] OR "Program Evaluation"[Mesh] OR "Patient Compliance"[Mesh] OR "Patient Satisfaction"[Mesh])	6,321
#6	#5 AND ("randomized controlled trial"[ptyp] OR "controlled clinical trial"[ptyp] OR randomized[tiab] OR randomised[tiab] OR randomization[tiab] OR randomisation[tiab] OR placebo[tiab] OR randomly[tiab] OR trial[tiab] OR groups[tiab] OR "Comparative Study"[ptyp] OR "clinical trial"[pt] OR "clinical trial"[tiab] OR "clinical trials"[tiab] OR "evaluation studies"[ptyp] OR "evaluation studies as topic"[MeSH] OR "evaluation study"[tiab] OR "evaluation studies"[tiab] OR drug therapy[sh] OR "intervention study"[tiab] OR "intervention studies"[tiab] OR "case-control studies"[MeSH] OR "case-control"[tiab] OR "cohort studies"[MeSH] OR cohort[tiab] OR "longitudinal studies"[MeSH] OR longitudinal[tiab] OR longitudinally[tiab] OR prospective[tiab] OR prospectively[tiab] OR "retrospective studies"[MeSH] OR retrospective[tiab] OR "follow up"[tiab] OR "comparative study"[pt] OR "comparative studies"[tiab] OR nonrandom[tiab] OR "non-random"[tiab] OR nonrandomized[tiab] OR "non-randomized"[tiab] OR nonrandomised[tiab] OR "non-randomised"[tiab] OR quasi-experiment*[tiab] OR quasiexperiment*[tiab] OR quasirandom*[tiab] OR quasi-random*[tiab] OR quasi-control*[tiab] OR quasicontrol*[tiab] OR (controlled[tiab] AND (trial[tiab] OR study[tiab])) OR "pre-post"[tiab] OR "posttest"[tiab] OR "post-test"[tiab] OR pretest[tiab] OR pre-test[tiab] OR ("time series"[tiab] AND interrupt[tiab]) OR ("time points"[tiab] AND (multiple[tiab] OR one[tiab] OR two[tiab] OR three[tiab] OR four[tiab] OR five[tiab] OR six[tiab] OR seven[tiab] OR eight[tiab] OR nine[tiab] OR ten[tiab] OR month[tiab] OR monthly[tiab] OR day[tiab] OR daily[tiab] OR week[tiab] OR weekly[tiab] OR hour[tiab] OR	4,930

	hourly[tiab])) OR (before[tiab] AND after[tiab]) OR (before[tiab] AND during[tiab])) NOT (Editorial[ptyp] OR Letter[ptyp] OR Comment[ptyp]) NOT (animals[mh] NOT humans[mh])	
#7	#6 AND ("2016/01/01"[Date - Publication] : "3000"[Date - Publication])	785

CINAHL

S1	(MH "Geriatrics") OR (MH "Gerontologic Nursing+") OR (MH "Gerontologic Nurse Practitioners") OR (MH "Geriatricians") OR (MH "Geriatric Assessment+") OR (MH "Health Services for the Aged") OR (MH "Gerontologic Care") OR TI (gerontology OR geriatric OR geriatrics OR gerontologist OR gerontologists OR geriatrician OR geriatricians OR elderly OR elder OR elders OR "older adult" OR "older adults" OR "older patient" OR "older patients" OR senior OR seniors OR senium OR "aged care")	170,880
S2	(MH "Emergency Service+") OR (MH "Triage") OR (MH "Physicians, Emergency") OR (MH "Emergency Nurse Practitioners") OR (MH "Emergency Medicine") OR (MH "Emergency Patients") OR TI ("emergency medicine" OR "emergency nursing" OR "Hospital Emergency Service" OR "Hospital Emergency Services" OR "Emergency Hospital Service" OR "Emergency Hospital Services" OR "Emergency Department" OR "Emergency Departments" OR "Emergency Unit" OR "Emergency Units" OR "Emergency Ward" OR "Emergency Wards" OR "Emergency Room" OR "Emergency Rooms" OR "trauma center" OR "trauma centers" OR "trauma unit" OR "trauma units") OR AB ("emergency medicine" OR "emergency nursing" OR "Hospital Emergency Service" OR "Hospital Emergency Services" OR "Emergency Hospital Service" OR "Emergency Hospital Services")	67,453
S3	(S1 AND S2) Limiters - English Language; Age Groups: Middle Aged: 45-64 years, Aged: 65+ years, Aged, 80 and over; Publication Type: Journal Article	1,606
S4	(MH "Continuity of Patient Care+") OR (MM "Continuity of Patient Care In Old Age") OR (MH "Age Specific Care") OR (MH "Multidisciplinary Care Team+") OR (MH "Patient Care Plans+") OR (MH "Transitional Care") OR (MH "Critical Path") OR (MH "Medication Errors+") OR (MH "Polypharmacy") OR (MH "Outcomes (Health Care)+") OR (MH "Program Evaluation") OR (MH "Patient Compliance+") OR (MH "Medication Compliance") OR (MH "Organizational Compliance") OR (MH "Case Management") OR (MH "Patient Satisfaction") OR TI ("transitional care" OR "transition care" OR "case management" OR "critical pathway" OR "critical pathways" OR "clinical pathway" OR "clinical pathways" OR "critical path" OR "critical paths" OR "clinical path" OR "clinical paths" OR "healthcare team" OR "patient care team" OR "patient management" OR "medication management" OR "drug therapy management" OR "discharge planning" OR "patient discharge") OR AB ("transitional care" OR "transition care" OR "case management" OR "critical pathway" OR "critical pathways" OR "clinical pathway" OR "clinical pathways" OR "critical path" OR "critical paths" OR "clinical path" OR "clinical paths" OR "healthcare team" OR "patient care team" OR "patient management" OR "medication management" OR "drug therapy management" OR "discharge planning" OR "patient discharge")	525,454
S5	S3 AND S4 Limiters - Publication Type: Journal Article; Published Date: 20160101-20171231	41

EMBASE

#1	'geriatrics'/exp OR 'elderly care'/de OR 'geriatric care'/exp OR 'geriatrician'/exp OR 'geriatric assessment'/exp OR 'geriatric patient'/exp OR gerontology:ti,ab OR geriatric:ti,ab OR geriatrics:ti,ab OR gerontologist:ti,ab OR gerontologists:ti,ab OR geriatrician:ti,ab OR geriatricians:ti,ab OR elderly:ti,ab OR elder:ti,ab OR elders:ti,ab OR 'older adult':ti,ab OR 'older adults':ti,ab OR 'older patient':ti,ab OR 'older patients':ti,ab OR senior:ti,ab OR seniors:ti,ab OR senium:ti,ab OR 'aged care':ti,ab OR 'aged'/exp	2,851,327
#2	'emergency health service'/exp OR 'emergency ward'/exp OR 'emergency treatment'/exp OR 'emergency medicine'/exp OR 'emergency nursing'/exp OR 'emergency medicine':ti,ab OR 'emergency nursing':ti,ab OR 'Hospital Emergency Service':ti,ab OR 'Hospital Emergency Services':ti,ab OR 'Emergency Hospital Service':ti,ab OR 'Emergency Hospital Services':ti,ab OR 'Emergency Department':ti OR 'Emergency Departments':ti OR 'Emergency Unit':ti OR 'Emergency Units':ti OR 'Emergency Ward':ti OR 'Emergency Wards':ti OR 'Emergency Room':ti OR 'Emergency Rooms':ti OR 'trauma center':ti OR 'trauma centers':ti OR 'trauma unit':ti OR 'trauma units':ti OR ((emergency NEAR/3 hospital):ti)	218,949
#3	#1 AND #2 AND [humans]/lim AND [english]/lim	28,538
#4	'patient care'/exp OR 'clinical pathway'/exp OR 'medication error'/exp OR 'polypharmacy'/exp OR 'treatment outcome'/exp OR 'program evaluation'/exp OR 'patient satisfaction'/exp OR 'hospital discharge'/exp OR 'patient compliance'/exp OR 'transitional care':ti,ab OR 'transition care':ti,ab OR 'case management':ti,ab OR 'critical pathway':ti,ab OR 'critical pathways':ti,ab OR 'clinical pathway':ti,ab OR 'clinical pathways':ti,ab OR 'critical path':ti,ab OR 'critical paths':ti,ab OR 'clinical path':ti,ab OR 'clinical paths':ti,ab OR 'healthcare team':ti,ab OR 'patient care team':ti,ab OR 'patient management':ti,ab OR 'medication management':ti,ab OR 'drug therapy management':ti,ab OR 'discharge planning':ti,ab OR 'patient discharge':ti,ab	2,174,829
#5	#3 AND #4	9,717
#6	#5 AND [2016-2017]/py AND ([aged]/lim OR [very elderly]/lim)	1,920
#7	('randomized controlled trial'/exp OR 'crossover procedure'/exp OR 'double blind procedure'/exp OR 'single blind procedure'/exp OR random*:ti,ab OR factorial*:ti,ab OR crossover*:ti,ab OR ((cross NEAR/1 over*):ti,ab) OR placebo*:ti,ab OR ((doubl* NEAR/1 blind*):ti,ab) OR ((singl* NEAR/1 blind*):ti,ab) OR assign*:ti,ab OR allocat*:ti,ab OR volunteer*:ti,ab OR 'clinical study'/exp OR 'clinical trial':ti,ab OR 'clinical trials':ti,ab OR 'controlled study'/exp OR 'evaluation'/exp OR 'evaluation study':ti,ab OR 'evaluation studies':ti,ab OR 'intervention study':ti,ab OR 'intervention studies':ti,ab OR 'case control':ti,ab OR 'cohort analysis'/exp OR cohort:ti,ab OR longitudinal*:ti,ab OR prospective:ti,ab OR prospectively:ti,ab OR retrospective:ti,ab OR 'follow up'/exp OR 'follow up':ti,ab OR 'comparative effectiveness'/exp OR 'comparative study'/exp OR 'comparative study':ti,ab OR 'comparative studies':ti,ab OR 'evidence based medicine'/exp) NOT ('case report'/exp OR 'a case report':ti OR ': case report':ti OR 'case study'/exp OR 'editorial'/exp OR 'letter'/exp OR 'note'/exp OR [editorial]/lim OR [letter]/lim OR [note]/lim OR [conference abstract]/lim)	10,270,358
#8	#6 AND #7	1,309

APPENDIX C. STUDY SELECTION

STUDY ELIGIBILITY CRITERIA

Study Characteristic	Inclusion Criteria	Exclusion Criteria
Population	Adults aged ≥65 who present to an emergency department (ED) for acute, urgent, or emergency care	· Studies enrolling mixed samples with <70% of participants aged ³ 65 · Studies enrolling condition-specific subgroups of older adults (*eg,* with a single presenting condition such as "falls" or "dementia")
Interventions	4 intervention strategies (including those that use 1 or more strategies or are "multi-strategy") (see Appendix A for full definitions) · Discharge planning · Case management/transition of care · Medication safety/medication review · Strategies designed or guided by the 2014 Geriatric Emergency Department Guidelines[16-18]	· Interventions focused exclusively on risk or functional assessment instruments; otherwise-eligible interventions may utilize risk or functional assessment instruments to identify patients · Transition planning for patients who reside in nursing homes or involving transfers to other hospitals or hospital settings · Interventions focused on a single condition (*eg,* dementia) instead of general care of older adults in ED · Interventions focused on shared decision-making, including related to medication selection and management · Interventions performed after the final decision to admit the older adult to hospital or after discharge had been made
Comparator	Usual or enhanced ED care (*eg*, information or educational control)	No comparator
Outcomes	· **Clinical outcomes:** Overall functional status (or subdomains of physical or mental functioning), health-related quality of life, mortality[a] · **Patient satisfaction/experience:** Any validated measure of patient satisfaction/experience · **Care utilization:** ED readmission; hospitalization related to index ED visit; hospital admission rates (following ED discharge)	· Laboratory parameters (*eg*, A1c, cholesterol levels) · Disease-specific symptoms (*eg*, depressive symptoms, shortness of breath) · Guideline adherence · Prescribing behaviors · Patient/caregiver knowledge
Timing	· Time points that are logically affected by the intervention and are clinically relevant, prioritizing short (*eg*, 30 days) and longer (*eg*, 90 days) time points · For patient satisfaction, within 30 days of admission/discharge	None
Setting	Emergency departments	
Study design	· Randomized controlled trials	· Retrospective studies

Study Characteristic	Inclusion Criteria	Exclusion Criteria
	· Quasi-experimental studies (prospective controlled designs: controlled nonrandomized trial, before-after cohort study, case-matched controlled; interrupted time-series designs) · All studies must include an eligible comparator per EPOC criteria[29]	· Cross-sectional designed studies · Cost-effectiveness analyses · Program descriptions
Publication type	· English-language publications · 1990 to current date · OECD countries (North America, Australia, New Zealand, Japan, South Korea, Israel, Chile, Turkey, and Europe)	· Non-English language · Not a full publication in a peer-reviewed journal · Meeting abstracts, letters, editorials, and dissertations. · Pilot studies or sample sizes <20

[a] Given the potential array of conditions, disease-specific measures of severity and symptoms are not particularly practical or helpful to decision making; therefore we chose concepts that cut across conditions.
Abbreviations: A1c=glycosylated hemoglobin; ED=emergency department; EPOC=Effective Practice and Organisation of Care; OECD=Organisation for Economic Co-operation and Development

APPENDIX D. STUDY RISK OF BIAS ASSESSMENT

For full study citations, please refer to the report's main reference list.

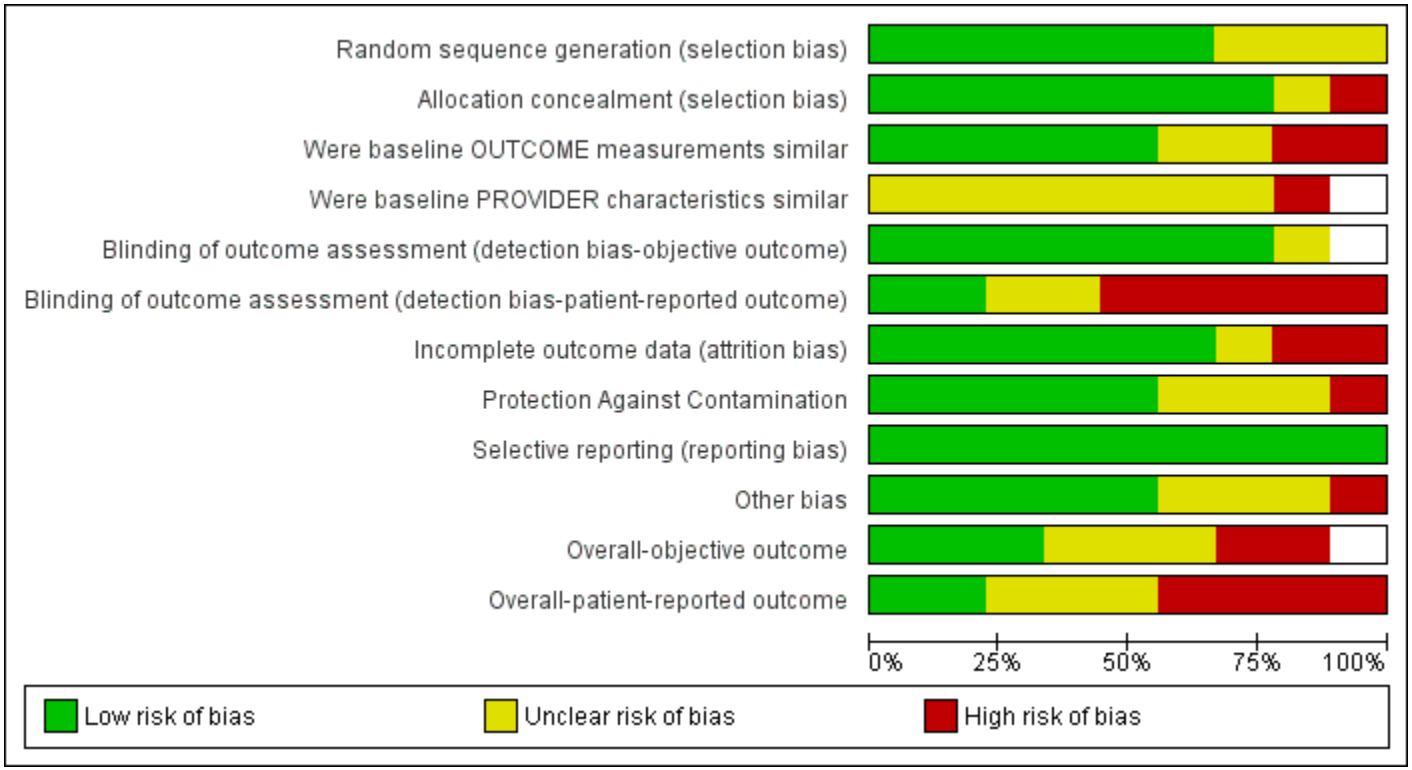
The following abbreviations are used in the risk of bias tables in this appendix:

1=Randomization adequate
2=Allocation concealment
3=Baseline measure similar
4=Baseline-provider contamination
5=Detection bias (objective outcome)
6=Detection bias (patient-reported outcome)
7= Incomplete outcome
8=Protection against contamination
9=Selective outcomes reporting
10=Other bias
11=Overall objective outcome
12=Overall patient-reported outcome
LR=low risk of bias; HR=high risk of bias; NR=not reported; NA=not applicable; UR=Unclear risk of bias

RANDOMIZED STUDIES

Study	1	2	3	4	5	6	7	8	9	10	11	12
Basic, 2005[34]	LR	LR	HR	UR	LR	HR	HR	LR	LR	LR	HR	HR
Biese, 2014[35]	UR	HR	UR	HR	LR	HR	HR	UR	LR	HR	HR	HR
Biese, 2017[36]	LR	LR	UR	UR	LR	HR	LR	UR	LR	UR	UR	HR
Caplan, 2004[37]	LR	LR	LR	UR	LR	HR	LR	LR	LR	LR	LR	UR
Eklund, 2013[38]	UR	LR	LR	UR	NR	HR	LR	UR	LR	LR	NA	HR
Gagnon, 1999[39]	LR	LR	LR	NR	LR	UR	LR	HR	LR	UR	UR	UR
McCusker, 2001[40]	LR	LR	LR	UR	LR	LR	LR	LR	LR	UR	LR	LR
Mion, 2003[41]	LR	LR	LR	UR	LR	LR	LR	LR	LR	LR	LR	LR
Runciman, 1996[42]	UR	UR	HR	UR	UR	UR	UR	LR	LR	LR	UR	UR

Summary Ratings Across Randomized Studies for Each Risk of Bias Domain

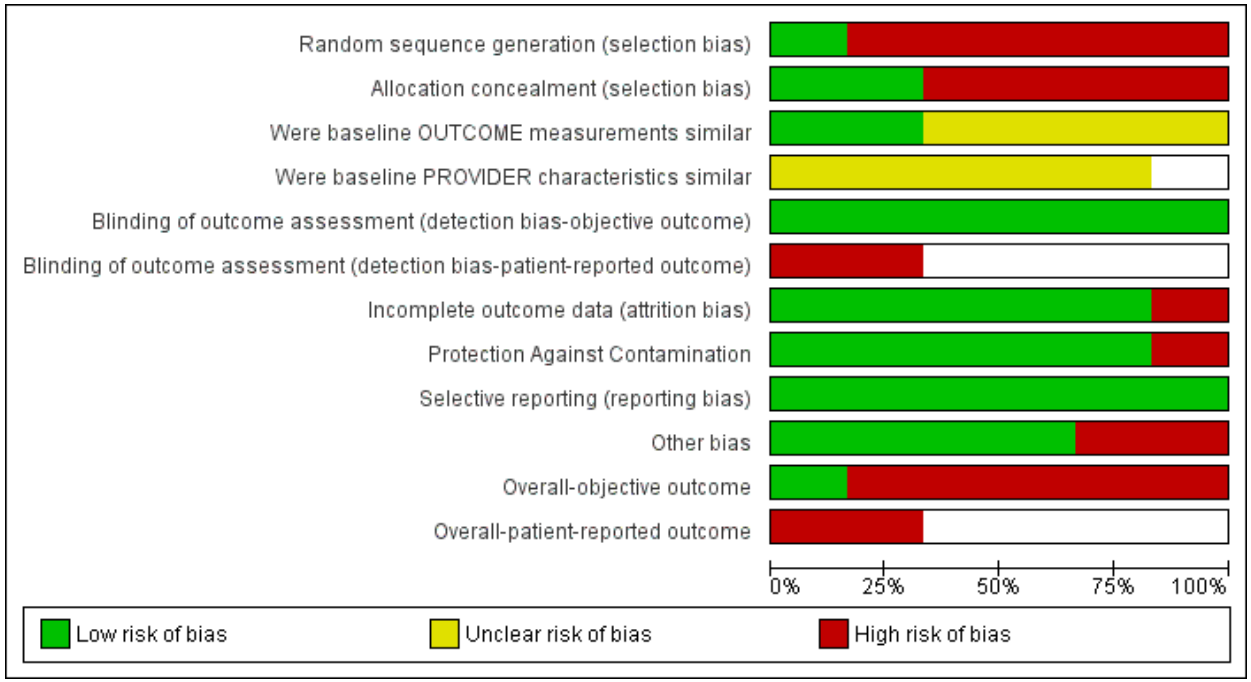


[a]White space indicates items that were not applicable.

NONRANDOMIZED STUDIES

Study	1	2	3	4	5	6	7	8	9	10	11	12
Arendts, 2012[43]	HR	HR	LR	UR	LR	NR	LR	LR	LR	LR	HR	NA
Arendts, 2013[44]	HR	HR	UR	UR	LR	NR	LR	LR	LR	HR	HR	NA
Bond, 2014[45]	HR	LR	UR	UR	LR	NR	LR	LR	LR	LR	HR	NA
Miller, 1996[46]	HR	HR	UR	NR	LR	HR	HR	LR	LR	HR	HR	HR
Mortimer, 2011[47]	HR	HR	UR	UR	LR	HR	LR	HR	LR	LR	HR	HR
Pedersen, 2016[48]	LR	LR	LR	UR	LR	NR	LR	LR	LR	LR	LR	NA

Summary Ratings for Nonrandomized Studies Across Each Risk of Bias Domain



[a]White space indicates items that were not applicable.

APPENDIX E. PEER REVIEW COMMENTS

Question Text	Reviewer Number	Comment	Response
Are the objectives, scope, and methods for this review clearly described?	1	Yes	Acknowledged
	2	Yes	Acknowledged
	3	Yes	Acknowledged
	4	Yes	Acknowledged
	7	Yes	Acknowledged
	8	Yes	Acknowledged
Is there any indication of bias in our synthesis of the evidence?	1	No	Acknowledged
	2	No	Acknowledged
	3	Yes - Reads as biased against studies that do not use the previously published 2014 guidelines or do not use conceptual model.	We respectfully disagree with this comment. In systematic reviews, bias is most likely to be introduced through study selection (search, eligibility criteria), or synthesis. Our search and eligibility criteria did not preferentially select for studies that used a conceptual model. Similarly, studies were included in syntheses of results without regard to the presence of a conceptual model. We have also added a note to the Research Gaps/Future Research section that there has not been sufficient time since publication of the 2014 Guidelines for hospitals to implement changes, evaluate the effects, and disseminate findings.
	4	No	Acknowledged
	7	No	Acknowledged
	8	No	Acknowledged
Are there any published or unpublished studies that we may have overlooked?	1	No	Acknowledged
	2	No	Acknowledged
	3	No	Acknowledged
	4	Yes - As described more fully in "additional comments" below, there may be a limitation with the Search Strategy defined in Appendix B. Search term #1 required a study that defined itself as geriatric or a "aged care " study may have reduced the yield in the literature search as some controlled studies that compare emergency department management for medical conditions of	We thank the reviewer for this observation. It is possible that studies conducted on a particular condition (*eg,* delirium, falls) that disproportionately affect older adults could be missed if they were not coded as geriatric or aged care. However, the reviewer raises this as a hypothetical, without identifying any missed studies. We repeated the search using terms for delirium and falls. Only 2 unique citations were identified that were not captured by our original search strategy, suggesting that relevant studies are indexed (MeSH terms) using “aged

Question Text	Reviewer Number	Comment	Response
		aging do not necessarily define themselves as geriatric or "older adult" studies.	care" terms. Neither citation met eligibility criteria. This test of our search strategy along with other methods to identify relevant studies (review of scoping and other reviews for relevant studies) give us confidence that we identified the eligible literature. Finally, as noted elsewhere in our response, our search strategy was discussed in collaboration with our operations partners. This report was commissioned to identify ED interventions that would be broadly applicable to older adults as opposed to focus on particular conditions or events.
	7	No	Acknowledged
	8	No	Acknowledged
Additional suggestions or comments can be provided below. If applicable, please indicate the page and line numbers from the draft report.	1	Very informative and excellent report summarizing ED interventions on improving patient care, experience, and utilization outcomes for older adults. A report like this is much needed and if (shortened and) reframed as a journal manuscript, will likely be of high interest by emergency medicine and geriatrics journals and their readers.	Acknowledged
	1	Major recommendations: Greater clarification in the methods section of how the review was conducted of each study – what was extracted and then "synthesized" would strengthen the paper and allow readers to understand how the review was conducted. Many of the categorizations, ratings (e.g., risk of bias) only come out in the results section and were not clarified in the methods for how these scores were generated (i.e., were these totally subjective in rating by reviewers?)	The Data Abstraction section of the Methods describes the major categories of data abstracted. In addition, Appendix A gives detailed definitions of the intervention elements abstracted and their definitions. We revised the report to consistently refer to risk of bias (elements described in the methods and Appendixes D and I), whereas the draft report described these elements inconsistently as risk of bias or study quality.
	1	Minor concerns: Pg. 1. GED Guidelines citation that this was issued by ACEP does not acknowledge the guidelines were also endorsed and issued by the American Geriatrics Society, Society for Academic Emergency Medicine, and Emergency Nurses Association. (1-3)	Thank you. These citations have been added to the background section.

Question Text	Reviewer Number	Comment	Response
	1	1. Carpenter CR, Bromley M, Caterino JM, et al. Optimal older adults emergency care: introducing multidisciplinary geriatric emergency department guidelines from the american college of emergency physicians, american geriatrics society, emergency nurses association, and society for academic emergency medicine. J Am Geriatr Soc. 2014;62(7):1360-1363.	This citation has been added to the background section.
	1	2. Carpenter CR, Bromley M, Caterino JM, et al. Optimal older adults emergency care: Introducing multidisciplinary geriatric emergency department guidelines from the American College of Emergency Physicians, American Geriatrics Society, Emergency Nurses Association, and Society for Academic Emergency Medicine. Acad Emerg Med. 2014;21(7):806-809.	This citation has been added to the background section.
	1	3. Carpenter CR, Bromley M, Caterino JM, et al. Optimal older adults emergency care: Introducing multidisciplinary geriatric emergency department guidelines from the American College of Emergency Physicians, American Geriatrics Society, Emergency Nurses Association, and Society for Academic Emergency Medicine. Ann Emerg Med. 2014;63(5):e1-3.	This citation has been added to the background section.
	1	Was a strategy or framework for assessing interventions and programs developed prior to data abstraction from the eligible studies? (aside from patient characteristics, intervention structure, comparator, and outcomes? And aggregating outcomes for at least 3 studies?) (i.e., overall conceptual model the motivated the intervention – was this defined before or during the study reviews?)	Thank you for this comment. We have clarified that our conceptual framework was developed *a priori* and that our intervention strategies and components were also developed prior to data abstraction, in collaboration with our stakeholders and technical expert panel.
	1	The conceptual framework for geriatric emergency patient care (Figure 1) predisposing factors and outcomes for older adults that utilize the ED is excellent.	Acknowledged

Question Text	Reviewer Number	Comment	Response
	1	How was risk of bias (ROB) measured? (Strength of Evidence is based on an AHRQ Methods Guide for Effectiveness and Comparative Effectiveness Reviews, but not there is no info for how ROB criteria were ascertained to give scores of low, unclear, vs. high ratings in the methods section).	In the draft report, ROB was referred to variably as study quality or ROB. We revised the report to consistently use the term "risk of bias." The approach (EPOC criteria) is described in the Methods section ("Risk of Bias" subsection), and further details are given in Appendix D).
	1	Decision to examine effects of intervention on patients, clinicians, policymakers determined a priori? Tying these effects to the conceptual model proposed by the ESP around geriatric emergency patient care would be helpful.	Thank you for this comment. In our methods section, we have clarified that our conceptual framework was determined *a priori*. We have also added language to our Limitations section in which we note that the limited information reported by many studies prevented us from exploring the effects of patient- and provider-level intervention components on our chosen outcomes.
	1	Were the 4 ED intervention strategies (pg.10) determined a priori to the review, or after the paper abstraction process?	Thank you for this comment. We have added language to clarify that intervention strategies were determined *a priori*.
	1	Were ED intervention components determined a priori or during abstraction?	Thank you for this comment. We have added language to clarify that intervention components were determined *a priori*.
	1	Figure 6 and 7 should include a legend describing the colored circles in the table.	We have added clarification describing the colored circles in the footer.
	1	Is there a reference for the PICOTS framework? (pg. 33)	We added the following citation which describes the use of PICOTS framework for identifying research gaps. Robinson KA, Akinyede O, Dutta T, Sawin VI, Li T, Spencer MR, Turkelson CM, Weston C. Framework for Determining Research Gaps During Systematic Review: Evaluation. Methods Research Report. (Prepared by Johns Hopkins University Evidence-based Practice Center under Contract No. 290-2007-10061-I.) AHRQ Publication No. 13-EHC019-EF. Rockville, MD: Agency for Health care Research and Quality. February 2013. www.effectivehealthcare.ahrq.gov/reports/final.cfm.
	2		
	3	Congratulations to the research team on a tremendous accomplishment completing this review. There are many strengths: rigorous methodology, great conceptual model proposed.	Acknowledged

Question Text	Reviewer Number	Comment	Response
	3	Tremendous redundancy. I think I read 6 times that the papers evaluated did not refer to the 2014 published guidelines (and this is just one example).	Thank you. We edited carefully to streamline the report and reduce redundancy.
	3	Lack of reported racial/ethnic/socioeconomic information in most papers is a bigger issue than the authors make it seem given the demographics of our VA population.	Thank you for this comment. We acknowledge that only 4 of 15 studies reported race for study participants. As noted in the PICOTS table of our Future Research section, the lack of this information limits the number of subgroup analyses that can be conducted. As noted, we believe the use of a comprehensive conceptual framework may encourage more complete reporting of participant characteristics, including race and other sociodemographic characteristics (*ie*, income, education) that may influence medical events and ED utilization.
	3	Conclusions do not always line up with reported results. Needs to be exact alignment between reported findings and results, for example is it only bridge interventions that were successful or not?	Thank you for this comment. We have revised our Conclusion section to be more consistent with the reported results.
	3	Should explicitly state which outcomes were primary outcomes for which the studies were designed with adequate statistical power to reject the null hypothesis versus those which measured the outcome as a secondary (exploratory) outcome.	Appendix F (Study Characteristics Tables) identifies the primary outcome for each study. For individual studies, we note when effects were imprecise. When grading the strength of evidence, we note when summary estimates of effect were imprecise and judged to cross decisional thresholds. We updated the key points to reflect this detail.
	3	Paper would be stronger summarizing the previous reviews in the intro not at the end.	Thank you for this comment. We selected to highlight gaps of previous reviews in the Introduction and address our findings in context of these reviews later in the paper. As highlighted in the Introduction, no prior reviews examined multi-strategy interventions and/or attempted to identify intervention components.
	3	Specific suggestions for improvement (some of these are big issues related to the above points and some are small points): Page 1: Study selection – why “in brief”? This should be more detailed. RE enrolling older adults: did studies have to enroll ONLY older adults? What about interventions that included	Detailed eligibility criteria are given in the body of the report and in Appendix C. No studies enrolled mixed samples of older and younger patients. In the description of included studies (Results Section, Detailed Findings), we clarified that only older adults were enrolled.

Question Text	Reviewer Number	Comment	Response
		older adults but also included middle aged patients?	
	3	Page 2 (and page 17): Term “best practices” not mentioned in the intro. Should either be mentioned in methods/part of “key question” (that currently only talks about interventions not “best practices”, or not included in top bullet.	Thank you for this comment. We have replaced the phrase “best practices” with “ED interventions.”
	3	Bullet 3 and 4 seem to contradict each other. Bullet 3 says only “bridge” interventions work, but bullet 4 talks about “ED” interventions possibly benefiting functional status. Does “ED” include “bridge” or mean ED only? Clarity of terminology in the bullets (and throughout) should be improved.	Thank you. We have reorganized the key points, adding greater specificity on potential benefits and using consistent language throughout the report.
	3	Bullet 6 (and this applies to Page 22): were any of these studies actually designed with enough statistical power to look at mortality as an outcome? If not, would just say that, rather than say the interventions did not affect mortality. Should be very clear whether these studies were designed with adequate power versus looking at mortality as a secondary outcome.(Comments for these bullets also apply to page 17 where the bullets are repeated).	We modified this key point to specify that no study selected mortality as the primary outcome. We are unable to address whether studies were designed with sufficient statistical power to address each outcome. This would require specification of a clinically important difference and a power calculation for each outcome.
	3	Page 4-5. What does “precise” mean? What does “indirect” mean? How was SOE and ROB determined?	By design, the Executive Summary does not give detailed definitions of terms. However, we have added a glossary that defines key terms. Details on the assessment of SOE and ROB are given in the Methods section of the main report.
	3	Page 5, line 24. What other reviews? References here would improve this para. I don’t see how this first sentence in this para is supported by the results of the presented analyses (it may be true but I don’t see this as a logical conclusion from the results). Seems like first implication (based on what I have read so far up to this para) should be that ED-focused interventions have been mostly unsuccessful.	Thank you for this comment. Prior research has suggested that bridge interventions, or those with planned contacts taking place both pre- and post-ED discharge, may be more effective. We have added a citation here to reflect this recommendation.

Question Text	Reviewer Number	Comment	Response
	3	Related in same para (and on page 32): "improving outcomes for older ED users will be challenging" is a statement of the obvious and has nothing to do with the results of the analyses.	Thank you for this comment. We have removed this statement entirely from the Executive Summary and revised our language in the Discussion to suggest that future work should be longitudinal and transdisciplinary.
	3	Page 5 – Research Gaps. One big gap that is not mentioned here is identifying an intervention that has a big meaningful effect size.	We agree and have outlined a future research agenda that we believe could contribute to identifying highly effective strategies.
	3	Page 5. What basis do the authors have for concluding that using a conceptual model will improve the science? (As a health services researcher I completely agree that conceptual models are important, but I don't see how this is a "conclusion" from the results.). Suggest reframing this as a suggestion/opinion on how to improve the state of the science moving forward.	We have added more information highlighting the potential value of a conceptual model in regards to its ability to depict hypothesized relationships between intervention strategies and outcomes of interest (*ie*, mechanisms of action).
	3	Page 6 line 22. "signal" is jargon (this comes up again at the end of the paper also).	Merriam-Webster defines "signal" as a *sign* or *indication.* Although accurate, we dropped this term.
	3	Page 10 line 34. "Best practices" comes up again – what does this mean and how does it fit with the rest of the methods?	Thank you for this comment. As address earlier, we have replaced "best practices" with "intervention strategies" throughout the report.
	3	Page 12, line 9. Should reference and describe findings from ED geriatrics assessment/discharge planning intervention reviews.	Thank you for this comment. We have elected to focus this paragraph on the conceptual model and its potential to help tease apart intervention strategies and components not previously addressed in prior reports. Results from prior reviews, including those examining geriatric assessments and discharge planning interventions, are addressed in the Introduction and Discussion sections of the report.
	3	Figure 1/Conceptual model is a strength of this review.	Acknowledged
	3	Page 13, line 12. What is a "scoping" review?	Scoping reviews are used to identify knowledge gaps, set research agendas, and identify implications for decision-making. Scoping studies differ from systematic reviews because authors do not typically assess the quality of included studies.
	3	Page 14. Now I see where the terms "directness" and "precision" come from (AHRQ publication) but I still don't know what these actually mean. Paper	We added a glossary that defines key terms.

Question Text	Reviewer Number	Comment	Response
		would be stronger with explanation/definition of each of these terms.	
	3	Pages 17-18: No studies with Veterans is stated twice in these 2 pages (and other times).	Thank you. We have addressed this redundancy.
	3	Table 5, row 1 (study design). Not clear whether the 2nd line of text is a subset or an additional study. Is the cluster-randomized trial also considered one of the 8 randomized trials or is it a 9th RCT? Same with the non-randomized – is the pre-post considered one of the 5 non-randomized?	The total number of studies is given in the column header. Except where noted in a footnote, all counts of studies are independent and sum to the total given in the column header.
	3	The finding that so many studies do not report race deserves more attention.	We thank the reviewer for this comment. We have added a statement to the PICOTS table of our Future Research section stating that the lack of this information prevented us from conducting subgroup analyses. We have also elaborated on the benefit of a conceptual model to take a more comprehensive view of ED use and explore how, if at all, sociodemographic factors, including race, income, and education, may impact ED use and outcomes.
	3	Page 22, line 52 (and many other places throughout the manuscript): suggest replacing the word “evaluated” or “examined” with “measured” ie the study MEASURED the effect of the ED intervention (not evaluated or examined).	We considered these terms and edited the manuscript to consistently use the term “evaluated” as we think this best describes the goal of studies designed to determine the effects of ED strategies on the selected outcomes.
	3	Figure 4 and 5. Clarify that column header R=randomized	The figures have been changed to clarify the column header.
	3	Figure 6 and 7 are confusing for several reasons. Since the title has “bias” in the title it would seem that a plus sign would indicate more bias but at the same time more bias is undesirable so would that be red (bad)or green (good)? At a minimum need a legend/color scheme but also would be good if direction of bias and plus sign went same direction. “Objective” outcome is not correct term for non patient-reported outcomes. Suggest “administrative” or non-patient-reported. It is not clear how the summary “objective” and patient-reported outcomes ROB scores were calculated.	Thank you for this comment. These figures were created in Cochrane software using their standard visual approaches which are well understood in the SR community. We have added a footer to define the color/symbol scheme. We agree that “non-patient reported” is a better term than “objective” but it is a noun-string that decreases readability. We now describe these as non-patient-reported outcomes but tell the reader we will use objective outcomes for readability. Summary ROB ratings are not calculated. They are based on judgments after considering each of the items in the ROB

Question Text	Reviewer Number	Comment	Response
			assessment. We have added the definitions for low, unclear and high ROB.
	3	Page 30, lines 13-14. Patients may be similar in level of acuity but likely to be dissimilar in terms of race/ethnicity/socioeconomic status.	Thank you for this comment. We have clarified that the patients in the identified studies may be medically similar to Veterans. We have expanded our section on "Applicability to Veterans" to highlight potential differences in race, ethnicity, and socioeconomic status.
	3	Page 30, lines 26-27. I don't understand what is meant here about low-intensity interventions having limited applicability? Are you trying to say that higher intensity interventions might have bigger impacts?	Thank you for this comment. We have clarified that low-intensity interventions were classified as being short in duration and having a limited number of patient contacts. We have also clarified that most studies examined low intensity interventions, thus limiting our results to our low intensity interventions in the ED.
	3	Thank you for the opportunity to participate in the review of this interesting project.	Acknowledged
	4	This VA ESP is an exceptionally well-written document that addresses a critical problem of great interest to the VHA, i.e., the need to provide high quality care to the many elderly individuals who use emergency services. The emergency department (ED) is a critical access point that offers important opportunities to improve care and avoid deleterious outcomes. The document was developed using a standardized protocol to conduct the literature synthesis, which is a strength. The mission of this ESP review is reported as follows: To build on the ACEP Geriatric Emergency Department Guidelines published in 2014 that provides a template for many aspects to ER practice, education and assessment and evaluation to improve care for older adults. It is additionally stated that this document is intended to be used by the VHA Offices of Geriatrics and Extended Care Operations and Emergency Medicine to evaluate best practices in emergency care.	Thank you for this feedback.

Question Text	Reviewer Number	Comment	Response
	4	As noted below, the results from this synthesis may be somewhat limited in their ability to meet the goals stated above, and this may be related to the search design for the literature review. The search terms selected for this synthesis, as outlined in excellent detail in Appendix B, might be unable to capture all relevant papers. Review of these search terms suggests that they captured the constructs of 1) geriatric focused study 2) ED service examined in the study 3) Absence of a focus on children or adolescents and 4) Presence of clinical trial/clinical intervention comparison methods. Including these four features resulted in only nine randomized trials and six non-randomized trials. This very small number of studies greatly reduced the authors' ability to derive helpful conclusions for future guidelines. A possible source of this small yield could be the requirement for explicit "geriatric" terms in the search – for example, the vast majority of ED visits are related to the top contributors to aging complications: Falls/syncope, heart failure, delirium. While these conditions occur almost exclusively in the elderly, a comparative study of best practices for their ED treatment may or may not define itself as "geriatric." For example, there is a superb conceptual model from the Society of Academic Emergency Medicine and the Heart Failure Society to guide ED management of heart failure in the paper: Collins S. Journal of Cardiac Failure Vol. 21 No. 1 2015. Despite the paper noting that this is addressing a critical need for the growing population of older adults, the paper does not identify itself as geriatric per se. Since heart failure occurs almost entirely in the geriatric population, this paper is one example of a study	The comment regarding the "small yield" resulting from our search strategy was addressed above. This evidence synthesis was requested by our operational partners to evaluate strategies that would apply generally to older adults presenting to VA EDs, rather than older adults with specific conditions. Older Veterans have, on average, 4 chronic conditions, lower physical and mental health-related quality-of-life, and higher rates of functional impairment compared to non-Veterans. In an effort to meet the needs of a highly complex patient population, our operational partners commissioned this report to evaluate general strategies that would be applicable to the VA's patient population. Our description of studies table (Appendix F) describes the 3 most frequent conditions/presenting symptoms reported in each study. We summarize this information in the results subsection "Description of Included Studies for ED Interventions for Older Adults." We agree that evidence syntheses on strategies to address specific conditions in older adults would be valuable, but this would have been inconsistent with our operational partners' guidance.

Question Text	Reviewer Number	Comment	Response
		that may offer insights to the topic at hand that could have been confirmed as a study of older adults in the literature review while not noting itself as a “geriatric” or "older adult" study. The main issue at hand is that ED services are invariably applied and studied to diseases of aging, but the denotation of “geriatric” is a subspecialty designation that is not available in all ED settings. Despite this, a full synthesis to understand best practices in the ED for older adults should at least be aware of this limitation, even if the ultimate decision is to focus only on “geriatric” specialty services. It is very understandable that the authors do not want to limit the ESP to specific medical conditions and the authors are absolutely correct that an over-focus on only medical signs and diagnostic tests without a full conceptual model that includes social factors can lead to major failures to address critical needs. On the other hand, the acute medical diagnosis has such a great effect on the nature of the ED service and follow-up quality that the medical condition cannot be excluded entirely. For this reason, the ACEP Guidelines do specifically provide guidance on some of the top ED conditions that are intervenable. That is, the ACEP specifically addresses falls, urinary catheters/UTI, complex medication use/polypharmacy, delirium and palliative care needs. While this submitted ESP does take a broad-spectrum approach with good reason to avoid specific conditions, unfortunately the outcome obtained by the ESP avoiding overly medically-focused studies, was that the results were very small. This occurrence is important to note since it is meaningful that some bit of medical need must be in the model, since it accounts for	

Question Text	Reviewer Number	Comment	Response
		variance both in seeking care and after-care needs.	
	4	The current yield in this synthesis does not give the field good fodder to grow into evidence-based practices for the VHA emergency services. To be truly patient-centered and provide precision care, EBPs must at least address the medical needs of the specific patient somewhat. Consequently, this ESP unfortunately does not meet its goal of expanding upon the ACEP document. So the happy medium may most likely be achieved by taking a similar approach to the ACEP and at least examine the most common and intervenable conditions that are likely to bring Veterans to the ED. For example, the ACEP has a well-crafted series of potential interventions for patients who have suffered a fall, this includes equipment, care strategies, interdisciplinary interventions and quality measures related to care for older patients with falls who have been in the ED. Following this lead, this ESP analysis could have provided a literature synthesis (presently absent for the ACEP report) regarding the literature on randomized trials comparing ED interventions for patients with falls. For the search terms in the literature synthesis, this would involve adding (instead of the geriatric terms in #1), the presence of hip fracture, other fracture, syncope, falls, dizziness, unsteady gait, other injury including head injury from falls, etc. This type of ESP approach may lead to more operational outcomes. Without more to offer from this ESP, is does not provide a substantial advancement over the ACEP guidelines	The goal of this review was to review the evidence to determine the effectiveness of emergency department (ED) interventions for improving clinical, patient experience, and utilization outcomes in older adults (age ≥65). We did not have a goal of "expanding upon the ACEP document." Although the ACEP guidelines provide practical consensus-based recommendations, we agree that evidence syntheses that summarize the evidence for common geriatric conditions could be of great value. However, our review was not commissioned for this purpose. We have strived to make it clear that our findings apply only to strategies that are not condition-specific.
	4	This is not to say that this ESP information is not useful, it is good information to see what was found. But the results did not lead to any definitive	We thank the reviewer for this comment and agree that critical steps in the care process are not depicted in our model. However, conceptual models within systematic reviews are

Question Text	Reviewer Number	Comment	Response
		steps for evidence based practice as there is no clear signal reported other than multi-strategy or case-management type interventions may reduce ED re-admissions. Unfortunately, this finding does not give compelling support to next steps as there is no clear operational strategy derivable from this finding. The authors mention a number of times that a clear conceptual model is needed to conduct better research, but the framework proposed in Figure 1 on page 12 is challenging to interpret regarding how it may work as it jumps from "older adults presenting to ED" directly to three different intervention components, it is missing the information gathering, interview, examination and diagnostic piece in the middle. It is commendable that the model includes the socio-demographic and other preexisting factors the patient brings to the ED, but it is missing the fact that the patient's clinical reason for presenting does matter in the model. Establishing a clinical/medical understanding of the individual patient cannot be skipped over – and consequently it is difficult to determine how this model can be applied as it appears to lack specificity that is essential for the patient centered and precision-care world that we live in.	not meant to be all-encompassing. The model shown in our paper was a purposeful simplification of what we believe all causal pathways to be. We agree that a more robust model should be developed prior to intervention design and dissemination.
	4	Another comment may be helpful regarding the use of conceptual frameworks (generally speaking) in research: It may be useful to appreciate that the emphasis on conceptual models as a requisite for research is largely unique to the VHA in current times. Outside DOD and VHA services research, other funding agencies evaluate research based on scientific premise and rationale, while conceptual framework language is more often reserved for studies that are speculative - or preliminary work based on theory such as projects for career	Thank you for this comment. We believe that conceptual models provide tremendous value in identifying causal processes, including mediating mechanisms and moderating effects, particularly in areas of research where such information has not been well-established. We have revised our language to better emphasize that the presence of a conceptual model was not a requirement for inclusion into our study and did not suggest a deficiency when not present.

Question Text	Reviewer Number	Comment	Response
		awards, pilot grants and preliminary research awards. Consequently, it may not always be a deficiency in a research study not to begin with a conceptual model diagram, but rather just a difference in approach between different funding sources for research.	
	7		
	8	Appreciate the opportunity to read this.	Acknowledged

APPENDIX F. STUDY CHARACTERISTICS TABLES

For full study citations in this appendix, please refer to the report's main reference list.

RANDOMIZED STUDIES

Study Country # Enrolled # of Arms	Key Intervention Components	Eligibility	Population High Risk? Mean Age (SD) Female % Race % Living Alone % Top 3 Conditions	Outcomes Reported[a] Outcome Timing Primary Outcome	Risk of Bias for Objective and Patient- Reported Outcomes[b]
Single-Strategy Interventions					
Case Management/Transition of Care					
Basic, 2005[34] Australia 224 2	Comprehensive assessment Referral to specialist, no follow-up Intervention delivered within ED	Inclusion: "Older adult" functional impairment; psychological disability; social disability; active multisystem disease Exclusion[c]: Medically unstable; living in nursing home	High risk: Yes, based on functional status or other Age: 78.7 (6.4) Female: 60% Race: NR Living alone: 39% Top 3: Musculoskeletal, cardiovascular, neurological	Functional status: Modified Barthel index Hospitalization: At index[d] visit Timing: Index visit Primary: Index hospital admission, length of inpatient stay, functional decline	Objective: High Patient: High
Caplan, 2004[37] Australia 739 2	Semi-structured assessment Referral plus follow-up Intervention delivered both within and after discharge from ED ("bridge")	Inclusion: Aged ≥75 Exclusion: Lived in a nursing home; previously enrolled in this study	High risk: No Age: 82.2 (6.0) Female: 61% Race: NR Living alone: 39% Top 3: Ischemic heart disease, falls, diabetes mellitus	Functional status: Composite Mortality Hospitalization: After index visit ED readmit Timing: 30 days; 3, 6, 12, 18 months Primary: All hospital admissions within 30 days of ED visit	Objective: Low Patient: Unclear

Study Country # Enrolled # of Arms	Key Intervention Components	Eligibility	Population High Risk? Mean Age (SD) Female % Race % Living Alone % Top 3 Conditions	Outcomes Reported[a] Outcome Timing Primary Outcome	Risk of Bias for Objective and Patient-Reported Outcomes[b]
Gagnon, 1999[39] Canada 427 2	Comprehensive Assessment No referral, only follow-up Intervention delivered only after discharge from ED	Inclusion: Aged ≥70 with cardiac disease (part of risk assessment) Exclusion: Admitted to ED from long-term care facility or nursing home; currently in another research study or followed by a geriatric team; hospitalized; partner already enrolled	High risk: Yes, based on ADL and Boult assessment tool Age: 81.6 (6.4) Female: 58% Race: NR Living alone: 61% Top 3: Diabetes, cardiac	Functional Status: ADL, IADL Quality of life: SF-36 Mortality Patient experience Hospitalization: follow-up ED readmit Timing: 10 months Primary: Quality of life, satisfaction with care, functional status, admission to hospital, length of hospital stay, or readmission to ED	Objective: Unclear Patient: Unclear
Runciman, 1996[42] Europe 424 2	Comprehensive assessment No referral or follow-up Intervention delivered only after discharge from ED	Inclusion: Aged ≥75; accident Exclusion: NR	High risk: No Age: 81 (NR) Female: NR Race: NR Living alone: NR Top 3: Fall and soft-tissue injury	Functional Status: SF-36 Patient experience: Informal ED readmit Timing: 4 weeks Primary: Patient satisfaction, ED readmission rate, dependency, functional outcome	Objective: Unclear Patient: Unclear

Study Country # Enrolled # of Arms	Key Intervention Components	Eligibility	Population High Risk? Mean Age (SD) Female % Race % Living Alone % Top 3 Conditions	Outcomes Reported[a] Outcome Timing Primary Outcome	Risk of Bias for Objective and Patient-Reported Outcomes[b]
Multi-Strategy Interventions					
Discharge Planning PLUS Case Management/Transition of Care					
Eklund, 2013[38] Europe 181 2	Geriatric assessment Referral plus follow-up Intervention delivered both within and after discharge from ED ("bridge")	Inclusion: Aged 65-79 with 1 or more chronic disease and dependent in 1 or more ADLs, or ≥ age 80 Exclusion: Dementia; palliative care; and acute severe illness with immediate need of assessment and treatment by physician	High risk: Yes, based on ADL and diagnosis Age: NR Female: 55% Race: NR Living alone: NR Top 3: Frail, visual impairment	Functional status Timing: 3, 6, 9, 12 months Primary: Frailty (Berg Balance scale)	Objective: NA Patient: High
McCusker, 2001[40] Canada 388 2	Brief nursing assessment Referral plus follow-up Intervention delivered both within and after discharge from ED ("bridge")	Inclusion: Aged ≥65 Exclusion: Referred from nursing home or chronic disease hospital; patient expected by ED staff to be admitted; medically unstable or cognitively impaired with no family as proxy; already seen by a member of the hospital's geriatric staff prior to enrollment	High risk: Yes, based on ISAR score Age: 76.6 (7.0) Female: 61% Race: NR Living alone: 40% Top 3: Cardiorespiratory, musculoskeletal, digestive	Functional status: ADL Patient experience Hospitalization: At index visit ED readmit Costs Timing: 1, 4 months Primary: functional status and depression, change in caregiver physical and mental health status, patient and caregiver satisfaction with care	Objective: Low Patient: Low

Study Country # Enrolled # of Arms	Key Intervention Components	Eligibility	Population High Risk? Mean Age (SD) Female % Race % Living Alone % Top 3 Conditions	Outcomes Reported[a] Outcome Timing Primary Outcome	Risk of Bias for Objective and Patient-Reported Outcomes[b]
Mion, 2003[41] USA 650 2	Comprehensive assessment Referral plus follow-up Intervention delivered both within and after discharge from ED ("bridge")	Inclusion: Aged ≥65 Exclusion: Not expected to discharge from ED; impaired hearing; no family caregiver as proxy for cognitively impaired	High risk: No Age: 74.4 (6.9) Female: 59% Race: White (39%), other categories (NR) Living alone: NR Top 3: NR	Functional status: SF36 Mortality Patient experience Hospitalization: After index visit ED readmit Costs Timing: 30, 120 days Primary: Health care service use (defined as ED, hospital, nursing home, health care costs)	Objective: Low Patient: Low
Case Management/Transition of Care PLUS Medication Management					
Biese, 2014[35] USA 178 3	No assessment Referral to community services plus follow-up Intervention delivered after discharge from ED	Inclusion: Aged ≥65 Exclusion: Admitted to hospital; discharged to setting other than home; not referred to outpatient follow-up; cognitively impaired; patient excluded from primary outcome ONLY if returned to ED or was hospitalized within 5 days of index ED visit	High risk: No Age: 75 (7.58) Female: 60% Race: White (67%-74%), Black (23%-31%) Living alone: NR Top 3: NR	Hospitalization: After index visit ED readmit Costs Timing: 35 days Primary: Post-ED discharge measured by expedited outpatient follow-up and/or increased compliance with medication changes	Objective: High Patient: High

Study Country # Enrolled # of Arms	Key Intervention Components	Eligibility	Population High Risk? Mean Age (SD) Female % Race % Living Alone % Top 3 Conditions	Outcomes Reported[a] Outcome Timing Primary Outcome	Risk of Bias for Objective and Patient-Reported Outcomes[b]
Biese, 2017[36] USA 2000 2	No assessment Referral, no follow-up Intervention delivered post ED discharge	Inclusion: Aged ≥65 Exclusion: discharged to hospice or skilled care facility or correctional institution; failed cognitive test; no phone; no ER note; psychiatric reason for ER visit; left ER against medical advice prior enrollment or refusal	High risk: No Age: 74 (7.1) Female: 60% Race: White (77%), Black (19%) Living alone: NR Top 3: Traumatic injury, pain (any), cardiac symptoms	Mortality Hospitalization: After index visit ED readmit Timing: 30 days Primary: Composite of # days from ED discharge to return to ED, hospitalization, or death	Objective: Unclear Patient: High

[a] Outcomes limited to those prioritized for this review.
[b] Objective outcomes (*ie*, non–patient-reported outcomes): mortality, hospitalization, ED readmission. Patient-reported outcomes; health-related quality of life, functional status, patient experience.
[c] Exclusion criteria shown are limited to those relevant to this review.
[d] Index refers to the ED visit during which study enrolment occurred.
Abbreviations: ADL=activities of daily living; ED=emergency department; IADL=independent activities of daily living; ISAR=identification of seniors at risk; NA=not applicable; NR=not reported; SD=standard deviation; SF-36=short-form health assessment questionnaire

NONRANDOMIZED STUDIES

Study Country # Enrolled # of Arms	Key Intervention Components	Eligibility	Population High Risk? Mean Age (SD) Female % Race % Living Alone % Top 3 Conditions	Outcomes Reported[a] Outcome Timing Primary Outcome	Risk of Bias for Objective and Patient-Reported Outcomes[b]
Single-Strategy Interventions					
Discharge Planning					
Arendts, 2012[43] Australia 5265 2	Comprehensive assessment No referral or follow-up Intervention delivered within ED	Inclusion: Aged ≥65;10 conditions including UTI, respiratory infection, fall with minor injury, hip or knee pain, back pain, cardiac failure, angina pectoris, syncope, TIA, new onset confusion or delirium Exclusion[c]: Need for immediate resuscitation; triage to critical care bay in ED or other urgent medical input needed	High risk: Yes, diagnosis Age: 79.6 (8.0) Female: 55% Race: NR Living alone: 30% Top 3: Angina, cardiac failure, respiratory infection	Hospitalization: At index[d] visit Timing: At index visit Primary outcome: Proportion of hospital admissions from ED	Objective: High Patient: NA
Arendts, 2013[44] Australia 2196 2	Comprehensive assessment (only high-risk group) Referrals only, no follow-up Intervention delivered within ED	Inclusion: Aged ≥65 Exclusion: cognitively impaired without surrogate; ED arrival and discharge between 21:00 and 7:00	High risk: Yes, admitted Age: 77.5 (8.0) Female: 56% Race: NR Living alone: 31% Top 3: Fall (no injury or minor injury), ischemic chest pain, non-traumatic musculoskeletal pain	Mortality Hospitalization: After index visit ED readmission Timing: 28 days Primary outcome: ED visit within 28 days	Objective: High Patient: NA

Study Country # Enrolled # of Arms	Key Intervention Components	Eligibility	Population High Risk? Mean Age (SD) Female % Race % Living Alone % Top 3 Conditions	Outcomes Reported[a] Outcome Timing Primary Outcome	Risk of Bias for Objective and Patient-Reported Outcomes[b]
Case Management/Transition of Care					
Pedersen, 2016[48] Europe 1330 2	Assessment part of routine care Referral plus follow-up Intervention delivered after discharge from ED	Inclusion: Aged ≥70; pneumonia, COPD, delirium, dehydration, UTI, constipation, anemia, heart failure, other infections Exclusion: Terminal at admission; already in a follow-up program with the geriatric team; living out of the municipality; transferred to another hospital department	High risk: Yes, diagnosis Age 86.4 (6.2) Female: 62% Race: NR Living alone: 52% Top 3: Urinary tract infection, other infections, pneumonia	Mortality ED readmit Timing: 30 days Primary outcome: ED Readmission rate	Objective: Low Patient: NA
Medication Management					
Mortimer, 2011[47] Australia 199 2	No assessment of risk Referral only, no follow-up Intervention delivered within ED	Inclusion: Aged ≥65 with chronic condition; aged ≥70 without chronic condition; Australasian triage category 2 Exclusion: Australasian triage category 1 (requiring immediate attention)	High risk: No Age: 77.3 (NR) Female: 54% Race: NR Living alone: NR Top 3: "Medical" patient, "surgical" patient, third condition NR	Patient experience ED readmission Timing: Index, 14 & 28 days Primary outcome: NR but power calculation for ED length of stay and ED readmission	Objective: High Patient: High

Study Country # Enrolled # of Arms	Key Intervention Components	Eligibility	Population High Risk? Mean Age (SD) Female % Race % Living Alone % Top 3 Conditions	Outcomes Reported[a] Outcome Timing Primary Outcome	Risk of Bias for Objective and Patient-Reported Outcomes[b]
Multi-Strategy Interventions					
Discharge Planning PLUS Case Management/Transition of Care					
Bond, 2014[45] Canada 1820 2	Assessment by care coordinator Referral only, no follow-up Intervention delivered within ED	Inclusion: Aged ≥65; ICD-10 discharge diagnosis of fall, fracture, sprain, strain, laceration, contusion, superficial injury, or bursitis Exclusion: Discharge diagnosis of hip fracture or trimalleolar ankle fracture; patients who presented to ED for a musculoskeletal complaint within previous 30 days	High risk: Yes, diagnosis and falls Age: 80.5 (8.0) Female: 70% Race: NR Living alone: NR Top 3: NR	Hospitalization: At index visit Hospitalization: After index visit ED readmission Timing: 30 days Primary outcome: Hospital admission rate at index visit	Objective: High Patient: NA
Miller, 1996[46] USA 770 2	Assessment of risk Referral and follow-up Intervention delivered both within and after discharge from ED (“bridge”)	Inclusion: Aged ≥65 Exclusion: Acute illness too severe to permit participation; having <1 hour stay/departure without being seen; revisit by a previously included patient; lack of proxy for patients who did not appear to understand informed consent	High risk: No Age 75.0 (7.0) Female: 60% Race: White (67%), Black/Other (32%) Living alone: 35% (only for intervention group; control data not provided) Top 3: Delirium, depression and undernutrition	Functional status: ADL/IADL, quality of life Mortality Hospitalization: After index visit (# nights) ED readmission Costs Timing: 3 months Primary outcome: NR	Objective: High Patient: High

[a] Outcomes limited to those prioritized for this review.
[b] Objective outcomes (*ie*, non–patient-reported outcomes): mortality, hospitalization, ED readmission. Patient-reported outcomes: health-related quality of life, functional status, patient experience.
[c] Exclusion criteria shown are limited to those relevant to this review.
[d] Index refers to the emergency department visit during which study enrolment occurred.
Abbreviations: ADL=activities of daily living; COPD=chronic obstructive pulmonary disease; ED=emergency department; IADL=independent activities of daily living; ISAR=identification of seniors at risk; NA=not applicable; NR=not reported; SD=standard deviation; SF-36=short-form health assessment questionnaire; TIA=transient ischemic attack; UTI=urinary tract infection

APPENDIX G. INTERVENTION CHARACTERISTICS TABLES

For full study citations in this appendix, please refer to the report's main reference list.

RANDOMIZED STUDIES

Study	Intervention Setting/Timing Intervention Target	# of Providers Type of Provider(s) Geriatrics Trained?	Patient-focused Intervention Components[a]	Provider- or System-focused Intervention Components[a]	Mode of Delivery # Planned Contacts
Single-Strategy Interventions					
Case Management/Transition of Care					
Basic, 2005[34]	Pre-ED discharge Patient	Single provider RN Yes	· **Comprehensive assessment** · **Caregiver support** · *No medication review or rehabilitation intervention* · *No intervention*	· **Referral to specialists** · **Communication between providers** · *No follow-up*	In-person 1
Caplan, 2004[37]	Before and after ED discharge (Bridge)[b] Patient	Multiple providers MD, RN, PT Yes	· **Semi-structured assessment of function & cognition** · *No education/support* · *No medication review or rehabilitation intervention*	· **Follow-up communication** · **Referrals to specialists, community services** · **Interdisciplinary team meeting**	In-person 1
Gagnon, 1999[39]	Post-ED Patient	Single provider RN Yes	· **Comprehensive assessment** · *No education/support* · *No medication review or rehabilitation intervention*	· **Follow-up visit scheduled** · **Interdisciplinary team meeting** · *No referrals to specialist*	In-person NR
Runciman, 1996[42]	Post-ED Patient	Multiple providers PT NR	· **Comprehensive in-home assessment** · *No education/support* · *No medication review or rehabilitation intervention*	· **Referrals to community services** · *No follow-up* · *No continuity of care*	In-person NR

Study	Intervention Setting/Timing Intervention Target	# of Providers Type of Provider(s) Geriatrics Trained?	Patient-focused Intervention Components[a]	Provider- or System-focused Intervention Components[a]	Mode of Delivery # Planned Contacts
Multi-Strategy Interventions					
Discharge Planning PLUS Case Management/Transition of Care					
Eklund, 2013[38]	Before and after ED discharge (Bridge)[b] Patient	Multiple providers RN Yes	· **Frailty screening & geriatric assessment** · *No education/support* · *No medication review or rehabilitation intervention*	· **Follow-up visit scheduled** · **Interdisciplinary team meeting** · *No referrals*	In-person, telephone NR
McCusker, 2001[40]	Before and after ED discharge (Bridge)[b] Patient	Multiple providers MD, RN, SW Yes	· **Brief standardized geriatric nursing assessment** · *No education/support* · *No medication review or rehabilitation intervention*	· **Follow-up communication** · **Referral to primary care provider, specialists** · *No continuity of care*	In-person, telephone NR
Mion, 2003[41]	Before and after ED discharge (Bridge)[b] Patient, caregiver	Multiple providers RN, SW Yes	· **Comprehensive geriatric assessment** · **Caregiver support** · *No medication review or rehabilitation intervention*	· **Follow-up communication** · **Referrals to community services** · **Communication between providers**	In-person, telephone NR
Case Management/Transition of Care PLUS Medication Management					
Biese, 2014[35]	Post-ED Patient	Single provider RN NR	· **Medication review** · *No assessment/ screening* · *No education/support* · *No rehabilitation intervention*	· **Follow-up visits scheduled** · **Referrals to community services** · *No continuity of care*	Telephone NR
Biese, 2017[36]	Post-ED Patient	Single provider RN NR	· **Medication review** · *No assessment screening* · *No education/support* · *No rehabilitation intervention*	· **Referrals to community services** · *No follow-up* · *No continuity of care*	Telephone 1

[a] Bolded text indicates intervention components that were present in the study. Italicized text indicates intervention components were not present in the study.

[b] Bridge setting refers to interventions conducted both before ED discharge and after ED discharge.
Patient-focused intervention components include comprehensive assessment and/or risk screening, patient and/or caregiver education and/or support, intervention (medication, rehabilitation). See Appendix A for more detail.
Provider or systems-focused intervention components include planned follow-up communication or visit, referral to provider, specialist or community resource, continuity of care/care coordination, and changes to ED environment and/or procedures. See Appendix A for more detail.
Abbreviations: ED=emergency department; NR=not reported; MD=physician; RN=nurse; SW=social worker; PT=physical therapist; OT=occupational therapist.

NONRANDOMIZED STUDIES

Study	Setting Intervention Target	# of Providers Type of Provider(s) Geriatrics Trained?	Patient-focused Intervention Components[a]	Provider- or System-directed Intervention Components[a]	Mode # Planned Contacts
Single-Strategy Interventions					
Discharge Planning					
Arendts, 2012[43]	Pre-ED discharge Patient	Multiple providers SW, PT Yes	· **Comprehensive functional assessment** · *No education/support* · *No medication review or rehabilitation intervention*	· **Interdisciplinary team meeting** · *No follow-up* · *No referral*	In-person 1
Arendts, 2013[44]	Pre-ED Patient	Multiple providers MD, RN, SW, PT Yes	· **High-risk screening; comprehensive functional & needs assessment** · *No education/support* · *No medication review or rehabilitation intervention*	· **Referrals made (no details provided)** · *No follow-up* · *No continuity of care*	In-person 1
Case Management/Transition of Care					
Pedersen, 2016[48]	Post-ED Patient	Multiple providers MD, RN Yes	· **Assessment part of routine ED care** · *No education/support* · *No medication review or rehabilitation intervention*	· **Home visit scheduled** · **Patient-initiated follow-up communication** · **Referrals to primary care provider, community services**	In-person 1

Study	Setting Intervention Target	# of Providers Type of Provider(s) Geriatrics Trained?	Patient-focused Intervention Components[a]	Provider- or System-directed Intervention Components[a]	Mode # Planned Contacts
				· *No continuity of care*	
Medication Management					
Mortimer, 2011[47]	Pre-ED discharge Patient	Single providers NR Yes	· **Patient education** · **Medication review & reconciliation** · *No assessment/ screening* · *No rehabilitation intervention*	· **Referrals to other health services** · *No follow-up* · *No continuity of care*	In-person NR
Multi-Strategy Interventions					
Discharge Planning PLUS Case Management/Transition of Care					
Bond, 2014[45]	Pre-ED discharge Patient, caregiver	Single provider RN Yes	· **Assessment performed by ED care coordinator** · **Caregiver education & support** · *No medication review or rehabilitation intervention*	· **Referral to community services** · *No follow-up* · *No continuity of care*	In-person NR
Miller, 1996[46]	Before and after ED discharge (Bridge)[b] Patient	Multiple providers MD, RN Yes	· **Caregiver support** · *No assessment/ screening* · *No medication review or rehabilitation intervention*	· **Follow-up communication/visit** · **Referral to provider, community services** · **Interdisciplinary team meeting**	In-person 1

[a] Bolded text indicates intervention components that were present in the study. Italicized text indicates intervention components not present in the study.
[b] Bridge setting refers to interventions conducted both before ED discharge and after ED discharge.
Patient-focused intervention elements include comprehensive assessment and/or risk screening, patient and/or caregiver education and/or support, intervention (medication, rehabilitation). See Appendix A for more detail.
Provider or systems-focused intervention elements include planned follow-up communication or visit, referral to provider, specialist or community resource, continuity of care/care coordination, and changes to ED environment and/or procedures. See Appendix A for more detail.
Abbreviations: ED=emergency department; NR=not reported; MD=physician; RN=nurse; SW=social worker; PT=physical therapist; OT=occupational therapist.

APPENDIX H. EXCLUDED STUDIES

Exclusion reason Study	Not full publication	Not eligible country	Not population of interest	Not eligible setting	Not eligible intervention	Not eligible design	Not eligible outcome
Adedipe, 2006[1]				X			
Aldeen, 2014[2]						X	
Aldeen, 2014[3]	X						
Anonymous, 2010[4]	X						
Anonymous, 2011[5]	X						
Anonymous, 2012[6]	X						
Anonymous, 2012[7]	X						
Anonymous, 2013[8]	X						
Anonymous, 2014[9]	X						
Anonymous, 2015[10]	X						
Arendts,2013[11]					X		
Arendts, 2017[12]					X		
Argento, 2010[13]	X						
Ballham, 2017[14]	X						
Bell, 2014[15]	X						
Brymer, 2001[16]					X		
Chou, 2015[17]	X						
Chui, 2013[18]	X						
Clegg, 2013[19]				X			
Close, 1999[20]			X				
Conroy, 2014[21]			X				
Corbett, 2005[22]						X	
Davison, 2005[23]			X				
deClifford, 2016[24]			X				
Edgren, 2016[25]			X				
Ellis, 2012[26]						X	
Ellis, 2014[27]	X						
Fallon, 2015[28]						X	
Foo, 2014[29]		X					
Foo, 2012[30]		X					
Fox, 2016[31]						X	
Grudzen,2015[32]						X	
Gutteridge, 2014[33]					X		

Exclusion reason Study	Not full publication	Not eligible country	Not population of interest	Not eligible setting	Not eligible intervention	Not eligible design	Not eligible outcome
Guttman, 2004[34]						X	
Haag, 2016[35]				X			
Harper, 2013[36]						X	
Hegney,2006[37]					X		
Hughes, 2014[38]	X						
Hullick, 2016[39]				X			
Ismail, 2014[40]	X						
Jin, 2016[41]			X				
Jones, 2013[42]						X	
Keelan, 2016[43]	X						
Keyes, 2014[44]						X	
Knowles, 2016[45]			X				
Launay, 2013[46]						X	
Launay, 2013[47]	X						
Launay, 2016[48]				X			
Leah, 2010[49]						X	
Leung, 2016[50]		X					
Liao, 2012[51]						X	
Mahony, 2008[52]					X		
Marsden, 2017[53]							X
Moss, 2016[54]					X		
Ngian, 2008[55]						X	
Nguyen, 2014[56]						X	
Olufajo, 2016[57]				X			
O'Reilly, 2016[58]	X						
Pareja, 2008[59]	X						
Pareja-Sierra, 2013[60]						X	
Polinder, 2016[61]					X		
Rosenberg, 2016[62]						X	
Sahota, 2017[63]				X			
Salvi, 2008[64]						X	
Santolaya-Perrin, 2016[65]							X
Schubert, 2016[66]				X			
Scott, 2014[67]	X						
Shaw, 2016[68]						X	

Exclusion reason Study	Not full publication	Not eligible country	Not population of interest	Not eligible setting	Not eligible intervention	Not eligible design	Not eligible outcome
Silvester, 2014[69]					X		
Sophia, 2014[70]	X						
Stergiopoulos, 2016[71]	X						
Tan, 2012[72]						X	
Tang, 2016[73]	X						
Terrell, 2009[74]			X				
Waldron, 2011[75]					X		
Warburton, 2005[76]						X	
Weir, 1999[77]							X
Weng, 2017[78]		X					
Wentworth, 2015[79]	X						
Wilber, 2013[80]	X						
Wright, 2014[81]						X	
Yim, 2011[82]							X
Yuen, 2013[83]		X					

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APPENDIX I. GLOSSARY

Term	Definition
Assessment	A structured and/or targeted assessment performed as a part of the intervention. A structured assessment may include a comprehensive geriatric assessment or biopsychosocial assessment covering common domains including cognitive performance, functional status, social status and living environment, health behaviors, and psychosocial factors. Brief or targeted assessments may include 1 or more specific domains, such as cognitive performance or functional status.
Bridge	An intervention that takes place across settings, including 1 or more planned contacts before discharge from the ED and again after discharge.
Case management	Case management takes place over time and across settings, initially beginning within the ED and continuing after discharge, and includes the activities that a physician or other health care professional performs to ensure coordination of medical services needed by the patient. The ultimate goal of case management is to help support successful transition from the ED to post-ED settings. Unlike discharge planning in which the patient or caregiver may be responsible for identifying and securing services, in case management, the major responsibility and coordination rests with 1 or more providers.
Discharge planning	Discharge planning is time-limited, taking place fully within the ED, and encompassing the process of thinking about and formalizing a plan of care prior to a patient's discharge from the ED. Discharge planning may incorporate 1 or more of the following: geriatric consultation or geriatric assessment in the ED, patient/caregiver education, or a follow-up plan. Although the initial assessment and discharge planning take place within the ED, the responsibility for coordinating and obtaining follow-up care rests with the patient or caregiver.
Geriatric EDs	EDs designed or guided by the 2014 Geriatric ED Guidelines.[16-18]
Medication safety or management	Interventions that assist patients or caregivers in managing and monitoring drug therapy for older adults with chronic conditions.
Objective outcomes (*ie*, non–patient-reported outcomes)	Objective outcomes are measures that are not subject to a large degree of individual interpretation and are likely to be reliably measured across patients in a study, by different health care providers, and over time.[51]
Patient-reported outcomes	Patient-reported outcomes are directly reported by the patient without interpretation of the patient's response by a clinician or anyone else and pertains to the patient's health, quality of life, or functional status associated with health care or treatment.[52]
Referral plus follow-up	Referral to 1 or more of the following: primary care provider, specialty provider, or community resource or services plus planned communication or visit(s) with intent of following up on referral.
Risk of bias (ROB)	We used the key ROB criteria described in the Cochrane Effective Practice and Organization of Care (EPOC) guidance[29]: · Randomization and allocation concealment · Comparability of groups at baseline · Blinded outcomes assessment · Completeness of follow-up and differential loss to follow-up · Whether incomplete data were addressed appropriately · Protection against contamination · Selective outcomes reporting.

<table>
<tr><th>Term</th><th>Definition</th></tr>
<tr><td></td><td>Summary ROB ratings for a study:
· Low ROB—Bias, if present, is unlikely to alter the results seriously
· Unclear ROB—Bias that raises some doubts about the results
· High ROB—Bias that may alter the results seriously</td></tr>
<tr><td>Scoping review</td><td>Scoping reviews are used to identify knowledge gaps, set research agendas, and identify implications for decision-making. Scoping studies differ from systematic reviews because authors do not typically assess the quality of included studies.</td></tr>
<tr><td>Strength of evidence (SOE)</td><td>We assessed SOE using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach for 4 domains[32]:
<table>
<tr><th>Domain</th><th>Rating</th><th>How Assessed</th></tr>
<tr><td>Risk of bias</td><td>Low
Unclear
High</td><td>Assessed primarily through study design and aggregate study quality</td></tr>
<tr><td>Consistency</td><td>Consistent
Inconsistent
Unknown/NA</td><td>Assessed primarily through whether effect sizes are generally on the same side of “no effect,” the overall range of effect sizes, and statistical measures of heterogeneity</td></tr>
<tr><td>Directness</td><td>Direct
Indirect</td><td>Assessed by whether the evidence involves direct comparisons or indirect comparisons through use of surrogate outcomes or use of separate bodies of evidence</td></tr>
<tr><td>Precision</td><td>Precise
Imprecise</td><td>Based primarily on the size of the confidence intervals of effect estimates, the optimal information size and considerations of whether the confidence interval crossed the clinical decision threshold for using a therapy</td></tr>
</table>
Summary SOE ratings for a body of evidence:
· High—High confidence that the true effect lies close to that of the estimate of the effect.
· Moderate—Moderate confidence in the effect estimate. The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
· Low—Limited confidence in the effect estimate. The true effect may be substantially different from the estimate of the effect.
· Very low—Very little confidence in the effect estimate. The true effect is likely to be substantially different from the estimate of effect.
· Insufficient—Impossible or imprudent to rate. In these situations, a rating of insufficient is assigned.</td></tr>
</table>