Geriatric emergency medicine – why we should use the Clinical Frailty Scale

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“Geriatric emergency medicine – why we should use the Clinical Frailty Scale”

Thesis submitted to the Faculty of Medicine of
the University of Geneva
for the degree of Privat-Docent
by

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Geneva

2024

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Declaration

In this thesis, AI tools ChatGPT-4 and Claude 3.5 Sonnet were employed to enhance the overall quality of the language. These tools assisted in refining sentence structures, improving clarity, and ensuring a polished and professional tone throughout the text. The specific prompt used was: “Review the text to make it compatible with medical, scientific writing—short sentences, clear and concise; avoid bullet points as much as possible; keep it as impersonal as possible.”

Summary

Over the last decade, the proportion of emergency department (ED) visits by patients aged 65 and older has significantly increased, now accounting for more than 40% of all ED visits. Approximately 10% of these visits require critical interventions such as emergency surgery or admission to monitored units. Frailty, a clinical syndrome characterized by diminished physiological reserves and increased vulnerability to adverse health outcomes, is particularly common in this population and poses unique challenges for acute care management. Patients with frailty are more susceptible to complications during their ED and beyond visits, including delirium, unnecessary hospitalizations, and prolonged recovery times. Addressing these challenges requires a tailored approach to both the identification and management of frailty in emergency settings to improve outcomes and reduce the risks associated with acute care in this vulnerable population.

In this thesis, I began by reviewing **the current use of the Clinical Frailty Scale (CFS)** in the scientific literature in the emergency settings, identifying existing research gaps and potential areas for improvement. This comprehensive analysis allowed for the identification of areas where the CFS is being effectively applied and where further research or refinement is needed to enhance its utility in clinical practice. I then **synthesized the evidence on the association between frailty and outcomes following emergency general surgery**, a critical aspect of acute care. The findings demonstrated that frail patients tend to have worse outcomes, further emphasizing the importance of identifying frailty as early as possible. Recognizing the challenges of frailty assessment in the emergency department, the potential for prehospital frailty screening was explored. Specifically, **the performance of paramedic assessments of frailty using the CFS** was examined. The results showed that while the reliability of paramedic assessments was excellent, there is room for improvement in terms of validity, highlighting the need for further refinement in frailty identification at this stage of care. Finally, a **survey of over 60 European emergency departments** was conducted to evaluate their operational characteristics, revealing significant variability in the availability and structure of geriatric-dedicated services. This diversity emphasizes the need for standardized approaches to optimize care for older adults in emergency settings and opportunities for improving and expanding geriatric-specific resources across different healthcare systems.

Introduction

This introduction outlines the demographic trends of the aging population, the growing number of older adults using emergency departments (EDs), and their profile. It discusses the challenges faced by EDs and healthcare providers when managing older patients and introduces the concept of frailty as a critical framework for understanding and addressing the specific needs of older ED patients. Existing tools for measuring frailty and practical approaches to screening for frailty in the ED setting are examined.

Demographics and Health Profile of Older Patients in Emergency Departments

Switzerland, like many developed countries, is experiencing a significant demographic shift due to an aging population. With advancements in healthcare, improved living conditions, and longer life expectancy, the proportion of older adults in the Swiss population has steadily increased. Currently, approximately 19% of Switzerland's population is aged 65 and older, and this figure is expected to rise to around 26% by 2050. At this time, it is expected that 320'000 people will be 90 years or older, representing an eightfold increase. Moreover, over the past century, life expectancy at age 65 has doubled, increasing from approximately 10 years to over 20 years.[1] This aging demographic has profound implications for the country's healthcare system, particularly in EDs, where older adults are increasingly represented.

The impact of the aging population on EDs is crucial and represents one of the most important challenges EDs will face in the future. In Geneva, the proportion of older patients (≥65 years) among ED visits increased from 25.8% in 2009 to 30.1% in 2019 (Figure 1), with an overall increase over the same decade higher than 50%.[2] These numbers are similar to what can be seen in the US.[3] At a national level, 15.1% of older adults visit the ED at least once a year. Among those aged 80 and older, this figure rises to nearly 20%, equating to 1 in 5 individuals.[4]

In the ED, this rise is consistent across all levels of severity as classified by the Swiss Emergency Triage Scale (SETS): one in ten older patients visiting the ED will be triaged as a vital emergency, while more than half will present with mild or non-urgent conditions (local data, unpublished). Among these patients, there is reasonable evidence that several could be adequately managed at appropriately resourced outpatient medical services.[5]

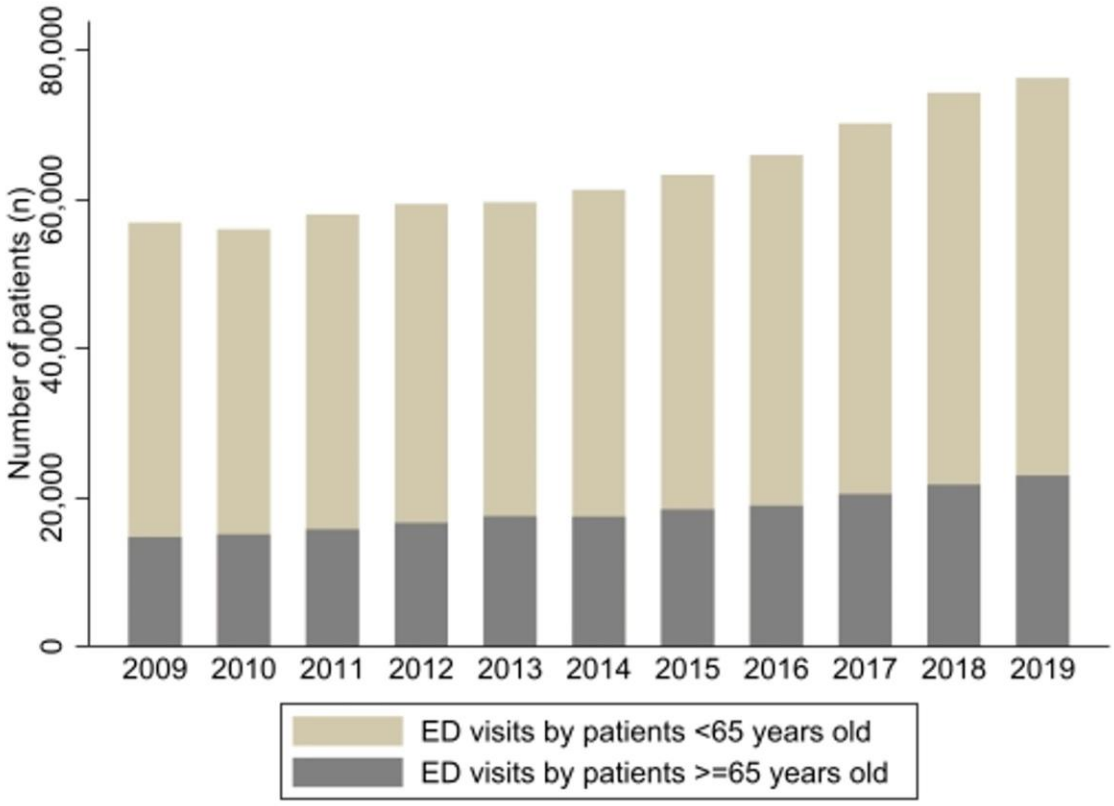

Figure 1 – Demographic trends in emergency department visits among older patients (≥65 years) (Van Delden L, submitted)

When examining the profile of older patients visiting the ED, a distinct pattern emerges. Over 80% of these visits are prompted by non-traumatic complaints, emphasizing the predominance of medical issues rather than injuries in this population.[6] Comorbidities are exceedingly common, with only 10% of older patients presenting without any chronic conditions. The most prevalent comorbidities include hypertension (57%), diabetes (24%), and coronary artery disease (20%). Furthermore, multiple medication use is widespread among older ED patients, with only one in six reporting that they are not taking any medications, indicating a significant reliance on pharmacological management for chronic conditions, adding another layer of complexity to their care. These characteristics collectively illustrate the chronic and multifaceted health conditions of older adults seeking emergency care. Their presentations often involve a combination of acute exacerbations of chronic illnesses, new medical issues superimposed on pre-existing conditions, and complications related to physiological aging. This profile underscores the importance of a multidisciplinary approach in managing older patients in the ED.

Challenges in Emergency Care for Older Adults

Clinical challenges

Diagnosing and managing complex health conditions in older adults within the emergency care setting poses significant challenges for healthcare providers.[7] Older adults often present with a range of age-related physiological changes, chronic diseases, and atypical symptoms that complicate the diagnostic process. These factors, combined with the high-pressure, fast-paced environment of EDs, can lead to delays, misdiagnoses, and suboptimal care.

One key challenge is the frequent atypical presentation of illnesses in older adults.[8] Conditions such as acute abdomen, myocardial infarction, or sepsis may manifest with vague symptoms like delirium, weakness, or generalized malaise, rather than classic signs.[9-11] This can obscure the true underlying condition and lead to diagnostic uncertainty. Moreover, cognitive impairments such as dementia or delirium, which are common in older patients, can hinder effective communication about symptoms, further complicating the diagnostic process.[12]

Another challenge lies in the presence of multiple chronic conditions, or multimorbidity, which is prevalent among older patients and associated with a higher hospitalization risk.[13, 14] Multimorbidity often requires careful consideration in older patients admitted to the ED. A new acute condition may interact with existing health issues, making it difficult to identify the root cause of the patient's symptoms.

Polypharmacy, commonly defined as the use of five or more medications, is a prevalent issue among older adults visiting EDs.[15, 16] While often necessary to manage multiple chronic conditions, polypharmacy significantly increases the risk of drug interactions, adverse drug events, and medication errors, posing substantial challenges for emergency care providers. Complex medication regimens, often prescribed by multiple healthcare professionals, can result in unintended interactions between drugs, leading to adverse effects such as dizziness, confusion, falls, or life-threatening reactions.[17, 18] Identifying these interactions in a busy ED setting can be difficult, particularly when medication histories are incomplete or unavailable.[19, 20] Time-sensitive decisions in the ED further complicate the management of polypharmacy. Providers may be required to prescribe new medications for acute conditions without fully understanding the patient's existing drug profile, increasing the risk of compounding adverse effects or interactions. Renal or hepatic impairment, common in older adults, alters drug metabolism and clearance, heightening the complexity of prescribing safely.

Older adults are particularly vulnerable to adverse outcomes in the ED due to the interplay of acute medical conditions, chronic illnesses, and environmental factors unique to the ED setting. The most common and concerning complications are delirium and falls, both of which significantly worsen health outcomes and prolong recovery. Delirium, an acute state of altered mental status, is frequently triggered by personal factors highly prevalent in the ED, such as pain, dehydration, infections, or medication changes. About 10% of older patients visiting the ED will develop delirium.[21, 22] Moreover, environmental risk factors like the chaotic, noisy, and overstimulating environment of the ED exacerbate this risk, particularly for older adults with pre-existing cognitive impairments or sensory deficits.[23] Delirium is associated with longer hospital stays, higher rates of functional decline, and increased mortality.[24] Falls represent another critical risk for older patients in the ED. Contributing factors include mobility limitations, muscle weakness, medication side effects (e.g., dizziness from sedatives or antihypertensives), and environmental hazards such as crowded or unfamiliar spaces.[25] A fall in the ED not only causes immediate physical harm, such as fractures or head injuries, but also leads to a loss of confidence and independence in older adults.[26]

Operational and Systemic Challenges

ED faces significant challenges in accommodating the needs of older patients, particularly in the areas of architectural design, staffing, and equipment. Traditional EDs are often designed to handle high patient volumes with a focus on efficiency rather than accommodating the specific needs of older adults. Crowded, noisy, and overstimulating environments can exacerbate conditions such as delirium and anxiety in older patients. Inadequate lighting, lack of clear signage, and poor accessibility further increase the risk of falls and confusion. Many EDs also lack private spaces for discussions about sensitive issues such as palliative care or end-of-life decisions, which are common among older patients.[27] The complex needs of older patients require specialized knowledge and skills that are not always prioritized in standard ED training. A shortage of geriatric-trained staff means that many older adults are cared for by providers who may lack expertise in managing multimorbidity, polypharmacy, or atypical disease presentations.[28] High staff turnover and burnout in busy EDs further reduce the ability to provide consistent, high-quality care for this population. Finally, standard ED equipment is often not tailored to the needs of older adults.[29] For instance, stretchers and examination tables may not be adjustable for patients with mobility

impairments, increasing the risk of injury. Devices for monitoring vital signs may not be calibrated for the physiological differences in older adults. Additionally, the lack of assistive devices such as hearing aids, mobility aids, and vision support tools can further hinder communication and patient safety.

Overcrowding is another crucial issue that has become a pressing issue worldwide, significantly impacting the quality of care for all patients, particularly older adults.[30] As mentioned earlier, older patients constitute an increasing proportion of ED visits, often presenting with complex medical and social needs. Overcrowding amplifies the challenges faced by this vulnerable population, leading to delays in care, compromised patient outcomes, and increased stress on healthcare systems.[31] Older patients often require more time-intensive assessments due to multimorbidity, polypharmacy, and atypical disease presentations. In an overcrowded ED, staff may struggle to allocate sufficient time and resources to these complex cases, increasing the likelihood of misdiagnoses or delayed interventions. Time-sensitive conditions such as sepsis or stroke can go unrecognized, leading to worse outcomes.[32] Prolonged waits in crowded EDs can exacerbate conditions such as delirium, dehydration, and pressure ulcers, further compromising older patients' functional health.[33] Beyond physical health concerns, overcrowding also undermines the emotional and psychological well-being of older adults. Prolonged exposure to a chaotic, noisy environment can heighten feelings of anxiety, confusion, and distress, particularly in patients with dementia or sensory impairments.[34] Overcrowding reduces opportunities for meaningful communication between healthcare providers and patients, leaving older adults and their families feeling unsupported in making critical decisions about care.

Ethical and Legal Challenges

Decision-making for patients with cognitive and functional impairments in EDs presents unique challenges for healthcare providers. Older adults with conditions such as dementia, delirium, or other cognitive disorders often experience difficulty understanding, processing, or communicating information, which complicates informed consent and shared decision-making. Assessing decision-making capacity in the ED is particularly challenging due to the high-pressure, time-sensitive environment.[35] Providers must quickly evaluate whether the patient can understand the nature of their condition, weigh the risks and benefits of proposed treatments, and communicate their choice. Cognitive impairment, whether chronic (e.g., dementia) or acute (e.g., delirium), is frequent in the ED and can affect one or more of these elements, raising ethical and practical

concerns about autonomy and consent.[36] Delirium, a common and reversible condition in the ED, requires careful differentiation from baseline cognitive impairments like dementia. This distinction is crucial, as delirium often impairs capacity temporarily, and interventions can restore decision-making abilities.[37] In cases of persistent cognitive impairment, providers may need to involve family members, legal representatives, or advanced directives to guide care decisions. Providers also face the challenge of balancing respect for patient autonomy with the need to act in their best interest. Situations involving refusal of critical care by a cognitively impaired patient, or the absence of a clear surrogate decision-maker can result in legal and ethical dilemmas.

EDs often serve as the point of care for critically ill patients nearing the end of life, making advanced directives, palliative care, and end-of-life decisions critical aspects of emergency medicine. However, the fast-paced nature of the ED and the lack of pre-existing care plans frequently complicate the delivery of patient-centered care in such situations. Advanced directives, including living wills and do-not-resuscitate (DNR) orders, provide essential guidance for healthcare providers in aligning medical interventions with patients' preferences and values. Yet, these directives are often unavailable or uncommunicated during emergency visits.[38, 39] Without this information, ED teams may default to aggressive, life-sustaining treatments that may conflict with patients' wishes. Improved systems for accessing advanced directives, such as electronic medical records integration, are essential to addressing this gap.

Palliative care, which focuses on symptom management and quality of life, is underutilized in the ED despite its benefits for patients with life-limiting illnesses.[40, 41] Incorporating palliative care principles into emergency medicine can help guide decisions, prioritize comfort, and reduce unnecessary interventions. Early consultation with palliative care specialists can support comprehensive discussions about goals of care, particularly in the context of terminal illnesses or irreversible conditions.

Half of patients who pass away in the ED are older adults.[42] End-of-life decisions in the ED often involve complex ethical and emotional challenges for patients, families, and providers. In many cases, families are unprepared for these decisions, requiring sensitive communication and shared decision-making. Providing clear, compassionate explanations of prognosis and treatment options is critical to ensuring informed choices.

Frailty

The profile of older patients visiting the ED is highly variable but can be roughly categorized into two groups: those with severe acute illnesses requiring immediate, intensive treatment, such as resuscitation, and those with low-severity conditions who are at risk of developing geriatric-specific complications, such as falls, delirium, or functional decline. In the first group, it is critical to distinguish patients who are likely to benefit from intensive interventions from those for whom such treatments may be futile or burdensome. In the second group, identifying individuals at risk of developing geriatric-specific complications is essential, as these issues may present atypically and could easily be overlooked in a busy ED environment. Frailty identification emerges therefore as a key tool in managing these scenarios.

Concept

Frailty is a critical concept in medical settings, particularly in the care of older adults, as it represents a state of increased vulnerability to adverse health outcomes. Frailty is typically characterized by diminished physiological reserves, which lead to an impaired ability to cope with stressors such as acute illness, surgery, or hospitalization. As described by Clegg and demonstrated in Figure 2, a seemingly minor event, such as starting a new medication, a mild infection, or a minor surgery, can lead to a dramatic and disproportionate decline in health, shifting a person from being independent to dependent, mobile to immobile, stable to prone to falls, or clear-headed to experiencing delirium.[43] Frailty is particularly relevant because it affects decision-making in acute care, surgery, and chronic disease management. Frail patients often respond poorly to treatments that would be otherwise standard for healthier individuals. For example, after surgery or emergency interventions, frail individuals are more likely to experience complications such as infections, delirium, functional decline, or death.[44-46] As a result, the assessment of frailty has become an essential component in determining the best care strategies, particularly in geriatric medicine, emergency departments, and preoperative planning.[47]

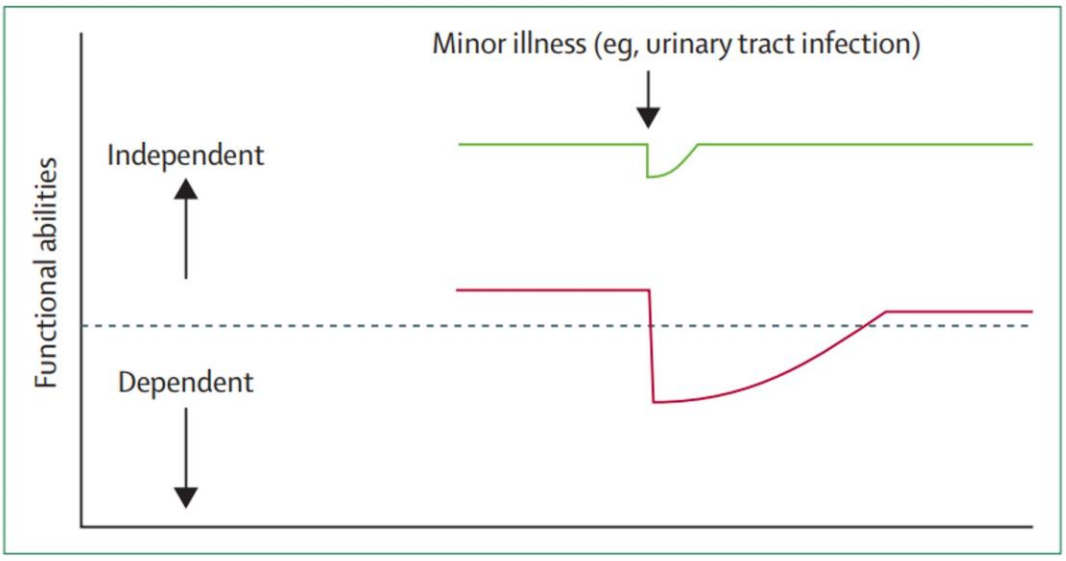

Figure 2 – Vulnerability of frail elderly people to a sudden change in health status after a minor illness (Clegg A, Lancet, 2013)

Various tools are used to assess frailty, including:

The Fried's Frailty Phenotype,[48] which defines frailty based on five clinical criteria: unintentional weight loss, muscle weakness (measured by grip strength), self-reported exhaustion, slow walking speed, and low physical activity. If a patient meets three or more of these criteria, they are considered frail. This tool focuses on physical aspects of frailty and is useful in settings where physical fitness and mobility are critical for care planning.

The Frailty Index (FI),[49] which takes a more comprehensive approach, calculating frailty as the proportion of deficits an individual has across a broad range of health issues, including comorbidities, functional impairments, and psychological factors. It is a cumulative deficit model, meaning the more health problems a person has, the higher their frailty score.

Other tools, like the Edmonton Frail Scale (EFS) and PRISMA-7, also incorporate cognitive and social factors, broadening the scope of frailty assessment.[50, 51] These tools are particularly valuable for more detailed assessments, often in geriatric and multidisciplinary care settings. In emergency medicine, the most widely utilized tool for assessing frailty is the Clinical Frailty Scale.

The Clinical Frailty Scale

The Clinical Frailty Scale (Figure 3) is a widely used tool that allows healthcare professionals to assess frailty levels in older adults.[52] It provides a quick and standardized method to evaluate a patient's overall health status, considering factors such as physical function, cognitive abilities, and independence in performing daily activities. By categorizing patients on a scale from 1 (very fit) to 9 (terminally ill), the CFS helps clinicians identify individuals who are frail and thus at greater risk for adverse health outcomes, including prolonged hospital stays, surgical complications, increased mortality, and functional decline.[46, 53, 54]

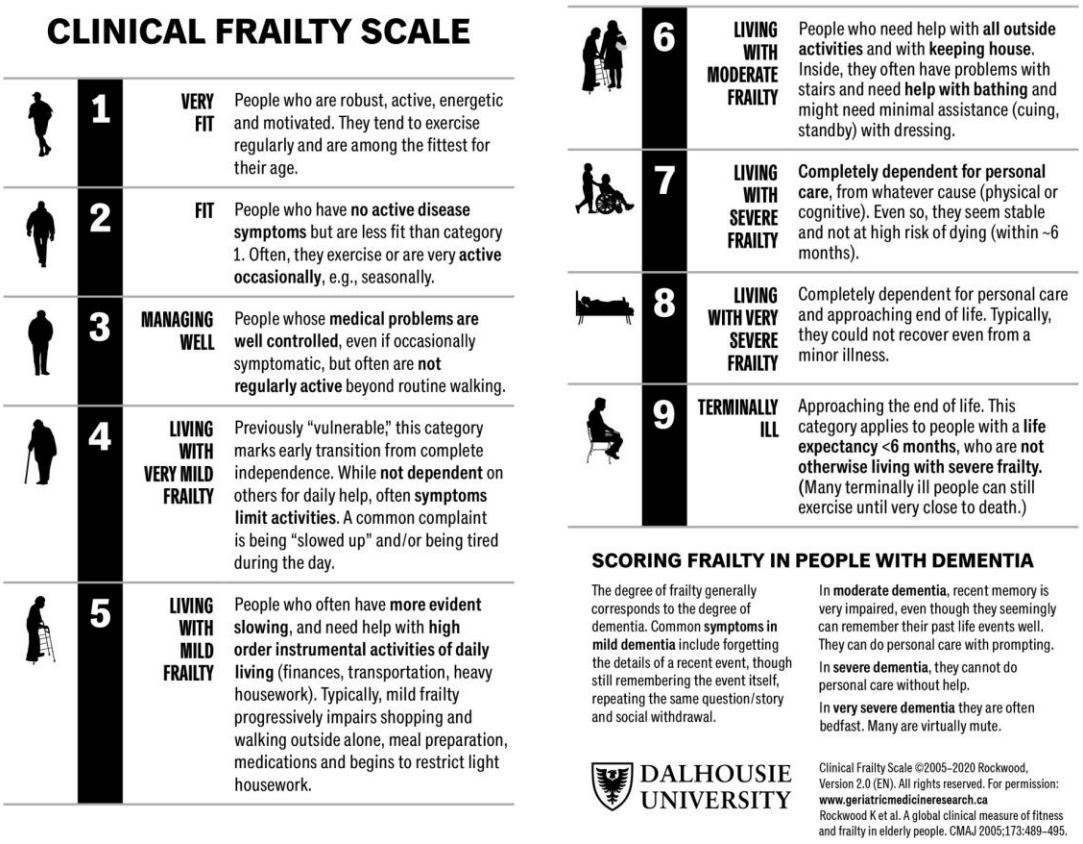

Figure 3 – The Clinical Frailty Scale (Rockwood K, Can Geriatr J, 2020)

The CFS is particularly valuable in high-pressure environments, such as emergency departments, where time is limited, and rapid decision-making is essential. Its simplicity and visual format enable healthcare providers to quickly gauge the frailty of older patients, guiding critical decisions regarding the intensity of care required, such as whether hospitalization is necessary, the appropriateness of surgical interventions, or the need for more tailored care plans.

The use of the CFS can also inform post-discharge planning, including referrals for geriatric assessments, rehabilitation services, or home care. Additionally, frailty identification via the CFS helps ensure that care is aligned with the patient's overall health condition and long-term prognosis, allowing clinicians to prioritize interventions that are most likely to improve outcomes and minimize risks.

Given its practicality and effectiveness, the CFS has become a standard tool in medicine, helping in the early identification of frailty and contributing to more personalized and appropriate care for older adults.

Frailty screening in the ED

A recent Delphi survey on frailty screening in ED examined three key aspects: principles, logistics, and domains.[55] Figure 4 provides a summary of the 19 statements that achieved consensus. Among these, some aspects warrant further development as they may be the most critical for implementing frailty screening in the ED. First and foremost, frailty screening should focus on assessing the overall baseline pre-morbid frailty status of individuals shortly before their ED presentation, rather than their current state (Statement 1). A recommended timeframe for evaluation is two to four weeks prior to the ED visit. This approach aims to prevent overassessment of frailty that could be influenced by the acute condition prompting the ED visit. Second, careful consideration should be given to the selection and design of the screening tool. A feasible and practical frailty screening instrument is preferred over an ideal one for use in the ED. It should be short, rapid, and capable of identifying older adults at high risk of adverse outcomes, such as hospital readmission, prolonged length of stay, or death. Additionally, it should be multidimensional, addressing at least two domains, such as cognition, daily functioning, healthcare utilization, nutrition, or physical status (Statements 5, 6, and 8). On a logistic plan, screening should be integrated into routine ED practice and conducted 24/7. It should be completed within 4 hours of patient arrival, with a short screening tool requiring under 5 minutes to administer (Statements 9, 10, and 12). Finally, frailty education for staff and integration of short screening tools into ED IT systems are essential to ensure routine and automated frailty screening (Statements 13 and 14).

Theme	Statement	% Agreement
1. Principles of frailty screening in ED	1. Frailty screening in ED should measure the overall general baseline pre-morbid frailty status of people shortly before ED presentation (i.e. their recent status—approximately 2–4 weeks before the current illness that resulted in their presentation to ED). (accepted but edited statement in R1)	97%
	2. Screening for frailty in ED is cost-effective (i.e. that the benefit to patients and hospitals outweighs the associated monetary/financial and time/opportunity costs). (New statement)	81%
	3. Frailty screening in the ED should be part of a broader ED protocol or pathway to account for the special care needs of older adults. (New statement)	97%
	4. Where frailty is identified in ED after screening and confirmed (subsequent assessment or already documented status), it is feasible to start individualised interventions in ED (i.e. tailored to the individual person's characteristics or needs rather than taking a broad, more generalised 'one-size-fits-all' approach). (New statement)	94%
	5. It is more important to have a feasible ED frailty screening instrument than an ideal frailty screening instrument. (New statement)	94%
	6. Short, rapid, frailty screening instruments in ED should identify older adults at high risk of adverse outcomes (e.g. predictive of hospital re-admission, prolonged length of stay, death). (Accepted statement in R1)	97%
	7. Frailty screening instruments for use in ED should be well-calibrated across the spectrum of frailty severity, disability and socioeconomic strata accounting for different levels of health literacy. (new statement)	81%
	8. A short frailty screening instrument for use in ED should be multidimensional, incorporating questions targeting different domains (e.g. two or more, including cognition, function in activities of daily living, healthcare utilisation, nutrition, physical status). (Accepted statement in R1)	97%
2. Logistics of frailty screening in ED	9. Frailty screening should be completed within 4 h of a patient attending ED. (Accepted statement 1e in R1)	88%
	10. The administration time of a short frailty screen for ED should be under 5 min. (Accepted statement in R1)	94%
	11. Frailty screening should be undertaken at point of first contact in ED, where it is appropriate (i.e. patient is sufficiently stable and capable of being screened) and provided ED resources allow. (New statement)	81%
	12. ED frailty screening should be conducted 24/7 (i.e. all the time) as part of routine ED practice. (New statement)	88%
	13. Frailty education initiatives for staff are required to support frailty screening in the ED. (New statement)	100%
	14. Short frailty screening instruments for use in ED need to be incorporated into the ED IT system to support routine, automatic mandated frailty screening. (New statement)	97%
3. Important domains to include in frailty screening instruments in ED	15. Functional ability (i.e. presence or absence of full functional capacity to undertake activities of daily living—e.g. washing, dressing, toileting, feeding, mobility, transferring, managing finances etc.). (Merged 3d/4w statements in R1)	94%
	16. Mobility factors (e.g. use of walking aids/frame, balance issues, falls history, etc.). (Merged 3e/4n statements in R1)	100%
	17. Cognition (e.g. any history of cognitive impairment, dementia, delirium, memory concerns, attention issues, deterioration in decision making, etc.). (Merged 3 g/4q statements in R1)	97%
	18. Medication use (e.g. polypharmacy, number or types of medication etc.). (Accepted statement in R1)	81%
	19. Social factors (e.g. Living situation alone or with others, sheltered housing, socio-economic status, social connections, such as social network or trusted people and family/friend supports etc.). (Accepted statement in R1)	94%

Figure 4 – Final consensus statements on the core requirements of frailty screening in the emergency department (ED) (Moloney E. Age and Aging, 2024)

In the ED, frailty, as measured by the CFS, has been consistently associated with adverse outcomes across a wide range of acute medical conditions. In serious conditions such as cardiac arrest, stroke, or sepsis, higher frailty scores on the CFS are strongly correlated with outcomes including increased mortality, impaired neurological function, greater dependency at discharge, higher utilization of healthcare resources, and elevated costs.[56-58] In patients with low-severity conditions, increased frailty is associated with increased delirium during ED stays.[59] When looking at all older patients consulting the ED, CFS is associated with readmission and mortality at several time points.[60-62]

From a logistical perspective, the CFS stands out as a practical and efficient tool. It is quick to administer, requiring less than one minute, and is favored over other screening instruments due to its simplicity and ease of use.[63, 64] Moreover, the CFS is widely acknowledged for its reliability in assessing frailty, particularly among older adults. Numerous studies have evaluated its use across various types of assessors in the ED, including medical students, residents, staff physicians, and nurses, consistently demonstrating excellent inter-rater reliability.[62, 65-67] This versatility highlights the CFS's adaptability across different professional roles while maintaining accuracy. While the scale allows for patient self-assessment, this method is generally not optimal, patients often underestimating their own frailty levels, potentially skewing the results.[67, 68]

This underscores the importance of having trained healthcare professionals conduct the assessment to ensure accuracy and consistency. The CFS's proven reliability across diverse assessors and its alignment with clinical observations solidify its role as a valuable tool for identifying frailty in the fast-paced environment of the ED.

Papers

The next section presents four published manuscripts that aim to advance the current understanding of the topics previously discussed. First, a scoping review identified gaps in the existing literature on the use of the Clinical Frailty Scale. A subsequent systematic review confirmed established associations between frailty and poor outcomes but highlighted that most evidence originates from studies conducted in the United Kingdom and North America. Additionally, a prospective study demonstrated that paramedic use of the CFS is reliable and may provide a valuable opportunity to enhance frailty screening. Finally, a survey conducted in European emergency departments revealed significant variability in geriatric frailty-focused service provision.

Paper 1 - Frailty assessment in emergency medicine using the Clinical Frailty Scale: a scoping review.

Citation [69]

Fehlmann CA, Nickel CH, Cino E, Al-Najjar Z, Langlois N, Eagles D. *Frailty assessment in emergency medicine using the Clinical Frailty Scale: a scoping review.* Intern Emerg Med. Jul 21 2022. https://doi.org/10.1007/s11739-022-03042-5

Summary of the paper

This scoping review aimed to describe how the CFS is applied in emergency medicine and to identify research gaps. A systematic literature search from 2005 to 2021 identified 4,818 citations, with 34 studies meeting inclusion criteria. Most studies (76%) were published after 2018, primarily in Europe and North America. The CFS was mainly used as a primary exposure (44%), with outcomes like mortality and hospital admissions commonly studied.

What this paper adds

This paper identifies significant gaps in current knowledge regarding the use of the Clinical Frailty Scale in emergency medicine, including a lack of standardization in reporting across studies, a lack of evidence on its use by paramedics, and the critical need to explore the impact of CFS screening in the Emergency Department.

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CE-SYSTEMATIC REVIEWS AND META-ANALYSIS

Frailty assessment in emergency medicine using the Clinical Frailty Scale: a scoping review

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Abstract

Background Frailty is a common condition present in older Emergency Department (ED) patients that is associated with poor health outcomes. The Clinical Frailty Scale (CFS) is a tool that measures frailty on a scale from 1 (very fit) to 9 (terminally ill). The goal of this scoping review was to describe current use of the CFS in emergency medicine and to identify gaps in research.

Methods We performed a systemic literature search to identify original research that used the CFS in emergency medicine. Several databases were searched from January 2005 to July 2021. Two independent reviewers completed screening, full text review and data abstraction, with a focus on study characteristics, CFS assessment (evaluators, timing and purpose), study outcomes and statistical methods.

Results A total of 4818 unique citations were identified; 34 studies were included in the final analysis. Among them, 76% were published after 2018, mainly in Europe or North America (79%). Only two assessed CFS in the pre-hospital setting. The nine-point scale was used in 74% of the studies, and patient consent was required in 69% of them. The main reason to use CFS was as a main exposure (44%), a potential predictor (15%) or an outcome (15%). The most frequently studied outcomes were mortality and hospital admission.

Conclusion The use of CFS in emergency medicine research is drastically increasing. However, the reporting is not optimal and should be more standardized. Studies evaluating the impact of frailty assessment in the ED are needed.

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Keywords Frailty · Clinical Frailty Scale · Older patients · Geriatric · Emergency medicine

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Introduction

Frailty is a physiological state where small perturbations in health result in disproportionate adverse effects due to an underlying decline in reserve of multiple physiological systems [1–3]. It is common in older Emergency Department (ED) patients with reported prevalence rates between 21 and 62 [4–7]. Frailty is associated with a wide range of adverse outcomes, including mortality [8], hospitalization [9], delirium [7] and diminished quality of life [10]. People often present to the ED due a change in health status, this offers a unique opportunity to alter their health trajectory. To meet the needs of the growing population of older adults with frailty presenting to the ED, there is advocacy for the integration of ED frailty evaluation [11, 12]. However, the benefit and harms associated with frailty screening in the ED are largely unknown [13, 14]. Furthermore, frailty identification in the ED is not common [15]. Cited barriers included feasibility of tools in the time pressured ED environment, lack of formal clinical frailty guidelines for the ED and geriatric expertise [11, 13, 15, 16].

Previous scoping reviews on frailty in the acute care setting have included multiple medical disciplines including geriatrics, emergency medicine, general medicine, cardiology and orthopedics [14, 17]. Van Dam et al. recently completed a narrative review of frailty assessment in the ED [18]. They focused on the predictive accuracy of frailty screening tools, the use of clinical gestalt to determine frailty, and the rationale for and implementation of frailty assessment in the ED. However, some of included studies have used tools that were initially designed to predict risk of adverse outcome (ie ISAR, TRST) and not frailty specifically [5, 19].

There are 89 different measures that have been used to evaluate frailty in the acute care literature [20]. The Clinical Frailty Scale (CFS) is one of the most commonly used tools. The CFS was initially a seven-point scale used as a judgment-based tool to assess frailty [21]. In 2007, it was expanded to a nine-point scale, from 1 (very fit) to 9 (terminally ill) (Fig. 1). Compared to other frailty tools, the CFS seems to be the ideal choice for measuring frailty in emergency medicine, because it is easier and faster to use, without giving up any prognostic accuracy [22]. There are no studies that exclusively synthesize information on the use of CFS in emergency medicine. This scoping review is intended to fill this gap, by focusing strictly on the CFS literature in the emergency medicine setting. We aimed to describe the current evidence and identify gaps in knowledge including: version of CFS, timing of CFS evaluation, who is completing the evaluation, goals of frailty evaluation, the prevalence of frailty, and the outcomes associated with frailty identification using the CFS.

Materials and methods

A protocol for this scoping review was developed and published on the Open Science Framework, where the study was registered before performing the search strategy (https://doi.org/10.17605/OSF.IO/W2F8N) [23]. We have followed the PRISMA-ScR Statement for reporting scoping reviews [24].

Eligibility criteria

Based on the population, concept, and context (PCC) framework for scoping reviews [25], inclusion criteria were: (1) adult (≥ 18 years) population; (2) use of the CFS; (3) emergency medicine setting (intra-hospital or pre-hospital); and (4) original research. We did not language restrict.

Studies not reporting frailty or reporting frailty using another tool (such as Fried [26], ISAR [27]) exclusively were excluded. We also excluded conference abstracts, editorials, commentaries, position papers, narrative and systematic reviews, and case studies, that did not report on original research.

Search strategy

The MEDLINE search strategy was developed by a health science librarian and peer-reviewed by another librarian [28]. Databases searched were MEDLINE(R) ALL via Ovid, Embase Classic + Embase via Ovid, EBM Reviews—Cochrane Central Register of Control Trials via Ovid, CINAHL via EBSCOhost, Ageline via EBSCOhost, and Scopus. The main search concepts were comprised of terms related to emergency department or pre-hospital settings and frailty. The date of publication was limited from 2005 to 2021. This limit was applied as the Clinical Frailty Scale (CFS) was introduced in 2005. The search strategy was developed in MEDLINE (Appendix 1) and translated to other databases. All databases were searched on July 6th, 2021. Additionally, a manual search of all eligible articles' reference lists was completed to identify any additional literature.

Selection of source of evidence

Search results were imported into Covidence and de-duplicated [29]. Screening and data abstraction were also completed in Covidence. First, team members screened a sample of 50 citations. Conflicts were reviewed and discussed. As the agreement on the pilot test was low (< 90%), another pilot was performed, with success. Then, two reviewers independently screened all remaining citations. Disagreements were resolved by consensus. Second-level screening was performed using a similar strategy (pilot, double

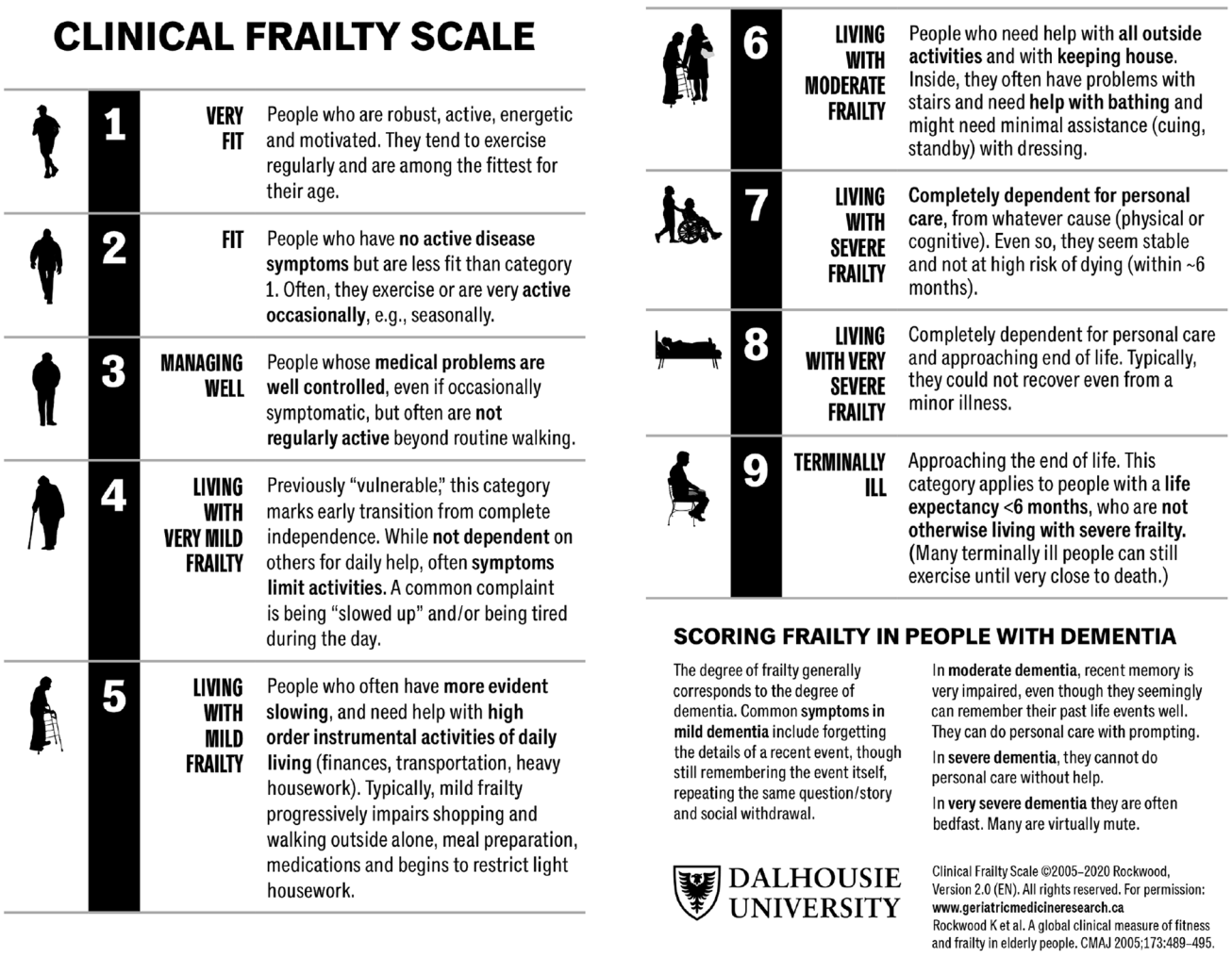

Fig. 1 The Clinical Frailty Scale

independent screening). The study screening form can be found in Appendix 2.

Data charting process and data items

Data were abstracted, using a pre-specified data abstraction form. To ensure consistency between reviewers, all reviewers initially abstracted the same five citations. Any discrepancies were resolved by consensus. The form was then adapted (Appendix 3), and data abstraction was completed independently by two reviewers. We collected data on publication characteristics (authors, country, year of publication, journal), study characteristics (design, sample size, setting, patients' age and sex), frailty [version of CFS used, cut-off used to define frail people, type of categorization of CFS, purpose of the assessment (outcome, screening, descriptive, exposure, covariate, potential predictor), assessor, prevalence of frailty] and outcomes under study. When composite outcomes were studied, we collected each outcome of the composite outcome individually.

Critical appraisal of individual sources of evidence

As the main goal of this study was to report on the contextual features of frailty in emergency medicine literature, no critical appraisal was performed on the individual studies.

Synthesis of results

Results of the search and the screening process are presented using a flow diagram. Outcomes were grouped according to essential themes for the purpose of analysis.

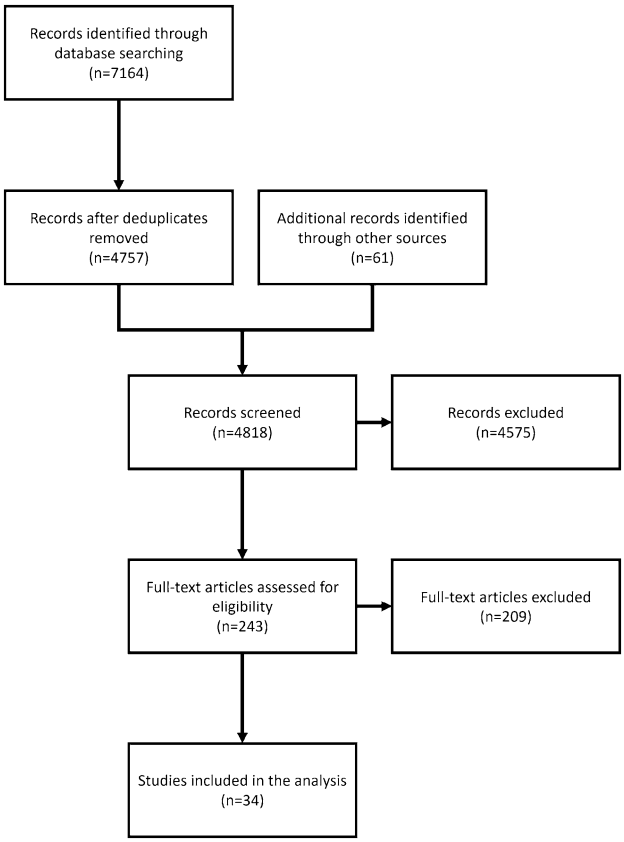

Fig. 2 Flow diagram

Results

Figure 2 presents the study flow diagram. From the 7164 records, we identified 4757 unique citations after deduplication. Sixty-one studies were also identified from references of included articles. Following first-level screening, 4575 were deemed irrelevant. Second-level screening excluded a further 209 citations. Thirty-four manuscripts (33 full manuscript and one research letter) underwent complete data abstraction and are presented in this manuscript (Appendix 4). No potentially relevant studies were excluded.

Table 1 presents characteristics of the included studies. All studies were published in English and the primary author affiliation was mainly from North America [7, 30–43] (44%) and Europe [44–55] (35%). No papers had been published before 2015, and most of the papers (76%) were published beginning 2019. Studies were published in emergency medicine journals (41%) [7, 30, 32, 33, 36, 40, 46, 48–50, 53, 54, 56, 57], geriatric journals (38%) [31, 34, 35, 38, 39, 41, 42, 45, 47, 56, 58, 59] or other types of journals (21%) [37, 43, 51, 52, 55, 60, 61].

Two-thirds of the studies were prospective cohorts [7, 30, 33, 35–38, 40, 42, 43, 47–50, 52, 54–59, 62], while the remaining were retrospective cohorts (24%) [34, 39, 41, 45, 46, 53, 60, 61], intervention studies (9%) [31, 44, 51] or cross-sectional studies (3%) [32] (Table 1). One study [45]

Table 1 Summary of study characteristics, $N = 34$

Study Characteristics	
Main author affiliation-*n* (%)	
North America	15 (44)
Europe	12 (35)
Oceania	4 (12)
Asia	3 (9)
Year of publication-*n* (%)	
Before 2018	6 (18)
2018	2 (6)
2019	7 (21)
2020	8 (24)
2021	11 (32)
Journal category-*n* (%)	
Emergency medicine	14 (41)
Geriatric medicine	13 (38)
Other	7 (21)
Study design-*n* (%)	
Prospective cohort	22 (65)
Retrospective cohort	8 (24)
Intervention study	3 (9)
Cross-sectional study	1 (3)
Required participant consent-*n* (%)	
No	4 (12)
Yes	20 (59)
Not reported	10 (29)
Study sample size – median (IQR)	612 (330–1309)
Female proportion – median (IQR)	55 (51–63)
Mean or median age – median (IQR)	79 (77–82)
CFS version-*n* (%)	
7 levels	6 (18)
9 levels	25 (74)
Not reported	3 (9)
Cut-off to define frailty-*n* (%)	
≥4	5 (14)
≥5	12 (35)
Not reported	15 (44)
Not applicable	2 (6)
Frailty prevalence–median (IQR)	36.8 (31.8–57.6)
Assessment purpose-*n* (%)	
Main exposure	15 (44)
Predictor	5 (15)
Outcome (including reliability studies)	5 (15)
Descriptive	3 (9)
Inclusion criteria	2 (6)
Covariate	1 (3)
Other	3 (9)

was performed in pre-hospital setting only, and another one [43] included both pre-hospital and ED patients. Overall, the median sample size was 612, with an important variability from one study to the other (IQR 330–1309). The median or mean age varied between 75 and 85, while the proportion of female patients varied between 36 and 77%. Patient consent was required in 20 studies and not required in four studies [36, 45, 53, 54]. The 10 remaining studies [32, 34, 41, 43, 46, 50, 51, 59–61] did not mention patient consent.

The majority (74%) of the studies used the nine-point CFS [32–34, 36, 39–41, 44–46, 48–62]. For three studies [30, 43, 47], it was not possible to assess which CFS version was used. Only two studies excluded patients with CFS score of nine. [33, 49] Thirteen studies reported frailty prevalence, with a median (using authors' cut-off) of 36.8% (IQR 31.8–57.6). Frailty was assessed mostly during patient work-up (65%) [31–33, 35–38, 40, 42, 44, 45, 47–49, 51, 53, 55, 56, 58, 59, 61, 62], while some authors assessed it at triage (18%) [41, 46, 50, 52, 54, 60], at patient disposition (9%) [7, 34, 57] or at other times (9%) [30, 39, 43]. Table 2 shows the different types of assessors. Research staff (35%) [7, 30, 31, 35, 37, 38, 43, 47, 49, 56, 59, 62], nurse (32%) [36, 40, 41, 44, 46, 48, 50, 52, 54, 58, 60] and ED physician (20%) [32, 33, 36, 40, 42, 46, 57] were the most frequent.

CFS was most commonly used as a main exposure (44%) [7, 33, 37–39, 41, 42, 46, 49, 52, 53, 55, 57, 60]. Other frequent purposes included potential predictor (15%) [30, 35, 45, 56, 62] and outcome (15%) [32, 36, 40, 43, 48]. Only two studies used it as an eligibility criterion. When CFS was used as a main exposure or a predictor (20 studies), the most frequent studied outcomes (either alone or in composite) were mortality (10 studies, 50%) [33, 39, 46, 49, 55–58, 60, 62] and hospital admission (7 studies, 35%) (Table 3) [33, 35, 41, 49, 53, 55, 60]. For mortality, several time points were used, including 1 month [33, 39, 49, 55, 57, 60], 3 months [56, 62] or 1 year. Three papers used it as a time-to-event variable [39, 46, 49]. Four papers considered patient-oriented outcomes (alone or included in a composite outcome), such as quality of life [37, 58], functional decline [38, 42] or need for community service following discharge [58]. In the case of use as the main exposure, a sample size calculation was reported only in three studies [7, 49, 52]. Different methods to deal with the CFS variable as exposure or predictor were used for the statistical analysis: binarization (35%) [7, 33, 38, 55, 56, 58, 62], categorisation in 3 or more groups (30%) [35, 37, 39, 42, 46, 49] or continuous (20%) [41, 45, 53, 57]. One study [60] used different methods and two studies [30, 52] did not mention their analytic approach. Among the 15 studies looking for an association between a main exposure and an outcome, only 3 (20%) mentioned a sample size calculation [7, 49, 52]. Finally, these 15 studies found a statistically significant association. Three studies did not incorporate any covariate in the model [41, 42, 52]. For the other ones, age (10 studies [7, 33, 38, 46, 49, 53, 55, 57, 58, 60]), sex or gender (9 studies [33, 38, 46, 49, 53, 55, 57, 58, 60]) and comorbidities (7 studies [37, 38, 46, 53, 57, 58, 60]) were the most frequent covariates used for adjustment (Table 4).

Table 3 Reported study outcome measures

Outcomes	Number of studies (frequency)*
Mortality	10 (50)
Admission	7 (35)
Readmission or return to the ED	4 (20)
Length of stay	3 (14)
Delirium	2 (10)
Functional decline	2 (10)
ICU admission	2 (10)
Quality of life	2 (10)
Others	7 (35)

*Total of studies can exceed number of studies as some looked at more than one outcome

N = 20

Table 2 Person completing Clinical Frailty Scale assessment

Assessor	Number of studies (frequency)*
Research staff	12 (35)
Nurse	11 (32)
ED physician	7 (20)
Patients	3 (9)
Geriatric physician	2 (6)
Other	3 (9)
Not reported or unclear	3 (9)

*Total of studies can exceed number of studies as some studies used more than one type of assessor

Table 4 Adjusting variables,

Variables	Number of studies (frequency)*
Age	10 (67)
Sex/gender	9 (60)
Comorbidities	7 (47)
Severity/Acuity	6 (40)
At least one other	6 (40)
None	3 (20)

*Total of studies can exceed number of studies as some studies included more than one covariate

N = 15

Discussion

We conducted a scoping review that explored the use of the CFS in adult patients in emergency medicine. We found there is increasing use of the CFS in the emergency setting. Most of the studies using it have been published in recent years. The revised version of the CFS with nine points was the most frequently used; however, the purpose and timing of the CFS, who performed the assessment and the analytic approach differed between studies. The cut-off used to define frailty not reported in almost half of studies and the most frequent use of CFS was as an exposure, to look at an association with an outcome.

Our study adds to the work of Church et al., and van Dam et al. [18, 63]. Van Dam et al. completed a narrative review of frailty assessment in the ED. Their study evaluated multiple tools and only included three studies that used the CFS. Church, on the other hand, focused exclusively on use of the CFS, but only six were in the ED. While there are some similarities, including trend over time, assessors and outcomes under study, our findings contribute significantly to our understanding of the current use of the CFS in the ED, as we focused on the ED setting and we examined additional characteristics, such as consent and statistical analysis.

This research showed that consent was required for study inclusion most of the time. While we acknowledge the importance to seek patient consent to participate in a study, studies looking at the impact of frailty assessment or association with outcomes that exclude patients that cannot give informed consent are at risk of, in the very least, limiting the generalizability of the results but in the worst case biasing their results. The impact of patient selection based on consent on study results has been shown in other vulnerable populations, including patients with delirium and stroke [64, 65]. As there appears to be a relation between frailty and ability to give informed consent, the risk of bias in this patient population is high [66]. Therefore, it would be optimal to get a waiver of consent for minimum risk studies.

Another important finding of this study is suboptimal reporting regarding CFS. It was occasionally difficult to determine who completed the CFS assessment, when the assessment took place, which version of the CFS was used or how the CFS was considered in the analysis. A lack of standardized reporting is a crucial issue in research as it could impact interpretation and reproducibility of results [20].

Regarding the analysis, our study highlights several issues that should be mentioned. Studies that reported frailty prevalence or used frailty as a binary variable in their analysis, did not use a consistent CFS cut-off, some authors used four and more whereas other authors used five and more, likely because of the recent change of wording ("vulnerable" to "very mild frailty"). Although binarization is never the best solution, there needs to be consensus regarding a standardized cut-off if the CFS is to be dichotomized. While many studies consider frailty as a binary variable, some authors used it as a continuous one. Such analysis should be performed with caution as it is unlikely that regression fundamental assumptions would be met, such as linearity of the log-odds. Using categories, or even more advanced methods such as restricted cubic spline, could improve the rigor in this part of a study [67]. Almost all authors chose to adjust the main association. Age and comorbidities were frequently chosen. It can be argued that, because the CFS is a multi-faceted tool, incorporating already such aspects, there is a risk of collinearity.

Some limitations of this scoping review should be acknowledged. Our search strategy was developed for our specific question, however there is the possibility that studies could have been missed, especially studies with CFS used as inclusion criteria, baseline characteristics or covariates as they are frequently not mentioned in the abstract. Therefore, the results regarding the purpose of the CFS assessment in the ED could be biased, with a risk of underestimating the use of CFS for those purposes. We decided a priori to include only studies with patients, as our goal was to see how the CFS was used in the ED. There are, however, some papers on the reliability of the CFS that were based on clinical vignettes. Those studies were excluded. Finally, to ensure the homogeneity of our results, we excluded papers that included both ED patients and ward patients, as the finding could have biased our results, if the CFS was not assessed in the ED environment.

This scoping review has strengths. To our knowledge, this is the first exhaustive review on the CFS in the ED. The results from this review will help to define future research questions. Secondly, we used rigorous methodology for the sources (several databases, published papers and conferences abstract), the search strategy (more comprehensive than previous studies), the screening (pilot testing, double independently review) and the data extraction. This process reinforces the internal validity of our results. Finally, this scoping review was registered, its protocol is available, and all amendments to this protocol are listed to increase the transparency of our work.

Based on this review, we identify several gaps that could be considered in future research projects. From a global perspective, there needs to be a move toward common data elements (including cut-off point where appropriate) and core outcome measures [68]. Consensus on data elements and outcome measures for the CFS in the ED could be achieved using the Delphi methodology [69]. We identified multiples

studies that looked at the association between CFS level and outcomes. Robust synthesis, including bias assessment and meta-analysis should be performed. From a clinical perspective, there are currently few studies looking at the added value of the systematic use of the CFS in the ED. Evaluation of the impact of ED frailty screening with this tool is therefore needed. Studies comparing frailty screening to no screening are required before advocating for a large implementation of frailty screening. Other important questions include who should complete the frailty evaluation and what is the optimal timing of frailty assessment during the ED course. While it has been shown in the ICU that assessment based on chart review, with family or directly to the patient were quite similar [70], the research on this issue within emergency medicine is scarce. It is likely that assessing frailty at triage versus at disposition could have a different impact. Finally, we found only one study performed exclusively in the pre-hospital setting. When paramedic attend at patients' home, they could have a better perspective of their environment and could therefore have a more accurate assessment of their frailty.

In summary, this scoping review found increasing use of the Clinical Frailty Scale in studies with adults presenting to the ED. The majority of studies used it as a predictor for adverse outcomes, most commonly admission to hospital and mortality. The quality of the reporting in future studies must be improved. Future research should look at how patients can benefit from its use in the ED and when, how and by whom the CFS should be used.

Appendix 1: Search strategy draft Ovid MEDLINE(R) ALL < 1946 to July 02, 2021 >

#	Searches	Results
1	((emergenc* or accident) adj3 (department? or room? or ward? or unit? or service? or hospital? or care? or medicine? or treatment? or technician* or practioner* or rescu* or triag*)).ti,ab,kf	180,881
2	(Out of hospital or Prehospital or pre-hospital or paramedic* or ambulance* or dispatch* or first responder*).ti,ab,kf	45,798
3	(Emergenc* adj2 (medical or health) adj2 service*).ti,ab,kf	11,447
4	"observation unit?".ti, ab, kf	886
5	exp Emergency Medical Services/	150,742
6	Emergencies/	41,625
7	exp Emergency Service, Hospital/	85,732
8	exp Emergency Medicine/	14,435
9	Emergency Medical Technicians/	5820
10	exp Emergency Treatment/	125,715
11	or/1–10	409,059
12	CFS.ti, ab, kf	7384
13	frail*.ti, ab, kf	26,761
14	Frailty/	4442
15	Frail Elderly/	12,681
16	or/12–15	38,245
17	11 and 16	1375
18	limit 17 to year = "2005-Current"	1218

Appendix 2: Screening form

Question	Answer	Decision
1st-level screening (Title and abstract)		
Does the study concern emergency medicine patients (Emergency department, pre-hospital field, paramedics)?	No	Exclusion
	Yes/Unsure	Go-on screening
Does this study report original research?	No	Exclusion
	Yes/Unsure	Go-on screening
Does the title or the abstract mention CFS or frailty?	No	Exclusion
	Yes	Inclusion
2nd-level screening (Full text screening)		
Does the study report original research?	No (systematic or scoping review)	Exclusion
	No (editorial, letter, etc.)	Exclusion
	Yes (intervention, cohort, case control, secondary analysis, etc.)	Go on screening
Does the study report the assessment of frailty using the CFS (inclusion criteria, Table 1, exposure, results, etc.)?	No	Exclusion
	Yes / Doubt	Go on screening
Are the patients assessed in the pre-hospital field or in the ED?	No	Exclusion
	Doubt/Yes	Go on screening

Appendix 3: Extraction form

Type	Full text / Letter
First author name	Free text

Type	Full text / Letter
Country of first affiliation	Free text
Email of corresponding authors	Free text
Year of publication	XXXX
Journal	Free text
Study design	Not mentioned/Unclear/Intervention/Prospective cohort/retrospective cohort/Case control/Other (Free text)
Sample size	XXX
Setting	ED only/Prehospital only/Mixed/Other (Free text)
Patient's age (mean or median)	Not mentioned/XXX
Female proportion (%)	Not mentioned/XXX
Version of CFS used	7/9/Not mentioned
Cut-off to define frail patients	Not mentioned/Free text
Purpose of the assessment	Eligibility criteria/Main exposure/Co-variate/Outcome/Predictor/Descriptive only/Other (Free text)
If main exposure or covariate, how was the variable analyzed	Continuous
	Binarization
	Categorization
	Transformed
	Other
If main exposure, sample size calculation performed	Yes/No/Not mentioned
Assessor	Not mentioned/Nurse/ED physician/Geriatric physician/Research staff/Administrative staff/Other (Free text)
Time of assessment	Triage
	Patient's work-up
	Disposition
	Other (Free text)
Prevalence of frailty (%)	Not mentioned/XXX
Primary outcome	Not mentioned/Free text
Statistically significant association between frailty and the outcome	Not mentioned/Yes/No
Secondary outcomes	Free text
Confounders adjusted association	Yes/No
If confounders:	Free text

Appendix 4: Studies included in the analysis

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Declarations

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Amendments Some amendments were done to our protocol. We dropped the language restriction and we adapted screening form and data extraction form following initial training.

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Paper 2 - Association between mortality and frailty in emergency general surgery: a systematic review and meta-analysis.

Citation [70]

Fehlmann CA, Patel D, McCallum J, Perry JJ, Eagles D. *Association between mortality and frailty in emergency general surgery: a systematic review and meta-analysis*. Eur J Trauma Emerg Surg. 2021. https://doi.org/10.1007/s00068-020-01578-9

Summary of the paper

This systematic review examined frailty in patients aged 65 or older undergoing emergency general surgery (EGS). A comprehensive search of several databases up to March 2020 identified six cohort studies, including 1,289 patients, with 283 classified as frail. Frailty was measured using the Clinical Frailty Scale or Modified Frailty Index. The primary outcome was 30-day mortality, with secondary outcomes including 90-day and 1-year mortality, length of stay, complications, change in level of care, and loss of independence. Meta-analysis showed frail patients had significantly higher odds (OR 2.91) of 30-day mortality and increased risks for all secondary outcomes.

What this paper adds

This study was the first to specifically synthesize the use of the CFS in emergency general surgery. It found that frailty is strongly associated with poorer outcomes in older adults undergoing emergency surgery and suggested that the CFS could enhance preoperative risk assessment and support shared decision-making. The study also emphasized that the CFS is primarily utilized in the UK and North America, with relatively limited research conducted in other European contexts.

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ORIGINAL ARTICLE

Association between mortality and frailty in emergency general surgery: a systematic review and meta-analysis

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Abstract

Purpose The purpose of this review was to determine the association between frailty and mortality among adults ≥ 65 years old undergoing emergency general surgery (EGS).

Methods This systematic review followed the PRISMA guidelines (CRD42020172482 on PROSPERO). A search in MEDLINE, PubMed, EMBASE, Scopus, Web of Science, and the Cochrane Database of Systematic Reviews was conducted from inception to March 5, 2020. Studies with patients ≥ 65 years undergoing EGS were included. The primary exposure was frailty, measured using the Clinical Frailty Scale or the Modified Frailty Index. The primary outcome was 30-day mortality. Secondary outcomes were 90-day and 1-year mortality, length of stay, complications, change in level of care at discharge, and loss of independence. Two independent reviewers screened articles and extracted data. Risk of bias was assessed according to the Newcastle–Ottawa Scale and quality of evidence was assessed using the GRADE approach. A meta-analysis was performed for 30-day mortality using a random-effects model.

Results Our search yielded 847 articles and six cohort studies were included in the systematic review. There were 1289 patients, 283 being frail. The pooled OR from meta-analysis for frail compared to non-frail patients was 2.91 (95% CI 2.00, 4.23) for 30-day mortality. Frailty was associated with increased odds of all secondary outcomes.

Conclusion Frailty is significantly associated with worse outcomes after emergency general surgery in adults ≥ 65 years of age. The Clinical Frailty Scale could be used to improve preoperative risk assessment for patients and shared decision-making between patients and healthcare providers.

Registration number CRD42020172482 (PROSPERO).

Keywords Systematic review · Frailty · Clinical frailty scale · Emergency general surgery

Introduction

In 2050, approximately one-quarter of the population in western countries will be over the age of 65 [1]. The number of unscheduled emergency department visits by this population has increased by 30% during the last 10 years

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[2]. Aging populations have increased the number of older patients presenting for emergency surgery, with patients over 60 representing greater than 30% of all emergency general surgery cases [3]. Given the significant proportion of older patients in the population, it is important to determine the impact of older age on healthcare outcomes.

Overall, 11% of general surgery cases are emergency general surgeries. Compared to elective surgery, emergency general surgery is associated with a fivefold higher mortality rate and a threefold higher complication rate [4]. In older patients, improvements and advancements in anaesthesiologic care and surgical techniques resulted in a decrease in mortality and post-operative complications in recent years. However, this remains an important issue, as their risk of death after emergency laparotomy is more than twice than that of patients less than 70 years old [5]. The predictors of mortality in older patients who undergo emergency general surgery warrant further investigation.

Frailty can be defined as "a condition or syndrome which results from a multisystem reduction in reserve capacity to the extent that a number of physiological systems are close to, or past, the threshold of symptomatic clinical failure"[6]. More than 50 tools have been developed to measure frailty [7]. Several studies have shown that frailty is associated with poorer outcomes: in the emergency department, frail patients are at increased risk of death or complications for several pathologies, such as acute coronary syndrome, trauma, pneumonia, and acute cardiac failure [8–12]. Concerning surgery, frailty was also associated with mortality, complications, and length of stay, independent of the type of surgery [13–15]. To our knowledge, there is no prior systematic review specifically assessing the impact of frailty on mortality among older patients who undergo emergency general surgery.

Objectives

The primary objective of this systematic review was to assess the association between frailty and 30-day mortality after emergency general surgery in patients aged ≥ 65 years. Our secondary objectives were to summarize the association between frailty and 90-day mortality, 1-year mortality, complications, hospital length of stay, change in level of care at discharge, and loss of independence at any time.

Methods

This study was submitted to PROSPERO on March, 6th 2020 and registered on April, 28th 2020. The protocol was not published, but is available upon request. It was amended on March 7th (regarding the requirement for 80% of patients to meet inclusion criteria in mixed studies) and April 5th (major complications being Clavien-Dindo ≥ 3, i.e., complications requiring intervention, life-threatening complications requiring admission to intensive-care unit, death) [16]. We conducted this systematic review and meta-analysis according to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines (Online Appendix I)[17].

Eligibility criteria

We included English-only studies reporting human-only original research (randomized-controlled trials, prospective or retrospective comparatives cohorts, and case–control studies). We included studies examining adults ≥ 65 years of age who underwent emergency general surgery. The age criterion was a firm cut-off and all study subjects were required to be ≥ 65 years of age. Emergency general surgery was defined as any of the following procedures: appendectomy, cholecystectomy, laparotomy, lysis of adhesions, large bowel resection, small bowel resection, and peptic ulcer repairs, performed on a non-elective basis [18]. Studies were eligible if they reported stratified data for emergency general surgery or if 80% or more of the patients had emergency general surgery. Studies were included if frailty was measured by the Clinical Frailty Scale (CFS) or the Modified Frailty Index (mFI) [19, 20]. Frailty was studied as a dichotomous variable (frail versus non-frail); patients with a Clinical Frailty Scale ≥ 5 or a Modified Frailty Index ≥ 3/11 were considered as frail (Online Appendix II, S1 and S2). These cut-offs are most commonly used [19, 21].

The primary outcome was 30-day mortality, defined as death during the 30-day period following emergency general surgery. Secondary outcomes included 90-day and 1-year mortality, defined as death at any time during the 90-day period or 365 day period following emergency general surgery, respectively; hospital length of stay, defined as either (a) the number of days between admission and discharge or (b) the number of days between surgery and discharge; major post-operative complications at any time, defined as a Clavien–Dindo score of 3 to 5, compared to 0–2 (Online Appendix II, S3) [16]; an increase in level of care at discharge; and loss of independence at any time. We originally defined major complications as a Clavien–Dindo score of 3 or 4 [excluding 5 (death)]; however, since all included studies presented complications with a Clavien–Dindo score of 5, we re-defined this outcome to include death. Letters, editorials, review articles, case reports, and case series (≤ 10 patients) were excluded. We excluded studies with patients aged < 65, patients who were followed up for less than 30 days following the surgery, and if the scores from the Clinical Frailty Scale or Modified Frailty Index were not

presented as an absolute value or a dichotomous variable with our pre-specified cut-offs.

Information source and search strategy

Our literature search strategy was developed using medical subject headings (MeSH) and text words related to emergency general surgery and frailty. We searched MEDLINE, PubMed, EMBASE, Scopus, Web of Science, and the Cochrane Central Register of Controlled Trials from inception until March 5, 2020. We also scanned the reference lists of included studies and relevant reviews identified through the search. The search strategy was developed with a medical librarian. Search terms related to emergency, surgery, and frailty scores were included. Emergency terms included terms such as expedited OR urgent OR emerg*. Surgical terms included terms such as surgery OR laparotomy OR cholecystectomy OR colectomy OR hernia OR adhesion OR incision OR drainage. Frailty terms included terms such as frail*. The full search strategy can be found in online Appendix III.

Study selection

The results of the literature search were uploaded to Covidence Software [22]. Titles and abstracts yielded by the search were independently screened by CF and another reviewer (DP or JM). Discrepancies were resolved by the third reviewer. Full-text reports meeting inclusion criteria were reviewed by CF and another reviewer (DP or JM). Discrepancies were resolved by the other reviewer. Duplicates were removed either electronically during the search or manually during screening. If two or more papers reported the results for the same outcomes in the same study, only the study with the larger sample size was selected. Authors were contacted if study data were not stratified by frailty scale or not stratified by surgery type to determine if they met eligibility criteria.

Data extraction

A pre-designed, standardized data extraction sheet was created using Excel©. Two reviewers independently collected the pre-specified data. Disagreements were resolved by the third reviewer (DP or JM). For each study, we collected publication details (author, year of publication, country, journal), study details (study design, eligibility criteria, number of patients included, funding resource), type of frailty measure, and sample size of frail and non-frail. The pre-specified outcomes (including 30-day, 90-day, and 1-year mortality, complications, hospital length of stay, change in level of care at discharge, and loss of independence at any time) were extracted according to frail and non-frail for each group, in each study. Unadjusted and adjusted odds ratios were also collected. If essential data such as outcomes stratified by frailty scores, used for computing odds ratios, were not reported, study authors were contacted.

Risk of bias in individual studies

Risk of bias was evaluated using the Newcastle–Ottawa Scale (NOS) for cohort studies [23]. For our review, bias was only assessed for the main outcome of interest that was extracted. If there was insufficient detail reported, we judged the risk of bias as 'unclear'. Bias was evaluated independently by two review authors and disagreements were resolved by consulting the third reviewer (DP or JM).

Data synthesis

Clinical heterogeneity was evaluated based on study population, design, and assessment of the outcomes. When at least two studies were judged to be sufficiently clinically homogeneous, a meta-analysis was conducted using a random-effects model. We pooled dichotomous data and reported odds ratios and 95% confidence intervals. Statistical heterogeneity was then evaluated through the I^2 statistic. If this statistic was greater than 75%, we planned to explore possible sources of heterogeneity. When, for some outcomes, there were not enough data to effectuate a meta-analysis, results were reported descriptively. We planned to assess for potential publication bias by visual inspection of funnel plots. Review Manager 5.1 (Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014) was used for all statistical analyses [24].

Confidence in cumulative evidence

We planned to assess the quality of evidence for every outcome with a meta-analysis using the GRADE (grading of recommendations assessment, development, and evaluation) approach [25]. Only studies included in the meta-analysis were used for the assessment of the strength of evidence. Since a meta-analysis was only possible for the primary outcome, the GRADE approach was not used for secondary outcomes.

Results

Study selection

The search strategy identified 847 titles and abstracts, 19 duplicates were removed, 828 titles and abstracts were screened, and 651 studies were excluded yielding 177 full texts for review (Fig. 1). Six studies from five cohorts were

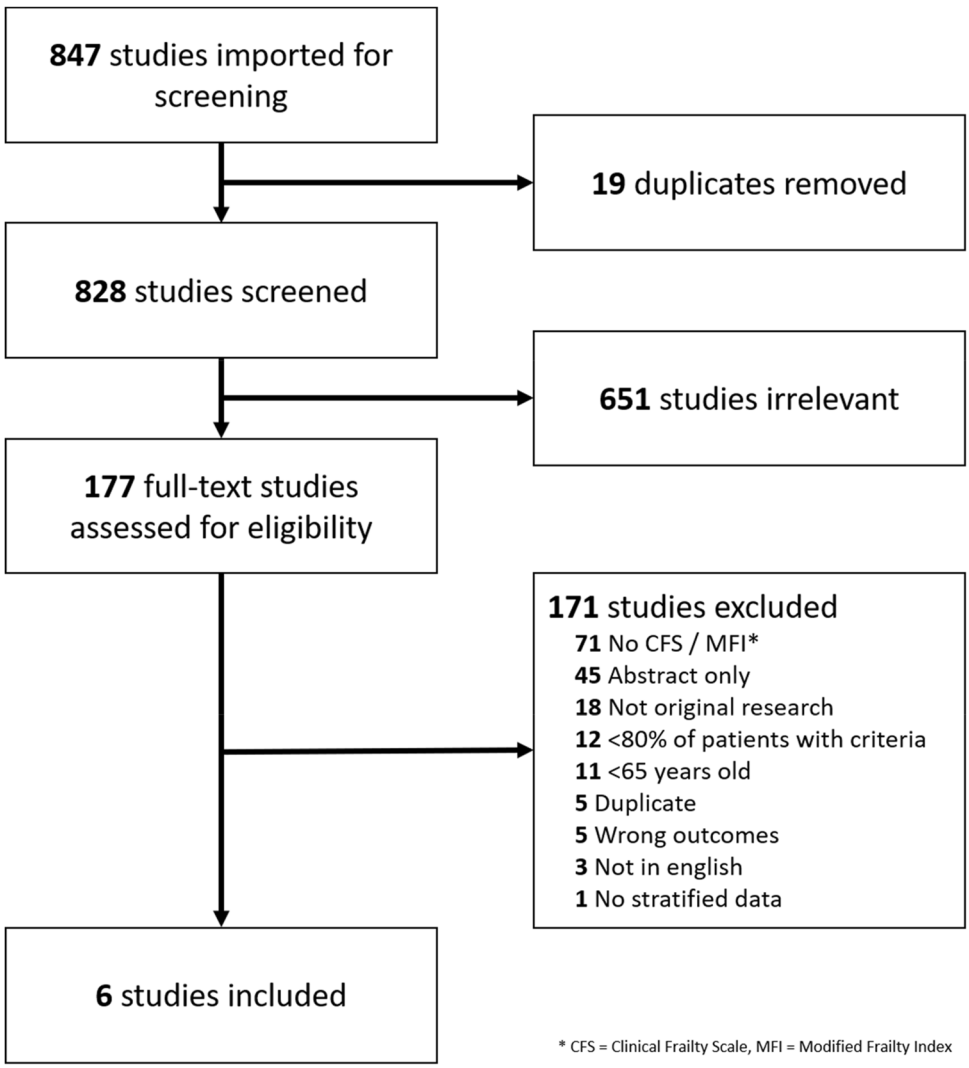

Fig. 1 Flowchart of search strategy and studies selection

included (five full studies and partial data from one study including colorectal and upper gastrointestinal surgery only) [26–31]. The main reason for the exclusion of full texts was if frailty was measured by alternative methods other than the Clinical Frailty Scale or Modified Frailty Index, or not measured at all.

Study characteristics

Information of included studies is presented in Table 1. Five were prospective cohort studies and one was a retrospective cohort. Study patients were enrolled between June 2012 and April 2019. They were conducted in the United Kingdom [26, 28, 29, 31], Singapore [27], and Spain [30]. Five of them reported frailty measured by the Clinical Frailty Scale [26, 28–31] and only one by the Modified Frailty Index [27]. Inclusion criteria were 65 for four studies [26–29], and 70 and 75 for the two other studies [30, 31].

Patient characteristics

Patient characteristics and outcomes are shown in Table 2. The six included studies were comprised of 1289 different patients (718 females, 283 frail patients). The smallest study sample size was 38 patients [26] (stratified data from a larger study) and the largest was 937 patients [28]. Half of the patients of each study were female, and the prevalence of frailty was between 20 and 32%. Clinical heterogeneity in reporting of demographic data in the studies precluded pooling of all other demographic variables of interest except gender.

Primary outcome

Three studies reported 30-day mortality [26, 28, 30]. Based on the stratified data of the first one, we computed an unadjusted OR of 5.78 [26]. The second one reported an unadjusted OR of 2.71 [28]. There was also an increase in

Table 1 Study characteristics of the included studies

Authors, year, and journal	Design	Country	Period	Frailty measure	Inclusion criteria	Exclusion criteria	Funding
McGuckin et al., Anaesthesia [26]	Retrospective Cohort	United Kingdom	June 2012 – January 2013	CFS	Age ≥ 65 Unscheduled non-cardiac surgery Stratified data: Colorectal and upper gastrointestinal surgery	None	Research institute
Tan et al., World Journal of Emergency Surgery [27]	Prospective Cohort	Singapore	June 2016–February 2018	MFI	Age ≥ 65 Emergency abdominal surgery (including diagnostic laparoscopies and emergency abdominal wall hernia repairs)	Vascular, gynaecological and transplant surgeries Emergency operations for complications of elective surgery Patients who were not expected to survive the index admission	University, Hospital
Parmar et al., Annals of Surgery[28][a]	Prospective cohort	United Kingdom	20 March 2017–19 June 2017	CFS	Age ≥ 65 Expedited, urgent, or emergency surgical abdominal procedure for gastrointestinal pathology (laparoscopic or open procedure) Returning to theatre for any major postoperative complication/dehiscence	Diagnostic intervention Appendicectomy only Cholecystectomy only Vascular surgery, including abdominal aortic aneurysm repair Laparotomy/laparoscopy for pathology caused by blunt or penetrating trauma	Research foundation
Carter et al., British Journal of Surgery [29][a]	Prospective cohort	United Kingdom	20 March 2017–19 June 2017	CFS	Age ≥ 65 Expedited, urgent, or emergency surgical abdominal procedure for gastrointestinal pathology (laparoscopic or open procedure) Returning to theatre for any major postoperative complication/dehiscence	Diagnostic intervention Appendicectomy only Cholecystectomy only Vascular surgery, including abdominal aortic aneurysm repair Laparotomy/laparoscopy for pathology caused by blunt or penetrating trauma	Research foundation
Arteaga et al., European Journal of Trauma and Emergency Surgery [30]	Prospective cohort	Spain	September 2017–April 2019	CFS	Age ≥ 70 Emergency abdominal surgery	Moderate-severe cognitive deterioration Terminal illness, defined as a life expectancy of less than 6 months	None

Table 1 (continued)

Authors, year, and journal	Design	Country	Period	Frailty measure	Inclusion criteria	Exclusion criteria	Funding
Vilches-Moraga et al., Aging Clinical and Experimental Research [31]	Prospective cohort	United Kingdom	September 2014–March 2017	CFS	Age ≥ 75 Emergency general surgery	Diagnostic intervention Appendicectomy only Cholecystectomy only Vascular surgery, including abdominal aortic aneurysm repair Laparotomy/laparoscopy for pathology caused by blunt or penetrating trauma	None

MFI Modified Frailty Index, *CFS* Clinical Frailty Scale

[a]For those studies, patients were part of the National Emergency Laparotomy Audit (NELA), which has specific inclusion and exclusion criteria. Only important criteria have been mentioned in the table. Moreover, the articles from Parmar and Carter report results from the same cohort

the adjusted OR with the increase in Clinical Frailty Scale (2.05, 3.11, 7.49, 9.79, and 10.40 for CFS 2, 3, 4, 5, and 6–7, respectively). The third, conducted in patients over 75, reported an unadjusted OR of 5.74[30]. The pooled OR, using random-effect models, was 2.91 (95% CI 2.00, 4.23). We did not observe any statistical heterogeneity between the studies. (Tau = 0.00, $I^2 = 0\%$) (Fig. 2). Based on the GRADE approach, the quality of this evidence is high (low risk of bias, large effect, and dose–response gradient).

Secondary outcomes

One study reported 90-day mortality, with an unadjusted OR of 2.50 for frail patients compared to non-frail patients [28]. There was an increase in the adjusted OR with an increase in Clinical Frailty Scale (2.05, 3.11, 7.49, 9.79, and 10.40 for CFS 2, 3, 4, 5, and 6–7, respectively). One study reported 1-year mortality, with an unadjusted OR of 3.60 [31]. Two studies from the same cohort reported length of stay as an outcome [28, 29]. There was a significant association between frailty and length of stay (adjusted ORs were 1.21, 1.26, 1.48, 1.44, and 1.62 for CFS 2, 3, 4, 5, and 6–7).

Major complications (Clavien–Dindo ≥ 3) were reported in only one study [30]. There was a positive association between frailty and major post-operative complications, with an unadjusted OR of 3.39.

One study reported increased level of care as outcome and another study reported loss of functional independence at 1 year, defined as a Modified Barthel's Index < 80/100 [27, 29]. Compared to non-frail patients, frailty was associated with both outcomes, with an unadjusted odds ratio 2.30 for increased level of care and of 4.42 for loss of functional independence at 1 year [27, 29]. For the increased level of care, the adjusted odds ratio was also progressively increasing for the different levels of frailty scores above 3 (4.48 for CFS 4, 5.94 for CFS 5, and 7.88 for CFS 6 or 7) [29].

Quality assessment

Table 3 presents the quality assessment of the six studies, based on the Newcastle–Ottawa Scale, where 'high' quality choices are given a star from a minimum of 0 to a maximum of 9; more stars indicate less risk of bias and a higher study. Scores from the six studies ranged from 5 to 9. Exposed and non-exposed patients were from the same cohort and were representative of the community. In one study, the exposure was measured differently during the study (prospectively and retrospectively)[31]. Three studies did not present adjusted estimates [26, 27, 30]. The outcomes were mostly obtained by record linkage. Finally, the overall follow-up was judged as sufficient, with an important (31%) loss of follow-up for only one study [27].

Table 2 Patient demographics and relevant outcomes for included studies

Authors	Sample size	Frailty measure	Female *N* (%)	Frail *N* (%)	Relevant outcomes
McGuckin et al. [26]	38	CFS	18 (47)	11 (29)	*30-day mortality* Frail patients: 2/11 (18.2%) Non-frail patients: 1/27 (3.7%) Unadjusted OR = 5.78 *Length of stay* Frail patients: mean 54.2 days (SD = 77.3) Non-frail patients: mean 38.3 days (SD = 54.0)
Tan et al. [27]	109	MFI	51 (47)	22 (20)	*Loss of functional independence at 1 year* Compare to patients with MFI 1–2, patients with MFI ≥ 3 has an unadjusted OR 4.42 for the outcome *Complications* Frail patients: 1/22 (4.5%) Non-frail patients: 6/87 (6.9%) Unadjusted OR = 0.64 *Length of stay* Frail patients: mean 15.5 days (SD = 9.6) Non-frail patients: mean 14.3 days (SD = 9.7)
Parmar et al. [28]	937	CFS	540 (58)	190 (20)	*90-day mortality* Frail patients: 62/189 (32.8%) Non-frail patients:121/741 (16.3%) Unadjusted OR = 2.50 Compare to patients with CFS = 1, the adjusted ORs were 0.84, 1.38, 3.15, 3.18, 6.10 for CFS 2, 3, 4, 5 and 6–7(adjusted for age and sex) *30-day mortality* Frail patients: 50/190 (26.3%) Non-frail patients: 87/747 (11.6%) Unadjusted OR = 2.71 Compare to patients with CFS = 1, the adjusted ORs were 2.05, 3.11, 7.49, 9.79 and 10.40 for CFS 2, 3, 4, 5 and 6–7 (adjusted for age and sex) *Length of stay* Compare to patients with CFS = 1, the adjusted ORs were 1.21, 1.26, 1.48, 1.44 and 1.62 for CFS 2, 3, 4, 5 and 6–7
Carter et al. [29]	934	CFS	538 (58)	189 (20)	*Increased level of care* Frail patents: 101/189 (53.4%) Non-frail patients: 248/745 (33.3%) Unadjusted OR 2.30 Compare to patients with CFS = 1, the adjusted ORs were 2.14, 1.84, 4.48, 5.94 and 7.88 for CFS 2, 3, 4, 5 and 6–7 (adjusted for sex, age and care level before admission) *Length of stay* Compared to patients with CFS = 1, the adjusted HRs were 0.74, 0.66, 0.50, 0.52 and 0.55 for CFS 2, 3, 4, 5 and 6–7 (adjusted for sex, age and care level before admission)
Arteaga et al. [30]	92	CFS	49 (53)	23 (25)	*30-day mortality* Frail patients: 6/23 (26.1%) Non-frail patients: 4/69 (5.8%) Unadjusted OR = 2.71 *Complications* Frail patients: 9/23 (39.1%) Non-frail patients: 11/69 (15.9%) Unadjusted OR = 3.39

Table 2 (continued)

Authors	Sample size	Frailty measure	Female *N* (%)	Frail *N* (%)	Relevant outcomes
Vilches-Moraga et al. [31]	113	CFS	60 (53)	37 (33)	*1-year mortality* Frail patients: 22/37 (59.5%) Non-frail patients: 22/76 (28.9) Unadjusted OR 3.60 Compare to non-frail patients, frail patients had an adjusted HR of 5.40 (adjusted for ASA, reduced mobility and, peri-operative geriatric team)

MFI Modified Frailty Index, *OR* Odds Ratio, *CFS* Clinical Frailty Scale, *HR* Hazard Ratio

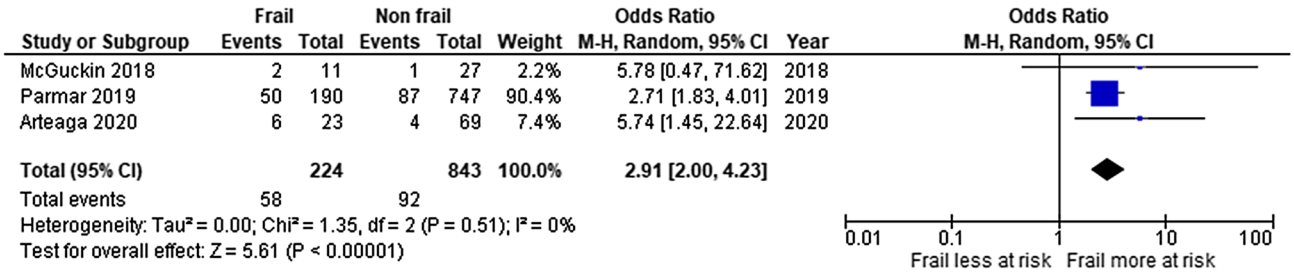

Fig. 2 Forest plot for unadjusted OR of 30-day mortality in older patients undergoing emergency general surgery

Table 3 Results of the Newcastle–Ottawa Scale quality assessment

Authors	Year	Selection (4)	Comparability (2)	Outcome (3)
McGuckin et al. [26]	2018	****		***
Tan et al. [27]	2019	****		*
Parmar et al. [28]	2019	****	**	***
Carter et al. [29]	2020	****	**	***
Arteaga et al. [30]	2020	****		***
Vilches-Moraga et al. [31]	2020	***	*	***

Discussion

This systematic review and meta-analysis found that frailty (measured by Clinical Frailty Scale ≥ 5) increased the odds of 30-day mortality in frail compared to non-frail older adults who underwent emergency general surgery. This systematic review also found increased odds of secondary outcomes including 90-day mortality, 1-year mortality, hospital length of stay, complications, and change in level of care at discharge using the Clinical Frailty Scale. There was evidence of increased loss of functional independence in frail patients (≥ 3/11) using the Modified Frailty Index. Several studies found increased odds of adverse outcomes for increasing scores on the Clinical Frailty Scale, consistent with dose–response using the Bradford Hill Criteria [32].

Several recent systematic reviews have assessed the impact of frailty on mortality in surgical patients [33–36]. Previous systematic reviews have found an association between frailty, mortality, and adverse functional outcomes after endovascular procedures for peripheral arterial disease, and in all vascular surgeries [33, 34]. Another recent systematic review in all surgical patients aged 60 years or older used the Fried frailty phenotype to categorize patients as frail vs not frail and robust vs pre-frail vs frail [35]. They found that the risk ratio (RR) of post-operative complications was 1.60 (1.20–2.13) when comparing frail patients to non-frail patients. Similarly, compared to the robust group, the risk ratio for complications was 1.77 (1.40–2.25) for the pre-frail group and 1.45 (1.17–1.80) for the frail group. Panayi et al. reported on the impact of frailty using the Modified Frailty Index on all surgical patients for post-operative complications, re-admission, re-operation, discharge to a skilled care facility, and mortality [36]. They included 16 studies in their meta-analysis and found that frail patients were more likely to experience complications (RR 1.48 [1.35–1.61]), major complications (RR 2.03 [1.26–3.29]), wound complications (RR 1.52 [1.47–1.57]), re-admission (RR 1.61[1.44–1.80]), and discharge to skilled care (RR 2.15 [1.92–2.40]). In this study, the risk of mortality was also 4.19 ([2.96–5.92] $p < 0.001$) times higher in frail patients. However, emergency general surgery is relatively different from other surgeries, as mortality is often higher [4]. Our systematic review expands the understanding of the association between frailty and poor outcomes in the emergency general surgery population specifically.

The strengths of this systematic review are that this is the first the authors are aware of that pools' results of the Clinical Frailty Scale to predict 30-day mortality in older adults undergoing emergency general surgery specifically. We used rigorous methodology according to PRISMA guidelines and had a strict age criterion for our included studies where all patients were age ≥ 65 years. This was evident in our low statistical heterogeneity. Therefore, the results of this study can be widely applied to emergency general surgery patients ≥ 65 years. Another strength is that five of the six included studies were prospective cohorts by design [27–31], four of which were considered low risk of bias according to the NOS scale.

This systematic review has several limitations. We only included studies that reported frailty measured by the Clinical Frailty Scale or the Modified Frailty Index. This decision was based on a preliminary literature search where studies we reviewed used these two tools most frequently; however, many of these studies were later excluded using other exclusion criteria. During the screening process, we identified several studies that could have been included, but used another tool to discriminate frail and non-frail patients. As we chose these two scores a priori, we continued our systematic review accordingly. Another limitation was the specific population; although many studies included patients over the age of 65 with emergency general surgery, they were often mixed with younger patients, patients without surgery, patients with non-emergency general surgery, or patients with different types of surgery (such as orthopaedic or vascular surgery). These studies were then excluded, because the proportion of emergency general surgery patients was very small or unknown. We attempted to mitigate this by contacting authors; however, we were not able to obtain stratified data for our specific population. Another limitation is that the meta-analysis was based on unadjusted estimates. The pooled estimate could therefore be biased due to confounding. Finally, our systematic review also only found one study meeting our eligibility criteria using the Modified Frailty Index.

Our study has several clinical and research implications. The first is that it can be widely applied to emergency general surgery patients ≥ 65 years of age as another tool to help patients and their families determine the patients' risk of 30-day mortality based on their score on the Clinical Frailty Scale. For frail patients, they may choose a non-surgical option that is in keeping with their stated goals of care. On the other hand, older patients who score lower on the Clinical Frailty Scale may choose to pursue surgical interventions if it would improve their quality or quantity of life. It should be cautioned that the results of this study are not sufficient to promote the exclusive use of this scale to guide management decisions, as only two studies were included in the meta-analysis. However, the results of this meta-analysis do provide evidence that the Clinical Frailty Scale can be used as part of the decision-making process. The Clinical Frailty Scale can be widely, reliably, and rapidly applied by various healthcare providers in the acute care setting for geriatric patients at low cost [37]. Future research should investigate the use of the Clinical Frailty Scale with other risk factors for mortality to develop a more robust prognostic score for emergency general surgery patients ≥ 65 years. Additional meta-analyses are also required to compare different frailty scales in emergency general surgery patients ≥ 65 years.

Conclusion

Frailty is significantly associated with worse outcomes after emergency general surgery in adults ≥ 65 years of age. The Clinical Frailty Scale could be used to improve preoperative risk assessment for patients and shared decision-making between patients and healthcare providers. Future research should explore the utility of the Clinical Frailty Scale in developing a prognostic score in emergency general surgery.

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Author contributions Conceptualization: CAF, DP, and JM; data curation: CAF, DP, and JM; formal analysis: CAF; investigation: CAF, DP, and JM; methodology: CAF, DP, JM, JP, and DE; supervision: JP and D; validation: DP and JM; visualization: CAF, DP, and JM; writing—original draft: CAF; writing—review and editing: CAF, DP, JM, JP, and DE.

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Data availability Data are available on request to the authors.

Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

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Paper 3 - Assessment of frailty by paramedics using the clinical frailty scale - an inter-rater reliability and accuracy study.

Citation [71]

Fehlmann CA, Stuby L, Graf C, Genoud M, Rigney R, Goldstein J, Eagles D, Suppan L. *Assessment of frailty by paramedics using the clinical frailty scale - an inter-rater reliability and accuracy study.* BMC Emerg Med. Oct 13 2023;23(1):121. https://doi.org/doi:10.1186/s12873-023-00875-x

Summary of the paper

This cross-sectional study aimed to evaluate the inter-rater reliability and accuracy of paramedics using the Clinical Frailty Scale through 30 clinical vignettes. Paramedics were provided only the French version of the CFS without prior teaching. The primary outcome was inter-rater reliability, measured by intraclass correlation coefficient (ICC), and the secondary outcome was accuracy compared to expert assessments. Fifty-six paramedics participated, showing good inter-rater reliability (ICC = 0.87) but moderate overall accuracy (60.6%), which improved to 94.8% when close assessments were considered. Field experience was the only factor linked to accuracy.

What this paper adds

Before this study, the use and performance of frailty assessments by paramedics using the CFS were largely unknown. Our findings concluded that while paramedics demonstrated reliable frailty assessments, the accuracy of these assessments could be improved. This underscores the importance of providing even minimal training when implementing the CFS in the prehospital setting.

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RESEARCH

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Assessment of frailty by paramedics using the clinical frailty scale - an inter-rater reliability and accuracy study

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Abstract

Background Frailty assessment by paramedics in the prehospital setting is understudied. The goals of this study were to assess the inter-rater reliability and accuracy of frailty assessment by paramedics using the Clinical Frailty Scale (CFS).

Methods This was a cross-sectional study with paramedics exposed to 30 clinical vignettes created from real-life situations. There was no teaching intervention prior to the study and paramedics were only provided with the French version of the CFS (definitions and pictograms). The primary outcome was the inter-rater reliability of the assessment. The secondary outcome was the accuracy, compared with the expert-based assessment. Reliability was determined by calculating an intraclass correlation coefficient (ICC). Accuracy was assessed through a mixed effects logistic regression model. A sensitivity analysis was carried out by considering that an assessment was still accurate if the score differed from no more than 1 level.

Results A total of 56 paramedics completed the assessment. The overall assessment was found to have good inter-rater reliability (ICC = 0.87 [95%CI 0.81–0.93]). The overall accuracy was moderate at 60.6% (95%CI 54.9–66.1) when considering the full scale. It was however much higher (94.8% [95%CI 92.0–96.7] when close assessments were considered as accurate. The only factor associated with accurate assessment was field experience.

Conclusion The assessment of frailty by paramedics was reliable in this vignette-based study. However, the accuracy deserved to be improved. Future research should focus on the clinical impact of these results and on the association of prehospital frailty assessment with patient outcomes.

Registration This study was registered on the Open Science Framework registries (https://doi.org/10.17605/OSF.IO/VDUZY).

Keywords Paramedics, Clinical frailty scale, Cfs, Reliability, Accuracy, Emergency medical services, Prehospital care, Triage system

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Background

Frailty can be defined as state of vulnerability generated by the cumulative decline of several physiological systems. This decline results in a progressive depletion of patient reserves which can lead even minor stressor events to trigger disproportionate adverse effects [1–3]. Frailty prevalence among older patients in the Emergency Department (ED) is high, with up to two thirds of patients aged 65 years or older living with frailty [4]. Identification of frailty in the ED has been largely advocated [5]. It can however prove challenging as it requires acquiring data regarding the patient's state prior to the current acute episode. Such data is not always readily available since patients are sometimes unable to communicate reliably, if at all. Therefore, obtaining relevant data in the prehospital phase could help ED clinicians take more appropriate decisions, such as discharge on scene or transport to a geriatric ED.

Prehospital assessment of frailty by paramedics, nurses or even physicians is currently understudied [6]. Since prehospital providers frequently respond at patients' homes, they may have a more thorough understanding of the environment patients live in. Thus, prehospital assessment of frailty could be more accurate than ED assessment.

The main limitation of prehospital frailty assessment is the relative short time prehospital providers spend on site. Therefore, tools requiring either too much time or the availability of special equipment (such as the comprehensive geriatric assessment program) would not be a suitable option for these professionals. Simpler yet accurate tools should therefore be made available to prehospital providers. The Clinical Frailty Scale (CFS), whose score is based on clinical judgment, could be well suited for this task [7]. The CFS is a nine-point scale which extends from 1 (very fit) to 9 (terminally ill). It is considered easy to use, especially in busy clinical environments [8]. In the ED, it has been proven to be an accurate and reliable tool for predicting short-term and long-term mortality as well as an association with adverse events (initial admission rate, readmission, mortality) [9–11].

The use of the CFS in the prehospital environment has not been reported often and has scarcely been assessed [12, 13] Bernard et al. reported about Alternative Care Pathways (ACPs), a project aiming to reduce ED transport of patients with non-urgent needs who could be treated elsewhere [14]. In this cohort, patients had a median CFS of 6. Two other studies showed that frailty prevalence was around 60% [15,16]. More recently, authors showed that use of the CFS by paramedics was feasible [17, 18]. However, little information about the training, reliability, or accuracy of the CFS was reported in those studies. It is nevertheless essential to demonstrate that the use of the Clinical Frailty Scale by paramedics is reliable and accurate if one wants to use frailty to guide decision making in the prehospital environment.

There is therefore a knowledge gap regarding the use of the CFS in the prehospital setting. The goals of this study were to assess the inter-rater reliability and accuracy of frailty assessment using the CFS and to identify factors associated with accurate CFS assessment among paramedics.

Methods

Design and setting

This was a closed web-based cross-sectional study carried out on Swiss paramedics working in Geneva, Switzerland. It was designed according to the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) and is reported accordingly (Appendix I) [19]. This study was registered on the Open Science Framework [20].

Swiss paramedics follow a three-year education program which includes theoretical lectures, simulation workshops, and field internships [21]. There are seven ambulances companies in Geneva, five of which are privately owned and operated, while the two others are state-run. Together, they take care of more than 35'000 patients per year [22]. In Geneva, there is currently no frailty screening by paramedics. However, physicians working in the prehospital medical mobile unit perform frailty screening using the Clinical Frailty Scale. There is however no formal screening in the Emergency Department, contrarily to many hospitals from the German-speaking part of Switzerland. Since this study design does not fall within the scope of the Swiss Federal Act on Research Involving Human Beings, the need for a formal IRB approval was waived by the president of the regional ethics committee ("clarification of responsibility", Req-2022-00921).

Web-based platform and study procedure

A specific web-based platform was developed using the Joomla! 4.2 content management system (Open Source Matters, New York, USA) and thoroughly tested by four investigators prior to study inception. The AcyMailing 7.9 component (Acyba, Lyon, France) was used to send individual invitation email to all the paramedics working in Geneva between February and March 2023. Their email addresses were obtained through the companies' chief ambulance officers, all of whom endorsed this study. To promote participation, all chief medical officers agreed to award continuous education credits to the paramedics who completed the study. This was the only incentive and participation was entirely voluntary. Invitation reminders were sent twice at 14-day intervals.

The invitation email contained information regarding the study's aim and design, including the time required to complete it. It was signed by the principal investigator

(CF), and a generic email address was provided to allow paramedics to ask further questions to the study team. The participants who chose to click on the link to the study platform were directed to the platform's main page where they were reminded of the study's aim, design, and data protection procedures. Since paramedics often follow continuous medical education interventions while at work, it was considered that they could be interrupted at any time during the study and were therefore asked to create unique accounts. To avoid attrition, the registration form was kept as short as possible: participants were only asked to provide an e-mail address, enter a password, and provide electronic informed consent. A Completely Automated Public Turing test to tell Computers and Humans Apart (CAPTCHA v2, Google LLC, Mountain View, USA) was also used to avoid the creation of fake accounts. The registration process was managed using the Membership Pro 3 component (Joomdonation, Hanoi, Vietnam).

Joomla's access control list was used to manage the study sequence. Before accessing the clinical vignettes, participants were asked to answer a first questionnaire designed to gather demographic data. This questionnaire was created using Shondalai's Community Survey 5.9 component (Bulasikku Technologies, Hyderabad, India). After completing this step, the paramedics accessed the 30 clinical vignettes in random order. This was managed using Shondalai's Community Quiz 6.3 component (Bulasikku Technologies, Hyderabad, India), and participants were able to leave the platform at any time and to resume the study path at will without data loss. It was not possible to skip from one vignette to another and participants were required to provide an answer before moving on the next vignette. For each vignette, participants were asked to assess the frailty level, using the CFS. No formal training was provided, but for each vignette, the official CFS (French version) was displayed along with the CFS pictograms. A certificate was automatically awarded once the 30 clinical vignettes were completed.

All data was stored in an encrypted MySQL-compatible database (MariaDB 10.3, MariaDB Foundation, Delaware, USA) hosted on a Swiss server (Kreativ Media GmbH, Zurich, Switzerland). Admin Tools Professional 7 (Akeeba Ltd, Nicosia, Cyprus) and RS Firewall 3 (RSJoomla!, Constanta, Romania) were used to secure the platform from external intrusion.

Table 1 Characteristics of vignettes' patients

Patients	N = 30
Patient's gender – n (%)	
Women	14 (46.7)
Men	16 (53.3)
Patient's age (years) – median (IQR)	79 (74–86)
Patient's age (years) – n (%)	
65–75	9 (30.0)
76–80	8 (26.7)
81–86	6 (20.0)
> 86	7 (23.0)
Living in a nursing home	
No	26 (86.7)
Yes	4 (13.3)
Clinical Frailty Scale – n (%)	
1	3 (10.0)
2	3 (10.0)
3	4 (13.3)
4	5 (16.7)
5	4 (13.3)
6	3 (10.0)
7	3 (10.0)
8	3 (10.0)
9	2 (6.7)

Clinical vignettes

Thirty clinical vignettes were created by the main author (CF), based on real-life patients brought to the ED by paramedics (names were changed). The main characteristics of the patients described in the vignettes are displayed in Table 1. All the data deemed necessary to assess the CFS were provided with no need to search for specific information. There was no possibility to gather further information. The vignettes were reviewed and tested by three of the co-authors (CG, LSu, LSt). The detailed vignettes (in French, with English translation) are available as supplementary material (Appendix II).

A reference CFS was defined for each vignette by a panel of multidisciplinary experts (one research paramedic, one board-certified geriatrician, and one physician certified in emergency medicine and specialized in prehospital emergency medicine). Each of them assessed the CFS independently. Disagreements were mostly caused by unclear or ambiguous sentences. They were resolved by consensus and led to appropriate scenario modifications.

Outcomes

The primary outcome was the inter-rater reliability of frailty assessment. The secondary outcome were the accuracy of the assessment compared with the reference CFS, using specific definitions (inaccurate, under-assessment and over-assessment), and factors associated with accurate CFS assessment. An assessment was considered accurate if the paramedic assigned the same CFS level as the reference. Overassessment and underassessment were defined with regard to the reference CFS level.

Statistical analysis

Continuous variables were presented by their median and interquartile ranges, and categorical variables by

their frequency and relative proportions. To measure the inter-rater reliability in frailty assessment among the participants, an intraclass correlation coefficient (ICC) with its 95% confidence interval (CI) was calculated using a two-way random effects model (absolute agreement). The ICC was interpreted in line with prior publications: values less than 0.5, between 0.5 and 0.75, between 0.75 and 0.9, and greater than 0.90 were considered indicative of poor, moderate, good, and excellent reliability, respectively [23].

For the accuracy, we first reported the proportion of correct assessment of each rater and for each vignette, with their 95% CI. Then, considering the fact that the observations are not truly independent (same paramedics, same scenarios), we reported the overall accuracy and its 95%CI. They were estimated using a mixed effects logistic regression model with crossed random effects on the intercept. We also reported the absolute differences between the reference CFS and the one assessed by paramedics. We performed one post-hoc sensitivity analysis, by considering that an assessment was still accurate if the score differed from no more than 1 level.

We then realised an exploratory analysis to assess the factors associated with the accuracy of CFS assessment by performing a generalized linear mixed model using a logit function and a vignette-random effects on the intercept. The model was adjusted for the following prespecified variables: gender of the paramedic, experience of the paramedic in years, patient's gender and age, and place of living (long-term care facility or not). These variables were chosen based on previous knowledge of their influence on frailty assessment. As patient age and field experience did not respect the assumption of the linearity of the log-odds, categories were created and cut-off points were chosen using quartiles. For each variable, we reported an adjusted odds ratio (aOR) with its 95% CI. All analyses were performed using Stata version 17 (Stata Corp., College Station, Texas, USA). Statistical significance was defined as a P value <0.05 (two sided).

Sample size calculation

The number of clinical vignettes was fixed (N=30). Data were crossed as the same 30 clinical vignettes were allocated to each paramedic. Only the vignette order randomly varied from one paramedic to another. Using the formula provided by Bonett, [24] and expecting an ICC of 0.80, the number of paramedics needed for a precision of +/- 0.1 was of 22. A sample of 50 paramedics was nevertheless planned to allow multivariable analyses without a risk of overfitting. More participants were accepted as there was no risk for them, and because it could prevent overfitting even further in the multivariable model.

Results

Of all invited paramedics (n=193), 56 (29%) completed the assessment and met eligibility. They were thus included in the final analysis (Fig. 1) and their characteristics can be seen in Table 2. Thirty-two of them (57.1%) were men. The median age was 31.5 years (IQR 28.0–37.5), with a median field experience of 7 years (IQR 3–12). Before this study, only 4 paramedics (7.1%) had heard about the CFS, and none of them had ever used it in clinical practice.

Regarding the overall inter-rater reliability, the ICC was 0.87 (95%CI 0.81–0.93). It was similar between men (0.86 [95%CI 0.80–0.92]) and women (0.87 [95%CI 0.81–0.93]) paramedics and also similar between men (0.87 [95%CI 0.78–0.95]) and women (0.87 [95%CI 0.78–0.95]) patients. The agreement rate by vignette varied between 23.2% (one vignette, "Hervé") and 85.7% (one vignette, "Eugenia") (Fig. 2). Figure 2 shows the answers of each paramedic to each vignette.

Regarding the accuracy, 1'008 (60.0%) assessments were correct, 288 (17.1%) were over-assessments and 384 (22.9%) were under-assessments. Among the 672 inaccurate assessments, 538 (80.1%) deviated by only one level from the reference (Fig. 3). The overall accuracy was 60.6% (95%CI 54.9–66.1); the median correct assessment rate was 64.3% (IQR 53.4–69.6) by vignette and 61.7% (IQR 51.7–66.7) by paramedic. Our sensitivity analysis showed higher accuracy: the overall accuracy was 94.8% (95%CI 92.0–96.7) when close assessments (deviations of no more than one level) were considered as accurate.

Only field experience was associated with accurate assessment, with paramedics who had between 4 and 7 years of field experience providing less accurate assessments (OR=0.66, 95%CI 0.50–0.88) (Table 3).

Discussion

In this study based on clinical vignettes, the assessment of frailty by paramedics using the Clinical Frailty Scale had an excellent inter-rater reliability albeit a moderate accuracy.

1° reliability

Many studies assessed the reliability of the CFS, mostly based on the assessment of unique real patients by two different raters [25, 26]. Some studies have however assessed reliability with designs similar to ours. In a study by Nissen et al., 40 health care providers rated 15 clinical case scenarios with an good reliability (ICC=0.85) [27]. In a small study comparing the assessment of seven vignettes by 124 care providers also showed a good agreement, with median CFS scores varying by a maximum of only one point [28]. Our study confirms that CFS assessment by paramedics is highly reproductible, even with a no prior training.

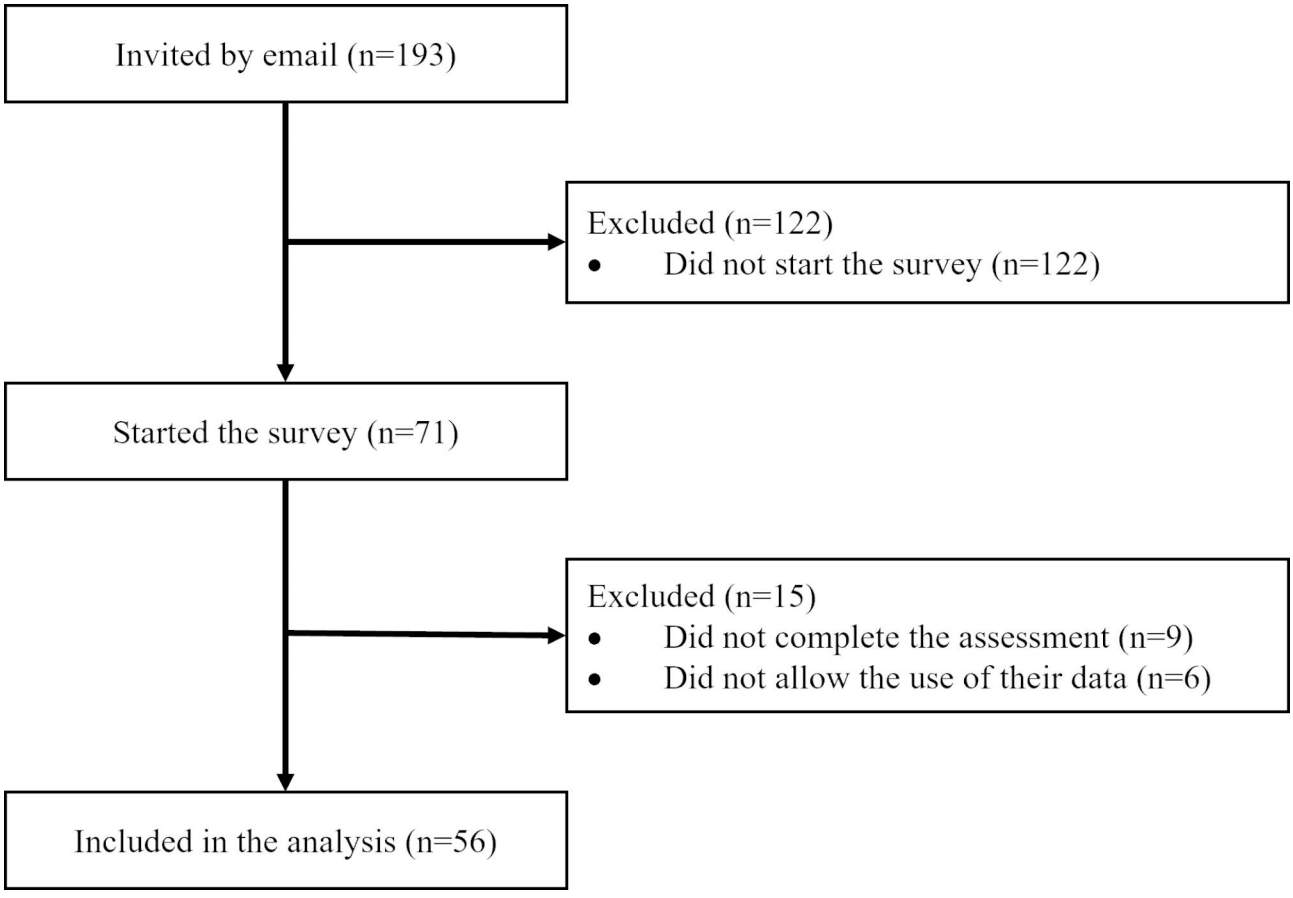

Fig. 1 Flowchart of the study

Table 2 Characteristics of the paramedics

Paramedics	N = 56
Gender of paramedics – n (%)	
Women	23 (41.1)
Men	32 (57.1)
Other	1 (1.8)
Paramedic's experience (years) – median (IQR)	7 (3–12)
Paramedic's experience (years) – n (%)	
0–3	16 (28.6)
4–7	13 (23.2)
8–12	14 (25.0)
> 12	13 (23.2)
Previous knowledge of Clinical Frailty Scale – n (%)	
No	52 (92.9)
Yes	4 (7.1)

2° accuracy

In our study, when compared to a reference defined by a multidisciplinary team of experts in their field, the accuracy of CFS assessment by untrained paramedics assessment was not optimal, with an accurate assessment rate around 60%. In a study looking at the effect of training on the accuracy of the assessment by registered nurses, the median overall agreement was 55.8% [29]. When comparing assessment by medical students to expert assessment, Kaeppeli et al. did not find a perfect agreement either (Kappa = 0.74) [30]. The weak accuracy of the CFS assessment might be explained by the high numbers levels at disposition, some of which with differences that might not be perceptible by non-expert. This hypothesis is strengthened by our sensitivity analysys which showed a much higher accuracy when close assessments were considered as accurate. A 1-point discrepancy in the CFS score might indeed be considered as a negligible difference. The design of our study might also explain this suboptimal accuracy, as vignettes might have been possibly too vague in some situations. While training nurses experienced in the use of the Clinical Frailty Scale does not seem to improve the accuracy, we believe that an initial training of unexperienced assessor could improve the accuracy of the assessment.

We also identified field experience as a potential predictor of accuracy: paramedics with 4 to 7 years of professional experience were less likely to give an accurate assessment compared to less experienced professionals. However, this association seems to have a J shape, and it is difficult to distinguish whether it is a true better accuracy for inexperienced paramedics, it results from newly

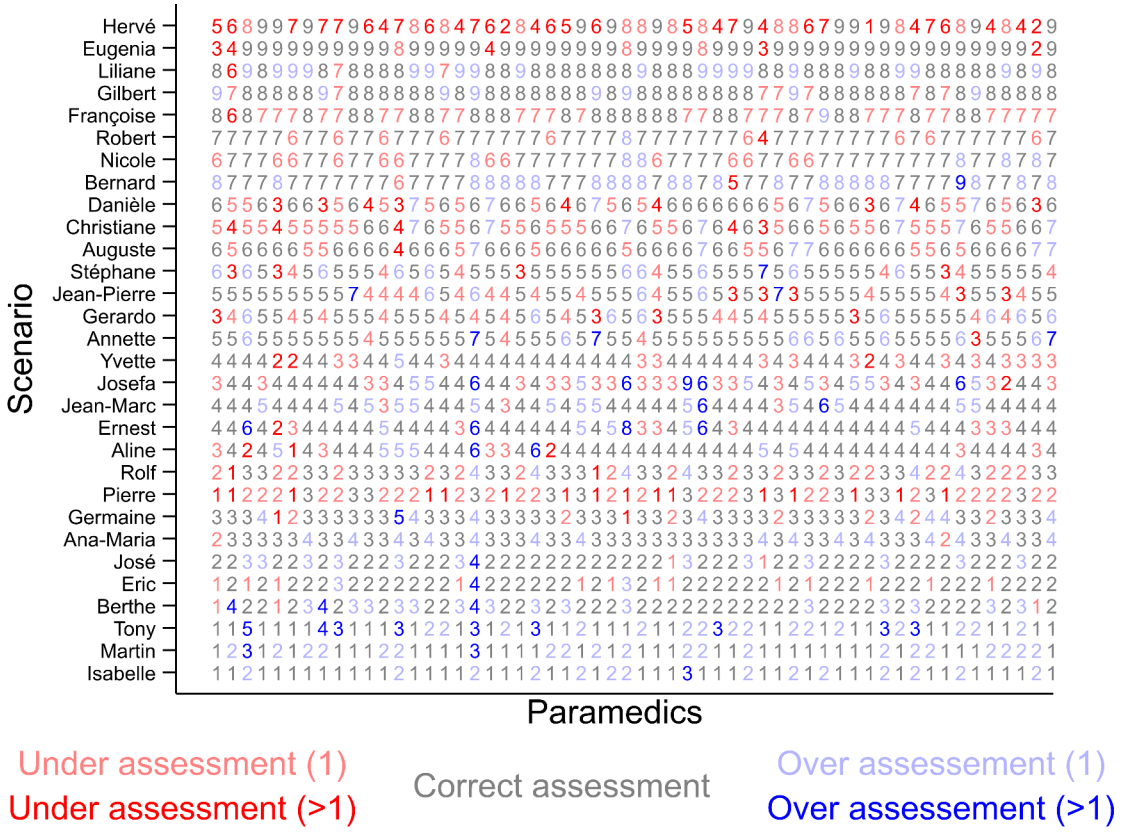

Fig. 2 Answers of each paramedic to each vignette

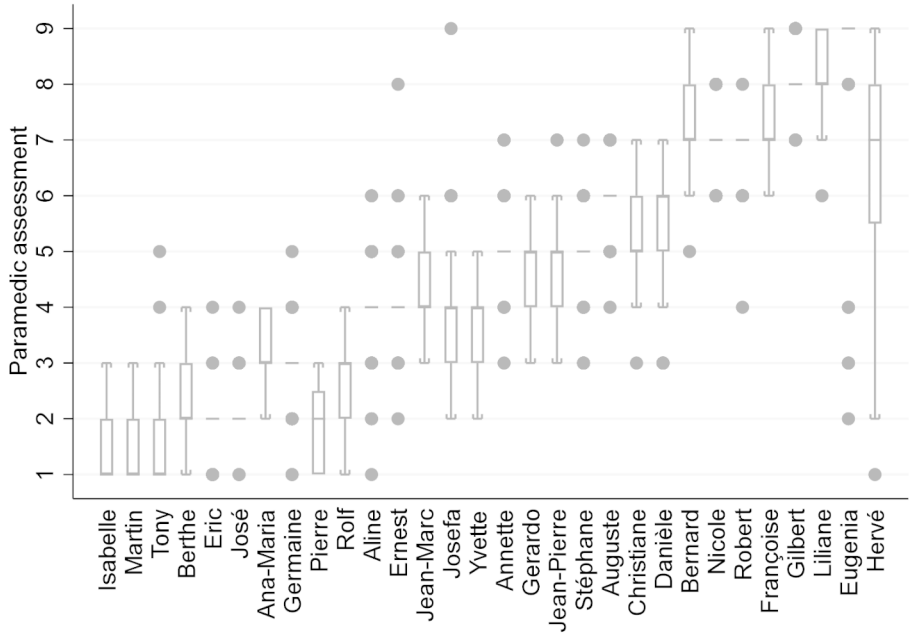

Fig. 3 Agreement by vignettes

Table 3 Predictors of correct assessment

	OR	95%CI
Gender of paramedics		
Women	Ref.	
Men	1.01	0.82–1.24
Other	1.27	0.56–2.85
Paramedic's experience in prehospital care (years)		
0–3	Ref.	
4–7	0.66	0.50–0.88
8–12	0.78	0.58–1.03
> 12	0.93	0.70–1.25
Patient's gender		
Women	Ref.	
Men	0.91	0.57–1.45
Patient's age (years)		
65–75	Ref.	
76–80	0.91	0.50–1.69
81–86	0.69	0.36–1.32
> 86	1.30	0.70–2.40
Living in a nursing home		
No	Ref.	
Yes	1.27	0.64–2.50

graduate paramedics being more attentive in the reading of the vignette or it is a type I error.

3° limitation and strengths

This study was based on vignettes and not on a simulator. Therefore, participants did not have to actively collect the information needed to assess frailty. It could potentially overestimate the results of the study, as all variables needed for the assessment were presented right away. On the contrary, in real life paramedics might use the visual representation of the situation (patient general appearance, place of living, etc.) in their assessment, which could improve their assessment. Another limitation was the recruitment, which was based purely on volunteers, even if a high rate of paramedics did participate to the study. As participant could have a special interest for geriatric patients, their performance could be better than that of their less interested colleagues. The main strength of this study is the comprehensive statistical analysis, which carried out using the CFS both as a continuous variable and as a binary variable.

4° clinical implication

Some practical implications can be mentioned. Based on this study, it could be beneficial to train paramedics, before implementing a systematic regular screening in prehospital, to enhance the accuracy. While some training materials exist, none was specifically developed for paramedics, and training modules should be adapted to this specific population.

The use of the CFS in the prehospital field could help in identifying the older patients living with frailty and at highest risk of adverse outcomes, and therefore require more specialized care to improve their outcomes. Early identification of vulnerability, particularly among older patients who are frequently transported to the hospital, is needed [31, 32]. A better triage of those patients could also help to reduce ED workload, either by helping paramedics to orientate them to geriatrics wards, or to release them on-site and thus contribute to decrease ED overload [33]. From a patient perspective, early identification of frailty level by paramedics might optimise the triage process on arrival in the ED, improve communication between clinicians, patients and families, and also facilitate transitions in care, by activating discharge planning staff prior to in-hospital assessments.

Moreover, the use of the CFS in the context of out-of-hospital cardiac arrest could help make difficult clinical decisions and predict outcomes after return of spontaneous circulation. Indeed, frailty is associated with survival and with cognitive and functional status after cardiac arrest [34–36].

5° research implication

Several questions remain to be answered. The use of the CFS during real prehospital interventions should be studied to assess its feasibility and to identify barriers and difficulties paramedics might encounter. Such a study could also help assess the actual accuracy of CFS assessment by paramedics, by comparing their assessment to that of a specialist geriatrician. Then, it could be useful to study the association between prehospital frailty assessed by CFS with outcomes such as patients' disposition (by paramedics but also after ED stay) and mortality [16].

Conclusion

The assessment of frailty by paramedics using the Clinical Frailty Scale was reliable in this vignette-based study. The accuracy nevertheless deserved to be improved. Future research should focus on the clinical impact of these results and on the association of prehospital frailty assessment with patient outcomes.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12873-023-00875-x.

Appendix I ? CHERRIES Checklist. Appendix II ? Clinical vignettes with English translation.

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Data availability
The dataset supporting the conclusions of this article is available in the Open Science Framework repository [https://doi.org/10.17605/OSF.IO/4ETPV].

Declarations

Ethics approval and consent to participate
The study was conducted at Geneva University Hospitals in accordance with Good Clinical Practice (Declaration of Helsinki 2002). This study was considered to fall outside the scope of Swiss human research legislation (Federal Act on Research involving Human Beings Art 2), therefore approval from a local ethics committee was not required. Only data from paramedics who accepted their use for research purposes were included.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Previous study
The main author is also the first author of a study (under review) with a very similar design and identical statistical analysis process that was performed to assess a paediatric triage scale. It might explain the similar structure and method description between both articles.

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Publisher's Note

Paper 4 - Service provision for Frailty in European Emergency Departments (FEED): a survey of operational characteristics

Citation [72]

Fehlmann CA, Mc Loughlin K, Cosgriff EJ, Ferrick JF, van Oppen JD, European Taskforce for Geriatric Emergency M. *Service provision for Frailty in European Emergency Departments (FEED): a survey of operational characteristics*. Scand J Trauma Resusc Emerg Med. Jul 29 2024;32(1):64. https://doi.org/doi:10.1186/s13049-024-01234-w

Summary of the paper

This cross-sectional survey of 68 sites across 17 countries explored variations in frailty-focused service provision. Results showed that 69% of sites used frailty screening, though it was mandated at only 38%. Staffing levels were lower at night compared to daytime, and frailty specialist services were often unavailable overnight. There was also inconsistency in defining "older age" and in the use of the Clinical Frailty Scale, which was rarely mandated or recorded electronically.

What this paper adds

Building on the findings of the important European study, "The Frailty in European Emergency Departments (FEED) study," this research highlights significant variability in frailty service models across emergency departments. Understanding these differences could help inform targeted improvements in emergency care for older adults. Since the survey specifically targeted EDs with an interest in geriatric emergency medicine, the overall variability across Europe is likely even greater.

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ORIGINAL RESEARCH

Open Access

Service provision for Frailty in European Emergency Departments (FEED): a survey of operational characteristics

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Abstract

Background The observational Frailty in European Emergency Departments (FEED) study found 40% of older people attending for care to be living with frailty. Older people with frailty have poorer outcomes from emergency care. Current best practice calls for early identification of frailty and holistic multidisciplinary assessment. This survey of FEED sites explores variations in frailty-attuned service definitions and provision.

Methods This cross-sectional survey included study sites across Europe identified through snowball recruitment. Site co-ordinators (healthcare professionals in emergency and geriatric care) were surveyed online using Microsoft Forms. Items covered department and hospital capacity, frailty and delirium identification methods, staffing, and frailty-focused healthcare services in the ED. Descriptive statistics were reported.

Results A total of 68 sites from 17 countries participated. Emergency departments had median 30 (IQR 21–53) trolley spaces. Most defined "older people" by age 65+ (64%) or 75+ (25%). Frailty screening was used at 69% of sites and mandated at 38%. Night-time staffing was lower compared to day-time for nursing (10 [IQR 8–14] vs. 14 [IQR 10–18]) and physicians (5 [IQR 3–8] vs. 10 [IQR 7–15]). Most sites had provision for ED frailty specialist services by day, but these services were rarely available at night. Sites mostly had accessible facilities; however, hot meals were rarely available at night (18%).

Conclusion This survey demonstrated variability in case definitions, screening practices, and frailty-attuned service provision. There is no unanimous definition for older age, and while the Clinical Frailty Scale was commonly used, this was rarely mandated or captured in electronic records. Frailty services were often unavailable overnight. Appreciation of the variation in frailty service models could inform operational configuration and workforce development.

Keywords Emergency care, Frailty, Delirium, Health services

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Introduction

The European population is ageing, and more older people are living with frailty. Frailty is present in 40% of older people (age 65+) attending European Emergency Departments (ED), varying broadly between countries from 26 to 54% [1, 2]. It is recognised that this population is often poorly served by and have poor experiences through traditional emergency care models [3, 4]. The complex nature of this cohort means they often present with undifferentiated complaints and are vulnerable to undertriage and ultimately poorer outcomes, including more frequent mortality, admissions, and longer stays [5–7]. Geriatric emergency medicine has emerged as a field of subspecialty interest with its own training curriculum, clinical guidance, and research agenda [8–10].

The core tenet of geriatric emergency medicine is a holistic approach which adopts the principles of comprehensive geriatric assessment (CGA) [11, 12]. Current, 'traditional', emergency care systems are not designed to deliver this at scale, typically best-serving people with single and specific injuries or illnesses rather than enabling multidisciplinary evaluation of complex and interacting problems [13, 14].

Accordingly, healthcare service models worldwide are being reconfigured to better provide for the needs of older people living with frailty. European guidelines provide advice on optimising ED care models for older people, and international accreditation programmes advocate for core processes and services [15]. However, practice and outcomes are known to vary across European EDs [16]. It is unclear to what extent these are currently adjusted to recommendations. Insight into differences in current approaches for frailty identification and service availability across European EDs could contribute to improving practice and provision.

Therefore, the aim of this project is to report on methods in use for the definition, identification, and management of frailty using a survey of European emergency departments. This project was a planned secondary objective of the FEED study, which sought primarily to evaluate the prevalence of Frailty in European Emergency Departments [2].

Methods

Design, recruitment and participants

This was a planned survey study performed during preparation for the FEED observational phase [17]. The FEED study recruited European emergency departments using snowball sampling (new units are recruited by other units to form part of the sample) through mailing lists (European Taskforce for Geriatric Emergency Medicine), research networks (European Geriatric Medicine Society and European Society for Emergency Medicine), and social media. A site co-ordinator at each participating department was invited to complete a survey on their service characteristics. Site co-ordinators were healthcare professionals (doctors or advanced clinical practitioners) working in emergency and geriatric care. Hospitals that did not participate in the FEED study were not included in this survey.

Survey instrument and administration

The survey items were designed by consensus with eleven experts in geriatric emergency medicine. All were working in Europe and held current or recent leadership positions in special interest groups on acute frailty care. Items were in English and considered department and hospital capacity, frailty and delirium identification methods, typical professional staffing, and frailty-attuned healthcare services available in the ED (Supplementary Material 1). The name of the site co-ordinator was requested to minimise the risk of site duplication.

Administration of the survey was online using Microsoft Forms in the period May–June 2023. Due to the expected heterogeneity of health service models, a document of abbreviations and definitions was prepared and provided to participants (Supplementary Material 2). Three reminder emails at fortnightly intervals were sent to sites identified as potential participants, and recruited site co-ordinators were asked to complete the survey prior to collecting data for the prevalence phase of the FEED study. Service characteristics survey data were retained for those sites withdrawing from the observational phase.

Analysis

Site characteristics were described by country, hospital and emergency department capacity (bed spaces), and the emergency department's physician and nursing staff levels. Frailty-attuned services were described by use (recommended or mandatory) of screening tools for frailty and delirium, presence or availability of specialist professional services, and availability of departmental facilities. Summary statistics (frequencies, medians with interquartile range, and means with standard deviation as appropriate) were prepared using Stata version 17 (Stata Corp., College Station, Texas, USA) and charts using R with packages *ggplot2* and *ggmap* (R Core Team 2022). The manuscript was prepared with reference to the Consensus-Based Checklist for Reporting of Survey Studies (CROSS) (Supplemental Material 3). As this was a convenience sample, no power analysis was performed. For continuous variables, unanswered questions were considered missing and no imputation was performed. For categorical variables, responses "no" or "none" were imputed for unanswered questions.

Regulatory approval

The study received ethical approval (University of Leicester ref 39346) and the protocol was deposited online [17]. Site co-ordinators obtained additional approvals for participation where required by local and national policies and legislation.

Results

Site characteristics

Professionals representing sixty-eight sites in sixteen countries participated in the survey. Sites were spread across Europe, although North-Eastern and Scandinavian countries were not represented (Fig. 1). Departments varied widely in capacity, with a median number of 30 (IQR 21–53) trolley spaces.

Sites most commonly defined “older people" as being aged 65+ (64%) or 75+ (25%). The Clinical Frailty Scale was used at 69% of the sites, but screening for frailty was a mandatory element of care only at 38% (Table 1). Delirium screening also was rarely mandated (24%). The 4AT was the most frequently used delirium screening tool (31%). Half of the sites using electronic health records (EHR) did not have fields to capture frailty or delirium assessments.

The respondents’ emergency departments had one-third lower nursing staffing at night-time (10 [IQR 8–14] vs. 14 [IQR 10–18]). Meanwhile the physician staffing overnight was half that in daytime (5 [IQR 3–8] vs. 10 [IQR 7–15]) (Table 2).

Provision of frailty-attuned services

One- to two-thirds of sites had frailty specialist services present or available to attend the ED during the day, including social workers (72%), geriatricians and geriatric specialist nurses (63%, 49%), pharmacists, physiotherapists, and occupational therapists (57%, 63%, 47%), and palliative care specialists and discharge nurses (56%, 41%) (Table 2). These services were mostly unavailable overnight (0–12% presence). The frequency of sites providing for 1:1 care support was similar at day (29%) and night (22%).

There was little diurnal variation in the availability of most department environmental facilities, with 94% having accessible toilets, 73% having pressure-relieving mattresses available, and 78% (65% overnight) able to access walking aids. Hot meals were rarely available overnight (18%).

Discussion

This survey investigated for the first time the type of specific assessment and services for geriatric patients in European emergency departments and has demonstrated heterogeneity in case definitions, screening standards, and provision of frailty-attuned services.

Current literature in geriatric emergency medicine focuses on frailty and delirium as predictive markers for poorer outcomes from healthcare [18, 19], and yet fewer than half of sites mandated screening for these. While mandatory screening with the Clinical Frailty Score was

Fig. 1 Sites distribution

Table 1 Sites characteristics

	Total (N = 68)
Country—n (%)	
UK	23 (33.8)
Spain	7 (10.3)
Turkey	7 (10.3)
Republic of Ireland	6 (8.8)
Switzerland	4 (5.9)
Belgium	3 (4.4)
France	3 (4.4)
Greece	3 (4.4)
The Netherlands	3 (4.4)
Croatia	2 (2.9)
Malta	2 (2.9)
Czech Republic	1 (1.5)
Germany	1 (1.5)
Hungary	1 (1.5)
Iceland	1 (1.5)
Italy	1 (1.5)
Number of trolleys or bed spaces in the ED—median [IQR]	30 [21–53]
Age cut-off used to define older or to screen for geriatric disease—n (%)	
60	1 (1.5)
65	43 (64.2)
67	1 (1.5)
70	4 (6.0)
75	17 (25.4)
80	1 (1.5)
Mandatory frailty screening—n (%)	
No	35 (51.5)
Yes	26 (38.2)
Partially/Unclear	7 (10.3)
Tools used to screen for frailty—n (%)	
None	14 (20.6)
Clinical Frailty Scale (CFS) only	47 (69.1)
Other tools than the CFS	6 (8.8)
Multiples tools, including the CFS	1 (1.47)
Mandatory delirium screening—n (%)	
No	52 (76.5)
Yes	16 (23.5)
Tools used to screen for delirium—n (%)	
None	20 (29.4)
4AT only	21 (30.9)
Other tools than 4AT	12 (17.6)
Multiples tools, including 4AT	15 (22.1)
ED electronical health record – n (%)	60 (88.2)
Without collection of frailty or delirium screen	31 (51.7)
With collection of delirium screen only	2 (3.3)
With collection of frailty screen only	16 (26.7)
With collection of frailty and delirium screen	11 (18.3)

Table 2 Staff, facilities, and resources available during day and night shifts

	Day (2PM)	Night (2AM)
ED staff		
ED nurses—median [IQR]	14 [10–18]	10 [8–14]
ED physician—median [IQR]	10 [7–15]	5 [3–8]
Professional support present or available		
Social worker	49 (72.1)	7 (10.3)
Geriatrician	43 (63.2)	7 (10.3)
Physiotherapist	43 (63.2)	6 (8.8)
Pharmacist	39 (57.4)	8 (11.8)
Geriatric nurse	33 (48.5)	2 (2.9)
Occupational therapist	32 (47.06)	0 (0.0)
Palliative care specialist	38 (55.9)	4 (5.9)
Discharge nurse	28 (41.2)	3 (4.4)
1:1 care support	20 (29.4)	15 (22.1)
ED facilities—n (%)		
Accessible toilet	64 (94.1)	64 (94.1)
Hot meal	44 (64.7)	12 (17.6)
Pressure mattress	50 (73.2)	49 (72.1)
Walking aids	53 (77.9)	44 (64.7)

low, this was consistent with systematic review findings around the instrument's implementation [20]. With worldwide population ageing, presentations to emergency departments by people living with frailty will inevitably increase. While protocols and policies have been developed and implemented to improve the collaboration with other specialists, delays in people reaching these services due to resource pressures mean there remains a gap in healthcare needing to be filled by professionals competent in geriatric emergency medicine [8, 9].

Most participating departments did not have access to frailty-specialised healthcare professionals overnight, and fewer than one-fifth were able to provide hot food to a person attending at night. In the context of a worldwide crisis in emergency department crowding it is highly likely that older people living with frailty were attending and remaining in the participating departments overnight, prompting uncomfortable reflections on the likelihood of hospital-associated harms and deterioration [21].

Limitations

The study aimed to represent Europe, and yet participation was mostly in North-Western and Southern countries. This could perhaps be due to differences in frailty prevalence and perspectives, and scope of practice and priorities for emergency care across nations. Where we corresponded with potential sites including in Scandinavia and North-Eastern Europe (suggesting the recruitment strategy reached these regions), non-participation

was frequently attributed to the study's summer timing and difficulties in obtaining local regulatory approvals.

The findings presented here may not accurately portray populations and practices in Scandinavian and North-Eastern European countries or indeed in other continents. However, this study follows national-level inquiry as the first European-level evaluation of emergency frailty care provision [22]. Further knowledge might be gained through additional international observation.

Response to surveys is often by those who have existing interest in the topic. In this case, respondents were likely to have been special interest group members or following geriatric emergency medicine themed social media accounts. Participation may therefore have been by professionals working at sites with better-established frailty practices and resources. The present study might then overestimate the true presence of frailty-attuned services and practices.

Clinical implication

The results of this study reinforce the need for uniform practices. Despite collegiate collaboration and ambition, disparate targets, quality criteria, and data recording limit the potential for large scale comparative studies. International professional associations might therefore work towards a common core set of definitions and standards, ultimately to enable outcomes research and improvement using routine data. Implementation of established standards may improve geriatric emergency care provision through service reconfiguration and audit. While the impact on patient-reported outcomes has not yet been evaluated, the North American Geriatric Emergency Department Accreditation scheme has led to reduced admissions and healthcare costs (23, 24). These guidelines have now also been adopted in several Asian, European, and South American centres. While outcomes might be more feasibly compared using consistent core definitions and practice, the precise operationalisation currently does and inevitably will continue to vary between settings due to local demographics and available health service resources. Service configuration and innovation will require evaluation and ongoing monitoring for meaningful local effect as well as for contribution to wider scale endeavours. Emergency departments with lower provision of frailty-attuned services could refer to these results when seeking support for additional hospital resourcing.

Research implication

On a research perspective, the issue of the impact on patients' outcomes remains. Future studies should look at the association between frailty-attuned services and patient-reported outcomes. Researchers should also consider healthcare providers' perspectives. While this survey was filled by each site's representative, their vision might not be the same as others working daily in the ED (physicians, nurses, allied health professionals), especially on the importance of those services and their utilisation of frailty assessment and delirium screening results.

Conclusion

This European survey demonstrated variability in case definitions, screening practices, and frailty-attuned service provision. There is no unanimous definition for older age. While the Clinical Frailty Scale was commonly used, this was rarely mandated or captured in electronic records. Provision of frailty-attuned specialist services was infrequent overnight. Appreciation of the variation in frailty service models could inform operational configuration and workforce development.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13049-024-01234-w.

Additional file 1.

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Author contributions

Conceptualization: JDvO. Data curation: JDvO. Formal analysis: CAF, JDvO. Funding acquisition: JDvO. Investigation: JDvO. Methodology: JDvO. Project administration: JDvO. Software: CAF. Supervision: JDvO. Validation: JDvO.

Visualiszation: JF. Writing—original draft: CAF, KM, JDvO. Writing—review and editing: CAF, KM, JF, JDvO.

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Availability of data and materials
The data that support the findings of this study (dataset, Stata code, R code) are available from the corresponding author at reasonable request.

Declarations

Ethics approval and consent to participate
No patient was involved in this study. Only site coordinators were requested to fill the survey, with the purpose being for research.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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Publisher's Note

Perspectives and conclusion

This research demonstrates that the Clinical Frailty Scale represents the most practical tool for frailty assessment in emergency departments. The findings indicate a strong association between frailty, measured by CFS, and poor outcomes following acute interventions such as emergency general surgery. The reliability of CFS assessments conducted by paramedics suggests the feasibility of prehospital frailty screening in emergency settings. The research also revealed substantial heterogeneity in geriatric service availability, including frailty screening, across European countries. These findings establish a foundation for enhancing acute care for older patients throughout the emergency care continuum, from dispatch to ED discharge.

Dispatching

The optimization of geriatric acute care should commence at the initial healthcare system contact point, typically through Emergency Medical Call Centers (ECC, 144 in Switzerland). Current data indicates that approximately 20% of ECC calls relate to patients aged over 75 years[73] While living arrangement queries are not standard protocol, the implementation of frailty screening at this stage could enhance resource allocation and support mechanisms for these patients. The assessment of dispatcher-performed frailty screening quality and reliability warrants investigation. Validation of this assessment could enable response customization based on frailty levels, particularly benefiting nursing home residents whose ED visits often present more risks than advantages, including unnecessary stress, increased delirium risk, and care continuity disruptions, with limited clinical benefit.

Priority should be given to developing protocols for identifying nursing home residents requiring genuine ED intervention, while establishing alternative care pathways to reduce unnecessary transfers. Research in this domain has predominantly emerged from the United Kingdom and United States, indicating a need for broader geographical investigation and context-specific adaptations.[[74] The current absence of standardized criteria for "inappropriate" transfers complicates case evaluation and management. Dispatch centers could serve as crucial intermediaries in care pathway optimization. For residents with high level of frailty, this might entail early consultation with physicians, including general practitioners or emergency physicians, to evaluate and implement hospital transfer alternatives.

Prehospital

Previous research has demonstrated the reliability of CFS implementation by paramedics. The next critical step involves investigating this reliability's translation into real-world practice. Emergency departments face implementation challenges due to high workload and perceived time constraints for assessment, despite the CFS being among the most rapid frailty screening tools available.[75] The prehospital phase presents an opportunity to address these barriers, as the fixed transport duration provides adequate time for frailty assessment

Further investigation of facilitators and barriers affecting paramedic adoption of frailty screening in real-world settings is warranted. Understanding these factors could optimize CFS integration in prehospital care, enhancing early frailty detection and care pathway optimization for acute geriatric patients. While similar investigations exist in ED settings,[75] the prehospital context presents distinct challenges and opportunities.

The identification of implementation barriers and facilitators enables development of comprehensive paramedic training programs. These training initiatives could include:

On-Field Supervision: Providing real-time guidance and support during actual emergency responses to ensure paramedics effectively apply the CFS. This hands-on supervision helps reinforce best practices and allows for immediate feedback and correction.

E-Learning Modules: Offering flexible, online training resources that paramedics can access at their convenience. These modules can cover the theoretical aspects of frailty assessment, the importance of early detection, and the practical application of the CFS in various scenarios. Interactive elements such as quizzes and case studies can enhance understanding and retention.

Regular Feedback Sessions: Implementing periodic reviews and debriefings to discuss performance, share experiences, and address any challenges encountered during frailty assessments. These sessions provide opportunities for continuous learning, skill refinement, and the sharing of successful strategies among peers.

Ongoing Support and Resources: Establishing a support system that includes access to experts, reference materials, and a platform for paramedics to ask questions and share insights. Providing these resources ensures that paramedics have the necessary tools to maintain high standards of care and stay updated on best practices.

By implementing these multifaceted training components, we can ensure that paramedics are well-equipped to perform frailty assessments efficiently and accurately. This not only enhances the quality of care for geriatric patients but also facilitates the seamless integration of the Clinical Frailty Scale into prehospital settings, ultimately improving outcomes for older adults requiring acute care.

Finally, it would be valuable to investigate the association between frailty, as measured by paramedics, and patient outcomes. If such associations are identified, it could pave the way for adapting prehospital care practices to better align with the specific frailty levels of patients. For instance, tailored interventions could be implemented, such as:

> Referring frail patients to their general practitioner for follow-up care, rather than immediate emergency transport, when appropriate.
>
> Prioritizing transport to specialized acute geriatric emergency departments for patients identified as moderately frail, ensuring they receive care tailored to their needs.
>
> Considering the option of non-transport for patients with high levels of frailty residing in nursing homes, in cases where hospital transfer may not align with the goals of care or might not improve outcomes.

By customizing prehospital interventions based on frailty assessments, we could optimize resource allocation, reduce unnecessary hospitalizations, and improve the overall quality of care for older adults. This approach would also promote a more patient-centered model of emergency care, focusing on individualized needs and outcomes.

Triage

Extended waiting times for older patients in emergency departments present significant risks. Suboptimal conditions during these waits, including inadequate nutrition, natural light exposure, and comfort, can increase vulnerability and contribute to adverse outcomes such as delirium.[33, 76, 77]

While the prolonged wait times for older patients in emergency departments may sometimes be attributed to lower severity of their conditions, it would be important to explore whether there is also an element of age-related discrimination at play. Some studies have highlighted this kind of bias in healthcare settings, where younger patients receive faster care compared to older adults.[78]

However, it remains unclear whether the Swiss Emergency Triage Scale contributes to this issue. A focused study examining the application of the SETS could help determine if age bias influences triage decisions and delays the care of older adults in Swiss emergency departments.

If age-related bias in triage is confirmed, it could prompt important recommendations for healthcare providers education and refining triage protocols to ensure equitable treatment of patients based solely on clinical urgency rather than age. These recommendations could include several strategies to address potential biases and improve care for older adults.

One potential approach is to consider upscaling the triage level for older patients, setting an age threshold (such as 65+ or 75+) to prioritize their care based on the increased risks associated with age-related conditions. However, a more refined and perhaps more effective solution could be to focus on frailty rather than age alone. Using the CFS, patients with a score higher than 4 could be automatically assigned a higher triage level, ensuring that their overall vulnerability and higher likelihood of adverse outcomes are taken into account, regardless of their chronological age.[79]

Workup and care

To date, few authors have explored how healthcare providers utilize frailty assessments in their decision-making processes. During the COVID-19 pandemic, many guidelines include the Clinical Frailty Scale to determine certain care limitations or as a criterion for admission to intensive care.[80] It would be particularly interesting to investigate whether frailty level influences the choice of diagnostic tests or treatments, the implementation of therapeutic limitations, or the establishment of advanced care directives.[80] It would be particularly interesting to investigate whether frailty level influences the choice of diagnostic tests or treatments, the implementation of therapeutic limitations, or the establishment of advanced care directives. We should also evaluate how frailty is communicated to patients and utilized in discussions, particularly when addressing personal goals and end-of-life care. A qualitative or mixed-methods study could be conducted to explore these aspects, with particular attention to regional differences within Switzerland. This is especially relevant given the notably diverse ways in which EDs operate, including variations in the profiles and roles of physicians.

Similarly, it is essential to study the true impact of frailty screening in the ED, both with and without targeted interventions. While screening for frailty can provide valuable insights into a

patient's overall vulnerability, it is crucial to evaluate whether such screening alone—without follow-up actions—improves patient outcomes. If it does not, we need to assess the effectiveness of integrating frailty screening with tailored multidomain interventions, to determine if these measures lead to better outcomes, reduced hospitalizations, and improved quality of care for older adults.

Orientation from the ED

It is well-established that hospitalization can have detrimental effects on older patients, potentially leading to complications such as delirium, sarcopenia, cognitive decline and mobility issues.[81, 82] These risks are particularly concerning because older adults are often more vulnerable to the negative impacts of prolonged bed rest, undernutrition, unfamiliar environments, and disruptions to their normal routines.

Therefore, finding solutions to safely discharge older patients to their homes, rather than admitting them to the hospital, could be an ideal strategy to minimize the adverse effects of hospitalization.

Geriatrician in the ED: With the growing availability of geriatric specialist consultations, it would be valuable to explore whether incorporating frailty screening along with a Comprehensive Geriatric Assessment (CGA) for selected patients can increase home discharge rates, enhance patient satisfaction and quality of life, and reduce readmission rates. The CGA, which provides a holistic evaluation of older adults' medical, functional, psychological, and social needs, could play a crucial role in identifying patients who are suitable for discharge. Combining this assessment with frailty screening could help clinicians determine which patients can be managed effectively at home, allowing for more tailored, patient-centered decisions.

Multidisciplinary team: Involving a multidisciplinary team is also essential in this process. Engaging social workers, home healthcare services, nurses, and physical therapists could provide the necessary support to ensure a smooth transition from the hospital to the home. This team could coordinate services such as in-home nursing care, physical therapy to maintain mobility, and social aid to address logistical needs, helping to reduce the burden on the hospital while ensuring that patients receive the care they need in a familiar environment.

Conclusion

Frailty assessment at any care stage informs decision-making processes for patients, families or caregivers, and medical teams regarding treatment options and care planning. Future research directions should encompass both frailty assessment reliability and practical implementation, including resultant interventions and their outcomes.

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