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What evidence is there for the identification and management of frail older people in the emergency department? A systematic mapping review

Louise Preston, Duncan Chambers, Fiona Campbell, Anna Cantrell, Janette Turner and Elizabeth Goyder



***National Institute for
Health Research***

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Abstract

What evidence is there for the identification and management of frail older people in the emergency department? A systematic mapping review

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Background: Emergency departments (EDs) are facing unprecedented levels of demand. One of the causes of this increased demand is the ageing population. Older people represent a particular challenge to the ED as those older people who are frail will require management that considers their frailty alongside their presenting complaint. How to identify these older people as frail and how best to manage them in the ED is a major challenge for the health service to address.

Objectives: To systematically map interventions to identify frail and high-risk older people in the ED and interventions to manage older people in the ED and to map the outcomes of these interventions and examine whether or not there is any evidence of the impact of these interventions on patient and health service outcomes.

Design: A systematic mapping review.

Setting: Evidence from developed countries on interventions delivered in the ED.

Participants: Frail and high-risk older people and general populations of older people (aged > 65 years).

Interventions: Interventions to identify older people who are frail or who are at high risk of adverse outcomes and to manage (frail) older people within the ED.

Main outcome measures: Patient outcomes (direct and indirect) and health service outcomes.

Data sources: Evidence from 103 peer-reviewed articles and conference abstracts and 17 systematic reviews published from 2005 to 2016.

Review methods: A review protocol was drawn up and a systematic database search was undertaken for the years 2005–2016 (using MEDLINE, EMBASE, The Cochrane Library, Web of Science, Cumulative Index to Nursing and Allied Health Literature, Health Management Information Consortium and PROSPERO). Studies were included according to predefined criteria. Following data extraction, evidence was classified into interventions relating to the identification of frail/high-risk older people in the ED and interventions relating to their management. A narrative synthesis of interventions/outcomes relating to these categories was undertaken. A quality assessment of individual studies was not undertaken; instead, an assessment of the overall evidence base in this area was made.

Results: Of the 90 included studies, 32 focused on a frail/high-risk population and 60 focused on an older population. These studies reported on interventions to identify ($n = 57$) and manage ($n = 53$) older people. The interventions to identify frail and at-risk older people, on admission and at discharge, utilised a number of different tools. There was extensive evidence on these question-based tools, but the evidence was

inconclusive and contradictory. Service delivery innovations comprised changes to staffing, infrastructure and care delivery. There was a general trend towards improved outcomes in admissions avoidance, reduced ED reattendance and improved discharge outcomes.

Limitations: This review was a systematic mapping review. Some of the methods adopted differed from those used in a standard systematic review. Mapping the evidence base has led to the inclusion of a wide variety of evidence (in terms of study type and reporting quality). No recommendations on the effectiveness of specific interventions have been made as this was outside the scope of the review.

Conclusions: A substantial body of evidence on interventions for frail and high-risk older people was identified and mapped.

Future work: Future work in this area needs to determine why interventions work and whether or not they are feasible for the NHS and acceptable to patients.

Study registration: This study is registered as PROSPERO CRD42016043260.

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List of abbreviations

ACE	acute care of the elderly	HARP	hospital admission risk profile
ADL	activities of daily living	HOTEL	Hypotension, Oxygen saturation, low Temperature, ECG changes and Loss of independence
AMAU	acute medical assessment unit	HSDR	Health Services and Delivery Research
ASET	aged care service emergency team	ICU	intensive care unit
ATOP	assessment team for older people	ISAR	Identification of Seniors at Risk
AUC	area under the curve	MDT	multidisciplinary team
BGA	brief geriatric assessment	MGT	mobile geriatric team
BRIGHT	Brief Risk Identification for Geriatric Health Tool	MMSE	Mini Mental State Examination
CAM	confusion assessment method	OPAL	older people assessment and liaison
CCT	care co-ordination team	OR	odds ratio
CFS	Clinical Frailty Scale	PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
CGA	comprehensive geriatric assessment	RAC	rapid access centre
CI	confidence interval	RCT	randomised controlled trial
COMPRI	complexity prediction instrument	REMS	Rapid Emergency Medicine Score
CTAS	Canadian Triage and Acuity Scale	ROC	receiver operating characteristic
DAI	Deficit Accumulation Index	SCHARR	School of Health and Related Research
ED	emergency department	SHARE-FI	Survey of Health, Aging and Retirement in Europe Frailty Instrument
EDCC	emergency department care co-ordinator	SHERPA	Evaluation du Risque de Perte d'Autonomie
EDOU	emergency department observation unit	SIS	six-item screener
EFU	emergency frailty unit	TREAT	triage and rapid elderly assessment team
EGS	emergency geriatric screen	TRST	triage risk screening tool
ESI	emergency screening instrument	TUGT	timed up and go test
FITT	frail intervention therapy team	VIP	variables indicative of placement
FSAS-ED	Functional Status Assessment of Seniors in Emergency Departments		
GED	geriatric emergency department		
GEDI-WISE	Geriatric Emergency Department Innovations through Workforce, Informatics and Structural Enhancements		
GNI	geriatric nurse liaison intervention		
GRAY	Geriatric Readmission Assessment at Yale		

Plain English summary

In the UK, emergency departments (EDs) are facing high levels of demand, which are in part related to the number of frail older people presenting to EDs. Frail older people require care in the ED that considers their frailty alongside their health problems. Even though it is important, it can be challenging to identify older people as being frail. Once they have been identified as frail, it is important to deliver the most appropriate care to them.

To better understand how to identify and/or manage frail and older people, we undertook a review of published evidence on the types of initiatives that have been tested in the ED.

We identified a large body of evidence in three areas:

1. how to identify frail patients and patients at risk
2. how to change ED services to meet the needs of frail and older patients
3. initiatives combining identification and changes to ED services.

However, this evidence included different patient and health service outcomes, so it was difficult to compare initiatives.

The majority of the initiatives that we identified did not focus on frail older people, but involved older people more generally. Patients were identified as being frail or at high risk at admission and at discharge. This identification tended to take the form of tools that included questions for patients. The evidence regarding their usefulness was not conclusive. The initiatives that focused on ED services changed ED staffing, infrastructure and how care was delivered. There was a general trend towards improved outcomes in terms of admissions avoidance, reduced ED reattendance and improved discharge outcomes.

Further research would be useful on interventions undertaken elsewhere in the health system to prevent frail older people from attending the ED and on seeking a better understanding of whether or not the initiatives reported are acceptable to patients.

Scientific summary

Background

Emergency departments (EDs) are facing unprecedented levels of demand. There are numerous causes of the increase in demand, including the increase in the proportion of older people in the population of the UK. The population of the UK is ageing and older people represent a particular challenge to the ED, as those older people who are frail or at high risk of negative outcomes will require management that considers their frailty alongside their presenting complaint. How to identify these older people as frail and how to best manage them in the ED is a major challenge for the health service to address. Being able to better identify and manage these patients is likely to have benefits for both individual and health service outcomes. Therefore, it is timely and relevant to undertake a review of the published evidence to examine the interventions that exist to identify frail and high-risk older people when they present at the ED, to see if there are standard ways to identify older people as frail, and also to examine interventions to manage frail older people and the outcomes that they may influence.

Objective

The objective of the review was to answer the following research questions:

- What is the evidence for the range of different approaches to the management (identification and service delivery interventions) of frail older people within the ED?
- Is there any evidence of their potential and actual impact on health service and patient-related outcomes, including impacts on other services used by this population and health and social care costs?

Methods

Protocol development

The review was guided by a protocol developed by the team at the School of Health and Related Research at the University of Sheffield, led by the lead review author. The protocol was shared with our internal team and our clinical experts as well as with the National Institute for Health Research Health Services and Delivery Research (HSDR) team. The final protocol was produced in June 2016 and registered with the international database of prospectively registered systematic reviews (PROSPERO).

Literature search

The search for evidence was conducted in three stages.

Stage 1

An initial search (in May 2016) was undertaken of the database of references retrieved for a previous review undertaken by the research team on emergency and urgent care, which was supplemented by a scoping search of MEDLINE (2005–16).

Stage 2

The second stage of the search (in July 2016) covered a wider range of health and medical databases using an improved version of the MEDLINE scoping search. Databases searched were EMBASE, The Cochrane Library, Web of Science, Cumulative Index to Nursing and Allied Health Literature, Health Management Information Consortium and PROSPERO.

Stage 3

The third stage of the search (in autumn 2016) involved scrutiny of reference lists of included papers and relevant reviews, plus citation searching of studies that included a frail or high-risk population.

Study selection

References identified by the literature search were uploaded into EndNote reference management software (version 8; Clarivate Analytics, Philadelphia, PA, USA) for study selection. Screening of titles/abstracts and full texts against the review inclusion criteria was undertaken by three reviewers (LP, AC and DC). Two reviewers screened 50% of the records each and then, to check the screening consistency of the reviewers, a third reviewer screened approximately 50% of the references from each reviewer and a kappa coefficient was calculated. Uncertainties were discussed until a consensus was reached, with reference to a fourth reviewer (JT) when necessary. Review articles that met the inclusion criteria and background articles were also identified in the screening process.

The review inclusion criteria were:

- population
 - aged \geq 65 years or described as frail or high-risk older people
- intervention
 - to either identify or manage (or both) frail or high-risk older people in the ED
- outcome
 - patient or health service outcomes as the result of a specific intervention
 - patient opinions and experiences of specific interventions
- setting
 - delivered within the ED or in units embedded in the ED
- study type
 - peer-reviewed evidence, published from 2005 to 2016
 - evidence from qualitative and quantitative studies relating to specific interventions
 - English-language evidence from Organisation for Economic Co-operation and Development countries to ensure comparability.

Study classification

Following the screening process, a list of included studies was drawn up. Full-text papers were obtained for all of the included studies. An examination of titles, abstracts and full texts was undertaken. As this review was a systematic mapping review, it was important to classify the evidence in order to develop a better understanding of the evidence base. It became clear that there was not a clear definition of the population of frail older people, so the review would need to include evidence on a wider population of older people (generally aged $>$ 65 years). In addition, this classification allowed the review team to divide articles into two categories: (1) those looking at the identification of frail older people or older people at high risk and (2) those looking at service delivery interventions to better manage older people and frail older people in the ED.

Data extraction

Single data extraction was undertaken by one of four reviewers (AC, LP, DC and FC) in order to meet the review deadline. A standardised approach was used and a data extraction form was developed for all of the three types of data extraction undertaken. These were:

1. full data extraction for all studies on population groups defined as frail older people or older people at 'high risk' by the study authors
2. brief data extraction for all studies on a population of older people, normally aged > 65 years, without any specific risk criteria
3. brief data extraction for all relevant (systematic or other) reviews that met our inclusion criteria.

All of these data extraction tables were tested and refined by the review team. When it was clear that a conference abstract was related to a study that was published later, these were extracted together in a combined data extraction.

Assessment of the evidence base

As the review was a mapping review, formal quality assessment of individual studies, according to a checklist, was not undertaken. Instead, we carried out a bespoke assessment of the evidence base mapped in our review using three methods:

1. an examination of the research designs used and the strengths and limitations of those designs
2. an examination of the self-reported limitations included in the articles relating to frail or high-risk older people
3. an assessment of the relevance of the evidence to the contemporary UK NHS setting.

Synthesis

Data were extracted and tabulated and summary tables were created. These were used to inform the narrative synthesis. Because of the heterogeneity of study interventions and outcomes, it was not possible to undertake any formal meta-synthesis. Data were synthesised by intervention type – interventions to identify older people at risk of frailty and adverse outcomes and service delivery-type interventions.

Results

The evidence base

- In total, 103 peer-reviewed articles/conference abstracts reporting primary research and 17 systematic reviews were included in the mapping review.
- Ninety data extractions were undertaken on the 103 articles/conference abstracts.
- Fifty-seven studies included a population of older people and 32 included a population that was described as frail and/or at high risk.
- The population of frail older people is not reported consistently in the literature. Some articles/conference abstracts defined their study population as frail or high-risk older people, others used an age criteria threshold (> 65 years, > 75 years, etc.) to define older people and a number defined their population as older/geriatric.
- Fifty-three of the studies were focused on service delivery interventions and 37 on identifying frail or high-risk older people.
- The majority of the 90 studies were undertaken in the USA ($n = 27$), the UK ($n = 14$) and Australia ($n = 10$), with the UK studies appearing to have more of a specific focus on frail or high-risk older people.
- A wide range of study types was reported.

Table a maps the evidence base identified in this review.

TABLE a Overview of the evidence base (by studies)

Population	Frail or high-risk older people (<i>n</i> = 33)	
	Older people (<i>n</i> = 57)	
Interventions	To identify frail or high-risk older people (<i>n</i> = 37)	Diagnostic tools to screen for frailty-related issues (<i>n</i> = 7)
		Prognostic tools to measure risk of adverse events in the ED (<i>n</i> = 5)
	To manage frail and older people in the ED (<i>n</i> = 53)	Diagnostic tools to identify frailty (<i>n</i> = 7)
		Prognostic tools to measure risk of adverse events on discharge (<i>n</i> = 18)
Outcomes	Patient outcomes	Changes to ED staffing (<i>n</i> = 21)
		Changes to the physical infrastructure (<i>n</i> = 11)
	Health service outcomes	Changes to how care is delivered (<i>n</i> = 18)
	Patient outcomes	ADL decline; appropriate/correct admission/discharge/referral; appropriate/correct diagnosis; appropriate/correct medication; frailty; long-term care placement; morbidity; mortality; return to home (for how long?); and satisfaction with the ED
	Health service outcomes	Admission to acute care; admissions avoided; attendance or reattendance at the ED; bed occupancy rates; costs/resource utilisation; discharge rates; ED returns/readmissions; ED waiting times; and length of stay

ADL, activities of daily living.

Identification of frail/high-risk older people

Thirty-seven studies (40 publications) dealt with strategies aimed at identifying patients with frailty or distinguishing higher- from lower-risk patients in the ED. The great majority of these studies assessed the diagnostic or prognostic accuracy of tools using a prospective or retrospective cohort design. These are presented in *Table b*. Only one UK study was identified.

Seven studies of diagnostic tools to identify frailty and seven studies of tools to screen for specific frailty-related issues were identified. Overall, the evidence base was limited. None of the tools has been evaluated extensively and differences in terminology make it unclear whether or not different studies are examining the same phenomenon. In addition, individual studies have different methodological features and settings.

Other studies evaluated tools for their ability to predict the risk of adverse events either in the ED or following discharge (prognostic accuracy). The five studies considering adverse events in the ED all used different tools. These tools assessed the short-term outcomes of older patients attending the ED.

TABLE b Evidence on tools to identify frailty

Type of tool	Publications (<i>n</i>)
Diagnostic tools to identify frailty	9
Diagnostic tools to screen for frailty-related issues	7
Prognostic tools to measure risk of adverse events in the ED	5
Prognostic tools to measure risk of adverse events on discharge	19

Eighteen studies (19 publications) evaluated tools to predict the risk of adverse events following discharge, with follow-up periods ranging from 28 days to 12 months. The well-established Identification of Seniors at Risk (ISAR) tool and triage risk screening tool (TRST) were most frequently evaluated, but a number of newer tools were evaluated in single studies. None of these studies was performed in the UK.

Overall, the evidence on tools to support the identification and management of patients with frailty in the ED is extensive but inconclusive. ISAR and TRST are the most extensively evaluated tools but many other tools are available, including non-question-based tests and tools using administrative data. Limitations of the included studies include the small sample sizes, that most were conducted at a single centre and that many were published as conference abstracts with limited details provided. Contradictory results obtained in different prognostic studies using the same tool reflect the fact that outcomes, such as repeat ED visits and hospital admission, will be influenced by the health and care system as well as by patient factors. Hence, the results of studies performed in one country cannot be readily generalised to other countries. The lack of UK studies in this body of evidence limits the relevance of the evidence to UK NHS settings.

Managing (frail) older people in the emergency department

Studies of service delivery interventions were divided into four categories, presented in *Table c*.

The service delivery intervention studies reported a wide variety of (mostly patient-related) outcomes. Determining which interventions were targeted at the frail older people and which were targeted at a general older population was challenging. The evidence shows a general pattern of increased discharge rates, reduced ED admission and reduced length of stay for those admitted when receiving a service delivery intervention.

Review-level evidence

The review-level evidence that we identified confirmed the findings of our review. Interventions and screening tools were heterogeneous and outcomes measured in individual studies were highly variable. Key messages emerging were that some screening tools demonstrated diagnostic validity, that ED utilisation could be reduced by specific interventions and that improving the intensity and consistency of interventions is essential when assessing effectiveness.

Limitations

This review was a mapping review and did not aim to measure the effectiveness of interventions. In addition, formal quality assessment of individual studies was not undertaken; instead, the overall evidence base was assessed using a bespoke method.

TABLE c Service delivery interventions for frail and older people

Category	Details and example	Publications (n)
Changes to ED staffing	Adding specific staff to the MDT with responsibility for older patients (e.g. geriatric liaison nurse) or restructuring or developing teams to improve care delivery (e.g. CCT)	26
Changes to the physical infrastructure	Making the ED more 'frail friendly', establishing specific units in the ED for older patients or creating GEDs	12
CGA	Multifaceted screening/assessment and planning of older people's care	22
Individual studies	Not replicated elsewhere	3

CCT, care co-ordination team; CGA, comprehensive geriatric assessment; GED, geriatric emergency department; MDT, multidisciplinary team.

Conclusions

There is an extensive but inconclusive evidence base for tools to identify frail and at-risk older people. These tools have not been tested in the UK and are variable in their outcomes. Service delivery interventions demonstrate a general trend towards reduced admissions, reduced ED reattendance and improved discharge rates. However, the evidence base was mixed in terms of interventions and the outcomes that they measured and assessing which outcomes are important to patients and which are important to the health service.

Future research should attempt to assess the relative effectiveness of interventions as well as their acceptability to patients. It would also be interesting to measure outcomes in the short and medium term, to better understand issues around avoiding admissions. As the population becomes older, it would be of use to compare the acceptability and outcomes of services dedicated to older people with the acceptability and outcomes of tailoring all services to better meet the needs of an ageing and potentially frail population.

Study registration

This study is registered as PROSPERO CRD42016043260.

Funding

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Chapter 1 Introduction

The emergency department (ED) setting has long been acknowledged as a complex setting in which to deliver care to older people. The difficulties of delivering care have to be viewed alongside the more general challenges that are facing NHS EDs. In 2013, NHS England set out a strategy for an urgent care system that was:

more responsive to patients' needs, improves outcomes and delivers clinically excellent and safe care.

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This strategy also needs to be viewed alongside the UK government target of 95% of all ED patients being discharged, transferred or admitted within 4 hours of presenting at an ED.

The delivery of safe and appropriate care to older patients in the ED has a number of challenges. Older patients are not a homogeneous group. They encompass a wide age range and are a diverse group in terms of their general health and presenting complaints. The *National Service Framework: Older People*² describes older people as being in one of three groups: entering old age (still living an active and independent life), transitional (between healthy active life and frailty) and frail older people (vulnerable as a result of health problems or social care needs).

This review is focused on the delivery of care to this last group (frail older people). Set within the context of increasing demand and pressure on the delivery of care in the ED, frail older people are a group who present a specific challenge to the ED. First, older people are more likely to present to the ED and, second, once they are in the ED, they present a specific set of challenges to the delivery of safe and effective care.

In terms of the volume of demand that older people place on the ED, this is in part a result of the ageing population. There has been an increase in the absolute and relative numbers of older people in the general population as people are living to an older age. The University of Sheffield undertook a rapid review on urgent care for the National Institute for Health Research, which found that frail older people use emergency care more frequently (especially those who are aged > 80 years and those who are acutely unwell or in the last year of life).³ Gruneir *et al.*⁴ report on the disproportionate use of the ED by older age groups compared with younger age groups. However, this disproportionate use is not inappropriate: both medical and non-medical reasons underpin the reliance of this group on the care provided in EDs. A recent literature review commissioned by the NHS Confederation,⁵ which examined the evidence on how to improve urgent care for older people, found that demand on the ED from older people is not simply related to their need for urgent and emergency care; it is also related to the care that they receive (or do not receive) elsewhere in the health-care system. Examples of the types of interventions that might reduce demand on EDs include preventing ED admission through ambulatory triage, referring older people directly to a ward, a medical assessment unit or elderly care unit, delivering appropriate care within a home/community setting (a nursing home or their own home) and preventing readmissions when older people are discharged from acute medical care through interventions delivered in the home.

Once older people present to the ED, they present a specific set of challenges in terms of their management and care. Older people are more likely to have long-term conditions and multiple morbidities and they are often taking multiple medications. They may have disabilities that make the fast-moving nature of the ED highly unsuitable. They are also more likely to have dementia, or present with delirium, and this is often alongside the presenting complaint that has required them to seek emergency care. Older patients can also often present non-specifically⁵ and are therefore difficult to diagnose and treat accordingly. Underlying all of this is that a number of older patients are frail and the ED faces difficulties in identifying those who are frail and delivering appropriate care to them. Once frail older people are in the ED, it becomes critical to manage their presenting complaint in the context of their frailty. A recent *Lancet* editorial⁶ outlined the four

issues facing EDs in their management of frail older people: (1) timely recognition of frail patients is difficult; (2) there is no standard definition for frailty; (3) frail older people need to be treated in the context of their frailty as opposed to treating them only according to their presenting complaint; and (4) there are a lack of clinical guidelines for treating frail older people in the ED.

Identifying frail older people is highly challenging and this challenge is acknowledged widely in the academic literature: '... there is no single operational definition of frailty that can satisfy all experts'.⁷ There is no set age threshold for when an older person becomes frail; however, Dent *et al.*⁸ suggest that frailty is present in around one-quarter of people aged > 85 years. Carpenter *et al.*⁹ discuss how chronological age is often seen as synonymous with biological age and the majority of research studies consider people aged ≥ 65 years as a homogeneous population. In an evidence review examining discharge interventions, Lowthian *et al.*¹⁰ found three groups of older people in the literature: (1) patients stratified by age (which varied from ≥ 65 years to ≥ 75 years); (2) vulnerable people within these age categories; and (3) older people who had been screened and were considered to be at high risk.

Some clinicians and academics believe that frailty can be defined using a set of clinical indicators (e.g. patients with multimorbidity or an increased risk of falls). Others believe that frailty is more closely linked to changes in the physiology of older people (accumulated deficits). However, what is widely acknowledged in the literature is the need to manage these patients with their frailty considered alongside their presenting complaint.^{8,11} There are numerous reasons for this, such as the need to avoid polypharmacy,¹² the need for follow-up care for patients and the high rate of readmission of frail patients.¹³ It is known that frail patients have worse outcomes than the general population of older people if they attend the ED. Maile *et al.*¹⁴ cite 46% mortality for frail older people within a year of them attending the ED.

Therefore, the scope of this review is how best to manage frail older people within the ED. This will allow us to map interventions to identify frail older people and those at high risk of adverse outcomes, study the management of frail older people in the ED and examine the potential for improvements in both patient and health service outcomes.

The research questions for the review were as follows:

- What is the evidence for the range of different approaches to the management (identification and service delivery interventions) of frail older people within the ED?
- Is there any evidence of their potential and actual impact on health service and patient-related outcomes, including impacts on other services used by this population and health and social care costs?

Additional research questions included:

- What specific approaches to the management of frail older people exist within the ED?
- What evidence is there that these approaches to management within the ED could influence attendance and/or reattendance rates in frail older people, hospital admission and/or readmission rates in frail older people, patient-centred outcomes in frail older people and costs to the health service?
- What evidence is there that these approaches to management within the ED could influence other health service outcomes (as reported in the literature and as mentioned as important by the clinical academics/topic experts) and is there evidence of any unintended outcomes (such as the displacement of care) as a result of how frail older people are managed in the ED?

Chapter 2 Review methods

This chapter describes the methods utilised in our evidence synthesis. These are:

- protocol development
- literature search
- choice of review methodology
- study selection
- study classification
- data extraction
- synthesising evidence
- assessment of the evidence base
- use of internal and external experts.

Protocol development

The protocol was developed following the suggestion of the review topic by the Health Services and Delivery Research (HSDR) review commissioners. The protocol was developed by the team at the School of Health and Related Research (SchARR), led by the review author. The protocol was shared with our internal team and our topic experts, as well as with the HSDR team. Suggested changes were made and the final protocol was produced in June 2016. Following this, the review was registered with PROSPERO (reference number CRD42016043260).

Literature search

The review started with the search for evidence and three search iterations were undertaken to efficiently identify relevant evidence for the review. The review team was already aware that the topic had a substantial evidence base in terms of the quantity of evidence, with a number of evidence reviews already published. Therefore, the search strategy had to be designed in light of these considerations and in light of the fact that the aim of the review was to systematically map the current evidence base.

Stage 1: search of evidence retrieved for earlier review and scoping search

An initial search (in May 2016) was undertaken using the evidence base retrieved for the Turner *et al.*³ review. These references were filed in an EndNote library (version 8; Clarivate Analytics, Philadelphia, PA, USA) and this was searched using terms for older people and frail older people. The purpose of this search was to provide an initial idea of the size and scope of the available literature and to refine search terms for the database search. The following keywords were searched for in the title of the references: 'ageing', 'aged', 'elderly', 'frail', 'old' and 'geriatric'.

Additionally, a search was conducted in May 2016 in MEDLINE (via OvidSP) for reviews and other relevant literature; it was developed using pre-existing search strategies, used for reviews in the same topic area, devised by information specialists at the University of Sheffield. The search was structured using terms for population (frail older people) and setting (ED). The search was not limited by intervention type as an a priori decision about which interventions were to be included could have limited our understanding of the scope of the topic. The search was limited to evidence published from 2005 to 2016 to ensure currency of the included research and limited to English-language-only papers as time constraints meant that it would not have been feasible to translate non-English-language papers. The search was not limited to any specific geographical region as published search filters to identify evidence from specific countries are not always successful. The MEDLINE search strategy is provided in *Appendix 1*.

Stage 2: search of health and medical databases

The second search, undertaken in July 2016, involved a wider range of health and medical databases. The following databases were searched, with the MEDLINE search adapted appropriately for the different databases:

- EMBASE via OvidSP
- The Cochrane Library via Wiley Online Library
- Web of Science via Web of Knowledge via ISI
- Cumulative Index to Nursing and Allied Health Literature via EBSCOhost
- Health Management Information Consortium via OpenAthens
- PROSPERO.

Stage 3: complementary searching

We also undertook a number of complementary searches (in autumn 2016) to ensure that we had retrieved all relevant evidence for the review. These included scrutiny of reference lists of included papers and relevant reviews. Any relevant papers that were within our date range were obtained and, if they met the inclusion criteria, were included in the review. The reviews used for this exercise are detailed in *Appendix 2*. In addition, we undertook citation searching of included primary studies that focused on a frail or at-risk population.

Choice of review methodology

Based on our knowledge of the volume of evidence on interventions for older people in the ED and the need to generate a useful review product for the HSDR programme and the ED/frailty community, a systematic mapping review was selected as the most appropriate evidence product.¹⁵ The appropriateness of the mapping review methodology was based on the diverse and diffuse evidence base and the need to 'collate, describe and catalogue available evidence relating to a topic or question of interest'.¹⁵ The aim of a mapping review is to 'map out and categorize existing literature from which to commission further reviews and/or primary research by identifying gaps in research literature'.¹⁶

Study selection

Studies were included in the review according to the inclusion and exclusion criteria in *Table 1*.

Screening criteria

We limited the evidence included in our review to that published from 2005 to 2016. The reason for this was related to the volume of evidence in the area and the need to retrieve a manageable evidence base. In addition, earlier evidence would have been identified and included in the many evidence reviews published in this area. Restricting the date ensured that the evidence included was relevant to the current clinical environment.

Notably, the review does not include 'frail older people' as an inclusion criteria. Throughout the process of the review, from the development of the protocol onwards, it became clear that identifying papers that had a population of frail older people according to predefined criteria would be challenging. Had we included only evidence from papers in which the authors had defined their population as frail, or their intervention as targeted at frail older people, then we would have limited the review, as scrutiny of titles and abstracts often did not reveal the population included. Therefore, we took the approach at the screening stage to include all studies in which the population was aged ≥ 65 years and then, at a later stage, further divided these studies into those including frail older people and those including a general population of older people.

TABLE 1 Inclusion and exclusion criteria

Category	Inclusion criteria	Exclusion criteria
Population	<ul style="list-style-type: none"> • Aged ≥ 65 years (older people) • Frail older people • High-risk older people 	Aged < 65 years
Intervention	<ul style="list-style-type: none"> • Interventions to identify older people who are frail or at high risk of adverse outcomes because of their frailty • Interventions to manage (frail) older people in the ED 	Interventions that are delivered wholly outside the ED
Outcome	The study had to report either patient or health service outcomes. Qualitative studies that report service user views or experiences of specific interventions would be included	Studies that do not report an outcome of an intervention; for example, a study that reported only the mean age of people being treated in an EFU would not be included. Qualitative evidence providing general experiences of ED care of (frail) older people would not be included, unless relating to a specific intervention
Setting	Delivered within the ED or units embedded in the ED	Delivered in community/home settings or ambulatory care When patients are admitted (e.g. medical assessment units and frailty units)
Study type	<ul style="list-style-type: none"> • Quantitative studies • Qualitative evidence • Publication date 2005–16 • Published, peer-reviewed evidence 	<ul style="list-style-type: none"> • Evidence from surveys of views/experiences (e.g. of ED care more generally) • Editorials • Opinions • Non-English-language papers • Non-OECD countries • Evidence published before 2005

EFU, emergency frailty unit; OECD, Organisation for Economic Co-operation and Development.

Screening process

Screening was undertaken by three reviewers (LP, AC and DC). All titles and abstracts retrieved by the searches were entered into EndNote and EndNote was used for screening. All titles and abstracts were screened by one reviewer (either LP or AC), with DC screening 50% of the titles and abstracts screened by LP and 50% of the titles and abstracts screened by AC (i.e. 50% of all titles and abstracts). The decisions made about whether articles should be 'included', 'excluded' or 'queried' were noted in EndNote. Any queries were discussed with a fourth reviewer (JT) until consensus was reached. The inclusion and exclusion criteria were used to guide this discussion. Queries tended to be around the setting of an intervention and whether or not it was delivered in an ED setting. Articles that met the inclusion criteria that were (systematic) reviews were also marked as 'include' and background articles were also identified. To check the screening consistency of the two reviewers, a third reviewer screened approximately 50% of the references as detailed above and a kappa coefficient was calculated.

Study classification

Following the screening process, a list of included studies was drawn up. Full-text papers were obtained for all of the included studies and an examination of titles, abstracts and full texts was undertaken. As this review was a systematic mapping review, it was important to classify the evidence in order to develop a better understanding of the evidence base. It became clear that there was not a clear definition of the population of frail older people and so the review would need to include evidence on a wider population of older people (generally aged ≥ 65 years). In addition, this classification allowed the review team to divide articles into two categories: (1) those looking at the identification of frail older people or older

people at high risk and (2) those looking at service delivery interventions to better manage older people and frail older people in the ED.

Data extraction

Once the final list of included studies had been determined, data extraction was undertaken by one of four reviewers (AC, LP, DC and FC). As this review was a mapping review, the focus was on extracting data that described interventions and their outcomes, rather than on numerical estimates of effectiveness. Therefore, single data extraction was an appropriate method as it can be undertaken with limited risk to the interpretation of results and findings from individual studies.

A standardised approach was developed and a data extraction form was developed for all of the three types of data extraction undertaken. These were:

1. full data extraction for all studies on population groups defined as frail older people or older people at 'high risk' by the study authors
2. brief data extraction for all studies on a population of older people, normally aged ≥ 65 years, without any specific risk criteria
3. brief data extraction for all relevant reviews that met our review inclusion criteria.

All of these data extraction tables were tested and refined by the review team. When it was clear that a conference abstract was related to a study that was published later, the data from these publications were extracted together.

Bearing in mind the complexity involved in defining frailty and the varying views about how it should be measured and applied in clinical care, our approach was to use the definitions of frailty described by study authors, but to also include older patients defined by study authors as being at high risk alongside frail patients. This approach was required partly because of the lack of clear definitions in the literature about which groups were frail and which groups consisted of all older people, for example whether or not the existence of a specific condition (e.g. patients aged ≥ 65 years with a fall) meant that patients were considered to be frail, and partly because of the lack of research into older people with frailty both generally and specifically in terms of their use of Emergency and Urgent Care.¹⁷

Therefore, the approach adopted by this review was to undertake a full data extraction on evidence that was clearly about frail or at-risk older people. However, as it became clear that focusing solely on this evidence would not allow the development of understanding about how different approaches might influence outcomes, a brief data extraction was undertaken on the interventions that targeted a general older population, aged ≥ 65 years. This approach extends what was outlined in the review protocol. The approach described in the review protocol was that 'where evidence exists for other elderly populations, this may be extracted into evidence tables (depending on the volume of evidence retrieved) but not used in the evidence synthesis'. However, the review used this evidence in a more thorough manner to better map the range of interventions that may potentially be used for older people in the ED.

Synthesising evidence

Data were extracted and tabulated and summary tables were created. These were used to inform the narrative synthesis presented in *Chapter 4*. Because of the heterogeneity of study interventions and outcomes, it was not possible to undertake any formal meta-synthesis. Data were synthesised by intervention type: interventions to identify patients as being frail or at high risk and interventions that changed the delivery of care to patients (service delivery innovations).

Assessment of the evidence base

This review aimed to map the evidence on interventions to identify and manage frail older people. Mapping reviews seek to characterise an evidence base, not compare interventions on the basis of their effectiveness. Although formal quality assessment is appropriate within the systematic review process to examine whether or not included studies may be at risk of bias, it is not required in a mapping review, as a mapping review does not interpret evidence to inform specific clinical questions or decisions. Indeed, use of a standard tool would not have been possible in this review because of the diversity of the study designs.

Rather than a formal quality assessment, we carried out a bespoke assessment of the evidence base using three distinct methods:

1. an examination of the research designs used and the strengths and limitations of those designs
2. an examination of the self-reported limitations included in the articles relating to frail or high-risk older people
3. an assessment of the relevance of the evidence to the contemporary UK NHS setting.

Use of internal and external experts

Our review used internal and external experts. Within SCHARR, three very experienced professors of emergency medicine, who are also practising ED consultants, advised on the research questions and the protocol and commented on the summary documents for the final report. In addition, we were aided by the Sheffield Teaching Hospitals NHS Foundation Trust Clinical Research Office Online Patient Advisory Panel who read and commented on our plain English summary and scientific summary.

Changes from the protocol

The protocol was developed prior to extensive literature searching and the choice of a mapping review methodology was made by the research team once the volume of evidence, diversity of study designs and heterogeneity of the evidence was clear. The choice of a mapping review impacted on two main areas: how evidence from other systematic reviews was used and how quality assessment was handled.

A more methodical approach to handling evidence from relevant reviews was adopted. Rather than simply mapping reviews against primary studies, as per the protocol, we used relevant reviews (whether systematic or not) as a source of evidence to locate additional papers for this review. In addition, when reviews matched the inclusion criteria for this review, these data were extracted and review findings were summarised in the results.

The review protocol stated that the Cochrane risk-of-bias tool would be used for quality assessment. However, this tool is appropriate only for a selected number of study designs, few of which were used by the studies reported in the review. As stated earlier, formal quality assessment using a validated checklist is not a standard feature of a mapping review. Therefore, we developed criteria to assess the evidence base, which are described in *Chapter 4, Assessment of the evidence base*.

Chapter 3 Results: included and excluded studies

This chapter details the studies that were included in, and excluded from, the review.

Preferred Reporting Items for Systematic Reviews and Meta-Analyses

The full papers, conference abstracts and reviews identified as a result of the literature search are described in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram in *Figure 1*.

Second screening of retrieved references

A kappa coefficient was calculated for the double screening process, demonstrating good agreement between the reviewers [$\kappa = 0.794$, 95% confidence interval (CI) 0.665 to 0.929].

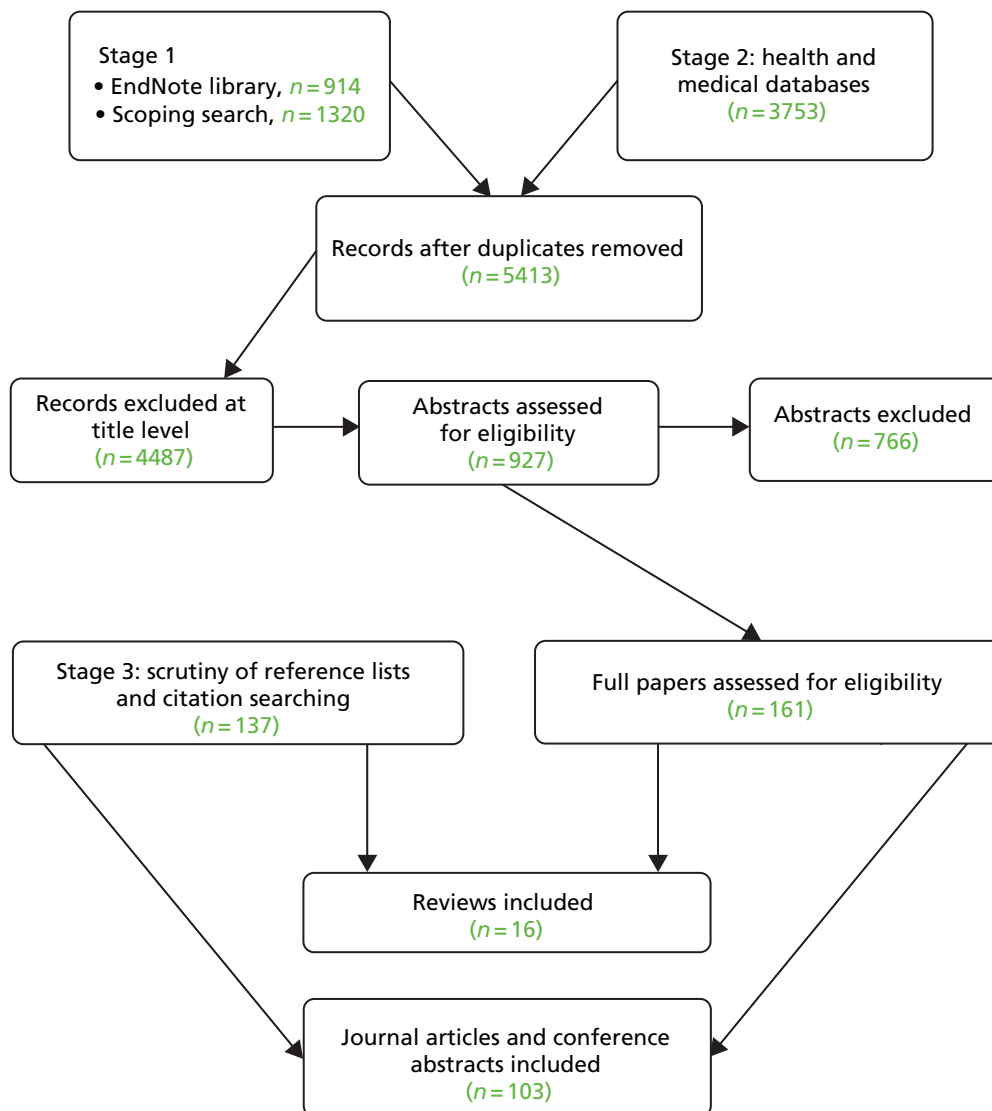


FIGURE 1 Modified PRISMA flow diagram.

Studies included in the review

A total of 103 papers (full journal articles and conference abstracts) and 16 reviews were included in the review. Further details of the characteristics of these studies are provided in *Chapter 4*.

Studies excluded from the review

A list of the full-text studies and conference abstracts excluded from the review and the reasons for their exclusion is available in *Appendix 3*.

Chapter 4 Results of the review

This chapter presents the main results from the review, related to:

- the overall evidence base
- the characteristics of included studies (identification of frail/at-risk older people and service delivery innovations for this group)
- a narrative summary of the evidence
- a patient pathway diagram
- an assessment of the evidence base.

Characteristics of the overall evidence base

In total, 103 articles,^{18–120} representing 90 studies, were included in this systematic mapping review. Detailed data extraction tables of included studies are provided in *Appendices 2, 4* and *5*.

There were 61 full papers,^{19,21,23,27–29,33,35,36,38–43,49–61,63–65,68,69,71–73,76–82,86,88–90,93,95,101,106,108,110,112–117,119,120} 38 conference abstracts^{18,20,22,25,30,32,34,37,45–48,62,66,67,70,74,75,83–85,87,91,92,94,96–100,102–105,107,109,111,118} and four papers^{24,26,31,44} classified as ‘other’ (letters to the editor and editorials containing data).

Of the 92 studies reported in the 103 articles/conference abstracts, 32 included a frail or high-risk population^{21–25,27,29,30,49,50,52–54,61,62,67,68,71–75,78,83,86–90,98,99,102–104,106,112,114,118,119} and 60 included a population of older people.^{18–20,23,26,28,31–48,51,55–60,63–66,69,70,76,77,79–82,84–97,100,101,105,107–111,113,115–117,120}

Thirty-seven studies^{18–23,27–60} reported on interventions to identify frail or high-risk older people. These comprised diagnostic tools to screen for frailty-related issues ($n = 7$ ^{20,22,27–33}), diagnostic tools to screen for frailty ($n = 7$ ^{18,34–39}), prognostic tools to measure the risk of adverse events in the ED ($n = 5$ ^{23,40–43}) and prognostic tools to measure the risk of adverse events on discharge ($n = 18$ ^{19,21,44–60}).

Interventions to manage older people and frail older people in the ED were reported in 53 studies: 21 examined changes to ED staffing,^{26,61–85} 11 examined changes to the physical infrastructure of the ED,^{86–97} 18 examined changes to how care was delivered^{24,25,98–117} and other interventions were reported in three studies.^{119–121}

The majority of the studies were undertaken in the USA ($n = 27$ ^{18,19,35,36,38–40,45,46,48,57,59,64,66–68,70,84,91–94,96,97,113,114,116,119,120}), the UK ($n = 14$ ^{20,61,62,72,74,83,86,88,89,95,98,102–106,117}) and Australia ($n = 10$ ^{26,44,60,63,73,76–80,82,110}). The UK studies were more likely to focus on frail or high-risk older people ($n = 11$). Other studies were undertaken in Italy ($n = 7$ ^{21,27,49,58,90,111,118}), Canada ($n = 6$ ^{28,37,47,51,52,65}), Ireland ($n = 5$ ^{34,69,71,75,107}), Switzerland ($n = 3$ ^{22,33,42,53,54}), the Netherlands,^{32,55} Singapore,^{112,115} Hong Kong,^{25,108,109} Spain,^{87,99} Sweden^{24,31} and France^{41,81,85} (all $n = 2$) and Belgium,⁵⁶ Germany,⁵⁰ New Zealand,^{29,30} South Korea,²³ Taiwan^{100,101} and Turkey⁴³ (all $n = 1$).

A wide number of study types were utilised. *Table 2* gives the study designs and number of studies of each type. No studies on the cost-effectiveness of interventions to identify and manage older people in the ED were located in the evidence base.

Table 3 highlights that the main group that interventions were targeted at was adults aged > 65 years with no specific condition.

TABLE 2 Study designs

Experimental studies	Observational studies	Unclear
<ul style="list-style-type: none"> • RCT • Quasi-RCT • Diagnostic accuracy study • Non-RCT 	<ul style="list-style-type: none"> • Medical record review • Observational study • Before-and-after observational study • Prospective pragmatic study • Retrospective observational study • Prospective data analysis • Longitudinal study • Retrospective cohort study • Prospective cohort study • Prospective observational study • Prospective comparative study • Before-and-after cohort study • Retrospective before-and-after study • Before-and-after prospective study • Cross-sectional cohort study 	<ul style="list-style-type: none"> • Action research • Audit • Evaluation • Feasibility study • Pilot project • Prospective evaluation • Questionnaire

RCT, randomised controlled trial.

TABLE 3 Target age of intervention

Age category	Studies (n)
≥ 65 years	44
≥ 65 years with trauma/acute condition	4
≥ 65 years with fall/chronic condition	3
≥ 65 years with positive diagnosis of 'at risk'	3
≥ 65 years with, or ≥ 70 years without, chronic condition	4
≥ 70 years	5
≥ 72 years	1
≥ 75 years	11
≥ 75 years, frail/multiple comorbidities	2
≥ 80 years with syndromes described as geriatric	2
≥ 85 years	1
No age category	10
Total	90

Although it was not possible to undertake a numerical analysis of the mean or median age of the population of older people studied in the review, because of the incomplete reporting of data, it is possible to say that, although interventions tended to be targeted at those aged > 65 years (considered to be older people in the literature), the average age of study participants (and, therefore, those benefiting from interventions) was much higher, generally around 80 years of age.

Studies were categorised as being related to either the identification of frail older people or changes to how ED services were configured or delivered. The classification of the service delivery interventions was based on how studies were reported in the included articles and the elements of service delivery that were researched. Fifty-eight of the studies focused on service delivery interventions and 37 on screening (diagnostic and prognostic). A further breakdown of these categories is given in *Table 4*.

TABLE 4 Studies by category

Category	Description	Studies (n)	Articles (n)
Screening	Diagnostic tools to identify frailty	7	7
	Diagnostic tools to screen for frailty-related issues	7	9
	Prognostic tools to measure risk of adverse events in the ED	5	5
	Prognostic tools to measure risk of adverse events on discharge	18	19
Service delivery interventions	Individual or team changes to ED staffing	21	26
	Changes to the physical infrastructure of the ED	11	12
	Care delivery and assessment interventions (CGA)	18	22
Miscellaneous	Various	3	3

CGA, comprehensive geriatric assessment.

Characteristics of included studies: screening

Thirty-seven studies (40 publications^{18–23,27–60}) dealt with strategies aimed at identifying patients with frailty or distinguishing higher- from lower-risk patients in the ED. The great majority of these studies assessed the diagnostic or prognostic accuracy of tools using a prospective or retrospective cohort design, which is an appropriate design for this type of study. Only one study (published as a conference abstract) used a randomised trial design¹⁸ and one was a secondary analysis of data from a randomised trial.¹⁹ Both of these studies were conducted in the USA.

The largest group of studies came from the USA ($n = 12$ ^{18,19,35,36,38–40,45,46,48,57,59}), followed by Canada ($n = 5$ ^{28,37,47,51,52}). Among European countries, the largest numbers of studies were performed in Switzerland ($n = 3$ ^{22,33,42,53,54}) and Italy ($n = 4$ ^{21,27,49,58}). The Netherlands ($n = 2$ ^{32,55}) was the only other European country with more than one included study. The only study included from the UK was a study of a screening tool that was reported in abstract form only.²⁰ Outside Europe, studies were included from Australia,^{44,60} New Zealand,^{29,30} Turkey⁴³ and South Korea.²³

The numbers of patients included in screening studies ranged from 69¹⁸ to 2057.²¹ Two other studies^{22,23} recruited > 1000 patients. Most studies recruited patients aged ≥ 65 years, but the average age of patients actually recruited was considerably older, typically in the mid-seventies or older (see data extraction tables in *Appendices 4* and *5*). The proportions of men and women included varied among the included studies.

Characteristics of included studies: interventions

Fifty-three studies (63 articles^{24–26,61–120}) examined changes made to how ED services were delivered to populations of (frail) older people. These studies tended to investigate changes to the structure of the ED ($n = 11$ ^{86–97}), changes to staffing in the ED ($n = 21$ ^{26,61–85}) or changes to how care is delivered ($n = 18$ ^{24,25,98–117}), such as the introduction of comprehensive geriatric assessment (CGA) or similar assessment-type interventions. There were also a number of unique interventions ($n = 3$ ^{119–121}), which are also reported here.

The majority of the studies reported here were observational studies; predominantly before-and-after studies or cohort studies. Three studies reported results from randomised controlled trials (RCTs).^{24–26}

All of the studies reported either patient or health service outcomes that were derived from patient data, with the exception of one study,¹²⁰ which reported changes in ED clinician prescribing behaviour. The main patient-related outcome measures were mortality, functional status, frailty and place of residence (own home or residential/nursing care). The main health service outcomes were admissions, readmissions, ED reattendance and length of stay.

The largest group of studies came from the USA ($n = 15^{64,66-68,70,84,91-94,96,97,113,114,116,119,120}$), followed closely by the UK ($n = 13^{61,62,72,74,83,86,88,89,95,98,102-106,117}$). Nine studies were undertaken in Australia.^{63,73,76-80,82,110}

Most studies reported outcomes for patients aged ≥ 65 years, as these patients were considered to be 'older people' and, therefore, the target age for identification of frailty or at risk of adverse outcomes. However, when a mean age was reported, this tended to be > 75 years (see *Appendix 6*; more detailed reporting of age is not possible because of variable reporting in the included articles). The proportion of men and women included varied among the studies.

Detailed analysis of study and intervention characteristics was hindered by the limited data in the included papers, many of which were conference abstracts.

Narrative synthesis of screening papers

The objective of using a diagnostic or prognostic screening tool as a supplement to clinical judgement is to improve the health-care provider's ability to distinguish older people who are frail or at high risk of adverse outcomes from those who are not. Older people who are identified as frail can then be considered for specific management in the ED. A test to identify older people as frail in the ED setting needs to be both accurate and feasible to apply. The interventions that may be delivered to these groups are described in *Diagnostic tools to identify frailty*.

The evidence identified in this review showed that screening tests were used on both populations of older adults aged > 65 years and on populations that were already considered to be at high risk. We distinguished between:

- studies that compared the findings of the test with those of a more comprehensive test (reference standard, i.e. diagnostic accuracy studies); these tended to be related to the identification of frailty or frailty-related issues
- studies that evaluated the ability of the test to predict adverse outcomes during a period of follow-up (i.e. prognostic studies); these tended to be screening tests to identify older people at risk of adverse events in the ED or adverse events following discharge from the ED.

Further details of all of the studies can be found in the data extraction tables (see *Appendices 2, 4 and 5*).

Diagnostic tools to identify frailty

We included seven studies (nine publications^{20,22,27-33}) of diagnostic tools to identify frailty (*Table 5*). These were studies that recruited a sample of older people attending the ED and assessed the accuracy of a screening tool against a reference standard.

The included studies evaluated a wide variety of screening tools. The Identification of Seniors at Risk (ISAR) tool was the only tool to be evaluated in two studies.^{27,28} A diagnostic accuracy study²⁷ reported that the ISAR tool had a sensitivity of 94% and specificity of 63% relative to a frailty measure, the Deficit Accumulation Index (DAI). The area under the receiver operating characteristic (ROC) curve was 0.92, indicating a good performance in identifying frailty based on the DAI definition. However, a study of the implementation of the ISAR tool in a Canadian ED setting found that only 51.6% of eligible patients actually received an ISAR screen.²⁸ This was attributed to the fast-paced nature of emergency care and lack of staff resources at night.

Other screening tools have been evaluated in single diagnostic accuracy studies. The Brief Risk Identification for Geriatric Health Tool (BRIGHT), developed in New Zealand, is an 11-item tool that showed a good ability to identify older people with 'decreased function' relative to a reference standard of CGA.^{29,30} The limitations of this study, identified by the authors, include that it was a small, single-centre study and that 18% of patients who completed BRIGHT were lost to follow-up, raising the possibility of follow-up bias.

TABLE 5 Summary of studies evaluating the diagnostic accuracy of frailty screening tools

Study	Participants (n)	Tool	Reference standard	Findings
Salvi <i>et al.</i> ²⁷	200	ISAR	DAI	The ISAR tool had sensitivity of 94% and specificity of 63%. The ISAR tool is a useful screening tool for frailty and identifies patients who are at risk of adverse outcomes after an ED visit as well as those who are likely to benefit from a geriatric intervention
Asomaning and Loftus ²⁸	525	ISAR	No reference standard	271 patients (representing 51.6% of those eligible for screening) were screened with the ISAR tool. Low compliance by staff was a barrier to implementation of the tool
Boyd <i>et al.</i> ^{29,30}	139	BRIGHT	CGA	The BRIGHT tool successfully identifies older adults with decreased function and may be useful in differentiating patients in need of comprehensive assessment
Eklund <i>et al.</i> ³¹	161	FRESH	Frailty indicators	Both sensitivity (81%) and specificity (80%) of the FRESH tool were high. The tool is simple and rapid to use, takes only a few minutes to administer and requires minimal use of energy by the patient
Wall and Wallis ²⁰	118	CFS	Validated frailty scales	Analysis of ROC curves showed that the CFS accurately identified frail patients compared with other well-established frailty scales (AUC 89–91%) at appropriate cut-off points. Its implementation in the ED could increase the proportion of frail patients admitted directly to a geriatric ward
Lonterman <i>et al.</i> ³²	300	ED screening tool	Safety management screening bundle	The ED screening tool has moderate validity compared with the screening bundle and can identify most older ED patients at high risk of adverse outcomes
Schoenenberger <i>et al.</i> ^{22,33}	1547	EGS	ED diagnosis	Introduction of the EGS was associated with an increase in the detection of potentially overlooked geriatric problems. Adaptations to enhance feasibility and to ensure clinical benefit are needed

AUC, area under the curve; BRIGHT, Brief Risk Identification for Geriatric Health Tool; CFS, Clinical Frailty Scale; DAI, Deficit Accumulation Index; EGS, emergency geriatric screen; ISAR, Identification of Seniors at Risk; ROC, receiver operating characteristic.

BRIGHT is designed to be suitable for completion by the patient or a carer and used in combination with a particular type of CGA.

The only other fully published study of this type evaluated FRESH, which is a five-item tool (subsequently reduced to four items) that was specifically designed to screen for frailty.³¹ FRESH was evaluated using a range of frailty indicators as reference standards and performed well, with both sensitivity and specificity being around 80%. The test takes only a few minutes to administer and requires minimal input from the older person. However, the tool has been evaluated in only one small study to date ($n = 161$) and the data were not collected during the ED visit but during a subsequent visit to patients at home.³¹

Finally, of three diagnostic accuracy studies published only as conference abstracts, one was carried out in a UK setting.²⁰ This study used the Clinical Frailty Scale (CFS), a rapid and simple case-finding tool, to assess 118 older patients admitted to geriatric wards from the ED. The CFS performed well in comparison with established frailty scales at appropriate cut-off points. The authors suggested that use of the CFS as a triage tool in the ED could increase the proportion of frail older people admitted directly to geriatric wards

(i.e. admitted earlier rather than later). However, although this was a study of a relevant population, data were not actually collected in the ED and patient management and outcomes were not evaluated. Thus, the value of this study by itself appears to be limited.

The other two conference abstracts evaluated an ED screening tool³² and an emergency geriatric screen (EGS).^{22,33} The ED screening tool performed well, with an area under the curve (AUC) of 0.83 relative to a reference standard, described as a safety management screening bundle. However, few details of either tool were reported in the abstract. The second study used actual ED diagnoses as the reference standard and reported an increase in the detection of potentially overlooked geriatric problems compared with a control period.

Overall, the evidence for the diagnostic accuracy of tools for identifying frail older people is limited. None of the tools has been evaluated extensively using this methodology and differences in terminology make it unclear whether or not different studies are examining the same phenomenon. In addition, individual studies have different methodological features and settings, which may limit their internal or external validity. However, the evidence base using follow-up to evaluate the predictive abilities of these tools is more extensive and the evidence summarised here should be read alongside *Prognostic tools for adverse events after discharge*.

Diagnostic tools to identify specific frailty-related issues

We identified seven diagnostic accuracy studies of tools to screen for specific frailty-related issues (as distinct from frailty as a general overall condition) in the ED (Table 6). All of the studies evaluated screening for cognitive impairment/dysfunction and most used the Mini Mental State Examination (MMSE)

TABLE 6 Summary of studies evaluating screening tools for specific frailty issues

Study (issue)	Participants (n)	Tool	Reference standard	Findings
Carpenter <i>et al.</i> ¹⁸ (geriatric syndromes)	69	MMSE/CAM	N/A (RCT of screening)	Screening did not appear to influence the decisions made by physicians
Carpenter <i>et al.</i> ³⁵ (cognitive dysfunction)	169	Ottawa 3DY; Brief Alzheimer's Screen; SBT; and caregiver-completed AD8	MMSE	Brief screening instruments such as the SBT can rapidly identify patients at lower risk of cognitive dysfunction
Carpenter <i>et al.</i> ³⁶ (cognitive dysfunction)	371	SIS and caregiver-completed AD8	MMSE	The SIS was superior to the caregiver-completed AD8 for identifying older adults at increased risk of cognitive dysfunction
Eagles <i>et al.</i> ³⁷ (impaired mental status)	260	Ottawa 3DY	MMSE	Ottawa 3DY is a simple screening tool that has been shown to be feasible for use in the ED
Hadbavna <i>et al.</i> ³⁴ (cognitive impairment)	117	TRST and SIS	N/A	A high proportion of older patients attending the ED met criteria for cognitive impairment. There was considerable variation in the implementation of the screening instruments between nurses, despite training
Wilber <i>et al.</i> ³⁸ (cognitive impairment)	352	SIS	MMSE	The sensitivity of the SIS (63%) was lower than in earlier studies. Further research is needed to identify the best brief mental status test for ED use
Wilber <i>et al.</i> ³⁹ (cognitive impairment)	150	SIS and Mini-Cog	MMSE	The SIS had a sensitivity of 94% and specificity of 86%. The test is short, easy to administer and unobtrusive, allowing it to be easily included in the initial assessment of older ED patients

AD8, Ascertain Dementia 8; CAM, confusion assessment method; N/A, not applicable; SBT, Short Blessed Test; SIS, six-item screener; TRST, triage risk screening tool.

as a reference standard. Two studies did not use a standard diagnostic accuracy design.^{18,34} In a randomised trial published as a conference abstract,¹⁸ physicians were either informed or not informed of the results of screening for mental status and delirium. The study found that information about screening results did not appear to influence physicians' decisions in relation to documentation, disposition or management.¹⁸ This is a potentially important finding, but the study was small (69 patients).

Hadbavna *et al.*³⁴ also did not use a conventional diagnostic accuracy study design in their study evaluating the six-item screener (SIS) test and triage risk screening tool (TRST). Instead, repeat screening with the SIS was used to confirm whether or not patients met the criteria for cognitive impairment. The authors found that there was considerable variation between nurses in the implementation of screening.³⁴ This adds to the study of Asomaning and Loftus²⁸ in identifying potential problems in administering screening tools in normal clinical practice.

Prognostic tools for adverse events within the emergency department

We included five studies evaluating the accuracy of screening tools for assessing patients' risk of adverse events within the ED itself (*Table 7*). Each study used a different tool, suggesting that there is currently no consensus around which tools to use. Follow-up was limited to the time that the patient was in hospital, with the exception of one study that included a 30-day follow-up.⁴⁰ This study⁴⁰ found that a delirium prediction rule based on age, prior stroke or transient ischaemic attack, dementia, suspected infection and acute intracranial haemorrhage had good predictive accuracy for delirium determined by the confusion assessment method (CAM).

One study carried out in France used a brief geriatric assessment (BGA) method to identify patients in the ED who were at high risk of a long hospital stay.⁴¹ The BGA consisted of six items and the authors concluded that a history of falls, male sex, cognitive impairment and age of < 85 years identified patients at increased risk of a long hospital stay (≥ 13 days). The authors noted that this group of patients would require geriatric care and planning for discharge. Further evidence on the management of patients following geriatric assessment in the ED is presented in *Narrative synthesis of service delivery intervention papers*.

TABLE 7 Summary of studies of screening tools for the risk of adverse events within the ED

Study	Participants (n)	Tool	Follow-up	Findings
Beauchet <i>et al.</i> ⁴¹	424	BGA	In hospital	The combination of a history of falls, male sex, cognitive impairment and aged < 85 years identified older ED patients at high risk of a long hospital stay
Dundar <i>et al.</i> ⁴³	939	REMS/HOTEL	In hospital	The REMS, REMS without age and HOTEL scores cannot be used to identify GED patients requiring hospital admission, but they are of value for predicting in-hospital mortality and intensive care admission
Grossmann <i>et al.</i> ⁴²	519	Emergency Severity Index	In ED	The Emergency Severity Index level showed good validity for resource consumption, disposition, ED length of stay and survival
Kennedy <i>et al.</i> ⁴⁰	700	Delirium prediction rule	30 days	The delirium prediction rule had good predictive accuracy (area under the ROC curve = 0.77)
Lee <i>et al.</i> ²³	1903	CTAS	In ED	The CTAS is a triage tool with high validity for older patients and is especially useful for categorising severity and recognising those who require an immediate life-saving intervention

BGA, brief geriatric assessment; CTAS, Canadian Triage and Acuity Scale; GED, geriatric emergency department; HOTEL, Hypotension, Oxygen saturation, low Temperature, ECG changes and Loss of independence; REMS, Rapid Emergency Medicine Score.

The other studies in this group evaluated tools for predicting the risk of hospital or intensive care unit (ICU) admission or the need for an immediate life-saving intervention. Emergency Severity Index level 1 had low sensitivity (46.2%) but high specificity (99.8%) for predicting the need for a life-saving intervention.⁴² The index level was also correlated with resource consumption, disposition, ED length of stay and survival. The Canadian Triage and Acuity Scale (CTAS) showed both high sensitivity (97.9%) and high specificity (89.2%) for the need for life-saving intervention.²³ The results of a Turkish study evaluating the Rapid Emergency Medicine Score (REMS) and Hypotension, Oxygen saturation, low Temperature, ECG changes and Loss of independence (HOTEL) tools indicated that these tools cannot be efficiently used to identify older ED patients requiring hospital admission.⁴³ However, the tools had reasonable validity for predicting ICU admission and in-hospital mortality. The HOTEL score was a stronger predictor than REMS or REMS without taking age into account.

These studies focus on the short-term outcomes of older patients attending the ED. The exception is the study by Beauchet *et al.*,⁴¹ which may be read alongside other studies of geriatric assessment in the ED. The limited number of studies identified makes it difficult to draw conclusions about which tools may be of most value in the setting of the UK NHS.

Prognostic tools for adverse events after discharge

Eighteen studies (19 publications^{19,21,44-60}) assessed the ability of screening tools to predict adverse outcomes following a patient's discharge from the ED (*Table 8*). The studies evaluated a wide range of tools, with follow-up ranging from 28 days to 12 months. The ISAR tool and TRST were most commonly evaluated, with one study⁴⁴ evaluating a tool derived from the ISAR tool. None of the included studies was performed in the UK. Four studies were published as conference abstracts only.⁴⁵⁻⁴⁸

The ISAR tool was developed in Canada in the 1990s.¹²² It is a self-report screening tool with six questions related to functional dependence, recent hospitalisation, impaired memory and vision and polypharmacy. A score of ≥ 2 (i.e. positive answers to two or more items) is the normal cut-off point for being considered high risk. Two studies in this review evaluated the ISAR tool alone for screening older patients in the ED.^{49,50} Both studies concluded that the ISAR tool was a valid and reliable screening tool in their setting. Singler *et al.*⁵⁰ used a cut-off point of ≥ 3 rather than ≥ 2 in their study, which would have the effect of increasing the specificity of the tool. A study of a screening tool derived from the ISAR used a before-and-after design and found a decrease in re-presentation to the ED after introduction of the tool.⁴⁴ The authors suggested that this was attributable to an increase in referrals to community-based services, which diverted patients away from attending the ED.

The TRST is a risk-screening tool designed to be applied to patients aged ≥ 75 years in the ED. Like the ISAR tool, it includes six items and a score of ≥ 2 indicates high risk. Three studies in the review evaluated the TRST alone and two of them^{51,52} cast doubt on the predictive ability of the tool. By contrast, a study in the USA concluded that the TRST was a valid measure for assessing functional status in the ED and may be useful in identifying patients requiring referral or monitoring after discharge.¹⁹ Thus, the evidence base for the TRST when evaluated alone is limited and mixed.

Although evaluation of single screening tools appears most feasible for delivery in the ED and the least burdensome for patients, many studies have compared two or more tools using the same sample of patients. Three studies compared the ISAR tool and the TRST. Salvi *et al.*²¹ and Graf *et al.*^{53,54} both concluded that the tools are useful for risk stratification in the ED and have similar properties. However, Salvi *et al.*²¹ emphasised use of the screening tools to select patients who could benefit from geriatric interventions, whereas Graf *et al.*^{53,54} favoured their use to avoid unnecessary intervention. By contrast, a US study⁴⁵ found that neither tool successfully distinguished patients at high and low risk for adverse outcomes at 1 and 3 months. Once again, it is difficult to draw firm conclusions from this group of studies.

Two further studies compared the performance of ISAR and TRST with that of two other tools, the Runciman¹²³ and Rowland¹²⁴ questionnaires. Moons *et al.*⁵⁶ highlighted the value of the Rowland

TABLE 8 Summary of studies of screening tools for the risk of adverse events after ED discharge

Study	Tool	Follow-up	Findings
Studies of ISAR			
Hegney <i>et al.</i> ⁴⁴ (<i>n</i> = 2139)	Screening tool adapted from the 'Screening Tool for Elderly Patients', which in turn was developed from the ISAR tool	28 days (study used a before-and-after design)	There was a decrease in re-presentations. It is suggested that this is because of increased referral to other community-based services (i.e. diverting patients elsewhere)
Salvi <i>et al.</i> ⁴⁹ (<i>n</i> = 200)	ISAR	6 months	The ISAR tool was a reliable and valid predictor of death, long-term care placement, functional decline, ED revisit or hospital admission at 6 months' follow-up
Singler <i>et al.</i> ⁵⁰ (<i>n</i> = 520)	ISAR	28 days	The ISAR tool with a cut-off score of ≥ 3 is an acceptable screening tool for use in German EDs
Studies of TRST			
Fan <i>et al.</i> ⁵¹ (<i>n</i> = 120)	TRST	120 days	The TRST cannot be used as a single diagnostic test to predict whether or not Canadian ED elders will have an ED revisit, hospital admission or long-term care placement at 30 or 120 days
Hustey <i>et al.</i> ¹⁹ (<i>n</i> = 650)	TRST	120 days	The TRST is a valid proxy measure for assessing functional status in the ED and may be useful in identifying patients who would benefit from referrals or surveillance after discharge
Lee <i>et al.</i> ⁵² (<i>n</i> = 788)	TRST	12 months	The TRST demonstrated only moderate predictive ability and, ideally, a better prediction rule should be sought
Studies comparing ISAR with TRST			
Carpenter <i>et al.</i> ⁴⁵ (<i>n</i> = 225)	ISAR and TRST	3 months	Neither the ISAR tool nor the TRST distinguish older ED patients at high or low risk for 1- or 3-month adverse outcomes
Graf <i>et al.</i> ^{53,54} (<i>n</i> = 375)	ISAR, modified ISAR and TRST	12 months	The screening tools may be useful for identifying older patients who can be discharged from the ED without further geriatric evaluation, thus avoiding unnecessary CGA
Salvi <i>et al.</i> ²¹ (<i>n</i> = 2057)	ISAR and TRST	6 months	Risk stratification of older ED patients with the ISAR tool or TRST is substantially comparable for selecting older ED patients who could benefit from geriatric interventions. The ISAR tool had slightly higher sensitivity and lower specificity than TRST
Studies comparing several tools			
Buurman <i>et al.</i> ⁵⁵ (<i>n</i> = 381)	ISAR, TRST, questionnaires of Runciman <i>et al.</i> ¹²³ and Rowland <i>et al.</i> ¹²⁴	120 days	None of the screening tools was able to discriminate clearly between patients with and without poor outcomes
Moons <i>et al.</i> ⁵⁶ (<i>n</i> = 314)	ISAR, TRST, questionnaires of Runciman <i>et al.</i> ¹²³ and Rowland <i>et al.</i> ¹²⁴	90 days	Repeat visits in older persons admitted to an ED seemed to be most accurately predicted using the Rowland questionnaire, with an acceptable number of false positives. This instrument can be easily integrated into the standard nursing assessment

continued

TABLE 8 Summary of studies of screening tools for the risk of adverse events after ED discharge (*continued*)

Study	Tool	Follow-up	Findings
Studies of other tools			
Baumann and Strout ⁵⁷ (n = 929)	ESI	1 year	When used to triage patients aged > 65 years, the ESI algorithm demonstrates validity. Hospitalisation, length of stay, resource utilisation and survival were all associated with ESI categorisation in this cohort
Di Bari <i>et al.</i> ⁵⁸ (n = 1632)	ISAR, Silver Code	6 months	Prognostic stratification with the Silver Code is comparable with that obtained by direct patient evaluation
Dziura <i>et al.</i> ⁴⁶ (n = 250)	Rapid screening assessment	30 days	Rapid screening assessment provides a rapid and accurate method for identifying older patients in the ED who are likely to return to the ED
Eagles <i>et al.</i> ⁴⁷ (n = 504)	TUGT	6 months	TUGT scores were associated with frailty, functional decline and fear of falling. TUGT scores were associated with falls at the initial ED visit but were not predictive of falls at 3 or 6 months
Post <i>et al.</i> ⁴⁸ (n = 250)	GRAY	30 days	The ED GRAY can be quickly performed in the ED to initially assess disability and identify issues that need to be addressed. Combined with other data, it provides good discrimination of the risk of ED readmission within 30 days
Stiffler <i>et al.</i> ⁵⁹ (n = 107)	SHARE-FI	30 days	The SHARE-FI tool appears to be a feasible method to screen for frailty in the ED
Tiedemann <i>et al.</i> ⁶⁰ (n = 397)	Two-item screening tool (falls)	6 months	The two-item screening tool showed good external validity and accurately discriminated between fallers and non-fallers. The tool could identify people who may benefit from referral or intervention after ED discharge

ESI, emergency screening instrument; GRAY, Geriatric Readmission Assessment at Yale; SHARE-FI, Survey of Health, Aging and Retirement in Europe Frailty Instrument; TUGT, timed up and go test.

questionnaire for predicting repeat ED visits, whereas Buurman *et al.*⁵⁵ found that none of the screening instruments distinguished between patients with and without poor outcomes over 120 days of follow-up. These similarly designed studies were carried out in Belgium and the Netherlands, respectively, and so their relevance to UK settings is uncertain.

Other screening tools have been evaluated in single studies. We included seven studies of this type, all of which reported positive results. The emergency screening instrument (ESI),⁵⁷ rapid screening assessment⁴⁶ and Survey of Health, Aging and Retirement in Europe Frailty Instrument (SHARE-FI)⁵⁹ are short question-based tools similar to those discussed above. Eagles *et al.*⁴⁷ evaluated the timed up and go test (TUGT) and reported that scores were associated with frailty, functional decline and fear of falling. Limited details of this study are available as it was published as a conference abstract only. Two studies described tools to predict specific frailty-related outcomes: falls⁶⁰ and ED readmissions.⁴⁸ Finally, the Silver Code differs from other risk screening tools by being derived from administrative data. When compared with the ISAR tool, the Silver Code showed a similar ability to predict ED return visits, hospital admission and mortality over 6 months of follow-up.⁵⁸ The concept of using administrative data to support initial triage in the ED seems attractive, but in this study the Silver Code was derived retrospectively several months after the patient was enrolled for the study. As noted by the authors, improved processing and flow of administrative data would be necessary for the data to be used for real-time triage in the ED.

Summary of screening papers

The evidence on tools to support the identification and management of patients with frailty in the ED is extensive but inconclusive. The ISAR tool and the TRST are the most extensively evaluated tools, but many other tools are available, including non-question-based tests and, potentially, tools using administrative data. Limitations of the included studies include the small sample sizes, that most were conducted at a single centre and that many were published as conference abstracts with limited details. Contradictory results obtained in different prognostic studies using the same tool reflect the fact that health service use-related outcomes, in particular outcomes such as repeat ED visits and hospital admission, will be influenced by the health and care system as well as by patient factors. Hence, the results of studies performed in one country cannot be readily generalised to another country. The lack of UK studies in this body of evidence limits the relevance of the evidence to NHS settings. There are other studies that examine screening tools for conditions that are common in frail older people; however, these have not been included in the review as they were not identified through the literature searches as they were not specifically limited to a frail or older population.

Narrative synthesis of service delivery intervention papers

This section reports papers that describe changes to how care is delivered to frail and older patients within the ED. The service delivery interventions that are reported here were targeted at both frail older people and a more general population of people aged > 65 years. Differentiating between the groups at whom interventions were targeted was often difficult. Data extraction tables for these service delivery interventions are available in *Appendices 4* and *5*.

Overall, the intervention reporting was descriptive rather than analytical, with limited data on the feasibility and acceptability of interventions. Therefore, this section aims to map, classify and describe the interventions delivered and the outcomes on which they are reported to have had an impact.

To present the synthesis in a clear and logical manner, interventions were classified as follows:

- ED staffing initiatives (21 studies reported in 26 articles^{26,61–85})
- changes to the physical infrastructure of the ED (11 studies reported in 12 articles^{86–97})
- care delivery interventions (18 studies reported in 22 articles^{24,25,98–117})
- other interventions (three studies reported in three articles^{119–121}).

Emergency department staffing initiatives

We identified 21 studies (26 publications^{26,61–85}) reporting on instances in which the staffing of the ED had been modified to better meet the needs of an older population. These staffing modifications varied; there were examples of initiatives in which a single individual was located in the ED or added to an existing multidisciplinary team (MDT) or in which a new MDT was established. Differentiating between staffing initiatives and care initiatives (e.g. when CGA was introduced to an ED and delivered by a newly established geriatric liaison nurse) was problematic. The description of the interventions was often brief, reflected in the fact that a number of the studies were reported in conference abstracts only. Details of these interventions are given in *Table 9*.

Individual initiatives

We identified nine studies (across 11 articles^{26,61–70}) of interventions in which a single clinician was introduced to the ED setting or added to an existing team. A variety of clinicians were introduced (geriatric consultants, pharmacists and nurses) in addition to other roles such as emergency department care co-ordinators (EDCCs).

Jones and Wallis⁶¹ and Jones *et al.*⁶² reported on an admissions avoidance consultant geriatrician. The geriatrician worked in conjunction with allied health professionals and also provided follow-up, which was required by one-third of the patients in the cohort. The geriatrician's role was to provide medication advice and follow-up planning. Outcomes for this intervention were broadly positive compared with 'hospital

TABLE 9 Staffing interventions

Intervention	Staff	Study, population	
		Frail older	General older
Staffing initiatives: individual	Admissions avoidance geriatrician	Jones and Wallis, ⁶¹ Jones <i>et al.</i> ⁶²	
	Aged care pharmacist		Mortimer <i>et al.</i> ⁶³
	Clinical pharmacy specialist		Shaw <i>et al.</i> ⁶⁴
	EDCCs		Bond <i>et al.</i> ⁶⁵
	Geriatric nurse practitioner		Argento <i>et al.</i> ⁶⁶
	Nurse liaison	Aldeen <i>et al.</i> , ⁶⁷ Aldeen <i>et al.</i> ⁶⁸	
	Aged care nurse liaison	Basic and Conforti ²⁶	
	Triage nurse		Fallon <i>et al.</i> ⁶⁹
	Geriatric nurse liaison		Dresden <i>et al.</i> ⁷⁰
Staffing initiatives: team	Geriatric medicine liaison	Tan <i>et al.</i> ⁷¹	
	ATOP	Leah and Adams ⁷²	
	ASET	Ngian <i>et al.</i> ⁷³	
	Geriatric liaison team	Thompson <i>et al.</i> ⁷⁴	
	FITT	O'Reilly <i>et al.</i> ⁷⁵	
	CCT (falls)		Harper <i>et al.</i> ⁷⁶
	CCT (general)		Arendts <i>et al.</i> ^{77,78}
	Allied health staff (falls)		Waldron <i>et al.</i> ⁷⁹
	MDT CCT		Corbett <i>et al.</i> ⁸⁰
	MGT		Launay <i>et al.</i> ⁸¹
	CCT		Arendts <i>et al.</i> ⁸²
	Acute care of the elderly service	Bell <i>et al.</i> ⁸³	
	Patient liaison service		Berahman <i>et al.</i> ⁸⁴

ASET, aged care service emergency team; ATOP, assessment team for older people; CCT, care co-ordination team; EDCC, emergency department care co-ordinator; FITT, frail intervention therapy team; MGT, mobile geriatric team.

averages'. However, the authors cautioned that reducing admissions among more-stable patients may lead to wards having a higher proportion of less-stable patients and, therefore, the outcomes of the admitted patients may appear to be negatively affected by the intervention.

Admissions avoidance was also the primary aim of the matched pairs study reported by Bond *et al.*⁶⁵ EDCCs aimed to reduce admission rates through better linkages with home care and community services. The study did not show any difference in any of the outcomes measured (admission rates, revisit rates or readmission rates) between those who received the EDCC intervention and those who did not, although the design of the study may have contributed to this.

Two studies reported on the role of a geriatric pharmacist.^{63,64} A prospective evaluation of an aged care pharmacist was undertaken by Mortimer *et al.*⁶³ The aged care pharmacist's role was to examine medication history, review medication orders and liaise with medical staff about medication-related issues. The aged care pharmacist was effective at reducing medication errors compared with the control group receiving usual care, the intervention was acceptable to patients and there was no difference in terms of re-presentation following discharge between the aged care pharmacist group and the control group. Shaw *et al.*⁶⁴ described a new role of a clinical pharmacy specialist, who delivered medication review and management. The study found that clinical outcomes were not improved as a result of the intervention.

Nursing interventions were also common. Argento *et al.*⁶⁶ reported a pilot study of a geriatric nurse practitioner intervention. The geriatric nurse practitioner provided specific care to older people, with the study finding positive outcomes. As part of the wider Geriatric Emergency Department Innovations through the Workforce, Informatics and Structural Enhancements (GEDI-WISE) programme, one of the innovations was to develop the geriatric assessment and care co-ordination skills of ED nurses, as reported in the study by Aldeen *et al.*⁶⁷ The nurse liaison undertook screening tests, liaised with the wider MDT, created safe discharge plans and followed up patients. Preventable admissions in high-risk patients were reduced (although admissions were increased in those with a less severe presentation, perhaps because of underlying problems being identified). Length of stay in the ED was increased for patients seen by the nurse. Basic and Conforti²⁶ reported on a RCT of an intervention for high-risk older people involving early geriatric assessment by an aged care nurse, who assessed, monitored and referred patients with high-risk criteria. They found that the intervention did not significantly reduce any of their outcomes of interest (admission, functional decline or length of stay), with the authors arguing that this was because the intervention did not influence patient care and management following discharge or have any influence over the care provided once patients had been admitted.

Fallon *et al.*⁶⁹ reported on a triage nurse initiative, which involved screening with the TRST. The intervention was delivered in the ED and patients were admitted to the acute medical assessment unit (AMAU) if it was deemed necessary. The TRST identified patients as being at risk of an adverse outcome. Although the outcomes of these patients are unknown, the study identified characteristics of the frail older population and suggested that geriatric AMAUs may better meet their needs.

Dresden *et al.*⁷⁰ undertook a prospective cohort study of a geriatric nurse liaison intervention (GNLI) involving assessment and care co-ordination in the USA. The GNLI group ($n = 829$) had significantly improved outcomes compared with the control group ($n = 873$) with regard to hospitalisation, 30-day readmission rates and length of stay. However, no data were collected past 30 days and no information on ED readmissions was collected.

Team initiatives

We identified 12 studies across 15 publications^{71–85} that reported team initiatives. Staff interventions also took the form of initiatives that involved the establishment of new MDTs for older patients. Six interventions^{71–73,83} were identified for frail or high-risk patients.

Three papers^{77,78,82} reported findings from an Australian study that established a care co-ordination team (CCT) to deliver comprehensive allied health assessment/intervention to older patients to improve patient outcomes. The CCT comprised a minimum of one physiotherapist, occupational therapist or social worker, all of whom had geriatric experience. The intervention included functional assessment to identify patients' needs and direct them to appropriate care and services. Further details are provided in *Table 10*.

The work of the CCT in the same setting was reported by Harper *et al.*,⁷⁶ who looked at the role of the CCT specifically for older falls patients. Patients referred by ED clinicians were given targeted falls support. The study reported the changes over 3 years since the introduction of the CCT, with regression modelling demonstrating a decrease in re-presentation and readmission rates, although these results were not significant. Another falls prevention intervention, also delivered in Australia by allied health professionals, was reported by Waldron *et al.*⁷⁹ A prospective before-and-after study of 313 geriatric falls patients demonstrated that allied health staff significantly increased the proportion of patients reviewed and significantly increased referrals for comprehensive guideline care, with a consequent increase in the average quality-of-care index score.

Patients with multiple diagnoses or aged > 80 years were referred to an ED geriatric medicine liaison service in a pilot study undertaken in Ireland.⁷¹ A MDT approach to assessment, led by a senior geriatrician, dealt with 285 patients over a nearly 3-year period. Although study numbers were relatively small, analysis was undertaken on the data collected, with the finding that mean length of stay was significantly shortened for the ED geriatric medicine patients compared with usual care patients. This did not adversely affect repeat attendances or readmission rates.

TABLE 10 Care co-ordination team interventions

Study and type	Sample characteristics and size	Outcome measured	Results
Arendts <i>et al.</i> ⁷⁸ (matched pairs study)	<ul style="list-style-type: none"> High-risk patients (locally developed screening tool) 2196 patients (1098 intervention patients, 1098 matched control patients) 	28-day ED reattendance, readmission and mortality	No difference in mortality between the intervention group and the control group. The intervention group had a slightly increased ED reattendance rate and a much higher risk of hospital readmission compared with the control group
Arendts <i>et al.</i> ⁷⁷ (non-randomised, prospective pragmatic study)	<ul style="list-style-type: none"> Aged ≥ 65 years with one of six common complaints 3572 patients (2121 intervention patients, 1451 comparator patients) 	Hospital length of stay for patients admitted	No difference in length of stay (median 88 vs. 87 hours) in unadjusted (log-rank $p = 0.28$) or adjusted (IRR 0.97, $p = 0.32$) analysis
Arendts <i>et al.</i> ⁸² (non-randomised, prospective study)	<ul style="list-style-type: none"> Aged ≥ 65 years with one of 10 common complaints 5265 patients (3165 intervention patients, 2100 control patients) 	Admission to inpatient beds	72.0% for the intervention group and 74.4% for the control group – borderline statistical significance (OR 0.88, 95% CI 0.76 to 1.00; $p = 0.046$)

IRR, incident rate ratio; OR, odds ratio.

An assessment team for older people (ATOP) was established in a UK hospital to meet the needs of an increasingly frail population.⁷² The focus of the team was to provide CGA to patients with two or more markers of frailty, with assessment not simply based on age alone. The ATOP consisted of a geriatrician, six senior nurses, a senior social worker and assistant, a senior occupational therapist and assistant and a health-care assistant. The aim of the ATOP was to prevent admissions and, in the 4 months of the study, 178 admissions were prevented in patients who the ED team would otherwise have admitted. A basic cost analysis stated that 'the potential cost saving from preventing the admission of the 89 patients aged 80 years and above seen in the study period could be more than £500,000'.⁷²

Seven studies^{73–75,80,81,83–85} examined interventions delivered to general geriatric populations. An aged care service emergency team (ASET) was established in Australia to reduce missed diagnoses in the ED and prevent inappropriate discharges (and, therefore, ED re-presentations). A study by Ngian *et al.*⁷³ examined these discordant cases (i.e. cases in which the ASET had recommended the admission of patients who were considered suitable for discharge by the ED). The study looked at what additional evidence was measured by the ASET and found that it was more likely to measure functional, cognitive and mobility impairments as well as identifying acute medical conditions. The data collected were largely qualitative and did not have a comparator; however, the study demonstrated the additional information that might be useful when planning the discharge or admission of frail older patients.

A conference abstract of a UK study carried out in the John Radcliffe Hospital ED reported findings from a newly established geriatric liaison team undertaking CGA.⁷⁴ The limited data reported indicated that, over 6 months, and for the 35 patients studied, the length of stay was reduced by 4.8 hours.

An intervention targeted specifically at frail older people was reported by O'Reilly *et al.*⁷⁵ The frail intervention therapy team (FITT) combined allied health professionals to identify all frail patients who presented to the ED and then deliver MDT assessment to them. To analyse the outcomes of the FITT, data were compared for the first quarter of 2015 and 2016 (after the FITT was established). The study reported an 11.6% increase in patients presenting to the ED, a 59% increase in patients discharged and a 42% increase in patients transferred to a ward in < 9 hours.

The formation of a care co-ordination programme in 2005 in Australia was reported by Corbett *et al.*⁸⁰ This MDT, with an emphasis on allied health professional input, was set up to reduce avoidable admissions and inappropriate re-presentations to the ED. Positive study outcomes confirmed a statistically significant reduction in the proportion of patients admitted as well as improvements in the mean quality-of-life score and user satisfaction following the introduction of the care co-ordination programme.

A brief report of a mobile geriatric team (MGT) was provided by Launay *et al.*^{81,85} The intervention consisted of medical assessment (termed geriatric assessment by the study authors) followed by geriatric (medical) and gerontological (medical and social) discharge recommendations. Although outcomes for a small number of patients were evaluated ($n = 168$), the study authors reported that only the geriatric recommendations were associated with early discharge from the ED [odds ratio (OR) 4.38; $p = 0.046$].

In another study, an acute care of the elderly (ACE) service was developed that focused on the establishment of a team (consultant, junior doctor and nurse) to deliver CGA to patients aged > 80 years with complex problems or frailty.⁸³ Data from 10 months of the service showed that 459 out of 662 inappropriate admissions were avoided.

A patient liaison service to better meet the needs of the older patient was evaluated and reported by Berahman *et al.*,⁸⁴ with the main outcome of the study being the measurement of patient satisfaction with the patient liaison service. Comparing the satisfaction of patients who had and had not received the intervention, there was a non-significant slight trend towards improved scores when a patient liaison was present.

Overall, mapping these studies showed that there were few similarities between them. Staffing interventions that added a single member of staff to an ED tended to focus on improving processes and outcomes related to medication management (whether they were delivered by a pharmacist or by another clinician) and improving care co-ordination, follow-up and linkages between the ED and home. Interventions that added a new team to the ED tended to have more of a focus on frail older people, perhaps indicating that, for care to be focused on the frail older person, a variety of health-care professionals need to be included. There were fewer similarities across all of the studies in the outcomes that were assessed, although avoiding admissions and mortality were most frequently measured.

Changes to the physical infrastructure of the emergency department

Eleven studies (12 articles^{86–97}) reported changes to the ED in terms of the physical infrastructure of the ED. These interventions ranged from the creation of geriatric emergency departments (GEDs) (which will also have included changes to staffing), through to making EDs 'frail friendly', making general changes to the ED to benefit all patients but with specific benefits for frail and older people and the establishment of specific units in the ED to meet the needs of frail and older patients. These studies are presented in Table 11.

TABLE 11 Physical infrastructure changes

Details	Study, population	
	Frail older	General older
Staff and structural changes	Silvester <i>et al.</i> ⁸⁶	
Geriatric/'frail-friendly' units	Pareja-Sierra <i>et al.</i> , ⁸⁷ Ellis <i>et al.</i> , ⁸⁸ Conroy <i>et al.</i> ⁸⁹	
GED/senior ED	Salvi <i>et al.</i> ⁹⁰	Genes <i>et al.</i> , ⁹¹ Karounos <i>et al.</i> , ⁹² Keyes <i>et al.</i> , ⁹³ Wilber <i>et al.</i> ⁹⁴
RAC in the ED		Tang <i>et al.</i> ⁹⁵
GED incorporating GEDI-WISE		Ng <i>et al.</i> ^{96,97}
RAC, rapid access centre.		

A UK study by Silvester *et al.*⁸⁶ reported on the redesign of the system of care for older people. This consisted of the formation of a MDT with a clinical systems engineer who facilitated changes in discharge, 7-day working and the designation of a medical assessment unit as a frailty unit with a co-located MDT. Analysis of data over 2 years (before and after the changes) demonstrated a fall in bed occupancy rates, a fall in mortality rates and unchanged rates of readmission.

A key UK study by Ellis *et al.*⁸⁸ evaluated an ACE unit. The four-bedded ACE unit undertook CGA, with the aim of admissions avoidance or direct speciality admission. The study was a non-randomised trial comparing three groups of patients: (1) patients admitted before the ACE unit was set up, (2) patients admitted to the ACE unit and (3) patients admitted to the medical receiving unit outside the hours that the ACE unit was open. The study measured a number of outcomes for patients receiving ACE care and found that there was an increase in same-day discharge, mixed findings on length of stay and no significant findings in terms of 7- and 30-day readmission, 12-month mortality, admission to residential care or living at home.

Another key UK intervention was the establishment of an emergency frailty unit (EFU) within an ED in the UK.⁸⁹ The study was a before-and-after study and the outcome measures were admission rate from the ED, readmission following an ED visit, length of stay for admitted patients and total bed-day use. The EFU, which had 8–12 beds and undertook CGA, was staffed by geriatricians, emergency physicians, physiotherapists, occupational therapists and 'primary care co-ordinators'. Analysis of the pre- and post-intervention data indicated that, although there was a pattern of increased ED attendances over the period of the study, admission rates fell significantly, from 69.6% in 2010 to 61.2% after the EFU was implemented. Readmission rates also decreased (4.7% vs. 3.3% at 7 days; 12.4% vs. 9.2% at 30 days; and 19.9% vs. 26.0% at 90 days). The EFU demonstrated a clear improvement in service delivery outcomes; however, no data on patient outcomes, such as mortality, were collected.

Salvi *et al.*⁹⁰ reported on the patterns of use of a GED (an ED with a six-bed elderly observation unit staffed by geriatricians) by frail older people. Comparing patients who had used the GED ($n = 200$) with those who had used a conventional ED, the patients using the GED had a small but significantly lower mortality rate.

Pareja-Sierra *et al.*⁸⁷ described the impact of an emergency department observation unit (EDOU) on admissions and length of stay. The EDOU was a small, six-bed unit staffed by geriatricians and targeted at frail older people. The author compared data from before and after the EDOU was set up. Although data were limited, the authors reported that an initial increase in admissions was followed by a decrease in admissions and length of stay.

Genes *et al.*⁹¹ reported on patient satisfaction with a GED that combined structural enhancements with service delivery changes. Analysing patient satisfaction data from 286 patients (67 of whom were described as geriatric) surveyed both before and after the GED was established, the authors found that, although overall satisfaction scores did not change significantly for either group, the geriatric group saw significant improvements in satisfaction relating to specific aspects of the GED.

Admissions data were analysed by Karounos *et al.*⁹² following the introduction of a GED. Examining data from pre and post introduction of the GED, there were significantly fewer admissions post introduction [2.9% fewer ($n = 1130$); $p < 0.001$]. This was a large data set ($n = 27,838$), although the authors caution that a further analysis on readmissions and costs is required.

Keyes *et al.*⁹³ also looked at admissions, length of stay and ED visits following the introduction of a senior ED and compared data with those from before the senior ED was introduced. The senior ED comprised a number of changes including staff education, changes to physical infrastructure and screening. Study outcomes demonstrated that the senior ED was associated with decreased admissions but not with ED return visits or length of stay.

A rapid access centre (RAC), a six-bed consultant-led ward, was introduced to a hospital in the UK in an intervention reported by Tang *et al.*⁹⁵ Data on admissions from the RAC were compared with data on admissions from the ED for two 7-month periods before and after the introduction of the RAC. Simple analysis of data from 441 patients showed that patients admitted from the RAC had a shorter length of stay and were discharged earlier.

Ng *et al.*^{96,97} reported on a GEDI-WISE intervention, the introduction of a GED and a before-and-after evaluation of admission rates. They found that admission rates declined by a statistically significant amount following introduction of the ED, from 58.9% in January 2011 to 50.7% in May 2013.

Wilber *et al.*⁹⁴ reported on a senior ED, which was a 15-bed unit, with assessment by a nurse care co-ordinator, interventions and discharge follow-up. This was a pilot intervention and quality assurance data were analysed from before and after the intervention. Statistically significant results were seen for the outcome of admissions, which significantly decreased (from 55.5% to 51.2%, difference -4.3 percentage points, 95 CI -7.2 to -1.4 percentage points). There was a small but insignificant decrease in length of stay and revisits resulting in admission or observation at 7 and 30 days.

Overall, the interventions reporting changes to the physical infrastructure of the ED were also highly variable. Predictably, in most of the studies reported here, changes to the physical infrastructure were made alongside changes to staffing as part of an overall reconfiguration of how care was delivered. Again, the outcomes measured and reported across the studies were variable; however, the majority of studies reported improvements in admissions-related outcomes, although whether or not these were planned outcomes of the interventions and the wider implications for patients of reduced admissions are not reported.

Care delivery interventions

The studies reported in this section are those that describe and evaluate changes to the whole care package delivered to (frail) older people within the ED. The interventions reported in this section take the form of CGA, which combines interventions to identify frail or at-risk older people and interventions to deliver targeted care to them. 'Comprehensive geriatric assessment has become the internationally established method to assess elderly people in clinical practice. It is a process of specialist elderly care delivered by a MDT to establish an elderly person's medical, psychological and functional capability, so that a plan for treatment and follow-up can be developed'.¹²⁵

The majority of studies that we identified in this review were descriptive reports of CGA and CGA-type interventions introduced to ED settings. Details of the 18 CGA studies (22 publications^{24,25,98-117}) included in this review are provided in *Table 12*.

Ismail *et al.*⁹⁸ reported on an interface geriatrician delivering CGA in the UK, which was positively received by staff and patients and led to a non-significant fall in admissions. Three additional UK studies evaluated CGA delivered by an older people assessment and liaison (OPAL) team in Manchester.¹⁰²⁻¹⁰⁴ In these very small-scale service evaluations, there were no significant changes in outcomes following the intervention, although the studies reported a non-significant decrease in admissions and in length of stay compared with age-matched control patients or patients not given CGA by the OPAL team. A similar evaluation of a CGA OPAL team elsewhere in the UK reported similar, improved patient outcomes, although these were also non-significant.¹⁰⁵

A study undertaken in Taiwan^{100,101} of CGA introduced to older people visiting the ED three times in 30 days found that ED revisits were reduced but that the intervention increased admissions. Whether or not this was a positive outcome for patients and the health service overall was not reported.

Identification of at-risk older people followed by CGA was reported in five studies. Beirne *et al.*¹⁰⁷ reported on the use of the ISAR tool to screen patients, who then received a CGA intervention if they were at risk.

TABLE 12 Comprehensive geriatric assessment interventions

Study (type); name of the intervention; who delivers it; where it is delivered	Type of study; sample size	Outcome measure(s)	Results (given only when the results are significant)
Ismail <i>et al.</i> ⁹⁸ (frail); CGA; interface geriatrician; ED	Service evaluation; 534 patients	Admissions avoidance	Not significant
Pareja ⁹⁹ (frail); CGA; geriatrician; ED medical short-stay unit	Prospective study; 1200 patients	Admissions avoidance	Not significant
Chou <i>et al.</i> , ¹⁰⁰ Liao <i>et al.</i> ¹⁰¹ (general); CGA; geriatric team; ED	Prospective cohort study; 137 patients (26 intervention patients)	Admissions, ED revisits	Intervention: more likely to be admitted (50% vs. 22%) and fewer visits to the ED within 1 month (0.81 vs. 1.75 visits) and 6 months (2.2 vs. 4 visits)
Scott <i>et al.</i> , ¹⁰² Wentworth <i>et al.</i> , ¹⁰³ Keelan <i>et al.</i> ¹⁰⁴ (frail); CGA; OPAL team; ED and clinical decisions unit	Scott <i>et al.</i> : ¹⁰² service evaluation; 148 patients	LOS, admissions	Not significant
	Wentworth <i>et al.</i> : ¹⁰³ service evaluation; 990 patients (plus age-matched controls)	LOS, admissions	Not significant
	Keelan <i>et al.</i> : ¹⁰⁴ service evaluation; not provided	Admissions, LOS, 4-hour ED target	Not significant
Hughes <i>et al.</i> ¹⁰⁵ (general); CGA; OPAL team; ED and clinical decisions unit	Service evaluation	Discharge location and discharge rates, admission location and admission rates, LOS, readmission rates	Not significant
Fox <i>et al.</i> ¹⁰⁶ (frail); CGA; embedded geriatrician; ED	Retrospective feasibility study; 168 patients	LOS, discharge rates, admission rates	No control group
Beirne <i>et al.</i> ¹⁰⁷ (general); ISAR plus CGA; ED	Prospective data analysis; 300 patients	ED reattendance	Not significant
Yuen <i>et al.</i> , ¹⁰⁸ Chui and Kun ¹⁰⁹ (general); 'We Care' CGA; ED	Retrospective study; 2202 patients	Admissions avoidance	Not significant
Yuen <i>et al.</i> , ¹⁰⁸ Chui and Kun ¹⁰⁹ (general); 'We Care' CGA; ED	Retrospective study; 1096 patients	Admissions avoidance	Not significant
Nguyen <i>et al.</i> ¹¹⁰ (general); synthesised geriatric assessment; ED	Pilot observational convenience study; 25 patients	Time taken to complete SGA	N/A
Lo Storto <i>et al.</i> ¹¹¹ (general); CGA; social health triage team	Prospective cohort study; 226 patients	Admissions avoidance	N/A
Foo <i>et al.</i> ¹¹² (frail); TRST, assessment, intervention; ED	Quasi-RCT; 780 patients (280 intervention and 500 control patients)	Change in functional status (3, 6, 9 and 12 months), ED reattendance, rehospitalisation	Intervention group had significant preservation in function at 12 months (basic ADL -0.99 vs. -0.24, $p < 0.01$; IADL -2.57 vs. 0.45, $p < 0.01$). Small but not significant reduction in ED reattendance and hospitalisation for the intervention group

TABLE 12 Comprehensive geriatric assessment interventions (continued)

Study (type); name of the intervention; who delivers it; where it is delivered	Type of study; sample size	Outcome measure(s)	Results (given only when the results are significant)
Yim <i>et al.</i> ²⁵ (frail); ISAR, intervention and CGA-type intervention; ED	RCT then cohort study; RCT 1279 patients, cohort study 1820 patients	Composite outcome of institutionalisation, hospital admission within 1 month, early return or frequent visits to ED or death	
Grudzen <i>et al.</i> ¹¹³ (general); screening, intervention; ED	Retrospective cohort study; 8519 patients	ICU admission rate	Over a 29-month study period, unadjusted ICU admission rate declined from 2.3% to 0.9%. Adjusting for age, sex, ESI score and others, decline was still significant (β -0.0073, 95% CI -0.0105 to -0.0041; $p < 0.001$)
Warburton ¹¹⁴ (frail); ISAR screening, intervention; community hospital ED	Evaluation research	LOS, ED returns, hospital admissions, multiple ED returns/admissions following the index episode	Reported qualitatively
Foo <i>et al.</i> ¹¹⁵ (general); geriatric nurse liaison assessment; EDOU	Prospective before-and-after study; 487 patients (315 intervention and 172 control patients)	ED reattendance, hospitalisation	Intervention: lower ED reattendance rate (adjusted IRR 0.59, 95% CI 0.48 to 0.71) and lower 12-month hospitalisation rate (adjusted IRR 0.64, 95% CI 0.51 to 0.79)
Eklund <i>et al.</i> ²⁴ (frail); continuum of care; ED and community	RCT; 76 control and 85 intervention patients	Functional ability, frailty	Improved degree of ADL independence at 3 and 12 months (OR: 2.37 intervention, 2.04 control). No differences between groups with regard to changes in frailty
Mahony <i>et al.</i> ¹¹⁶ (general); screening, discharge/admission, follow up; ED	Pilot project – chart review; 894 patients	Not stated	Not significant
Wright <i>et al.</i> ¹¹⁷ (general); TREAT (geriatrician, CGA, discharge support); ED	Before-and-after retrospective cohort study; 5416 patients before and 5370 patients after, with 593 geriatric admissions	Admissions, LOS	<p>Median LOS for intervention reduced by 2 days and mean LOS by 18.6% (1.78 days; $p < 0.001$)</p> <p>Control: median LOS was unchanged and mean LOS reduced by 1.08% (0.11 days; $p = 0.065$)</p> <p>Intervention: percentage of admissions resulting in same-day discharges increased from 12.26% to 16.23% (OR 1.386, 95% CI 1.203 to 1.597; $p < 0.001$) following the introduction of TREAT</p> <p>Control: same-day discharge fell from 15.01% to 9.77% (OR 0.613, 95% CI 0.737 to 0.509; $p = 0.001$)^a</p>

ADL, activities of daily living; IADL, instrumental activities of daily living; IRR, incidence rate ratio; LOS, length of stay; N/A, not applicable; OPAL, older people assessment and liaison; SGA, synthesised geriatric assessment; TREAT, triage and rapid elderly assessment team.

a Values reported in original text.

A convenience sample of the 'at-risk' patients received CGA in the ED with community follow-up. There was a small, insignificant, reduction in ED reattendance in the intervention group. Foo *et al.*¹¹² reported on a quasi-RCT undertaken in Singapore that had functional status as its primary outcome measure. Despite the fact that those in the intervention group were frailer than those in the control group, there was a significantly better outcome of functional preservation at 12 months in the intervention group than in the control group. There were also improvements for the control group in terms of avoiding admissions and ED reattendance, but these were not significant. Yim *et al.*²⁵ developed a Hong Kong version of the ISAR tool to screen patients and then delivered a CGA-type intervention to those identified as being at high risk. High-risk patients were identified through a cohort study of the Hong Kong ISAR tool and then patients were randomised to the intervention or the control. Limited information on the methods used in the RCT were provided and there were no significant differences between the intervention group and the control group in any of the individual or composite outcomes. Grudzen *et al.*¹¹³ reported on an intervention that combined screening to identify patients in need of an intervention to prevent inappropriate admissions with appropriate referrals to palliative care services. This was part of the wider GEDI-WISE intervention. With the premise that admission to acute services is not appropriate for patients who require palliative care services, ICU admissions significantly declined.

The development of a screening plus intervention 'elder alert' in the USA was described by Warburton.¹¹⁴ The aim of elder alert was to develop a strategy to identify and manage high-risk ED patients aged > 75 years. This included screening patients using the ISAR tool. Screening was found to be accurate and referral to appropriate management appeared to have a positive impact. Comparing groups of patients showed that screening needed to be followed by an intervention for patient outcomes to be improved. Notable cost savings were projected by the evaluation.

The Hong Kong-based 'We Care' CGA programme^{108,109} delivered CGA with the aim of admissions avoidance. The authors reported positive results, with only 15% of patients admitted; however, they did not compare these data with any other admissions data.

Limited evidence from Ngyuen *et al.*¹¹⁰ indicated that a self-administered intervention, the synthesised geriatric assessment, was feasible as it was completed within 20 minutes ($n = 25$ patients). Lo Storto *et al.*¹¹¹ reported on the introduction of a social health and triage team to deliver CGA and found that inappropriate admissions were avoided, although data to confirm this finding were not provided.

Four studies^{24,115-117} reported on discharge interventions, which was a smaller number than anticipated. In the study by Foo *et al.*,¹¹⁵ additional geriatric assessment prior to discharge was delivered by a geriatric nurse, with interventions delivered as appropriate. Positive outcomes for this assessment were reported in terms of hospitalisation and ED reattendance.

Interventions that started in the ED but that included substantial post-ED follow-up were reported in three studies.^{24,116,117} Eklund *et al.*²⁴ evaluated the 'continuum of care', which was designed to help frail older people to remain in their home environment. The intervention was initiated in the ED by geriatric nurses and followed up in the community by a multiprofessional team. The outcomes studied were frailty and activities of daily living (ADL), with the intervention demonstrating improvements in ADL compared with the control group; there were no differences in frailty scores.

Mahony *et al.*¹¹⁶ examined an intervention in which patients were screened by a nurse for palliative care triggers and, if they screened positive, received an intervention that consisted of an assessment of needs, consultation and follow-up. Although the results were not significant, there were small reductions in length of stay, which were attributed to better links with home care services.

A before-and-after cohort study by Wright *et al.*¹¹⁷ reported on the UK triage and rapid elderly assessment team (TREAT) intervention, consisting of assessment, CGA and pre- and post-discharge support. This complex intervention saw improvements in a number of outcomes. Median and mean length of stay were

significantly reduced. The same-day discharge rate significantly increased for those who had been given the TREAT intervention.

To summarise, the evidence base describing CGA and CGA-type interventions is larger than that for other types of service delivery innovations, which is suggestive of the acceptability and feasibility of these types of interventions. More data on outcomes were provided by study authors, with most of these studies measuring outcomes in terms of either admissions avoidance or ED reattendance. Only one study focused on patient outcomes alone (ADL and frailty).²⁴ There appears to be a general trend for these interventions to improve admissions avoidance. Notably, there was little evidence on discharge interventions that are delivered in the ED to prevent readmission.

Other interventions

Three additional interventions were identified and are reported in *Table 13*.

Terrell *et al.*¹²⁰ reported a RCT from the USA of computer-aided decision support to reduce prescribing errors for older people by reducing the prescription of potentially inappropriate medicines on discharge from the ED. The intervention was delivered to 32 ED physicians (with 31 acting as a control group). The RCT found that the proportion of potentially inappropriate medicines being prescribed significantly decreased from 5.4% to 3.4%.

A screening intervention to identify patients at a high risk of falls¹¹⁹ and a screening intervention to reduce waiting times¹¹⁸ were identified. Huded *et al.*¹¹⁹ reported on the use of the TUGT, which was performed on 443 of 1135 patients by a geriatric nurse. These patients had not presented with falls but those who screened positively were referred to fall prevention interventions.

In the study by Lovato *et al.*,¹¹⁸ the Silver Code prognostic tool was demonstrated to result in reduced waiting times for frail older people. On arrival in the ED, patients were allocated a colour code and those who received a specific code were seen more quickly. The observational retrospective data showed that waiting times for frail older people decreased, without waiting times for other groups increasing.

Summary of service delivery interventions

Staffing initiatives tended to take the form of either a specialist geriatric member of staff (doctor, nurse or pharmacist) working in the ED or the development of a geriatric MDT. Roles tended to be in care-co-ordination, assessment or medication management. Differentiating between studies of staff initiatives and the introduction of CGA-type initiatives was not always straightforward and interventions to change the physical infrastructure of the ED were often delivered in addition to a change in staffing.

The evidence for improved outcomes for individual staff interventions was limited. Across a broad range of outcomes there was limited evidence that the interventions had improved patient outcomes. Study authors attribute this to problems with study design and the lack of community follow-up of the ED intervention.

Evidence from MDT-type interventions largely showed beneficial outcomes in terms of reducing avoidable admissions and improving early discharge rates from the ED. The CCT interventions had mixed results,

TABLE 13 Other interventions

Details	Study, population	
	Frail older	General older
Silver Code to reduce waiting times	Lovato <i>et al.</i> ¹¹⁸	
TUGT assessment to identify 'at-risk' falls patients	Huded <i>et al.</i> ¹¹⁹	
Prescribing decision support to reduce prescribing errors		Terrell <i>et al.</i> ¹²⁰

with a borderline improvement in reducing avoidable admissions in one study,⁷⁸ but a higher risk of ED reattendance and a much higher risk of hospital readmission in another.⁸²

Structural changes to the ED took the form of the development of GEDs (all studies were from the USA), adapting ED environments to better meet the needs of older or frail patients or establishing units on the ED to meet the needs of these patients. A number of UK studies were reported in this category, with largely positive outcomes in terms of decreased admissions and improved discharge times and rates.

The evidence base for CGA-type interventions was much larger than that for other types of service delivery changes. Of the 18 studies^{24,25,98–117} that described CGA and assessment interventions in the ED, six reported results that had statistical significance.^{24,100,101,112,113,115,117} These results were again highly variable but there was a general trend towards improved outcomes in terms of admissions avoidance.

Narrative summary of relevant systematic reviews

A number of systematic reviews (and other review types) have examined interventions delivered in the ED to frail and older people. Seventeen reviews^{10,121,122,126–139} are presented below. As with the primary research papers, these have been divided into sections reporting studies on the identification of frail/high-risk populations and studies reporting service delivery interventions. Summary tables of data from these reviews are available in *Appendix 2*.

Identification of frail or at-risk older people

The review by Sutton *et al.*¹²¹ focused on screening tools to identify older patients presenting to EDs who are at risk of functional decline. Five separate screening tools were identified: the hospital admission risk profile (HARP), ISAR tool, TRST, complexity prediction instrument (COMPRI) and Evaluation du Risque de Perte d'Autonomie (SHERPA). None of these tools was recommended as a gold standard screening tool. Thiem *et al.*¹²⁶ also examined the same five tools, plus the Index of Functional Decline. They found that, even though the ISAR tool has been examined the most frequently and tested the most widely, even for this tool the evidence is weak or conflicting. The review authors also cautioned that management approaches need to be considered alongside screening tools, as there is no value in identifying frail or high-risk patients unless interventions can be tailored to meet their needs.

In 2012, McNamara *et al.*¹²⁷ examined six screening tools used during triage of older patients to identify those at risk. These tools comprised three 'general' tools (Manchester Triage, Emergency Severity Index and the CTAS) and three specific tools [ISAR, TRST and variables indicative of placement (VIP)]. The review found that the ISAR tool and TRST performed best, with good sensitivity, a high negative predictive value, low specificity and a low positive predictive value. The VIP had low sensitivity. The review cautioned that clear distinctions need to be made between those who are in need of acute medical care and those who are in need of discharge follow-on care.

Bissett *et al.*¹²⁸ looked at the functional assessment tools used in ED practice. They identified 14 different assessments, four of which were developed specifically for the ED [TRST, ISAR, Runciman questionnaire¹²³ and Functional Status Assessment of Seniors in Emergency Departments (FSAS-ED)]. The review examined the validity of the tools rather than their outcomes and found that the ISAR tool and TRST were most suitable for fast screening and the Runciman questionnaire¹²³ and FSAS-ED were most suitable for comprehensive screening.

The review by Yao *et al.*¹²² looked at the ISAR tool only, in terms of its predictive validity in identifying adverse outcomes for older patients following an ED visit. The review included 10 studies and found that the ISAR tool is quick to use and inexpensive and recommended its use. However, although it was found to have value in identifying high-risk patients with frailty, it has poor, or poor to fair, predictive validity for adverse health outcomes for patients discharged from the ED.

The review by Carpenter *et al.*¹²⁹ looked at what might predict short-term adverse outcomes in GED patients and examined the prognostic value of individual risk factors and ED screening instruments. Seven tools were examined: ISAR, TRST, VIP, Silver Code, Mortality Risk Index and Rowland¹²⁴ and Runciman¹²³ questionnaires. Various predictors of vulnerability were also considered. The review found that adverse outcomes often occurred post discharge and so identification of these outcomes is critical. However, the review found that there were no risk factors or screening instruments that had sufficient prognostic accuracy to distinguish patients at risk.

The findings of these reviews broadly reflect the findings of our mapping of the primary research – that there are a wide number of tools to identify older people at high risk of adverse outcomes following ED and to identify older patients with frailty. There is no clear recommendation on which tools to use in practice – the ISAR tool is used widely and has been extensively evaluated, but the evidence base for use of the tool is not strong.

Service delivery innovations

Looking specifically at the population of cognitively impaired older people, Parke *et al.*¹³⁰ examined screening and service delivery interventions to better manage this population in the ED. They found that the contextual details and characteristics of interventions were poorly reported and that there were no interventions that were effective and the screening tools identified were inconsistently used and it was therefore difficult to measure effectiveness.

Schnitker *et al.*¹³¹ also examined evidence on interventions for cognitively impaired older people and identified 12 studies of their management in the ED. These 12 studies were categorised into four groups: (1) those designed to improve recognition of cognitive impairment (and subsequent provision of care); (2) those designed to prevent delirium; (3) those designed to manage behavioural or psychological symptoms; and (4) 'other interventions'. They proposed the routine inclusion of screening and assessment into care practices and stressed the importance of both screening patients quickly to recognise cognitive dysfunction and using risk tools on discharge.

Two reviews examined the use of CGA in the ED. Graf *et al.*¹³² looked at how best to screen to identify eligible patients for CGA as well as the use and value of CGA. They found that routinely using CGA without screening first was too time-consuming and that an approach that screened for high-risk patients who were then given CGA was most effective. The most effective tool was found to be the ISAR tool. CGA was found to be effective at decreasing functional decline, ED readmission and possibly nursing home admission. Conroy *et al.*¹³³ looked at whether or not CGA improved outcomes for frail older people who received this intervention at the point of discharge when they had been discharged rapidly. Using formal systematic reviewing methods, the review looked at a number of outcomes and did not find clear evidence for the benefits of CGA at the point of discharge for this specific population. The review highlighted the lack of trial evidence in this population and the limitations of the small amount of trial evidence that does exist.

Fan *et al.*¹³⁴ reviewed interventions to reduce ED utilisation. The scope of their review was wider and looked at community interventions as well as those delivered in the ED. Although the community interventions were generally more effective than those delivered in the ED for reducing ED utilisation, five ED interventions significantly reduced ED utilisation. These interventions were varied and incorporated risk screening, assessments or discharge planning and referral co-ordination.

The review by Lowthian *et al.*¹⁰ looked at ED-to-community transition strategies. The review identified nine low-quality research studies that examined interventions that tended to consist of ED assessment with community follow-up. The assessments took a number of forms, including use of the ISAR tool, CGA and discharge planning. There was limited evidence of effectiveness with regard to the outcomes of interest, which included unplanned reattendance, admissions or mortality.

In 2015, Karam *et al.*¹³⁵ undertook a review of interventions delivered within EDs in relation to four outcomes (ED revisits, hospitalisations, nursing home admissions and deaths following discharge). Nine studies met the review inclusion criteria. The effectiveness of interventions was found to be related to intervention intensity – the more intensive an intervention, the more frequently it resulted in reduced adverse outcomes. For the less intensive interventions, effectiveness was enhanced when a screening tool for identifying high-risk patients was used. Karam *et al.*¹³⁵ argued that the specific choice of screening tool to use may be less important than how the tool is actually used.

Others

Tran *et al.*¹³⁶ examined interventions to prevent ED returns in a population of older ED patients. The intensive interventions that they examined, alongside risk factors for ED return, resulted in a reduction in short-term ED returns, but this pattern did not hold in the long term. It was not clear whether or not this long-term pattern was anticipated.

Sinha *et al.*¹³⁷ used a systematic review to develop a geriatric emergency practice model to improve patient outcomes. Examining 28 outcome measures, their review included eight model characteristic components that were seen to contribute to improved outcomes. These eight components were evidence-based practice, nursing clinical involvement/leadership, risk screening, focused geriatric assessments, discharge planning within the ED, interprofessional working practices, discharge follow-up and evaluation/monitoring.

Both screening and service delivery interventions were considered in the review by Fealy *et al.*,¹³⁸ who looked at the effectiveness of nursing interventions for older ED attendees. Although no statistically significant effects were found on patient or health service outcomes, improved effectiveness was demonstrated when interventions incorporated post-ED discharge planning and/or referral.

Summary of review-level evidence

The systematic and other types of reviews that we identified in the searches for the review of primary evidence encompassed both screening and intervention studies.

The screening reviews tended to identify the tools that were available and aimed to assess their value and determine whether or not a single tool could be recommended for use in the ED. The evidence for screening tools was found to be very mixed. The ISAR tool and TRST were found to be the best-performing tools for triage,¹²⁷ frailty screening¹²² and rapid functional assessments.¹²⁸ However, other reviews that examined these tools did not find sufficient evidence to recommend their use. A prognostic review by Carpenter *et al.*¹²⁹ found that there were no risk factors or screening instruments that had sufficient prognostic accuracy to distinguish patients at risk.

In terms of service delivery interventions, there was mixed evidence on the outcomes of CGA.^{132,133} There was evidence that specific interventions reduced short-term ED returns, but this did not hold in the long term.¹³⁶ Fan *et al.*¹³⁴ identified five ED interventions that reduced ED utilisation, which included elements of the following: risk screening, assessments, discharge planning and referral co-ordination. Karam *et al.*¹³⁵ examined the effect of interventions on ED revisits, hospitalisations, nursing home admissions and deaths following discharge and found that the intensity of an intervention was a greater predictor of effectiveness than the intervention itself and that the choice of which tool to use was less important than how the tool was used.

Focusing on interventions delivered by a specific health-care professional, Fealy *et al.*¹³⁸ examined nursing interventions, none of which was found to be significant in terms of patient or health service outcomes, although outcomes were improved when post-ED discharge planning was incorporated in the intervention.

Focusing on a specific population, Parke *et al.*¹³⁰ and Schnitker *et al.*¹³¹ examined screening and service delivery interventions to better manage cognitively impaired older people. No specific tools or interventions were found to be effective – the inconsistent application of the screening tools limited any conclusions that could be drawn from the evidence.

Patient pathway diagram

Summarising the evidence from the primary research studies on identifying frail and at-risk older people, interventions to manage them and the identified systematic reviews, a patient pathway diagram (*Figure 2*) was developed to present the interventions identified and their potential outcomes.

Assessment of the evidence base

This review aimed to map the evidence on interventions to identify and manage frail older people. Mapping reviews seek to characterise an evidence base, not compare interventions on the basis of their effectiveness. Although formal quality assessment is appropriate within the systematic review process, to examine whether or not included studies may be at risk of bias, it is not required in a mapping review, as a mapping review does not interpret evidence to inform specific clinical questions or decisions. Rather, it aims to summarise and map studies and make future research recommendations.

In the case of this mapping review, the use of a single standard tool for quality assessment, such as the Cochrane risk of bias tool, would not have been possible because of the diversity of the study designs. In addition, the use of a set of quality-assessment tools would have been challenging because of the variable reporting of interventions and outcomes in the research.

Rather than a formal quality assessment, we carried out a bespoke assessment of the evidence base using three distinct methods:

1. an examination of the research designs used and the strengths and limitations of those designs
2. an examination of the self-reported limitations included in the articles relating to frail or high-risk older people
3. an assessment of the relevance of the evidence to the contemporary UK NHS setting.

Research designs and their strengths and limitations

The majority of included studies used a prospective observational research design. The screening papers generally measured the accuracy of a tool by gathering follow-up data at a particular time point (that varied across studies) from different sources, including medical records, patient and carer interviews or return visits to the ED. This type of study design was also used in the majority of service delivery intervention studies. These studies, although valuable for descriptive purposes, do not provide direct evidence on the clinical usefulness of a screening tool (in comparison with another tool or an unscreened control group) or the effectiveness of an intervention. The lack of a control group means that it is not possible to determine if the intervention or tool is more clinically effective or cost-effective than usual care.

There are a number of other weaknesses of these study designs that may influence the reliability and validity of their findings. The selection of the study population depends on whether or not patients were exposed to the screening tool or the intervention. Selection bias may therefore influence which patients were given the assessment tool or the intervention. In some studies, for example, the use of a tool was limited to specific times of the day,²¹ or particular groups were excluded such as those presenting with trauma.⁹⁰ This might lead to an under- or over-representation of particular groups of patients and limits the generalisability of findings.

The methods of measuring follow-up outcomes may also introduce bias in studies of this design. Studies may rely on the collection of data that may not have been undertaken consistently. Patients may, for example, return to different ED departments or hospital records may not be consistently coded. The length of follow-up also varied in the included studies, meaning that comparisons between studies may be limited. The number of patients lost to follow-up was also poorly reported but is likely to be very high.

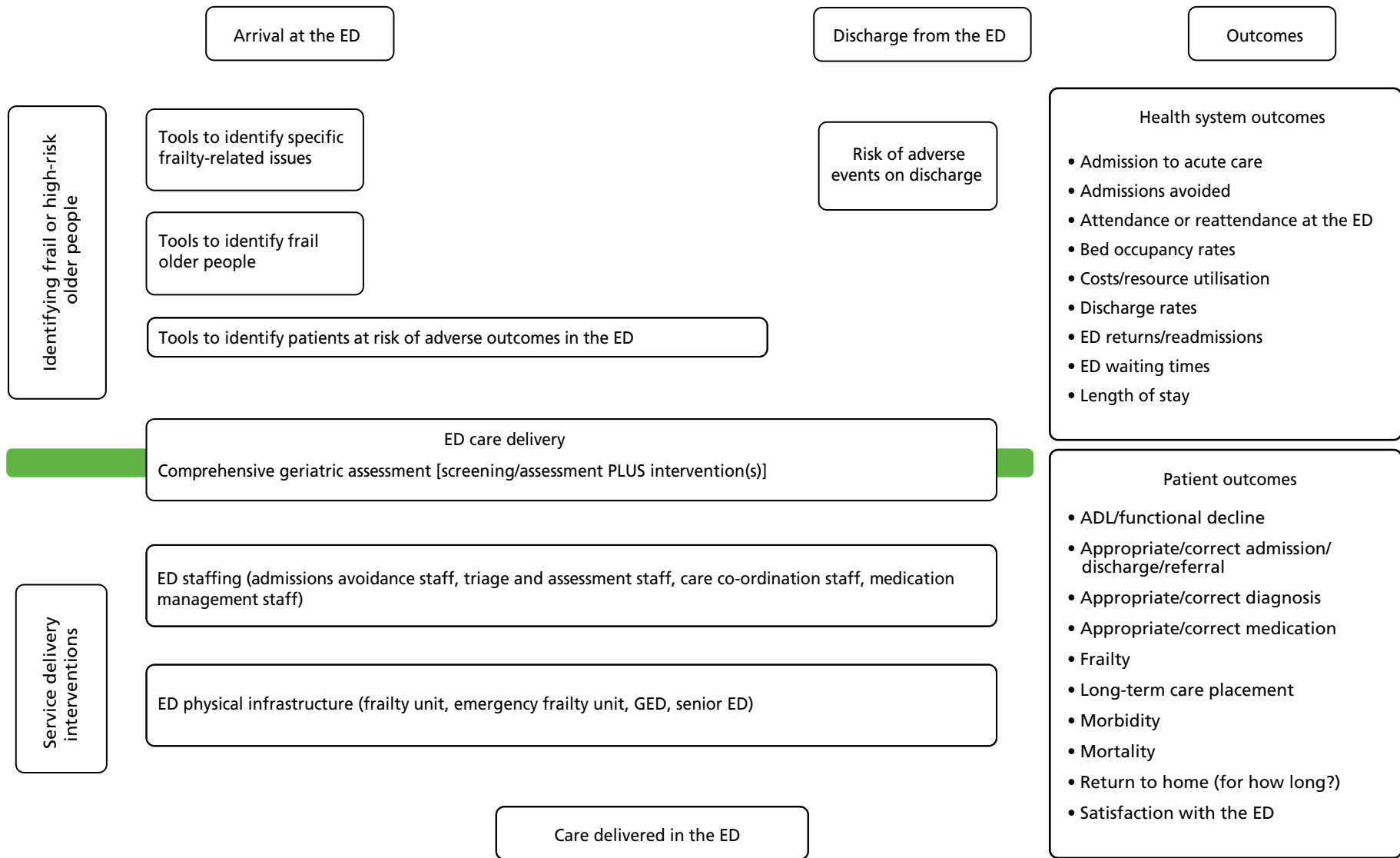


FIGURE 2 Patient pathway diagram.

This may result in bias if there are differences in follow-up between those who had the outcome being measured and those who did not.

Prospective studies in which data on explanatory and confounding variables are collected before outcomes are known to have an advantage over other study types in determining whether or not outcomes might be associated with the outcome of a tool or the effect of an intervention, as there is less risk of selection or information bias relating to outcomes. In contrast, a retrospective design, used in 12 studies in this review, may affect outcome classification if the exposure to the tool or intervention is known by the person assessing the outcome status (observer bias).

Of the included studies, only a small number used designs that would be appropriate for testing diagnostic accuracy of screening tools or the clinical effectiveness of interventions. The studies that were used to evaluate clinical effectiveness included RCTs, a quasi-randomised study and before-and-after studies.

These research designs are also at risk of bias. Diagnostic accuracy studies in this review may be vulnerable to selection bias if the sample of patients chosen to receive the screening tool or intervention is not random. It may be that the expertise of the individuals using the tools may influence how they are used, leading to measurement bias. The reference standards may also have limitations.

Before-and-after studies offer a valuable method of evaluating clinical effectiveness when a randomised trial may not be feasible. They can provide a historical control against which outcome data may be compared. A weakness of this type of study design is attributing change in outcomes solely to an intervention. It may be that other factors might also influence outcomes, for example staff changes or initiatives in the community for frail older people by a voluntary organisation.

There was a limited attempt to measure the costs of screening and interventions, in terms of either the cost of the intervention or the costs saved as a result of improved outcomes. The nature of many of the interventions reported here is that patients are more appropriately cared for in community settings on discharge, rather than in the acute setting, which is why reduced admissions are a frequently reported outcome. However, there is little evidence on measuring how this 'care' is displaced from the ED to the community and the effect that this has on costs.

Compared with service delivery intervention studies more generally, there was a lack of long-term follow-up of individual study participants in the studies reported here. This may be because of the nature of frail older people. Interventions delivered to general older populations, on the other hand, can be followed up over a longer period of time because of their relative better health. The nature of research in the ED means that short-term outcomes are more straightforward to measure. These shorter-term outcomes, such as admissions and length of stay, are outcomes for both the health service and patients. Longer-term patient outcomes (such as mortality) often assumed lesser importance in the reporting of study findings. However, shorter-term outcomes are much more appropriate for an older population, especially given that frail older people are often nearing the end of life. Not only are longer-term outcomes harder to measure, they also assume less importance for this population group, whose outcomes may be better reported in terms of intervention acceptability, for example.

Much of the evidence was not experimental; the majority of the study designs were retrospective or prospective before-and-after cohort studies, with very few trials (either randomised or non-randomised). The sample sizes tended to be small, particularly for the experimental research.

The ED is a challenging place to deliver care, let alone undertake experimental research. The difficulties in undertaking research are reflected in the fact that many of the described interventions are limited in terms of the hours during which they are offered to patients, the staff who are available to deliver them or unintended events (such as outbreaks of infectious diseases), which hamper their evaluation.

There was not much evidence on staff education, which is surprising. When looking at interventions that introduced staff changes, the extent to which staff members had received additional education and training is unclear. The lack of evidence on staff education in this review may in part be related to the outcomes of interest to this review; patient and health service outcomes may be too distal for staff education and the outcomes of interest to staff education interventions, such as increased knowledge and confidence, were outside the scope of this review.

One of the key limitations of the evidence base was the inability to distinguish the frail population from the general population of older adults. Much of the evidence included in the review was not specific to frail older people, instead including a target population aged ≥ 65 years. However, on closer scrutiny, although the interventions tended to be taken up by populations with a mean or median age of ≥ 65 years, in many cases the population was much older. However, the lack of consensus around the definition of frailty makes designing interventions for this population and monitoring their outcomes, and the effectiveness of their outcomes, challenging. In addition to the lack of 'frail' population groups, only two studies used changes to frailty as an outcome measure.^{24,112}

Author-reported limitations

The authors of studies routinely highlighted limitations of their methodology, which led them to caution the extent to which their findings can be generalised and compared with those of other studies. The self-reported limitations of the studies in which frail older people were the focus and full data extraction was undertaken were extracted and a narrative summary of these is given below. A major limitation is the number of conference abstracts that were included in the review; not only is detail missing on the study methods for our assessment of the limitations of the evidence, but conference abstracts rarely contain data on study limitations.

In terms of the sources of data used, data were often collected from routine sources not specific to the studies.^{86,88} Authors commented on the seasonal fluctuations in ED attendance,^{61,106} which may affect the generalisability of the results. There was a general lack of data from outside the ED on participants or service use (community or use in other settings),⁸⁶ which limited follow-up, and many of the data collected were retrospective.⁵³

Many of the studies were retrospective or prospective before-and-after studies and there were a limited number of controlled trials. Jones and Wallis⁶¹ and Fox *et al.*¹⁰⁶ noted the lack of a control group, with Silvester *et al.*⁸⁶ and Conroy *et al.*⁸⁹ commenting on the lack of a contemporaneous control group. In addition, a number of authors cautioned that their study had a small sample size,^{67,71,98,106} that both participants and staff were not blinded (when there was some element of controlling interventions);^{21,24,112} that not all variables were controlled for;^{27,78} that the study was conducted at a single centre therefore limiting generalisability;^{29,33,49,53} and that there may have been some selection bias.⁵²

The way in which screening and interventions were delivered was cited as a limitation; examples included that the intervention was not delivered 24 hours a day so not all potential participants were included;^{21,27,49,78,106} only non-urgent attenders were included; the screening tool used was amended for a local setting;⁷⁸ the difficulty in recruiting patients;¹¹² and unforeseen circumstances, such as an infectious disease outbreak, which may have influenced the study results (before-and-after study).⁸⁸

The impact of study findings was limited by the lack of long-term follow-up patient outcome data^{73,86,89} and the fact that, when there was follow-up, there were high rates of dropout^{24,29} because of the nature of the population. Two authors also mentioned that study findings would have been enhanced if qualitative data on staff or carer satisfaction with the intervention had been collected.^{86,112}

In line with the limitations that we identified, there was no clear definition of frail older people^{27,61} and there was a lack of cost data.^{72,89}

Relevance of the evidence to the current NHS setting

The consideration of the relevance of the included studies to the NHS setting lies largely in whether or not they have reported research undertaken within the same health system, whether or not the health systems in which the studies were undertaken can be compared with the NHS and whether or not the interventions and screening tools used could be used within the NHS.

In terms of the screening papers, it is noteworthy that only one screening paper²⁰ reported research undertaken in UK EDs. This is in contrast with the depth of research being undertaken in community settings on screening for frailty. In contrast, the intervention papers more widely reported UK research. In particular, interventions for frail populations in the UK combined screening and interventions, perhaps suggesting that it is considered more effective to combine these interventions rather than consider them separately.

In terms of whether or not the included studies could provide models that could be used in the NHS, it is unlikely, given the current NHS landscape, that the GED is a model that would be adopted. Indeed, the current pressures on the ED service make it a challenge (both financial and logistical) to introduce any new interventions and evaluate them.

Chapter 5 Discussion

This mapping review identified > 100 papers from the last 11 years that reported screening or management interventions for older people, including those identified as being frail or at high risk of adverse outcomes in the ED. This large body of evidence was subdivided into interventions for identifying those older people who are frail or who are at risk of adverse outcomes and interventions for managing them. The following sections summarise the overall evidence base and the evidence for the identification and management of frail older people.

The evidence base

This review has summarised a large and heterogeneous evidence base on approaches to the management of frail and older people in the ED. The review has taken an inclusive approach to evidence, looking at conference abstracts, full papers and systematic reviews in an attempt to examine the approaches used and the outcomes that they have (potentially) influenced. The way in which the term 'frail' was used by study authors was very variable and the age at which patients were considered to be older also varied. The evidence base in terms of study design and reporting is variable and not particularly robust. However, the aim of this review was not to compare the effectiveness of interventions, but to characterise the full range of interventions reported and their outcomes.

Summary of the evidence for screening

Many screening tools have been evaluated, particularly the ISAR tool and TRST, but few have been validated in a wide range of populations/settings and specifically in UK settings. The evidence demonstrates that screening tools are used for different purposes: to identify those requiring further assessment or, directly, to support management decisions. For example, a tool with a high diagnostic sensitivity for frailty may be useful for identifying people who are unlikely to benefit from further geriatric assessment. Newer tools appear worthy of further evaluation; these include the Silver Code, which uses administrative data available at the time of presentation. The ability of tools to predict patient outcomes such as return to the ED or hospital readmission is likely to be health system specific, as it depends in part on what support is available in the community to support patients to achieve these outcomes. Hence, it follows that results from non-UK settings cannot easily be generalised to the UK. The number and variety of tools used to identify frail and at-risk patients in the ED was reinforced through the findings of the review of systematic reviews. CGA interventions included screening patients for frailty or patients at high risk and then delivering bespoke interventions to this group.

Summary of the evidence for service delivery innovations

The evidence base on changes to service delivery for (frail) older people is large. Even limiting this to evidence from the last 10 years, a wide variety of approaches were identified. The evidence was divided into a number of categories: changes to ED staffing, structural changes, introduction of CGA and CGA-type interventions and other interventions. However, there was significant crossover in the interventions, for example structural changes tended to change what was done to patients, as well as where it was done. This was not a surprising finding, as to isolate and control for specific staff or structural elements in a system as complex as an ED would be a challenging undertaking. The range of outcomes was highly diverse, with an example being that some interventions focused on preventing inappropriate discharges (of patients who required an admission), whereas others focused on preventing inappropriate admissions (in patients who were medically able to be discharged but who, because of their frailty, were likely to be admitted).

Changes to staffing in the ED included the introduction of a specific member of staff or a new team with a specific remit to address an issue pertinent to the care of frail and at-risk older people (e.g. medication management or care co-ordination).

Physical infrastructure changes often incorporated staff changes in addition to those of the physical surroundings of the ED. All of these interventions reported positive outcomes for patients – generally reduced admissions to acute care and improved discharge times and rates. The three categories of physical infrastructure changes that we identified had slightly different mechanisms for how outcomes might be changed. GEDs may be available for all older people; therefore, those who are attending and who are frail or at high risk may need additional screening to identify their needs. Making all EDs frail friendly will have benefits for everyone who attends, but the greatest benefit should be for patients who are frail or at high risk, who may receive additional interventions. Finally, frailty units will require screening of older patients to identify those who are frail or at high risk. McNamara¹⁴⁰ discussed the development of GEDs, which have been largely developed in the USA¹¹ but are a proposed solution to the fact that older people have different clinical and social needs from those of the general adult population. However, Maile *et al.*¹⁴ argued that it is more appropriate and realistic to make EDs 'frail friendly', as to develop a specific GED has cost and access implications. It appears that the approach of making EDs more frail friendly, or introducing 'frail units' within EDs, has been adopted more widely in the UK than the more radical reorganisation of services to create GEDs.

The interventions focused on CGA and assessment of frail and high-risk older people demonstrated a general trend towards improved admissions avoidance and reduced ED attendance.

The review found some evidence on discharge planning. This took a number of forms: from prognostic screening to identify patients at risk on discharge, to CGA interventions that incorporated discharge planning, to interventions such as the continuum of care, which integrated ED and community follow-up. The aim of these interventions tended to be to prevent readmissions to the ED, which in turn can improve patient outcomes. There is little evidence in this review of evaluation taking place; interventions tended to be reported in terms of study outcomes at a single point in time, with few papers reporting ongoing data collection and evaluation of these data. In addition, there was little evidence of evaluation around satisfaction with interventions from staff or patient/carer perspectives.

A theme running throughout the interventions reported here is that increased engagement with health professionals through service delivery interventions may appear to stimulate demand through increased admissions to acute care (or increased readmissions), which could represent an unintended consequence of interventions. Additional admissions and readmissions may represent increased interaction with the health service, but these patients may well represent the frailest patients and it is not possible, using the data from the studies, to determine whether or not these admissions and readmissions were unexpected.¹⁴¹ Although this may be an unintended consequence of interventions, interventions may uncover unmet need or lead to older people receiving care in a more appropriate setting, resulting in positive outcomes for individual patients. Only one study looked at interventions for repeat attenders at the ED, even though repeat attendance was an outcome that was frequently measured. Even in the general population including all adults, not just those who are older/frail, readmissions to UK EDs within 1 week of attendance are around 8%.¹⁴²

Links with the wider literature

Looking at wider ED interventions, a systematic review by Fan *et al.*¹³⁴ identified seven elements that were common to effective interventions that reduced ED utilisation. These were (1) MDT gerontological expertise, (2) risk screening and geriatric assessment, (3) care planning and management, (4) discharge planning and referral, (5) integrated or enhanced primary care, (6) integration between health and social care and (7) co-ordination. This review has described interventions and outcomes for the first four

elements. However, this highlights that interventions to better manage frail older people in the ED also need to consider interventions that are delivered outside the ED, so that only those in real need of ED care for specific presenting complaints (as opposed to underlying frailty) present to the ED. Research focusing on the ED system alone is likely to influence only ED outcomes (as measured in the majority of the studies here). Whether or not these are salient outcomes for patients is another matter.

McCusker *et al.*¹⁴³ developed a checklist of categories for EDs to use to ensure that the care that they deliver is appropriately geriatricised.⁹ This checklist, presented in *Table 14*, highlights the areas in which interventions may be targeted to manage frail older people more effectively. This table has been added to with the evidence that we identified in our mapping review.

Limitations of the review

This review was a systematic mapping review. The review was systematic in how evidence was identified, extracted and synthesised and is transparent and reproducible. When feasible and methodologically necessary, we have undertaken double checking of our work (screening of study results). Although double data extraction was not undertaken, the extraction of verbatim data into extraction tables and the use of descriptive rather than numerical data limits the risk of errors in our interpretation of the evidence.

A systematic mapping review seeks to 'collate, describe and catalogue available evidence relating to a topic or question of interest'.¹⁵ In identifying > 100 research studies and classifying these according to the intervention delivered and the outcomes considered, we have met the aims of a mapping review. Despite this, the review has a number of limitations.

TABLE 14 Checklist based on McCusker *et al.*¹⁴³

Area	Intervention	Findings from our review
Education	Education and educational initiatives for staff working in elderly-focused ED care	No evidence of this; however, this may be related to our search strategy
Environment	<i>Elder-friendly physical environment and design principles</i>	Frail-friendly EDs, frailty units and GEDs were all identified in this review
Staff	Presence of staff with geriatrics expertise – either specialist or general	Addition of single staff members or teams of staff to the ED was identified
Screening/ assessment/ protocols	<i>High-risk screening tools to identify vulnerable elderly adults. Cognitive, functional and mobility assessments. Medication review and reconciliation</i> <i>Standardised protocols for identification, prevention and management of delirium, falls, functional decline, dehydration, incontinence and pain</i>	In this review we identified diagnostic tools to identify frail patients or patients at high risk because of frailty-related issues and prognostic tools to identify patients at risk of adverse events in the ED and on discharge from the ED. Assessments were carried out as part of CGA. Little evidence on the use of protocols for older adults in the ED was identified
Transitions of care	Discharge planning	We identified evidence on prognostic tools for patients at high risk on discharge, discharge co-ordinators or teams and CGA with community follow-up
Community services	Not applicable in this review	
Evaluation	Ongoing evaluation of care processes, in particular hospital admission rates, ED and hospital lengths of stay, ED repeat visits and subsequent hospital admission rates and patient, caregiver and provider satisfaction with service	We found little evidence of ongoing evaluation

The search strategy for the review was designed to find evidence on the identification of frailty and high risk in older people and interventions to manage (frail) older people in the ED. The search strategy may have missed evidence relating to specific conditions that, on the whole, affect only older people (e.g. delirium or falls). Such interventions, although targeted at older people, may not be indexed or keyworded as such and, therefore, may not have been identified by the search strategy.

The a priori exclusion of evidence relating to units, such as assessment units and frailty units, may have limited the review; some older patients are diverted straight to an assessment or frailty unit and, therefore, these units have a similar population to the population of older people presenting at the ED.

The arrival of a (frail) older person at an ED is part of a patient pathway. Interventions undertaken in other parts of the patient pathway, such as in the home setting, and admissions avoidance interventions clearly influence how patients use the ED, but were outside the inclusion criteria for this review.

The objectives of the review (as outlined in the study protocol) did include a research question relating to the effectiveness of interventions, although this was not the main aim of the review, which was to map the existing interventions. The review was unable to answer this research question, comparing the effectiveness of interventions. This was because of the variability of interventions identified (population, interventions and outcomes) and the methods through which they were tested (very few controlled studies). To draw any conclusions about the effectiveness of interventions would require much greater similarities between the studies. Despite this, when the evidence permits, we have summarised the evidence for effectiveness of interventions as reported in individual studies, but have not pooled these data.

The results are presented narratively and tabulated numerically when the evidence permits. The aim of a mapping review is not to produce a numerical synthesis of interventions to answer a specific question but rather to present the evidence and, when feasible, identify trends in the evidence.

A limited number of qualitative studies were included in the review, which is of note when summarising the evidence base. The reasons for this are unclear; however, the challenges in following up patients once they had left the ED, as reported in the studies included in the review, may account for the lack of evidence on intervention acceptability and feasibility (which is generally reported qualitatively). The focus of the review was on interventions for identifying and managing frail older people and mapping these interventions and their outcomes. Qualitative evidence of relevance to the review would have needed to be related to these interventions – either service user views on the interventions or service user views on their feasibility and acceptability.

The bespoke assessment of the evidence base allowed an assessment of the study designs, the self-reported study limitations and the applicability of the evidence to the NHS. Although this was not a standard quality-assessment approach, it is appropriate for a mapping review; indeed, the limited evidence provided in many of the studies would have made a standard assessment of risk of bias very difficult to undertake.

In terms of the evidence identified, we were limited by the reporting of the studies; a significant number of the studies were reported in conference abstracts, which contained limited information on interventions and outcomes. In addition, reporting of the results of studies was limited by the difficulty in identifying frail older people in the evidence. In the absence of any clearly defined criteria, we included both studies in which older people had been defined as frail in the literature or were a high-risk group and studies in which people were defined as older, which tended to be based on their age (> 65 years). This proxy for an agreed definition of frailty was the most feasible approach and did not lead to any studies being excluded from the review.

The evidence identified for the mapping review tended to view older people as a homogeneous group and not differentiate between specific population groups, for example older people with trauma or older

people with dementia or specific issues that might affect patients in the ED (e.g. recognition of polypharmacy). Service improvements are continually being made for specific populations or issues such as these, but these were not reflected in the evidence that we identified for the review.

Implications for practice

The extent to which a mapping review can have any implications for practice is limited as it does not seek to answer questions about the effectiveness of interventions. The data presented in this review are focused on what interventions have been implemented and reported and the outcomes that they influence. Therefore, any assessment of which are the best interventions to identify and manage frail and high-risk older people cannot be made. It is clear that specific screening tools, namely the ISAR tool and TRST, have been more frequently evaluated. However, the results of these studies may not be relevant to the NHS as they were undertaken outside the UK. The review mapped out a wide variety of interventions. There was evidence from individual studies of some positive findings; however, additional research would need to determine which of these interventions are effective and on which outcomes they have a positive impact. It is also evident that little attention has been paid to the costs and benefits of interventions and these would need to be determined prior to any implementation in a practice setting.

Implications for research

Key priority areas for further research

A number of areas warranting further examination have emerged throughout this review.

There is a lack of UK evidence relating to how to identify frail older people, compared with the volume of evidence on service delivery interventions from the UK. It is unclear whether this is because there is a greater consensus around how to identify older people who are frail or at risk, because older people are treated as a homogeneous group or because of some other reason. Research is needed in the UK on which tools are currently used in practice and how does identifying patients as frail or high risk subsequently link to their treatment and management. It would be useful to have evidence on whether the purpose of identifying frail and older patients is to identify those needing further assessment or to rule out those not needing it. Consensus on a tool to identify frailty needs to consider which aspects of frailty are more important in the ED, for example patients with dementia or delirium may need very different treatment from patients who are prone to falls and identifying them simply as frail or as being at high risk does not reflect these subtleties. The acceptability of tools to patients and the usefulness of tools to clinicians also needs to be examined. This could include a comparison between tools that are question based and those that employ different methods.

Looking at the complexity of the health-care system, it is unclear whether or not interventions to reduce inappropriate admissions are displacing care to elsewhere in the health-care system; the implications of 'displaced' care have not been considered. Another issue that has not been addressed in any detail is whether or not the staff member delivering an intervention has any effect on the outcomes or acceptability of the intervention (i.e. whether it is delivered by a doctor, nurse or other health-care professional and whether or not this staff member requires specific geriatric expertise). These models appear to have been evaluated in the literature; however, the reasons for why a specific clinician was chosen remain unclear and whether or not it is thought that this may have influenced the costs and outcomes of an intervention is not reported.

This review did not identify many interventions that were delivered both within and outside the ED. This may be related to our search approach; however, it would be interesting to further examine interventions that combine ED intervention with home follow-up and compare different models of discharge management and follow-up and the cost implications of these interventions. Community screening to identify those older patients at greater risk of admission to hospital or nursing homes may provide an

opportunity for patients who present at the ED to be 'prescreened' and identified as frail and high risk, so that their care can be managed accordingly. It may be that interventions that divert frail older people away from presenting at the ED may be more effective than trying to improve outcomes for the proportion who will inevitably attend the ED with an acute medical condition.

In terms of service delivery interventions, it has been argued that it is unlikely that the GED model will become widespread¹¹ because of the cost and resource implications required to develop this model. However, there is a precedent with the use of paediatric EDs in the UK. With an ageing population, further exploration of the GED may be of use.

One area that was not covered in this research and will undoubtedly be of interest and importance to patients, carers and the health service are which outcomes are important for patients and how long should we measure these outcomes for. Bearing in mind that many frail patients may be nearing the end of life, how important is it to measure long-term outcomes? The quality of the experience of ED care may well be more important to patients than how quickly they are discharged. Knowing more about which outcomes are important will help us to determine which interventions should be considered.

Key design features of research

A standard evidence review approach has allowed us to discover what evidence is available on the identification and management of frail older people in the ED. The variability in the types of interventions used, the outcomes reported and the standard of reporting more generally has meant that it is not possible to make overarching conclusions about which interventions are more effective. Limited qualitative data were identified on the feasibility and acceptability of interventions, so it would be useful to understand the views of patients, carers and clinicians about the ED more generally and the appropriateness of interventions. One way of doing this would be through a qualitative review or a realist synthesis of evidence, which would allow for disparate types of evidence to understand more about how and why interventions work and would be less restricted by the requirement of this review to focus on interventions and their outcomes.

Data on anything other than patient and health service outcomes were rare; a basic cost analysis was undertaken by Leah and Adams,⁷² who estimated cost savings from reducing avoidable admissions. Many of the studies reported increased engagement with health services as a beneficial outcome of the intervention, for example an increase in appropriate admissions, consultation with a geriatrician in the ED, increased community follow-up and more people referred for care according to guidelines and protocols. However, there is very little evidence on the cost of these outcomes. Although there may be a cost benefit in reducing admissions, there is no evidence on the displacement of these costs and the increased cost of community-based interventions when inappropriate admissions are avoided. This is specifically the case for older people generally, and frail older people in particular, as their engagement with the health service differs in its cost and frequency from that of the wider population.

Chapter 6 Conclusions

This review is a systematic mapping review that has identified > 100 studies that have investigated the identification and management of frail, older and high-risk patients in the ED. The variability of interventions and outcomes and the nature of and variability in reporting of interventions has made any summary of the evidence, other than a narrative assessment of interventions and outcomes, difficult to make. Any interpretation of causality between interventions and outcomes is challenging as there was little consistency between studies and, in some cases, there were contradictory results resulting from similar interventions.

In this review, we examined the approaches that exist to manage frail older people in the ED. Because of the difficulty in differentiating frail or high-risk older people from older people (aged > 65), the review looked at all evidence from 2005 to 2016 onwards on the management of frail older people, older people at high risk of adverse outcomes and older people aged > 65 years who met our inclusion criteria. Including only papers in which frail older people were a specific, named population would have limited the scope of the review and, as the aim of the review was to map all approaches to the management of frail older people, some of these may have been missed had the population group been limited. However, including the population of those aged > 65 years has meant that, in some cases, the exact nature of frailty has not been considered in the design and implementation of interventions.

The importance of the appropriate delivery of care to frail older people is highlighted by their recent inclusion in the research priority-setting exercise, undertaken by the James Lind Alliance and the Royal College of Emergency Medicine.¹⁴⁴ Included in their top 10 research priorities, published in early 2017, is a priority relating to service delivery, asking 'Is a traditional ED the best place to care for frail older people?'. The priority-setting exercise presents three alternative models of care: GEDs, geriatric liaison with the ED or the adaptation of current EDs to better meet the needs of older people with frailty. This research priority covers two of the three service delivery intervention categories developed in this review (physical infrastructure and staffing changes) and, arguably, geriatric liaison services cover both staffing and CGA interventions. The final research question, regarding whether or not current services should be made more frail friendly, has not been addressed in our review in terms of specific interventions, but is arguably the philosophy that underpins CGA.¹¹ The agreement between the findings from our review and the research priority-setting exercise is noteworthy.

Examining this heterogeneous body of evidence was challenging because of the sheer volume of evidence and the difficulty in bringing together very different study types, with different interventions and different methods. The variability in the reporting of these methods and the inclusion of evidence from conference abstracts meant that the data that the report is based on are highly variable. Despite this, we have been able to classify key interventions (both screening and service delivery interventions) for older people in the ED and, when specific issues have arisen for frail older people, have attempted to draw these out. We have considered the variety of outcomes that have been evaluated and have summarised the evidence base, with reference to key literature, including systematic reviews.

This review is unique in that it has brought together evidence from both screening and service delivery innovations and has considered all patient and health service outcomes. The emergent patient pathway diagram (see *Figure 2*) has represented these interventions and the outcomes that they may potentially influence, to guide the development of future interventions.

It is clear from the literature that improvements in the care of frail older people have the potential to improve both patient and health service outcomes, yet the purpose of this review was not to examine the effectiveness of interventions. The evidence for both screening and service delivery innovations was not sufficiently strong to suggest that specific interventions should be adopted because of their effectiveness and future research needs to determine the outcomes that are of importance to the health service and

patients. The research reported in this review establishes that a number of outcomes may be important to both of these groups (patients and the health service), but it is often difficult to unpick these and differentiate whether interventions are targeted at improving patient outcomes, health service outcomes or both.

We know from the published literature that frailty screening is complicated and definitions of frailty vary. There is no set age threshold for frailty and, although most of the interventions in this review were targeted at patients aged > 65 years, they seemed to have been utilised by an older population. It is clear that identifying frail populations will lead to appropriate care being delivered and indeed a number of (mostly UK) interventions reported in this review have taken the approach of combining screening with other interventions to improve outcomes. To meet the needs of frail older people, it is not sufficient to know that screening tools are effective at identifying a population at risk; they need to predict a risk that can be reduced by either delivering or not delivering interventions as appropriate.

Returning to the research questions, the studies included in the review have reported data on the health service outcomes of interest (attendance, reattendance, admissions and readmissions), although the findings from interventions could not be integrated to give any key messages about whether or not outcomes have been influenced. There is less evidence on patient-centred outcomes and a very limited amount of evidence on costs to the health service. We were unable to identify any patterns in unintended outcomes, although studies have reported increased engagement with health services, which may increase admissions. Discharging patients appropriately, rather than admitting those who do not require acute care, may lead to a greater proportion of acute older patients being very frail or unwell. This may lead to the outcomes for acute and older wards appearing to be worse, as a result of decreasing inappropriate admissions. There was no evidence on where patients were 'displaced' to if they were discharged early or not admitted. There was also no evidence that interventions increased ED demand. Interventions may lead to previously undiagnosed problems being diagnosed or to patients being labelled as frail or at high risk, which may actually increase health and social service use, improving patient outcomes but increasing costs.

The scope of this review was limited to interventions delivered in the ED. However, the review has put forward that the most effective interventions in terms of positive outcomes for the health service and patients are those that accept the complexity of the social and health needs of frail older people and are designed accordingly. This necessarily means that follow-up outside the ED is a key element of effective interventions.

A systematic review published in 2015 by Lowthian *et al.*¹⁰ highlights the dearth of research in frail older people in the ED. Despite the recognised challenges of undertaking research with this population, there is little high-quality evidence. They contrasted the findings of their review from 2015 with those of a review undertaken in 2005,¹⁴⁵ arguing that there has been little progression in the evidence base since this review.

Complex populations such as frail older people need to be identified in a timely fashion so that appropriate and often complex interventions can be targeted to address their needs. Limiting interventions for this population to the ED alone might demonstrate improvements in outcomes, such as increased discharge rates in the short or medium term, but it may well be the interventions that take place in the community that prevent re-presentations and readmissions in the longer term.

The studies reported in this review have demonstrated that interventions in frail elderly populations result in reduced admission rates; however, this is arguably only a successful outcome if we see a benefit in preventable reduced return ED visits; there is limited value in returning older people to their normal place of residence if they are just going to re-present to the ED again for the same reason. Ideally, evaluations of changes in ED service provision need to collect information about the impact on all relevant service use, both in hospital and in the community, and the associated costs and staffing implications.

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Louise Preston (Research Fellow, Health Economics and Decision Science) was responsible for screening of the search results, data extraction, analysis and synthesis of the intervention papers and writing up of this section, project management and report writing and editing.

Duncan Chambers (Research Fellow, Public Health) was responsible for screening of the search results, data extraction, analysis and synthesis of the screening papers and writing up of the section on screening of papers.

Fiona Campbell (Research Fellow, Health Economics and Decision Science) was responsible for data extraction and assessment of the evidence base.

Anna Cantrell (Research Associate, Health Economics and Decision Science) designed and ran the literature searches and was responsible for the screening of the search results, data extraction and writing up of the section on search methods.

Janette Turner (Reader in Urgent and Emergency Care Research, Health Services Research) was responsible for screening of the search results and report editing and contributed to ED expertise.

Elizabeth Goyder (Professor of Public Health) was responsible for report editing and project management.

All of the team contributed to writing the review protocol and commented on and edited the final report.

Data sharing statement

All available data can be obtained by contacting the corresponding author.

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Appendix 1 MEDLINE search strategy

Sample MEDLINE search

1. *Emergency Service, Hospital/
2. *Emergency Medical Services/
3. *Emergency Medicine/
4. (emergency adj2 service*).ab,ti.
5. "emergency care".ab,ti
6. "urgent care".ab,ti.
7. "emergency department* ".ab,ti.
8. "accident and emergency".ab,ti.
9. casualty.ab,ti.
10. or/1-9
11. *"Aged, 80 and over"/
12. *Health Services for the Aged/
13. *Frail Elderly/
14. *Aged/ or *Aging/
15. (ageing or elderly or geriatric or frail or aged).ti
16. (old or older).ti.
17. or/11-16
18. 10 and 17
19. limit 18 to (english language and humans and yr="2005 –Current")

Appendix 2 Review-level evidence data extraction table

Study	Population	Aim	Screening or intervention	Outcome(s)	Summary	Headline message
Tran <i>et al.</i> ¹³⁶	Geriatric (aged > 60 years)	Identify risk factors and interventions to prevent ED returns	Examination of risk factors Interventions (bundle of care: nursing screening then interventions outside the ED)	ED returns	There are risk factors that identify the likelihood of ED return. These are psychosocial (feeling depressed, no primary care practitioner, low primary care use, low socioeconomic status) and medical (digestive disease, cardiovascular disease, high-risk chief complaint)	Intensive bundle of interventions for this high-risk population appeared to be effective in preventing short- but not long-term ED returns
Kessler <i>et al.</i> ¹³⁹	Geriatric	Transitions of care for ED patients	Both	Errors in transitions of care to and from the ED	Specific challenges include complex medical morbidities, dependence in ADL, polypharmacy and higher frequency of transitions Central to adverse outcomes were communication issues. Communication on admission from nursing homes was limited	Failed transitions are implicated in morbidity and mortality. Standardised communication and robust metrics could reduce this
Sinha <i>et al.</i> ¹³⁷		Identify process, component and outcome measures in geriatric emergency practice model	Both	Health outcomes, social/health service utilisation outcomes	There were 28 outcome measures and eight model characteristic components. Programmes having more of these components tended to produce better outcomes	Successful models of ED case management have the following characteristics: evidence-based practice model; nursing clinical involvement or leadership; high-risk screening with a validated tool; focused (as opposed to time-intensive) geriatric assessments; care and disposition planning in the ED; interprofessional and capacity-building work practices; post-ED discharge follow-up with patients; and evaluation and monitoring processes

Study	Population	Aim	Screening or intervention	Outcome(s)	Summary	Headline message
Parke <i>et al.</i> ¹³⁰	Cognitively impaired, non-institutionalised older people (aged > 65 years)	Effectiveness of interventions to manage cognitively impaired older people in the ED	Both	Detection of cognitive impairment	Contextual details and relevant features of appropriate interventions poorly reported	Cognitive state has been shown to be one predictor of visits to the ED; there are a lot of older people with cognitive impairment receiving care in the ED. Screening tools exist to identify this population; however, they are inconsistently used so difficult to measure effectiveness. No specific interventions were identified to care for this population
Graf <i>et al.</i> ¹³²	Older patients	Use and value of CGA in the ED for evaluations of older patients; using ED screening tools to detect high-risk patients needing CGA	CGA efficiency Screening tools		CGA in the ED is efficient for decreasing functional decline, ED readmission and possibly nursing home readmission. This review found that the best tool was the ISAR tool (others not validated for screening plus CGA and TRST not accurate enough)	CGA is too time-consuming to use routinely in the ED, even though it has positive outcomes. Other tools to screen for high-risk older people exist. It is better to screen for high risk than carry out age-based screening. High-risk patients can then benefit from CGA and interventions. Advocate a two-stage approach (screening for high-risk patients using the ISAR tool and then CGA)
Conroy <i>et al.</i> ¹³³	Frail older people (aged > 65 years)	Does CGA improve outcomes for frail older people rapidly discharged from acute settings?	CGA (geriatrician led and nurse led)	Mortality, readmissions, subsequent institutionalisation, functional ability, quality of life and cognition	No clear benefit in terms of any outcome	CGA has been shown to have benefits. Limited research on CGA at the point of rapid discharge. Few trials undertaken and they are of poor quality; more trials required

Study	Population	Aim	Screening or intervention	Outcome(s)	Summary	Headline message
Sutton <i>et al.</i> ¹²¹	Patients aged > 65 years presenting to the ED of an acute hospital (three included studies included patients aged > 70 years)	Identify, appraise and characterise screening tools to screen for elderly patients at risk of functional decline	Screening		Five screening tools identified: HARP, ISAR, TRST, COMPRI and SHERPA	There is no gold standard tool. No single tool had better predictive validity to recommend its use. Therefore, undertaking an intervention based on the outcome of these screening tools is not advisable
Thiem <i>et al.</i> ¹²⁶	Elderly patients	Screening instruments for the identification of patients in EDs in need of geriatric care	Screening		TRST, SHERPA, ISAR, COMPRI, HARP and Index of Functional Decline	The ISAR tool is the most frequently studied tool and has been tested most widely; however, the evidence is weak or conflicting. Conflicting evidence also exists for the other tools. In addition, it is important to know how best to manage these patients once they have been screened
Fan <i>et al.</i> ¹³⁴		The effectiveness of interventions targeting the elderly population at reducing ED utilisation		Primary: ED utilisation	Qualitative appraisal resulted in the identification of seven 'elements' that were common to the interventions studied: MDT expertise; integrated/enhanced primary care; integrated social and medical care; risk screening and geriatric assessment; care planning and management; discharge planning and referral co-ordination; and follow-up/regular group visits	Review included hospital- and community-based interventions. A larger proportion of community interventions demonstrated reduced ED utilisation. Five of 20 hospital interventions significantly reduced utilisation. Most were characterised by risk screening and assessment and discharge planning and referral co-ordination. There was evidence of increased ED utilisation in some studies. These negative studies tended to have fewer 'elements' than the positive ones. The most effective interventions were those in which linkages were made (either MDT in the ED, links with social care, links to community and primary care)

Study	Population	Aim	Screening or intervention	Outcome(s)	Summary	Headline message
Karam <i>et al.</i> ¹³⁵		Review and update existing literature on interventions within EDs		ED revisits, hospitalisations, nursing home admissions and deaths following discharge	Nine studies met the inclusion criteria. The more intensive an intervention, the more frequently it resulted in reduced adverse outcomes compared with simple referrals <i>Amongst the lowest intensity, referral based interventions, studies that used a validated prediction tool to identify high risk patients more frequently reported improved outcomes than those that did not use such a tool</i>	<i>Interventions were more successful if they extended beyond referral and if they used a validated risk prediction tool to identify potential candidates</i> <i>... the specific tool used might not be as important as the actual implementation of one to screen patients and target interventions</i>
Lowthian <i>et al.</i> ¹⁰	People aged > 65 years	The effectiveness of the ED in community transition strategies	Intervention	Unplanned ED re-presentation or hospitalisation, functional decline, nursing home admission and mortality	Nine studies. Interventions tended to comprise assessment in the ED with community follow-up. These assessments included comprehensive geriatric nurse assessment and use of the ISAR tool, as well as discharge planning	The evidence base in this area is limited and the research is not of high quality. There is limited evidence on effectiveness in reducing unplanned ED reattendance, hospital admission or mortality
McNamara <i>et al.</i> ¹²⁷	People aged ≥ 65 years	Which triage tool is the most effective for use with older patients presenting to the ED?	Screening		Six tools were identified. Three general tools, Manchester Triage, Emergency Severity Index and CTAS – Manchester Triage and Emergency Severity Index, undertriage older adults. Three were specific tools: ISAR, TRST and VIP; ISAR and TRST have good sensitivity, a high negative predictive value, low specificity and a low positive predictive value and VIP has low sensitivity	Traditional tools undertriage. Need to differentiate between tools to identify who is in need of acute medical care and tools to identify who is in need of ongoing medical care following discharge

Study	Population	Aim	Screening or intervention	Outcome(s)	Summary	Headline message
Bissett <i>et al.</i> ¹²⁸	Older people	Identify functional assessments used in the ED, what psychometric properties analysis has been undertaken and what assessments are recommended for practice	Screening		14 functional assessments Four were developed for use in the ED to identify patients at risk [TRST, ISAR, Runciman questionnaire and FSAS-ED (FSAS-ED was available only in French)]. Four were recommended for practice with reservations: TRST, ISAR, OARS and FSAS-ED. Most tools used self-report rather than patient observation	his review did not look at outcomes of the screening tools, but at their validity, etc. ISAR and TRST were suitable for fast screening and FSAS-ED was suitable for comprehensive screening: <i>Where time and personnel are constrained and screening is the only realistic option for functional assessment of older people, the ISAR and TRST are the assessments of choice as they have had the most psychometric testing including positive ratings for clinical utility</i>
Fealy <i>et al.</i> ¹³⁸	Older persons	Effectiveness of nursing interventions targeted at older attendees of EDs	Screening and intervention	Patient and health service outcomes	Interventions categorised as assessment and screening interventions and referral and follow-up interventions	Benefits in terms of reduced service use and reduced functional decline. No statistically significant effects on patient or health service outcomes <i>Assessment interventions that incorporate a post-ED discharge planning and referral component appear to be more effective</i>
Schnitker <i>et al.</i> ¹³¹	Older, cognitively impaired patients	Identify practices designed to meet the specific care needs of older, cognitively impaired patients in EDs		Assessment of cognitive function	12 studies in the ED Four categories of best practice: interventions to improve recognition of cognitive impairment and subsequent provision of care; interventions designed to prevent acute confusion (delirium); interventions to manage behavioural/ psychological symptoms; and other interventions	Routine screening and assessment of cognitive function are not common practice and incorporating this into care practices would be beneficial: <i>There are several short, sensitive screening tools suited to the fast-paced ED environment that will identify cognitive dysfunction in older patients</i> Discharge risk tools are also beneficial

Study	Population	Aim	Screening or intervention	Outcome(s)	Summary	Headline message
Carpenter <i>et al.</i> ¹²⁹	Geriatric patients (aged ≥ 65 years)	The prognostic accuracy of individual risk factors and ED screening instruments to distinguish patients more or less likely to experience short-term adverse outcomes	Screening	Short-term adverse outcomes such as unanticipated ED returns, hospital readmissions, functional decline or death	Seven geriatric prognostic screening instruments: ISAR, TRST, VIP, Silver Code, Mortality Risk Index and Rowland and Runciman questionnaires	<p>Adverse outcomes often occur when older people are discharged from the ED. It would be useful to be able to identify these people and the risk factors that lead to unsatisfactory outcomes:</p> <p><i>None of the individual predictors of vulnerability or published risk stratification instruments demonstrate sufficient prognostic accuracy to distinguish high risk or low risk subsets of geriatric patients in EDs</i></p> <p>There are no significant prognostic differences when nurses administer screening instruments (as opposed to geriatric specialists or research teams)</p>
Yao <i>et al.</i> ¹²²	Elderly patients	Evaluate the predictive validity of ISAR in identifying older patients at risk of adverse outcomes after an ED visit	Screening	Adverse outcomes	10 studies ISAR has poor or poor/fair predictive validity for revisiting the ED, hospital readmission, mortality and composite outcomes	<p>The ISAR tool is quick and cheap to use so it is useful for screening high-risk patients for frailty who are seen in the ED; however, it has poor to fair predictive validity for adverse health outcomes for patients discharged from the ED:</p> <p><i>It is not suitable to use the ISAR alone for identifying seniors at risk for adverse outcomes in the ED</i></p>

LOS, length of stay; OARS, older adult resources and services.

Appendix 3 List of full texts excluded and reasons for exclusion

Study	Reason for exclusion
Gupta ¹⁴⁶	Not examining the impact on the ED or ED patient outcomes
Edmans <i>et al.</i> ¹⁴⁷	Study on whether or not the ISAR tool predicts clinical outcomes and health and social services costs of older people discharged from UK acute medical units
Carpenter <i>et al.</i> ¹⁴⁸	'This article describes recent and ongoing efforts to enhance the quality of emergency care for older adults' using a variety of management approaches (i.e. this is a descriptive article)
Swedish Council on Health Technology Assessment ¹⁴⁹	Non-English-language article
Patterson <i>et al.</i> ¹⁵⁰	Modelling the cost-effectiveness of providing vaccination to > 50 patients in EDs
Ong <i>et al.</i> ¹⁵¹	Setting in a medical assessment unit
Lowthian <i>et al.</i> ¹⁵²	Protocol for the SEED project (conference abstract is Lowthian <i>et al.</i> ¹⁵³ and full paper is Lowthian <i>et al.</i> ¹⁵⁴)
Lowthian <i>et al.</i> ¹⁵³	Review and audit of practices: conference presentation (full paper is Lowthian <i>et al.</i> ¹⁵⁴)
Wilhelmson <i>et al.</i> ¹⁵⁵	Intervention protocol for intervention delivered in the community
Thomas ¹⁵⁶	Discussion piece
Legrain <i>et al.</i> ¹⁵⁷	Setting is acute geriatric units (with ED visit as a primary outcome)
Carey <i>et al.</i> ¹⁵⁸	No data on outcomes
Mun Tan <i>et al.</i> ¹⁵⁹	Interventions take place outside the ED
McNicholas <i>et al.</i> ¹⁶⁰	Population aged > 60 years; outcomes related to trauma management
Flynn <i>et al.</i> ¹⁶¹	Geriatric emergency management nurses as a catalyst for change (no outcomes)
Hustey <i>et al.</i> ¹⁹	Screening for functional decline in the home setting following an ED admission
Lee <i>et al.</i> ¹⁶²	Predicative value of a tool that is not related to ED management
Shanley <i>et al.</i> ¹⁶³	Descriptive, no data
Meurer <i>et al.</i> ¹⁶⁴	Outcomes not relevant (infections)
Schumacher ¹⁶⁵	Opinion/discussion paper
Launay <i>et al.</i> ¹⁶⁶	Population is geriatric patients hospitalised in acute care medical units after admission to the ED
Milne <i>et al.</i> ¹⁶⁷	Discussion paper
Griffiths <i>et al.</i> ¹⁶⁸	Protocol/summary of study on transfer of information between care facilities and the ED
Somes ¹⁶⁹	Not an intervention
Booth ¹⁷⁰	Letter to the editor, no data
Mangram <i>et al.</i> ¹⁷¹	Specific to trauma ED care
Jackson ¹⁷²	Irrelevant outcomes
Wolfe ¹⁷³	Pain management intervention for elderly hip pain patients
Lees ¹⁷⁴	No data
Fernandes ¹⁷⁵	Commentary paper
Adams <i>et al.</i> ¹⁷⁶	Baseline description of intervention, no outcome data included
Beauchet <i>et al.</i> ¹⁷⁷	Intervention delivered outside the ED

Study	Reason for exclusion
Hullick <i>et al.</i> ¹⁷⁸	Descriptive paper (conference abstract) describing innovative interventions for the elderly in EDs via a questionnaire survey
Hwang <i>et al.</i> ¹⁷⁹	No outcome data
Lowthian <i>et al.</i> ¹⁵⁴	Not an intervention study
Stiffler <i>et al.</i> ¹⁸⁰	Tool to assess what proportion of older ED patients are frail; administered post discharge
Butler and Biram ¹⁸¹	Development of a short-stay medicine for the elderly ward
Carey <i>et al.</i> ¹⁸²	No data on outcomes
Ellis <i>et al.</i> ¹⁸³	Setting is an acute care for the elderly unit
Fernandez <i>et al.</i> ¹⁸⁴	Insufficient data
Huq <i>et al.</i> ¹⁸⁵	Outcomes and setting (medical assessment unit)
Michael and Ijaola ¹⁸⁶	Development of a frail elderly short-stay unit (conference abstract)
Miller <i>et al.</i> ¹⁸⁷	Outside the date range
McCusker <i>et al.</i> ¹⁸⁸	Outside the date range
McCusker <i>et al.</i> ¹⁸⁹	Outside the date range
Baumann and Strout ¹⁹⁰	Intervention not specific to older people
Sanon <i>et al.</i> ¹⁹¹	Short description of the intervention, no data, conference abstract
Taylor <i>et al.</i> ¹⁹²	Population is those admitted to the emergency assessment unit
Gorichky ¹⁹³	Survey of EDs regarding implementation of an EDCC
Caplan ¹⁹⁴	Abstract for a conference paper, no data
Edmans <i>et al.</i> ¹⁹⁵	Effect of specialist geriatric medical management on the outcomes of at-risk older people discharged from AMAUs
Rogers ¹⁹⁶	Description of an intervention; no data on implementation, uptake or use
Koehler <i>et al.</i> ¹⁹⁷	Impact of a supplemental care bundle on reducing readmission or ED visits in high-risk elderly inpatients
Biedsoe <i>et al.</i> ¹⁹⁸	Not an intervention
McCusker <i>et al.</i> ¹⁹⁹	Study looking at whether or not certain ED and non-ED variables are predictive of a return visit to the ED
Vandewoude <i>et al.</i> ²⁰⁰	Screening tool for admission
Small ²⁰¹	No outcomes

SEED, Safe Elderly Emergency Discharge.

Appendix 4 Brief data extraction table

Authors, year, country	Study design, population, patient numbers	Intervention/assessment tool	Results	Headline message
Wright <i>et al.</i> , ¹¹⁷ 2014, UK	Pre and post retrospective cohort study Patients aged > 70 years attending A&E department 5416 participants pre intervention and 5370 patients after intervention, TREAT accepted 593 geriatric admissions	Admissions avoidance system: TREAT. TREAT combines early A&E senior doctor review, CGA, therapist assessment and supported discharge; post-discharge supported recovery; and a rapid geriatric 'hot-clinic'. A PACE team provided short-term nursing support immediately following discharge to support TREAT	Following the TREAT intervention period, LOS was reduced (median LOS reduced by 2 days and mean LOS by 18.6% (1.78 days; $p < 0.001$). For residual admissions, LOS was unchanged (median LOS) and mean LOS was reduced by 1.08% (0.11 days; $p = 0.065$) For TREAT patients who were admitted, admissions resulting in discharge on the same day increased from 12.26% to 16.23% (OR 1.386, 95% CI 1.203 to 1.597; $p < 0.001$). Comparing with the residual population, admissions resulting in discharge on the same day fell from 15.01% to 9.77% (OR 0.613, 95% CI 0.737 to 0.509; $p < 0.001$)	TREAT appears to have reduced avoidable emergency geriatric admissions and to have shortened LOS for all emergency geriatric admissions
Kennedy <i>et al.</i> , ⁴⁰ 2014, USA	Prospective observational study Individuals aged ≥ 65 years presenting for ED care $n = 700$	Structured mental status assessment and attention tests. Delirium determined using the CAM	9% had delirium. Delirium patients had worse outcomes than those without (LOS 4 days vs. 2 days, ICU admission 13% vs. 6% and discharge to long-term facility 37% vs. 9%). ED delirium was associated with a higher 30-day mortality rate (6% vs. 1%) and 30-day readmission rate (27% vs. 13%)	Delirium prediction rule created as older age, prior stroke or transient ischaemic attack, dementia, suspected infection and acute intracranial haemorrhage and had good predictive accuracy (area under the ROC curve = 0.77)
Yuen <i>et al.</i> , ¹⁰⁸ 2012, Hong Kong	Retrospective study Older people referred by emergency physician 2202 geriatric patients were referred	Geriatric consultation programme 'We Care'. Older patients were referred by the emergency physician and screened by the geriatric consultation team, who provided CGA; they were detoured to acute medical admission via either direct admission to a convalescent hospital for further care or discharge with support of the community nursing service	Age of patients ranged from 45 to 99 years; 15.3% of cases needed acute medical admission for further management, whereas the rest could be admitted to a convalescent home or discharged home. Majority of patients (98.4%) did not suffer any adverse outcomes in the study period; there was a 1.6% reattendance rate and a 1.6% mortality rate after discharge The most prevalent case mix was chronic pulmonary disease, followed by debilitating cardiac disease and neurological problems. Small proportions of patients suffered from terminal malignancies and non-respiratory infection. Patients having chronic pulmonary disease, diabetes-related problems and non-respiratory infections were statistically more likely to be admitted to a convalescent home or discharged home after geriatric consultation	'We Care' provided CGA to suitable geriatric patients, resulting in an effective reduction in acute geriatric hospital admissions

Authors, year, country	Study design, population, patient numbers	Intervention/assessment tool	Results	Headline message
Harper <i>et al.</i> , ⁷⁶ 2013, Australia	Single-centred retrospective data analysis Patients aged ≥ 65 years presenting to the ED with a fall 5162 patients from 2006 to 2009	Introduction of multidisciplinary CCT staffed by occupational therapists and physiotherapists to intervene with older patients presenting with a fall. Majority of patients referred from ED doctors. Interventions by the CCT varied between patients, but usually included assessment and falls risk stratification, patient education, functional retraining, supply of equipment and referral to a falls clinic or outpatient allied health services	Statistically significant predictors for being referred to the CCT were increasing age, being female, arriving by ambulance, being transferred from a nursing home and higher socioeconomic category. Arrival by ambulance and a history of previous falls were associated with re-presentation and readmission. A decreasing trend from 2006 to 2009 was seen in rate ratios and ORs via regression modelling for both re-presentation and readmission in patients referred to the CCT	<i>Maturing of the CCT is associated with a decrease in re-presentation and readmission rates. Over time, the CCT attended higher-urgency patients associated with stable admission rates. These associations were not significant and the clinical effectiveness of ED CCTs requires further examination</i>
Arendt <i>et al.</i> , ⁷⁷ 2013, Australia	Non-randomised prospective pragmatic study Patients aged ≥ 65 years diagnosed with one or more of six conditions (cerebrovascular insufficiency, fractured neck of femur, cardiac failure, myocardial ischaemia, exacerbation of chronic airways disease and respiratory tract infection) 3572 patients (2121 intervention patients, 1451 comparator patients)	Early allied health intervention conducted in the ED by the CCT for older people with common diagnoses. The CCT consisted of at least one physiotherapist, occupational therapist or social worker with geriatric experience. Intervention patients received comprehensive allied health assessment/intervention by at least one professional working in the CCT. Comparison patients received no assessment	In 2121 intervention patients and 1451 comparator patients, there was no difference in LOS (median 88 vs. 87 hours) on unadjusted (log-rank $p = 0.28^a$) or adjusted (IRR 0.97; $p = 0.32^a$) analysis	Undertaking allied health assessment in ED earlier than in standard care has no effect on hospital length of stay

Authors, year, country	Study design, population, patient numbers	Intervention/assessment tool	Results	Headline message
Grossmann <i>et al.</i> , ⁴² 2012, Switzerland	Prospective, single-centre cohort study Patients aged ≥ 65 years $n = 519$	Emergency Severity Index. Test predictive validity, inter-rater reliability and diagnostic accuracy in older ED patients. Identify reasons for inadequate triage	<i>Emergency Severity Index level was associated with resource consumption (95% CI -0.519 to -0.379; Spearman's $r_p = -0.449$), disposition (Kendall's $r = -0.452$, 95% CI -0.516 to -0.387), ED LOS (Kruskal-Wallis $\chi^2 = 92.5$, $df = 4$; $p < 0.001$) and mortality (log-rank $\chi^2 = 37.04$, $df = 3$; $p < 0.001$)</i> ESI sensitivity to predict life-saving interventions was 0.462 (95% CI 0.232 to 0.709) and specificity was 0.998 (95% CI 0.989 to 1.000). There was high inter-rater reliability (Cohen's weighted $\kappa = 0.934$, 95% CI 0.913 to 0.954). Undertriage was reported in 117 cases	Undertriage was a risk for older patients and happened when high-risk situations and vital signs were not assessed appropriately. Another reason may have been that there was only moderate inter-rater reliability between triage nurses and triage experts. Emergency Severity Index level had good validity with resource consumption, disposition, ED LOS and survival
Foo <i>et al.</i> , ¹¹⁵ 2012, Singapore	Single-centre before-and-after prospective study Patients aged ≥ 65 years 172 control (25 December 2006 to 30 March 2007) and 315 intervention (1 April 2007 to 31 December 2007) group patients	Geriatric assessment in an EDOU. Intervention group received geriatric assessment by an emergency nurse trained in geriatric care before discharge. The nurse then discussed each patient with an ED physician trained in geriatric care or a geriatric nurse clinician and interventions were initiated as required. Control group received usual EDOU care	71.7% of patients in the intervention group had hidden needs that required intervention. The intervention group had significantly lower ED reattendance (adjusted IRR 0.59, 95% CI 0.48 to 0.71) and hospitalisation (adjusted IRR 0.64, 95% CI 0.51 to 0.79) rates at 12 months	Older patients admitted to an EDOU are an at-risk group and benefit from geriatric assessment before discharge

Authors, year, country	Study design, population, patient numbers	Intervention/assessment tool	Results	Headline message
Waldron <i>et al.</i> , ⁷⁹ 2011, Australia	Prospective before-and-after study Study participants were aged ≥ 65 years presenting to the ED as the result of a fall 313 participants	Allied health staff in the ED to facilitate the referral pathway, audit and feedback	Allied health staff increased the proportion of patients being reviewed from 62.7% before the intervention to 89% after the intervention ($p < 0.001$). Referral for comprehensive guideline care took place for only 6/177 patients (3.4%) before the intervention compared with 28/136 patients (20.6%) after the intervention (difference = 17.2%, 95% CI 11% to 23%). The average quality of care index (maximum score 100) increased from 18.6 (95% CI 16.7 to 20.4) to 32.6 (95% CI 28.6 to 36.6)	<i>A multifaceted change strategy was associated with an improvement in allied health in ED prioritising the review of ED fallers as well as subsequent referral for comprehensive geriatric care</i>
Mortimer <i>et al.</i> , ⁶³ 2011, Australia	Prospective evaluation of a newly established service Patients presenting to the DEM, aged ≥ 65 years with a chronic condition or aged ≥ 70 years without a chronic condition 199 patients (101 intervention patients, 98 control patients)	Specialist aged care pharmacist for reconciliation of initial medication history, review of medication orders and report of medication-related issues to the Department of Emergency Medicine (DEM) doctor. Control patients received continued management by the DEM doctor	Patients in the intervention group had a significantly longer LOS in the DEM compared with patients in the control group [12 hours 42 minutes ($n = 101$) vs. 10 hours 5 minutes ($n = 98$); $p < 0.01$]. 101 cases were managed by the ACP. Of these, 33 had medication orders from the DEM doctor. 48 errors and/or omissions were identified by the ACP. Patients admitted to a ward (control group, $n = 92$; intervention group, $n = 73$) had a second medication reconciliation by the ward pharmacist. 41 errors and/or omissions were identified in 25/66 DEM patients, compared with 2/73 ACP patients. For ACP admitted patients 51/73 had a medication related issue. Only 17/66 controls had a medication related issue. There was no difference in the groups in representation at 2 and 4 weeks	This study supports the integration of an ACP in the ED assessing elderly patients

Authors, year, country	Study design, population, patient numbers	Intervention/assessment tool	Results	Headline message
Mahony <i>et al.</i> , ¹¹⁶ 2008, USA	<p>Pilot project</p> <p>Patients were aged > 65 years and met the following criteria: uncontrolled chronic pain; multiple organ failure that had been rejected for ICU admission; hospice eligible, requiring relief from symptoms; and a chronic incurable illness requiring access to community resources</p> <p>The nurses conducted 894 consultations</p>	Two advance practice nurses carried out consultations on elderly patients using the palliative care trigger tool to identify patients with one or more 'palliative care triggers'. Patients eligible for the study then completed a needs assessment form, which was followed by a consultation. Nurses followed up patients to ensure that they had been linked with home care or hospice services	Of the 894 consultations, 263 patients were referred to home care organisations and 287 to hospice organisations, of whom 83 received home care and 91 received hospice services; 90% of patients were admitted to the medical centre, with 41.9% discharged to skilled nursing facilities, 24.2% discharged home with home care and 19.1% discharged home without home care. The project did not have an impact on rates of subsequent use of the ED. Compared with the pre-project chart review, there were small reductions in the length of hospital stay, from 7.9 to 7 days. Linkage with hospital-based palliative care services was enhanced. There was some evidence to suggest that the provision of palliative care and case management services in an ED was associated with increased patient and family satisfaction with symptom relief and increased uptake of hospital-based palliative care and hospice services. There was a limited impact on the utilisation of acute care for the patients in this study	The presence of palliative care, home care and hospice outreach services in the ED can connect end-of-life elderly patients with relevant services
Moons <i>et al.</i> , ⁵⁶ 2007, Belgium	<p>Longitudinal study of admission</p> <p>Patients were aged ≥ 65 years and had been admitted to the ED</p> <p>314 patients (agreed to participate) – 83 spent < 24 hours in the ED, 74 with complete follow-up after 90 days</p>	To compare the abilities of four different screening tools to predict return visits of older people after they have been discharged from the ED: ISAR tool; TRST; eight-item questionnaire of Runciman <i>et al.</i> ; ¹²³ and seven-item questionnaire of Rowland <i>et al.</i> ¹²⁴	There were 28 readmissions in 25 patients (three patients were readmitted twice). During the first 2 weeks of discharge, 10% (8/80) of the patients revisited the ED after 14 days. At 30 and 90 days, the readmission rates were 15.8% (12/76) and 32.5% (25/77), respectively. When using three or more positive answers as the cut-off scores, the Rowland questionnaire proved to be the most accurate predictive tool, with a sensitivity of 88%, specificity of 72% and negative predictive value of 98% at 14 days after discharge; 30 days after discharge, the sensitivity was 73%, specificity was 75% and negative predictive value was 92%. The ideal cut-off scores, as determined by the ROC curves in this study, were ≥ 2 for the ISAR tool, ≥ 2 for the TRST, ≥ 4 for the Runciman questionnaire and ≥ 3 for the Rowland questionnaire	<i>Repeat visits in older people admitted to an ED seemed to be most accurately predicted using the Rowland questionnaire, with an acceptable number of false positives. This instrument can be easily integrated into the standard nursing assessment</i>

Authors, year, country	Study design, population, patient numbers	Intervention/assessment tool	Results	Headline message
Baumann and Strout, ⁵⁷ 2007, USA	Retrospective health record survey methodology and a survival analysis Patients aged ≥ 65 years 929 patients	Estimate the validity of the Emergency Severity Index (version 3) triage algorithm and the association between the Emergency Severity Index categorisation and 1-year survival, LOS, disposition and resource utilisation	Hospitalisation associated with Emergency Severity Index triage assignment (Kendall's $\tau_b = 0.476$, 95% CI -0.524 to -0.425). LOS associated with Emergency Severity Index assignment (Kruskal–Wallis test $p = 0.000$). Emergency Severity Index categorisation was associated with vital status at 1 year (Kaplan–Meier $\chi^2 67.85$, df 4; $p = 0.0000$). The area under the ROC for Emergency Severity Index predictive ability for hospitalisation was 0.77 (95% CI 0.748 to 0.806). Significant relationship between triage category and resource utilisation (Spearman's r correlation 0.683, 95% CI 0.716 to 0.647 ⁹). Results show statistically significant reduction in the proportion of patients admitted from ED to ward since introduction of the care co-ordination programme. There was also a significant difference in the mean-related quality-of-life score before and after the intervention, and staff and patient satisfaction with the service	<i>When used to triage patients aged > 65 years, the Emergency Severity Index algorithm demonstrates validity. Hospitalisation, LOS, resource utilisation and survival were all associated with Emergency Severity Index categorisation in this cohort</i>
Corbett <i>et al.</i> , ⁸⁰ 2005, Australia	Programme effectiveness evaluation Patients aged ≥ 65 years presenting to an ED; able to speak and understand English; able to communicate by telephone after discharge; expected to be discharged back into the community; not exhibiting signs of diminished cognition (as assessed by the care co-ordinator); and requiring discharge planning	Introduction of a care co-ordination programme that consisted of a multidisciplinary case management approach by a team. The professional mix of the team has included physiotherapy, occupational therapy, speech pathology, nursing and social work. The intervention aimed to provide early interventions to prevent unnecessary admissions from the ED to hospital and inappropriate or unnecessary presentation or re-presentation to the ED. Additionally, it aimed to ensure co-ordination and provision of service and programmes for patients with complex care needs on discharge from the ED to the community. Primary role is co-ordination of services although team can provide services		A multidisciplinary case management approach was effective at reducing the admission rate for patients presenting to the ED. Results from this and other studies demonstrate that the care co-ordination programme provides positive outcomes for all stakeholders; it can be easily integrated into existing ED processes and, therefore, can be considered for inclusion in all ED settings

Authors, year, country	Study design, population, patient numbers	Intervention/assessment tool	Results	Headline message
Fallon <i>et al.</i> , ⁶⁹ 2015, Ireland	<p>Prospective data analysis</p> <p>Participants were aged ≥ 65 years</p> <p>Data from 3071 patients attending the AMAU over 1 year were collected and information on characteristics and outcomes for 1066 older patients was retrieved</p>	Patients attending the AMAU are initially reviewed by a triage nurse in the ED and referred following assessment if deemed suitable	In 2013, 3071 patients were assessed in the AMAU and one-third (1066/3071, 34.7%) were aged ≥ 65 years. Older people presented more acutely unwell than younger counterparts. The most common presenting complaints were breathing difficulty followed by chest pain. Further common presenting complaints were collapse, dizziness and confusion. Only 314/1067 older patients had a TRST assessment completed in ED triage; 196/314 (62.4%) were identified as being at risk of an adverse outcome. Admission rate (644/1067) for older patients was double that of younger patients	The higher admission rate highlights the increasing complexity of this group. AMAUs that are adapted for frailty have great potential to enhance care for older patients
Nguyen <i>et al.</i> , ¹¹⁰ 2014, Australia	<p>Pilot observational convenience study</p> <p>Patients aged ≥ 65 years (range 66–96 years, mean 78 years)</p> <p>25 participants</p>	SGA	Overall, the time required for completion of the SGA by 90% of this sample was 20 minutes 40 seconds	This pilot study shows that use of the SGA in Australian ED settings is possible within the time requirements of the new Australian NEAT, which requires discharge of patients within 4 hours of arrival. The SGA requires a small fraction of the 4-hour target, allowing an overall net benefit by improving patient outcomes and preventing readmissions
Beauchet <i>et al.</i> , ⁴¹ 2013, France	<p>Prospective cohort study design</p> <p>Elderly (aged 84.0 ± 6.5 years)</p> <p>424 patients</p>	<i>To examine whether or not a BGA administered to elderly patients admitted to the ED may predict the risk of a long hospital stay in the geriatric acute care unit</i>	Prediction of LOS with a six-item BGA was possible in the sample of older inpatients admitted to the ED. The risk of a long hospital stay changed depending on the different combinations of the six items on the BGA. The combination of a history of a recent fall, male sex, cognitive impairment and age < 85 years identified the elderly ED patients with the highest risk of a long hospital stay requiring geriatric care and planning for discharge	The combination of a history of falls, male sex, cognitive impairment and age < 85 years identified elderly ED patients at high risk of a long hospital stay

Authors, year, country	Study design, population, patient numbers	Intervention/assessment tool	Results	Headline message
Launay <i>et al.</i> , ⁸¹ 2013, France	Prospective cohort study Participants were aged ≥ 75 years 168 older adults admitted to the ED	MGT providing BGA and then related geriatric or gerontological recommendations. Geriatric recommendations defined as medical recommendations only (recommendations for diagnosis and treatment of polymorbid older adults with disabilities); gerontological recommendations defined as a combination of medical and social recommendations (as above with establishment of formal and adapted home-help services)	48/168 participants (28.6%) received MGT recommendations (16 geriatric recommendations and 32 gerontological recommendations); 32 participants (19.1%) were discharged early from the ED, including 12 who received a MGT programme. Multiple logistic regression showed that only the geriatric recommendations were associated with early discharge from the ED (OR 4.38; $p = 0.046$)	Study demonstrated that geriatric recommendations are more effective at reducing length of stay than gerontological recommendations. Gerontological recommendations provide specific social advice, which can take time, thus delaying discharge and explaining the result
Arendts <i>et al.</i> , ⁸² 2012, Australia	Prospective non-randomised trial Study participants were aged > 65 years and presented with 1 of 10 common complaints: urinary infection, respiratory tract infection, fall with minor injury, hip or knee pain, back pain, cardiac failure, angina pectoris, syncope, transient ischaemic attack or new-onset confusion or delirium 5265 patients, 3165 in the intervention group and 2100 in the control group	Early comprehensive allied health input was compared with no allied health input. The service was provided by a CCT consisting of at least one physiotherapist, occupational therapist or social worker with extensive geriatric experience. The CCT undertook comprehensive functional assessment followed by initiation of services to meet identified needs	The admission rate to an inpatient hospital bed from the ED was 72.0% for the intervention vs. 74.4% for the control. The difference was of borderline statistical significance (OR 0.88, 95% CI 0.76 to 1.00; $p = 0.046$). Subgroup analysis found that patients with musculoskeletal symptoms and angina pectoris in the intervention group had significantly lower admission rates than those in the control group	<i>Early allied health intervention in the ED had a significant but modest impact on admission rates in older patients. Effects appeared to be limited to a small number of common presenting problems</i>
Fan <i>et al.</i> , ⁵¹ 2006, Canada	Prospective, observational cohort study Patients aged > 64 years $n = 120$	TRST to predict resource utilisation defined as ED revisits, hospital admission and long-term care placement at 30 and 120 days after an ED presentation. TRST score of ≥ 2 defined patients as high risk for the above outcomes	<i>This study demonstrates that the TRST is a poor diagnostic test to predict ED revisit, hospital admission or long-term care placement at 30 and 120 days as witnessed by the failure of the likelihood ratio CIs to achieve levels of clinical significance</i>	<i>The TRST cannot be used as a single diagnostic test to predict whether or not Canadian ED elders will have an ED revisit, hospital admission or long-term care placement at 30 or 120 days</i>

Authors, year, country	Study design, population, patient numbers	Intervention/assessment tool	Results	Headline message
Argento <i>et al.</i> , ⁶⁶ 2010, USA	Prospective cohort study 100 consultations with patients aged > 65 years	Geriatric nurse practitioner stationed in ED to provide consultative care to supplement care already provided by ED staff	Of 100 patients assessed, 31% required admission, 16% returned to a nursing home and 5% were referred to a nursing home for ongoing care; 48 patients returned home, of whom 60% had a visiting nurse put in place and 6% were discharged with home hospice	Although the period of the study was short, the advance practice nurse was able to generate consultations and provide geriatric-specific care to elderly ED patients. Further research will focus on quality care initiatives and patient-specific outcomes
Carpenter <i>et al.</i> , ¹⁸ 2010, USA	RCT Adults aged > 65 years, mean age 76 years <i>n</i> = 69	Geriatric technicians screened elderly people presenting at the ED (MMSE and CAM ICU). Physicians were either informed or not informed of the results of the screening	<i>A chart review was conducted to assess admission rates, documentation of recognized geriatric syndromes, discharge instructions, and follow-up plans</i> Informed physicians were unaware of abnormal screening results in 71% of patients, including > 50% of delirium patients	Screening did not appear to influence the decisions made by physicians – either in their documentation, disposition or management decisions
Carpenter <i>et al.</i> , ⁴⁵ 2012, USA	Prospective consecutive patient trial Patients aged > 65 years 225 patients enrolled, 159 at 1-month follow-up	Baseline measures included the OARS ADL plus the ISAR tool and TRST. Telephone follow-up was carried out to quantify the composite outcome of reported ED recidivism, hospitalisation, OARS ADL functional decline and interval death	The TRST and ISAR tool labelled 65% and 82% of patients as being at high risk, respectively. At 3 months, 51% reported diminished function, 35% had another ED evaluation and were hospitalised, 2% had been institutionalised and 70% had the composite outcome. Neither TRST nor the ISAR tool predicted 1- or 3-month composite outcomes in either general geriatric patients or those with cognitive impairment or lower health literacy	<i>Neither the ISAR tool nor the TRST distinguish GED patients at high or low risk for 1- or 3-month adverse outcomes</i>
Dresden <i>et al.</i> , ⁷⁰ 2015, USA	Prospective cohort study Patients aged > 65 years 829 intervention patients, 873 control patients	GNLI using ED-based assessment and care co-ordination was implemented for GED patients	GNLI when compared with controls had: higher discharge rate (52.5% vs. 30.0%; RD 22.5%, 95% CI 17.8% to 27.0%); lower inpatient rate (28.6% vs. 48.3%; RD -19.7%, 95% CI -24.2% to -15.2%); no significant change in observation rate (18.9% vs. 21.7%; RD -2.8%, 95% CI -6.5% to 1.1%). 'Of potential 30-day readmissions, the GNLI group had a higher discharge rate than the control group (46.7% vs. 24.9%; RD 21.8%, 95% CI 11.1% to 32.0%)'. 'GNLI patients admitted to inpatient or observation had a shorter mean hospital LOS than control patients (88.2 vs. 104.3 hours; difference in mean -16.1 hours, 95% CI -30.9 to -1.3 hours)'	<i>GNLI in this sample was associated with significant decreases in hospitalisation rate, 30-day readmission rate and hospital LOS. A further study to evaluate ED recidivism after GNLI is needed</i>

Authors, year, country	Study design, population, patient numbers	Intervention/assessment tool	Results	Headline message
Dziura <i>et al.</i> , ⁴⁶ 2013, USA	Medical record review Patients aged > 65 years <i>n</i> = 250	Rapid screening assessment measuring ED visits in the past 12 months, disability, polypharmacy and age. Disability was assessed using a 12-item questionnaire	42 participants (17%) experienced at least one 30-day return visit or death. In the multivariable model, previous ED visits (OR 2.6, 95% CI 1.2 to 5.5), greater global disability (OR 1.56, 95% CI 0.99 to 2.5), age (OR 1.04, 95% CI 1.0 to 1.08) and polypharmacy (> 10 medications; OR 1.8, 95% CI 0.9 to 3.9) were associated with a greater likelihood of a 30-day event. The fit of the multivariable model was good (Hosmer–Lemeshow goodness of fit test, <i>p</i> = 0.85) and it provided good discrimination between those having and those not having 30-day events (area under ROC curve = 0.73). The predicted probability of a return visit ranged from 3% to 56%	Rapid screening assessment provides an accurate method to identify in the ED older patients who are likely to have a return visit or to die
Eagles <i>et al.</i> , ⁴⁷ 2015, Canada	Substudy of a prospective cohort study. ED following trauma then follow-up at 3 and 6 months Patients aged ≥ 65 years with minor trauma; mean age 76.8 years <i>n</i> = 504	Used a standardised test, the TUGT, for assessing mobility in the ED. Assessed the TUGT and its relationship with frailty, functional decline, fear of falling and falls	Significant association between TUGT scores and frailty, functional decline at 3 and 6 months, fear of falling at 0, 3 and 6 months and self-reported falls at 0 months	In a population of community-dwelling older people with trauma, on presentation to the ED the following were associated with TUGT scores: frailty, functional decline and fear of falling. There was an association between the TUGT and falls at the initial visit, but not at 3 or 6 months' follow-up. These findings suggest that the TUGT can be used to identify patients with frailty who are at risk of further decline

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Eagles <i>et al.</i> , ³⁷ 2014, Canada	Prospective cohort study Patients aged ≥ 75 years $n = 260$	The O3DY is a four-question cognitive screening tool. Abnormalities resulted in a comprehensive cognitive evaluation. Descriptive statistics were used to assess level of implementation, prevalence of altered mental status and sensitivity and specificity compared with the MMSE, using a cut-off point of < 25 . Kappa coefficients were calculated	Screening rates were 78.3% overall, 51.8% for physicians and 64.2% for nurses. Strong inter-rater reliability ($\kappa = 0.65$, 95% CI 0.51 to 0.80). Physician and nurse sensitivity compared with the MMSE was 78.9% (95% CI 53.9% to 93.0%) and 84.6% (95% CI 64.3% to 95.0%) and specificity was 39.4% (95% CI 23.4% to 57.8%) and 54.2% (95% CI 39.3% to 68.3%). Physicians and nurses reported that the O3DY was easy to learn (98%, 97%), remember (88%, 95%) and use (95%, 97%). Both groups were less sure about patient benefit (30%, 55%) and usefulness to practice (50%, 72%). Patient living situation, level of education, triage location, hospitalisation, admission location and death in 30 days were associated with altered mental status	<i>The O3DY is a simple screening tool for altered mental status that has been shown to be feasible for use in the ED. Implementation will increase the identification of altered mental status in elderly patients presenting to the ED</i>
Hadbavna <i>et al.</i> , ³⁴ 2013, Ireland	Convenience sample – data from clinical records Patients aged > 65 years $n = 117$	Brief nurse-administered 6-CIT in the ED	Over two-thirds (79/117, 67.5%) required hospital admission. The TRST was used on 48/117 patients (41%) and 37/48 (77%) were identified as being high-risk vulnerable older adults. The initial 6-CIT was positive in 43/117 patients (36.8%). The repeat 6-CIT was performed on 28/43 (65%) of these, with the remainder having been discharged from the ED. All except 4/28 (14%) remained positive. The CAM ICU was positive for delirium in 7/28 patients (25%) screened	'A high proportion of older patients attending the ED met the criteria for cognitive impairment. Of those admitted, many met the criteria for delirium. There was considerable variation in the applicability and implementation of the screening instruments between nurses, despite training.' The ED has the potential to be a location in which to identify patients with undiagnosed dementia
Launay <i>et al.</i> , ⁸⁵ 2013, France	Prospective cohort study 168 older adults	Early MGT combining BGA and standardised recommendations	Of the included patients ($n = 168$), 48 benefited from recommendations from the MGT (16 geriatric and 32 gerontological). Of the 168 patients, 32 (of whom 12 received MGT recommendations) were discharged early. Of the recommendations, only the geriatric recommendations were associated with ED early discharge (OR 4.38, $p = 0.046$)	MGT geriatric recommendations were associated with early discharge from the ED, whereas gerontological recommendations were not

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Lonterman <i>et al.</i> , ³² 2011, the Netherlands	Cross-sectional diagnostic cohort study Patients aged ≥ 65 years presenting to the ED $n = 300$	ED/geriatric screening tool compared with safety management system screening bundle (reference standard). Screening tool was administered by nurses (presumably at admission but not explicitly reported) and the screening bundle by researchers	Area under the ROC curve for the screening tool was 0.83 (95% CI 0.78 to 0.88). One of the original eight items could be removed without reducing validity. In both the eight- and seven-item screening tool, the overall misclassification was lowest at a cut-off score of 2 (52% and 47%, respectively). Using a cut-off score of 2, the seven-item screening tool had sensitivity of 64% and specificity of 89%	The screening tool has moderate validity compared with the screening bundle and can be used to identify most elderly ED patients at high risk of adverse outcomes
Terrell <i>et al.</i> , ¹²⁰ 2009, USA	RCT 63 emergency physicians (32 intervention and 31 control) Average patient age 74 years	Computer-assisted decision support to reduce potentially inappropriate medicine prescribing to older adults. Primary outcome was the proportion of visits that resulted in one or more prescriptions for a potentially inappropriate medicine	There were 2647 visits to an intervention physician; at 111 visits an intervention physician attempted to prescribe a potentially inappropriate medicine. Decision support was provided 114 times (107 visits); 49 (43%) of these decision support recommendations were accepted. One or more inappropriate medications were prescribed at 2.6% of intervention ED visits by seniors and 3.9% of control visits. The proportion of all prescribed medications that were inappropriate significantly decreased from 5.4% to 3.4%	There are specific medicines that are inappropriate for older people; however, these continue to be prescribed. As an intervention to improve ED care for older people, computerised decision support reduced the prescription of potentially inappropriate medications on discharge from the ED
Tiedemann <i>et al.</i> , ⁶⁰ 2013, Australia	Prospective cohort study (6-month follow-up) Patients aged ≥ 70 years who presented to the ED after falling or with a history of two or more falls in the previous year $n = 219$ in the development study and $n = 178$ in the subsequent external validation study	Final screening tool involved two items: two or more falls in the past year and taking six or more medications. Participants were assessed in the ED at the time of presentation by clinical staff as part of their normal duties	Mean patient age was 81 years; 46% of the development sample and 27% of the validation sample were male. During follow-up, 31% and 35% of participants fell in the development and external validation samples, respectively. Area under the ROC curve for the two-item screening tool was 0.7 (95% CI 0.64 to 0.76), which was similar to that for the FROP-Com and PROFET tools	<i>A simple, two-item screening tool demonstrated good external validity and accurately discriminated between fallers and non-fallers. This tool could identify high-risk individuals who may benefit from onward referral or intervention after ED discharge</i>

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Beirne <i>et al.</i> , ¹⁰⁷ 2012, Ireland	Prospective data analysis (1 year) All older attendees to the ED (aged > 72 years) ISAR, <i>n</i> = 7596; convenience sample (ISAR > 2), <i>n</i> = 300	Use of the ISAR tool for predicting ED reattendance; CGA	Patients aged ≥ 72 years attending the ED accounted for 20% of all attendances (2003 = 16%). ISAR for 15% of patients and sensitivity for ED reattendance was 77% at 1 month, 80% at 3 months and 79% at 6 months. Comparing patients with ISAR score of > 2 (<i>n</i> = 300) who received CGA, with those who did not, reattendance figures are as follows (21% vs. 24% at 3 months; 27% vs. 33% at 6 months)	In an intervention that combined identification of at-risk older people using the ISAR tool followed by CGA for those scoring 'at risk', ED reattendance was lower in the CGA group. 'Appropriate community follow-up' was also included
Berahman <i>et al.</i> , ⁸⁴ 2014, USA	Prospective questionnaire (five questions, scored from 0 to 10) survey about patient satisfaction and overall ED experience when a patient liaison was present and not present Patients aged 65–99 years, mean age 75 years 637 patients (432 with a patient liaison, 205 with no patient liaison)	Patient liaison programme: 'interaction with physician and staff in order to address non-medical needs and update them on the status of their ED visit'	There was no significant difference between the groups for four of the five questions. For the other question (increased satisfaction in how often visited by ED staff), the mean score was 7.83 for the patient liaison group and 7.23 for the non-patient liaison group (<i>p</i> = 0.012)	Trend towards improved satisfaction scores when a patient liaison was present but this was not statistically significant or was barely significant
Chou <i>et al.</i> , ¹⁰⁰ 2015, Taiwan; Liao <i>et al.</i> , ¹⁰¹ 2012, Taiwan	Appears to be a prospective cohort study (12-month follow-up, results at 6 months reported) Older people who visited the ED three times within 30 days (<i>n</i> = 137, of whom 26 received a CGA-based intervention)	After initial assessment in the ED, CGA and 'geriatric interventions' were performed by a geriatric team	Mean patient age was 80.3 years and 74% were male; there were no demographic differences between the intervention group and the non-intervention group. The intervention group was more likely to be admitted (50% vs. 22%) and made fewer visits to the ED within 1 (0.81 vs. 1.75 visits) and 6 (2.2 vs. 4 visits) months	The CGA-based intervention reduced subsequent ED visits significantly, but a RCT would be required to confirm the findings

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Chui and Kun, ¹⁰⁹ 2013, Hong Kong	All patients receiving a geriatric consultation service Prospective cohort study Patients aged 64–99 years, mean age 80.3 years <i>n</i> = 1096	'Program We Care' (geriatric consultation service)	Following the geriatric consultation, of the 1096 study participants, 508 were transferred for convalescent care, 475 were discharged home with follow-up, 111 were discharged home with follow up and a community nurse referral and 113 required acute medical admission. The total number who reattended the ED within 48 hours was 16	The aim of the intervention was to reduce acute medical admissions from the ED. Study authors argue that their intervention did reduce admissions; however, no control group or data for comparison
Dundar <i>et al.</i> , ⁴³ 2015, Turkey	Prospective cohort study (in-hospital follow-up) Patients aged ≥ 65 years admitted with acute medical or surgical complaints <i>n</i> = 939	REMS, REMS without age and HOTEL	Median patient age was 74 years and 54% were male. REMS and HOTEL scores differed significantly between patients who were discharged from the ED, those admitted to the ward and those admitted to intensive care. The scores of patients who died in hospital were significantly higher than those of survivors. Area under the ROC curve values for REMS, REMS without age and HOTEL were 0.77, 0.76 and 0.83, respectively	The REMS, REMS without age and HOTEL scores cannot be used to identify GED patients requiring hospital admission, but they are of value for predicting in-hospital mortality and intensive care admission
Genes <i>et al.</i> , ⁹¹ 2013, USA	Before-and-after study comparing 3-month periods before and after implementation of a GED Discharged patients aged < 65 years (<i>n</i> = 219) and ≥ 65 years (<i>n</i> = 67)	Press Ganey surveys [sic] were reviewed after discharge	Following implementation of the GED, patient satisfaction scores among older patients increased significantly for areas related to information about home care; measures to protect safety; treatment of family and friends; and ancillary testing. Non-significant increases in overall satisfaction, plus satisfaction regarding nurses, doctors, registration and arrival increased	Implementation of a GED increased patient satisfaction scores in people aged ≥ 65 years, but not in younger patients
Hughes <i>et al.</i> , ¹⁰⁵ 2014, UK	Prospective review of patients over a 4-week period Acute admissions presenting to the ED Patients aged ≥ 70 years 547 patients (admitted to ED and clinical decision unit)	CGA as delivered by an OPAL service	547 medical patients were admitted to the ED and clinical decision unit; 56% (<i>n</i> = 307) were assessed by the OPAL team and received CGA. Of these, 57% (174/307) returned to their usual place of residence, 8% (25/307) were transferred to a community hospital, 35% (108/307) were transferred to a medical specialty ward, 47% (51/108) were admitted to an elderly care ward and one patient died. In total, 53% (164/307) were discharged within 48 hours of admission. Median LOS was 2 days (range 2 hours to 37 days). Current readmission rate within 1 month of discharge was 14% (42/307)	<i>Older people who received CGA at the point of admission appeared to benefit from improved function at discharge, reduced length of stay and increased probability of returning to their usual place of residence on discharge</i>

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Karounos <i>et al.</i> , ⁹² 2014, USA	Retrospective review of geriatric admissions, 1 year before and after a GED opened Patients aged > 65 years <i>n</i> = 27,838	GED: geriatric-friendly physical attributes; educated staff; geriatric care team (care transitions); dementia screening as standard; and medication review for drug–drug interactions	Outcome measure was geriatric admissions. Before: 13,354 patients, 7065 admitted (52.9%); post: 14,484 patients, 7247 admitted (50%); 1130 fewer admissions (2.9%) (<i>p</i> < 0.001)	Admissions were reduced, possibly because of extra emphasis on transitions of care. Further research is needed to look at rates of revisit and cost savings required
Lo Storto <i>et al.</i> , ¹¹¹ 2011, Italy	Prospective cohort study Older patients (age range 65–100 years) attending the ED <i>n</i> = 226 over 2 years	CGA was performed by a team, including a geriatrician, a nurse and a social worker. When admission to hospital was considered inappropriate, alternatives including home services and/or temporary residential accommodation were proposed	Mean patient age was 80.5 years and 63.7% were female. Hospital admission was considered appropriate for 141 patients and inappropriate for 84, of whom 66 were discharged home after activating home services	The social health and triage team reduced hospital admissions and improved quality of care
Ng <i>et al.</i> , ^{96,97} 2014, USA	Before-and-after study using administrative data Patients aged ≥ 65 years attending an ED between January 2011 and May 2013 (GED opened in February 2012 and GEDI-WISE programme began in October 2012)	No details of screening in the GED were reported	Mean patient age was 77 years (SD 8.6 years). Admission rate declined from 58.9% in January 2011 to 50.7% in May 2013, a change that remained statistically significant after adjustment	There was a decrease in admission rates of patients aged > 65 years following the opening of a GED
Post <i>et al.</i> , ⁴⁸ 2013, USA	Retrospective chart review to develop a measure of disability for use in the ED, followed by a prospective cohort study (<i>n</i> = 250 patients aged ≥ 65 years) to further refine and validate the measure	The GRAY measure has five screening and 15 follow-up questions covering physical and cognitive disability, stress, depression and isolation. A global score and estimated risk of readmission within 30 days are generated. Not reported where screening takes place	56 participants (22%) experienced at least one 30-day return visit or death. Greater disability as measured by the ED GRAY global disability was associated with an increased likelihood of an event (OR 1.7 for each 1-point worsening in severity, 95% CI 1.2 to 2.5). In the multivariable model, prior ED visits (OR 2.7, 95% CI 1.4 to 5.2), ED GRAY global score (OR 1.4, 95% CI 1.0 to 2.1) and age (OR 1.03, 95% CI 0.99 to 1.07) were associated with a greater likelihood of a 30-day event. The fit of the multivariable model was good and it provided good discrimination between those having and those not having a 30-day event (area under the ROC curve = 0.70). The predicted probability of a return visit ranged from 3% to 56%	The GRAY measure can be quickly performed in the ED to initially assess disability and identify issues that need to be addressed. Combined with other data, it provides good discrimination of risk of ED readmission within 30 days

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Grudzen <i>et al.</i> , ¹¹³ 2015, USA	Review of administrative data from health records and billing data (1 January 2011 to 31 May 2013) All aged ≥ 65 years	Palliative care elements of GEDI-WISE: GED space, volunteers to help geriatric patients, screening using the ISAR tool (those with a score of > 2 had additional screening including identifying for palliative care) and training to carry out screening as well as additional training in palliative care ED screening tool for the rapid identification of older adults with a high likelihood of re-presentation or readmission, who require palliative care plus a wider model of care GEDI-WISE Because 50% of adults aged > 65 years in the last month of life present to the ED, there is a need for interventions to prevent admissions to intensive care for these adults and redirect them to appropriate palliative care	Primary outcome = ICU admission rate from the ED for patients aged > 65 years. Also measured ED-initiated palliative care consultations and hospice referrals. Over a 29-month study period, the unadjusted ICU admission rate declined from 2.3% to 0.9%. Adjusting for age, sex, ESI score and others, the decline was still significant ($\beta -0.0073$, 95% CI -0.0105 to -0.0041 ; $p < 0001$)	Decline in geriatric admissions cannot be attributed to GEDI-WISE because there were additional interventions taking place at the same time, such as the opening of a palliative care unit. However, there was a national increase in ICU admissions so this is against this trend
Wall and Wallis, ²⁰ 2014, UK	Diagnostic accuracy study People aged ≥ 75 years admitted to wards from the ED over a 2-week period $n = 118$	In this study the CFS was applied after admission to wards to compare the distribution of frail patients in geriatric vs. non-geriatric wards. The CFS was compared with other frailty scales (Edmonton Frailty Scale, PRISMA-7 and ISAR)	There was no statistically significant difference in frailty between patients in geriatric and patients in non-geriatric wards. Analysis of ROC curves showed that the CFS accurately identified frail patients compared with other well-established frailty scales at appropriate cut-off points	The CFS is a rapid and simple case-finding tool. Its implementation in the ED could increase the proportion of frail patients admitted directly to a geriatric ward
Lee <i>et al.</i> , ²³ 2011, South Korea	Diagnostic accuracy study People aged ≥ 65 years presenting to an ED over a 3-month period $n = 1903$	CTAS at admission	Severity (e.g. mortality and ICU admission) increased as CTAS score increased. In total, 94 patients received a life-saving intervention within 1 hour of arriving at the ED. The sensitivity and specificity of a CTAS score of ≥ 2 for identifying patients receiving an immediate intervention were 97.9% and 89.2%, respectively	The CTAS is a triage tool with high validity for elderly patients and is especially useful for categorising severity and recognising those who require an immediate life-saving intervention

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Hegney <i>et al.</i> , ⁴⁴ 2006, Australia	Before-and-after study Patients aged > 70 years <i>n</i> = 2139	Risk screening to refer patients for home and community care services. Screening tool adapted from the 'Screening Tool for Elderly Patients', which in turn was developed from the ISAR tool	2139 older people (of whom 246 were re-presentations and 1102 were admitted). There was a 16% decrease in re-presentation rate from 21% to 5% ($\chi^2 = 15.59$; $p < 0.001$) and a 5.5% decrease in readmission rate from 10.2% to 4.7% ($\chi^2 = 4.61$; $p < 0.05$). There was a decrease in re-presentations of those patients who present three or more times per month (not a significant result) and a decrease in LOS from 6.17 days to 5.37 (privacy restrictions made any substantial data analysis impossible)	There was a decrease in re-presentations. It was suggested that this was because of increased referral to other community-based services (i.e. diverting patients elsewhere) <i>The average number of days started to decrease prior to the introduction of the intervention, which may suggest some other factor(s) than the nurse-led model of discharge planning may have influenced the results</i>
Basic and Conforti, ²⁶ 2005, Australia	RCT Elderly patients [functional impairment, psychological disability, social disability, active multisystem (2+) disease, discharge from hospital within the last 14 days] Mean age 78.7 ± 6.4 years <i>n</i> = 224 (114 intervention patients, 110 control patients)	Early geriatric assessment in the form of an aged care nurse intervention – screening using a variety of instruments; liaison with carers and health-care professionals; and organised and assisted in the care of those admitted as inpatients	<i>Our aged care nurse intervention, based in the emergency department and comprising detailed assessment, monitoring and referral, failed to reduce admission of elderly patients to the hospital, LOS, or functional decline during the hospitalisation</i>	Intervention had no effect on admission rates, LOS or functional decline. The authors believe that this was because the intervention did not (1) give timely access to community support or (2) have the ability to change the course of care in hospital. However, impaired function was a strong predictor of outcomes. Delayed impact of nursing interventions
Asomaning and Loftus, ²⁸ 2014, Canada	Audit of implementation of the ISAR tool Patients aged ≥ 65 years presenting to the ED over two 14-day periods <i>n</i> = 525	Use of the ISAR tool by nurses in the ED	271 patients (51.6% of those eligible) were screened with the ISAR tool, of whom 158 (58%) had a positive result (answered yes to two or more questions). Patients with positive results were more likely to be aged > 79 years, were more likely to be admitted and had a longer LOS than those screening negative	Low compliance by staff was a barrier to implementation of the ISAR tool. Reasons identified included the fast-paced nature of emergency care and lack of staff at night. Strategies to address this included tool adaptation and providing staff with knowledge of ED and inpatient geriatric resources and feedback on completion rates

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Bond <i>et al.</i> , ⁶⁵ 2014, Canada	Matched paired study using administrative data (four EDs with an EDCC and four without) Seniors aged > 65 years with a discharge diagnosis of fall or musculoskeletal pathology 910 matched pairs (1820 patients; matched on a number of criteria)	EDCCs to reduce hospital admission rates on index visit (secondary outcomes: LOS, 30-day recidivism, 30-day revisit resulting in admission) through better linkages with home care and community services on discharge	No difference between EDCC and non-EDCC patients in the following: admission rates (OR 0.88, 95% CI 0.69 to 1.12); revisit rates at 30 days (OR 1.19, 95% CI 0.95 to 1.51); and readmission rates at 30 days (OR 1.03, 95% CI 0.73 to 1.46)	'This study showed no reduction in senior patients' admission rates, recidivism at 30 days or hospital LOS when comparing seniors seen by an EDCC with those not seen by an EDCC.' However, EDCC may have other positive outcomes not measured in this study. Numerous problems with the study design
Buurman <i>et al.</i> , ⁵⁵ 2011, the Netherlands	Prospective diagnostic cohort study Patients aged ≥ 65 years discharged from an ED over an 11-month period <i>n</i> = 381	ISAR tool, TRST and Runciman and Rowland questionnaires administered after discharge together with an interview to assess functional status at the time of visiting the ED	Mean patient age was 79.1 years. Within 120 days, 14.7% of patients returned to the ED, 17.2% were hospitalised and 2.9% died. The area under the ROC curve was low for all of the screening tools, indicating poor discriminatory power	None of the screening tools was able to discriminate clearly between patients with and without poor outcomes
Carpenter <i>et al.</i> , ³⁵ 2011, USA	Prospective diagnostic cohort study Patients aged ≥ 65 years attending an ED between June 2009 and March 2010 <i>n</i> = 169	O3DY, BAS, SBT and caregiver-completed AD8 compared with MMSE as reference standard. Screening by researchers in the ED	Complete data were collected for 163 patients, of whom 37% had cognitive dysfunction. The SBT, BAS and O3DY each showed 95% sensitivity, compared with 83% sensitivity for the caregiver-completed AD8. The SBT had the highest specificity (65%) followed by the caregiver-completed AD8 (63%). The SBT showed the best overlap with the MMSE	Brief screening instruments such as the SBT can rapidly identify patients at lower risk of cognitive dysfunction
Carpenter <i>et al.</i> , ³⁶ 2011, USA	Prospective diagnostic cohort study Patients aged ≥ 65 years attending an ED between June 2009 and March 2010 <i>n</i> = 371	SIS and AD8 compared with MMSE as reference standard. Screening by researchers in the ED	Of 319 patients who completed cognitive testing, 35% had cognitive dysfunction. The SIS had the highest sensitivity (74%), specificity (77%) and area under the ROC curve compared with either the caregiver- or the patient-completed AD8	The SIS was superior to the caregiver- or patient-completed AD8 for identifying older adults at increased risk of cognitive dysfunction

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Di Bari <i>et al.</i> , ⁵⁸ 2012, Italy	Prospective cohort study Patients aged ≥ 75 years attending a GED over an 8-month period $n = 1632$	The ISAR tool was administered at triage in the ED and compared with Silver Code results obtained retrospectively from administrative data	Mean patient age was 84 years and 61% were women; 75% were ISAR positive (answered yes to two or more questions). ISAR and Silver Code scores were moderately correlated ($r = 0.35$) and had a similar area under the ROC curve for predicting hospital admission. ISAR-positive patients had an increased risk of hospital admission and death and risks also increased with increasing Silver Code risk category. In a 6-month follow-up period, the tools had a similar ability to predict repeat ED visits, hospital admission and death	Prognostic stratification with the Silver Code is comparable with that obtained by direct patient evaluation. The Silver Code predicts ED readmission and future hospitalisations even in patients discharged directly from the ED. The Silver Code is based on data available at the time of accessing the ED and could in principle be used to aid triage, although only as a preliminary step
Hustey <i>et al.</i> , ¹⁹ 2007, USA	Secondary analysis of data from a randomised trial Patients aged ≥ 65 years who attended an ED and were discharged home $n = 650$	TRST administered at triage in the ED	Mean patient age was 74 years and 59% were women. TRST scores were correlated with baseline ADL impairments, IADL impairments and self-reported physical health at all end points. A TRST score of ≥ 2 was moderately predictive of decline in ADL or IADL at 30 and 120 days	<i>TRST provides a valid proxy measure for assessing functional status in the ED and may be useful in identifying high-risk patients who would benefit from referrals for further evaluation or surveillance upon ED discharge</i>
Keyes <i>et al.</i> , ⁹³ 2014, USA	<i>Retrospective pre/postintervention comparison study of 2 cohorts of patients</i> Four groups: seniors (aged ≥ 65 years) in the ED before the senior ED opened; those in the new senior ED; younger patients (aged 55–64 years) treated before the senior ED opened; and younger patients treated after it opened 12,015 patients (7598 aged > 64 years and 4417 aged 55–64 years); mean age of all patients was 70 years (77.5/76.9 years in the senior groups)	Effect of senior ED/GED on rates of admission to hospital, LOS and ED return visit within 30 and 180 days. GED comprised a case management approach, which included improved staff education; changes to physical space; and universal screening for common elderly comorbidities	<i>There was no significant difference in time to return within 30 days or average hospital LOS. Risk of being admitted on the index visit was lower for seniors treated in the senior ED than for seniors in the regular ED (relative risk 0.93, 95% CI 0.89 to 0.98)</i>	A new senior ED was associated with decreased admissions but not with ED return visits or LOS. 'There is evidence from our analysis that care in our senior ED might contribute to fewer admissions on the index visit, but this was not the primary hypothesis of this study.' We need to be sure that if patients are being discharged early then this is not just increasing the rates of return ED visits. Screening thresholds should allow us to identify those who are at risk of return. There may be an unintended consequence that a GED increases return rates because patients would prefer to be seen in this setting (no evidence for this in this study). Authors argue that the reason for improvements in admission rates is related to the use of social workers

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Wilber <i>et al.</i> , ³⁸ 2008, USA	Prospective diagnostic accuracy study Patients aged ≥ 65 years attending an ED between January 2006 and January 2007 $n = 352$	SIS before or after MMSE (reference standard) administered by a physician in the ED	Mean patient age was 77 years and 63% were women; 111 patients were cognitively impaired based on the MMSE. The SIS had 63% sensitivity and 81% specificity. The area under the ROC curve was 0.77 (95% CI 0.72 to 0.83)	Sensitivity of the SIS was lower in this study than in previous studies therefore unable to recommend it as a brief mental status test in the ED
Wilber <i>et al.</i> , ³⁹ 2005, USA	Diagnostic accuracy study Patients randomised between screening tests; aged ≥ 65 years attending an ED in autumn 2003 $n = 150$	SIS or Mini-Cog administered by a physician in the ED followed by MMSE (reference standard)	Mean patient age was 75 years and 55% were women. The SIS had sensitivity of 94% (95% CI 73% to 100%) and specificity of 86% (95% CI 74% to 94%). The Mini-Cog had sensitivity of 75% (95% CI 48% to 93%) and specificity of 85% (95% CI 73% to 93%)	<i>The SIS, with a cut-off point of ≤ 4, is short, easy to administer and unobtrusive, allowing it to be easily included in the initial assessment of older ED patients</i>
Stiffler <i>et al.</i> , ⁵⁹ 2016, USA	Prospective cohort study Patients aged ≥ 65 years attending an urban ED $n = 107$	SHARE-FI administered in the ED. Patients classified as non-frail, pre-frail and frail	Mean patient age was 79 years and 50% were women. The composite 30-day primary outcome (death, functional decline, repeat ED or hospital admission or nursing home admission) occurred in 19% of non-frail, 44% of pre-frail and 78% of frail patients. Falls occurred in 0%, 6% and 21%, respectively	The SHARE-FI tool appears to be a feasible method to screen for frailty in the ED
Eklund <i>et al.</i> , ³¹ 2016, Sweden	Cross-sectional diagnostic accuracy study Older patients attending the ED between October 2008 and June 2010; aged ≥ 80 years or aged 65–79 years with at least one chronic disease and dependence in at least one daily living activity $n = 161$	Five-question FRESH screening tool administered in participants' homes followed by measurement of eight frailty indicators (reference standard)	Both sensitivity (81%) and specificity (80%) of the FRESH tool were high. A question about repeated visits to the ED did not improve accuracy and was removed, reducing the number of questions to four	The FRESH tool has high clinical value in screening for frailty. It is simple and rapid to use, takes only a few minutes to administer and requires minimal energy use by the person being screened

Authors, year, country	Study design, population, patient numbers	Intervention/assessment tool	Results	Headline message
Tang <i>et al.</i> , ⁹⁵ 2016, UK	Observational before-and-after study (two 7-month periods) People aged > 65 years; RAC group (mean age 75 years), comparator group (A&E, mean age 73 years) <i>n</i> = 441 (346 A&E patients, 95 RAC patients)	RAC: six-bedded consultant-led ward	LOS was 5.6 days when admitted by A&E and 4.1 days when admitted by RAC. This relationship held when looking at groups by diagnosis	Use of RAC led to a shorter LOS and patients were discharged earlier
Shaw <i>et al.</i> , ⁶⁴ 2016, USA	Retrospective cohort analysis Patients aged > 65 years 4103 patients, 872 treated in the ED for seniors and 342 of these treated by the clinical pharmacy specialist	Implementation of the ED for seniors, including a clinical pharmacy specialist, specialised in geriatric training including medication management training, as a key member of the ED team	Compared with other patients, both patients treated in the senior ED and those treated by the clinical pharmacy specialist did not have a reduction in ED return visits at 30 or 90 days, mortality, cost of follow-up care or hospital admissions. The clinical pharmacy specialist identified 45% of patients as having at least one medication-related problem	<i>Although at least one medication-related problem was identified in almost half of patients treated by the clinical pharmacy specialist in the ED for seniors, incorporation of a clinical pharmacy specialist into the ED staff did not improve clinical outcomes</i>
Wilber <i>et al.</i> , ⁹⁴ 2013, USA	Retrospective cohort analysis of quality assurance data Patients aged ≥ 65 years 2260 eligible visits in 2012 (comparison group) and 2286 eligible visits in 2013 (intervention group)	Triage to a 15-bed senior ED, with overflow to a standard ED. Assessment by a registered nurse transitional care co-ordinator, care protocols, education, pharmacy review and call backs on discharged patients	There was a small but not significant decrease in LOS (300 minutes to 296 minutes). There was a significant decrease in admissions (55.5% to 51.2%; difference -4.3 percentage points, 95% CI -7.2 to -1.4 percentage points). There was an increase in patient observations were from 2.2% to 3.9% (difference 1.7 percentage points, 95% CI 0.7 to -2.7 percentage points) <i>Revisits resulting in admission or observation at 7 (4.9 to 4.5) and 30 (13.2 to 12.3) days^a were slightly but not significantly decreased</i>	<i>A pilot senior ED programme reduced admissions without increasing LOS or revisits resulting in admission or observation</i>

6-CIT, six-item cognitive impairment test; A&E, accident and emergency; ACP, aged care pharmacist; BAS, Brief Alzheimer's Screen; DEM, department of emergency medicine; df, degrees of freedom; FROP-Com, Falls Risk for Older People – Community; IADL, instrumental activities of daily living; ID, identification; IRR, incidence rate ratio; LOS, length of stay; NEAT, national emergency access target; O3DY, Ottawa 3DY Scale; OARS, older adult resources and services; PACE, post-acute care enablement; PRISMA-7, Program of Research to Integrate Services for the Maintenance of Autonomy – 7-item questionnaire; PROFET, Prevention of Falls in the Elderly Trial; RD, risk difference; SBT, Short Blessed Test; SD, standard deviation; SGA, synthesised geriatric assessment.

a Data supplied in original source.

Appendix 5 Full data extraction tables

Full paper	Authors: Silvester <i>et al.</i> ⁸⁶	Year: 2014	Country: UK
Study design	Prospective systems redesign study		
Data source	Routinely collected attendance and admissions data		
Study aim(s)	To conduct a patient flow analysis of older emergency patients to identify and address delays in ensuring timely care without extra resources		
Sample size			
Setting	GM directorate in an acute hospital (Sheffield Teaching Hospitals NHS Foundation Trust) with 1920 beds		
Frail elderly – definition			
Study population	Age: not defined	Condition: older people admitted as emergencies	
Intervention	What	Formation of a MDT, including consultant geriatricians, junior doctors, nurses, pharmacists, therapists and clerical staff, with expert clinical systems engineers as the facilitators who introduced a series of changes: <ul style="list-style-type: none"> • Discharge to assess: once patients' needs are established, social care is contacted for support packages. Ambulance services are made available to enable hospital MDT staff to return with each patient to carry out therapy assessment in their own home. Once plan is in place patients can go straight home • 7-day working: GM directorate consultant job plans changed from a 'post-take' working pattern to an 'on-take' pattern. New pattern allocated three sessions each day ensuring that a consultant geriatrician was able to see most patients on the day of their admission • Establishment of the frailty unit: one of the three medical assessment units became a dedicated 'frailty unit' (part of GM), which accepted frail patients of both sexes. This allowed co-location of the multidisciplinary clinic team, which minimised time between admission of a patient and multidisciplinary assessment 	
	Who	MDT, including consultant geriatricians, junior doctors, nurses, pharmacists, therapists and clerical staff, with expert clinical systems engineers as the facilitators	
	Duration	2 years	
	Other		
Comparator group	Analyses of attendance and admissions data for 1 April 2009 to 31 March 2010 to understand profile of attendance to ED and subsequent profile of admissions into GP specialty		
Outcome measures	<ul style="list-style-type: none"> • Average bed occupancy • In-hospital mortality • 28-day readmission rate 		
Findings	After the changes there was a fall in bed occupancy, a drop in mortality and no change in readmission rates. Statistical analyses showed that the average bed occupancy fell by 20.4 beds (95% CI -39.6 to -1.2; ³ $p = 0.037$) after the intervention. The odds of death in hospital reduced by 12% (OR 0.78, 95% CI 0.61 to 1.00; $p = 0.056$). The absolute reduction in risk of death before vs. after the intervention was 11.4% - 9.15% = 2.25%, which equates to a number needed to treat of 45 and a 19.7% reduction in risk of mortality. The odds of readmission remained unchanged (OR 0.94, 95% CI 0.75 to 1.18; $p = 0.61$) at 17.1% vs. 16.3% after the changes. Only cost associated with changes were those required for the improvement effort		
Conclusion	<i>Radically redesigning the system of care for older patients led to reductions in bed occupancy and mortality without adversely affecting the readmission rate or requiring additional resources. Radical redesign offers a promising way to meet the needs of patients within existing resources</i>		
Self-reported limitations	The study did not collect quality-of-care data from case note reviews so any specific aspects of care that changed remain unclear. The study focused on in-hospital mortality, but attention to longer-term mortality is warranted. The study did not undertake a qualitative study of patients' and carers' experiences of the changes, although anecdotal evidence was positive. No contemporaneous controlled comparisons with GM units in other hospitals or control wards in the same hospital were carried out		

Full paper	Authors: Silvester <i>et al.</i> ⁸⁶	Year: 2014	Country: UK
Headline message	Redesigning the system of care for older emergency patients led to reductions in bed occupancy and mortality without affecting readmission rates or requiring additional resources		
Other comments	No definition of frailty in article but do establish a frailty unit		
GM, geriatric medicine. a Data supplied in original text.			

Conference abstract	Authors: Ismail <i>et al.</i> ⁹⁸	Year: 2014	Country: UK
Study design	Service innovation		
Data source	ED records		
Study aim(s)	To reduce unnecessary admissions from the ED by accessing alternative pathways as appropriate		
Sample size	534 patients		
Setting	ED in Leeds, UK		
Frail elderly – definition	Medically stable frail older people experiencing a change in physical or cognitive function and/or complex comorbidities		
Study population	Age: not defined	Condition: generally frail	
Intervention	What	Two interface geriatricians provide early CGA by consulting in the ED. Following assessment, patients access appropriate alternative pathway: to admission, intermediate care or early geriatric outpatient review	
	Who	Interface geriatricians	
	Duration	Service has been running for 1 year	
	Other		
Comparator group	Discharge rates for intervention group are compared with previous ED discharge rates for frail older people		
Outcome measures	<ul style="list-style-type: none"> • Discharge • Suitable for discharge • Admission • Time waiting to be seen in ED 		
Findings	<ul style="list-style-type: none"> • 58% of selected patients were discharged from the ED; compares favourably with previous discharge rate of 20–33% for frail older people • Further 12% of patients were suitable for discharge but had to be admitted because of delays in accessing community services or investigations • 27% of selected patients needed admission for medical reasons • Readmission rate was similar to departmental rate of 20% • Small reduction in waiting time was seen for patients of all ages 		
Conclusion	Service is avoiding unnecessary admissions with their associated risks and costs. Feedback from ED staff, EDAT and patients has been extremely positive		
Self-reported limitations	Conference abstract so none discussed		
Headline message	Interface geriatricians performing early CGA can reduce unnecessary admissions		
Other comments	Small sample size; no information about the number of frail older people presenting to the ED. Promising but would need to be replicated. Conference abstract so no detailed methodological information		
EDAT, early discharge assessment team.			

Conference abstract and full paper		Authors: Aldeen <i>et al.</i> ^{67,68}	Year: 2014	Country: USA
Study design	Prospective, observational			
Data source	Medical records			
Study aim(s)	The aims of this GEDI project were to develop GEDI nurse liaisons by training ED nurses in geriatric assessment and care co-ordination skills, describe characteristics of patients who these GEDI nurse liaisons see and measure the admission rate of these patients			
Sample size	408 had consultations; 7213 total older adults in ED, 2124 eligible for GEDI consultation			
Setting	ED			
Frail elderly – definition	Individuals were eligible for GEDI consultation if they had an ISAR score of > 2 or it was requested by the ED clinician			
Study population	Age: ≥ 65 years, mean 79.3 years		Condition: ISAR score of > 2	
Intervention	What	GNL		
		An intervention for older adults. GEDI-WISE aims to reduce preventable admissions by assessing non-acute care needs in the ED that are related to the patient's age		
		<i>After consultation is triggered, the GNL administers a series of validated tests, assessing for cognition (Short Portable Mental Status Questionnaire), delirium (CAM), functional status, (Katz ADL), fall risk (TUGT), caregiver strain (Modified Caregiver Strain Index), and transitions (Care Transitions Measure-3)</i>		
		The GNL liaises with pharmacy, social work, physical therapy, geriatrics, palliative care and hospice services and advises the ED team and the patients primary care provider. A discharge plan is generated and two follow-up telephone calls are made to assess pain, medication concerns, outpatient appointment status, home health-care status and unexpected visits to health-care settings. Outcomes are noted in the patient's electronic medical record		
	By whom	GNL		
	Duration	Not reported, but did result in a longer ED stay		
	Other			
Comparator group	Those not receiving the intervention but who attended the ED during the same time period			
Outcome measures	Inpatient admissions			
Findings	GEDI was associated with 13% fewer admissions overall (16% fewer where Emergency Severity Index = 2). This reduction in inpatient admissions was the result of more discharges rather than more observation stays. Increase in discharges did not lead to an increase in representations			
Conclusion	Older adults with a high triage acuity score (Emergency Severity Index 2 or 3) who were given the GEDI-WISE intervention were more likely to be discharged from the ED than the control group			
		<i>Preventing hospital admission through geriatric-responsive ED management improves the care of older adults, potentially preventing significant physical and cognitive decline</i>		
Self-reported limitations	<i>There is no precisely defined comparison group with which the GEDI cohort can be compared with. That observation admissions were not different between the two cohorts suggests that the two groups were similar</i>			
		<i>A second limitation was that GEDI consultation was associated with a statistically significantly longer median ED LOS (1.1 hour longer)</i>		
		<i>The proportion of individuals undergoing the GEDI-WISE intervention has been small relative to the overall number of older adults in the ED (5.7%) and the number of individuals eligible for the intervention (19.2%)</i>		
Headline message	<i>ED nurses undergoing a 3-month training programme can develop geriatric-specific assessment skills. Implementation of these skills in the ED may be associated with fewer admissions of older adults</i>			
Other comments				

GEDI, geriatric emergency department innovations; GNL, geriatric nurse liaison; LOS, length of stay.

Full paper	Authors: Jones and Wallis ⁶¹	Year: 2013	Country: UK
Study design	Cohort study		
Data source	ED records. Data collected for all patients seen consecutively during four separate blocks each of 2 months' duration		
Study aim(s)	To investigate the effectiveness of basing a consultant geriatrician in the ED to facilitate admission prevention for older patients		
Sample size	848 patients seen by a consultant geriatrician		
Setting	ED in Birmingham Heartlands Hospital		
Frail elderly – definition	No clear definition		
Study population	Age: median 85 years, range 58–105 years	Condition: patients deemed by ED staff to be in definite need of admission or to require involvement of the ED geriatrician in the admission decision. Patients aged < 65 years had relevant condition (e.g. Parkinson's disease)	
Intervention	What	Consultant geriatrician based in the ED; 5.5 clinical sessions per week. Geriatrician also provided elderly care clinic with multidisciplinary support in the medical day hospital for patients discharged from the ED	
	By whom	Consultant geriatrician working in collaboration with a team of occupational therapists and physiotherapists	
	Duration	30 days	
	Other		
Comparator group	No		
Outcome measures	<ul style="list-style-type: none"> • Admission rates • Admission to elderly care wards • ED reattendance within 7 days • Level of burden to outpatient clinics 		
Findings	Most patients (804/848, 94.8%) either needed admission or needed review by a geriatrician prior to admission. A minority (44/848, 5.2%) were suitable for discharge but needed geriatrician input prior to discharge. ED geriatrician facilitated discharge of 543/848 patients (64%) and facilitated direct admission to the elderly care ward of 174/305 (57%). Minority of remaining patients were admitted elsewhere		
	The ED geriatrician facilitated discharge from the ED (and potential readmission) in 40/76 cases. These patients had a 7-day reattendance rate of 10.1% [86/848, which is higher than the hospital average (6.3% for the > 75 years age group)]. However, all patients were included regardless of problem or frailty		
Conclusion	ED based consultant geriatrician can facilitate safe admission prevention and can reduce readmission rates for patients recently discharged. Preventing admission required expansion of outpatient services		
Self-reported limitations	None reported		
Headline message	<i>The placement of a consultant geriatrician in the ED is effective in facilitating admission prevention for older patients</i>		
Other comments	Data collection was spread throughout the year so would include any seasonal fluctuations. No clear definition of frail elderly		
	No control group		

Full paper	Authors: Eklud <i>et al.</i> ²⁴	Year: 2013	Country: Sweden
Study design	Randomised non-blinded controlled trial		
Data source	Representative sample of frail older people at high risk of future health-care consumption		
Study aim(s)	To evaluate the effects of the 'Continuum of Care for Frail Older People' on functional ability in terms of ADL and frailty		
Sample size	161 elderly people (76 control group, 85 intervention group)		
Setting	ED in a Swedish hospital		
Frail elderly – definition	Aged ≥ 80 years or 65–79 years with at least one chronic disease and dependent in at least one ADL		
Study population	Age: ≥ 80 years or 65–79 years if has chronic disease or ADL dependency	Condition: ≥ 80 years or 65–79 years with at least one chronic disease and dependent in at least one ADL	
Intervention	What	'Continuum of Care for Frail Older People' intervention, which involved 'collaboration between a nurse with geriatric competence at the ED, the hospital wards and a multiprofessional team for care and rehabilitation of older people in the municipality with a case manager as the hub'	
		Usual care for the control group	
	Who	Older people seeking care at the ED of a Swedish hospital	
	Duration	Follow-up measured at 3, 6 and 12 months	
	Other		
Comparator group	76 people acted as the control group and 85 as the intervention group; outcomes were tested for confounders because of possibly relevant differences at baseline between groups		
Outcome measures	<ul style="list-style-type: none"> • Functional ability measured through ADL independence using ADL staircase • Frailty measured as the sum of eight core frailty indicators 		
Findings	<p>3- and 12-month follow-up found that the intervention group had a higher OR for improved degree of ADL independence (OR 2.37) compared with the control group (OR 2.04). At 6 months the older people who had decreased their ADL independence in the intervention group had a lower OR (OR 0.52, 95% CI 0.27 to 0.98) than those in the control group</p> <p>No differences between groups with regard to changes in frailty</p>		
Conclusion	Intervention could potentially reduce ADL dependencies and enable older people to live at home longer or need less help to remain living at home		
Self-reported limitations	<p>Non-blinded as participants could reveal their group at follow-up and there was an assumption that there would be less attrition if participants had the same research assistant at the follow-ups</p> <p>ADL staircase has fewer IADL items than other international ADL instruments have, but good validity in this age group</p> <p>Some dropouts, main reason deceased</p>		
Headline message	A continuum of care intervention could reduce dependency in ADL, enabling frail older people to age in place, benefiting both the individuals and society		
Other comments	<p>Excluded people with severe illness with immediate needs assessment and treatment, dementia and palliative care</p> <p>Good-quality RCT</p>		

IADL, instrumental activities of daily living.

Full paper	Authors: Arendts <i>et al.</i> ⁷⁸	Year: 2013	Country: Australia
Study design	Prospective comparative study with matched controls		
Data source	Prospective		
Study aim(s)	Are older patients who are discharged from the ED with support from allied health professionals (care co-ordination team) at increased risk of hospital readmission and/or death?		
Sample size	1098 patients enrolled to intervention group and matched 1 : 1 with control subjects deemed low risk on risk screening		
Setting	Tertiary referral hospital EDs in metropolitan Perth. One ED was exclusively an adult ED and trauma centre and the other was a mixed adult–paediatric ED		
Frail elderly – definition	Patients with a positive risk screen from the brief initial screening process applied soon after arrival at the ED by a nurse or member of the CCT		
Study population	Age: ≥ 65 years	Condition: varied	
Intervention	What	Patients aged ≥ 65 years presenting to the ED underwent risk screening. Positive screen led to intervention which was comprehensive functional and needs assessment to determine needs and discharge risk by the CCT. CCT care included referral to post-discharge services	
	By whom	CCT (physiotherapist, occupational therapist or social worker with the option to co-opt other allied health, nursing and medical input as required)	
	Duration	Patients were followed up at 28 days and 1 year	
	Other		
Comparator group	Intervention group matched 1 : 1 with control subjects deemed to be of low risk on risk screening		
Outcome measures	<ul style="list-style-type: none"> • ED reattendance within 28 days • Hospital readmission • Mortality 		
Findings	'At 28 days, there was a 3% absolute difference in the reattendance rate to the ED (cases 17.9%, controls 14.8%; $p = 0.05$) and no mortality difference (cases 1.4%, controls 1.3%; $p = 0.85$). Following up at 1 year, cases did have a higher incidence of unplanned hospitalisation but not death [hospitalisation (43.4% vs. 29.5%; $p < 0.001$) and death (10.7% vs. 10.2%; $p = 0.66$)]		
Conclusion	<i>Facilitated discharge of selected older adults by a CCT is relatively safe in the short term. Such patients have an increased likelihood of hospitalisation in the year after discharge</i>		
Self-reported limitations	Matching of cases and controls did not account for confounding variables		
	The CCT did not operate 24 hours a day and so not all patients in the study period were screened for inclusion		
	Screening tool not externally validated and processes, especially discharge, not standardised. Not all relevant outcome measures were included		
Headline message	<i>Allied health-facilitated discharge of patients with a positive risk screen is associated with a small increase in the risk of early re-presentation. However, these patients are at markedly increased risk of hospitalisation beyond the early discharge period</i>		
Other comments			

Full paper	Authors: Tan <i>et al.</i> ⁷¹	Year: 2012	Country: Ireland
Study design	Pilot service development		
Data source	Prospective data		
Study aim(s)	To assess the impact of the introduction of a pilot ED GM liaison service on appropriate discharge and LOS		
Sample size	285 patients		
Setting	ED in university hospital in Dublin		
Frail elderly – definition	No definition provided		
Study population	Age: ≥ 65 years with multiple medical diagnoses or aged > 80 years	Condition: patients with multiple medical diagnoses, frailty, dementia, delirium, falls, syncope and other common presentations in older adults	

Full paper	Authors: Tan <i>et al.</i> ⁷¹	Year: 2012	Country: Ireland
Intervention	What	Patients were referred to the ED GM liaison service by senior ED personnel. Patients were then assessed in the ED by a consultant geriatrician or senior trainee geriatrician and physiotherapy, medical social work and occupational therapy input was available when required. GM service also took over care of all patients aged > 80 years every 1 of 9 days	
	By whom	Consultant geriatrician or senior trainee geriatrician	
	Duration	Data collected over a period of 2 years and 9 months	
	Other		
Comparator group		No	
Outcome measures		<ul style="list-style-type: none"> • Discharge from ED • LOS • Admitted under GM • Admitted under GIM • ED reattendance • Readmission 	
Findings		<p>The ED referred 285 patients (mean age 83.5 ± 6.8 years) to the ED GM liaison service</p> <p>139 patients (49%) were discharged from the ED with appropriate follow-up. The 1-month re-presentation rate to the ED after discharge was 22%, with 8% admitted to hospital on subsequent presentation</p> <p>The remainder [146 (51%)] were admitted under the GIM team on call or other specialist services</p> <p>268 patients aged > 80 years were taken over from the GIM service every 1 of 9 days. This gave a total of 414 inpatients (mean age 84.6 ± 5.5 years) for analysis. Of these patients, 300 (72%) were admitted under GM, 71 (17%) under GIM and 43 (10%) under other specialist services. Overall, 54 (13%) inpatients died during their admission period. The mean LOS of the patients who died was 20.4 ± 25.6 days</p> <p>Comparison of LOS was carried out for 323 patients discharged alive from the GIM and GM services. The mean LOS of 62 patients discharged from GIM care was 33.5 ± 27.7 days compared with 20.3 ± 25.0 days ($p < 0.001$) for 261 patients under GM care</p> <p>When LOS analysis excluded patients discharged to a nursing home, mean LOS was 25.0 ± 18.6 days for GIM and 15.2 ± 16.3 days ($p < 0.0001$) for GM. Mean LOS of a patient admitted from home and discharged to a nursing home was 62.9 ± 35.9 days</p> <p>23% of patients admitted from home under GIM care were discharged to nursing home care compared with 14% of patients under GM care ($p = 0.11$)</p> <p>There were 320 patients who were discharged for whom there was 1-month follow-up data and this showed GM readmission was 14.7% and GIM was 19.4% ($p = 0.37$). The readmission rates did not differ significantly. There was 3-month follow-up data for 301 patients and the readmission rate was 17.4% for GM and 20.3% for GIM ($p = 0.59$)</p>	
Conclusion		<p><i>Direct admission of the older, frail adult under the GM service has the potential to reduce LOS without adversely affecting . . . the rate of ED repeat attendances and readmission to hospital. A substantial proportion of older adults could . . . be discharged from the ED with a tailored treatment and follow-up plan</i></p>	
Self-reported limitations		<p>The numbers analysed were small, leading to reduced statistical strength of the analysis. The reasons for attendance at the ED were also not recorded as it was decided to concentrate on the collection of basic demographic data, readmissions rates and ED repeat attendances. The future developments for the GM service in this department include formalisation of the ED GM liaison service with GM clinical nurse specialist support; an inpatient nursing home liaison service; and an outreach nursing home liaison service in which patients will be reviewed in their place of residence in the nursing home. The ISAR screening tool, which has good predictive validity for clinical outcomes and health services utilisation in the older adult, will be used to select patients suitable for assessment with the ED GM liaison team</p>	
Headline message		<p>The findings suggest that specialty-specific GM management of the older adult presenting to the ED can improve service and patient outcomes</p>	
Other comments		<p>Lack of detail about methodology. No definition of frailty. No comparator group</p>	

GIM, general internal medicine; GM, geriatric medicine; LOS, length of stay.

Full paper	Authors: Salvi <i>et al.</i> ²¹	Year: 2012	Country: Italy
Study design	Prospective observational study with 6 months' follow-up		
Data source	Hospital records		
Study aim(s)	The aim of this study was to compare the ISAR tool and TRST		
Sample size	2057		
Setting	ED in a geriatric hospital		
Frail elderly – definition			
Study population	Age: ≥ 65 years, mean age 81.7 years, range 65–103 years	Condition: an ISAR score of ≥ 2 (range 0–6) suggests an increased risk for functional decline, repeat ED visits, hospital admissions, institutionalisation and death within 6 months after an ED visit	
Intervention	What	ISAR tool and TRST	
	By whom	Nurse	
	Duration	Not reported	
	Other		
Comparator group	None		
Outcome measures	Hospital admission and mortality at the index ED access, early (within 30 days) and late ED revisit, hospitalisation and death in 6 months		
Findings	TRST and ISAR were significantly correlated in terms of predicting hospital admission, mortality and early ED revisit (ISAR 0.68; TRST 0.66), (ISAR 0.74; TRST 0.68), (ISAR 0.63; TRST 0.61)		
	Long term, using 6-month follow-up data, patients had comparable ED return visits (ISAR 0.60; TRST 0.59), hospital admission (ISAR 0.63; TRST 0.60) and mortality (ISAR 0.74; TRST 0.73)		
Conclusion	ISAR and TRST are comparable in terms of selecting elderly ED patients who need geriatric interventions. ISAR had slightly higher sensitivity and lower specificity		
Self-reported limitations	Under-representation of trauma patients. Exclusion of night time arrivals. This specific ED was unique in its characteristics therefore limiting generalisability. Triage nurse scored both ISAR and TRST. No data on inter-rater reliability. Some relevant outcomes such as functional status/delirium were not included		
Headline message	<i>ISAR and TRST can offer an accurate prognostic assessment of older patients presenting to an ED for medical reasons, in terms of the need for hospital admission and mortality, return ED visits, hospitalisation and long-term mortality</i>		
	Both tools appeared positive in the majority of patients, indicating that the tools lacked specificity		
Other comments			
INRCA, Italian National Research Center on Aging.			

Full paper	Authors: Salvi <i>et al.</i> ²⁷	Year: 2012	Country: Italy
Study design	Prospective observational study		
Data source	Secondary analysis of prospective observational cohort study		
Study aim(s)	To test the validity of the ISAR screening tool by testing whether or not a CGA-based approach using the ISAR tool was associated with the brief DAI of frailty		
Sample size	200		
Setting	Two urban EDs in Italy		
Frail elderly – definition	Frail subjects were defined as those in need of mobility or ADL assistance and/or who were cognitively impaired		
Study population	Age: ≥ 65 years, mean age 80.3 ± 7.4 years, 28.5% aged > 85 years		Condition: not given
Intervention	What	The ISAR tool was administered following triage to patients (or accompanying family member if patients were cognitively impaired or acutely confused). During the ED visit patients also underwent BGA using the Charlson index for comorbidity, the SPMSQ for cognitive function and the Katz ADL scale	
	Who	Trained research assistant	
	Duration	Follow-up telephone interviews at 30 days and 6 months to collect data on current Katz ADL dependence, number of ED visits, hospital admissions and mortality	
	Other	Not applicable	
Comparator group	No data are available for excluded patients, non-screened patients or patients who refused to participate		
Outcome measures	<ul style="list-style-type: none"> ● ADL dependence ● Number of ED visits ● Hospital admissions ● Mortality 		
Findings	Consistency of DAI-based frailty definition was tested by verifying the proportion of subjects according to frailty status who had experienced any adverse outcomes (30 days and 6 months) since ED discharge		
	Frail patients experienced more ED revisits within 30 days and 6 months and were more likely to undergo hospital admissions than non-frail patients		
	Frail patients did not have an increased risk of functional decline within 6 months after an ED presentation after adjusting for age, sex and living status		
	Occurrence of a combined outcome of ED revisit, hospital admission, functional decline or death within 6 months was significantly more frequent in frail patients		
	The 6-month mortality rate for frail elderly ED patients was higher than for non-frail patients (hazard ratio 8.68, 95% CI 2.60 to 28.94; $p < 0.0001$)		
	ISAR score was highly correlated with frailty: the AUC was 0.92 (95% CI 0.88 to 0.96), indicating good performance in identifying frailty according to the DAI-based definition		
	An ISAR cut-off score of 2 had a sensitivity of 0.94 (95% CI 0.88 to 0.97) and specificity of 0.63 (95% CI 0.51 to 0.73)		
Conclusion	Using a cut-off score of 3 allowed for stricter selection of frail patients: sensitivity was 0.79 (95% CI 0.71 to 0.86) and specificity was 0.93 (95% CI 0.84 to 0.97)		
	The ISAR score is a reliable and valid predictor of death, ED revisit, hospital admissions and functional detail in the 6 months after an ED visit in a complex ED population such as the elderly. The ISAR tool can identify high-risk patients who are more likely to benefit from an integrated clinical approach, longer observation time and appropriate referrals		

Full paper	Authors: Salvi <i>et al.</i> ²⁷	Year: 2012	Country: Italy
Self-reported limitations	'Choice of a simple DAI-based definition of frailty' 'post hoc analysis of a previously carried out study, therefore the choice of using the Rockwood criteria of frailty was formulated using the available data'. Sample limited to weekday/daytime ED arrival ($n = 200$). Data were in line with Hastings <i>et al.</i> ²⁰² on frailty. Generalisability may be limited due to the setting (two Italian cities)		
Headline message	The ISAR tool is a useful screening tool for frailty and identifies elderly patients at risk of adverse outcomes after an ED visit. The ISAR tool can also be used to select high-risk patients who are more likely to benefit from a geriatric approach or intervention		
Other comments	Small sample, applicability, no data for excluded non-screened patients or for patients who refused to participate		

SPMSQ, Short Portable Mental Status Questionnaire.

Full paper and conference abstract	Authors: Graf <i>et al.</i> ^{53,54}	Year: 2012	Country: Switzerland
Study design	Retrospective cohort study		
Data source	Review of patient records		
Study aim(s)	To assess the ability of two screening tools to predict readmissions after an ED visit in patients aged ≥ 75 years		
Sample size	375		
Setting	ED of Geneva University Hospitals, Switzerland		
Frail elderly – definition	Patients aged ≥ 75 years seen by the geriatrics team in the ED		
Study population	Age: mean 84 years (SD 5.7 years) Condition: orthopaedic problem or trauma (30%), cardiac problem (25%), psychiatric illness (12%)		
Intervention	What	Screening with the ISAR tool, modified ISAR tool and TRST	
	By whom	Geriatrics team physician	
	Duration	Not provided	
	Other	Patients seen between 2007 and 2009	
Comparator group	N/A		
Outcome measures	Accuracy of screening tools for predicting unplanned readmission at 1, 3, 6 and 12 months		
Findings	The ISAR tool, modified ISAR tool, TRST and a multiple regression model derived from them had similar power to predict readmissions at 1, 3, 6 and 12 months (area under the ROC curve between 0.6 and 0.7). Negative predictive values at 1 month were 89.1% for the ISAR tool and 83.6% for the TRST		
Conclusion	The screening tools studied have limited power to predict readmission risk. They may be useful for avoiding unnecessary interventions in people who screen negative because of their high negative predictive value		
Self-reported limitations	Single-centre study, limited to patients triaged as non-urgent; retrospective data collection		
Headline message	The screening tools may be useful for identifying older patients who can be discharged from the ED without further geriatric evaluation, thus avoiding unnecessary CGA		
Other comments	N/A, not applicable; SD, standard deviation.		

Full paper	Authors: Leah and Adams ⁷²	Year: 2010	Country: UK
Study design	Descriptive paper		
Data source	Patient records		
Study aim(s)	This article describes the establishment of an ATOP created to address the issues related to providing optimum care for those with complex health and social needs in a district general hospital		
Sample size	666		
Setting	ED		
Frail elderly – definition	<p>The frailty markers were developed locally using the <i>Urgent Care Pathways for Older People with Complex Needs</i>,²⁰³ <i>The Older Person in the Accident and Emergency Department</i>²⁰⁴ and the <i>Comprehensive Assessment for the Older Frail Patient</i>²⁰⁵</p> <p>Frailty markers (two or more)</p> <ul style="list-style-type: none"> ● inability to perform one or more basic ADL in the 3 days before admission ● a stroke in the previous 3 months ● depression ● dementia ● a history of falls ● one or more unplanned admissions in the previous 3 months ● difficulty walking ● malnutrition ● prolonged bed rest ● incontinence 		
Study population	Age: ranged from 60 to 103 years	Condition: older people attending an ED	
Intervention	What	<p>An ATOP was established in the ED and medical assessment unit at a district general hospital. The focus of the team was to provide CGA. Access to the ATOP was based on a combination of age and needs. ATOP based on Reforming Emergency Care,²⁰⁶ to provide an ‘accessible, patient-centred, integrated, high-quality service delivered without delay or loss of dignity’. Patients screened in the ED/MAU by a member of the ATOP. If patients screen positive for frailty markers they are assessed in a different environment to the ED. Care planning involves patients (and where appropriate, carers). Care planning involves staff within and outside hospital. Nursing assessment and mental health assessments also carried out. Swallow assessments and mobility assessments can be carried out by nurses</p>	
	By whom	<p><i>The ATOP team consists of a physician, a consultant nurse, five clinical nurse specialists, a senior social worker and assistant, a senior occupational therapist and assistant and a health-care assistant</i></p>	
	Duration	Not described	
	Other		
Comparator group	None		
Outcome measures	<ul style="list-style-type: none"> ● Admission rates ● Costs 		
Findings	<p>The ATOP prevented admission for 178/666 patients (27%) who other clinicians had decided to admit (either for medical reasons or because they were unsafe to discharge home). Of these 178, 19 reattended and six were admitted (readmissions due to falls and cognitive impairment). ‘As the cost of ‘hotel services’ alone in the hospital is estimated to be £600 per day, the potential cost saving from preventing the admission of the 89 patients aged ≥ 80 years seen in the study period could be > £500,000’</p>		
Conclusion	<p>In the 4 months of the study period, the ATOP prevented admission of 178 of the 666 patients seen. Of the 178 patients who were not initially admitted to hospital, 19 reattended the hospital and six were admitted. The majority of readmissions were as a result of recurrent falls and issues relating to cognitive impairment. Four patients returned with significant new, but unrelated, health problems, whereas five patients who had chosen to return home against advice also reattended</p>		
Self-reported limitations	<p>The actual cost saving is difficult to establish, as the ATOP may have made extra referrals that would have to be set against this potential saving</p>		
Headline message	<p><i>A dedicated team with a focus on the needs of frail older adults has proved to be a beneficial addition . . . A more comprehensive assessment process has been successful in preventing some admissions, with consequent improvement in outcomes, a probable financial saving for the trust and quality-of-life benefits for patients</i></p>		
Other comments	Not an effectiveness study – no comparison group		

Full paper	Authors: Salvi <i>et al.</i> ⁴⁹	Year: 2009	Country: Italy
Study design	Prospective observational study		
Data source	Hospital records		
Study aim(s)	This study evaluated the predictive validity of the ISAR tool for elderly patients presenting to an Italian ED		
Sample size	200		
Setting	Two urban EDs		
Frail elderly – definition	Acutely ill ED patients aged ≥ 65 years		
Study population	Age: 80.3 years (SD 7.4 years)	Condition: not given	
Intervention	What	ISAR screening tool – assesses risk factors predisposing elderly ED patients to adverse outcomes	
	By whom	Nurse	
	Duration	Not reported	
	Other		
Comparator group	None		
Outcome measures	Single outcomes: ED revisit at 30 days and 6 months, frequent ED return, hospital admission and functional decline		
	Composite outcomes: (1) death, long-term care placement, functional decline; (2) death, long-term care placement, functional decline plus any ED revisit or hospitalisation		
Findings	The ISAR screen was positive for 141 subjects (70.5%), who had high comorbidity, disability and cognitive impairment		
	ISAR-positive patients had an OR of 4.77 (95% CI 2.19 to 10.42) for undergoing the composite outcome and 3.46 (95% CI 1.68 to 7.15) for experiencing the composite outcome		
	The ISAR tool also predicted ED revisit and frequent use, hospitalisation and functional decline at 6 months and was an independent predictor of 6-month mortality (hazard ratio 6.9, 95% CI 1.65 to 29; $p = 0.008$)		
Conclusion	<i>The ISAR tool can be used as a screening test to identify Italian elderly ED patients who have an increased 6-month risk of death, long-term condition placement, functional decline, ED revisit or hospitalisation</i>		
Self-reported limitations	<i>Weekday/daytime convenience sample. Small sample size (200 patients). Limited generalisability (academic EDs located in cities with a lower prevalence of older people or without a GED). Sample size/admission rate at the index ED visit prevented analysis of the performance of the ISAR tool separately</i>		
Headline message	The ISAR tool was confirmed as a reliable and valid predictor of death, long-term condition placement, functional decline, ED revisit or hospital admission during the 6 months after an ED visit. The ISAR tool can be administered by a nurse immediately after triage without any further workload for ED staff. It can indicate high-risk patients who would benefit from an integrated approach, longer observation time and appropriate referral		
Other comments			
SD, standard deviation.			

Full paper	Authors: Salvi <i>et al.</i> ⁹⁰	Year: 2008	Country: Italy
Study design	Secondary analysis of a prospective observational cohort study		
Data source			
Study aim(s)	To consider patterns of use for a geriatric emergency service for acutely ill elderly patients compared with a conventional ED in Italy		
Sample size	200 acutely ill ED patients aged ≥ 65 years from two EDs (CED and GED)		
Setting	A CED and a GED. The CED was in a tertiary care academic hospital. The GED was a hybridised ED with a six-bed observation unit designed for elderly non-trauma patients within an academic-affiliated hospital		
Frail elderly – definition	Frail as suggested by high levels of comorbidity, disability and cognitive impairment		
Study population	Age: ≥ 65 years	Condition: not given	
Intervention	What	GED – ED department staffed by geriatricians for elderly non-trauma patients	
	By whom	Geriatricians	
	Duration	30-day and 6-month follow-up telephone interviews were conducted with patients	
	Other		
Comparator group	Patients from a CED		
Outcome measures	Early (within 30 days) and late (within 6 months) unscheduled ED revisit		
	Frequent ED return		
	6-month mortality		
	Hospital admission within 6 months		
	6-month functional decline		
Findings	Patient mean age 80.3 ± 7.4 years (28.5% were aged ≥ 85 years)		
	There was no significant difference between patients seen in the GED in terms of triage, comorbidity, admission at time of enrolment, ICU admissions and length of in-hospital stay (although they were older and medically and socially frailer)		
	<i>LOS was significantly shorted for CED than GED patients, although the later measure included time spent in the observation unit</i>		
	ED setting was not associated with early, late and frequent ED return rates, hospitalisation or functional decline. Although GED patients tended to be more frail, mortality rates did not differ significantly between the EDs		
	<i>At 30 days, 13 patients, 5 from the GED, had died and 6 had been in hospital since the time of recruitment. Of the remaining 181 patients, 48 had required one or more ED revisits and 24 had been admitted to hospital . . . at 6 months, 39 patients (19.5%), 19 of them GED patients, had died</i>		
Conclusion	<i>The data suggests a slight superiority for the GED in the acute care of older people, supporting the hypothesis that ED facilities specially designed for older adults may provide better care</i>		
Self-reported limitations	The fact that the INRCA hospital, unlike Azienda Ospedali Riuniti, lacked a resuscitation ward may have introduced a first pre-ED selection bias. Another limitation may be that the study included a convenience sample of 200 elderly ED patients and patients too ill to collaborate and those with cognitive impairment and no available informant were excluded. 'Nonetheless, the rate of urgent visits in the sample was higher than that in the general Italian ED population (25.5% vs. 8.4%) and was similar in the two EDs, suggesting that the sample was representative of elderly ED patients. Elderly patients are known to use EDs appropriately, because emergent and urgent visits are more frequent than semi-urgent and non-urgent ones'. Trauma patients were not included. This is a secondary analysis of data therefore the design of the study could be improved		

Full paper	Authors: Salvi <i>et al.</i> ⁹⁰	Year: 2008	Country: Italy
Headline message	A GED staffed by geriatricians and organised to meet the needs of older patients showed slight superiority, suggesting a benefit of specially designing care for older adults		
Other comments	CED, conventional emergency department; INRCA, Italian National Research Center on Aging; LOS, length of stay; SPMSQ, Short Portable Mental Status Questionnaire.		

Full paper	Authors: Lee <i>et al.</i> ⁵²	Year: 2008	Country: Canada
Study design	Prospective, observational study with 1 year of follow-up		
Data source	Medical records		
Study aim(s)	Predictive validity of the TRST to identify return to the ED (high-risk patients) or hospitalisation at discharge at 30, 120 and 365 days. To determine whether different TRST cut-off points to define high-risk patients or whether or not there were different explanatory variables		
Sample size	788		
Setting	EDs of three hospitals in Toronto, Canada		
Frail elderly – definition			
Study population	Age: range 65–101 (mean 76.6) years Condition: not given		
Intervention	What	TRST identifies older patients at risk for ‘failed’ discharge home from the ED (failed discharge is return to the ED, admission to the hospital or admission to a nursing home within 30–120 days after discharge). The five TRST items are:	
		<ol style="list-style-type: none"> 1. whether or not patients had a history or evidence of cognitive impairment (poor recall or not oriented) 2. whether or not patients had difficulty walking or transferring or had a history of recent falls 3. whether or not patients took five or more medications 4. whether or not patients had had an ED visit in the previous 30 days or a hospitalisation in the previous 90 days 5. whether or not there were any concerns about elder abuse or neglect, substance abuse, medication non-adherence or difficulty performing instrumental ADL 	
	By whom	Emergency nurse or a patient care co-ordinator	
	Duration	2–5 minutes	
	Other		
Comparator group	None		
Outcome measures	Return to the ED or admission to hospital (within 30, 120 and 365 days after discharge from the ED)		
Findings	147/788 subjects (18.7%) reached the composite endpoint in 30 days, 245 (31.1%) by 120 days and 346 (43.9%) by 365 days. Mean TRST score was 1.55 (range 0–5). Sensitivity of a TRST score of ≥ 2 was 62% (95% CI 54% to 70%), specificity was 57% (95% CI 53% to 61%) and likelihood ratio was 1.44 (95% CI 1.23 to 1.66). The AUC was 0.61 using a cut-off score of 2		
Conclusion	<i>The TRST demonstrated only moderate predictive ability and, ideally, a better prediction rule should be sought. Future studies to develop better prediction rules should compare their performance with that of existing prediction rules, including the TRST and ISAR tool, and assess the effect of any new prediction rule on patient outcomes</i>		
Self-reported limitations	TRST forms were completed for 49% of eligible patients, therefore selection bias was possible. This study did not include patients who were admitted to nursing homes after ED discharge. Staff were not blinded to TRST result when making post discharge referrals. Patients who experienced the study outcomes but who returned to another institution may have been missed. It was not established whether or not return ED visits were planned at the time of discharge		
Headline message	<i>The TRST demonstrated only moderate predictive ability and, ideally, a better prediction rule should be sought</i>		
Other comments			

Full paper	Author: Warburton ¹¹⁴	Year: 2005	Country: USA
Study design	Evaluation		
	Quality improvement project with nine Plan–Do–Study–Act cycles in 15 months to assess the Elder Alert screening and referral programme. Outcomes assessed by comparing patient subgroups based on risk status and interventions received. Cost and benefits assessed based on estimated programme outcomes and average costs		
Data source	The full evaluation of Elder Alert has six components: <ol style="list-style-type: none"> 1. process evaluation 2. simple comparison of LOS, repeat ED visits and subsequent hospital admission for high-risk vs. other patients 3. more careful outcome assessment using more sophisticated outcome measures 4. assessment of effects on staff and staff opinions about the Elder Alert programme 5. assessment of patient experience of care resulting from the Elder Alert programme 6. economic evaluation (cost–benefit, cost-effectiveness or cost–utility analysis) 		
Study aim(s)	The purpose of this article was to report preliminary outcome and cost–benefit results for a patient safety quality improvement programme intended to improve outcomes for patients aged ≥ 75 years visiting the ED. The programme uses the ISAR tool to screen and refers patients at high risk for appropriate intervention		
Sample size	277		
Setting	Community hospital ED		
Frail elderly – definition	None		
Study population	Age: patients aged ≥ 75 years visiting the ED	Condition: not given	
Intervention	What	ISAR plus intervention	
	By whom	ED staff	
	Duration	Not reported	
	Other		
Comparator group	150 who were not screened		
Outcome measures	Outcomes within 30 days of the end of the index care episode (discharged from ED or from hospital if admitted) were compared for the four patient groups (not screened, high risk, screened and receiving all intended services and risk). Outcomes were: <ul style="list-style-type: none"> • median LOS (for patients admitted directly from the index ED visit) • returns to the ED • subsequent hospital admission • multiple encounters (any combination of two or more ED returns or admissions after the index care episode) 		
Findings	<p>Screening tool appears to be accurate – outcomes better for patients screened as low risk than patients not screened (even though the ‘not screened’ group has younger/low risk patients). Referrals have a positive impact – outcomes for patients screened as high risk and receiving complete referrals are better than for patients screened as high risk and receiving partial or no referrals. Screening on its own has a negative effect (worse outcomes for high risk patients receiving no intervention)</p> <p>Using audit data, authors estimated the value of saved visits and days as a result of the Elder alert intervention. Assuming that all eligible patients were screened and all high-risk patients received referrals</p> <p><i>SPH could expect 78 fewer ED returns and 121 fewer admissions annually (value US\$130,000). Even as implemented (46% screened, referrals completed for 46% of high-risk patients, based on the average rate from process audits 5 through 9), SPH could expect 16 fewer ED returns and 26 fewer admissions annually (US\$28,000)</i></p>		

Full paper	Author: Warburton ¹¹⁴	Year: 2005	Country: USA
Conclusion	When completed, screening and referral slightly reduce LOS (for patients admitted at the index ED visit) and reduce returns to the ED and admissions to hospital within 30 days		
Self-reported limitations	None reported		
Headline message	Not all eligible patients were screened and referred however there is evidence that the Elder Alert intervention has a positive outcome on LOS. Low programme costs meant the programme had net benefits. 'The methods for improvement (the Plan-Do-Study-Act framework; process evaluation; multidisciplinary working; group meetings; outcome assessment) are practical and useful for improving quality and safety in a small community hospital with limited resources'		
Other comments	LOS, length of stay; SPH, Saanich Peninsula Hospital.		

Full paper and conference abstract	Author: Schoenenberger ^{22,33}	Years: 2013, 2014	Country: Switzerland												
Study design	Prospective controlled study: pre-post design, consecutively presenting patients														
Data source	Original EGS forms and ED discharge reports														
Study aim(s)	To evaluate feasibility of a 'novel multidimensional EGS tool' to detect geriatric problems in an ED setting. Study aims were to <ul style="list-style-type: none"> • 'determine the prevalence of abnormal EGS findings' • 'to establish whether or not EGS increased the number of EGS-related diagnoses on ED discharge reports' 														
Sample size	338														
Setting	University hospital ED														
Frail elderly – definition	Not reported														
Study population	Age: ED patients aged ≥ 75 years throughout a 4-month period	Condition:													
		<table border="1"> <thead> <tr> <th>Main condition leading to ED visit</th> <th>Control, n (%)</th> <th>Screening, n (%)</th> </tr> </thead> <tbody> <tr> <td>Cardiovascular</td> <td>179 (23.8)</td> <td>188 (23.6)</td> </tr> <tr> <td>Infectious disease</td> <td>136 (18.1)</td> <td>142 (17.9)</td> </tr> <tr> <td>Other conditions</td> <td>437 (58.1)</td> <td>465 (58.5)</td> </tr> </tbody> </table>		Main condition leading to ED visit	Control, n (%)	Screening, n (%)	Cardiovascular	179 (23.8)	188 (23.6)	Infectious disease	136 (18.1)	142 (17.9)	Other conditions	437 (58.1)	465 (58.5)
Main condition leading to ED visit	Control, n (%)	Screening, n (%)													
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Infectious disease	136 (18.1)	142 (17.9)													
Other conditions	437 (58.1)	465 (58.5)													
Intervention	What	The EGS contains four domains relevant for older ED patients: cognition, falls, mobility and ADL. For each, short validated instruments were selected: <ul style="list-style-type: none"> • the Ottawa 3DY test, which assesses orientation and the ability to spell a word backward, to evaluate cognition • two self-report questions to predict future falls • one self-report question to screen for mobility prior to the ED visit • current mobility in the ED was checked with the TUGT • ADL were screened with a standard instrument 													
	By whom	ED physicians													
	Duration	< 5 minutes													
	Other	457 patients did not receive EGS and were excluded from the per-protocol analysis (175 for clinical reasons and 282 for logistical reasons)													
Comparator group	Usual care (no geriatric screening/risk prediction tools)														
Outcome measures	The number of abnormal EGS findings														
	The number of EGS-related diagnoses on the ED discharge reports during screening in comparison with the preceding control period														

Full paper and conference abstract	Author: Schoenenberger ^{22,33}	Years: 2013, 2014	Country: Switzerland
Findings	<p>EGS was performed on 338 (42.5%) of 795 patients presenting during screening and took < 5 minutes to perform in most (85.8%) cases. Of the 338 screened patients, 285 (84.3%) had at least one abnormal EGS finding. In 270 of these patients, at least one abnormal EGS finding did not result in a diagnosis in the ED</p> <p><i>There were statistically significant increases in the number of patients with EGS-related diagnoses on ED discharge reports during screening . . . 142 (42.0%) of the 338 screened patients had at least one diagnosis listed within the four EGS domains, significantly more than the 29.3% of patients presenting during the control period</i></p> <p>Patients with three or four abnormal EGS findings were more frequently admitted from the ED to an inpatient unit than patients with two or fewer abnormal EGS findings (OR 2.68, 95% CI 1.65 to 4.35; $p = 0.001$). EGS predicted nursing home admission after the in-hospital stay (OR for ≥ 3 vs. < 3 abnormal domains 12.13, 95% CI 2.79 to 52.72; $p = 0.001$)</p>		
Conclusion	This new EGS was demonstrated to be feasible in the ED setting, to identify geriatric problems not previously identified and to predict future care. The study does not demonstrate that geriatric screening in the ED ultimately improves patient outcomes		
Self-reported limitations	The non-randomised pre–post design limited the comparability of the screening and control groups. Generalisability is limited as the EGS was only tested in one centre. Tester reliability was not assessed		
Headline message	The novel EGS is feasible, identifies previously undetected geriatric problems and predicts determinants of subsequent care		
Other comments	Claims to be feasible but was not used in 282 cases for logistical reasons		
LOS, length of stay.			

Full paper and conference abstract	Author: Boyd ^{29,30}	Years: 2007, 2008	Country: New Zealand
Study design	Cross-sectional study		
Data source	Assessment forms		
Study aim(s)	To test the ability of the BRIGHT to identify older ED patients with functional and physical impairment by comparing results from the BRIGHT with a CGA undertaken within 10 days of their index visit to the ED		
Sample size	139		
Setting	ED in an acute care hospital		
Frail elderly – definition	Not given		
Study population	Age: ≥ 75 years (65 years for Maori and Pasifika elders), mean age 82.5 years	Condition: presenting to the ED with a non-urgent complaint (triage level 3–5) during a convenience sample of 4-hour time blocks over a 12-week period	
Intervention	What	BRIGHT is a self-report tool (patients or carers) comparable with other tools such as the interRAI MDS-HC (interRAI MDS-HC requires staff input.) BRIGHT includes: help with bathing, personal hygiene, dressing the lower body, getting around indoors, difficulty making decisions about everyday activity, shortness of breath, recent falls, perception of general health, memory problems, ability to do ordinary housework and depression	
	By whom	Self-administered or with assistance from untrained caregivers or family members	
	Duration	Not reported	
	Other		

Full paper and conference abstract	Author: Boyd ^{29,30}	Years: 2007, 2008	Country: New Zealand
Comparator group	Results from the BRIGHT were compared with those of a CGA conducted using the interRAI MDS-HC or the interRAI-AC (acute care). After participants' ED visit, trained assessors ($n = 6$) conducted a CGA either in the hospital or in the home. The assessors were blinded to participants' BRIGHT score		
Outcome measures	Primary outcome measures were IADL, CPS and ADL. ROC curves and likelihood ratios were also used to identify an optimal BRIGHT cut-off score		
Findings	<p>Most (75%) patients did not complete the BRIGHT themselves (assistance from visitor/staff). CGA was completed for 114 (82%) participants; the average time between the BRIGHT screen and the interRAI full assessment was 3.98 days (SD 4.23 days)</p> <p>For predicting IADL deficit, sensitivity was 0.76 and specificity was 0.79 (cut-off score of ≥ 3) and the area under the ROC was 0.83 (95% CI 0.74 to 0.91). For predicting cognitive performance, sensitivity was 0.70 and specificity was 0.74 (cut-off score of ≥ 4) and the area under the ROC was 0.73 (95% CI 0.62 to 0.84). Both of these results indicated moderate accuracy</p> <p><i>For predicting ADL, BRIGHT performed the poorest; sensitivity and specificity were 0.69 and 0.70 with a cut-off score of ≥ 4 and the area under the ROC was 0.66 (95% CI 0.54 to 0.78), indicating low accuracy</i></p> <p>Positive likelihood ratios for the three outcomes of interest were 3.6, 1.7 and 1.8, respectively. Negative likelihood ratios were 0.3, 0.4 and 0.3, respectively</p>		
Conclusion	<i>The BRIGHT demonstrated a reasonable ability to identify functional issues in older adults presenting to the ED. This case-finding tool was designed to be used in combination with the interRAI assessment system and to be quickly and efficiently self-administered by older adults or their family caregivers</i>		
Self-reported limitations	<p>This study was conducted in a single ED with a small sample size</p> <p>18% of those who completed the BRIGHT were lost to follow-up for the CGA</p>		
Headline message	<i>The 11-item BRIGHT successfully identifies older adults in the ED with decreased function and may be useful in differentiating elder patients in need of comprehensive assessment</i>		
Other comments	CPS, Cognitive Performance Scale; IADL, instrumental activities of daily living; interRAI, International Resident Assessment Instrument; MDS-HC, minimum data set – home care; SD, standard deviation.		

Full paper	Author: Ngian ⁷³	Year: 2008	Country: Australia
Study design	Retrospective observational study		
Data source	ASET electronic databases		
Study aim(s)	To review discordant cases between the ED and the ASET (i.e. where elderly patients deemed for discharge by the ED were subsequently admitted following ASET review). These cases were examined with regard to clinical outcomes. ASET contribution was also reviewed with respect to assessment of cognitive, functional and mobility status as compared with that undertaken in the ED		
Sample size	1680 referrals were made to ASET; 103 (6.1%) were identified as discordant cases		
Setting	ED		
Frail elderly – definition	<p>Patients needed to fulfil two out of five of the following criteria for ASET referral:</p> <ol style="list-style-type: none"> 1. multiple health problems or more than three regular medications 2. history of falls or fall-related injury 3. more than three presentations to the ED in the last 6 months 4. problems with memory 5. patient or carer reports recent functional or behavioural change 		

Full paper	Author: Ngian ⁷³	Year: 2008	Country: Australia
Study population	Age: 83 (\pm 6.5) years	Condition: the three most commonly reported comorbidities were hypertension (56%), osteoporosis (38%) and ischaemic heart disease (37%)	
Intervention	What	ASET service which is led by doctors. Older patients are assessed by a geriatric team, having been initially assessed by the ED as suitable for discharge. ASET established in order to reduce missed diagnoses, prevent inappropriate discharge and prevent re-presentation of elderly ED attendees	
	By whom	<i>ASET consists of an on-call senior geriatrician supervising a geriatric medicine trainee based solely in the ED. The service is supported by on-site nursing and an allied health team comprising a physiotherapist, occupational therapist and social worker</i>	
	Duration	Study duration: 30 months	
	Other		
Comparator group	No		
Outcome measures	Clinical outcomes of patients who were deemed safe for discharge but were subsequently admitted		
Findings	There were 65 cases (63.1%) where ASET made additional acute medical diagnoses in referred patients - these were fractures (14%), complicated urinary tract infections (13%), cardiovascular disorders (15%), neurological diseases (16%), delirium (8%) and adverse drug reactions (6%). The average LOS was 14.6 days (range 1–51 days). Eighty four patients (81.5%) were admitted for acute care, with 19 (18.5%) requiring subacute care). 84% of patients were discharged to their usual residence and 15% required new residential care. One patient died		
Conclusion	Assessment of elderly patients by ASET yielded additional information on functional, mobility and cognitive issues, which were overlooked by the ED. ASET staff were more likely than the ED to document functional, cognitive and mobility impairment, either new or worsening		
	ASET was able to prevent 6.1% of inappropriate discharges from the ED		
Self-reported limitations	Limitations include that the study audited only those patients who were subsequently admitted from the ED. The study did not follow up patients who were discharged following the ASET review		
Headline message	<i>A physician-led ASET can complement and improve the current ED-based system of evaluating elderly patients, providing a more comprehensive medical assessment incorporating patients' cognitive, mobility and functional status and preventing inappropriate discharges</i>		
Other comments	LOS, length of stay.		

Full paper	Authors: Foo <i>et al.</i> ¹¹²	Year: 2014	Country: Singapore
Study design	Quasi-RCT		
Data source	Screening tool scores and hospital records		
Study aim(s)	Does risk stratification followed by rapid geriatric screening in an ED reduce patient outcomes of functional decline, ED reattendance and hospitalisation?		
Sample size	780 (500 control and 280 intervention group patients) (1156 were eligible)		
Setting	ED of a 1500-bed acute care public hospital in Singapore		
Frail elderly – definition	See below		
Study population	Age: the eligibility criteria for inclusion in the study were	Condition: not known	
	<ol style="list-style-type: none"> 1. Patients aged \geq 65 years 2. TRST score of \geq 2 3. Patients who were planned for discharge 		

Full paper	Authors: Foo <i>et al.</i> ¹¹²	Year: 2014	Country: Singapore
Intervention	What	TRST to risk stratify, followed by rapid geriatric screening and intervention for at-risk seniors	
		<p>Patients were assessed by the GEM nurse while still in the ED, prior to discharge. Nurse undertook focused geriatric screening (15-question screening form including cognition, mood, continence, visual acuity and hearing, mobility and social issues). In addition, the GEM nurses undertook medication reconciliation and measurement of postural blood pressure</p> <p>With the results of the screening, clinically significant findings were dealt with immediately. Referrals were made including to allied health professionals or to other services. Education and advice were given on discharge. Patients were followed up at 3, 6, 9 and 12 months to ascertain their BADL and IADL scores. Subsequent ED attendance and hospitalisation rates were recorded</p>	
	By whom	Nurse	
	Duration	15–30 minutes	
	Other		
Comparator group		Standard care	
Outcome measures		The primary outcome of the study was change in patients' functional status, measured using BADL and Lawton's IADL scores. The secondary outcomes were health-care utilisation, as measured by ED reattendance and rehospitalisation	
Findings		<p>Comparing control and intervention groups the intervention group had higher TRST scores (34.3% vs. 25.4% TRST ≥ 3; $p = 0.01$) and lower baseline IADL scores (22.84 vs. 24.18; $p < 0.01$). The most frequent findings were fall risk (65.0%), visual impairment (61.4%) and improper footwear (58.2%)</p> <p>Most of the intervention group had unmet needs (82.9%) but only 62.1% accepted the intervention – 28.2% referred to geriatric clinic and 11.8% admitted</p> <p>Over 80% of patients from both intervention and control groups completed follow up and after adjusting for TRST and baseline IADL scores, the intervention group had significant preservation in function (basic ADL -0.99 vs. -0.24, $p < 0.01$; IADL -2.57 vs. 0.45, $p < 0.01$) at 12 months. Reductions in ED reattendance and hospitalisation were not significant</p> <p>BADL scores for both control and intervention group deteriorated over 12 months. IADL scores for the control group also deteriorated over 12 months, the scores for patients in the intervention group actually improved and the difference was statistically significant (0.45 vs. -2.57; $p < 0.01$)</p>	
Conclusion		This method of screening was feasible and effective and resulted in positive outcomes through 'significant and sustained preservation of function over 12 months'	
Self-reported limitations		A large number of patients who were randomized to the intervention group were unwilling to participate in the intervention. Staff who did the patient follow up were not blinded to allocation group. Data were not collected on patient views of the GEM nurse screening in the ED	
Headline message		<i>Risk stratification and focused geriatric screening in the ED resulted in significant preservation of patients' function at 12 months. Multidisciplinary assessment as well as strong interdisciplinary collaboration are key components of an effective geriatric emergency service</i>	
Other comments			
BADL, Barthel Index of Activities of Daily Living; GEM, geriatric emergency medicine; IADL, instrumental activities of daily living; ITT, intention to treat; PACH, post-acute care at home.			

Letter	Authors: Pareja-Sierra <i>et al.</i> ⁸⁷	Year: 2013	Country: Spain
Study design	Data analysis (6 years, 2005–11)		
Data source	Not clear if data are prospective or retrospective		
Study aim(s)	To determine the impact on admissions and LOS of an EDOU for elderly adults		
Sample size	5571 patients admitted to the ED		
Setting	EDOU in a tertiary care urban hospital in Guadalajara, Spain. The EDOU has six beds and is visited by a geriatrician twice a day		
Frail elderly – definition	Aged ≥ 75 years with multiple comorbidities, dementia or physical impairment with acute illness that can be treated in < 72 hours. Admission to the unit was at the discretion of the emergency physician		
Study population	Age: ≥ 75 years, mean age 87.4 years	Multiple comorbidities, dementia or physical impairment with acute illness that can be treated in < 72 hours. Most had moderate to severe physical disability (70%) and mild to moderate cognitive impairment (70%) measured using the Barthel Index and Geriatric Dementia Scale	
Intervention	What	EDOU for elderly adults visited by the geriatrician twice daily, multidimensional geriatric assessment with individualised treatment, referring patients to different outpatient levels of the geriatric service and avoiding unnecessary hospital admissions and avoiding discharge of frail elderly adults without follow-up care	
	By whom	Geriatrician	
	Duration	6 years	
	Other	Admission to the unit was at the discretion of the emergency physician	
Comparator group	Comparison with data before the EDOU was implemented		
Outcome measures	<ul style="list-style-type: none"> • Admission to hospital • LOS • Readmission within 48 hours and 7 days 		
Findings	The percentage of individuals requiring admission to the geriatric ward has stabilised initial increase; this has been accompanied by a decrease in mean LOS from 9.9 days in 2006 to 7.6 days in 2011		
Conclusion	<i>Development and implementation of a geriatric observation unit in the ED for individuals aged ≥ 75 years with a geriatrician on call was effective at preventing admission to the hospital in a large percentage of elderly adults. There was also a decrease in mean LOS</i>		
Self-reported limitations	Other factors could be involved such as better qualification of nursing home medical staff or easier access to geriatric clinics in case of destabilisation or chronic illness		
Headline message	<i>Specialised geriatric assessment in the EDOU provides higher-quality health care, minimising the deleterious effects of hospitalisation in older adults and optimising the use of resources</i>		
Other comments	Very little detail on methodology		

LOS, length of stay.

Conference abstract	Authors: Yim <i>et al.</i> ²⁵	Year: 2011	Country: Hong Kong
Study design	Cohort study		
Data source	Telephone interview for the cohort study; not reported for the RCT		
Study aim(s)	To derive and validate a Hong Kong version of the ISAR screening tool and to use the validated tool to identify people at risk and study the effects of a structured ED intervention		
Sample size	Cohort study 1820; RCT 1279		

Conference abstract	Authors: Yim <i>et al.</i> ²⁵	Year: 2011	Country: Hong Kong
Setting	Three EDs in Hong Kong		
Frail elderly – definition	People identified as high risk based on positive answers to two or more of the six items of the Hong Kong ISAR tool		
Study population	Age: derivation cohort mean 74.5 years (SD 6.2 years); RCT: 75 years (SD 6.8 years) for the control group and 76.3 years (SD 6.8 years) for the intervention group	Condition (additional to frailty): patients aged ≥ 65 years who were about to be discharged from the ED	
Intervention	What	Administration of the validated Hong Kong ISAR tool followed by a structured ED intervention for those identified as high risk (scoring two or more out of six possible positive answers). The intervention consisted of a brief standardised assessment of functional status, mental state and relevant social factors. Referrals to community-based clinics and other agencies were arranged according to individual needs	
	By whom	Not specifically reported (presumably researchers)	
	Duration	Outcomes measured at 6 months	
	Other		
Comparator group	Usual care in the ED		
Outcome measures	Composite outcome of institutionalisation, hospital admission within 1 month, early return or frequent visits to the ED or death		
Findings	In the derivation group, the Hong Kong ISAR tool predicted poor outcomes, with a sensitivity of 68.3% and specificity of 49.4%. The area under the ROC curve was 0.62. Corresponding figures for the validation group were 76.1%, 33.3% and 0.59, respectively		
	In the RCT, there were no significant differences between the intervention group and the control group for the composite outcome or any of its components		
Conclusion	The Hong Kong ISAR tool is suitable for use in an ED setting to identify patients at risk of adverse outcomes; it is more applicable to the local population than the original ISAR tool. However, an ED-based intervention for patients identified as high risk did not improve outcomes at 6 months compared with usual care		
Self-reported limitations	Authors attributed failure of the intervention to a lack of co-ordination among the agencies receiving referrals		
Headline message	An ED-based assessment and referral intervention for elderly patients at high risk of adverse outcomes did not improve outcomes at 6 months		
Other comments	Authors noted that differences between the original and the Hong Kong ISAR tool may indicate differences between health systems in use of the ED by elderly patients. Methods of randomisation, etc., for the RCT were not reported and so the risk of bias is unclear		

SD, standard deviation.

Full paper	Authors: Ellis <i>et al.</i> ⁸⁸	Year: 2012	Country: Scotland
Study design	Cohort, prospective before-and-after service evaluation		
Data source	Not known		
Study aim(s)	To implement a four-bedded ACE unit in the ED to better undertake rapid and thorough CGA with an outcome of either direct speciality admission or admission avoidance		
Sample size	749 patients		
	Before: 212 consecutive patients admitted before the opening of the unit; ACE: 210 consecutive patients admitted to the unit; after: 327 patients admitted elsewhere after the opening of the unit		
Setting	District general hospital in Scotland		
Frail elderly – definition	Aged ≥ 65 years		

Full paper	Authors: Ellis <i>et al.</i> ⁸⁸	Year: 2012	Country: Scotland
Study population	Age: ≥ 65 years; mean age was 80.5 years (before), 81.1 years (ACE) and 80.3 years (after)	Condition (additional to frailty): functional impairment (acute or chronic); cognitive impairment (acute or chronic); falls, 'off legs' or other geriatric syndromes; care home patients	
Intervention	What By whom Duration Other	Rapid and thorough CGA in a discrete, acute care for elders unit Senior geriatricians, nursing staff N/A Usual care: standardised screening and assessment tools (functional need, falls risk, cognitive status, mood, pressure area risk or nutritional state, medical acuity), multidimensional assessment by a MDT and proactive discharge planning	
Comparator group	327 patients admitted after the opening of the unit but admitted to the medical receiving unit (outside the hours of the ACE unit). These were a parallel prospective control group		
Outcome measures	Primary outcome: same-day discharge Secondary outcomes: percentage access to specialty beds on day of admission, LOS in a non-specialty bed, acute and total LOS, 7-day readmission rates (so called 'failed discharges') and 30-day readmission rates (excluding elective admissions). The 12-month outcomes included mortality, admission to residential care and the outcome 'living at home' at 12 months (the inverse of death and admission to residential care)		
Findings	Patients in the ACE unit were more likely to be discharged immediately (17.1% vs. 1.4% 'before' and 7.7% 'after'; $p < 0.0005$) Access to specialty beds on the day of admission was significantly different (71% 'before', 69% ACE unit, 60% 'after'; $p = 0.019$) LOS in a non-specialty bed was not reduced compared with the 'before' group (1.0 days vs. 1.2 days; $p = 0.09$), but was compared with the 'after' group (1.0 days vs. 1.6 days; $p = 0.0001$) LOS was not significantly different [12.2 days 'before' vs. 12.7 days ACE unit ($p = 0.78$) or vs. 11.7 days 'after' ($p = 0.54$)] 7- and 30-day readmission, 12-month mortality, admission to residential care or living at home were not significantly different		
Conclusion	ACE unit patients were more likely to be discharged immediately Access to specialty beds on the day of admission was significantly different LOS in a non-specialty bed was not reduced compared with the 'before' group but was compared with the 'after' group LOS was not significantly different 7- and 30-day readmission, 12-month mortality, admission to residential care or living at home were not significantly different		
Self-reported limitations	This study has a number of important limitations. First, as an uncontrolled or non-randomised trial, the possibility exists that there are differences between the groups. This criticism cannot be eliminated but should be partly minimised by the prospective and unselected nature of the study. The fact that this was a service evaluation of routinely collected data does not allow patient-specific data such as functional or cognitive outcomes to be compared to evaluate this concern. The patients admitted out of hours may differ in disease severity from those admitted in daytime hours. The only anonymised data that we are able to present here to compare the groups is the proportion of patients classified as category 1 by the ED triage systems. These data do not show any striking differences. Second, and most importantly, the before-and-after design (rather than a randomised controlled design) means that complex interventions such as this can be subject to change in circumstances such as the outbreak of norovirus. This appears to have had a significant impact on the study outcomes and may account for the reduction in the impact seen for the ACE unit		

Full paper	Authors: Ellis <i>et al.</i> ⁸⁸	Year: 2012	Country: Scotland
Headline message	Having these units embedded in EDs allows for immediate CGA. This can have a positive impact on adverse outcomes for patients. There was an increase in same-day discharge and reduced LOS in non-specialty beds and increased access to specialty beds, with no impact on discharge, readmissions or long-term outcomes		
	Same-day discharge improved in the comparator group, which might reflect an overall change in emphasis on early discharge		
Other comments	Study was affected by an outbreak of norovirus, which affected study outcomes		
LOS, length of stay; N/A, not applicable.			

Conference abstract	Authors: Jones <i>et al.</i> ⁶²	Year: 2012	Country: UK
Study design	Not provided		
Data source	Not provided		
Study aim(s)	To reduce unnecessary admissions and their associated risks by the use of a geriatrician in the ED		
Sample size	441		
Setting	ED in Birmingham, UK		
Frail elderly – definition	'Frail elderly people'		
Study population	Age: not given	Condition: not given	
Intervention	What	Assess frail elderly patients who ED staff considered that it was necessary to admit	
	By whom	Consultant geriatrician	
	Duration	N/A	
	Other	During normal working hours	
Comparator group	None		
Outcome measures	Number discharged		
	7-day reattendance rate		
	LOS		
Findings	260/441 (59%) discharged by geriatrician; 46% of these had outpatient follow-up and 38% a therapist assessment		
	30/441 patients had already had an acute hospital admission with the same problem within the last 30 days and the geriatrician was able to discharge 16/30 (53%) of these		
	7-day ED reattendance rate was 9.5% (42/441) (hospital average 7.4%)		
Conclusion	<i>Based on these results, consultant geriatrician input supported by therapists within the ED is effective in admission avoidance of the frail elderly</i>		
Self-reported limitations	Not provided		
Headline message	Consultant geriatrician reduced admissions as all of the patients were admitted by the ED team		
Other comments	Undertaking admission prevention on more stable patients means that the wards will have a higher proportion of unwell and complex patients, so ward-based outcomes might appear to have worsened as a result of the intervention		
LOS, length of stay; N/A, not applicable.			

Conference abstracts		Authors: Scott <i>et al.</i> , ¹⁰² Wentworth <i>et al.</i> ^{103,104}	Years: 2014, 2015, 2016	Country: UK
Study design	Observational study with age-matched controls			
Data source	Appears to be hospital administrative data			
Study aim(s)	To assess the effect of CGA in the ED on hospital admissions and LOS			
Sample size	148 (2014); 990 (2015). Numbers refer to people assessed by the OPAL team			
Setting	ED of University Hospital of South Manchester			
Frail elderly – definition	Older patients (aged ≥ 80 years) presenting with 'geriatric syndromes' such as frailty or falls			
Study population	Age: average age not reported		Condition: see above	
Intervention	What	CGA performed in the ED		
	By whom	OPAL team consisting of a consultant geriatrician, physiotherapist, occupational therapist and discharge facilitator		
	Duration	N/A		
	Other			
Comparator group	Age-matched controls not seen by the OPAL team (further details not reported)			
Outcome measures	Hospital admissions and LOS for those admitted			
Findings	Rates of hospital admission were 26% (2014) for patients assessed by the OPAL team compared with 73% for those seen by ED staff alone. Between June 2014 and February 2015, admission rates were 39.2% and 65.6%, respectively. Average LOS for those admitted was 9.3 days (OPAL) and 10.1 days (control). The 4-hour ED target was achieved in 84.9% and 80.7% of patients, respectively			
Conclusion	CGA performed by a specialist team in the ED can avoid unnecessary admissions, reduce LOS and improve patient flow in the ED. Geriatricians have the skills to deal with these complex patients			
Self-reported limitations	None reported, but these are conference abstracts with limited reporting of methods			
Headline message	As above			
Other comments	LOS, length of stay; N/A, not applicable.			

Conference abstract		Authors: Thompson <i>et al.</i> ⁷⁴	Year: 2010	Country: UK
Study design	Appears to be an uncontrolled observational study			
Data source	Review of patient records			
Study aim(s)	To assess the impact of geriatric assessment in the ED on patients aged ≥ 65 years			
Sample size	35			
Setting	ED of John Radcliffe Hospital, Oxford			
Frail elderly – definition	Patients referred by ED staff for emergency (same-day) assessment by the GLT			
Study population	Age: mean 84 years (range 68–97 years)		Condition: various, including falls ($n = 25$) and 'collapse' ($n = 5$). Patients assessed by ED staff as definitely needing admission were excluded	
Intervention	What	CGA performed in the ED		
	By whom	GLT (no further details reported)		
	Duration	N/A		
	Other			

Conference abstract	Authors: Thompson <i>et al.</i> ⁷⁴	Year: 2010	Country: UK
Comparator group	None		
Outcome measures	Outcome of referrals and LOS for those admitted		
Findings	Of 35 patients assessed, 27 (77%) were female. 26 (75%) were discharged home, 7 (20%) were admitted to the acute medical unit and 2 (5%) were admitted to an intermediate care bed. ^a Of 26 discharged patients, 23 (88%) needed further geriatrics input. This was provided by the MDT in the day hospital (18 patients), in a next-day geriatric clinic (3 patients) and in a falls clinic (2 patients). Average LOS in the ED was reduced by 4.8 hours since GLT input became available (no further details reported)		
Conclusion	Same-day geriatric assessment in the ED has reduced hospital admissions, helped maintain patients in the community and reduced ED LOS		
Self-reported limitations	None reported but this is a conference abstract with limited reporting of methods		
Headline message	As above		
Other comments	Small study, no comparison group data reported. Data are for February–July 2009		
GLT, geriatric liaison team; LOS, length of stay; N/A, not applicable. a Data supplied in original text.			

Conference abstract	Authors: Bell <i>et al.</i> ⁸³	Year: 2014	Country: UK
Study design	Not provided. Service evaluation		
Data source	Not provided		
Study aim(s)	Development of an ACE service		
Sample size	662 patients		
Setting	ED observation ward of a district general hospital in London		
Frail elderly – definition	<i>Patients over the age of 80, with complex problems or frailty, but who do not require inpatient care</i>		
Study population	Age: > 80 years	Condition: complex problems or frailty	
Intervention	What	ACE service including CGA	
	By whom	Consultant with support from junior doctor and band 6 nurse	
	Duration	Study undertaken January–October 2013	
	Other	Based in ED observation ward: in-reach service to the ED and liaison to the acute medical unit. Weekday in-hours resource	
Comparator group	N/A		
Outcome measures	Inappropriate admissions avoided		
Findings	662 patients were assessed and 459 inappropriate admissions were avoided. CGA and treatment to discharge – extra 4.76 hours		
	Rate of admission reduced from 61.2% to 35.1%		
Conclusion	<i>ACE service has been beneficial in terms of avoiding admissions and providing timely care</i>		
Self-reported limitations	Not provided		
Headline message	ACE and CGA are effective		
Other comments	N/A, not applicable.		

Conference abstract		Authors: Lovato <i>et al.</i> ¹¹⁸	Year: 2012	Country: Italy
Study design		Observational retrospective study		
Data source		Administrative data		
Study aim(s)		To evaluate the impact of the SC prognostic tool in reducing waiting times for frail elderly		
Sample size		7061		
Setting		ED		
Frail elderly – definition		All aged > 85 years and aged > 75 years with some criteria of risk		
Study population		Age: ≥ 70 years (mean 79.5 years)	Condition: not given	
Intervention	What	SC (four-level triage: white, green, yellow, red) to identify elderly, then a 'priority green code' with certain characteristics		
	By whom	Not provided		
	Duration	N/A		
	Other	N/A		
Comparator group				
Outcome measures		Waiting time (arrival in the ED until medical care)		
Findings		7061 admitted to medical ward through the ED		
		Green code assigned to 96.4% of patients		
		Mean waiting time with SC was 65.8 (SD 72.55) minutes vs. 95.3 (SD 98.11) minutes without SC, regardless of colour ($p = 0.000$)		
		<i>In groups with initial green colour we identified a statistical difference in waiting time (65,5 min in SC vs 94,9 min without SC; p value = 0,000)</i>		
Conclusion		Application of SC resulted in reduced waiting times		
Self-reported limitations		None provided		
Headline message		Application of SC reduced waiting times; this did not increase waiting times for other patients		
Other comments		Abstract states that organisational aspects and management of ED were affected too		
N/A, not applicable; SC, Silver Code; SD, standard deviation.				

Conference abstract		Author: Pareja ⁹⁹	Year: 2008	Country: Spain
Study design		Prospective study		
Data source		Not provided		
Study aim(s)		Whether or not specialised geriatric evaluation may reduce rates of hospital admission and iatrogenesis (unnecessary interventions)		
Sample size		1200		
Setting		General hospital		
Frail elderly – definition		High-risk older patients		
Study population		Age: mean 86 years	Condition: not given (see Findings)	
Intervention	What	CGA and treatment for acute-mild severity or unstable chronic diseases		
	By whom	Geriatrician (in the short-stay unit, having been referred there by medical staff from the ED)		
	Duration	N/A		
	Other	N/A		

Conference abstract	Author: Pareja ⁹⁹	Year: 2008	Country: Spain
Comparator group	N/A		
Outcome measures	Admission		
Findings	72% were discharged home (29% were followed up in geriatric clinics, 9% by the home care medical team and 14% by the nursing home primary care doctor)		
	28% were admitted		
	18% of the discharged patients needed hospital attention in the following month		
Conclusion	Frail older people using the ED have different patterns of service use and the traditional disease-oriented model may not meet their health-care needs		
	<i>Short medical units carried out by geriatricians seem to have the potential to increase patient satisfaction, reduce the length of hospital stay and improve the efficiency of the emergency departments</i>		
Self-reported limitations	Not provided		
Headline message	This unit discharged a lot of patients; however, there was no comparator group		
Other comments	The conclusion makes claims that are not substantiated in the results of the study about patient satisfaction and efficiency		

N/A, not applicable.

Full paper	Authors: Singler <i>et al.</i> ⁵⁰	Year: 2014	Country: Germany
Study design	Prospective cohort study		
Data source	Review of patient records and follow-up telephone interviews		
Study aim(s)	To assess the validity of the ISAR screening tool in a German ED		
Sample size	520		
Setting	ED of an urban university-affiliated hospital		
Frail elderly – definition	Patients aged ≥ 75 years attending the ED and living at home or in a long-term care facility		
Study population	Age: mean 82.8 years (SD 5 years)	Condition: not reported but patients expected to die within 24 hours were excluded	
Intervention	What	Screening with the ISAR tool	
	By whom	Study nurses	
	Duration	N/A	
	Other		
Comparator group	N/A		
Outcome measures	Accuracy of the ISAR tool for predicting a composite end point of death, hospitalisation, repeat ED visit or transfer to a long-term care facility at 28 days		
Findings	Of the 520 patients, 425 patients scored ≥ 2 on the ISAR tool and 315 scored ≥ 3 . The primary end point was observed in 250 patients on day 28 and 260 on day 180. The area under the ROC curve for the ISAR score was 0.62 on day 28 and 0.66 on day 180		
Conclusion	The ISAR tool acceptably identified high-risk elderly patients in the ED. Using a cut-off score of ≥ 3 rather than ≥ 2 gave better overall results		
Self-reported limitations	Patients not recruited 7 days/week; lack of data on clinical utility of the ISAR tool		
Headline message	The ISAR tool with a cut-off score of ≥ 3 is an acceptable screening tool for use in German EDs		
Other comments			

N/A, not applicable; SD, standard deviation.

Full paper	Authors: Conroy <i>et al.</i> ⁸⁹	Year: 2014	Country: UK
Study design	Before-and-after study		
Data source	Hospital administrative data		
Study aim(s)	To evaluate the effect of implementing an EFU within an ED		
Sample size	Total ED attendance (number aged ≥ 85 years): <ul style="list-style-type: none"> • 2010 (usual care): 109,994 (6895) • January–June 2011 (transition period): 53,182 (4034) • July 2011 to June 2012 (EFU): 110,517 (9035) 		
Setting	Large ED in the East Midlands, UK		
Frail elderly – definition	Not specifically defined, but data were collected for ED attendees aged ≥ 85 years		
Study population	Age: average age not reported	Condition: older people attending the ED and likely to be discharged home within 24 hours	
Intervention	What	EFU with between 8 and 12 beds integrated with the main ED and performing CGA with referral to social and community care as required. Geriatricians also provided an in-reach function to the major receiving area of the ED	
	By whom	Geriatricians, emergency physicians, physiotherapists, occupational therapists and ‘primary care co-ordinators’	
	Duration	N/A	
Other			
Comparator group	People attending the ED before implementation of the EFU when standard care for frail older people was delivered in an emergency decisions unit without routine input from specialists in geriatric medicine		
Outcome measures	Primary outcome was admission rate from the ED. Secondary outcomes were readmissions following attendance at the ED, LOS for admitted patients and total bed-day use. Outcomes were assessed for age groups 16–64 years, 65–74 years, 75–84 years and ≥ 85 years		
Findings	ED attendances by older people increased over the study period. Admission rates from the ED of patients aged ≥ 85 years decreased from 69.6% in 2010 to 61.2% after the EFU was implemented. The change was statistically significant (relative risk 0.88, 95% CI 0.81 to 0.95). Readmission rates also decreased (4.7% vs. 3.3% at 7 days; 12.4% vs. 9.2% at 30 days; and 19.9% vs. 26.0% at 90 days). The relative risk for 90-day readmission was 0.77 (95% CI 0.63 to 0.93). Mean LOS in the oldest patients increased from 8.9 days to 11.1 days and total bed-day use from 4385 to 4826		
Conclusion	CGA can be performed in the ED and early intervention for frail older people may offer benefits for both patients and health services. More robust evaluations are required to assess the generalisability of the findings		
Self-reported limitations	No contemporaneous control group; lack of process data on the number of patients seen by the EFU; lack of patient outcome and service cost data		
Headline message	<i>CGA in the ED was associated with improved discharge rates and reduced readmissions in older people</i>		
Other comments	Admission and readmission rates also fell for younger age groups, which the authors suggested may be because emergency physicians had their time freed up, which allowed them to care for younger patients		

LOS, length of stay; N/A, not applicable.

Full paper	Authors: Fox <i>et al.</i> ¹⁰⁶	Year: 2016	Country: UK
Study design	Feasibility study		
Data source	Electronic patient record		
Study aim(s)	<i>To improve the quality of care delivered in the ED to frail older people</i>		
Sample size	168 patients		
Setting	ED of an urban teaching hospital		
Frail elderly – definition	<i>... defined as being from residential care or intermediate care, presenting with confusion as a result of dementia or delirium or admitted with a fall</i>		
Study population	Age: mean 84.9 years (range 70–102 years)	Condition: frail elderly were preferentially but not exclusively chosen for the intervention	
Intervention	What	Geriatrician-led CGA with an all-inclusive CGA document (functional and medical baselines, progress, problems and the plan of care):	
		<ul style="list-style-type: none"> • level of dependence in ADL (basic and instrumental) • mobility • continence • presence of cognitive impairment/mood disorder • medication review • targeted individual interventions • discharge planning with a clear management plan 	
	By whom	Consultant geriatrician (plus MDT – nursing staff, occupational therapist, physiotherapist, social worker)	
	Duration	N/A. Delivered between 10:00 and 20:00, 7 days a week	
	Other	N/A	
Comparator group	None		
Outcome measures	None		
Findings	<p>Most patients were dependent for ADL. Over 50% were admitted from their own home, with 41% admitted from institutional care. Over 40% had a confirmed dementia diagnosis and the mean number of comorbid conditions was 2.5. Median time from presentation at triage to consultation with a geriatrician was 1 hour 52 minutes</p> <p><i>Overall average hospital length of stay was 6.5 days (0–55 days) with 53 (32%) patients discharged from ED directly. Patients, relatives and General Practitioners received specific advice pertinent to their clinical presentation. Seven-day and 30-day readmission rates were 6.32% and 10.1% respectively with 30-day mortality rate of 1.79%</i></p>		
Conclusion	Compared with other research studies in this area, this intervention compares favourably in terms of positive outcomes (discharge, LOS and readmission)		
Self-reported limitations	The main limitations were lack of a control group, the small number of patients seen within the study time frame (168 patients in 31 days), the short length of the study (1 month) and the fact that the study was retrospective		
Headline message	This feasibility study highlighted that older patients were often being assessed by numerous different professionals. This intervention allowed them to be assessed once. There was no comparator group for the intervention		
Other comments			

LOS, length of stay; N/A, not applicable.

Conference abstract		Authors: O'Reilly <i>et al.</i> ⁷⁵	Year: 2016	Country: Ireland
Study design		Feasibility study/report of intervention		
Data source		N/A		
Study aim(s)		To identify 100% of frail patients who presented to the ED during core hours and deliver a MDT assessment		
Sample size		2200 screened for frailty		
Setting		ED of a hospital in Ireland		
Frail elderly – definition		... <i>medical conditions often further complicated by functional decline, cognitive deterioration and complex social care needs</i>		
Study population		Age: > 75 years	Condition: frail	
Intervention	What	Screening for frailty then referral to the MDT (FITT)		
	By whom	FITT (physiotherapy, occupational therapy, medical social work, speech and language therapy, dietetics and pharmacy)		
	Duration	N/A		
	Other	N/A		
Comparator group		Comparing data for the first quarter of 2015 (before) and the first quarter of 2016 (after)		
Outcome measures		Discharge directly home Transfer to ward in < 9 hours		
Findings		Over 75% of patients screened were deemed to be frail		
		Comparing quarter 1 in 2015 and quarter 1 in 2016: <ul style="list-style-type: none"> • 11.6% increase in the number of patients aged ≥ 75 years presenting to the ED • 59% increase in the number of patients discharged directly home • 42% increase in transfers to the wards in < 9 hours 		
Conclusion		FITT provided earlier intervention to frail adults thus improving hospital experience and patient outcomes		
Self-reported limitations		N/A		
Headline message		FITT can promote safe discharge and transfer with MDT intervention		
Other comments		N/A		
N/A, not applicable; FITT, Frail Intervention Therapy Team.				

Full paper		Authors: Huded <i>et al.</i> ¹¹⁹	Year: 2015	Country: USA
Study design		Prospective observational study		
Data source		Prospective		
Study aim(s)		To incorporate TUGT assessments by geriatric nurses into ED assessments in order to identify elderly patients at high risk of falls		
Sample size		19,511 patients treated in the ED, 1135 evaluated by a geriatric nurse and the TUGT performed on 443		
Setting		ED of an urban academic level 1 trauma centre with 56 beds		
Frail elderly – definition		Geriatric nurses assessed elderly patients and identified a high-risk population for the TUGT as identified by the GEDI-WISE protocol		
Study population		Age: ≥ 65 years	Condition:	
Intervention	What	Fall-risk screening with the TUGT		
	By whom	Geriatric nurses		
	Duration	Study ran from 1 April 2013 to 31 May 2014		
	Other			

Full paper	Authors: Huded <i>et al.</i> ¹¹⁹	Year: 2015	Country: USA
Comparator group	No		
Outcome measures	Positive TUGT Referral interventions Number of patients discharged Number of patients admitted Number of patients under observation		
Findings	368 patients experienced a positive result on the TUGT. Interventions for positive results included referral to an ED-based physiotherapist ($n = 63$, 17.1%), outpatient physiotherapist referral ($n = 56$, 12.2%) and social work consultation ($n = 162$, 44%) For those with a positive TUGT score, 74% were discharged home ($n = 274$) and the remainder were admitted under inpatient or observation status		
Conclusion	The ED visit may provide an opportunity for older adults to be screened for fall risk ED nurses can conduct the TUGT, a validated and time-efficient screen, and place appropriate referrals based on assessment results		
Self-reported limitations	This study shows how it is possible, using a protocol, to measure the risk of falls in elderly patients requiring acute care from the ED for reasons other than falls. The study limitations were single site study and screening delivered by specialised staff already in place. Only a small number of potentially eligible patients were screened. TUGT needs to be adapted to the ED		
Headline message	Identifying and intervening in high fall-risk patients who visit the ED has the potential to improve the trajectory of functional decline in our elderly population		
Other comments			
GNL, geriatric nurse liaison; RN, registered nurse.			

Appendix 6 Data tables

TABLE 15 Locations of studies

Location	Total (n)
Australia	10
Belgium	1
Canada	6
France	2
Germany	1
Hong Kong	2
Ireland	5
Italy	7
The Netherlands	2
New Zealand	1
Singapore	2
South Korea	1
Spain	2
Sweden	2
Switzerland	3
Taiwan	1
Turkey	1
UK	14
USA	27
Total	90

TABLE 16 Types of studies

Type of study	Reference
Action research	114
Audit	28
Before-and-after cohort study	117
Cross-sectional cohort	29,32
Diagnostic accuracy study	20,23,31,38,39
Evaluation	80,83
Feasibility study	75,106
Longitudinal study	56
Medical record review	34,46,113
Observational study	74,102,110
Observational before-and-after study	95
Pilot project	116
Prospective before-and-after study	22,33,44,79,88,89,91,115
Prospective cohort study	30,35–37,41–43,47,48,50,51,55,58–62,66,70–72,81,85,86,100,105,109,111
Prospective comparative study	78
Prospective data analysis	69,99,107
Prospective evaluation	63
Prospective non-randomised study	82
Prospective observational study	21,27,40,49,52,67,90,119
Prospective pragmatic study	45,77
Prospective questionnaire	84
Quasi-RCT	112
RCT	18,19,24,26,120
Retrospective before-and-after study	92,96
Retrospective cohort study	53,57,64,65,76,93,98,108
Retrospective observational study	73,87,118

TABLE 17 Sample size and target age of interventions

Sample size	Reported age of participants (years)			Reference
	Mean (SD)	Median	Range	
5416 pre, 5370 post				117
Not provided				86
700				40
534				98
7213	79.3			67,68
2202			45–99	108
848		85	58–105	61
5162				76
85 intervention, 76 control				24
2121 intervention, 1451 comparator				77
2196 (1098 matched pairs)				78
285	83.5 ± 6.8			71
2057	81.7		65–103	21
200	80.3 ± 7.4			27
519				42
375	84 (5.7)			53,54
315 intervention, 172 control				115
313				79
101 intervention, 98 control				63
666			60–103	72
200	80.3 (7.4)			49
200	80.3 ± 7.4			90
894				116
788	76.6		65–101	52
314				56
929				57
277				114
Not provided				80
795 screening, 752 control	82.7 ± 5, 82.6 ± 5.1			22,33
139 index visit and 130 follow-up visit	82.5 ± 5.4, 80			29,30
1680	83 ± 6.5			73
3071				69
280 intervention, 500 control				112
25	78		66–96	110
424	84 ± 6.5			41
5571	87.4			87

continued

TABLE 17 Sample size and target age of interventions (continued)

Sample size	Reported age of participants (years)			Reference
	Mean (SD)	Median	Range	
168				81
3165 intervention, 2100 control				82
120				51
100				66
69	76			18
225				45
829 intervention, 873 control				70
250				46
504	76.8			47
260				37
117				34
168				85
300				32
32 intervention, 31 control	74			120
219 development, 178 validation	81			60
1820 cohort, 1279 RCT	Derivation group, 74.5 (6.2); Control group, 75 (6.8); Intervention group, 76.3 (6.8)			25
300				107
432 intervention, 205 control	75			84
137	80.3			100,101
1096	80.3			109
939		74		43
212 before, 210 intervention, 327 comparator	80.5, 81.1, 80.3			88
< 65 years = 219, ≥ 65 years = 67				91
547				105
441				62
13,354 pre, 14,484 post				92
226	80.5			111
Not provided	77 (8.6)			96,97
250				48
148 in 2014, 990 in 2015				102–104
35	84		68–97	74
662				83
Not provided				113
118				20
7061	79.5			118
1903				23

TABLE 17 Sample size and target age of interventions (continued)

Sample size	Reported age of participants (years)			Reference
	Mean (SD)	Median	Range	
1200				99
2139				44
114 intervention, 110 control	78.7 ± 6.4			26
525				28
1820 (910 matched pairs)				65
381	79.1			55
169				35
371				36
1632	84			58
650	74			19
4417 (55–64 years), 7598 (≥ 65 years)	77.5, 76.9			93
520	82.8 (5)			50
352	77			38
150	75			39
109,994 usual care, 53,182 transition, 110,517 intervention				89
107	79			59
161				31
168	84.9		70–102	106
2200				75
346 before, 95 after	73, 75			95
19,511				119
4103				64
2286 intervention, 2260 control				94

SD, standard deviation.

TABLE 18 Targeted age of participants

Category	Reference	Total, n
≥ 65 years	18,19,21,23,27,28,32,34–36,38–40,42,43,46,48,51,52,55–57,59,64,66,69,70,74,76,77,79,80,84,88,91–96,109–111,113,115,119	46
≥ 65 years with trauma	45,47	2
≥ 65 years with fall	65	1
≥ 65 years with chronic condition	82,116	2
≥ 65 years with acute condition	49,90	2
≥ 65 years with positive screen for 'at risk'	78,88	2
≥ 65 years, ISAR score > 2	25,67	2
≥ 65 years, TRST score > 2, eligible for discharge	112	1
≥ 65 years with chronic condition, ≥ 70 years without	63	1
≥ 65 years with chronic condition, ≥ 80 years without	24,31,71	3
≥ 70 years	44,60,73,105,117,118	6
≥ 72 years	107	1
≥ 75 years	20,29,33,37,41,50,53,58,81,86,114	11
≥ 75 years, frail	75	1
≥ 75 years, multiple comorbidities	87	1
≥ 80 years with geriatric syndromes	83,102	2
≥ 85 years	89	1
No category	21,26,27,61,62,72,74,85,98,100,106,108,118,120	14

TABLE 19 Outcomes measured in service delivery interventions

Outcome	Reference	
	Frail elderly population	General geriatric population
ADL	24	
Acute admissions from the ED	25,71,87,89,90,99,102–104,114	26,65,80,82,93,94,96,97,100,115,117
Admission to specialty bed	88	
Avoided admissions	61,67,68,72,83,98	92,113
Costs	72	
Discharge rates	62,71,88,98,99	81,85,105,116
Discharges: inappropriate	73	
ED reattendance	25,62,71,78,90,112,114	65,76,93,94,100,107–109,115
ED waiting times	98,118	
Frailty	24	
Functional decline/functional status	90,112	26
In-hospital mortality	86	
Inpatient bed occupancy	86	
Institutionalisation	25	
Intervention acceptability		110
Length of stay	62,71,74,87–89,102–104,106,114	26,63,77,93–95,105,116,117
Living at home vs. access to residential care	88	
Medication errors avoided/problems identified		63,64
Mortality (all)	25,78,88,90	108
Outcome of referrals	74	
Quality-of-life score		80
Readmission	71,78,86–89,99,106,112,114	65,76,105
Referred for appropriate care		79
Satisfaction with the ED		84,91
Total bed-day use	89	

Appendix 7 Example brief data extraction form

Reference ID, author, year, country	Study design, population, patient numbers	Intervention/assessment tool	Results	Headline message
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Appendix 8 Example full data extraction form

Reference ID	Author	Year	Country
Study design			
Data source			
Study aim(s)			
Sample size			
Setting			
Frail elderly – definition			
Study population	Age	Condition	
Intervention	What		
	Who		
	Duration		
	Other		
Comparator group			
Outcome measures			
Findings			
Conclusion			
Self-reported limitations			
Headline message			
Other comments			
ID, identification.			

A decorative graphic consisting of numerous thin, parallel green lines that curve from the left side of the page towards the right, creating a sense of movement and depth.

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