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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.

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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

Preston L*, Chambers D, Campbell F, Cantrell A, Turner J and Goyder E

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 to best 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. To map the outcomes of these interventions and to examine whether there is any evidence of the impact of these interventions on patient and health service outcomes.

Design: Systematic mapping review.

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

Participants: Frail and high risk older people and older people (aged over 65).

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 conference abstracts and 17 systematic reviews published from 2005-2016.

Review methods: A review protocol was drawn up and a systematic database search was undertaken 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. Narrative synthesis of interventions/outcomes relating to these categories was undertaken. Quality assessment of individual studies was not undertaken. Instead, an assessment of the overall evidence base in this area was made.

Results: Of the included studies, 33 focused on a frail/high risk population and 62 on an older population and were interventions to identify (37) and manage (58) older people. Interventions to identify frail and at risk older people, on admission and at discharge utilised a number of different tools. There was extensive evidence of these question based tools but the evidence was inconclusive and contradictory. Service delivery innovations comprised changes to staff, infrastructure and care delivered. 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 of a standard systematic review. Mapping the evidence based 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: The aim of future work in this area needs to determine why interventions work, whether they are feasible for the NHS and acceptable to patients.

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List of Abbreviations

ACE	Acute Care of the Elderly/Acute Care for Elders
ACP	Aged care pharmacist
ADL	Activities of Daily Living
AMAU	Acute Medical Assessment Unit
ASET	Aged Care Service Emergency Team
ATOP	Assessment Team for Older People
AUC	Area Under the Curve
BGA	Brief Geriatric Assessment
BRIGHT	Brief Risk Identification for Geriatric Health Tool
CAM	Confusion Assessment Method
CC	Care Coordination
CCT	Care Coordination Team
CFS	Clinical frailty score
CGA	Comprehensive Geriatric Assessment'
CI	Confidence Interval
COMPRI	Complexity Prediction Instrument
CTAS	Canadian Triage and Acuity Score
DAI	Deficit Accumulation Index
ED	Emergency Departments
EDCC	Emergency Department Care Co-ordinators
EDGM	Emergency Department Geriatric Medicine
EDOU	Emergency Department Observation Unit
EFU	Emergency Frailty Unit
EGS	Emergency Geriatric Screen
ESI	Emergency Screening Instrument
FITT	Frail Intervention Therapy Team
FSAS-ED	Functional Status Assessment of Seniors in Emergency Departments
GED/GeriED	Geriatric Emergency Departments

GEDI-WISE	Geriatric Emergency Department Innovations through Workforce, Informatics and Structural Enhancements
GNLI	Geriatric nurse liaison intervention
GRAY	Geriatric Readmission Assessment at Yale
HARP	Hospital Admission Risk Profile
HOTEL	Hypotension, Oxygen saturation, low Temperature, ECG changes and Loss of Independence
HS&DR	Health Service and Delivery Research Programme.
ICU	Intensive Care Unit
ISAR	Identification of Seniors at Risk
K	Kappa
LOS	Length of stay
MDT	Multi-Disciplinary Team
MGT	Mobile Geriatric Team
MMSE	Mini Mental State Examination
NETSCC	NIHR Evaluation, Trials and Studies Coordinating Centre
NHS	National Health Service
NIHR	National Institute for Health Research
OARS	Older Adult Resources and Services
OECD	Organisation for Economic Co-operation and Development
OPAL	Older People Assessment and Liaison
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PROSPERO	International prospective register of systematic reviews
RCT	Randomised Controlled Trial
REMS	Rapid Emergency Medicine Score
ROC	Receiver operating characteristic
ScHARR	School for Health and Related Research
SHARE-FI	Study of Health, Aging and Retirement in Europe Frailty Instrument
SHERPA	Evaluation du Risque de Perte d'Autonomie
SHT	Social Health and Triage Team
SIS	Six item screener

TREAT	Triage and Rapid Elderly Assessment Team
TRST	Triage Risk Screening Tool
TUGT	Timed up and go test
UK	United Kingdom
USA	United States of America
VIP	Variables Indicative of Placement

Plain English Summary

In the United Kingdom, Emergency Departments (EDs) are facing high levels of demand which are in part related to the number of frail older people presenting to the ED. 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.

In order 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. However this evidence measured different patient and health service outcomes, so it was difficult to compare the initiatives.

- How to identify frail patients and patients at risk.
- How to change ED services to meet the needs of older and frail patients.
- Initiatives combining identification and changes to ED services.

The majority of the initiatives we identified did not focus on frail older people, but older people more generally. Patients were identified as frail or high risk at admission and at discharge. This tended to take the form of tools using questions for patients. The evidence for these was not conclusive as to their usefulness. 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 admissions avoidance, reduced ED reattendance and improved discharge outcomes.

Further research which includes interventions undertaken elsewhere in the health system to prevent frail older people attending the ED and a better understanding of whether the initiatives reported are acceptable to patients would be useful.

Word Count 296 words.

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 United Kingdom. The population of the United Kingdom 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.

Objectives

The objective of the review is 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 (ScHARR), 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 Service & Delivery Research (NIHR HS&DR) team. The final protocol was produced in June 2016 and registered with the International prospective register of systematic reviews (PROSPERO)

Literature search

The search for evidence was conducted in three stages.

Stage One - An initial search (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 the MEDLINE (2005–2016).

Stage Two - The second stage of the search (July 2016) covered a wider range of health and medical databases using an improved version of the Medline scoping search. Databases search were EMBASE, Cochrane Library, Web of Science, CINAHL, HMIC and PROSPERO

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

Study selection

References identified by the literature search were uploaded into Endnote reference management software 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 in order 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) where necessary. Review articles that met the inclusion criteria and background articles were also identified through the screening process.

The review inclusion criteria were:

- Population
    - Aged 65 and over 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 2005-2016
    - Evidence from qualitative and quantitative studies relating to specific interventions.
    - English language evidence from OECD 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 over 65). In addition, this classification allowed the review team to divide articles into two categories – those looking at the identification of frail older people, or older people at high

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

- Full data extraction for all studies on population groups defined as frail older people or older people at 'high risk' by the study authors
- Brief data extraction for all studies on population of older people, normally aged 65+ without any specific risk criteria
- 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. Where 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 developed a bespoke assessment of the evidence base mapped in our review using three methods.

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

Synthesis

Data were extracted and tabulated. Summary tables were created. These were used to inform the narrative synthesis. Due to 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

- One hundred and three peer reviewed articles/conference abstracts reporting primary research and seventeen systematic reviews were included in the mapping review.
- Ninety-five data extractions were undertaken on the 103 articles/conference abstracts
- Sixty two studies had a population of older people and 33 had a population that were described as frail and/or high risk.
- The population of frail older people is not reported consistently in the literature. Some articles/conference abstracts had a study population defined as frail or high risk older people, others used an age criteria threshold (over 65, over 75 etc.) to define older people and there were a number of articles/conference abstracts that defined their population as older/geriatric.
- Fifty eight of the papers were focused on service delivery interventions and 37 on identifying frail or high risk older people.
- The majority of the studies were undertaken in the USA (27), the UK (15) and Australia (12), 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 were reported.

Table A maps the evidence base identified in this review

Table A Overview of the evidence base

<table>
<tr><td>Population</td><td colspan="3">Frail or high risk older people (n=33)
Older people (n=62)</td></tr>
<tr><td rowspan="4">Interventions</td><td rowspan="2">To identify frail or high risk older people (n=37)</td><td>Diagnostic tools to screen for frailty related issues (n=7)</td><td>Prognostic tools to measure risk of adverse events in the ED (n=5)</td></tr>
<tr><td>Diagnostic tools to identify frailty (n=7)</td><td>Prognostic tools to measure risk of adverse events on discharge (n=18)</td></tr>
<tr><td rowspan="2">To manage frail and older people in the ED (n=58)</td><td>Changes to ED staffing (n=25)</td><td>Changes to the physical infrastructure (n=11)</td></tr>
<tr><td>Changes to how care is delivered (n=19)</td><td>Other interventions (n=3)</td></tr>
<tr><td rowspan="2">Outcomes</td><td>Patient outcomes</td><td colspan="2">Activities of daily living/functional 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?), Satisfaction with the ED</td></tr>
<tr><td>Health service outcomes</td><td colspan="2">Admission to acute care, Admissions avoided, Attendance or reattendance at the ED, Bed occupancy rates, Costs/resource utilisation, Discharge rates, ED returns/re admissions, ED waiting times, Length of stay</td></tr>
</table>

Identification of frail/high risk older people

Thirty-seven studies (40 publications) dealt with strategies aimed at identifying patients with frailty or distinguishing higher risk 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 below in Table B. Only one UK study was identified.

Table B Evidence on tools to identify frailty

	Publications (n)
Diagnostic tools to identify frailty	9
Diagnostic tools for frailty related issues	7
Prognostic tools to identify risk of adverse events in the ED	5
Prognostic tools to identify risk of adverse events following discharge	19

Nine 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 have 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 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. Eighteen studies (19 publications) evaluated tools to predict risk of adverse events following discharge, with follow-up periods of 28 days to 12 months. The well-established Identification of Seniors at Risk tool (ISAR) 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 were performed in the UK.

Overall, the evidence on tools to support 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 small sample sizes, most were conducted at a single centre and many were published as conference abstracts with limited details. Contradictory results obtained in different prognostic studies with the same tool reflect the fact that outcomes like repeat ED visits and hospital admission

will be influenced by the health and care system as well as by patient factors. Hence results of studies performed in one country cannot be readily generalised to another. 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 ED

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

Table C Service delivery interventions for frail and older people

Category	Details and example	n
Changes to ED staffing	Adding specific staff to the MDT with responsibility for older patients (e.g. geriatric liaison nurse), or by restructuring or developing teams to improve care delivery (e.g. care coordination team).	26
Physical infrastructure	Making the ED more 'frail friendly', establishing specific units in the ED for older patients, or the creation of Geriatric Emergency Departments (GEDs).	12
Comprehensive Geriatric Assessment	Multi-faceted screening/assessment and planning of older people's care.	22
Individual studies	Not replicated elsewhere.	3

The service delivery intervention studies reported a wide variety of outcomes, 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, 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, this review did not undertake formal quality assessment of individual studies, rather assessed the overall evidence base using a bespoke method. .

Conclusions

There is an extensive but inconclusive evidence base on 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 impact on reduced admissions, ED reattendance and improved discharges. However, the evidence base was mixed in terms of interventions and the outcomes they measured and assessing which outcomes are important to patients and which 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 as compared to tailoring all services to better meet the needs of an ageing and potentially frail population.

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Word Count 2340 words.

Chapter 1. Introduction

The 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".[1] This strategy also needs to be viewed alongside the UK government target of 95% of all ED patients to be discharged, transferred or admitted within four 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 homogenous 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 for Older People[2] describes older people as being in one of three groups – entering old age (still living an active and independent age), transitional (between healthy active life and frailty) and frail older people (vulnerable due to health problems or social care needs).

This review is focused on the delivery of care to this latter group of 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. Firstly, older people are more likely to present to the ED and secondly, 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, The demand for ED services by older people is in part due to the ageing population. There is 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 for the NIHR on urgent care which found that frail older people use emergency care more frequently (especially those who are aged over 80 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 when 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] examining 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, but 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 or to a medical assessment unit or elderly care unit, delivering appropriate care within a home/community setting (nursing homes or their own home) and preventing readmissions when older people are discharged from acute medical care through interventions delivered in their homes.

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. They are often taking multiple medications. They may have disabilities that make the fast moving nature of the ED highly unsuitable. They are more likely to have dementia, or present with delirium, and this is often alongside their presenting complaint which has required them to seek emergency care. Older patients can also often present non-specifically[5] and are therefore difficult to diagnose and treat accordingly. Underlying all of these 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 Emergency Department, it becomes critical to manage their presenting complaint in the context of their frailty. A recent Lancet Editorial[6] outlined the four issues facing the emergency department in their management of frail older people: timely recognition of frail patients is difficult, there is no standard definition for frailty, frail older people need to be treated in the context of their frailty as opposed to only treating them according to their presenting complaint and there are a lack of clinical guidelines to treat frail older people in the emergency department.

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[8] suggests that frailty is present in around a quarter of people aged over 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+ as a homogenous population. In an evidence review examining discharge interventions, Lowthian[10] found three groups of older people in the literature - patients stratified by age, (which varied from 65+ to 75+), vulnerable people within these age categories and older people who had been screened and considered to be high risk.

Some clinicians and academics believe that frailty can be defined using a set of clinical indicators (for example, patients with multimorbidity or an increased risk of falls) and others 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 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 readmissions of frail patients.[13] It is known that frail patients have worse outcomes than the general population of older people if they attend the emergency department. Maile[14] cites a figure of 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 and 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 are as follows:

Research questions

- What is the evidence for the range of different approaches to the management (screening 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 include:

- What specific approaches to the management of frail older people exist within the Emergency Department?

- What evidence is there that these approaches to management within the ED could influence attendance and/or re-attendance rates of the ED by frail older people, hospital admission and/or re-admission rates for frail older people, patient-centred outcomes for the frail older people and costs for 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

- 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 HS&DR review commissioners. The protocol was developed by the team at ScHARR, led by the review author. The protocol was shared with our internal team and our topic experts as well as with the HS&DR team. Suggested changes were made and the final protocol was produced in June 2016. Following this, the review was registered with PROSPERO and is review number CRD42016043260.

Literature search

The review started with the search for evidence and three search iterations were undertaken in order to efficiently identify relevant evidence for the review. The review team were 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 One – Search of evidence retrieved for earlier review and scoping search

An initial search (May 2016) was undertaken using the evidence base retrieved for the Turner et al[3] review. These references were filed in an Endnote Library 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 - 'ageing, aged, elderly, frail, old and geriatric' were searched for in the title of the references.

Additionally, a search was conducted in May 2016 on Medline (via OVID) for reviews and other relevant literature. The search 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 (emergency departments). The search was not be limited by intervention type as an a priori decision about which interventions are to be included could have limited our understanding of the scope of the topic. The search was limited to evidence published from 2005 onwards to ensure currency of the included research. The searches were limited to English Language only papers due to the time constraints of the reviews making the time taken for translation of papers unfeasible. 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 Two – Search of health and medical databases.

The second search, undertaken in July 2016, searched 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 OVID
- Cochrane Library via Wiley Interscience
- Web of Science via Web of Knowledge via ISI
- CINAHL via EBSCO
- HMIC via OpenAthens
- PROSPERO

Stage Three – Complementary searching

We also undertook a number of complementary searches (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 in Appendix 7. In addition, we also undertook citation searching of included primary studies that focussed 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 HS&DR 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

The inclusion of studies in the review was according to Table 1:

Screening criteria

Table 1 Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Population	Aged 65 years and older (older people). Frail older people.	Younger than 65 years

Criteria	Inclusion	Exclusion
	High risk older people	
Intervention	Interventions to identify older people who are frail or at high risk of adverse outcomes due to their frailty. Interventions to manage (frail) older people in the ED	Interventions that are delivered wholly outside of 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 which do not report an outcome of an intervention, for example, a study which reported only the mean age of people being treated in an Emergency Frailty Unit, would not be included. Qualitative evidence which reports on general experiences of ED care by (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. Where patients are admitted (for example medical assessment units, frailty units)
Study Type	Quantitative studies. Qualitative evidence. Publication Date 2005-2016.	Evidence from surveys of views/experiences e.g. of ED care more generally. Editorials. Opinions.

Criteria	Inclusion	Exclusion
	Published, peer reviewed evidence.	Non-English-language papers. Non OECD countries. Evidence published prior to 2005.

We limited the evidence included in our review to that published in the last 11 years (2005-2016). The reason for this was related to the volume of evidence in the area and the need to retrieve a manageable evidence base and also that earlier evidence would have been identified and included in the many evidence reviews published in this area. In addition, restricting the date ensures that the evidence included is relevant to the current clinical environment.

Notably the review does not state '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 a predefined criteria would be challenging. Had we included evidence from papers only where 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. Therefore we took the approach, at the screening stage, to include all studies where the population was aged over 65 and then at a later stage, further divide these into frail older people and a general population of older people

Screening process

Screening was undertaken by three reviewers (LP, AC and DC). All titles and abstracts retrieved by the search were entered into Endnote and Endnote was used for screening. All titles and abstracts were screened by one reviewer (either LP or AC) and DC screened 50% of the titles and abstracts screened by either LP or AC (i.e. 50% of all titles and abstracts). The decisions made about whether the article was an' include', 'exclude' or 'query' was 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 the intervention and whether 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. In order 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. 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 over 65). In addition, this classification allowed the review team to divide articles into two categories – those looking at the identification of frail older people, or older people at high risk and 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:

- Full data extraction for all studies on population groups defined as frail older people or older people at ‘high risk’ by the study authors Brief data extraction for all studies on a population of older people, normally aged 65+ without any specific risk criteria
- 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. Where 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.

Bearing in mind the complexity of 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 as described by study authors, but to also include older patients defined by study authors as high risk alongside frail patients. This approach was required partly due to the lack of clear definition in the literature about which groups were frail and which groups were all older people, whether the existence of a specific condition, for example, patients aged over 65 years with a fall, meant that they were considered to be frail and also, partly to do with the “embarrassing paucity of research into the needs of frail older people in general, and hardly any direct relevant research addressing 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 focussing 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 which targeted a general older population, aged 65+. This approach extends what was outlined in the review protocol. In the review protocol, the approach was that “where evidence exists for other elderly populations, this may be extracted into evidence tables (depending upon the volume of evidence retrieved) but not used in the evidence synthesis”. However, the review uses 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. Summary tables were created. These were used to inform the narrative synthesis presented in Chapter Four. Due to 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 frail or 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 of 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. Whilst formal quality assessment is appropriate within the systematic review process, to examine whether included studies may be at risk of bias, it is not required in a mapping review, as a mapping review does not interpret evidence in order to inform specific clinical questions or decisions. Indeed, use of a standard tool would not have been possible in this review, due to the diversity of study designs.

Rather than a formal quality assessment, we developed a bespoke assessment of the evidence base using three distinct methods.

- An examination of the research designs used and the strengths and limitations of those designs
- An examination of the self-reported limitations included in the articles relating to frail or high risk older people.
- 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 the ScHARR, three very experienced Professors of Emergency Medicine, who are also practicing 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 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, where reviews matched the inclusion criteria for this review, these data were extracted and review findings 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 only appropriate for a selected number of study designs, few of which were used by the studies reported in the review. 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 the section entitled Assessment of the evidence base.

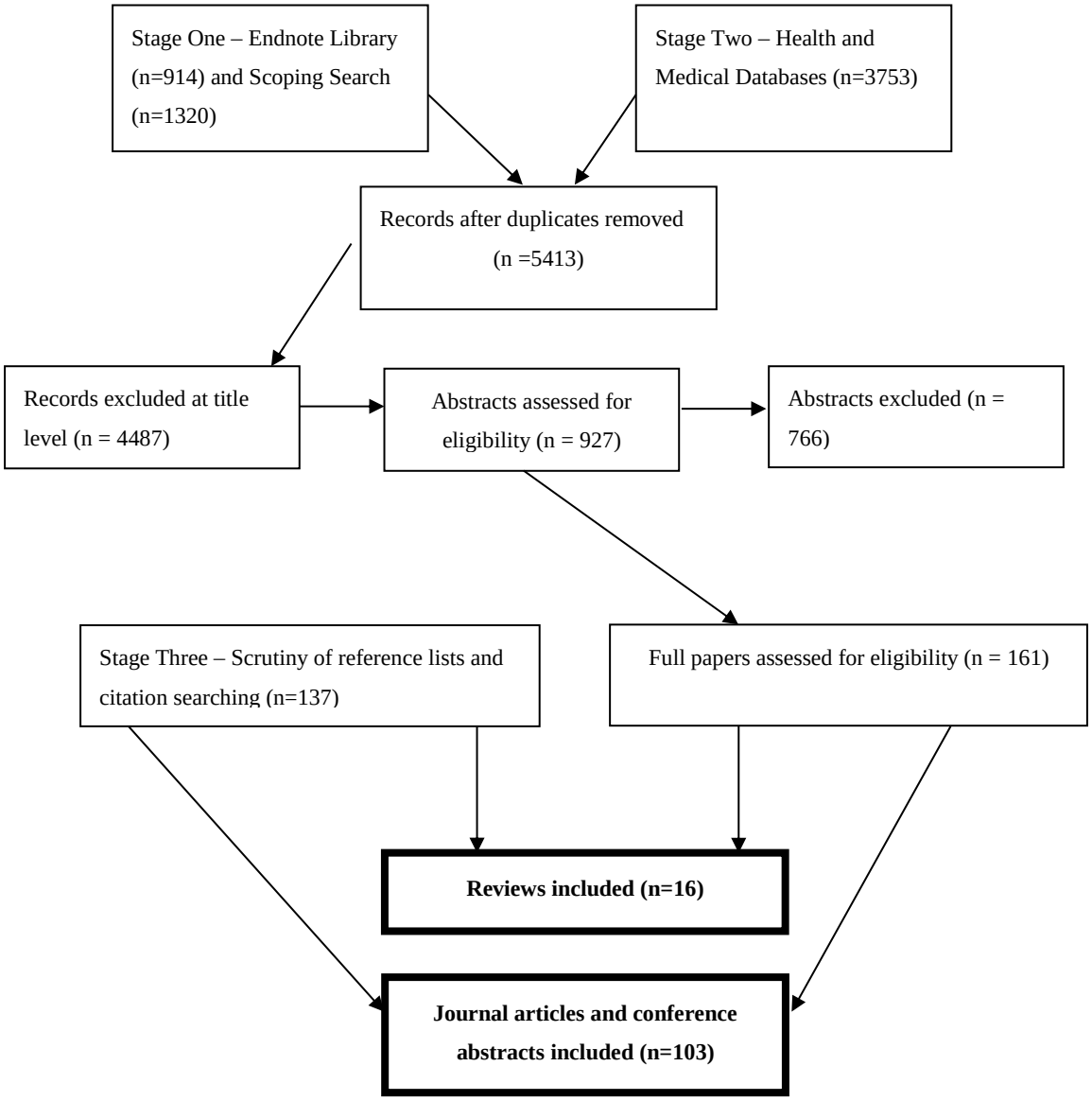
Chapter 3. Results - Included and Excluded Studies

Chapter 3 presents the studies that were included and excluded in the review. A PRISMA diagram (Figure 1) details the search process. The results from the double screening process are given, prior to details of included and excluded studies.

PRISMA

The full papers, conference abstracts and reviews identified as a result of the literature search are described in the following modified PRISMA diagram:

Figure 1 Modified PRISMA diagram



Second screening of retrieved references

A Kappa coefficient was calculated demonstrating good agreement between reviewers: K = 0.794, 95% CI, 0.665-0.929.

Studies included in the review

A total of 103 papers (full journal articles and conference abstracts) and 16 reviews have been included in the review. Further details on the characteristics of these studies are given in Chapter Four.

Studies excluded from the review

A list of the full text studies and conference abstracts excluded from the review at abstract level and the reasons for their exclusion is available in Appendix 2.

Chapter 4. Results of the review

Chapter Four presents the main results from the review.

- The overall evidence base
- Characteristics of included studies (identification of frail/at risk older people and service delivery innovations for this group)
- Narrative summary of the evidence
- Patient pathway diagram
- Assessment of the evidence base

Characteristics of the overall evidence base

One hundred and three articles, representing 95 studies are included in this systematic mapping review. Detailed data extraction tables of included studies are provided in Appendices 5, 6 and 7.

There were 61 full papers, 38 conference abstracts and four papers classified as 'other' (letters to the editor, editorials containing data).

Of the 95 studies reported in the 103 articles/conference abstracts, 33 were on a frail or high risk population and 62 had a population of older people.

Thirty seven studies reported on interventions to identify frail or high risk older people. These comprised of diagnostic tools to screen for frailty related issues (n=7), diagnostic tools to screen for frailty (n=7), prognostic tools to measure risk of adverse events in the ED (n=5) and prognostic tools to measure risk of adverse events on discharge (n=18).

Interventions to manage older people and frail older people in the ED were reported in 58 papers – 25 examined changes to ED staffing, 11 examine changes to the physical infrastructure of the ED, 19 examined changes to how care was delivered and other interventions were reported in 3 papers.

The majority of the studies were undertaken in the USA (27), the UK (15) and Australia (12). The UK studies were more likely to focus on frail or high risk older people (11 articles). Other studies were undertaken in Italy (7), Canada (6), Ireland (5), France/Hong Kong/Switzerland (3), Netherlands/Singapore/Spain/Sweden (2) and Belgium/Germany/New Zealand/South Korea/Taiwan/Turkey (1).

There was a wide number of study types 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 2 Study Designs

Experimental Studies	Observational studies	Unclear
RCT (6) Quasi RCT (1) Diagnostic Accuracy Study (5) Non randomised trial (1)	Medical record review (3) Observational (3) Before and After Observational Study (1) Prospective pragmatic (2) Retrospective observational (3) Prospective data analysis (3) Longitudinal (1) Retrospective cohort (9) Prospective cohort (28) Prospective Observational (8) Prospective comparative (1) Before and After Cohort Study (1) Retrospective Before and After Study (2) Before and After Prospective Study (8)	Action Research (1) Audit (1) Evaluation (2) Feasibility (2) Pilot project (1) Prospective Evaluation (1) Questionnaire (1)

	Cross sectional cohort (2)	

Table 3 highlights that the main group at which interventions were targeted was adults aged over 65 with no specific condition. A total of 23 papers included interventions that were aimed at groups that were aged older than 65, although some interventions were targeted at the over 65's with a specific condition, such as trauma or falls.

Table 3 Target age of intervention

Age category	n
65 and over	46
65 and over with trauma/acute condition	4
65 and over with fall/chronic condition	3
65 and over with positive diagnosis of 'at risk'	5
65 and over with chronic condition, 70/80 or over without	4
70 and over	6
72 and older	1
75 and older	11
75 and over, frail/ multiple comorbidities	2
80 and over with syndromes described as geriatric	2
85 and over	1
No age category	10
Total	**95**

Whilst 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 due to the incomplete reporting of data, it is possible to say that whilst interventions tended to be targeted at the over 65s (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 either related to identification of frail older people or changes to how ED services were configured or delivered. The classification of the service delivery interventions was based upon how studies were reported in the included articles and

the elements of service delivery that were researched. Fifty eight of the studies were 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	9
	Diagnostic tools to screen for frailty related issues	7	7
	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	25	26
	Changes to the physical infrastructure of the ED	11	12
	Care delivery and assessment interventions (CGA)	19	22
Miscellaneous	Various	3	3

Characteristics of included studies – screening

Thirty-seven studies (40 publications) dealt with strategies aimed at identifying patients with frailty or distinguishing higher risk 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 design[18] and one was a secondary analysis of data from a randomised trial.[19] Both these studies were conducted in the USA.

The largest group of studies came from the USA (12 studies) followed by Canada (5). Among European countries, the largest numbers of studies were performed in Switzerland (4) and Italy (3). The Netherlands (2) was the only other European country with more than one included study. Only one conference abstract study of a screening tool was included from the UK[20]. Outside Europe, studies were included from Australia, New Zealand (2 each), Turkey and South Korea (1 each).

Numbers of patients included in screening studies ranged from 69[18] to 2057.[21] Two other studies[22, 23] recruited over 1000 patients. Most studies recruited patients aged 65 years or older but the average age of patients actually recruited was considerably older, typically in the mid-70s or older (see data extraction tables in Appendices 5 and 6). The proportions of men and women included varied among the included studies.

Characteristics of included studies – interventions

Fifty eight studies (63 articles) examined changes made to how ED services were delivered to (frail) older people populations. These studies tended to comprise of either changes to the structure of the ED (11 studies), changes to staffing in the ED (25 studies) and changes to how care is delivered (19 studies), such as the introduction of Comprehensive Geriatric Assessment (CGA) or similar assessment type interventions. There were also a number of unique interventions (3 studies) 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.[24-26]

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

main health service outcomes were admissions, readmissions, ED reattendance and length of stay (LOS).

The largest group of studies came from the UK (14 studies) followed closely by the US (13 studies). There were also 10 studies that were undertaken in Australia, the rest being undertaken in Europe (France 2, Ireland 4, Italy 3, Spain 2 and Sweden 1) and worldwide (Canada, Singapore 2, Taiwan 1 and Hong Kong 3).

Most studies reported outcomes for patients aged 65 years or older (as these patients were considered to be 'older people' and therefore the target age for identification of frailty or at risk of adverse outcomes and service delivery interventions. However, when a mean age was reported, this tended to be over 75 (see Appendix 8 – more detailed reporting of age is not possible due to variable reporting in the included articles). The proportion of men and women included varied among the included 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 healthcare 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 the section below.

The screening process of the evidence identified for this review showed that screening tests were used on both populations of older adults aged over 65 and on populations that were already considered to be 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 identification of frailty or frailty related issues
- 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.

The main findings of the included studies of screening tools are discussed in this section. Further details of all the studies can be found in the data extraction tables (ces 5-7).

Diagnostic tools to identify frailty

We included seven studies (nine publications) (see Table 5) of diagnostic tools to identify frailty. 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 (Table 5). The Identification of Seniors at Risk (ISAR) tool was the only one to be evaluated in two studies.[27, 28] A diagnostic accuracy study[27] 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 ROC curve (AUC) 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.

Table 5 Summary of studies evaluating diagnostic accuracy of frailty screening tools

Study	n	Tool	Reference standard	Findings
Salvi[27]	200	ISAR	DAI	The ISAR had sensitivity 94% and specificity 63%. ISAR is a useful screening tool for frailty and identifies patients at risk of adverse outcomes after an ED visit as well as those likely to benefit from a geriatric intervention
Asomaning[28]	525	ISAR	N/A	Of 575 eligible patients, 271 (51.6%) were screened with the ISAR. Low compliance by staff was a barrier to implementation of ISAR
Boyd[29, 30]	139	BRIGHT	CGA	Successfully identifies older adults with decreased function and may be useful in differentiating patients in need of comprehensive assessment
Eklund[31]	161	FRESH	Frailty indicators	Both sensitivity (81%) and specificity (80%) of FRESH were high. FRESH is simple and rapid to use, takes only a few minutes to administer and requires minimal energy use by the patient

Study	n	Tool	Reference standard	Findings
Wall[20]	118	Clinical frailty score (CFS)	Validated frailty scales	Analysis of ROC curves showed that the CFS accurately identified frail patients when 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[32]	300	ED Screening Tool	Safety management screening bundle	The screening tool has a moderate validity compared with the screening bundle and can identify most older ED patients at high risk of adverse outcomes
Schoeneberger[22, 33]	1547	EGS	ED diagnosis	Introduction of the tool was associated with an increase in the detection of potentially overlooked geriatric problems. Adaptations to enhance feasibility and to ensure clinical benefit are needed

ISAR = Identification of Seniors at Risk; BRIGHT = Brief Risk Identification for Geriatric Health Tool; FRESH = N/A; EGS = Emergency Geriatric Screen; CFS = Clinical frailty score

Other screening tools have been evaluated in single diagnostic accuracy studies. The BRIGHT (Brief Risk Identification for Geriatric Health) tool, 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] Limitations of this study, identified by the

authors, include that this 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. 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) specifically designed to screen for frailty.[31] FRESH was evaluated using a range of frailty indicators as reference standard 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 only been evaluated in one small study to date (n = 161) and the data were not collected during the ED visit but during a subsequent visit to the patient at home.[31]

Finally, of three diagnostic accuracy studies only published 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 limited.

The other two conference abstracts evaluated an ED screening tool[32] and an Emergency Geriatric Screen (EGS).[22, 33] The ED screening tool performed well, with an 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 diagnostic accuracy of tools for identifying frail older people is limited. None of the tools have 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 the relevant section below.

Diagnostic tools for 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 MMSE 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, 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 6-item screen/test and TRST (triage risk screening tool). Instead, repeat screening with the SIS was used to confirm whether patients met 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 et al. discussed above[28] in identifying potential problems in administering screening tools in normal clinical practice.

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

Study (issue)	n	Tool	Reference Standard	Findings
Carpenter[18] ('geriatric syndromes')	69	MMSE/Confusion Assessment Method (CAM)	N/A (RCT of screening)	Screening did not appear to influence the

Study (issue)	n	Tool	Reference Standard	Findings
				decisions made by physicians
Carpenter[35] (cognitive dysfunction)	169	Ottawa 3DY, Brief Alzheimer's Screen, Short Blessed Test and caregiver-completed AD8	MMSE	Brief screening instruments such as the SBT can rapidly identify patients at lower risk of cognitive dysfunction
Carpenter[36] (cognitive dysfunction)	371	6-item screener (SIS) and AD8	MMSE	The SIS was superior to the AD8 for identifying older adults at increased risk of cognitive dysfunction
Eagles[37] (impaired mental status)	260	Ottawa 3DY	MMSE	Ottawa 3DY is a simple screening tool which has been shown to be feasible for use in the ED
Hadbavna[34] (cognitive impairment)	117	TRST and 6-item screener	N/A (repeat test?)	A high proportion of older patients attending ED met criteria for cognitive impairment. There was considerable variation in the implementation of the screening instruments

Study (issue)	n	Tool	Reference Standard	Findings
				between nurses, despite training
Wilber[38] (cognitive impairment)	352	6-item screener	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[39] (cognitive impairment)	150	6-item screener 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

MMSE = Mini Mental State Examination; SIS = Six item screener; TRST = Triage Risk Screening Tool

Prognostic tools for adverse events within the ED

We included five studies evaluating the accuracy of screening tools to assess 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 the patient was in hospital with the exception of one study that had a 30-day follow-up.[40] This study 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.

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 comprised six items and the authors concluded that a history of falls, male gender, cognitive impairment and age under 85 years identified patients at increased risk of a long hospital stay (13 days or more). The authors noted that this group of patients would require geriatric care and planning for discharge. Further evidence on management of patients following geriatric assessment in the ED is presented elsewhere in this report.

The other studies in this group evaluated tools for predicting risk of hospital or intensive care unit (ICU) admission, or need for an immediate life-saving intervention. Emergency Severity Index level 1 had low sensitivity (46.2%) but high specificity (99.8%) for predicting 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 need for life-saving intervention.[23] The results of a Turkish study evaluating the Rapid Emergency Medicine Score (REMS) and HOTEL (Hypotension, Oxygen saturation, low Temperature, ECG changes and Loss of Independence) 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.

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

Study	n	Tool	Follow-up	Findings
Beauchet[41]	424	Brief geriatric assessment	In hospital	The combination of a history of falls, male gender, cognitive impairment, and age under 85 years identified older ED patients at high risk of a long hospital stay
Dundar[43]	939	REMS/HOTEL	In hospital	The REMS, REMS without age and HOTEL scores cannot be used to identify geriatric ED patients requiring hospital admission but they are of value for predicting in-hospital mortality and intensive care admission
Grossman[42]	519	Emergency Severity Index	In ED	Emergency Severity Index level showed good validity with resource consumption, disposition, ED length of stay, and survival.
Kennedy[40]	700	Delirium prediction rule	30-days	Delirium prediction rule had good predictive accuracy (area under the receiver operating characteristic curve = 0.77).
Lee[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

REMS = Rapid Emergency Medicine Score; HOTEL = Hypotension, Oxygen saturation, low Temperature, ECG changes and Loss of Independence); CTAS = Canadian Triage and Acuity Score.

Prognostic tools for adverse events after discharge

Eighteen studies (19 publications) assessed the ability of screening tools to predict adverse outcomes following a patients' discharge from the ED (Table 8). The studies evaluated a wide range of different tools, with follow-up ranging from 28 days to 12 months. The ISAR and TRST tools were most commonly evaluated (eight studies), while another study[44] evaluated a tool derived from ISAR. None of the included studies were performed in the UK. Four studies were published as conference abstracts only.[45-48] These studies are presented below in Table 8.

Table 8 Summary of prognostic studies of screening tools (follow-up after ED discharge)

Study	Tool(s)	Follow-up	Findings
Studies of ISAR			
Hegney[44] (n=2139)	Screening tool adapted from the 'Screening Tool for Elderly Patients' which in turn was developed from ISAR	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[49] (n=200)	ISAR	6 months	ISAR was a reliable and valid predictor of death, long-term care placement, functional decline, ED revisit or hospital admission at 6-month follow-up
Singler[50] (n=520)	ISAR	28 days	ISAR with a cut-off score of ≥3 is an acceptable screening tool for use in German EDs
Studies of TRST			
Fan[51] (n=120)	TRST	120 days	The TRST cannot be used as a single diagnostic test to predict whether Canadian ED elders will have an ED

			revisit, hospital admission, or long-term care placement at 30 or 120 days.
Hustey[19] (n=650)	TRST	120 days	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[52] (n=788)	TRST	12 months	The TRST demonstrated only moderate predictive ability, and ideally, a better prediction rule should be sought.
Studies comparing ISAR vs. TRST			
Carpenter[45] (n=225)	ISAR and TRST	3 months	Neither the ISAR nor the TRST distinguish older ED patients at high or low risk for 1- or 3-month adverse outcomes
Graf[53, 54] (n=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[21] (n=2057)	ISAR and TRST	6 months	Risk stratification of older ED patients with ISAR or TRST is substantially comparable for selecting older ED patients who could benefit from geriatric interventions. ISAR had slightly higher sensitivity and lower specificity than TRST
Studies comparing several tools			

Buurman[55] (n=381)	ISAR, TRST, Runciman, Rowland	120 days	None of the screening tools were able to discriminate clearly between patients with and without poor outcomes
Moons[56] (n=314)	ISAR, TRST, Runciman, Rowland	90 days	Repeat visits in older persons admitted to an ED seemed to be most accurately predicted by using the Rowland questionnaire, with an acceptable number of false positives. This instrument can be easily integrated into the standard nursing assessment.
Studies of other tools			
Baumann[57] (n=929)	ESI (Emergency Screening Instrument)	1 year	When used to triage patients older than 65 years, the ESI algorithm demonstrates validity. Hospitalization, length of stay, resource utilization, and survival were all associated with ESI categorization in this cohort
Di Bari[58] (n=1632)	ISAR, Silver Code	6 months	Prognostic stratification with the SC is comparable with that obtained by direct patient evaluation.
Dziura[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[47] (n=504)	Timed up and go (TUG)	6 months	TUG scores were associated with frailty, functional decline and fear of falling. TUG scores were associated

			with falls at the initial ED visit but not predictive of falls at 3 or 6 months
Post[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 risk of ED readmission within 30 days
Stiffler[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[60] (n=397)	2-item screening tool (falls)	6 months	The 2-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

ISAR = Identification of Seniors at Risk; TRST = Triage Risk Screening Tool; ESI = Emergency Screening Instrument; TUG = Timed up and go; GRAY = Geriatric Readmission Assessment at Yale; SHARE-FI = Study of Health, Aging and Retirement in Europe Frailty Instrument

The ISAR tool was developed in Canada in the 1990s.[61] 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 or more (i.e. positive answers to two or more items) is the normal cut-off for being considered high-risk. Two studies in this review evaluated the ISAR alone for screening older patients in the ED.[49, 50] Both studies concluded that ISAR was a valid and reliable screening tool in their setting. Singler et al.[50] used a cut-off of ≥3 rather than ≥2 in their study, which would have the effect of increasing 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.

TRST is a risk screening tool designed to be applied to patients aged 75 years or older in the ED. Like ISAR it comprises six items and a score of ≥2 indicates high risk. Three studies in the review evaluated 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 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 TRST evaluated alone is limited and mixed.

While evaluation of single screening tools appears most feasible for delivery in the ED and least burdensome for the patient, many studies have compared two or more tools using the same sample of patients. Three studies compared the ISAR and TRST tools. 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. emphasised use of the screening tools to select patients who could benefit from geriatric interventions, while Graf et al. favoured their use to avoid unnecessary intervention. By contrast, a US study[45] 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 Rowland and Runciman questionnaires.[55, 56] Moons et al.[56] highlighted the value of the Rowland questionnaire for predicting repeat ED visits, while 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, 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 ESI[57], rapid screening assessment[46] and SHARE-FI[59] are short question-based tools similar to those discussed above. Eagles et al. [47]evaluated the timed up and go (TUG) test 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: falls[60] 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 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 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 potentially tools using administrative data. Limitations of the included studies include small sample sizes, most were conducted at a single centre and many were published as conference abstracts with limited details. Contradictory results obtained in different prognostic studies with 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 results of studies performed in one country cannot be readily generalised to another. 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 which 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 over 65. Differentiating between the groups at whom interventions were targeted was often difficult. Data extraction tables for these service delivery interventions are available in Appendices 5 and 6.

Overall, the intervention reporting was highly descriptive, 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.

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

- ED staffing initiatives (23 studies reported in 26 articles)
- Changes to the physical infrastructure of the ED (11 studies reported in 12 articles)
- Care delivery interventions (19 studies reported in 22 articles)
- Other interventions (3 studies reported in 3 articles)

ED staffing initiatives

We identified 23 studies (26 publications) where the staffing of the ED had been modified in order to better meet the needs of an older population. These staffing modifications varied – there were examples of initiatives where a single individual was located in the ED or added to an existing multidisciplinary team (MDT) or where a new MDT was established. Differentiating between staffing initiatives and care initiatives (for example where 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 on these interventions are given in Table 9.

Table 9 Staffing interventions

Intervention	Staff	Frail	General
Staffing initiatives – individual	Admissions avoidance geriatrician	[62, 63]	
	Aged care pharmacist		[64]
	Clinical Pharmacy Specialist		[65]
	Emergency Department Care Co-ordinators		[66]
	Geriatric nurse practitioner		[67]
	Nurse liaison	[68, 69]	
	Aged care nurse liaison	[26]	
	Triage nurse		[70]
	Geriatric Nurse Liaison		[71]
Staffing initiatives – team	Geriatric Medicine Liaison	[72]	
	Assessment Team for Older People	[73]	
	Aged Care Service Emergency Teams	[74]	
	Geriatric Liaison Team	[75]	
	Frail intervention therapy team	[76]	
	Care Co-ordination Team (falls)		[77]
	Care Co-ordination Team (general)		[78, 79]
	Allied health staff (falls)		[80]
	MDT care coordination team		[81]
	Mobile geriatric team		[82, 83]
	Care Co-ordination team		[84]
	Acute Care for the Elderly Service	[85]	
	Patient Liaison Service		[86]

Individual initiatives

We identified nine studies (across eleven articles) of interventions where a single clinician was introduced to the ED setting or added to an existing team. A variety of different clinicians were introduced – geriatric consultants, pharmacists, nurses and other roles such as emergency department care co-ordinators.

Jones[62] and Wallis[63] 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 in medication advice and follow up planning. Outcomes for this intervention were broadly positive when compared with 'hospital averages' However, the authors caution that reducing admissions in 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.[87] Emergency Department Care Co-ordinators (EDCCs) aimed to reduce admission rates through better linkages with homecare and community services. The study did not show any difference in any outcomes measured (admission rates, revisit rates or readmission rates) between those who received the EDCC intervention and those that did not, although the design of the study may have contributed to this.

Two studies reported on the role of a geriatric pharmacist.[64, 88] A prospective evaluation of an aged care pharmacist was undertaken by Mortimer et al.[64] The aged care pharmacists role was in examining medication history, reviewing medication orders and liaising with medical staff about medication related issues. Comparing the aged care pharmacist patients to a control group who received usual care, the aged care pharmacist was effective in reducing medication errors when compared with the control group, was an acceptable intervention to the patients and were no different in terms of re-presentation following discharge. Shaw et al[65] 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[67] reports on a geriatric nurse practitioner to provide specific care to older people, a pilot study that showed positive outcomes. As part of the wider GEDI-WISE programme, one of the innovations was to develop the geriatric assessment and care-coordination skills of ED nurses, as reported in the study by Aldeen.[68] 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 due to underlying problems being identified). Length of stay in the ED was increased for patients seen by the nurse. Basic[26] reports on a randomised controlled trial on an intervention for high risk older people of 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) – 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[70] reported 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. Whilst the outcomes of these patients are unknown, the study identifies characteristics of the frail older population and suggests that geriatric AMAU's may better meet their needs.

Dresden[71] undertook a prospective cohort study of a geriatric nurse liaison intervention (GNLI) of a nurse who delivered assessment and care-coordination in the USA. The GNLI group (n=829) had significantly improved outcomes, when compared with the control group (n=873) in hospitalisation, 30 day readmission rates and length of stay. However no data was collected past 30 days and no information on ED recidivism was collected.

Team initiatives

Staff interventions also took the form of initiatives that involved the establishment of new multidisciplinary teams for older patients. For frail or high risk patients, six interventions were identified.

Three papers reported findings from an Australian study which established a Care Coordination Team (CCT) to deliver comprehensive allied health assessment/intervention to

older patients to improve patient outcomes. The CCT comprised of a minimum of one physiotherapist, occupational therapist and social worker, all of whom had geriatric experience. The intervention comprised of functional assessment to identify patients' needs and direct them to appropriate care and services and further details are given in Table 10.

Table 10 Care coordination team interventions

Study and type	Sample characteristics and size	Outcome measured	Results
[79] Matched pairs study	High risk patients (locally developed screening tool) 2196 patients (1098 intervention, 1098 matched control)	28 day ED reattendance, readmission and mortality	No difference in mortality between the intervention and control groups, the intervention group had slightly increased ED reattendance rates and a much higher risk of hospital readmission when compared with the control group.
[78]Non-randomised prospective pragmatic study	Over 65 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 h) on unadjusted (log-rank p 0.28) or adjusted (IRR 0.97, p 0.32) analysis.

[84] Prospective, non-randomised.	Over 65 with one of ten common complaints 5265 patients (3165 intervention, 2100 control)	Admission to inpatient beds	72.0% for intervention and 74.4% for the control group - borderline statistical significance (p = 0.046, OR 0.88 (0.76=1.00)).

The work of the CCT in the same setting was reported by Harper et al[77] 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 reports the changes over three years since the introduction of the CCT and regression modelling demonstrated a decrease in representation 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.[80] 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 over 80 were referred to an Emergency Department Geriatric Medicine (EDGM) liaison service in a pilot study undertaken in Ireland.[72] An MDT approach to assessment, led by a senior geriatrician, dealt with 285 patients over a nearly three year period. Whilst study numbers were relatively small, analysis was undertaken on the data collected and found that mean length of stay was significantly shortened for the EDGM patients, when compared with usual care. This did not adversely affect repeat attendances or readmission rates.

An Assessment Team for Older People (ATOP) was established in a UK hospital to meet the needs of an increasingly frail population.[73] The focus of the team was to provide CGA to patients with two or more markers of frailty, not simply on age alone. The ATOP team consists of a geriatrician, six senior nurses, a senior social worker and assistant, a senior

occupational therapist and assistant, and a healthcare assistant. The aim of the ATOP is to prevent admissions and in the four months of the study, 178 admissions were prevented in patients that 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".[73]

Seven studies 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[74] examined these discordant cases – i.e., cases where ASET had recommended the admission of patients that were considered suitable for discharge by the ED. The study looked at what additional evidence was measured by the ASET team and found that they were more likely to measure functional, cognitive and mobility impairments as well as identifying acute medical conditions. The data collected was largely qualitative and did not have a comparator; however the study demonstrated the additional information that might be useful when planning discharge or admission of frail older people patients.

A conference abstract of a UK study from the John Radcliffe Hospital ED[75] reports findings from a newly established Geriatric Liaison Team undertaking CGA. Limited data reported indicated that over six months, and for the 35 patients studied, length of stay was reduced by 4.8 hours.

An intervention targeted specifically at frail older people was reported by O'Reilly.[76] The Frail Intervention Therapy Team (FITT) combined allied health professionals to identify all frail patients who present 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 wards in less than nine hours.

The formation of a Care Coordination (CC) program in 2005 in Australia was reported by Corbett et al.[81] This multidisciplinary team, with an emphasis on allied health professional

input, was set up to reduce avoidable admissions and inappropriate representations to the ED. Positive study outcomes confirmed a statistically significant reduction in the proportion of patients admitted as well as improvements in mean quality of life score and user satisfaction following the introduction of the CC program.

A brief report of a Mobile Geriatric Team (MGT) was provided by Launay et al.[82, 89] The intervention comprised 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 = 4.38, p = .046).

An Acute Care of the Elderly (ACE) service was developed which focussed on the establishment of a team (consultant, junior doctor and nurse) to deliver CGA to patients over 80 with complex problems or frailty.[85] Data from 10 months of the service show 459/662 inappropriate admissions were avoided.

A patient liaison service to better meet the needs of the older patient was evaluated and reported by Berahman.[86] with the main outcome of the study being the measurement of patient satisfaction with the patient liaison service Comparing the patient 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 be focused on improving processes and outcomes in medication management (whether they were delivered by a pharmacist or other clinician) and improving care coordination, 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 in order for care to be focused on the frail older person, a variety of healthcare professionals need to be included. There were fewer similarities across all of the studies in the outcomes that were being assessed, although avoiding admissions and mortality were more frequently measured.

Physical infrastructure changes

Eleven studies (12 articles) reported changes to the ED in terms of the physical infrastructure of the ED. These interventions range from the creation of Geriatric Emergency Departments (which will also have included changes to staffing), through to making ED's 'frail friendly', through general changes to the ED which will benefit all patients, but have specific benefits for frail and older people or the establishment of specific units on the ED to meet the needs of frail and older patients. These papers are presented in Table 11.

Table 11 Physical infrastructure changes

Details	Frail	General older
Staff and structural changes	90	
Geriatric/Frail Friendly Units	91-93	
GED/Senior ED	94	95-98
Rapid Access Centre in the ED		99
GED incorporating GEDI WISE		100, 101

A UK study by Silvester et al[90] reported on the redesign of the system of care for older people. This consisted of the formation of an MDT with a clinical systems engineer who facilitated changes in discharge, seven day working and the designation of a medical assessment unit as a Frailty Unit with a co-located MDT. Analysis of data over two 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 is the evaluation of the Acute Care for Elders (ACE) unit, reported on by Ellis.[92] The four bedded ACE unit undertook CGA with the aim of admissions avoidance or direct specialty admission. The study was a non-randomised trial comparing three groups of patients; patients admitted before the ACE unit was set up, patients admitted to the ACE unit and 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 seven 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.[93] The study was a before and after study, the outcome measures were admission rate from the ED, readmissions following an ED visit, LOS 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 coordinators'. Analysis of the pre and post intervention data indicated that whilst there was a pattern of increased ED attendances over the period of the study, admission rates fell by a significant amount 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 was collected.

Salvi[94] reports 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 that had used a conventional ED, the patients using the GED had a small but significantly lower mortality rate.

Pareja-Sierra[91] describes the impact of an Emergency Department Observation Unit (EDOU) on admissions and length of stay. The EDOU is a small, six bed unit staffed by geriatricians, targeted at frail older people. The author compared data from before and after the EDOU was set up. Whilst data were limited, the authors reported that an initial increase in admissions was followed by a decrease in admissions and LOS.

Genes et al[95] reported on patient satisfaction with a geriatric ED (GeriED), which 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 GeriED was established, the authors found that whilst overall satisfaction scores did not

change significantly for either group, the geriatric group saw significant improvements in satisfaction relating to specific aspects of the GeriED.

Admissions data were analysed following the introduction of a geriatric ED by Karounos et al.[96] Examining data from pre and post introduction of the GED, there were significantly fewer admissions (2.9% fewer (n=1130), $p < 0.001$). This was a large data set (n=27838), although the authors caution that further analysis on readmissions and costs is required.

Keyes[97] also looked at admissions, length of stay and ED visits following the introduction of a Senior ED and compared data from before the Senior ED was introduced. The Senior ED comprised of 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 6 bed consultant led ward was introduced to a hospital in the UK in an intervention reported by Tang et al.[99] Data on admissions from the RAC was compared with admissions via the ED for two seven month periods before and after the introduction of the RAC. Simple data analysis on data from 441 patients showed patients admitted from the RAC had shorter LOS and were discharged earlier.

Ng[100, 101] reported on a GEDI WISE intervention, the introduction of a geriatric ED 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.

A Senior ED reported on by Wilber et al[98] was a 15 bed unit, with assessment by a nurse care coordinator, 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 in the outcome of admissions, which significantly decreased (55.5% to 51.2%, difference -4.3, 95% CI -7.2 to -1.4). 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 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 which describe and evaluate changes to the whole care package that is delivered to (frail) older people within the ED. The interventions reported in this section take the form of Comprehensive Geriatric Assessment, which combines interventions to identify frail or at risk older people and 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 multidisciplinary team to establish an elderly person's medical, psychological and functional capability, so that a plan for treatment and follow-up can be developed".[102]

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 19 CGA studies (22 publications) included in this review are given in Table 12.

Table 12 Comprehensive Geriatric Assessment interventions

ID (type) Name of the intervention , Who delivers it, Where is it delivered	Type of study Sample size	Outcome measure	Results (only given where the results are significant)
[103] (Frail) CGA Interface Geriatrician ED	Service evaluation 534 patients	Admissions avoidance	Not significant.
[104] (Frail) CGA Geriatrician ED medical short stay unit	Prospective 1200 patients	Admissions avoidance	Not significant
[105, 106] (General) CGA Geriatric Team ED	Prospective cohort 137 (26 intervention)	Admissions ED revisits	Significant results. Intervention - more likely to be admitted (50 vs. 22%) and fewer visits to the ED within 1 (0.81 vs. 1.75 visits) and 6 (2.2 vs. 4) months.
[107-109](Frail) CGA OPAL team ED and Clinical Decisions Unit	[107] – Service evaluation 148 patients	LOS Admissions	Not significant
	[108] - Service evaluation 990 (plus age matched controls)	LOS Admissions	Not significant.

ID (type) Name of the intervention , Who delivers it, Where is it delivered	Type of study Sample size	Outcome measure	Results (only given where the results are significant)
	[109] – Service evaluation Not given	Admissions LOS 4 hour ED target	Not significant
[110] (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
[111] (Frail) CGA Embedded Geriatrician ED	Retrospective feasibility Study 168 patients	LOS Discharge rates Admission rates	No control group.
[112] (General) ISAR plus CGA ED	Prospective Data Analysis 300	ED reattendance	Not significant
[113, 114] (General)	Retrospective	Admissions avoidance	Not significant

ID (type) Name of the intervention , Who delivers it, Where is it delivered	Type of study Sample size	Outcome measure	Results (only given where the results are significant)
'We Care' CGA ED	2202 patients		
[113, 114] (General) 'We Care' CGA ED	Retrospective 1096 patients	Admissions avoidance	Not significant
[115] (General) Synthesised Geriatric Assessment ED	Pilot observational convenience study 25 patients	Time taken to complete SGA	N/A
[116] (General) CGA Social Health Triage Team	Prospective cohort study 226 patients	Admissions avoidance	N/A
[117] (Frail) TRST, assessment, intervention	Quasi RCT 780 (280 intervention and 500 control)	Change in functional status (3,6,9, 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.

ID (type) Name of the intervention , Who delivers it, Where is it delivered	Type of study Sample size	Outcome measure	Results (only given where the results are significant)
[25] (Frail) ISAR, intervention CGA type intervention Not given	RCT then Cohort study RCT 1279 Cohort 1820	Composite outcome of institutionalisation; hospital admission within 1 month; early return or frequent visits to ED; or death	
[118] (General) Screening, intervention ED	Retrospective cohort 8519	ICU admissions rate	Over 29 month study period, unadjusted ICU admissions rate declined from 2.3 to 0.9%. Adjusting for age, sex, ESI score and others, decline was still significant (beta -0.0073/ 95% CI -0.0105, -0.0041/ p<0 001)
[119] (Frail) ISAR screening , Intervention	Evaluation research	LOS ED returns Hospital admissions Multiple ED returns/admissions	Reported qualitatively

ID (type) Name of the intervention , Who delivers it, Where is it delivered	Type of study Sample size	Outcome measure	Results (only given where the results are significant)
		following the index episode	
[120] (General) Geriatric nurse liaison assessment	Prospective before and after 477 (315 intervention and 172 control)	ED reattendance Hospitalisation	Intervention - less ED re-attendance (adjusted incidence rate ratio (IRR) 0.59, 95% confidence interval (CI) 0.48–0.71) and lower 12 month hospitalisation (adjusted IRR 0.64, 95% CI 0.51–0.79)
[24] (Frail) Continuum of care ED and Community	RCT 76 control and 85 intervention	Functional ability Frailty	Improved degree of ADL independence at 3 and 12 months (OR = 2.37 intervention and OR = 2.04 control). No differences between groups with regards to changes in frailty
[121] (General) Screening, discharge/admission, follow up ED	Pilot project – chart review 894 patients	Not stated	Not significant

ID (type) Name of the intervention , Who delivers it, Where is it delivered	Type of study Sample size	Outcome measure	Results (only given where the results are significant)
[122] (General) TREAT (geriatrician, CGA, discharge support) ED	Before and after retrospective cohort 5,416 before and 5,370 after, with 593 geriatric admissions	Admissions LOS	Median LOS for intervention reduced by 2 days and mean LOS by 18.6% (1.78 days, P<0.001). Control - median was unchanged and mean LOS reduced by 1.08% (0.11 days, P=0.065). Intervention - percentage of admissions resulting in same-day discharges increased from 12.26% to 16.23% (OR: 1.386, (95% CI: 1.203-1.597, P<0.001) following the introduction of TREAT. Control - same-day discharge fell from 15.01 to 9.77% (OR: 0.613, P,0.001, 95% CI: 0.737-0.509).

Ismail[103] 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 of CGA delivered by an Older People Assessment and Liaison (OPAL) team in Manchester were evaluated.[107-109] 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 to age matched controls or patients not given CGA by OPAL. A similar evaluation of CGA OPAL[110] elsewhere in the UK reported similar, improved patient outcomes, although these were also non-significant.

A study undertaken in Taiwan [105, 106] 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 were reported in five studies. Beine[112] reported on the use of ISAR to screen patients who then received a CGA intervention if they were at risk. 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[117] reported on a quasi RCT undertaken in Singapore which had functional status as its primary outcome measure. Despite the fact that the intervention group were frailer than the control group, there was a significantly better outcome in functional preservation at 12 months, when compared with the control group. There were also improvements for the control group in avoiding admissions and ED reattendance but these were not significant. Yim[25] developed a Hong Kong version of ISAR to screen then deliver a CGA type intervention to those identified as high risk. High risk patients were identified through a cohort study of the Hong Kong ISAR, then patients were randomised to the intervention or control. Limited information on the methods for the RCT were given and there were no significant differences between intervention and control groups in any of the individual or composite outcomes. Grundzen[118] reported on an intervention which combined screening to identify patients in need of an intervention to prevent inappropriate admissions

and ensure 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" was described by Warburton[119] in a 2005 study from the USA . The aim of Elder Alert was to develop a strategy to identify and manage high risk ED patients aged over 75. This comprised screening patients using ISAR. 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 are projected by the evaluation.

The Hong Kong based "We Care" CGA programme[113, 114] delivered CGA with the aim of admissions avoidance. The authors reported positive results with only 15% of patients admitted, however they did not compare this to any other admissions data.

Limited evidence from Ngyuen et al indicated that a self-administered intervention, Synthesised Geriatric Assessment[115] was feasible as it was completed within 20 minutes (n=25 patients) and Lo Storto et al[116] reported on the introduction of a Social Health and Triage Team (SHT) to deliver CGA and found that inappropriate admissions were avoided, although data to confirm this finding were not provided.

Three studies reported discharge interventions, which was a smaller number than anticipated. Foo et al[120] reported an intervention where 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 had substantial post ED follow up were reported in three studies. Eklund[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 multi professional team. The

outcomes studied were frailty and ADL and the intervention demonstrated improvements in ADL as compared to control, but there were no differences in frailty scores.

O'Mahoney[121] examined an intervention where patients were screened by nurses for palliative care triggers and if they screened positive, were delivered an intervention which consisted of assessment of needs, consultation and follow up. Whilst results were not significant, there were small reductions in LOS which were attributed to better links with homecare services.

The UK Triage and Rapid Elderly Assessment Team (TREAT) intervention, comprising of assessment, CGA, pre and post discharge support was reported in a before and after cohort study by Wright et al.[122] This complex intervention saw improvements in a number of outcomes. Median and mean LOS were significantly reduced. Same day discharges significantly increased for those who had been given the TREAT intervention.

To summarise the evidence describing CGA and CGA type interventions, the evidence base for these 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 was provided by study authors and most of these interventions measure outcomes in terms of either admissions avoidance or ED reattendance. Only one study focussed on patient outcomes alone (ADL and frailty). There appears to be a general trend for these interventions to improve admissions avoidance. Notably there is 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.

Table 13 Other interventions

Detail	Frail	General
Silver Code to reduce waiting times	[123]	
TUGT assessment to identify 'at risk' falls patients	[124]	
Prescribing decision support to reduce prescribing errors		[125]

Terrel[125] reported an RCT from the USA of a computer aided decision support to reduce prescribing errors for older people by reducing potentially inappropriate medicines (PIM) prescribed 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 PIM significantly decreased from 5.4% to 3.4%.

A screening intervention to identify patients at a high risk of falls[124] and a screening intervention to reduce waiting times[123] were identified. Huded[124] reports on the use of the Timed Up and Go Test (TUGT), performed on 443/1135 patients evaluated by a geriatric nurse. These patients had not presented with falls but those who screened positively were referred to fall prevention interventions.

The Silver Code prognostic tool[123] was demonstrated to have reduced waiting times for the frail older people. Upon 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 had 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 (doctors, nurses or pharmacists) working in the ED or the development of a geriatric MDT. These roles tended to be in care-coordination, 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 with a change in staffing alongside.

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 lack of community follow up from the ED intervention.

Evidence from MDT type interventions largely showed beneficial outcomes in reducing avoidable admissions and improving early discharge rates from the ED. The care coordination team interventions had mixed results, with a borderline improvement in reducing avoidable admissions in one reported study,[79] but higher risk of ED reattendance and a much higher risk of hospital readmission in another.[84]

Structural changes to the ED took the form of the development of geriatric ED's (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. There were a number of UK studies reported in this category, with largely positive outcomes in 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 that described CGA and assessment interventions in the ED, seven reported results that had statistical significance. These results were again highly variable but there was a general trend to improved outcomes in admissions avoidance.

Narrative summary of relevant systematic reviews

There have been a number of systematic reviews (and other review types) which have examined interventions delivered in the ED to frail and older people. Sixteen reviews are presented below. Summary tables of data from these reviews are available in Appendix 7. As

with the primary research papers, these have been divided into sections reporting studies on identification of frail/high risk populations and, service delivery interventions.

Identification of frail or at risk older people

The review by Sutton[126] focused on screening tools to identify older patients, presenting to emergency departments, who are at risk of functional decline. Five separate screening tools were identified – HARP, ISAR, TRST, COMPRI and SHERPA. None of these tools were recommended as a gold standard screening tool. Thiem[127] also examined the same five tools, plus the Index of Functional Decline. Thiem found that, even though the ISAR 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 caution 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[128] examined six screening tools used at triage of older patients to identify those at risk. These tools comprised of three 'general' tools (Manchester Triage, Emergency Severity Index and the Canadian Triage and Acuity Scale) and three specific tools (ISAR, TRST, VIP). The review found that the ISAR and TRST performed best, with good sensitivity, high negative predictive value, low specificity and low positive predictive value. The VIP had low sensitivity. The review cautions 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[129] 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 and FSAS-ED). The review examined the validity of the tools, rather than their outcomes and found that the ISAR and TRST were most suitable for fast screening and the OARS and FSAS-ED for comprehensive screening.

The review by Yao[61] looked at ISAR only, in terms of its predictive validity in identifying adverse outcomes for older patients following ED visits. Looking at ten studies they found

that ISAR is quick to use and inexpensive, which recommends it for use, however, although it was found to have value in identifying high risk patients as frail, it has poor, or poor-fair predictive validity for adverse health outcomes for patients discharged from the ED.

The review by Carpenter[130] looked at what might predict short term adverse outcomes in geriatric ED 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, Rowland and Runciman. Various predictors of vulnerability were also considered. The review found that adverse outcomes often occurred post discharge 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 – ISAR 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[131] examined screening and service delivery interventions to better manage this population in the ED. Finding that the contextual details and characteristics of interventions were poorly reported, no interventions were found that were effective and the screening tools identified were inconsistently used and therefore difficult to measure effectiveness.

Schnitker[132] also examined evidence for interventions for cognitively impaired older people and identified 12 studies of their management in the ED. These 12 studies were categorised into four groups – those designed to improve recognition of cognitive impairment (and subsequent provision of care), those designed to prevent delirium, those to manage

behavioural or psychological symptoms and ‘other interventions’. They propose the routine inclusion of screening and assessment into care practices and the importance of both screening patients quickly to recognise cognitive dysfunction and using risk tools upon discharge.

Two reviews examined the use of CGA in the ED. Graf [133] looked at how best to screen to identify eligible patients for CGA and then the use and value of CGA. They found that routinely using CGA without screening first was too time consuming and an approach that screened for high risk patients, who were then given CGA was most effective. The most effective tool was found to be ISAR. CGA was found to be effective in decreasing functional decline, ED readmission and possibly nursing home admission. Conroy[134] looked at whether 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 highlights the lack of trial evidence in this population and the limitations of the small amount of trial evidence that does exist.

Fan et al[135] 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 and whilst the community interventions were generally more effective than those delivered in the ED in reducing ED utilisation, five ED interventions significantly reduced ED utilisation. These interventions were varied and incorporated risk screening or assessments or discharge planning and referral coordination.

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

In 2015 Karam[136] undertook a review of interventions delivered within EDs on four outcomes (ED re-visits, hospitalisations, nursing home admissions and deaths following discharge)Nine studies that 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 argues that the specific choice of which screening tool to use may be less important than how the tool is actually used.

Others

Tran et al[137] 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 found that short term ED returns were reduced, but that this pattern did not hold in the long term. It was not clear whether this long term pattern was anticipated.

Sinha[138] used a systematic review to develop a geriatric emergency practice model to improve patient outcomes. Examining 28 outcome measures, their review had eight model characteristic components which 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 and inter-professional work practices.

Both screening and service delivery interventions were considered in the review by Fealy[139] who looked at the effectiveness of nursing interventions for older ED attendees. Whilst 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 a single tool could be recommended for use in the ED. The evidence for screening tools was found to be very mixed. ISAR and TRST were found to be the best performing tools for triage,[128] frailty screening[61] and rapid functional assessments.[129] However other reviews that examined these tools did not find sufficient evidence to recommend their use. A prognostic review by Carpenter[130] 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.[133, 134] There was evidence that specific interventions reduced short term ED returns, but this did not hold in the long term.[137] Fan[135] identified five ED interventions that reduced ED utilisation (risk screening, assessments, discharge planning and referral coordination). Karam[136] examined the effect of interventions on ED re-visits, hospitalisations, nursing home admissions and deaths following discharge and found that intensity of interventions was a greater predictor of effectiveness than the intervention itself and that the choice of which tools to use was less important than how the tool was used.

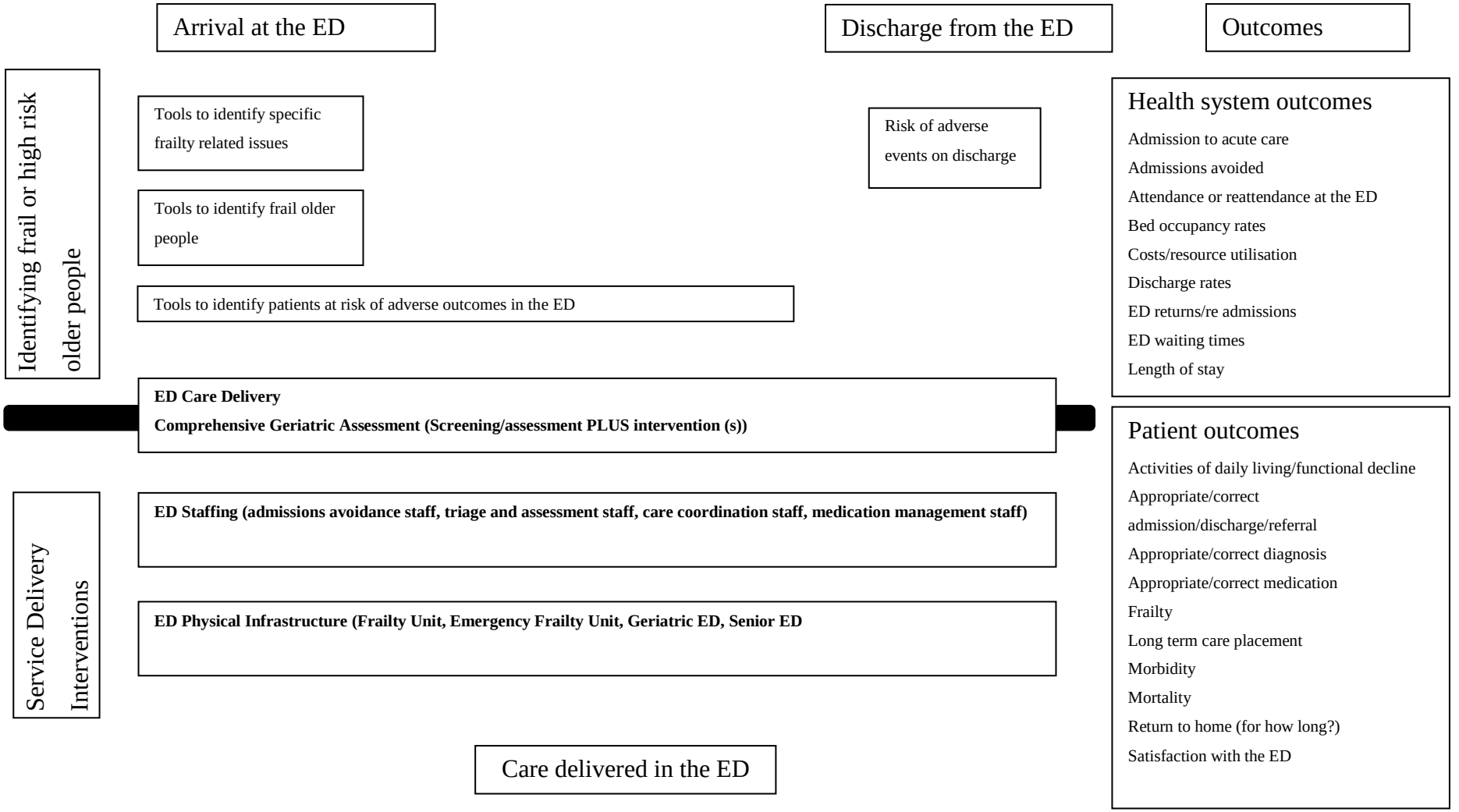
Focusing on interventions delivered by a specific healthcare professional, Fealy[139] examined nursing interventions, none of which were found to be significant in terms of patient or health service outcomes, although outcomes were improved when post ED discharge planning was incorporated in the intervention.

Focusing on a specific population, Parke[131] and Schnitker[132] 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 and 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.

Figure 2 Patient pathway diagram



Assessment of the evidence base

This review aimed to map the evidence of 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. Whilst formal quality assessment is appropriate within the systematic review process, to examine whether included studies may be at risk of bias, it is not required in a mapping review, as a mapping review does not interpret evidence in order 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 would not have been possible in this review, due to the diversity of study designs and the use of a set of quality assessment tools would have been challenging due to the variable reporting of interventions and outcomes reported in the research.

Rather than a formal quality assessment, we developed a bespoke assessment of the evidence base using three distinct methods.

- An examination of the research designs used and the strengths and limitations of those designs
- An examination of the self-reported limitations included in the articles relating to frail or high risk older people.
- 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 the 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 by the majority of service delivery intervention papers. These studies, while

valuable for descriptive purposes, do provide direct evidence for the clinical usefulness of a screening tool (in comparison to 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 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 they 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 the tool was limited to specific times of the day [21] or particular groups were excluded such as those presenting for trauma.[94] 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 a bias in studies of this design. They may rely on 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. This may result in bias if there are differences in the follow-up between those that had the outcome being measured and those that did not.

Prospective studies in which data on explanatory and confounding variables are collected before outcomes are known have an advantage over other study types in determining whether the outcome might be associated with the outcome of the tool or the effect of the 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 (n=5), or the clinical effectiveness of interventions (n=18). The studies that were used to evaluate clinical effectiveness included; randomised controlled trials (n=6), a quasi-randomised study (n=1) and before and after studies (n=11).

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 for 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. It can provide an historical control against which outcome data may be compared. A weakness of this type of study design is attributing change on outcomes solely to the intervention. It may be that other factors might also influence the outcomes, for example, staff changes or initiatives in the community for frail older people by a voluntary organisation.

There was limited attempt to measure the costs of screening and interventions, either in terms of the cost of the intervention or in terms of 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 upon 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 to service delivery intervention studies more generally, there is a lack of long term follow up of individual study participants. This may be to do with the nature of frail older people; however interventions delivered to general older populations have the ability to follow up over a longer period of time due to the relative better health of their participants. The nature of research in the ED means that short term outcomes are more straightforward to

measure. These shorter term outcomes, such as admissions, length of stay are outcomes for both the health service and patients. Longer term patient outcomes (such as mortality) often assumed less 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 is not experimental – the majority of study designs are retrospective or prospective before and after cohort studies, there are very few trials (either randomised or non-randomised). The sample sizes tend 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 the hours that they are offered to patients, or in the staff that are available to deliver them or in unintended events, such as outbreaks of infectious diseases, that hamper the evaluation of the interventions.

There is not much evidence on staff education, which is surprising. It is unclear when looking at interventions that introduced staff changes, the extent to which these staff members had received additional education and training. The lack of evidence on staff education in this review may be in part due 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 population of older adults. Much of the evidence included in the review was not specific to frail older people, with a target population of 65 years and older. However upon closer scrutiny, the interventions tended to be taken up by populations with a mean or median age of older than 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.

Author-reported limitations

The authors of studies routinely highlight limitations of their methodology, which leads them to caution the extent to which their findings can be generalised and compared with other studies. From the papers where frail older people were the focus and full data extraction was undertaken, the self-reported limitations of the studies 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, conference abstracts rarely contain data on study limitations.

In terms of the sources of data used, data was often collected from routine sources, not specific to study.[90, 92] Authors commented on the seasonal fluctuations in ED attendance[62, 111] which may affect generalisability of results. There was a general lack of data from outside of the ED on participants or service use (community or use from other settings)[90] which limited follow up and much of the data collected was retrospective.[53]

As mentioned in Chapter Four, many of the studies were retrospective or prospective before and after studies and there were a limited number of controlled trials. Jones[62] and Fox[111] note the lack of a control group, with Silvester[90] and Conroy[93] commenting on the lack of a contemporaneous control group. In addition, a number of authors caution that their study had a small sample size,[68, 72, 103, 111] that both participants and staff were not blinded (where there was some element of controlling interventions),[21, 24, 117] that not all variables were controlled for,[27, 79] that the study was 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 including that the intervention was not delivered 24 hours a day so not all potential participants were included,[21, 27, 49, 79, 111] that only non-urgent attenders were included, that the screening tool used was amended for a local setting,[79] the difficulty in recruiting patients[117] and unforeseen circumstances, such as an infectious disease outbreak which may have influenced study results (before and after study).[92]

The impact of study findings was limited by the lack of long term follow up patient outcome data[74, 90, 93] and the fact that where there was follow up, there were high rates of drop outs[24, 29], due to 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.[90, 117]

In line with the limitations that we identified, there was no clear definition of the frail older people[27, 62] and lack of cost data.[73, 93]

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 they have reported research undertaken within the same health system or whether the health systems in which the studies were undertaken can be compared with the NHS and whether 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 paper reported research undertaken in the UK. 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 which 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 the included studies could provide models that could be used in the NHS, it is unlikely, given the current NHS landscape, that geriatric EDs are 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 over 100 papers from the last 11 years which reported screening or management interventions for older people, including those identified as 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 risk of adverse outcomes and interventions for managing them. The following sections summarise the overall evidence base and the evidence for 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 and TRST scales, 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 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 to (frail) older people is large. Even limiting 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 style interventions, and other interventions. However, there was significant cross over 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 – 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 due to 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, for example, medication management or care coordination.

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 in 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. Geriatric EDs may be available for all older people; therefore those who are attending and who are frail or 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 high risk, who may receive additional interventions. Finally frailty units will require screening of older patients to identify those who are frail or high risk. McNamara[140] discusses the development of geriatric ED's, which have been largely developed in the USA[11] but are a proposed solution to the fact that older people have different clinical and social needs to the general adult population. However Maile[14] argues that it is more appropriate and realistic to make the Emergency Department 'Frail Friendly', as to develop a specific geriatric emergency department has cost and access implications. It appears that the approach of making ED's more frail friendly, or introducing 'frail units' within ED's 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 demonstrate 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 upon discharge, to CGA interventions which 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 tend to be reported in terms of study outcomes at a single point in time – there are few papers that report ongoing data collection and evaluation of this data. In addition there is 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 the intervention. 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 with the data from the studies to

determine whether these admissions and readmissions are unexpected[141]. Although this may be an unintended consequence of the intervention, the intervention may uncover unmet need or lead to older people receiving care in a more appropriate setting, so have positive outcomes for individual patients. There was only one study looking at interventions for repeat attenders at the ED, even though repeat attendances were an outcome that was frequently measured. Even in the general population, including all adults, not just those who were older/frail, readmissions to UK ED's within one week of attendance are around 8%.[142]

Links with the wider literature

Looking at wider Emergency Department interventions, a systematic review by Fan et al[135] identified seven elements that were common to effective interventions that reduced ED utilisation. These were MDT gerontological expertise, Risk screening and geriatric assessment, Care planning and management, Discharge planning and referral, Integrated or enhanced primary care, Integration between health and social care and coordination. 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 of 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 focussing on the ED system alone is only likely to influence ED outcomes (as measured in the majority of the studies here). Whether these are salient outcomes for patients is another matter.

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

Table 14 Checklist based on McCusker

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	Elder friendly physical environment and design principles	Frail friendly EDs, frailty units and geriatric EDs 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 were identified.
Screening /Assessment/Protocols	High-risk screening tools to identify vulnerable elderly adults. Cognitive, functional, and mobility assessments. Medication review and reconciliation Standardized protocols for identification, prevention, and management of delirium, falls, functional decline, dehydration, incontinence, and pain.	In this review we identified diagnostic tools to identify frail patients or patients at high risk due to 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 upon discharge, discharge co-ordinators or

Area	Intervention	Findings from our review
		teams and CGA with community follow up.
Community Services	Not applicable in this review	
Evaluation	Ongoing evaluation of care processes, in particular Hospital admission rate/ED and hospital lengths of stay/ ED repeat visits and subsequent hospital admission rate/ Patient, caregiver, and provider satisfaction with service	We found little evidence of ongoing evaluation.

Limitations of the review

This review was a systematic mapping review. The review was systematic in how evidence was identified, extracted and synthesised. The review that we have undertaken is transparent and reproducible. Where feasible and methodologically necessary, we have undertaken double checking of our work (screening of study results). Whilst 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 over 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.

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, only affect older people, such as delirium or falls. These interventions, whilst 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, therefore having a similar population to 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 due to 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, where the evidence permits, we have summarised the evidence for effectiveness of interventions as reported in individual studies, but have not pooled this data.

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

There were limited qualitative studies 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 (and this 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 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. Whilst this was not a standard quality assessment approach, it is appropriate for a mapping review and 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 we 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 studies on the both groups where older people had been defined as frail in the literature or were a high risk group and also where people were defined as older, which tended to be based on their age (over 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 homogenous group and did not tend to 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, for example recognition of polypharmacy. Service improvements are continually being made for specific populations or issues like 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 make any implications for practice is limited as it does not seek to answer questions about the effectiveness of intervention and the data presented in this review is focused on what interventions have been implemented and reported and the outcomes that they influence. Therefore clear recommendations on 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 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 of 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 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 f 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, whether older people are treated as a homogenous group, or 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 to patients who are prone to falls and identifying them simply as frail or high risk

does not reflect these subtleties. The acceptability of tools to patients and the usefulness to clinicians also needs to be examined. This could include a comparison of tools which are question based and those which employ different methods.

Looking at the complexity of the healthcare system, it is unclear whether 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 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 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 it is thought that this may have influenced the costs and outcomes of the 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 incorporate 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 from presenting at the ED may be more effective than trying to improve outcomes for the proportion that will inevitably attend the ED with acute medical conditions.
In terms of service delivery interventions, it is has been argued that it is unlikely that the geriatric ED model will become widespread[11] due to the cost and resource implications required to develop this model. However, there is a precedent set with the use of pediatric EDs in the UK. With an ageing population, further exploration of the geriatric ED 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 be measuring these outcomes. 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 experience of ED care may well be more important to patients, rather 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 there is for the identification and management of frail older people in the ED. The variability both in the types of interventions, the outcomes that are reported and in the standard of reporting more generally has meant that it is not possible to make overarching conclusions about which interventions are more effective. There was limited qualitative data 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 allows for disparate types of evidence to understand more about how and why interventions work and is 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 was rare – a basic cost analysis was undertaken by Leah and Adams[73] who estimated cost savings from reducing avoidable admissions. Many of the studies report increased engagement with health services as a beneficial outcome of the intervention, for example, 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 that looks at the cost of these outcomes. Whilst there may be a cost benefit in reducing admissions, there is no evidence that looks at 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 differ in its cost and frequency to that of the wider population.

Chapter 6. Conclusions

This review is a systematic mapping review which has identified over 100 studies which look at the identification and management of frail, high risk and older patients in the ED. The variability of interventions and outcomes and the nature 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 is little consistency between studies and in some cases, contradictory results resulting from similar interventions.

In this review we have examined the approaches that exist to manage frail older people in the ED. Due to the difficulty in differentiating frail or high risk older people from older people (aged over 65), the review has looked at all evidence from 2005 onwards about the management of frail older people, older people at high risk of adverse outcomes and older people over 65 years that met our inclusion criteria. Including only papers where 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 over 65 years old 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. 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? Would a dedicated service for these patients be better (involving either a geriatric ED, or geriatric liaison services within the ED), or given that this population is expanding should our current services be tailored towards this group?".[144] 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 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, due to 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 is 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 where 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 has represented these interventions and the outcomes that they may potentially influence, in order to guide the development of future interventions.

It is clear from the literature that improvements in care of frail older people have the potential to improve both patient and health service outcomes, although the purpose of this review was not to examine the effectiveness of interventions. Whilst the evidence for both screening and service delivery innovations was not sufficiently strong to suggest that specific interventions should be adopted due to evidence of their effectiveness, 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 there are a number of outcomes that may be important to both of these populations, 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 whilst most of the interventions in this review were targeted at patients aged over 65, 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. In order to meet the needs of frail older people, it is not sufficient to know that screening tools are effective in 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 reported 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 outcomes have been influenced. There is less evidence on patient centred outcomes and a very limited amount on costs for 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 of 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 patients being labelled as frail or 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 which accept the complexity of the social and health needs of frail older people and design interventions accordingly. This necessarily means that follow up outside of the emergency department is a key element of the intervention.

A recent systematic review from 2015 by Lowthian et al[10] highlights the dearth of research in frail older people in the ED. Despite the recognised challenges this population there is little, high quality evidence. They contrasted the findings of their review in 2015, with that of one

under taken in 2005 and argue 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 discharges in the short or medium term, but it may well be the interventions that occur in the community that prevent representations and readmissions in the longer term.

The studies reported in this review have demonstrated an effect on reduced admissions, however it 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 evaluation of changes in ED service provision need to collect information about the impact on all relevant service use, both in hospital and the community and the associated costs and staffing implications.

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

Related Publications

There are currently no publications associated with this review.

Data Sharing Statement

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

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Appendices

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 - List of full text excludes and reasons for exclusion

	Ref ID	Reason for exclusion
1.	70[145]	Not examining the impact on the ED or ED patient outcomes
2.	237[146]	Whether ISAR predicts clinical outcomes and health and social services costs of older people discharged from UK acute medical units
3.	258[147]	"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.
4.	285[148]	Non English Language
5.	326[149]	Modelling the cost effectiveness of providing vaccination to 50+ in Emergency Departments

	Ref ID	Reason for exclusion
6.	331[150]	Medical Assessment Unit
7.	344[151]	Protocol for the SEED project (conference abstract is 346[152] and full paper is 3171[153])
8.	346[152]	Review and audit of practices. Conference presentation.(full paper is 3171[153])
9.	434[154]	Intervention protocol for intervention delivered in the community
10.	444[155]	Discussion piece
11.	485[156]	Setting is acute geriatric units (with ED visit as a primary outcome)
12.	530[157]	No data on outcomes
13.	585[158]	Interventions occurs outside of the ED
14.	592[159]	Population older than 60. Outcomes related to trauma management.
15.	621[160]	Geriatric emergency management nurses as a catalyst for change (no outcomes)
16.	822[161]	Screening for functional decline in the home setting following an ED admission
17.	1168[162]	Predicative value of a tool that is not related to ED management
18.	1614[163]	Descriptive – no data
19.	1625[164]	Outcomes not relevant (infections)
20.	1795[165]	Opinion/discussion paper
21.	1854[166]	Population is geriatric patients hospitalised in acute care medical units after their admission to the ED
22.	1904[167]	Discussion paper
23.	1966[168]	Protocol/summary of study on transfer of information between care facilities and the ED
24.	1985[169]	Not an intervention
25.	2010[170]	Letter to the editor – no data
26.	2199[171]	Specific to trauma ED care
27.	2361[172]	Exclude – irrelevant outcomes
28.	2561[173]	Pain management intervention for elderly hip pain patients
29.	2613[174]	No data

	Ref ID	Reason for exclusion
30.	2616[175]	Commentary paper
31.	2628[176]	Baseline description of intervention, no outcomes data included
32.	2685[177]	Exclude – intervention delivered outside of the ED
33.	3037[178]	Descriptive paper (conference abstract) describing innovative interventions for the elderly in emergency departments via a questionnaire survey
34.	3049[179]	No outcomes data
35.	3171[153]	Not an intervention study
36.	3446[180]	Tool to assess what proportion of older ED patients are frail, administered post discharge
37.	3669[181]	Development of a short stay medicine for the elderly ward
38.	3684[182]	No data on outcomes
39.	3812[183]	Exclude – setting is an acute care for the elderly unit
40.	3829[184]	Exclude – insufficient date
41.	4920[185]	Exclude – outcomes and setting (medical assessment unit)
42.	5223[186]	Development of a Frail Elderly Short Stay Unit (Conference Abstract)
43.	5792[187]	Outside of the date range
44.	5794[188]	Outside of the date range
45.	5797[189]	Outside of the date range
46.	6383[190]	Intervention not specific to older people
47.	6473[191]	Short description of the intervention, no data, conference abstract
48.	6521[192]	Population is those admitted to the Emergency Assessment Unit
49.	6631[193]	Survey of emergency departments regarding implementation of an ED care coordinator.
50.	6688[194]	Abstract for a conference paper – no data
51.	7042[195]	"Specialist geriatric medical management on the outcomes of at risk older people discharged from acute medical assessment units"
52.	7781[196]	Description of an intervention – no data on implementation, uptake or use

	Ref ID	Reason for exclusion
53.	7815[197]	Impact of a supplemental care bundle to reduce readmission or ED visits in high risk elderly inpatients
54.	7875[198]	Not an intervention
55.	8121[199]	Study looking at whether certain ED and non ED variables are predictive of a return visit to the ED
56.	8435[200]	Exclude – screening tool for admission
57.	8445[201]	Exclude – no outcomes

Appendix 3 - Example brief data extraction form

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/ Assessment tool	Results	Headline Message

Appendix 4 - Example full data extraction form

Ref 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	

Appendix 5 - Brief data extraction table

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
Wright, P. et al, 2013, UK[122]	Pre- and post-retrospective cohort study. Patients over 70 attending A&E department. 5,416 participants pre-intervention and 5,370 patients after intervention, Triage and Rapid Elderly Assessment Team TREAT accepted 593 geriatric admissions.	Admissions-avoidance system - TREAT. TREAT combines early A&E senior doctor review, Comprehensive Geriatric Assessment (CGA), therapist assessment and supported discharge; post-discharge supported recovery; and a rapid geriatric 'hot-clinic'. A post-acute care enablement (PACE) team provided short-term nursing support immediately following	In the post-TREAT period, the median length of stay (LOS) for TREAT-matching admissions reduced by 2 days and mean LOS by 18.6% (1.78 days, P<0.001). For residual admissions the median was unchanged and mean LOS reduced by 1.08% (0.11 days, P=0.065). For all Emergency Geriatric Admissions population, median LOS reduced by 1 day, and the mean LOS by 11.65% (1.13 days, P<0.001).	TREAT appears to have reduced avoidable emergency geriatric admissions and to have shortened length of stay (LOS) for all emergency geriatric admissions.

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
		discharge to support TREAT.	For TREAT-matching admissions the Percentage of admissions resulting in same-day discharges increased from 12.26% to 16.23% (OR: 1.386, (95% CI: 1.203-1.597, P<0.001) following the introduction of TREAT. For the residual population same-day discharge fell from 15.01 to 9.77% (OR: 0.613, P,0.001, 95% CI: 0.737-0.509).	
Kennedy, 2014, USA[40]	Prospective observational study. Individuals aged 65 and over presenting for ED care. N=700.	Structured mental status assessment and attention tests. Delirium determined using the Confusion Assessment Method.	9% had delirium. Delirium patients had worse outcomes compared to those without (LOS 4 rather than 2 days, ICU admission 13% rather	Delirium prediction rule = older age, prior stroke or transient ischemic attack, dementia, suspected infection, and acute

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
			than 6% and discharge to long term facility 37% rather than 9%). ED delirium was associated with higher 30-day mortality (6% vs 1%) and 30-day readmission (27% vs 13%).	intracranial haemorrhage was created had good predictive accuracy (area under the receiver operating characteristic curve = 0.77).
Yuen, 2012[113], Hong Kong	Retrospective study. Older people referred by emergency physician, 2202 geriatric patients were referred.	Geriatric consultation programme 'We Care' older patients are referred by emergency physician and are screened by geriatric consultation team who provide comprehensive geriatric assessment and they are detoured to acute medical admission via either direct admission to	Age of patients ranged from 45 to 99. 15.3% cases needed acute medical admission for further management, while remaining majority could be admitted to convalescent home or discharged home. Majority of patients (98.4%) didn't suffer any adverse outcomes in study period;	'We Care' provided comprehensive geriatric assessment to suitable geriatric patients, resulting in an effective reduction of acute geriatric hospital admission.

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
		convalescent hospital for further care or discharge with support of community nursing service.	there were 1.6% reattendance and 1.6% mortality cases after discharge. 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	

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
			admitted to convalescent home or discharged home after geriatric consultation.	
Harper, K. et al 2013[77], Australia	Single-centred retrospective data analysis. Patients aged 65 years or over presenting to ED with fall. 5162 from 2006 to 2009.	Introduction of multidisciplinary Care Coordination Team (CCT) staffed by occupational therapists and physiotherapists to intervene in older patients presenting with a fall. Majority of patients referred from ED doctors. Interventions by CCT vary between patients, but usually include assessment and falls risk stratification, patient education, functional	Statistically significant predictors for being referred to 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 representation and readmission. A decreasing trend from 2006 to 2009 was seen in rate ratios and odds	Maturing of the CCT is associated with a decrease in representation and readmission rate. Over time, the CCT attended higher urgency patients with stable admission rates. Associations were not significant though and the clinical effectiveness of ED CCTs requires further examination.

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
		retraining, supply of equipment, and referrals to falls clinics or outpatient allied health services.	ratios via regression modelling for both representation and readmission in patients referred to CCT.	
Arendt, G. et al 2013[78], Australia	Non-randomised prospective pragmatic study. Patients aged 65 or over diagnosed with one or more of six conditions (cerebrovascular insufficiency; fractured neck of femur; cardiac failure; myocardial ischaemia; exacerbation of chronic airways disease; respiratory tract infection).	Early allied health intervention conducted in ED for older people with common diagnoses by care coordination team (CCT). CCT consisted of at least one physiotherapist, occupational therapist and social worker with extensive geriatric experience. Intervention patients received comprehensive allied health	In 2121 intervention patients and 1451 comparator patients, there was no difference in length of stay (median 88 vs 87 h) on unadjusted (log-rank p 0.28) or adjusted (IRR 0.97, p 0.32) analysis.	Front loading allied health assessment in ED has no effect on hospital length of stay.

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
	3572 patients, 2121 intervention patients, 1451 comparator patients.	assessment/intervention by at least one professional working in care coordination team. Comparison patients received no assessment.		
Grossman, 2012[42], Switzerland	Prospective, single-centre cohort study. Age; ≥ 65 years. 519.	To test the predictive validity, interrater reliability, and diagnostic accuracy of the Emergency Severity Index in older emergency department (ED) patients and identify reasons for inadequate triage	Emergency Severity Index level was associated with resource consumption (Spearman's p= -0.449; 95% confidence interval [CI] -0.519 to -0.379), disposition (Kendall's $_{r}$ =– 0.452; 95% CI -0.516 to -0.387), ED length of stay (Kruskal-Wallis x2=92.5; df=4; P<.001), and mortality (log-rank x2=37.04; df=3; P<.001). The sensitivity of	Older patients were at risk of under triage. The main reasons for under triage were neglect of high-risk situations and failure to appropriately interpret vital signs. Although interrater reliability was high between experts, we found only moderate agreement between triage nurse and triage experts, the latter providing an opportunity for

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
			the Emergency Severity Index to predict lifesaving interventions was 0.462 (95% CI 0.232 to 0.709), and the specificity was 0.998 (95% CI 0.989 to 1.000). Interrater reliability between experts was high (raw agreement 0.917, 95% CI 0.894 to 0.944; Cohen's weighted kw=0.934, 95% CI 0.913 to 0.954). Under triage occurred in 117 cases. Main reasons were neglect of high-risk situations and failure to appropriately interpret vital signs.	under triage to occur. Our results indicate good validity in regard to the associations of the Emergency Severity Index level with resource consumption, disposition, ED length of stay, and survival.

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
Foo, C.L. et al, 2012[120], Singapore	Single-centre before/after prospective study. Patients aged 65 years and over. 172 control (25/12/2006-30/03/2007) and 315 intervention (01/04/2007-31/12/2007) group patients.	Geriatric assessment in an emergency department observation unit (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 then 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 less ED re-attendance (adjusted incidence rate ratio (IRR) 0.59, 95% confidence interval (CI) 0.48–0.71) and hospitalisation rates (adjusted IRR 0.64, 95% CI 0.51–0.79) at 12 months.	Older patients admitted to an EDOU are an at-risk group and benefit from geriatric assessment before discharge.
Waldron et al, 2011[80], Australia	Prospective before and after study. Study participants were aged 65 years and	Allied health staff in ED to facilitate referral pathway, audit and feedback.	Allied health staff increased the proportion of patients being reviewed from 62.7%	A multi-faceted change strategy was associated with an improvement in allied

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	older presenting to ED as a result of a fall. 313 participants.		before to 89% after the intervention ($p < 0.001$). Before the intervention referral for comprehensive guideline care occurred for only 6/177 (3.4%) of patients, afterwards for 28/136 (20.6%) (difference = 17.2%, 95% CI 11-23%). Average quality of care index (max score 100) increased from 18.6 (95% CI: 16.7-20.4) to 32.6 (28.6-36.6).	health in ED prioritising the review of ED fallers as well as subsequent referral for comprehensive geriatric care.
Mortimer, C. et al, 2011[64], Australia	Prospective evaluation of a newly established service. Patients presenting to Department of Emergency	Specialist aged care pharmacist (ACP) for reconciliation of initial medication history, review	Patients in the intervention group had a significantly longer length of stay in DEM when compared with	This study supports the integration of an ACP in the ED assessing elderly patients.

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	Medicine (DEM) 65 years or over with a chronic condition or 70 years or over without a chronic condition. 199 patients, 101 intervention, 98 control group.	of medication orders and report of medication-related issues to DEM doctor. Control patients received continued management by DEM doctor.	patients in the control group (12 hours : 42 minutes, n=101 vs. 10 hours: 05 minutes, n=98, P<0.01). For the 101 cases managed by the ACP, 33 had medication orders charted in the initial work-up by the DEM doctor. Within these orders, 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. A total of 41 inaccuracies were	

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			identified in 25 of the 66 DEM-managed patients, compared with a total of two inaccuracies in one of the 73 ACP-managed patients. The ACP was highly effective in reviewing the appropriateness of patients' medications. For the 73 admitted patients managed by the ACP, 51 had one or more medication-related issue, and the ward pharmacist did not identify any further medication related problems (MRPs). In comparison, of the 66 control group patients, 15	

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			patients had at least one medication-related issue and 17 MRPs were identified. There was no significant difference between the proportions of intervention and control patients regarding re-presentation at 14 and 28 days following discharge. Vast majority of patients reported positive experiences with ACP.	
O'Mahony, S. et al, 2008[121], US	Pilot project. Patients were over 65 years and met the following criteria: a. uncontrolled chronic pain, b. multiple organ failure that have been rejected for ICU	Two advance practice nurses carried out consultations on elderly patients using the palliative care trigger tool to identify patients with 1 or more "palliative care	Of the 894 consultations, 263 patients were referred to homecare organisations and 287 to hospice organisations of these 83 received homecare and 912 hospice	The presence of palliative care, homecare and hospice outreach services in ED may provide effective strategy to link elderly patients at the

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
	admissions, c. Hospice eligible, requiring relief from symptoms and d. A chronic incurable illness requiring access to community resources. The nurses conducted 894 consultations.	triggers". Patients eligible for study then completed a needs assessment form which was followed by a consultation. Nurses' followed-up patients to ensure that had been linked with homecare or hospice services.	services. 90% of patients were admitted to the medical centre then 41.9% discharged to skilled nursing facilities, 24.2% home with homecare and 19.1% were discharged home without homecare. The project did not impact on rates of subsequent use of the ED. Compared with the pre-project chart review there were small reductions in length of hospital stay from 7.9 to 7 days. Linkage with hospital-based palliative care services was enhanced.	end of life with otherwise underutilized services.

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			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 services and hospice. There was limited impact on utilisation of acute care for the patients in this study.	
Moons, 2007[56], Belgium	Longitudinal study of admission. Patients aged 65 years and above, who were admitted to the ED. 314 (agreed to participate), 83	To compare the abilities of four different screening tools to predict return visits of older persons after they have	28 readmissions in 25 patients. Three patients were readmitted twice. During the first 2 weeks of discharge, 10% (8/80) of the patients	Repeat visits in older persons admitted to an ED seemed to be most accurately predicted by using the Rowland

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	(less than 24 h in ED), 74 (complete follow-up after 90 days)	been discharged from the emergency department (ED). • Identification of Seniors at Risk (ISAR) • Triage Risk Screening Tool (TRST) [2003], • 8-item questionnaire by Runciman [1996], • 7-item questionnaire by Rowland [1990].	revisited the ED.After 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 cutoff 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. Thirty days after discharge, the sensitivity was 73%, specificity was 75%, and negative predictive value was 92%. The ideal	questionnaire, with an acceptable number of false positives. This instrument can be easily integrated into the standard nursing assessment.

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			cutoff scores, as determined by the ROC curves in this study, were ≥2 for the ISAR, ≥2 for the TRST, ≥4 for the questionnaire of Runciman, and ≥3 for the questionnaire of Rowland.	
Baumann, 2007[57], USA	Retrospective health records survey methodology and a survival analysis. Patients aged 65 and older, 929 patients.	Emergency Severity Index (version 3) (ESI) triage algorithm. Association between ESI categorisation and 1 year survival, length of ED stay, disposition, resource utilization	Hospitalization was associated with ESI triage assignment (Kendall's $_{r}b$=0.476; 95% confidence interval [CI] -0.524 to -0.425). The area under the receiver operating characteristic curve for the predictive ability of the ESI for hospitalization was 0.77 (95% CI 0.748 to 0.806).	When used to triage patients older than 65 years, the ESI algorithm demonstrates validity. Hospitalization, length of stay, resource utilization, and survival were all associated with ESI categorization in this cohort

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
			Length of stay was associated with ESI assignment (Kruskal-Wallis test, P=0.000). The relationship between triage categorization and resource utilization was significant (Spearman's correlation0.683; 95% CI 0.716 to 0.647). ESI categorization was associated Vital status at 1 year (Kaplan-Meier x^2 67.85; df4; P=0.0000).	

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
Corbett, H. et al, 2005[81], Australia	Programme effectiveness evaluation. Patients were 65+ years of age presenting to 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 coordinator); and requiring discharge planning.	Introduction of care coordination programme which consisted of a multi-disciplinary case management approach by a team. The professional mix of the team has changed over time but has included physiotherapy, occupational therapy, speech pathology, nursing and social work. The intervention aimed to provide early interventions to prevent unnecessary admissions from ED to hospital and inappropriate or unnecessary presentation or re-presentation to the ED.	Results indicate a statistically significant reduction in the proportion of patients admitted from the ED to a ward since introduction of care coordination programme. There was also a significant difference in the mean-related quality of life score before and after intervention and staff and patient satisfaction with the service.	A multi-disciplinary case management approach was effective in reducing admissions rate of patients presenting to ED. Results from this and other studies demonstrate the care coordination programme is one that 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.

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		Additionally, it aims to ensure coordination and provision of service and programmes for patients with complex care needs upon discharge from ED to community. Primary role is coordination of services although team can provide services.		
Fallon, A. et al, 2015[70], Ireland	Prospective data analysis. Participants were aged 65 years and older. Data from 3071 patients attending the acute medical assessments unit (AMAU) over one year was collected and information on	Patients attending AMAU are initially reviewed by a triage nurse in ED and referred following assessment if deemed suitable.	In 2013 3071 patients were assessed in AMAU and 1/3 (1066/3071, 34.7%) were aged 65 and older. Older people presented more acutely unwell than younger counterparts. Most common presenting complaints were	The higher admission rate highlights the increasing complexity of this group. Gerontologically attuned AMAUs have great potential to enhance care for frail older patients from the time of their acute presentation to

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	characteristics and outcomes for 1066 older patients was retrieved.		breathing difficulty followed by chest pain. Further common presenting complaints were collapse, dizziness and confusion. Only 314/1067 of older patients had a triage risk screening tool (TRST) assessment completed in ED triage. 196 of 314 (62.4%) were identified as being at-risk of an adverse outcome. Admission rate (644/1067, 69%) for older patients was double that of younger patients.	hospital. As AMAUs evolve they have enormous potential to provide enhanced gerontologically-attuned medical care to increasing proportions of frail older patients presenting to the acute setting.
Nguyen, 2014[115], Australia	Pilot observational convenience study.	Synthesised Geriatric Assessment (SGA)	Overall, the time required for completion of the SGA	This pilot study shows that use of the SGA in Australian

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	65 and older (66-96, mean 78) 25 participants		by 90% of this sample was 20 min 40 s	ED settings is possible within the time requirements of the new Australian NEAT that require discharge of patients within 4 h of arrival. The SGA requires a small fraction of the 4-h target allowing an overall net benefit by improving patient outcomes and preventing readmissions.
Beauchet, 2013[41], France	Prospective cohort study design. Elderly (age 84.0 ± 6.5 years) 424	To examine whether a BGA (brief geriatric assessment) administered to elderly patients admitted to the ED may predict the risk of a long hospital stay in the geriatric acute care unit.	Prediction of LOS with a six-item BGA was possible in the studied sample of older inpatients admitted to the ED. The risk of a long hospital stay changed depending on the different	The combination of a history of falls, male gender, cognitive impairment, and age under 85 years identified elderly ED patients at high risk of a long hospital stay

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
			combinations of the six items on the BGA. The combination of a history of a recent fall, male gender, cognitive impairment, and age under 85 years identified the elderly ED patients with the highest risk of a long hospital stay requiring geriatric care and planning for discharge.	
Launay, C. et al 2013[82], France	Prospective cohort study Participants were aged 75 years and older. 168 older adults admitted to ED.	Mobile geriatric team (MGT) provide brief geriatric assessment and then related geriatric or gerontological recommendations. Geriatric recommendations defined as	48 (28.6%) of 168 participants received MGT recommendations (16 geriatric recommendation and 32 gerontological recommendations). 32 participants (19.1%) were	Study demonstrated that geriatric recommendations are more effective at reducing length of stay than gerontological recommendations. Gerontological

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		medical recommendations only (recommendations for diagnosis and treatment of polymorbid older adults with disabilities), gerontological recommendations defined as combination of medical and social recommendations (above with establishment of formal and adapted home-help services).	discharged early from ED, including 12 who received an MGT programme. Multiple logistic regression showed that only the geriatric recommendations were associated with early discharge from the ED (odds ratio = 4.38, p = .046).	recommendations provide specific social advice which can take time thus delay discharge and explain result.
Arendts, G. et al, 2012[84], Australia	Prospective non-randomized trial. Study participants were over 65 and presenting with 1 of 10 common complaints; urinary infection, respiratory tract infection, fall with minor injury, hip or knee	Early comprehensive allied health input was compared to patients receiving no allied health input. The service was provided by a care coordination team (CCT) consisting of at least	The admission rate, to an inpatient hospital bed from ED, was 72.0% for intervention compared to 74.4% in the control group. Statistical analysis found difference to be borderline	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

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
	pain, back pain, cardiac failure, angina pectoris, syncope, transient ischaemic attack new onset confusion or delirium. 5265 patients, 3165 in intervention group and 2100 in control group.	one physiotherapist, occupational therapist and social worker with extensive geriatric experience. CCT undertook comprehensive functional assessment followed by initiation of services to meet identified needs.	statistical significant (p = 0.046, OR 0.88 (0.76=1.00)). Subgroup analysis found that patients with musculoskeletal symptoms and angina pectoris in the intervention group had significantly lower admission rates compared with the control group.	small number of common presenting problems.
Fan, 2006[51], Canada	Prospective, observational cohort study Age >64 years 120	TRST to predict resource utilization defined as ED revisits, hospital admission, and long-term care (LTC) placement at 30 and 120 days after an ED presentation.	This study demonstrates that the TRST is a poor diagnostic test to predict ED revisit, hospital admission, or LTC placement at 30 and 120 days as witnessed by the failure of the LR CIs to	The TRST cannot be used as a single diagnostic test to predict whether Canadian ED elders will have an ED revisit, hospital admission, or long-term care placement at 30 or 120 days.

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		TRST score ≥2 defined patients as high risk for the above outcomes	achieve levels of clinical significance.	
Argento, V. et al, 2010[67], US	Prospective cohort study 100 consultations of patients over 65 years.	Geriatric nurse practitioner stationed in ED to provide consultative care to supplement care already provided by ED staff.	Of 100 consults, 31% required admission, 16% returned to nursing homes, 5% were referred to nursing homes for ongoing care. 48 patients returned home, of these 60% had visiting nurse put in place and 6% were discharged with home hospice.	Even in short time advanced practice nurse was able to generate consults and provide geriatric specific care to elderly ED patients. Further research will focus on quality care initiatives and patient specific outcomes.
Carpenter, 2010[18], USA	Randomized Controlled Trial Adults over 65 years old	Geriatric technicians screened elderly people presenting at ED (Mini mental status exam and	"A chart review was conducted to assess admission rates, documentation of recognized	Screening did not appear to influence the decisions made by physicians – either in their documentation,

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	69 subjects. Mean age 76 years.	Confusion Assessment Method ICU). Physicians were either informed or not informed of the results of the screening.	geriatric syndromes, discharge instructions, and follow-up plans" Informed physicians were unaware of abnormal screening results in 71% of patients, including >50% of delirium patients.	disposition or management decisions.
Carpenter 2010[45], USA	Prospective consecutive patient trial Age over 65 years 225 enrolled, 159 at one month follow up.	Baseline was Older American Resources and Services Activities of Daily Living (OARS ADL) plus ISAR and TRST. Then telephone follow up to quantify the composite outcome of reported ED recidivism, hospitalization,	The TRST and ISAR labelled 65% and 82% of patients as high-risk, respectively. At 3 months, 51% reported diminished function, 35% another ED evaluation and hospitalization, 2% had been institutionalized, and 70%	Neither the ISAR nor the TRST distinguish geriatric ED patients at high or low risk for 1- or 3-month adverse outcomes

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		OARS ADL functional decline, and interval death	had the composite outcome. Neither TRST nor ISAR predicted 1-month or 3-month composite outcomes in either general geriatric patients or those with cognitive impairment or lower health literacy.	
Dresden, 2015[71], USA	Prospective Cohort Study Age 65+ 829 intervention, 873 control.	Geriatric nurse liaison intervention (GNLI) using ED based assessment and care coordination was implemented for geriatric ED patients.	Compared to controls, the GNLI group had a 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), and no significant change in observation rate: 18.9% vs. 21.7%, RD -2.8%	GNLI in this sample was associated with significant decreases in hospitalization rate, 30 day readmission rate, and hospital LOS. Further study to evaluate ED recidivism after GNLI is needed.

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			(95% CI -6.5 to 1.1). 18% (310) of all patients were potential 30 day re-admissions: 12% of GNLI (137) and 15% (173) of controls. 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 shorter mean hospital LOS than controls 88.2 vs. 104.3 hours, difference in mean -16.1 hours (95% CI -30.9 to -1.3).	

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Dziura, 2013[46], USA	Medical record review Age 65+ years n=250	Rapid screening assessment measuring: prior ED visits in the past 12 months, disability, polypharmacy, and age. Disability was assessed by a 12-item questionnaire	42 (17%) participants experienced at least one 30-day return visit or death. In the multivariable model, prior ED visits (OR=2.6, 95% CI=1.2,5.5), greater global disability (OR=1.56 , 95%CI=0.99,2.5), age (OR=1.04 , 95%CI=1.0,1.08), and polypharmacy greater than 10medications (OR=1.8, 95%CI=0.9,3.9) were associated with a greater likelihood of a 30- day event. The fit of the multivariable model was good (Hosmer-Lemeshow	Rapid screening assessment provides a rapid and accurate method for identifying older patients in the ED who are likely to recidivate.

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			Goodness of Fit test, p=0.85) and it provided good discrimination between those having and not having 30-day events (AUCROC= 0.73). The predicted probabilities of a return visit ranged from3%to56%.	
Eagles, 2015[47], Canada	Substudy of a prospective cohort study. Initial ED then follow up at 3 and 6 months. Generalized linear model with log-binomial distribution was utilized to evaluate association between the measures	A standardised test for assessing mobility in the ED – The Timed Up and GO. The relationship between the TUG and its relationship with frailty, functional decline, fear of falling and falls.	Significant association between TUG scores and frailty, functional decline at 3,6 months, fear of falling at 0,3,6 months and self-reported falls at 0 months,	"In community dwelling elders presenting to the ED following minor trauma, TUG scores are associated with frailty, functional decline and fear of falling. TUG scores were associated with falls at initial ED visit but not predictive of falls at 3 or 6 months. Use of the

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	Patients ≥ 65 years with minor trauma. 504 patients. Mean age of 76.8.			TUG in the ED will help identify frail patients at risk of functional decline"
Eagles, 2010[37], Canada	Prospective cohort study Age: ≥ 75 years of age 260	Ottawa 3DY Scale (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	Screening rates were: overall - 78.3%; physician - 51.8%; and nurse - 64.2%. Interrater reliability was 0.65Physician and nurse sensitivity was 78.9, 84.6% and specificity was 39.4, 54.2%, respectively, compared with the Mini-Mental State Exam. Clinicians (physician, nurse) reported the O3DY was easy to learn (98%, 97%), remember (88%,	The Ottawa 3DY Scale is a simple screening tool for altered mental status which 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.

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		of <25. Kappa coefficients were calculated.	95%) and use (95%, 97%). However, patient benefit (30%, 55%) and usefulness to practice (50%, 72%) were not strongly endorsed. There was strong interrater reliability (kappa: 0.65 (95% CI 0.51-0.80). O3DY by nurses had a sensitivity of 84.6% (95% CI 64.3 – 95.0) and specificity of 54.2% (95% CI 39.3 – 68.3). O3DY by physicians had a sensitivity of 78.9% (95% CI 53.9 – 93.0) and specificity of 39.4% (95% CI 23.4 – 57.8). Prevalence of altered mental status was	

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			38.4% (95% CI 34.4 – 0.42.6). Patient living situation, level of education, triage location, hospitalization, admission location and death in 30 days were associated with altered mental status.	
Hadbavna, 2013[34], Ireland	Convenience sample. Data from clinical records. 117 patients. Aged > 65	Brief nurse-administered 6-item cognitive impairment test (6-CIT) in ED.	Over two-thirds 79/117 (67.5%) required hospital admission. A triage risk screening tool (TRST) was performed on 48/117 (41%) of patients and 37/48 (77%) were identified as high-risk vulnerable older adults. Initial 6-CIT was positive in	A high proportion of older patients attending ED met criteria for cognitive impairment. Of those admitted, many met criteria for delirium. There was considerable variation in the applicability and implementation of the

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			43/117 (36.8%). Repeat 6-CIT was performed on 28/43 (65%) of these, the remainder having been discharged from ED. All except 4/28 (14%) remained positive. CAM-ICU was positive for delirium in 7/28 (25%) of patients screened.	screening instruments between nurses, despite training. Attendance at ED represents an opportunity to identify older patients with undiagnosed dementia.
Launay, 2013[89], France	Prospective Cohort Study 168 older adults	Early Mobile Geriatric Team combining Brief Geriatric Assessment and standardized recommendations	Among 168 included patients, 28.6% (n = 48) benefited from MGT recommendations (n = 16 geriatric recommendations, and n = 32 gerontological recommendations). In all, 32 patients (19.1%) were discharged early from ED,	Mobile geriatric team geriatric recommendations were associated with an early discharge from the ED, although gerontological recommendations were not.

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			including 12 who received a MGT program … Multiple logistic regression showed that only the geriatric recommendations were associated with an early discharge from ED (odds ratio = 4.38, P = 0.046)"	
Lonterman, 2011[32], Netherlands	Cross-sectional diagnostic cohort study, patients aged 65 or older presenting to ED (n=300)	Emergency Department/Geriatric Screening Tool (ST) compared with Safety Management System Screening Bundle (SB; reference standard). ST administered by nurses (presumably at admission	Area under the receiver operating characteristic (ROC) curve for the ST was 0.83 (95% CI 0.78 to 0.88). One of the original 8 items could be removed without reducing validity. In both the 8-item and 7-item ST, the overall misclassification was lowest at a cut-off score of 2	The ST has a moderate validity compared with the SB and can be used to identify most elderly ED patients at high risk of adverse outcomes

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		but not explicitly reported) and SB by researchers	(52% and 47%, respectively). Using a cut-off score of 2, the 7-item ST had a sensitivity of 64% and a specificity of 89%	
Terrell, 2009[78], USA	Randomized Controlled Trial 63 emergency physicians (32 intervention and 31 control). Average patient age was 74.	Computer assisted decision support to reduce potentially inappropriate medicines (PIM) prescribing to older adults. Primary outcome – proportion of visits that resulted in one or more prescriptions for a PIM.	2647 visits to intervention physician. 111 visits where an intervention physician attempted to prescribe a PIM. Decision support provided 114 times (107 visits). 49 (43%) of these decision support recommendations were accepted.	There are specific medicines that are inappropriate for older people; however these continue to be prescribed. As an intervention to improve emergency department care for older people, computerized decision support reduced the prescription of potentially inappropriate medications upon discharge from the emergency department.

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
			One or more inappropriate medications prescribed (Intervention 2.6%, control 3.9%) of ED visits by seniors. Proportion of all prescribed medications that were inappropriate significantly decreased from 5.4% to 3.4%.	
Tiedemann, 2012[60], Australia	Prospective cohort study (6-month follow-up), patients aged 70 or older 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 178	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,	The 2-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

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	for the subsequent external validation study)		respectively. Area under the ROC curve for the 2-item screening tool was 0.7 (95% CI 0.64 to 0.76), similar to the FROP-Com and PROFET tools	
Beirne, 2012[112], Ireland	Prospective data analysis (one year) All older attendees to the ED (older than 72 years) ISAR (n=7596) Convenience sample ISAR>2 (n=300)	ISAR in predicting ED reattendance CGA	"7,596 patients C72 years accounted for 20 % of ED attendances in 2011, compared with 16 % in 2003. ISAR was performed in 14.9 % (1,136). ISAR sensitivity for ED re-attendance at 1, 3 and 6 months was 77, 80 & 79 % respectively. In the 'at risk' group, 300 patients received CGA in the ED. ED	Main outcome was ED reattendance and ISAR to identify then CGA as an intervention. ED reattendance was lower in the CGA group. There was "appropriate community follow up" also included.

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			reattendance compared favourably with the group that did not receive CGA (21 vs. 24 % at 3 months and 27 vs. 33 % at 6 months)"	
Berahman 2014[86] USA	Prospective questionnaire (5 questions, 0-10) survey about patient satisfaction and overall ED experience when a patient liaison was present and not present. Patients aged >65-99 (mean age 75 years) 637 (432 with a PL, 205 no PL)	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"	No significant difference between groups for 4/5 questions. 1/5 question (increased satisfaction in how often visited by ED staff) (mean score for PL group was 7.83 vs. mean score for non-PL group was 7.23) (p = 0.012)	Trend towards improved satisfaction scores for when there was a PL present but not statistically significant, or barely significant.

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
Chou, 2015[105], Taiwan Liao, 2012[106], Taiwan	Appears to be prospective cohort study (12-month follow-up, results at 6 months reported), older people who visited the ED three times within 30 days (n=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 and non-intervention groups. The intervention group were 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) months	The CGA-based intervention reduced subsequent ED visits significantly but an RCT would be required to confirm the findings
Chui 2013[114] Hong Kong	All patients receiving geriatric consultation service. Prospective Cohort	"Program We Care" (Geriatric Consultation Service)	"After geriatric assessment, 508 patients (46.4%) were transferred to convalescent hospital for further care. 475 patients (43.3%) were discharged home with early	Aim of the intervention was to reduce acute medical admissions from the ED. Study authors argue that their intervention did reduce

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
	Geriatric. 64-99 (mean 80.3) 1096 patients		specialty follow up and, 111 patients (16.1%) were also referred to community geriatric nurse. 113 patients (10.3%) still needed acute medical admission. There were 16 re-attendance (1.5%) to the ED within 48 hours"	admissions. However no control group or data for comparison.
Dundar, 2015[43], Turkey	Prospective cohort study (in-hospital follow up), patients aged 65 or older admitted with acute medical or surgical complaints (n=939)	Rapid Emergency Medical Score (REMS), REMS without age and HOTEL (Hypotension, Oxygen saturation, low Temperature, ECG changes and Loss of independence)	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	The REMS, REMS without age and HOTEL scores cannot be used to identify geriatric ED patients requiring hospital admission but they are of value for predicting in-hospital mortality and intensive care admission

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
			patients who died in hospital were significantly higher than those of survivors. Area under the ROC curve values of REMS, REMS without age and HOTEL were 0.77, 0.76 and 0.83, respectively.	
Genes, 2013[95], USA	Study Design, population, patient numbers Before-after study comparing 3-month periods before and after implementation of a geriatric ED, discharged patients aged <65 (n=219) and ≥65 (n=67)	Press Ganey surveys [sic] were reviewed after discharge	Following implementation of the geriatric ED, 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. Satisfaction regarding nurses, doctors,	Implementation of a geriatric ED increased patient satisfaction scores in people older than 65 years but not in younger patients

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
			registration and arrival increased, as did overall satisfaction, though not significantly. Satisfaction among patients aged <65 did not change appreciably during this time	
Hughes 2014[110] UK	Prospective review of patients over 4 week period Acute admissions presenting to the ED 547 patients (admitted to ED and CDU) 70 and over	CGA as delivered by an 'Older Persons Assessment and Liaison (OPAL) service'	547 medical patients were admitted to ED and CDU; 56% (307) assessed by OPAL team and received CGA. 57% (174/307) returned to their usual place of residence, 8% (25/307)	"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"

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
			were transferred to community hospitals, 35% (108/307) were transferred to a medical speciality ward, 47% (51/108) of these were admitted to an elderly care ward and 1 patient died. 53% (164/307) discharged within 48 hours of admission. Median LOS 2 days (range 2 hours to 37 days). Current readmission rate within one month of discharge is 14% (42/307).	

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
Karounos 2014[96] USA	Retrospective review of geriatric admissions, one year prior and one year after a Geriatric Emergency Departments opened Patients aged > 65 27838	Geriatric Emergency Department • geriatric friendly physical attributes • educated staff • geriatric care team (care transitions) • dementia screening as standard • medication review for drug-drug interactions	Outcome measure was geriatric admissions. Prior - 13354 patients, 7065 admitted (52.9%). Post - 14484 patients, 7247 admitted (50%). 1,130 fewer admissions (2.9%) $p < 0.001$	Admissions reduced. Possibly to do with extra emphasis on transitions of care. Further research to look at rates of revisit and cost savings required.
Lo Storto, 2011[116], Italy	Appears to be a prospective cohort study, older patients (range 65–100 years) attending the ED (n=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,	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	The social health triage (SHT) team was a useful and effective tool to reduce hospital admissions and improve quality of care

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
		alternatives including home services and/or temporary residential accommodation were proposed	whom 66 were discharged home after activating home services	
#Ng, 2014[100, 101], USA	Before-after study using administrative data, patients aged ≥ 65 years attending an ED between Jan 2011 and May 2013 (geriatric ED opened in Feb 2012 and GEDI WISE programme began in October 2012)	No details of screening in the geriatric ED were reported	Mean patient age was 77 (SD 8.6). Admission rate declined from 58.9% in January 2011 to 50.7% in May 2013, a change which remained statistically significant after adjustment	There was a decrease in admission rates of patients aged over 65 following the opening of a geriatric ED
Post, 2013[48], USA	Retrospective chart review to develop a measure of disability for use in the ED, followed by prospective cohort study (n=250 patients aged ≥ 65 years) to further	The Geriatric Readmission Assessment at Yale (GRAY) measure has five screening and 15 follow-up questions covering physical and cognitive disability, stress,	56 participants (22%) experienced at least one 30-day return visit or death. Greater disability as measured by the ED GRAY	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

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
	refine and validate the measure	depression and isolation. A global score and estimated risk of readmission within 30 days are generated. Not reported where screening occurs	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, 2.5). In the multivariable model, prior ED visits (OR=2.7, 95% CI=1.4, 5.2), ED GRAY global score (OR=1.4, 95% CI=1.0, 2.1), and age (OR=1.03, 95% CI=0.99, 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	good discrimination of risk of ED readmission within 30 days

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
			those having and not having a 30-day event (AUROC=0.70). The predicted probability of a return visit ranged from 3 to 56%.	
Grudzen, 2015[118], USA	Review of administrative data from health records and billing data (1/1/11 to 31/5/13). All people ages 65 and older	Palliative Care elements of GEDI WISE – geriatric ED space, volunteers to help geriatric patients, screening using ISAR (score of >2 had additional screening including identifying for palliative care) and training to do this screening as well as additional training in palliative care.	Primary outcome = ICU admission rate from the ED for patients ages 65+. Also measured ED initiated palliative care consultations and hospice referrals. Over 29 month study period, unadjusted ICU admissions rate declined from 2.3 to 0.9%. Adjusting for age, sex, ESI score and others,	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.

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
		ED screening tool for the rapid identification of older adults with a high likelihood of re-presentation or re-admission, who require palliative care plus a wider model of care GEDI WISE (Geriatric Emergency Department Innovations in Care through Workforce, Informatics and Structural Enhancement) Because 50% of 65+ adults in the last month of life present to the ED – interventions to prevent admissions to intensive care	decline was still significant (beta -0.0073/ 95% CI -0.0105, -0.0041/ p<0 001)	

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
		for these adults and redirect them to appropriate palliative care.		
Wall and Wallis, 2014[20], UK)	Diagnostic accuracy study, people aged ≥ 75 admitted to wards from the ED over a 2-week period)n=118)	Clinical Frailty Scale (CFS). 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 (reported Edmonton Frailty Scale, PRISMA-7 and ISAR	There was no statistically significant difference in frailty between patients in geriatric and non-geriatric wards. Analysis of ROC curves showed that the CFS accurately identified frail patients when 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 et al., 2011[23], South Korea	Diagnostic accuracy study, people aged ≥65 presenting to an ED over a 3-month period (n=1903)	Canadian Triage and Acuity Scale (CTAS) at admission	Severity (e.g. mortality and ICU admission) increased as CTAS score increased. Ninety-four patients	The CTAS is a triage tool with high validity for elderly patients and is especially useful for categorising

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
			received a life-saving intervention within an hour of arriving at the ED. The sensitivity and specificity of a CTAS score ≥2 for identifying patients receiving an immediate intervention were 97.9 and 89.2%, respectively	severity and recognising those who require an immediate life-saving intervention
Hegney, 2006[44], Australia	Before and After study 2139 Over 70 years of age	Risk screening to refer patients for Home and Community Care Services (HACC) Screening tool adapted from the 'Screening Tool for Elderly Patients' which in turn was developed from ISAR	2139 older people (of whom 246 were representations and 1102 were admitted) 16% decrease in re-presentation rates from 21% to 5%. ($\chi 2=15.59$, $p<0.001$) 5.5% decrease in readmission rate from 00.2% to 4.7% ($\chi 2=4.61$, $p<0.05$)	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).

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
			Decrease in representations of those patients who present 3+ times per month – not a significant result. Decrease in LOS 6.17 days to 5.37 (privacy restrictions made any substantial data analysis impossible)	"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"
Basic, 2005[26], Australia	Randomised Controlled Trial Elderly patients (functional impairment , psychological disability, social disability, active multi (2+) system disease, discharge from the hospital within the last 14 days.)	Early geriatric assessment in the form of an aged care nurse intervention Screening using a variety of instruments. Liaison with carer and HCP, organised and assisted in the	"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"	Intervention had no effect on admission rates, length of stay or functional decline. . Authors believe this was because the intervention did not (a) give timely access to community support or (b) have the ability to change

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
	Mean age of 78.7 ± 6.4 years n=224 (114 intervention, 110 control)	care of those admitted as inpatients		the course of care in hospital. They did however find that impaired function was a strong predictor of outcomes. Delayed impact of nursing interventions.
Asomaning et al., 2014[28], Canada	Audit of implementation of the ISAR, patients aged ≥65 presenting to the ED over two 14-day periods (n=525)	ISAR by nurses in the ED	271 patients (51.6% of those eligible) were screened with the ISAR, of whom 158 (58%) had a positive result (answered yes to two or more questions). Patients with positive results were more likely to be over age	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

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
			79, more likely to be admitted and had a longer length of stay than those screening negative	included tool adaptation and providing staff with knowledge of ED and inpatient geriatric resources and feedback on completion rates
Bond[66], 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.	Emergency Department Care Coordinators (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) • Readmission rates at 30 days (OR = 1.03;	This study showed no reduction in senior patients' admission rates, recidivism at 30 days, or hospital length of stay 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.

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
	910 matched pairs (1820 patients) (matched on a number of criteria)		95% CI, 0.73 to 1.46).	Numerous problems with study design.
Buurman et al., 2011[55], Netherlands	Prospective diagnostic cohort study, patients aged ≥65 discharged from an ED over an 11-month period (n=381)	ISAR, triage risk screening tool(TRST) and Runciman and Rowland questionnaires administered after discharge together with 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 the screening tools, indicating poor discriminatory power	None of the screening tools were able to discriminate clearly between patients with and without poor outcomes
Carpenter et al., 2011[35], USA	Prospective diagnostic cohort study, patients aged ≥65 attending an ED between June 2009 and March 2010 (n=169)	Ottawa 3DY (O3DY), Brief Alzheimer's Screen (BAS), Short Blessed Test (SBT) and caregiver-completed AD8 compared with Mini Mental State Exam (MMSE)	Complete data were collected for 163 patients, of whom 37% had cognitive dysfunction. The SBT, BAS and O3DY each showed 95% sensitivity, compared	Brief screening instruments such as the SBT can rapidly identify patients at lower risk of cognitive dysfunction

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
		as reference standard. Screening by researchers in the ED	with 83% sensitivity for the cAD8. The SBT had the highest specificity (65%) followed by the cAD8 (63%). The SBT showed the best overlap with the MMSE	
Carpenter et al., 2011[36], USA	Prospective diagnostic cohort study, patients aged ≥65 attending an ED between June 2009 and March 2010 (n=371)	Six-item Screener (SIS) and AD8 compared with Mini Mental State Exam (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-completed or patient-completed AD8	The SIS was superior to the caregiver- or patient-completed AD8 for identifying older adults at increased risk of cognitive dysfunction
Di Bari et al., 2011[58], Italy	Prospective cohort study, patients aged ≥75 attending	ISAR administered at triage in the ED compared with	Mean patient age was 84 years and 61% were women;	Prognostic stratification with the SC is comparable with

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
	a geriatric ED over an 8-month period (n=1632)	Silver Code (SD) obtained retrospectively from administrative data	75% were ISAR-positive (answered yes to two or more questions). ISAR and SC scores were moderately correlated (r=0.35) and had a similar area under the ROC curve for predicting hospital admission. ISAR-positive patients had increased risk of hospital admission and death and risks also increased with increasing SC risk category. In a 6-month follow-up period, the tools had similar ability to predict repeat ED visits, hospital admission and death	that obtained by direct patient evaluation. The SC predicts ED readmission and future hospitalisations even in patients discharged directly from the ED. The SC is based on data available at the time of accessing the ED and could in principle be used to aid triage, though only as a preliminary step

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
Hustey et al., 2007[19], USA	Secondary analysis of data from a randomised trial, patients aged ≥65 who attended an ED and were discharged to 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 endpoints. A TRST score of 2 or more was moderately predictive of decline in ADL or IADL at 30 and 120 days	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

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
Keyes, 2014[97], USA	"Retrospective pre/postintervention comparison study of 2 cohorts of patients" 4 groups: seniors (65+) in the ED before the Senior ED opened, those in the new Senior ED, younger (55-64) patients treated before the Senior ED opened, and younger patients treated after it opened 12015 patients (7598 older than 64 years and 4417 aged 55-64).	Senior/Geriatric Emergency Department on rates of admission to hospital, LOS and ED return visit within 30 days and within 180 days. GED comprising of a case management approach which included • Improved staff education • Changes to physical space • Universal screening for common elderly comorbidities	There was no significant difference in time to return within 30 days or average hospital length of stay. Risk of being admitted on the index visit was lower for seniors treated in the Senior ED compared with the regular ED (Relative Risk=0.93; 95% CI 0.89 to 0.98).	A new Senior ED 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 patients are being discharged early then this is not just increasing rates of return ED visits. Screening thresholds

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
	Mean age of ALL patients was 70 years (77.5/76.9 in the senior groups)			should allow us to identify those who are at risk of return. May be an unintended consequence that a geriatric ED 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 is related to the use of social workers.
Wilber et al., 2008[38], USA	Prospective diagnostic accuracy study, patients	SIS before or after MMSE (reference standard)	Mean patient age was 77 years and 63% were women;	The sensitivity of the SIS was lower than in earlier

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
	aged ≥65 attending an ED between January 2006 and January 2007 (n=352)	administered by physician in the ED	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)	studies. Further research is needed to identify the best brief mental status test for ED use
Wilber et al., 2005[39], USA	Diagnostic accuracy study, patients randomised between screening tests, patients aged ≥65 attending an ED in autumn 2003 (n=150)	SIS or Mini-Cog administered by physician in the ED followed by MMSE (reference standard)	Mean patient age was 75 years and 55% were women. The SIS had a sensitivity of 94% (95% CI 73 to 100) and a specificity of 86% (95% CI 74 to 94). The Mini-Cog had sensitivity of 75% (48 to 93) and specificity of 85% (73 to 93)	The SIS, with a cut-off of ≤4, is short, easy to administer and unobtrusive, allowing it to be easily included in the initial assessment of older ED patients

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
Stiffler et al., 2016[59], USA	Prospective cohort study, patients aged ≥65 attending an urban ED (n=107)	Survey of Health, Ageing and Retirement in Europe Frailty Instrument (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 et al., 2016[31], Sweden	Cross-sectional diagnostic accuracy study, older patients attending ED between October 2008 and June 2010 (n=161). Patients had to be aged ≥80 years or	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 FRESH were high. A question about repeated visits to the ED did not improve accuracy and	FRESH has high clinical value in screening for frailty. It is simple and rapid to use, takes only a few minutes to administer and requires

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
	65–79 with at least one chronic disease and dependence in at least one daily living activity		was removed, reducing the number of questions to four	minimal energy use by the person being screened
Tang 2016[99] UK	Observational before and after study (two seven month periods) People aged over 65 • Rapid Access Centre Group (mean age 75). • Comparator group (A and E mean age 73) 441 patients (346 A and E, 95 RAC)	Rapid Access Centre – 6 bedded consultant led ward	LOS was 5.6 days (admitted by A and E) and 4.1 days (admitted by RAC). This relationship held when looking at groups by diagnosis.	RAC led to shorter LOS

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
Shaw, P.B. et al 2016[65], US	Retrospective cohort analysis. Patients over 65. 4103 patients, 872 treated in ED for seniors and 342 of these treated by the clinical pharmacy specialist.	Implementation of ED for seniors with a clinical pharmacy specialist, with specialised geriatric training including medication management training, as a key member of the ED team.	Patients who received medication review and management by the clinical pharmacy specialist did not experience a reduction in ED return visits at 30 or 90 days, mortality, cost of follow-up care, or hospital admissions compared with the other groups. Of the patients treated by the clinical pharmacy specialist, 154 (45.0%) were identified as having at least 1 medication-related problem.	Although at least 1 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.
Wilber, S.T. et al 2013[98], US	Retrospective cohort analysis of quality assurance data.	Triage to 15 bed Senior ED, with overflow to standard ED. Assessment by an RN	During the pilot senior ED program length of stay was slightly but not	A pilot Senior ED program reduced admissions without increasing length of stay or

Ref ID, Author, Year, Country	Study Design, population, patient numbers	Intervention/Assessment tool	Results	Headline Message
	Patients 65 years and over. 2260 eligible visits in 2012 (comparison group) and 2286 eligible visits in 2013 (intervention group).	transitional care coordinator, care protocols, education, pharmacy review and call backs on discharged patients.	significantly decreased (300 to 296 minutes), admissions significantly decreased (55.5% to 51.2%, difference -4.3, 95%CI -7.2 to -1.4), and observation patients increased (2.2% to 3.9%, difference 1.7, 95%CI 0.7 to -2.7). This resulted in trends towards decreased admission or observation and towards increased discharge to home rates. Revisits resulting in admission or observation at 7 (4.9 to 4.5) and 30 (13.2 to 12.3) days were slightly but not significantly decreased.	revisits resulting in admission or observation.

Appendix 6 - Full data extraction tables

Full paper		Author Silvester, K.M. et al[90]	Year 2014	Country UK
Study design		Prospective systems redesign study		
Data source		Routinely collected attendance and admissions data.		
Study aim(s)		To conduct a patients flow analysis of older emergency patients to identify and address delays in ensuring timely care without extra resources.		
Sample size				
Setting		Geriatric Medicine (GM) Directorate in an acute hospital (Sheffield Teaching Hospital NHS Foundation Trust) with 1920 beds		
Frail Elderly - definition				
Study population		Age	Condition Older people admitted as emergencies	
Intervention	What	Formation of a multidisciplinary team including consultant geriatricians, junior doctors, nurses, pharmacists, therapists and clerical staff with expert clinical systems engineers as the Facilitators who introduced series of changes: 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 perform therapy assessment in their own home. Once plan is in place patients can go straight home. Seven 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 (MAUs) became a dedicated 'Frailty Unit' (part of GM) which accepted frail patients of both sexes. This allowed co-location of multidisciplinary clinic team which minimised time between admission of a patient and multidisciplinary assessment.
	Who	Multidisciplinary team 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 1/4/2009 – 31/3/2010 to understand profile or attendance to ED and subsequent profile of admissions into GP speciality.
Outcome measures		Average bed occupancy In-hospital mortality 28-day readmission rate
Findings		After changes there was a fall in bed occupancy, a drop in mortality after the intervention and no change in re-admission rates. Statistical analyses showed that the average bed occupancy fell by 20.4 beds (95% CI -39.6 60 -1.2, p=0.037) after the intervention. The odds of death in hospital reduced by 12% (odds ratio 0.78 95%CI 0.61-1.00, p=0.056). The absolute reduction in risk of death before versus after the intervention was 11.4-9.15% = 2.25%, which equates to a number needed to treat of 45 and 19.7% reduction in risk of mortality. The odds of re-admission remained unchanged (odds ratio 0.94, 95% CI 0.75-1.18, p=0.61) at 17.1% versus 16.3% after the changes. Only cost associated with changes were those required for the improvement effort.

Conclusion	Radically redesigning the system of care for older patients led to reductions in bed occupancy and mortality without adversely affecting re-admission rate or requiring additional resources. Radical redesign offers a promising way to meet the needs of patients within existing resources.
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 experience with the changes although anecdotal evidence was positive. No contemporaneous controlled comparisons with GM units in other hospitals or control wards in our own hospital.
Headline message	Redesigning the system of care for older emergency patients led to reductions in bed occupancy and mortality without affecting re-admission rates or requiring additional resources.
Other comments	No definition of frailty in article but do establish a frailty unit.

Conference abstract	Author Ismail, S. et al[103]	Year 2014	Country UK
Study design	Service innovation		
Data source			
Study aim(s)	To reduce unnecessary admissions from the Emergency Department (ED) by accessing alterative 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 co-morbidities.		
Study population	Age Not defined	Condition Generally frail	

Intervention	What	2 interface geriatricians provide early Comprehensive Geriatric Assessment (CGA) by consulting in ED. Following assessment access appropriate alternative pathway, to admission, Intermediate Care or early Geriatric outpatient review.
	Who	Interface geriatricians
	Duration	Service has been running for a year
	Other	
Comparator group?		Discharge rates for intervention group are compared with previous ED discharge rates for frail older people
Outcome measures		Discharge Suitable for discharge Admission Time waiting to be seen in ED
Findings		58% selected patients were discharged from ED, compares favourably with previous discharge rate for frail older people of 20-33%. Further 12% patients were suitable for discharge but had to be admitted due to delays in accessing community services or investigations. 27% 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 study, no info about the size of frail older people presenting to ED. Promising but would need to be

	replicated. Conference abstract so no detailed methodological information.

Conference abstract and full paper		Author: Aldeen[68, 69]	Year: 2014	Country: USA
Study design		Prospective, observational		
Data source		medical records		
Study aim(s)		The aims of this geriatric ED innovations (GEDI) project were to develop GEDI nurse liaisons by training ED nurses in geriatric assessment and care coordination skills, describe characteristics of patients that 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 Identification of Seniors At Risk (ISAR) score greater than 2 or at ED clinician request		
Study population		Age: ≥ 65 years Mean 79.3	Condition : ISAR > 2	
Intervention	What	Geriatric Nurse Liaison (GNL). The main goal of the Geriatric Emergency Department innovations through Workforce, Informatics, and Structural Enhancements (GEDI WISE) model was to reduce preventable admissions for older adults by assessing and meeting their geriatric-specific, non-acute care needs in the ED. Individuals who do not have a clear, urgent medical indication for admission are the primary targets of the intervention. After		

		consultation is triggered, the GNL administers a series of validated tests, assessing for cognition (Short Portable Mental Status Questionnaire),13 delirium (Confusion Assessment Method),4 functional status, (Katz Activities of Daily Living),14 fall risk (Timed Up and Go test),15 caregiver strain (Modified Caregiver Strain Index),16 and transitions (Care Transitions Measure-3) In the ED, the GNL is able to consult with pharmacy, social work, physical therapy, geriatrics, palliative care, and hospice services as needed. The GNL will then make recommendations to the ED team and discuss the care plan with the individual's primary care provider. Upon completion of the assessment, the GNL creates a care plan for safe discharge instead of admission. For older adults who are discharged, the GNL performs follow-up telephone calls at 1 to 3 days and 10 to 14 days. Follow-up calls assess pain, medication concerns, outpatient appointment status, home healthcare status, and unexpected visits to healthcare settings. The GNLs document all actions in the electronic medical record, which is available to other providers and is used for programmatic data analysis.
	By whom	Geriatric nurse liaison
	Duration	Not reported – but did result in longer ED stay
	Other	
Comparator group?		Those not receiving the intervention but who attended ED during same time period
Outcome measures		Inpatient admissions
Findings		GEDI was associated with 13% fewer admissions overall, including almost 16% fewer in subjects who had an ESI score of 2. This reduction in inpatient admissions

	was due to more discharges rather than more observation stays. The increase in discharges did not occur at the expense of a higher 3-day ED revisit rate.
Conclusion	Older adults who presented to the ED with a high triage acuity score (ESI 2 or 3) and received the GEDI WISE intervention were more likely to be discharged from the ED than their control counterparts. Preventing hospital admission through geriatric-responsive ED management improves the care of older adults, potentially preventing significant physical and cognitive decline. GEDI WISE at Northwestern University is one of the first structured models of care identifying and providing for the needs of older adults in the ED staffed completely by ED personnel. With the GNL managing these needs, factors that once led to hospital admission are being addressed in the ED, often facilitating safe discharge. There has been an increase in hospital admissions in older adults who received the GEDI WISE intervention and had a less-severe ED presentation (ESI 4) (GEDI 7%, non-GEDI 3%). It may be that the GNLs uncovered underlying problems in older adults with lower-acuity complaints that necessitated admission. Before GEDI WISE, these would not have been identified in the ED before discharge. It may be that these admissions were of lower acuity because the conditions were caught earlier or prevented future morbidity and mortality (e.g., from falls or cognitive dysfunction) had the conditions not been identified. Lengths of stay for these hospitalizations and outcomes are currently being tracked, with results forthcoming.
Self-reported limitations	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. A second limitation was that GEDI consultation was associated with a statistically significantly longer median ED length of stay (1.1 hours longer). The proportion of individuals that has undergone the GEDI WISE intervention has been small relative to the overall number of older adults in the ED (5.7%) and to the number of individuals eligible for the intervention (19.2%).
Headline message	ED nurses undergoing a 3-month training program can develop geriatric-specific assessment skills. Implementation of these skills in the ED may be associated with fewer admissions of older adults
Other comments	

Full paper	Author Jones, S. & Wallis, P.[62]	Year 2013	Country UK
Study design	Cohort study		
Data source	Emergency Department (ED) records. Data collected for all patients seen consecutively during 4 separate blocks or 2 month 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 consultant geriatrician		
Setting	ED in Birmingham Heartlands Hospital		
Frail Elderly - definition	**No clear definition**		

Study population		Age – median 85, range 58 to 105	Condition - Patients deemed by ED staff to be in definite need of admission or to require involvement of the ED geriatrician in decision of admission. Patients aged under 65 had relevant condition e.g. Parkinson's Disease.
Intervention	What	Consultant geriatrician based in ED. 5.5 clinical session per week. Geriatrician also provide elderly care clinic with multidisciplinary support in the medical day hospital for patients discharged from ED.	
	By whom	Consultant geriatrician working in collaboration with team of occupational and physiotherapists.	
	Duration	30 days	
	Other		
Comparator group?		No	
Outcome measures		Admission rates Admission to elderly care wards ED reattendance within 7 days Level of burden to outpatients clinics	
Findings		The majority of patients (804/848, 94/8%) were deemed by the ED staff to be in need of admission or to require ED geriatrician involvement in decision. A minority (44/848, 5.2%) had already been deemed suitable for discharge by ED team, but still needed ED geriatrician input for follow-up plan or medication advice. ED geriatrician facilitate discharge of 543/848 (64%) of the patients and facilitated direct admission to elderly care ward of 174/305 (57%) of those who were admitted, compared with virtually no direct admission to elderly care wards from ED pre-intervention. Minority of remaining patients were admitted elsewhere for specific complaints. Major limiting factor in enabling direct admission	

	to elderly care wards was a lack of available beds within 4-hour target. 108/848 patients seen by the ED geriatrician had been discharged from hospital less than 30 days ago, 76 with same problem. Geriatrician facilitated discharge from ED and potential readmission in 40/76 cases. Patients seen by the ED geriatrician had a 7-day reattendance rate of 10.1% (86/848) this includes patients presenting with a different problem. This is higher than overall hospital average of 6.3% for the over 75 years age group but this does include all patients in this age group regardless of problem or frailty. Only 3.4% (29/848) of patients seen by geriatrician reattended and were then admitted with the same problem within 7 days.
Conclusion	A consultant geriatrician based in ED is effective in facilitating safe admission prevention for the older patient. Facilitating direct admission to elderly care wards was not the primary aim for the geriatrician but this was achieved for 174 of the 305 patients admitted. Additionally, this intervention can also substantially reduce 30-day readmission rate for older patients recently discharged from hospital. This service development required expansion of outpatient clinic service, predominantly within the elderly-care day hospital rapid access service, one-third of patients in this cohort discharged from the ED required outpatient follow up.
Self-reported limitations	None reported
Headline message	The placement of a consultant geriatrician in the ED is effective in facilitating admission prevention for older patients.
Other comments	Data collection was spread throughout year so would include any seasonal fluctuations. No clear definition of frail elderly. No control group.

Full paper		Author Eklud et al[24]	Year 2013	Country Sweden
Study design		Randomised non-blinded controlled trial		
Data source		Representative sample of frail older people at a 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 activities of daily living (ADL) and frailty		
Sample size		161 elderly people, 76 control group, 85 intervention group		
Setting		Emergency department in Swedish hospital		
Frail Elderly - definition		Over 80 or 65 to 79 with at least one chronic disease and dependent in at least one ADL		
Study population		Age over 80 or 65 to 79 if has chronic disease or ADL dependency	Condition Over 80 or 65 to 79 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 emergency department, the hospital wards and a multi-professional team for care and rehabilitation of older people in the municipality with a case manager as the hub or usual care for control group		
	Who	Older people seeking care at the emergency department of Swedish Hospital		
	Duration	Follow-up measured at 3, 6 and 12 months		
	Other			
Comparator group?		76 people acted as control group and 85 intervention group, outcomes were tested for confounders due to possibly relevant differences at baseline between groups.		
Outcome measures		Functional ability measured through ADL independence using ADL staircase Frailty measured as sum of 8 core frailty indicators		

Findings	3 and 12 months follow-ups found that intervention group had higher odds ratio in improved degree of ADL independence (OR = 2.37) compared to control (OR = 2.04). At 6 months the older people who had decreased their ADL independence in the intervention group had a lower OR (0.52, 95% CI; 0.27-0.98) compared to those in control group. No differences between groups with regards to changes in frailty
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	Non-blinded as participants could reveal their group at follow-up and assumption less attrition if generally same research assistant at follow-ups. ADL staircase has fewer I-ADL items than other international ADL instruments have but good validity in this age group. Some drop-outs main reason deceased
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	Excluded people with severe illness with immediate need assessment and treatment, dementia and palliative care. Good quality RCT

Full paper	Author Arendts, G. et al,[79]	Year 2011	Country Australia
Study design	Prospective comparative study with matched controls.		
Data source	Prospective		
Study aim(s)	To determine whether older patients requiring allied health-facilitated discharge from the emergency department (ED)		

		were at increased risk of hospital readmission and death following discharge.	
Sample size		1098 patients enrolled to intervention group and matched 1:1 with controls deemed low risk on risk screening.	
Setting		Tertiary referral hospital EDs in metropolitan Perth. One ED exclusively an adult ED and trauma centre and the other a mixed adult-paediatric ED.	
Frail Elderly - definition		Patients identified as positive risk screen from brief initial screening process applied soon after arrival at ED by nurse or member of CCT.	
Study population		Age 65 years and over	Condition Varied
Intervention	What	Patients aged 65 years and over presenting to the ED underwent risk screening. Those with positive screen formed intervention group. Intervention group underwent comprehensive functional and needs assessment by care coordination team (CCT) prior to confirm risk status and identify and manage any possible barriers to discharge. Where necessary CCT care included referral to post discharge services to address any medical, allied health or social needs found in assessment.	
	By whom	Care coordination team (CCT) team within each ED are multidisciplinary teams containing at least 1 physiotherapist, occupational therapist and social worker with option to co-opt other allied health, nursing and medical input as required.	
	Duration	Patients were followed-up for 1 year post discharge. Follow-up was at 28 days and 1 year.	
	Other		
Comparator group?		Intervention group were matched 1:1 with controls deemed low risk on risk screening	
Outcome measures		ED re-attendance within 28 days	

	Hospital readmission Mortality
Findings	At 28 days, there was a 3% absolute difference in the re-attendance rate to ED (17.9% cases, 14.8% controls, p=0.05) and no mortality difference (1.4% cases, 1.3% controls, p=0.85). At 1 year, cases had a higher incidence of unplanned hospitalisation (43.4% vs 29.5%, $p < 0.001$) but not death (10.7% vs 10.2%, p= 0.66).
Conclusion	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. The 1 year mortality rate even in a 'low-risk' discharged population is 10%.
Self-reported limitations	This is a non-randomised trial and matching of cases and controls was on predetermined measurable criteria. This design was necessary to enable us to compare our cases to a low-risk similar group; however, our design cannot account for other variables that might have confounded the results. For instance, potentially important patient characteristics such as cognitive impairment and non- English speaking background were not used as matching criteria. CCT did not operate 24 h a day and so not all patients in the study period were screened for inclusion. The screening tool used, although similar to those validated by other authors and services, was locally developed and has not been externally validated. CCT assessment processes are not standardised, and individual clinicians within the CCT will have different thresholds for deciding whether a patient was safe for discharge. We have measured some important

	outcomes, but others such as functional decline have not been measured and might be significantly different between the two groups.
Headline message	Allied health facilitated discharge of patients with a positive risk scree 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.
Other comments	

Full paper		Author Tan, K.M. et al[79]	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 emergency department (ED) Geriatric Medicine (GM) Liaison Service on appropriate discharge and length of stay.		
Sample size		285 patients		
Setting		ED in university hospital in Dublin		
Frail Elderly - definition		No definition provided		
Study population		Age 65 years or over with multiple medical diagnoses or aged over 80.	Condition Patients with multiple medical diagnoses, frailty, dementia, delirium, falls, syncope and other common presentations in older adults.	
Intervention	What	Patients were referred to the EDGM liaison service by senior ED personnel. Patients were then assessed in ED by consultant geriatrician or senior trainee geriatrician and physiotherapy, medical social work and occupational therapy input was available where required. GM service also took over care of all patients over 80 every one of 9 days.		
	By whom	Consultant geriatrician or senior trainee geriatrician		

	Duration	Data collected over period of 2 years and 9 months
	Other	
Comparator group?		No
Outcome measures		Discharge from ED Length of stay (LOS) Admitted under GM Admitted under GIM ED reattendance Readmission
Findings		The ED referred 285 patients (mean age 83.5 +/- 6.8 years) to the EDGM liaison service. One hundred and thirty-nine (49%) patients were discharged from the ED with appropriate follow-up. The one month representation rate to the ED after discharge was 22% with 8% admitted to hospital on subsequent presentation. The remainder one hundred and forty-six (51%) patients were admitted under the GIM team on call or other specialist services. Two hundred and sixty-eight patients over 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 (73%) were admitted under GM, 71 (17%) under GIM and 43 (10%) under other specialist services. Overall 54 (13%) inpatients died during their admission period. Mean LOS of the patients who died was 20.4 +/- 25.6 days. Comparison of LOS was done for 323 patients discharged alive from the GIM and GM service. Mean LOS of 62 patients

	discharged from GIM care was 33.5 +/- 27.7 days compared to 20.3 +/- 25.0 days ($p<0.001$) of 261 patients under GM care. When LOS analysis excluded patients discharged to a NH, mean LOS was 25.0+/-18.6 days for the GIM and 15.2 +/- 16.3 ($p<0.0001$) days for GM. Mean LOS of a patient admitted from home and discharged to a NH was 62.9 +/- 35.9 days. Twenty-three percent of patients admitted from home under GIM care were discharged to NH care in comparison to 14% of patients under GM care ($p=0.11$). For 320 patients discharged alive from hospital with 1 month follow-up data, the one month ED repeat attendance rate was 14.7% (GM) vs. 19.4% for GIM ($p=0.37$). The readmission rate one month after discharge from hospital was 10.5% (GM) vs. 9.7% for GIM (p=not significant). For 310 patients discharged alive from hospital with 3 month follow-up data, four patients had died and the 3 months readmission rate to hospital after discharge was 17.4% (GM) and 20.3% for GIM ($p=0.59$). Of the remaining 12 patients, 7 had not reached the 3 month follow-up point and 5 patients were recorded as dead on the hospital computer system, but the date of death was not recorded, whether it was before or after the 3 month follow-up point.
Conclusion	Direct admission of the older, frail adult under the GM service has the potential to reduce LOS without adversely affecting other quality markers including the rate of ED repeat attendances and readmission to hospital. A substantial proportion of older adults could also be discharged from the ED with a tailored treatment and follow-up plan.

Self-reported limitations	The numbers analysed were small, leading to reduced statistical strength of analysis. The reasons for attendance to ED was also not recorded as we had decided to concentrate on collection of basic demographic data and readmissions rates and ED repeat attendances as outlined above. The future developments for the GM service in our department include formalisation of the EDGM liaison service with GM clinical nurse specialist support; an inpatient NH liaison service and an outreach NH liaison service where patients will be reviewed in their place of residence in the NH. The Identification of Seniors at Risk (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 EDGM liaison team.
Headline message	The findings suggest specialty specific geriatric medicine management of the older adult presenting to ED can improve service and patient outcomes.
Other comments	Lack of detail about methodology. No definition of frailty. No comparator group.

Full paper	Author: Salvi, F. at al[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 Identification of Seniors at Risk (ISAR) and Triage Risk Screening Tool (TRST), based on direct patient evaluation.		
Sample size	2057		
Setting	ED in a geriatric hospital		
Frail Elderly - definition			

Study population		Age: 65 years and older. mean age 81.7 years, range 65–103	Condition: An ISAR score ≥ 2 (in a range from 0 to 6) suggests an increased risk for functional decline, repeated ED visits, hospital admissions, institutionalization, and death within 6 months after an ED visit.
Intervention	What	ISAR 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, hospitalization, and death in 6 months.	
Findings		ISAR (cutoff of ≥2) was positive in 68% of patients, whereas 64% were TRST positive. The two scores were significantly correlated and had similar areas under the receiver operating characteristic (ROC) curves in predicting hospital admission (ISAR, 0.68; TRST, 0.66) and mortality (ISAR, 0.74; TRST, 0.68), as well as early ED revisit (ISAR, 0.63; TRST, 0.61). In the 6-month follow-up of patients discharged alive, the tools predicted comparably ED return visit (ISAR, 0.60; TRST, 0.59), hospital admission (ISAR, 0.63; TRST, 0.60), and mortality (ISAR, 0.74; TRST, 0.73). A similar performance was observed in the subgroup of participants discharged directly from the ED.	
Conclusion		Risk stratification of elderly ED patients with ISAR or TRST is substantially comparable for selecting elderly ED patients who	

	could benefit from geriatric interventions. ISAR had slightly higher sensitivity and lower specificity than TRST
Self-reported limitations	1) Participants admitted to the ED at INRCA hospital were almost entirely preselected by community emergency medical services as nontrauma cases; therefore, trauma patients could be underrepresented. 2) External validity was probably further limited by exclusion of night time arrivals. The study was carried out at a unique and peculiar site (geriatric ED), whereas ISAR and TRST have been developed in multicentre studies. Thus, the results may not be easily generalized to other standard EDs and non-geriatric hospitals 3) Third, the triage nurse scored both ISAR and TRST in a patient, and this could have affected correlation between the two tests. Similarly, several nurses worked at triage, and have no data on interrater reliability; however, triage nurses received a specific training on the scoring system of both tools before the study started. 4) Fourth, other clinical events, such as change in functional status or incident delirium, are important in hospitalized older patients and might have been considered as study outcomes but, unfortunately, were unavailable. 5) Finally, data on recurrent ED access and hospitalization were limited to the Marche Region, thus there may be some missing events; however, the use of out-of-region hospitals is negligible, especially at an old age.
Headline message	ISAR and TRST can offer an accurate prognostic assessment of older patients presenting to an ED for medical reasons, in terms of the need of hospital admission and mortality, return

	ED visit, hospitalization, and long-term mortality. However, both ISAR and TRST were positive in most of the participants in this study, thus lacking in specificity.
Other comments	

Full paper		Author Salvi, F. et al[27]	Year 2012	Country Italy
Study design		Prospective observational study		
Data source		Secondary analysis of prospective observational cohort study		
Study aim(s)		To test validity of Identification of Seniors At Risk (ISAR) screening tool by testing whether a comprehensive geriatric assessment (CGA) based approach using the ISAT screening tool was association with the brief deficit accumulation index (DAI) of frailty		
Sample size		200		
Setting		Two urban emergency departments (ED) in Italy		
Frail Elderly - definition		Frail subjects were defined as those in needs of mobility or ADL assistance and/or cognitively impaired.		
Study population		Age 65 or over mean age 80.3 ±7.4; 28.5% over 85 years	Condition	
Intervention	What	ISAR administered following triage to patients or accompanying family member if patients were cognitively impaired or acutely confused. During ED visit patients also underwent brief geriatric assessment using the Charlson index for comorbidity, the SPMSQ for cognitive function and the Katz activities of daily living (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 is available for excluded, non-screened or for those patients who refused to participate
Outcome measures		ADL dependence Number of ED visits Hospital admissions Mortality
Findings		Consistency of DAI-based frailty definition was tested by verifying the proportion of subjects who had experienced any adverse outcomes within 30 days and within 6 months since ED discharge according to frailty status. Frail patients experienced more ED revisits within 30 days and 6 months, and were more likely to undergo hospital admissions compared with non-frail patients. Frail patients did not have an increased risk for 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. 6 month mortality rate of frail elderly ED patients was higher than non-frail patients. (hazard ration = 8.68, 95%CI = 2.60-28.94, $p<0.0001$. ISAR highly correlated with frailty: AUC was 0.92 (95%CI 0.88-0.96) indicating good performance in identifying frailty according to DAI-based definition. An ISAR cutoff of 2 had sensitivity 0.94 (95%CI 0.88-0.97) and specificity 0.63 (95%CI 0.51-0.73). Using a cutoff of 3 allowed for stricter selection of frail patients, ISAR had sensitivity 0.79 (95%CI 0.71-0.86) and specificity 0.93 (95%CI 0.84-0.97).

Conclusion	ISAR is a reliable and valid predictor of death, Ed revisit, hospital admissions and functional detail in 6 months after an ED visit in a complex ED population such as the elderly. The ISAR can recognise high-risk patients more likely to benefit from an integrated clinical approach, longer observation time and appropriate referrals.
Self reported limitations	Some limitations of our study should be considered. A first possible criticism could be the choice of a simple Dai-based definition of frailty (20). the present paper is a post-hoc analysis of a previously carried out study (15), therefore the choice of using the rockwood criteria of frailty was formulated using the available data (a brief cGa conducted by using charlson index, SpMSQ and Katz' aDl scale). although the phenotypic criteria are able to predict eD utilization and hospitalization (34), some recent studies comparing the Daibased frailty have shown better associations of Dai-based operational definitions on predicting adverse outcomes, such as mortality and institutionalization (36, 37). Moreover, phenotypic criteria of frailty are not easy to verify in an eD setting. A second limitation was that the sample is limited to weekday/daytime eD arrival (n=200). Nevertheless, data were highly concordant with those obtained in a larger population (1851 patients) by Hastings et al. on frailty (4). Finally, the study was conducted in two eDs of a large Italian city: the pattern of the eD use could be different in other cities and countries, so caution should be used in generalizing the results
Headline message	ISAR is a useful screening tool for frailty and identifies elderly patients at risk of adverse outcomes after an ED visit. ISAR can also be used to select high-risk patients 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 that refused to participate.

Full paper and conference abstract		Author Graf, C. et al[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 seen by Geriatrics team (GT) in the ED		
Study population		Age Mean 84 years (SD 5.7)	Condition Orthopaedic problem or trauma (30%), cardiac problem (25%), psychiatric illness (12%)	
Intervention	What	Screening with ISAR, modified ISAR and TRST		
	By whom	GT physician		
	Duration	N/A		
	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, modified ISAR, 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 ISAR and 83.6% for 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	

Full paper	Author: Leah and Adams[73]	Year: 2010	Country: UK
Study design	Descriptive paper		
Data source	Journal		
Study aim(s)	This article describes the establishment of an assessment team for older people (ATOP) that has been created to address these issues in a district general hospital.		
Sample size	666		
Setting	ED		
Frail Elderly - definition	The frailty markers have been developed locally using the Urgent Care Pathways for Older People with Complex Needs (DH 2007), The Older Person in the Accident and Emergency Department (Birns and Beaumont 2008) and the Comprehensive Assessment for the Older Frail Patient (British Geriatrics Society 2010). Two or more of the following are considered markers of frailty: • Inability to perform one or more basic activities of daily living in the three days before admission. • A stroke in the previous three months. • Depression. • Dementia. • A history of falls.		

		• One or more unplanned admissions in the previous three months. • Difficulty walking. • Malnutrition. • Prolonged bed rest. • Incontinence.	
Study population		Age: ranged from 60-103	Condition: older people attending an ED
Intervention	What	Assessment team for older people (ATOP) was established in the emergency department and medical assessment unit at a district general hospital. The focus of the team is to provide comprehensive geriatric assessment. Access to the ATOP is based on age and multiple needs, rather than on age alone. Older adults with a single pathology do not generally require the services of the ATOP and they have access to sub-specialty physicians in the same way as younger patients. Similarly, older patients who are critically ill are not referred to the ATOP. Based on the principles outlined in Reforming Emergency Care (DH 2001), the ATOP has been designed to provide an accessible, patient-centred, integrated, high quality service delivered without delay or loss of dignity. Patients are screened in the emergency department and medical assessment unit by a member of the ATOP based on their presenting history and age. Those patients presenting with frailty markers receive comprehensive assessment away from the emergency department, in an appropriate environment with adequate facilities, to ensure they feel comfortable and where their dignity can be better maintained. Integrated plan is agreed with the patient and carers, if appropriate. If the patient lacks capacity to make decisions regarding the plan of care, the next of kin will be involved. In situations where there is no next of	

		kin, an independent advocate will be instructed. This involves communication and collaboration between healthcare professionals from a variety of disciplines, not least the community services in instances where a community hospital bed or community admission avoidance services would best meet a patient's needs. Nursing assessment includes assessment of pressure ulcer risk (and implementation of preventive measures), and assessment of pain and need for analgesia, particularly in those with communication difficulties. Patients with mental health needs are assessed, managed and, where appropriate, referred to local mental health services. Identification of and response to suspected elder abuse and the protection of vulnerable adults is also a high priority (DH 2000). The ability to perform swallow assessments has proved to be invaluable. An average of six swallow assessments are performed each month, ensuring that patients' nutritional status is not further compromised and that appropriate alternatives to oral nutrition can be discussed and implemented, if necessary. Nurses in the team also carry out assessment of social care needs and have a good awareness of local provision available in the community to support independent living. The team's social workers provide specialist input and timely access to social services, thereby reducing the difficulties that ward staff commonly experience. Mobility assessment can be carried out by nurses.
	By whom	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 healthcare assistant.
	Duration	Not described
	Other	

Comparator group?	none
Outcome measures	Admission rates. costs
Findings	The ATOP prevented admission for 178 (27%) of the 666 patients seen. These are patients that the medical on-call team or emergency department team had decided to admit because they were considered to have an ongoing need for medical treatment in a hospital setting. In many instances, it was considered to be unsafe for the patient to return home at that time. Following assessment by the ATOP, an alternative plan of care was devised and the admission to an acute bed was avoided. 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 and above seen in the study period could be more than £500,000.
Conclusion	In the four months of the study period, the ATOP prevented admission of 178 of the 666 patients seen. Of these 178 patients, 19 re-attended the hospital and six were admitted. Of the 178 patients who were not initially admitted to hospital, 19 re-attended 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, while five patients who had chosen to return home against advice also re-attended.
Self-reported limitations	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;
Headline message	A dedicated team with a focus on the needs of frail older adults has proved to be a beneficial addition to the emergency department of a district general hospital. 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.
Other comments	Not an effectiveness study – no comparison group

Full paper		Author: Salvi, F. et al[49]	Year: 2009	Country : Italy
Study design		Prospective observational study		
Data source		Journal - Aging Clinical and Experimental Research		
Study aim(s)		This study evaluated the predictive validity of ISAR for elderly patients presenting to Italian ED		
Sample size		200		
Setting		2 urban ED departments		
Frail Elderly - definition		Acutely ill ED patients aged ≥ 65 years		
Study population		Age: 80.3 (SD 7.4)	Condition	
Intervention	What	ISAR (Identification of Seniors At Risk) 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: early (30-day) and late (6-month) ED revisit, frequent ED return, hospital admission and functional decline. Composite outcomes: (1) death, long-term care placement, functional decline, (2) the same as (1) plus any ED revisit or hospitalisation		
Findings		ISAR was positive for 141 (70.5%) subjects, who had high comorbidity, disability and cognitive impairment. ISAR positive patients had an OR of 4.77 (95% CI, 2.19-10.42) to		

	undergo composite outcome [1] and of 3.46 (95% CI, 1.68-7.15) to experience composite outcome [2]. ISAR also predicted ED revisit and frequent use, hospitalization and functional decline at 6 months. ISAR was also an independent predictor of 6-month mortality (Hazard Ratio 6.9, 95% CI 1.65-29, p=0.008).
Conclusion	ISAR can be used as a screening test to identify Italian elderly ED patients who have an increased 6-month risk of death, LTC placement, functional decline, ED revisit, or hospitalization.
Self-reported limitations	First, this study used a weekday/daytime convenience sample limited to 200 patients. However, this design was deliberately chosen in order to simulate the most feasible screening of the general elderly population in our ED setting. our results may not be capable of being generalized to community hospital settings (since both study sites were academic ED) and cities with a lower prevalence of geriatric population or without a geriatric hospital. Moreover, the limited sample and high admission rate at the index ED visit prevented us from analysing the performance of ISAR separately among patients admitted and discharged from the ED. Nevertheless, excluding admitted patients, ISAR did remain significantly predictive of frequent ED return, 6-month functional decline, and both composite outcomes (data not shown). Further studies are warranted to clarify this issue. Second, did not exclude patients coming to the ED from an LTC setting. Recruited only 9 such subjects (4.5%) and, excluding them from the analyses, our results become even stronger (data not shown). In addition, we used a selective definition of functional decline (loss of at least one ADL) and excluded patients with an ADL score of zero at recruitment.

	Reclassifying these patients among those who experienced functional decline, as McCusker et al. did (10), our results become even stronger (composite [1]: adjusted OR 4.24, 95% CI 2.06-8.74, p<0.0001).
Headline message	ISAR was confirmed as a reliable and valid predictor of death, LTC placement, functional decline, ED revisit or hospital admission during the 6 months after an ED visit. ISAR can be administered by a nurse immediately after triage without any further workload for ED staff. ISAR can signal high-risk patients who would benefit from an integrated (geriatric) clinical approach, longer observation time (or access to Observation Units) and appropriate referral (primary physician, geriatric evaluation and management unit, social services).
Other comments	

Full paper	Author Salvi, F. et al[94]	Year 2008	Country Italy
Study design	Secondary analysis of 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 emergency department in Italy		
Sample size	200 acutely ill ED patients aged 65 and older enrolled from 2 EDs, a conventional ED (CED) and a geriatric ED (GED).		
Setting	A conventional ED (CED) and a geriatric ED (GED). The CED was in a tertiary-care academic hospital. The GED was a hybridized ED with a six bed observation unit designed for elderly non-trauma patients within academic-affiliated hospital.		

Frail Elderly - definition		Frail as suggested by high levels of comorbidity, disability and cognitive impairment	
Study population		Age 65 years and over	Condition
Intervention	What	Geriatric ED – 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 person.	
	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		Overall, the study population was old (28.5% were aged ≥85, mean age 80.3 ± 7.4) and frail. GED patients were older and medically and socially frailer, but no significant differences were found in terms of triage, comorbidity, admission at time of enrolment, ICU admissions and length of in-hospital stay. Length of stay was significantly shorted for CED than GED patients, although the later measure included time spent in the observation unit. At 30 days, 13 patients, 5 from GED, had died and 6 had been in hospital since the time of recruitment. Of the remaining 181 patients 48 had required 1 or more ED revisits and 24 had been admitted to hospital. Early ED return was not different between EDs.	

	Late and frequent ED return rates were not significantly different between the 2 EDs. ED setting was not associated with hospitalisation or functional decline. At 6 months, 39 patients (19.5%), 19 of them GED patients, had died. Despite the greater frailty of the GED patients, mortality rates were not significantly different between the EDs, although the Cox regression model adjusting for age; sex; living status; admission at the time of recruitment; and Charlson Comorbidity Index, SPMSQ, and ADL scores showed a lower, although barely significant risk for GED patients (hazard ratio = 0.47, 95% CI = 0.22–0.99, P=.047.
Conclusion	GED patients were older and frailer than CED patients. The two EDs didn't differ in terms of early, late, or frequent ED return or in 6-month hospital admission or functional decline. Mortality rate was slightly but significantly lower in GED patients. Data suggests slight superiority for GED in acute care of older people supporting hypothesis that ED facilities specially designed for older adults may provide better care.
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 this was a convenience sample of 200 elderly ED patients that excluded patients too ill to collaborate and those with cognitive impairment and no available informant. Nonetheless, the rate of urgent visits in the sample was higher than that of 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 semiurgent and nonurgent ones, at least in the

	United States and Canada. Furthermore, in the current study, diagnoses and number of ICU admissions were similar for the two EDs. These findings, together with data adjustment for comorbidity, strengthens the significance of the slight difference in mortality, although the effect of other variables cannot be excluded. Third, this sample does not include patients presenting for trauma. Falls and trauma are frequent presenting complaints in elderly people, and their exclusion may have introduced another selection bias, although because the INRCA hospital lacks an orthopedic unit, whereas the Azienda Ospedali Riuniti has two, this may have ensured greater patient homogeneity. Finally, although comparing different care systems requires a study design free of any selection biases and confounders, this was a secondary analysis of a study designed to validate the ISAR screening tool at two Italian ED. Further studies with appropriate design (trials enrolling patients matched for age, sex, severity and presenting complaint) are therefore warranted.
Headline message	A GED staffed by geriatricians and organised to meet the needs of older patients showed slight superiority suggesting benefit of specially designing care for older adults.
Other comments	

Full paper	Author : Lee, J. S. et al[52]	Year: 2008	Country: Canada
Study design	Prospective, observational study with 1-yearfollow-up		
Data source	Medical records		
Study aim(s)	To assess the predictive validity of the Triage Risk Stratification Tool (TRST) to identify return to the emergency department (ED) or hospitalization in a multicentre patient sample. The primary objective was to assess the ability of the		

		TRST to identify older patients at high risk after discharge from the ED in a larger, multicentre patient sample at 30, 120, and 365 days. The secondary objectives were to examine the effect of using different TRST cutpoints to define high risk and whether other combinations of variables better predicted patient outcomes than the TRST.	
Sample size		788	
Setting		EDs of three hospitals in Toronto, Canada	
Frail Elderly - definition			
Study population		Age: range 65 to 101 (mean 76.6 years)	Condition
Intervention	What	The Triage Risk Stratification Tool (TRST) was developed to identify older patients who are at risk for ‘‘failed’’ discharge home from the ED, defined as return to the ED, admission to the hospital, or admission to a nursing home within 30 to 120 days after discharge. The TRST is a five-item clinical prediction rule designed for rapid administration by the triage nurse in an ED after minimal training. The five TRST items • whether patients had a history or evidence of cognitive impairment (poor recall or not oriented); • had difficulty walking, transferring, or a history of recent falls; • took five or more medications; • had had an ED visit in the previous 30 days or a hospitalization in the previous 90 days • any concerns about elder abuse or neglect, substance abuse, medication nonadherence, or difficulty performing instrumental activities of daily living.	
	By whom	Emergency nurse or a patient care coordinator (PCC)	
	Duration	2-5 minutes	

	Other	
Comparator group?		none
Outcome measures		The composite endpoint was defined as return to the ED or admission to hospital within 30, 120, and 365 days after discharge from the ED.
Findings		Of the 788 subjects, the composite endpoint occurred in 147 (18.7%) by 30 days, 245 (31.1%) by 120 days, and 346 (43.9%) by 365 days. The mean TRST score was 1.55 (range 0–5), and 147 (18.7%) patients experienced the composite endpoint of return to the ED or hospital admission by 30 days. The sensitivity of a TRST score of 2 or greater was 62%, (95% confidence interval (CI) 54–70%), specificity was 57% (95% CI 53–61%), and likelihood ratio was 1.44 (95% CI 1.23–1.66). The area under the curve was 0.61 using a cutoff score of 2.
Conclusion		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 Identifying Seniors at Risk tool, and assess the effect of any new prediction rule on patient outcomes.
Self-reported limitations		TRST forms were completed on only 49% of eligible patients. Although the age and sex distributions of patients who were enrolled were similar to those of patients who were not enrolled, a selection bias cannot be excluded. It is possible that the emergency nurses and PCCs were more likely to complete forms on patients who seemed to be at highest risk; thus if universal screening of older ED patients using the TRST were implemented, the TRST might perform differently because of a potential spectrum effect, although it is likely that the predictive performance found in the current study reflects how

	the TRST would perform in actual clinical practice. This study did not capture patients who were admitted to nursing homes after ED discharge. PCCs were not blinded to the results of the TRST score when determining whether post discharge referrals were required; thus it is possible that this may have reduced the apparent predictive performance of the TRST by reducing the outcome rate. Because only patients who returned to the three participating centers were captured, patients who experienced the study outcomes but returned to another institution may have been missed. The effect of missing patients who presented to other centers is difficult to predict, but these missed patients might have reduced the precision but not the validity of the findings. Finally, it was not established whether return ED visits were planned at the time of discharge (e.g., returning for a dressing change). Including planned visits might have reduced the precision of the findings as well, but this is unlikely to have substantially altered the results, because planned follow-up in the ED is discouraged because of overcrowding.
Headline message	The TRST demonstrated only moderate predictive ability, and ideally, a better prediction rule should be sought.
Other comments	

Full paper	Author: Warburton, R. N.[119]	Year: 2005	Country: USA
Study design	Action Research? Evaluation research? The Plan-Do-Study-Act improvement cycle was used as a framework. The cycle is repeated to create continuous quality improvement. This improvement project has had at least nine Plan-Do-Study-Act cycles over its 15-month history. Simple		

	outcomes have been assessed by comparing patient sub-groups based on risk status and interventions received. Cost and benefits were assessed based on estimated program outcomes and average costs. Sensitivity analysis was performed to test alternate assumptions.
Data source	The full evaluation of Elder Alert has six components: (1) process evaluation; (2) simple comparison of length of stay, repeat ED visits, and subsequent hospital admission for high-risk versus 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 program; (5) assessment of patient experience of care resulting from the Elder Alert program; and (6) Economic evaluation (cost-benefit, cost-effectiveness, or cost-utility analysis).
Study aim(s)	The purpose of this article is to report preliminary outcome and cost-benefit results for a patient safety quality improvement program intended to improve outcomes for patients aged 75 or more visiting the Emergency Department (ED). The program uses the Identification of Seniors at Risk (ISAR) scale to screen, and refers patients at high risk for appropriate intervention.
Sample size	277
Setting	Community hospital emergency department
Frail Elderly - definition	none

Study population		Age: Patients aged 75 or more visiting the ED.	Condition
Intervention	What	A high-risk screening and referral programme for all patients aged 75 or more attending as an emergency. The goal was to devise a screening and referral program for ED patients aged 75 +, who without screening might not be recognized as high risk.	
	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 are compared for the four patient groups (N (not screened), HP (high risk), HC (screened and receiving all intended services) and L (low risk)). For patients visiting the ED and not admitted to hospital, the index care episode ended when they left the ED; for patients admitted immediately following the index ED visit, the index care episode ended when they were discharged from hospital. Outcomes assessed were: . median length of stay (for patients admitted directly from the index ED visit); . returns to the ED; . subsequent hospital admission; and . multiple encounters (any combination of two or more ED returns or admissions after the index care episode).	
Findings		Most hypotheses are supported: • the screening tool appears to be accurate – outcomes are better for patients screened low-risk (L) than for patients not screened (N);	

	• the screening and referral programs appear to be having a positive impact –most outcomes are better for patients screened and receiving all intended services (HC) than for patients not screened (N), even though group N is composed of younger, less emergent patients; referrals appear to have a positive impact – outcomes for patients screened high-risk and receiving complete referrals (HC) are consistently better than for patients screened high-risk and receiving partial or no referrals (HP); and • comparing outcomes for patients screened high-risk and receiving services (HC) to other groups, it appears that screening and referral improves outcomes to a level intermediate between that experienced by group HP (worst outcomes; high-risk patients receiving partial or no services) and that of group L (best outcomes; low-risk patients), and (for most outcomes) better than that of patients not screened (N). One hypothesis is rejected: • There is good evidence that screening on its own does not have a positive effect outcomes are worse (not better) for patients screened as high-risk but with partial or no referrals (HP) than for patients not screened (N). The 12 percent difference in rates of subsequent admission is statistically significant Based on audit data, it appears that SPH would see approximately 2,900 eligible patient visits in the ED each year. Based on average costs for acute care ($988/day) and ED visits ($153 each) (Vancouver

	Island Health Authority, 2004), the value of saved visits and days resulting from Elder Alert screening are estimated as follows: • with all eligible patients screened, and all high-risk patients receiving complete referrals, SPH could expect 78 fewer ED returns and 121 fewer admissions annually (value $130,000); • with 46 percent screened (average rate for audits 5 through 8) and all high-risk patients receiving complete referrals, SPH could expect 36 fewer ED returns and56 fewer admissions annually (value $60,000); • even as implemented (46 percent screened, referrals completed for 46 percent 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 (value $28,000).
Conclusion	main conclusions 1. screening all eligible patients and completing referrals for all high-risk patients have still not been achieved, and Pharmacy reviews have not been included in referral services as intended, these are areas for future investigation and improvement, particularly for ED patients not admitted. 2. when completed, screening and referral appears to slightly reduce length of stay (for patients admitted at the index ED visit), and to reduce returns to the ED and admissions to hospital within 30 days of the end of the index care episode. 3. because program costs were low, net benefits have most likely been achieved despite implementation difficulties; however, given global budgeting for

	hospital care, budgetary savings are unlikely. Instead, reallocating care is expected to have increased the health benefit gained by the population for a given level of acute care spending. Larger gains from reallocation are possible if implementation can be improved without significantly increasing resource requirements.
Self-reported limitations	None reported
Headline message	Screening and referring all eligible patients has still not been achieved; these are areas for future investigation and improvement. Screening and referral appear to be effective in improving outcomes but because program costs were low, net benefits may have been achieved; however given global budgeting for hospital care improvements in the use of resources (rather than budgetary savings) would be expected. 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	

Full paper and conference abstract	Author: Schoenenberger[33] and Schoenberger [22]	Year: 2014	Country: Switzerland
Study design	prospective controlled study – pre post design, consecutively presenting		
Data source	Original EGS forms and ED discharge reports		
Study aim(s)	This study evaluated the feasibility of a novel multidimensional emergency geriatric screening (EGS) tool specifically designed		

<table>
<tr><td colspan="2"></td><td colspan="2">to detect geriatric problems in an ED setting. Goals were to determine the prevalence of abnormal EGS findings and to establish whether EGS increased the number of EGS-related diagnoses on ED discharge reports.</td></tr>
<tr><td colspan="2">Sample size</td><td colspan="2">338</td></tr>
<tr><td colspan="2">Setting</td><td colspan="2">University Hospital ED</td></tr>
<tr><td colspan="2">Frail Elderly - definition</td><td colspan="2">Not reported</td></tr>
<tr><td colspan="2">Study population</td><td>Age: ED patients 75 years or older throughout a 4-month period
Screening gp: mean 82.7 (5) n = 795
Control gp: mean 82.6 (5.1)
N= 752</td><td>Condition
<table><tr><td>Main condition leading to ED visit</td><td>control n (%)</td><td>screening n (%)</td></tr><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></table></td></tr>
<tr><td>Intervention</td><td>What</td><td colspan="2">The EGS tool consisted of short validated instruments used to screen 4 domains (cognition,falls, mobility, and activities of daily living)

The tool met the following prerequisites:
(1) EGS is multidimensional and covers relevant domains of geriatric problems;
(2) EGS uses validated instruments; and
(3) EGS must be feasible in an ED.</td></tr>
</table>

		It considered 4 domains relevant for older ED patients: cognition, falls, mobility, and activities of daily living (ADLs). For each, they selected short validated instruments. the Ottawa 3DY test, which assesses orientation and the ability to spell a word backward, to evaluate cognition . To evaluate falls, used 2 self-report questions that predict future falls . One self-report question screened for mobility prior to the EDvisit. Current mobility in the ED was checked with the Timed Up and Go Test. Activities of daily living were screened with a standard instrument.
	By whom	ED physicians
	Duration	Less than 5 minutes
	Other	457 did not receive EGS and were excluded from per-protocol analysis (175 EGS unfeasible due to patient's clinical situation in the ED 282 did not receive EGS due to logistical reasons)
Comparator group?		Preceding control period- usual care. Usual care does not include geriatric screening or the use of other geriatric risk prediction tools
Outcome measures		• the numbers of abnormal EGS findings. • the number of EGS-related diagnoses on the ED discharge reports during screening, in comparison with the preceding control period
Findings		Emergency geriatric screening was performed on 338 (42.5%) of 795 patients presenting during screening. Emergency geriatric screening was unfeasible in 175 patients (22.0%) because of life-

	threatening conditions and was not performed in 282 (35.5%) for logistical reasons. Emergency geriatric screening took less than 5 minutes to perform in most (85.8%) cases. Among screened patients, 285 (84.3%) had at least 1 abnormal EGS finding. In 270 of these patients, at least 1 abnormal EGS finding did not result in a diagnosis in the ED and was reported for further workup to subsequent care. **Emergency geriatric screening findings and related diagnoses on ED** **discharge reports** There were statistically significant increases in the number of patients with EGS-related diagnoses on ED discharge reports during screening. During the screening period, 142 (42.0%) of the 338 screened patients had at least 1 diagnosis listed within the 4 EGS domains, significantly more than the 29.3% of the patients presenting during the control period. This was due to a marked increase of diagnoses in cognition-related and falls-related domains **Predictive analysis** Predictive analysis showed that patients with 3 or 4 abnormal EGS findings were more frequently admitted from the ED to an inpatient unit as compared with patients with 2 or less abnormal EGS findings (OR, 2.68; 95% CI, 1.65-4.35; P b .001). For inpatients, the presence of 3 or 4 abnormal EGS findings significantly predicted in-hospital LOS

	(time ratio, 1.26; 95% CI, 1.05-1.51; P = .01) and whether patients were institutionalized in a nursing home after their in-hospital stay (OR, 12.13; 95% CI, 2.79-52.72; P = .001).
Conclusion	Emergency geriatric screening predicted nursing home admission after the in-hospital stay (odds ratio for ≥3 vs <3 abnormal domains 12.13; 95% confidence interval, 2.79-52.72; P = .001)
Self-reported limitations	This study has limitations. The nonrandomized pre-post design limited the comparability of screening and control group. However baseline characteristics were similar between the 2 groups and primary analyses were adjusted for baseline factors. Because the study was conducted in one academic center, generalizability is limited. We also did not address intra tester and inter tester reliability. Finally, the study does not demonstrate that geriatric screening in the ED ultimately improves patient outcomes.
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 as not logistical.

Full paper and conference abstract	Author: Boyd[29] and Boyd [30]	Year: 2008	Country: New Zealand
Study design	Cross-sectional study -comparing the results of the BRIGHT with a comprehensive interRAI geriatric assessment		
Data source	Assessment forms		
Study aim(s)	To test the ability of the Brief Risk Identification for Geriatric Health Tool (BRIGHT) to identify older emergency		

		department (ED) patients with functional and physical impairment	
Sample size		139	
Setting		ED in an acute care hospital.	
Frail Elderly - definition		The BRIGHT score was the total of all positive item responses (possible range 0 to 11), with higher scores indicating greater impairment.	
Study population		Age: aged 75 years and older (65 years or Maori and Pasifika elders18) mean age: 82.5 (5.4)	Condition: presented 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	The Brief Risk Identification for Geriatric Health Tool (BRIGHT) was developed to provide a self-report tool compatible with the interRAI MDS-HC. (The interRAI MDS-HC assessment is extremely thorough, but resource-intensive, requiring 40 to 60 minutes to administer by specially trained staff.) The items address the following common geriatric issues: 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. The BRIGHT screen was designed to quickly identify those older adults who would benefit most from a comprehensive geriatric assessment	
	By whom	Self administered or with assistance by untrained caregivers or family members	
	Duration	Not reported	

	Other	
Comparator group?		Results compared with those of the Comprehensive geriatric assessments were conducted using the interRAI MDS-HC (Home Care) or the interRAI-AC (Acute Care) which takes 30-60 mins to administer and is carried out by a health care professional. After the participant's ED visit, trained assessors (n = 6) conducted a comprehensive geriatric assessment either in the hospital or at the older adult's home. The assessors were blinded to the participant's BRIGHT score
Outcome measures		Primary outcome measures were instrumental activities of daily living (IADL), cognitive performance scale (CPS), and activities of daily living (ADL). Receiver operating characteristic (ROC) curves and likelihood ratios (LRs) were also used to identify an optimal BRIGHT cutoff score.
Findings		The majority (75%) of participants had assistance from a visitor or the RA to complete the BRIGHT; 25% completed the BRIGHT independently. Comprehensive geriatric assessment 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). Predicting IADL deficit, the sensitivity and specificity of the BRIGHT were 0.76 and 0.79 with a cutoff of 3 or more, and the area under the ROC was 0.83 (95% CI = 0.74 to 0.91) indicating moderate accuracy. Predicting cognitive performance, the sensitivity and specificity of the BRIGHT were 0.70 and 0.74 with a cutoff of 4 or more; and the area under the ROC was 0.73 (95% CI = 0.62 to 0.84), again indicating moderate accuracy.

	Predicting ADLs, the BRIGHT performed the poorest, the sensitivity and specificity were 0.69 and 0.70 with a cutoff of 4 or more, and the area under the ROC was 0.66 (95%CI = 0.54 to 0.78), indicating low accuracy. Positive likelihood ratios (LR+) for the three outcomes of interest were 3.6, 1.7, and 1.8, respectively. Negative likelihood ratios (LR)) were 0.3, 0.4, and 0.3.
Conclusion	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 able to be quickly and efficiently self-administered by older adults or their family caregivers. The tool compares favourably with other reported brief case-finding tools and could be used as a basis for early intervention for older adults at risk.
Self-reported limitations	This study was conducted in a single ED with a predominantly New Zealand European (Caucasian) sample. Among eligible patients, 41% completed the BRIGHT. Eighteen percent of those who completed the BRIGHT were lost to follow-up for the comprehensive assessment, thus introducing the possibility of follow-up bias. In addition, the sample size was small; for example, the 95% confidence limits around the point estimate for a positive BRIGHT (57%, based on a cutoff score of 3) was ±9. This is the first application of the BRIGHT. Further testing across settings and locations with larger samples and different risk profiles is needed. In populations with less (or more) morbidity, the BRIGHT might perform differently. For

	example, this study was designed to include only nonurgent older adults in the ED and was conducted in a setting with a low proportion of discharged patients (29%). Further research is needed to compare the utility of the BRIGHT screen to identify high-risk older people discharged from the ED and those who are admitted. In addition to the incomplete cognitive geriatric assessment follow-up bias and the single-center, largely Caucasian sample limiting external validity, numerous other forms of bias are possible. For example, non-consecutive non-consecutive patient recruitment possibly overestimates diagnostic accuracy.48 Regarding measurement error, the interRAI-AC is not widely used to date and has limited validation evidence.
Headline message	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
Other comments	

Full paper	Author: Ngian[74]	Year: 2008	Country: Australia
Study design	Retrospective observational study		
Data source	ASET electronic database was used to identify all patients encountered during the period 1 January 2004 to 30 April 2006. Discordant cases were identified and their medical records interrogated with respect to the objectives set out. Data collected included patient's age, gender, languages spoken, medical co-morbidities, admission principal diagnoses, care categories and discharge destinations. In addition, documentation by ED and ASET was interrogated for differences in recording of patients' cognitive, functional and mobility status. Additional medical problems identified by		

		ASET were noted. The seniority of ED staff involved in each case was also recorded.	
Study aim(s)		Our study objectives were to review discordant cases—elderly patients deemed for discharge by ED but 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.	
Sample size		For the designated period, 1680 referrals were made to ASET. One hundred and three (6.1%) were identified as discordant cases.	
Setting		ED	
Frail Elderly - definition		2 out of 5 of these criteria for ASET referral (1) Multiple health problems or more than three regular medications. (2) History of falls or fall-related injury. (3) More than three presentations to ED in the last six months. (4) Problems with memory. (5) Patient or carer reports recent functional or behavioural change.	
Study population		Age: 83 (±6.5) years	Condition: The three most commonly reported co-morbidities were hypertension (56%), osteoporosis (38%) and ischaemic heart disease (37%).
Intervention	What	Aged Care Service Emergency Teams (ASET) whose principal role was to improve the care of elderly ED presenters. Physician-led ASET service in which elderly patients were reassessed by a geriatric team, having been initially assessed by ED as suitable for discharge. ASET was established at the hospital in 2003 with	

		the main objectives of reducing missed diagnoses and preventing inappropriate discharge or re-presentation of elderly ED attendees. ASET comprises of an on-call senior geriatrician supervising a Geriatric Medicine trainee based solely in ED. The service is supported by on-site nursing and an allied health team comprising of a physiotherapist, occupational therapist and social worker. Post-discharge follow-up facilities include falls, memory and general outpatient clinics. An electronic database was set up at service inception.
	By whom	Physician led
	Duration	The operating hours are 10 a.m. to 6 p.m. during weekdays and 10 a.m. to 4 p.m. during weekends.
	Other	
Comparator group?		no
Outcome measures		To look at cases where elderly patients deemed for discharge ED but are 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.
Findings		ASET staff was more likely than ED to document functional, cognitive and mobility impairment, either new or worsening. In 65 cases (63.1%), ASET identified additional Acute medical problems in referred patients. These additional diagnoses were identified irrespective of the seniority of the initial ED reviewer. The main diagnoses responsible for admission collectively, were fractures (14%); complicated urinary tract infections (13%), cardiovascular disorders (15%), neurological diseases (16%), delirium (8%) and adverse drug reactions (6%). The average length of hospital stay (LOS) was 14.6 days (range, 1–

	51 days). As many as 84 (81.5%) patients were admitted for acute care; 19 (18.5%) required sub-acute care, i.e. needing admission for predominantly functional impairment; 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 ED ASET was able to prevent 6.1% of inappropriate discharges from ED. With no reports of similar services, there is no comparable data in the current literature. However, given the severity of the diagnoses for the discordant cases, it is implicit that there was a qualitative improvement in patient care.
Self-reported limitations	Limitations include: the study audited only those patients who were subsequently admitted from ED. There are likely to be other cases where an additional medical diagnosis was made and treated, but still allowing the patient to be discharged safely. Furthermore, did not follow up those patients who were discharged after ASET review.
Headline message	Study showed that 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.
Other comments	

Full paper	Author: Foo[117]	Year: 2014	Country: Singapore
Study design	quasi-randomised controlled trial.		
Data source	Screening tool scores and hospital records		

Study aim(s)		To determine if risk stratification followed by rapid geriatric screening in an emergency department (ED) reduced functional decline, ED reattendance and hospitalisation.	
Sample size		780 (500 control and 280 intervention group) (1156 were eligible)	
Setting		ED of a 1,500-bedded acute care public hospital in Singapore	
Frail Elderly - definition		See below	
Study population		Age: The eligibility criteria for inclusion in the study were: (1) patients aged 65 years old and above; (2) TRST score of 2 or more; and (3) patients who were planned for discharge.	Condition
Intervention	What	Triage Risk Screening Tool (TRST) to risk stratify, followed by rapid geriatric screening and intervention of at-risk seniors. Intervention group patients were assessed by the Geriatric Emergency Medicine (GEM) nurse while still in ED, prior to discharge. The nurse performed focused geriatric screening using a 15-question screening form. The focused areas included cognition, mood, continence, visual acuity and hearing, mobility and social issues. Medication reconciliation and a postural blood pressure were also performed. Clinically significant findings were addressed immediately where possible. Referrals to allied health professionals e.g. physiotherapist and occupational therapist were done as deemed necessary. When appropriate, patients were referred to the geriatric assessment clinic, post acute care at home (PACH), transitional services and community outreach services. Upon discharge, education and advice regarding fluid management, falls prevention, sleep hygiene and active lifestyle were provided where necessary.	
	By whom	nurse	

	Duration	15- 30 mins
	Other	
Comparator group?		standard care
Outcome measures		The primary outcome of the study was a change in the patient's functional status, measured by BADL (Barthel's Index of Activities of Daily Living) and IADL (Lawton's Instrumental Activities of Daily Living score) scores. The secondary outcomes were healthcare utilization, as measured by ED reattendance and rehospitalisation. The patients were followed up via telephone call at 3, 6, 9 and 12 months to ascertain their BADL and IADL scores. Subsequent ED attendance and hospitalization were obtained via the national electronic medical records.
Findings		There were 500 and 280 patients in the control and intervention groups. The intervention group had higher Triage Risk Screening Tool (TRST) scores (34.3% vs 25.4% TRST ≥3, p = 0.01) and lower baseline Instrumental Activity of Daily Living (IADL) scores (22.84 vs 24.18, p < 0.01). 82.9% of the intervention group had unmet needs; 62.1% accepted our interventions. Common positive findings were fall risk (65.0%), vision (61.4%), and footwear (58.2%). 28.2% were referred to a geriatric clinic and 11.8% were admitted. 425 (85.0%) controls and 234 (83.6%) in the intervention group completed their follow-up. After adjusting for TRST and baseline IADL, 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. The reduction in ED reattendance (OR0.75, CI 0.55-1.03, p = 0.07) and hospitalization (OR0.77, CI0.57-1.04, p = 0.09) were not significant, however the real difference would have been wider as 21.2% of the control group received geriatric screening at

	the request of the ED doctor. A major limitation was that a large proportion of patients who were randomized to the intervention group either refused (18.8%) or left the ED before being approached (32.0%). These two groups were not followed up, and hence were excluded in the analysis. **BADL and IADL scores** of patients in the control group appeared to have deteriorated, and the difference was statistically significant starting at 3 months. BADL scores for both control and intervention groups deteriorated over 12 months, but the degree of deterioration for the control group was more (−0.99 vs. -0.24, $p < 0.01$). Whilst the IADL scores for the control group also deteriorated over 12 month, the scores for patients in the intervention group actually improved, and the difference was statistically significant (0.45 vs. -2.57, $p < 0.01$). **Healthcare utilization**, No statistical difference in the ED reattendance and hospital admissions between the control and intervention group. NB: ITT analysis did not elucidate any difference in ED reattendance and hospitalisation rates. Per protocol analysis revealed a sustained reduction in ED reattendance over 6, 9 and 12 months. Per protocol results suggest that geriatric screening may be particularly beneficial to a frailer group of ED elders.

Conclusion	Risk stratification followed by focused geriatric screening is feasible and effective even in a busy ED. Significant and sustained in preservation of function over 12 months. Multidisciplinary assessment as well as strong interdisciplinary collaboration are key components of an effective geriatric emergency service
Self-reported limitations	The major shortcoming was that a large proportion of patients who were randomized to the intervention group either refused (18.8%) or left the ED before being approached (32.0%). These two groups were not followed up, and hence were excluded in the analysis. The size of these groups would have impacted the study results, although it is uncertain in which direction. Another significant limitation is that the RA who collected BADL and IADL scores via telephone call was not blinded to patients' group allocation. Although observer bias maybe an issue, the fact that the BADL and IADL scoring checklists are objective would have reduced this to a minimum. Furthermore, ED re-attendance and hospitalisation data were retrieved via electronic medical records and would not be subject to bias. Finally, they did not collect data regarding quality of life as well as patient satisfaction levels for GEM screening in ED.
Headline message	Risk stratification and focused geriatric screening in ED resulted in significant preservation of patients' function at 12 months
Other comments	**Context:** The context may mean the results are less relevant to the UK setting. The vast majority of patients in this study do not have a regular general practitioner, and geriatric screening is not commonly performed at primary care. Majority of patients

	would have heard the question 'do you feel sad?' for the first time during their encounter with GEM nurse. **Baseline differences between groups:** The baseline age, gender, racial distribution and patient acuity category (PAC) were similar in both groups However, there was higher proportion of patients with a TRST score between 3–6 in the intervention group (34.3% vs. 25.4%, p = 0.01) and the difference was statistically significant. Similarly, there was a statistically significant difference in the baseline mean IADL scores between the groups, the intervention group being more dependent (22.84 vs. 24.18, p < 0.01). This suggested that the patients in the intervention group were more frail

Letter	Author Pareja-Sierra, T.[91]	Year 2013	Country Spain
Study design	Data analysis (6 years 2005-2011)		
Data source	Not clear if data prospective or retrospective		
Study aim(s)	To determine the impact of an Emergency Department Observation Unit (EDOU) for elderly adults on admissions, length of stay.		
Sample size	5,571 patients admitted to ED		
Setting	EDOU in a tertiary-care urban hospital in Guadalajara in Spain. EDOU has 6 beds and is visited by geriatrician twice a day.		
Frail Elderly - definition	Aged 75 years and older with multiple comorbidities, dementia, or physical impairment with acute illness that can be treated in less than 72 hours. Admission to unit at discretion of emergency physician.		

Study population		Aged 75 years and older, mean age 87.4.	Multiple comorbidities, dementia, or physical impairment with acute illness that can be treated in less than 72 hours. Most had moderate to severe physical disability (70%) and mild to moderate cognitive impairment (70%) measured using Barthel Index and Geriatric Dementia Scale.
Intervention	What	Implementation of EDOU for elderly adults that is visited by geriatrician twice daily. EDOU objectives include providing diagnostic specificity through multidimensional geriatric assessment followed by individualised treatment, optimising the use of different outpatient levels of the Geriatrics Service, and avoiding unnecessary hospital admissions or discharge planning of frail elderly adults without follow-up care.	
	By whom	Geriatrician	
	Duration	6 years	
	Other	Admission to unit at discretion of emergency physician.	
Comparator group?		Comparison with data before EDOU implemented	
Outcome measures		Admission to hospital, length of hospital stay, readmission within 48 hours and 7 days	
Findings		Since development of EDOU, the percentage of individuals requiring admission to the geriatric ward stabilized after a period of progressively increasing and was accompanied by a decrease in mean length of stay from 9.9 days in 2006 to 7.6 days in 2011.	
Conclusion		Development and implementation of a geriatric observation unit in the ED for individuals aged 75 and older with a geriatrician on call was effective at preventing admission to the hospital in a large percentage of elderly adults. Also, decrease in mean length of stay.	

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	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.
Other comments	Very little detail on methodology so will be hard to comment on quality

Conference abstract	Author Yim[25]	Year 2011	Country Hong Kong
Study design	Cohort study to derive and validate a screening tool for high-risk elderly people in the ED, followed by a randomised trial of a structured ED intervention for those identified as high-risk for adverse outcomes		
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 Identification of Seniors at Risk (ISAR) screening tool; 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		
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 Identification of Seniors at Risk (HK-ISAR) tool		
Study population	Age Derivation cohort mean 74.5 (SD 6.2). RCT 75 (6.8) for control	Condition (additional to frailty) Patients aged ≥65 years who were about to be discharged from the ED	

		group and 76.3 (6.8) for intervention group	
Intervention	What	Administration of the validated HK-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 comprised 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 the individual's 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 ED; or death	
Findings		In the derivation group, the HK-ISAR 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 and control groups for the composite outcome or any of its components	
Conclusion		The HK-ISAR is suitable for use in an ED setting to identify patients at risk of adverse outcomes; it is more applicable to the local population compared with 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 differences between original and HK-ISAR may indicate differences between health systems in use of the ED by elderly patients. Methods of randomisation etc. for the RCT were not reported, so risk of bias is unclear

Full paper	Author Ellis[92]	Year 2012	Country Scotland
Study design	Cohort, prospective before and after service evaluation		
Data source			
Study aim(s)	To implement a four bedded Acute Care for Elders unit in the ED to better undertake rapid and thorough CGA with an outcome of either direct specialty 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 after the opening of the unit elsewhere		
Setting	District General Hospital in Scotland		
Frail Elderly - definition	Over 65		
Study population	Age 65 and older. Mean age was 80.5 (before), 81.1 (ACE) and 80.3 (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	Rapid and thorough CGA in a discrete, acute care for elders unit	
	By whom	Senior geriatricians, nursing staff	
	Duration	N/A	
	Other	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 multidisciplinary team and proactive discharge planning. This was the same as for the	
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, length of stay in a non-specialty bed, acute and total length of stay, 7-day readmission rates (so called ‘‘failed discharges’’) and 30-day readmission rates (excluding elective admissions). Twelve-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’’, $P = 0.019$). • Length of stay in a non-specialty bed was not reduced compared to the ‘‘before’’ group (1.0 days vs. 1.2 days,	

	P = 0.09) but was compared to the ‘‘after’’ group (1.0 days vs. 1.6 days, P = 0.0001). • Length of stay 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). • Seven and 30-day readmission, 12-month mortality, admission to residential care or living at home were not significantly different.
Conclusion	ACE unit patients • more likely to be discharged immediately • Access to specialty beds on the day of admission was significantly different • Length of stay in a non-specialty bed was not reduced compared to the ‘‘before’’ group but was compared to the ‘‘after’ ’group • Length of stay was not significantly different • Seven and 30-day readmission, 12-month mortality, admission to residential care or living at home were not significantly different.
Self-reported limitations	The study has a number of important limitations. Firstly, as an uncontrolled or non-randomised trial, the possibility exists that patients between the groups are different. This criticism cannot be eliminated but should be partly minimised by its prospective and unselected nature. 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. It might theoretically be possible for patients with different disease severity to be admitted out of hours than those admitted during daytime. The

	only anonymised data that we are able to present here to compare the groups is the proportion of patients classified as category one by the emergency department triage systems. These data do not show any striking difference. Secondly and most importantly here, 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 in a reduction in the impact size seen for the ACE unit.
Headline message	Having these units embedded in emergency departments 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 no specialty beds and increased access to specialty beds with no impact on discharge, readmissions or LT 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 has affected study outcomes.

Conference abstract	Author Jones[63]	Year 2012	Country UK
Study design	Not given		
Data source	Not given		
Study aim(s)	To reduce unnecessary admissions and their associated risks by use of a geriatrician in the emergency department		
Sample size	441		
Setting	Emergency Department in Birmingham, UK		
Frail Elderly - definition	“Frail Elderly People”		

Study population		Age Not given	Condition Not given
Intervention	What	Assess frail elderly patients that ED staff had considered to be necessary to admit.	
	By whom	Consultant Geriatrician	
	Duration	N/A	
	Other	During normal working hours	
Comparator group?		None	
Outcome measures		Number discharged Seven day reattendance rate LOS	
Findings		• 260/441 (59%) discharged by geriatrician. 46% of these had outpatient follow up and 38% 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 re-attendance rate was 10.2% (42/441) (hospital average 7.4%) • admitted	
Conclusion		"Based on these results, consultant geriatrician input supported by therapists within the ED is effective in admission avoidance of the frail elderly"	
Self-reported limitations		Not given	
Headline message		Consultant geriatrician reduced admissions as all of the patients were admit 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.	

Full paper and conference abstract		Author Scott et al.[107]; Wentworth et al.[108, 109]	Year 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 comprehensive geriatric assessment (CGA) in the ED on hospital admissions and length of stay		
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	Older Persons Assessment and Liaison (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 OPAL team (further details not reported)		
Outcome measures		Hospital admissions and length of stay for those admitted		
Findings		Rates of hospital admission for patients assessed by OPAL were 26% (2014) 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 lengths of stay for those admitted were 9.3 days (OPAL) and 10.1 (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 length of stay and improve patient flow in the ED
Self-reported limitations	None reported but these are conference abstracts with limited reporting of methods
Headline message	As above
Other comments	

Conference abstract		Author Thompson et al.[75]	Year 2010	Country UK
Study design		Appears to be 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		
Sample size		35		
Setting		ED of John Radcliffe Hospital, Oxford		
Frail Elderly - definition		Patients referred by ED staff for emergency (same day) assessment by Geriatric Liaison Team (GLT)		
Study population		Age Mean 84 years (range 68 to 97)	Condition Various, including falls (25 patients) and 'collapse' (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			
Comparator group?		None		
Outcome measures		Outcome of referrals and length of stay for those admitted		
Findings		Of 35 patients assessed, 27 (77%) were female. Twenty-six (75%) were discharged home, 7 (20%) were admitted to the acute medical unit and 2 (5%) admitted to intermediate care		

	beds. Of 26 discharged patients, 23 (88%) needed further geriatrics input. This was provided by the multidisciplinary team in the day hospital (18 patients); in a next-day geriatric clinic (3); and in a falls clinic (2). Average length of stay 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 length of stay
Self-reported limitations	None reported but these are conference abstracts with limited reporting of methods
Headline message	As above
Other comments	Small study, no comparison group data reported. Data are for February to July 2009

Conference abstract		Author Bell[85]	Year 2014	Country UK
Study design		Not given. Service evaluation.		
Data source		Not given		
Study aim(s)		Development of an Acute Care of the Elderly (ACE) service		
Sample size		662 patients		
Setting		ED observation ward of a District General Hospital in London		
Frail Elderly - definition		"Patients over the age of 80, with complex problems or frailty, but who do not require inpatient care"		
Study population		Age Over 80	Condition Complex problems or frailty	
Intervention	What	ACE service including Comprehensive Geriatric Assessment		
	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 assessed. 459 inappropriate admissions avoided. CGA and treatment to discharge – extra 4.76 hours. Rate of admission reduced from 61.2% to 35.1%.
Conclusion	"Comparing similarly aged patients and episode diagnosis coding, in excess of 4,200 bed days could be saved per year"
Self-reported limitations	Not given
Headline message	ACE and CGA effective.
Other comments	

Conference abstract		Author Lovato[123]	Year 2012	Country Italy
Study design		Observational retrospective study		
Data source		Administrative Data		
Study aim(s)		To evaluate the impact of the 'Silver Code' prognostic tool in reducing waiting times for frail elderly		
Sample size		7061		
Setting		ED		
Frail Elderly - definition		All aged over 85 and aged over 75 with some criteria of risk		
Study population		Age 70 years and older (mean 79.5)	Condition	
Intervention	What	Silver Code (four level triage, white, green, yellow, red) to identify elderly, then a 'priority green code' with certain characteristics		
	By whom	Not given		
	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 via ED Green code assigned to 96.4% of patients.		

	Mean waiting time – with Silver Code - 65,8 minutes (SD = 72,55) vs 95,3 (SD = 98,11) without SC, regardless of colour (p value = 0,000). "In groups with initial green colour we identified a statistical difference in WT (65,5 min in SC vs 94,9 min without SC; p value = 0,000).
Conclusion	Silver Code has reduced waiting times
Self-reported limitations	None given.
Headline message	Application of Silver Code has 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.

Conference abstract		Author Pareja[104]	Year 2008	Country Spain
Study design		Propsective study		
Data source		Not given		
Study aim(s)		Whether specialised geriatric evaluation may avoid hospital admission and iatrogenesis (unnecessary interventions)		
Sample size		1200		
Setting		General Hospital		
Frail Elderly - definition		High risk older patients		
Study population		Age Mean age 86	Condition Not given (see results)	
Intervention	What	Comprehensive Geriatric Assessment and treatment for acute-mild severity or unstable chrnoci 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		
Comparator group?		N/A		
Outcome measures		Admission		

Findings	72% discharged home (29% followed up in geriatric clinics, 9% home care medical team or 14% nursing home-primary care doctor). 28% admitted. 18% of the discharged patients needed hospital attention in the following month.
Conclusion	"Geriatric patients in the ER have different patterns of service use and health care needs. The actual disease oriented models of emergency attention may not be adequate for frail older patients. 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"
Self-reported limitations	Not given
Headline message	This unit discharged a lot of patients. However no comparator group.
Other comments	The conclusion is reported verbatim. It makes claims that are not substantiated in the results of the study about patient satisfaction and efficiency.

Full paper	Author Singler et al.[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 (SD 5) years	Condition Not reported but patients expected to die within 24 hours were excluded
Intervention	What	Screening with ISAR	
	By whom	Study nurses	
	Duration	N/A	
	Other		
Comparator group?		N/A	
Outcome measures		Accuracy of ISAR for predicting a composite endpoint of death, hospitalisation, repeat ED visit or transfer to a long-term care facility at 28 days	
Findings		425 patients scored ≥2 on ISAR and 315 scored ≥3. The primary endpoint was observed in 250 patients on day 28 and 260 on day 180. Area under the ROC curve for 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 of ≥3 points rather than 2 points gave better overall results	
Self-reported limitations		Patients not recruited 7 days/week; lack of data on clinical utility of ISAR	
Headline message		ISAR with a cut-off score of ≥3 is an acceptable screening tool for use in German EDs	
Other comments			

Full paper	Author Conroy et al[93]	Year 2014	Country UK
Study design	Before-after study		
Data source	Hospital administrative data		
Study aim(s)	To evaluate the effect of implementing an 'Emergency Frailty Unit' (EFU) within an ED		

Sample size		Total ED attendance (number aged ≥85): 2010 (usual care): 109,994 (6,895); January–June 2011 (transition period): 53,182 (4,034); July 2011–June 2012 (EFU): 110,517 (9,035)	
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 comprehensive geriatric assessment (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 coordinators'	
	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; length of stay for admitted patients; and total bed-day use. Outcomes were assessed for age groups 16–64, 65–74, 75–84 and 85+	
Findings		ED attendances by older people increased over the study period. Admission rates from the ED of patients aged ≥85 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 length of stay in the oldest patients increased from 8.9 to 11.1 days and total bed-day use from 4,385 to 4,826
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 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	CGA in the ED was associated with improved discharge rates and reduced readmissions in older people
Other comments	Admission and readmission rates also fell for younger age groups, which the authors suggested may be due to time freed up for emergency physicians to care for younger patients

Full paper	Author Fox[111]	Year 2016	Country UK
Study design	Feasibility Study		
Data source	Electronic patient record		
Study aim(s)	"The aim of our study was to establish the feasibility of a geriatrician working with the MDT when embedded within the ED"		
Sample size	168 patients managed by the geriatrician in the study period		
Setting	Emergency Department of an Urban Teaching Hospital		
Frail Elderly - definition	"defined as being from residential care or intermediate care, presenting with confusion as a result of dementia or delirium or admitted with a fall"		

Study population		Age Mean age 84.9 (range 70-102)	Condition Frail 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) • 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 10-8 7 days a week	
	Other	N/A	
Comparator group?		NONE	
Outcome measures		NONE	
Findings		"The majority of patients were dependent for activities of daily living and required an aid to mobilise. Over half were admitted from their own home with 41% admitted from an institution (either IMC or a care home). Mean number of comorbid conditions was 2.5 (range: 1–7) with 71 (42%) with a confirmed diagnosis of dementia. Range and frequency of comorbid conditions is presented in Table 2. The median time to being seen by a geriatrician from presentation at triage was 1 hr and 52 mins and patients were reviewed by one doctor on average (0–4) prior to a geriatrician. Afternoons and evenings were significantly busier than mornings with the majority of older people presenting later in the day. 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%"
Conclusion	Compared to other research studies in this area, this intervention compares favourably in terms of positive outcomes (discharge, LOS and readmission).
Self-reported limitations	"The main limitation of our study is the lack of a control population to demonstrate the true impact of this service delivery. Having said that our service development compares favourably with data published by other authors. …. The number of patients seen by the service was relatively small with only 168 patients seen within the 31 days of the study period suggesting that only 5 patients were seen each day which may raise questions about efficiency. However, during the study period, several shifts were uncovered or only partially covered and the actual numbers of patients seen each day was more than this. The study was undertaken for only 1 month and this may not be representative of overall performance for the rest of the year. In addition, this was a retrospective analysis of case notes, and conclusions should be made with this caveat"
Headline message	The feasibility study highlighted that older patients were often being assessed by numerous different professionals. This intervention allowed them to be assessed once. No comparator group for the intervention.
Other comments	

Conference abstract	Author O'Reilly[76]	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 an MDT assessment.	
Sample size		2200 screened for frailty	
Setting		ED of a hospital in Ireland	
Frail Elderly - definition		"medical conditions often further complicated by functional decline, cognitive deterioration and complex social care needs"	
Study population		Age Over 75	Condition Frail
Intervention	What	Screening for frailty then referral to MDT (FITT)	
	By whom	Frail Intervention Therapy Team (FITT) (Physiotherapy, Occupational Therapy, Medical Social Work, Speech & Language Therapy, Dietetics, & 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 less than 9 hours	
Findings		Over 75% of patients screened were deemed frail Comparing Q1 in 2015 and Q1 in 2016 • 11.6% increase in the number patients over 75 presenting to the ED • 59% increase in the number of patients discharged directly home • 42% increase in transfers to the wards in less than 9 hours	
Conclusion		N/A	
Self-reported limitations		N/A	
Headline message		It is hoped that this early intervention improves hospital experience and overall patient and health service outcomes	

Other comments	N/A

Full paper		Author Huded, J.M. et al.[124]	Year 2015	Country US
Study design		Prospective observational		
Data source		Prospective		
Study aim(s)		To describe the incorporation of Timed Up & Go Test (TUGT) assessments by geriatric nurses to identify elderly patients at high risk of falls.		
Sample size		19,511 patients treated in ED, 1,135 evaluated by a geriatric nurse and TUGT) performed on 443 patients.		
Setting		ED of urban academic Level 1 trauma centre with 56 beds.		
Frail Elderly - definition		Geriatric nurses assessed elderly patients and identified high-risk population for TUGT as identified by GEDI WISE protocol.		
Study population		Age 65 years and over	Condition	
Intervention	What	Fall risk screening with the TUGT		
	By whom	Geriatric nurses		
	Duration	Study ran from 4/1/13 – 5/31/14		
	Other			
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 TUGT. Interventions for positive results included ED-based PT (n=63, 17.1%), outpatient PT referrals (n=56, 12.2%) and social work consultation (n=162, 44%).		

	For those with positive TUGT scores, 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. Our results show ED nurses can conduct the TUGT, a validated and time efficient screen, and place appropriate referrals based on assessment results.
Self-reported limitations	This is the first study showing that a protocoled method of identifying fall risk in elderly patients is possible for those presenting to the ED for acute care needs other than a recent fall. Several limitations deserve mention. This was a single-site study and was incorporated into a geriatric specific protocol supported by specialized registered nurse (RN) staff already in place. All RNs performing the TUGT were initially trained as emergency medicine nurses and continued to have weekly ED shifts working in a traditional RN capacity. The TUGT is designed to be a simple test that all health personnel can perform. EDs initiating similar screening programs may need to invest more energy in ensuring appropriate interventions for positive TUGT scores than the actual training of TUGT administrators. We recognize that the TUGT is one screen in addition to many already being emphasized in the ED; however, targeting appropriate older patients may minimize the workload and is timely in light of geriatric-specific EDs evolving across the U.S. While a small percentage of the potentially eligible geriatric patients were screened with the TUGT, we believe the sample of patients who were assessed by GNLs represents a high-risk population, as identified by GEDI WISE protocol, or clinician consult; 15.8% of screened patients presented to the ED after a fall, and this may have

	increased the perceived benefit of the TUGT screen compared to a more widespread screening protocol. However we believe this high rate of previous fall in the screened population demonstrates appropriate targeting of screening to a population at high risk for repeat falls. Without intervention more that 20% will present to the ED within 12 months with another fall related diagnosis.1 Finally, previously defined TUGT cutoffs for outpatients may not be the most appropriate cutoffs for older adults in the ED who are presenting with acute medical conditions that may affect their gait.
Headline message	Identifying and intervening on high fall risk patients who visit the ED has the potential to improve the trajectory of functional decline in our elderly population.
Other comments	Links with 116 and 117 GEDI WISE Program

Appendix 7 - Review level evidence data extraction table

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
Tran 2014[137]	Geriatric (age greater than 60)	Identify risk factors and interventions to prevent ED returns	Examination of risk factors Interventions (bundle of care- nursing screening then interventions outside of the ED)	ED returns	There are risk factors that identify likelihood of ED return. These are psychosocial (feeling depressed, no PCP, low primary care use, low socio economic status). They are also 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 term but not long term ED returns.
Kessler 2013[202]	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,	Failed transitions implicated in morbidity and mortality. Standardised

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
					higher frequency of transitions Central to adverse outcomes were communication issues. Communication on admission from nursing homes limited.	communication and robust metrics could reduce this.
Sinha 2011[138]		To 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 8 model characteristic components. Programs having more of these components tended to produce better outcomes.	Successful models of ED based case management have the following characteristics Evidence based practice model Nursing clinical involvement or leadership

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
						High risk screening with a validated tool Focused (as opposed to time intensive) geriatric assessments Care and disposition planning in the ED Inter-professional and capacity building work practices Post ED discharge follow up with patients Evaluation and monitoring processes
Parke 2011[131]	Cognitively impaired, non-institutionalised	Effectiveness of interventions to manage	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 and we know that there are a lot

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
	older people (65+ years)	cognitively impaired older people in the ED				of older people with CI receiving care in the ED. Screening tools exist to identify this population – however inconsistently used so difficult to measure effectiveness. No specific interventions were identified to care for this population.
Graf 2010[133]	Older patients	Use and value of CGA in ED for evaluations of older patients	CGA efficiency Screening tools		CGA in the ED is efficient for decreasing functional decline, ED readmission and possibly nursing home readmission.	CGA is too time consuming to use routinely in ED, even though it has positive outcomes.

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
		Using ED screening tools to detect high risk patients needing CGA			This review found that the best tool was ISAR (Others not validated for screening plus CGA and TRST not accurate enough.	Other tools to screen for high risk older people exist. It is better to screen for high risk than do age based screening. High risk can then benefit from CGA and interventions. Advocate a two stage approach (screening for high risk using ISAR then CGA).
Conroy 2011[134]	Frail older people, over 65	Does CGA improve outcomes for frail older	CGA (geriatrician led and nurse led)	Mortality, readmissions, subsequent institutionalisation,	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.

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
		people rapidly discharged from acute settings		functional ability, quality of life, cognition		Few trials undertaken, quality poor, more trials required.
Sutton 2008[126]	Over 65 years presenting to ED of an acute hospital (three included studies used over 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, Complexity Prediction Instrument, SHERPA	There is no gold standard tool. No single tool reported better predictive validity to recommend its use. Therefore undertaking an intervention based on the outcome of these screening tools is not advisable.
Thiem 2015[127]	Elderly patients	Screening instruments for the identification	Screening		TRST, SHERPA, ISAR, COMPRI, HARP, Index of Functional Decline.	ISAR is the most frequently studied tool and has been tested most widely. Even for ISAR,

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
		of patients in emergency departments in need of geriatric care				evidence is weak or conflicting. Conflicting evidence also exists for the other tools. Also we need to know how best to manage these patients once they have been screened.
Fan 2015[135]		The effectiveness of interventions targeting the elderly population in reducing ED utilisation		Primary – ED utilisation Secondary - LOS	Qualitative appraisal resulted in Seven 'elements' identified which were common to the interventions studied, namely MDT/Gerontological expertise Integrated/enhanced primary care	Review included hospital and community based interventions. A larger proportion of community interventions demonstrated reduced ED utilisation. 5/20 hospital interventions significantly reduced

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
					Integrated social and medical care Risk screening and geriatric assessment Care planning and management Discharge planning and referral co-ordination Follow up/regular group visits	utilisation. Most were characterised by risk screening and assessment and discharge planning and referral coordination. 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 where there were linkages made (either MDT in the ED,

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
						links with social care, links to community and primary care).
Karam 2015[136]		Review and update existing literature on interventions within emergency departments		ED re-visits Hospitalisations Nursing home admissions Deaths following discharge	Nine studies met inclusion criteria. The more intensive an intervention, the more frequently it resulted in reduced adverse outcomes compared to simple referrals "Amongst the lowest intensity, referral based interventions, studies that used a validated prediction tool to identify	"Interventions were more successful if they extended beyond referral and if they used a validated risk prediction tool to identify potential candidates" "… the specific tool used might not be as important as the actual implementation of one to screen patients and target interventions"

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
					high risk patients more frequently reported improved outcomes than those that did not use such a tool"	
Lowthian 2015[10]	People aged over 65 years	The effectiveness of ED to community transition strategies (ED-CTS)	Intervention	Unplanned ED representation or hospitalisation Functional decline Nursing home admission Mortality	Nine studies. Interventions tended to comprise of assessment in the ED with community follow up. These assessments included Comprehensive geriatric nurse assessment, ISAR as well as discharge planning.	The evidence base in this area is limited and the research is not of high quality. Limited evidence for effectiveness in reducing unplanned ED re-attendance, hospital admission or mortality.

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
McNamara 2012[128]	Aged 65 and over	Which triage tool has the most effective use with older patients presenting to the ED	Screening	?	Six tools identified. Three general tools (Manchester Triage, Emergency Severity Index, Canadian Triage and Acuity Scale) Manchester and Emergency Severity Index undertriage older adults. Three specific tools – ISAR, TRST, VIP. ISAR and TRST – good sensitivity, high negative predictive value, low specificity, low positive predictive value. VIP low sensitivity	Traditional tools undertriage. Need to differentiate between tools to identify who is need of acute medical care and tools to identify who is need of ongoing medical care following discharge.

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
Bissett 2013[129]	Older people	Identify functional assessments used in the ED. What psychometric properties analysis has been undertaken? What assessments are recommended for practice?	Screening	N/A	14 functional assessments. 4 developed for use in the ED to identify patients at risk (TRST, ISAR, Runciman, FSAS-ED) FSAS-ED only available in French. 4 assessments recommended for practice with reservations. TRST, ISAR, OARS, FSAS-ED.	This review did not look at outcomes of the screening tools, but at their validity etc. ISAR and TRST suitable for fast screening OARS and FSAS-ED suitable for comprehensive screening. "Where time and personnel are constrained and screening is the only realistic option for functional assessment of older people, the ISAR

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
					Most tools were done by self-report rather than patient observation.	and TRST are the assessments of choice as they have had the most psychometric testing including positive ratings for clinical utility".
Fealy 2009[139]	Older persons	Effectiveness of nursing interventions targeted at older attendees of emergency departments.	Screening and intervention	Patient and health service outcomes.	Interventions categorised as Assessment and screening interventions 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. "Assessment interventions that incorporate a post-ED discharge planning and

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
						referral component appear to be more effective".
Schnitker 2013[132]	Older, cognitively impaired patients	Identify practices designed to meet the specific care needs of older, cognitively impaired patients in emergency departments		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 Other interventions	Routine screening and assessment of cognitive function are not common practice and incorporating this into care practices would be beneficial. "There are several short, sensitive screening tools suited to the fast paced ED environment that will identify cognitive dysfunction in older patients"

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
						Discharge risk tools are also beneficial.
Carpenter 2014[130]	Geriatric patients, 65 years plus	The prognostic accuracy of individual risk factors and ED validated screening instruments to distinguish patients more or less likely to experience short term adverse outcomes	Screening	Short term adverse outcomes like unanticipated ED returns, hospital readmissions, functional decline or death.	Seven geriatric prognostic screening instruments: ISAR, TRST, VIP, Silver Code, Mortality Risk Index, Rowland, Runciman.	Adverse outcomes often occur when older people are discharged from the ED. It would be useful if we could identify these people and the risk factors that lead to unsatisfactory outcomes. "None of the individual predictors of vulnerability or published risk stratification instruments demonstrate sufficient prognostic accuracy to distinguish high risk or

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
						low risk subsets of geriatric patients in EDs" No significant prognostic difference when nurses administer screening instruments (as opposed to geriatric specialists or research teams)
Yao 2015[61]	Elderly patients	Evaluate the predictive validity of ISAR in identifying older patients at risk of adverse	Screening	Adverse outcomes	Ten studies. ISAR has poor or poor/fair predictive validity for Revisiting the ED Hospital readmission Mortality Composite outcomes	ISAR is quick and cheap so it is useful for use in the ED. It is useful for screening high risk patients for frailty seen in the ED but it has poor to fair predictive validity for

Reference	Population	Aim	Screening or Intervention	Outcome (s)	Summary	Headline message
		outcomes after an ED visit				adverse health outcomes for patients discharged from ED. "It is not suitable to use the ISAR alone for identifying seniors at risk for adverse outcomes in the ED"

Appendix 8 - Data Tables

Table 15 Location of studies

Setting	Total
Australia	12
Belgium	1
Canada	6
France	3
Germany	1
Hong Kong	3
Ireland	5
Italy	7
Netherlands	2
New Zealand	1
Singapore	2
South Korea	1
Spain	2
Sweden	2
Switzerland	3
Taiwan	1
Turkey	1
UK	15
USA	27
Total	**95**

Table 16 Type of study

Type of study	Ref ID
Action Research	[119]
Audit	[28]
Before and After Cohort Study	[122]

Type of study	Ref ID
Cross sectional cohort	[32, 29]
Diagnostic Accuracy Study	[20, 23, 38, 39, 31]
Evaluation	[81, 85]
Feasibility	[111, 76]
Longitudinal	[56]
Medical record review	[46, 34, 118]
Observational	[115, 107, 75]
Observational Before and After Study	[99]
Pilot project	[121]
Prospective Before and After Study	[120, 80, 95, 22, 44, 33, 92, 93]
Prospective cohort	[42, 41, 82, 51, 67, 71, 47, 37, 89, 60, 105, 114 43, 110, 116, 48, 30, 55, 35, 36, 58, 59, 90, 62, 72, 73, 63, 50]
Prospective comparative	[79]
Prospective data analysis	[70, 112, 104]
Prospective evaluation	[64]
Prospective non randomized	[84]
Prospective Observational	[40 68, 21 27, 49, 94, 52, 124]
Prospective pragmatic	[78, 45]
Prospective questionnaire	[86]
Quasi RCT	[117]
RCT	[18, 125, 26, 19, 24, 24]
Retrospective Before and After Study	[96, 100]
Retrospective cohort	[113, 77, 57, 66, 97, 65, 65, 103 53]
Retrospective observational	[74, 91, 123]

Table 17 Sample size and target age of interventions

Ref ID	Sample Size	Reported age of participants (years)		
		Mean (SD)	Median	Range
[122]	5416 pre and 5370 post			
[90]	Not given			
[40]	700			
[103]	534			
[68] and [69]	7213	79.3		
[113]	2202			45-99
[62]	848		85	58-105
[77]	5162			
[24]	76 control and 85 intervention			
[78]	2121 intervention and 1451 comparator			
[79]	2196 (1098 matched pairs)			
[72]	285	83.5 +/- 6.8		
[21]	2057	81.7		65-103
[27]	200	80.3 +/- 7.4		
[42]	519			
[53] and [54]	375	84 (SD 5.7)		
[120]	172 control and 315 intervention			
[80]	313			
[64]	101 intervention and 98 control			
[73]	666			60-103
[49]	200	80.3 (SD 7.4)		
[94]	200	80.3 +/- 7.4		
[121]	894			
[52]	788	76.6		65-101
[56]	314			
[57]	929			

Ref ID	Sample Size	Reported age of participants (years)		
		Mean (SD)	Median	Range
[119]	277			
[81]	Not given			
[33] and [22]	795 screening and 752 control	82.7 +/- 5/82.6 +/- 5.1		
[29] and [30]	139 and 130	82.5 +/- 5.4 and 80		
[74]	1680	83 +/- 6.5		
[70]	3071			
[117]	280 intervention and 500 control			
[115]	25	78		66-96
[41]	424	84 +/- 6.5		
[91]	5571	87.4		
[82]	168			
[84]	3165 intervention and 2100 control			
[51]	120			
[67]	100			
[18]	69	76		
[45]	225			
[71]	829 intervention and 873 control			
[46]	250			
[47]	504	76.8		
[37]	260			
[34]	117			
[89]	168			
[32]	300			
[125]	32 intervention and 31 control	74		
[60]	219 development and 178 validation	81		

Ref ID	Sample Size	Reported age of participants (years)		
		Mean (SD)	Median	Range
[25]	1820 cohort and 1279 RCT	74.5 (SD 6.2) 75 (SD 6.8) 76.3 (SD 6.8)		
[112]	300			
[86]	432 intervention and 205 control	75		
[105] and [106]	137	80.3		
[114]	1096	80.3		
[43]	939		74	
[92]	212 before/210 intervention/327 comparator	80.5/81.1/80.3		
[95]	<65=219 >65=67			
[110]	547			
[63]	441			
[96]	13354 pre and 14484 post			
[116]	226	80.5		
[100] and [101]	Not given	77 (SD 8.6)		
[48]	250			
[107], [108], [109]	148 in 2014 990 in 2015			
[75]	35	84		68-97
[85]	662			
[118]	Not given			
[20]	118			
[123]	7061	79.5		

Ref ID	Sample Size	Reported age of participants (years)		
		Mean (SD)	Median	Range
23	1903			
104	1200			
44	2139			
26	114 intervention and 110 control	78.7 +/- 6.4		
28	525			
66	(1820) 910 matched pairs			
55	381	79.1		
35	169			
36	371			
58	1632	84		
19	650	74		
97	4417 (55-64) and 7598 (65+)	77.5/76.9		
50	520	82.8 (SD 5)		
38	352	77		
39	150	75		
93	109994 usual care, 53182 transition, 110517 intervention			
59	107	79		
31	161			
111	168	84.9		70-102
76	2200			
99	346 before and 95 after	73/75		
124	19511			
65	4103			
98	2286 intervention and 2260 control			

Table 18 Targeted age of participants

Category	Reference	Total (n)

65 and over	[40], [77], [78], [42], [120], [80], [52], [56], [57], [81], [70], [115], [51], [67], [18], [71], [46], [34], [32], [86], [114], [43], [95], [96], [116], [100], [48], [118], [23], [28], [55], [35], [36], [19], [97], [38], [39], [59], [99], [65], [98], [21], [27], [92], [75], [124]	46
65 and over with trauma	[47], [45]	2
65 and over with fall	[66]	1
65 and over with chronic condition	[121], [84]	2
65 and older with acute condition	[49], [94]	2
65 and over with positive screen for 'at risk'	[79], [92]	2
65 and over, ISAR > 2	[68], [25]	2
65 and older, TRST >2, eligible for discharge	[117]	1
65 and over with chronic condition, 70 or over without	[64]	1
65 and over with chronic condition, 80 or over without	[31], [24], [72]	3
70 and over	[122], [74], [60], [110], [44], [123]	6
72 and older	[112]	1
75 and older	[90], [41], [82], [37], [20], [58], [53], [119], [33], [29], [50]	11
75 and over, frail	[76]	1
75 and over, multiple comorbidities	[91]	1
80 and over with geriatric syndromes	[107], [85]	2
85 and over	[93]	1
No category	[103], [113], [62], [21], [27], [73], [89], [125], [105], [63], [75], [123], [26], [111]	14

Table 19 Outcomes measured in service delivery interventions

Outcomes	Frail Elderly	General Geriatric
Activities of Daily Living	[24]	
Acute admissions from the ED	[72, 94, 119, 91, 25, 107-109, 104, 93]	[122, 120, 81, 84, 105, 105, 100, 101, 26, 66, 97, 98]
Admission to specialty bed	[92]	
Avoided admissions	[103, 68, 69, 62, 73, 85]	[96, 118]
Costs	[73]	
Discharge rates	[103, 72, 92, 63, 104]	[121, 82, 89, 110]
Discharges – inappropriate	[74]	
ED reattendance	[79, 72, 94, 119, 117, 25, 63]	[113, 77, 120, 112, 105, 114, 66, 97, 98]
ED waiting times	[103, 123]	
Frailty	[24]	
Functional Decline/ Functional Status	[94, 117]	[26]
In hospital mortality	[90]	
In patient bed occupancy	[90]	
Intervention acceptability		[115]
Institutionalisation	[25]	
Length of stay	[72, 119, 91, 92, 63, 107-109, 75, 93, 111]	[122, 78, 64, 121, 110, 26, 97, 99, 98]
Living at home vs. access to residential care	[92]	
Medication errors avoided/problems identified		[64, 65]
Mortality (all)	[79, 94, 25, 92]	[113]
Outcome of referrals	[75]	
Quality of Life score		[81]
Referred for appropriate care		[80]
Readmission	[90, 79, 72, 119, 117, 91, 92, 104, 93, 111]	[77, 110, 66]
Satisfaction with the ED		[86, 95]

Total bed day use	93	