

Linköping University Medical Dissertations, No. 2036

Why use the Clinical Frailty Scale in the Emergency Department?

How assessing frailty with purpose could improve emergency care



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Samia Munir Ehrlington




Department of Biomedical and Clinical Sciences,

Linköpings universitet, SE-581 83 Linköping, Sweden

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*They always say time changes things,
but you actually have to change them yourself.*

- Andy Warhol

ABBREVIATIONS

AuROC	Area Under the Receiver Operating Curve
CFS	Clinical Frailty Scale
CI	Confidence Intervals
ED	Emergency Department
ESS	Emergency Symptoms and Signs
EWS	Early Warning Score
FaP-ED	Frailty adjusted Prognosis in ED
FI	Frailty Index
ICU	Intensive Care Unit
IQR	Interquartile Range
ISAR	Identification of Seniors At Risk
In-hosp	In-hospital
LOS	Length Of Stay
NEWS	National Early Warning Score
NPV	Negative Predictive Value
OR	Odds Ratio
Pre-imp	Pre-implementation

Post-imp	Post-implementation
PPV	Positive Predictive Value
RETTs	Rapid Emergency Triage and Treatment System
ROC	Receiver Operating Curve
SD	Standard deviation
SOF	Study of Osteoporotic Fractures
TEWS	Triage Early Warning Score
TTAS	Taiwan Triage and Acuity Scale

POPULÄRVETENSKAPLIG SAMMANFATTNING PÅ SVENSKA

Vad är skörhet?

Allt fler äldre personer söker vård på akutmottagningar. Många av dessa patienter lever med skörhet (frailty), ett tillstånd som innebär att kroppens motståndskraft mot sjukdom och påfrestningar är nedsatt. Skörhet är inte detsamma som hög ålder – två personer i samma ålder kan ha helt olika biologiska förutsättningar och därmed olika förmåga att stå emot sjukdom, även lindrig sådan. Personer som lever med skörhet har en ökad risk för komplikationer, längre vårdtider och död. I den här avhandlingen undersöker jag användbarheten av att värdera skörhet på akutmottagningar.

Hur kan skörhet skattas och borde akutsjukvården ta hänsyn till det?

Skörhet kan skattas med hjälp av olika bedömningsverktyg, varav flera har utvärderats i akutsjukvården. Clinical Frailty Scale (CFS) är ett av de mest använda och graderar skörhet på en niogradig skala, från mycket vital till mycket svårt skör. Instrumentet har visat god träffsäkerhet för att förutsäga allvarliga hälsoutfall. Gränsen för skörhet sätts oftast vid CFS 5, det vill säga en person som behöver hjälp med vardagliga aktiviteter som inköp, ekonomi eller transporter. CFS-poängen har visat sig spegla biologisk ålder bättre än kronologisk ålder och kan därmed ge en uppskattning av hur allvarligt sjuk en person riskerar att bli.

Trots detta har skörhetsskattning inte en självklar plats i akutsjukvården. På akutmottagningen genomgår alla patienter en första bedömning, så kallad triage, där vitalparametrar som andningsfrekvens, puls, blodtryck och temperatur mäts. Tillsammans med sökorsaken avgör dessa hur snabbt patienten behöver undersökas.

Ett problem är att äldre personers kroppar kan reagera annorlunda på sjukdom, vilket gör att vitalparametrarna inte alltid blir lika avvikande som hos yngre. Äldre patienter riskerar därför att få en lägre prioritering än yngre med samma åkomma, vilket kan fördröja och förlänga handläggningen. Långa väntetider på akuten ökar risken för vårdrelaterade komplikationer, särskilt för äldre. Att enbart väga in ålder fångar inte risken lika bra som att väga in skörhet. Mycket talar därför för att skörhetsskattning borde

ingå i den initiala bedömningen på akutmottagningen – något som ännu inte är klinisk praxis.

Vad vill vi veta om skörhetsskattning med CFS på akuten?

Denna avhandling undersöker hur användbart CFS är i det dagliga arbetet på en akutmottagning. Tidigare studier har till stor del utvärderats av forskningspersonal, vars förutsättningar skiljer sig från den kliniska personalen som parallellt hanterar många andra arbetsuppgifter. Mycket av den tidigare forskningen har dessutom undersökt CFS hos patienter med specifika diagnoser, vilket inte speglar den bredd av patienter som söker sig till en akutmottagning.

Avhandlingen består av fyra studier som tillsammans vill svara på: 1) Kan skörhetsskattningar gjorda av ordinarie personal under kliniskt arbete, förutspå risken att avlida inom 30 dagar? 2) Förbättrar CFS nuvarande riskbedömningsinstrument som redan används på akutmottagningen? 3) Hur upplever personalen på akutmottagningar det att använda CFS? Finns det hinder och vad kan underlätta användningen? 4) Kan en klinisk rutin baserad på skörhet minska väntetiden på akutmottagningen för äldre som lever med skörhet?

Vad har vi kommit fram till?

Den första studien visade en tydlig skillnad i hur många som avled inom 30 dagar när jämförelse mellan gruppen CFS >4 gjordes med gruppen CFS <5. Gruppen med patienter som levde med skörhet lades också in oftare och vårdades längre, både på akutmottagningen och på sjukhuset. Detta visar att en strukturerad bedömning av skörhet ger information om patientens risknivå – information som inte fångas enbart genom den traditionella triageringen.

Den andra studien visar att kombinationen av skörhetsbedömning med befintliga triagesystem förbättrar träffsäkerheten att identifiera patienter med hög risk att avlida inom 30 dagar, jämfört med bara traditionella triagesystem. Att väga in skörhet kan ge bättre beslutsunderlag och möjliggöra tidigare, individanpassade vårdinsatser samt öppna för samtal med patienten om vårdens inriktning.

Att ett instrument har god träffsäkerhet innebär inte automatiskt att det fungerar i en pressad klinisk vardag. Den tredje studien undersökte därför hur personalen upplevde att använda CFS, genom en kombination av frågeformulär och analys av hur många patienter som faktiskt skattades.

Personalen upplevde instrumentet som relevant och relativt enkel att använda, men hög arbetsbelastning, en kritiskt sjuk patient och otydliga rutiner gjorde att bedömningen inte alltid genomfördes. I samma studie såg vi att 47% av alla patienter som skulle kunna bli skattade, faktiskt blev skattade. Bedömningar gjordes oftare för patienter över 80 år, vid ankomst per ambulans och under förmiddagar – det vill säga under de tider och omständigheter då arbetsbelastningen tenderar att vara lägre. Slutsatsen var att skörhetsbedömning med CFS i sig inte är svår, men att en stressig arbetsmiljö och oklart syfte med skattningen påverkar om, och hur, instrumentet används.

För att adressera utmaningarna som framkom i den tredje studien, implementerades en ny klinisk rutin på akutmottagningen i Linköping. Rutinen rekommenderade att patienter med CFS >4 skulle prioriteras för läkarbedömning i sin egen triagekategori, då det var känt att denna patientkategori i väntade länge på akuten och i högre grad behövde läggas in. Skörhetsskattning skulle helst utföras i samband med triage och om patienter bedömdes vara CFS > 4 var personalen informerad om att prioritera patientens åtgärder och handläggning. I rutinen fanns också konkreta rekommendationer om omvårdnad och planering, utifrån vårdrelaterade risker som ökar för patienter som lever med skörhet.

Den fjärde studien undersökte om rutinen minskade väntetiden till läkare och den totala vistelsetiden på akuten, genom att jämföra tider före och efter införandet. Sammanlagt analyserades 542 akutbesök varav 248 patienter från perioden innan rutinen och 294 patienter efter rutinstart. Resultatet visade att väntetiden, både till läkare och på akuten, minskade signifikant efter start av den kliniska rutinen. Väntetiden till läkare minskade från 44 minuter till 31 minuter och vistelsetid på akuten minskade från 352 till 319 minuter. Inläggningsfrekvensen var i stort oförändrad på 59% respektive 60%. För att se om andra patientgrupper påverkades negativt av denna rutin, undersöktes väntetiderna för patienter som skattades CFS < 5 under samma studieperioder. Väntetiden på akuten minskade även för denna grupp från 317 minuter

till 303 minuter, dock var skillnaden inte signifikant. En signifikant minskning sågs dock i väntetid till läkare från 54 till 46 minuter. Även här var inläggningsfrekvensen oförändrad på 41%.

Slutsatsen var att väntetider kan kortas för sköra patienter utan att det sker på bekostnad av andra grupper – trots oförändrade resurser. Även om kortare väntetider i sig inte garanterar säkrare vård, kan de minska risken för de vårdrelaterade komplikationer som långa vistelsetider medför, särskilt för äldre patienter.

Vad betyder detta för vården?

Sammantaget visar resultaten i denna avhandling att bedömning av skörhet med hjälp av CFS på akuten inte bara är ett sätt att förutsäga risk för allvarliga händelser, utan att det också kan vara ett praktiskt verktyg för att förbättra logistiken inom vården. För patienten kan det innebära större möjligheter till individanpassad vård och tidigare samtal om vårdens inriktning. För akutmottagningen och sjukhuset kan det innebära bättre prioriteringar, effektivare resursanvändning och ett mer strukturerat omhändertagande av de mest utsatta patienterna.

Rekommendationer för akutmottagningar som vill börja arbeta med CFS eller andra sätt att bedöma skörhet

- ◆ **Fundera över vilka hinder för att skatta som kan finnas innan ni börjar.** Genom att i förväg identifiera vad som kan göra bedömningar svårt att genomföra blir det lättare att införa ett nytt arbetssätt på ett smidigt sätt.
- ◆ **Bestäm tydligt vem som ansvarar för att göra bedömningarna.** Om det är "någons" ansvar finns risken att "ingen" gör dem alls.
- ◆ **Att bara mäta hur många bedömningar som görs är sällan en morot.** Koppla bedömningen till ett tydligt syfte och konkreta åtgärder, snarare än att bara mäta antalet utförda skattningar. Skörhetsbedömningen gör störst skillnad för patienter med hög sannolikhet att behöva inläggning, vårdplanering eller återkommande akutbesök.
- ◆ **Att göra skörhetsbedömningar utan att kunna förklara varför kan medföra etiska problem, både för patient samt personal.** Det är särskilt viktigt att undvika att skörhet används som argument för att begränsa vård. Personalen

behöver förstå att skörhetspoängen är ett verktyg för att bedöma risker och planera vården bättre — inte för att begränsa ingrepp och behandlingar.

- ◆ **Med ett tydligt syfte och tidigt utförande — gärna redan i triage — kan CFS vara ett värdefullt stöd.** Instrumentet ger personalen en tidig bild av patientens risknivå och resursbehov, både under akutbesöket och i den fortsatta vårdplaneringen.

ABSTRACT

Background

The growing number of older adults presenting to the Emergency Department (ED) challenges traditional models of acute care, which are often poorly aligned with the complex and heterogeneous needs of this population. Frailty, characterized by decreased physiological reserve and increased vulnerability to stressors, has emerged as a key determinant of adverse outcomes in older patients. However, frailty is not systematically integrated into ED assessment and decision-making, which could be explained by persisting knowledge gaps. Comparison among various frailty assessment instruments in ED settings, has demonstrated good prognostic ability regarding adverse outcomes. Their ease of use in this time- and resource-pressured environment has been evaluated, in which the globally used assessment tool CFS was gauged as usable in the ED. Focus on specific patient groups and research personnel conducting the CFS assessments have limited the generalizability of previous research, resulting in lacking evidence of the instrument's applicability and usability in actual emergency medicine.

Aim

Since uncertainty remains regarding the instrument's usefulness in EDs, this thesis aims to answer (1) whether frailty assessment performed by regular ED staff retains prognostic validity in real-world conditions, (2) whether frailty adds relevant predictive value beyond established triage systems, (3) how feasible and acceptable frailty assessment with CFS is within time-pressured ED workflows, and (4) whether frailty-informed routines, assessed with CFS early during the ED visit, can improve operational performance.

Method

This thesis consists of Studies I-IV with observational, both prospective and before-and-after, as well as mixed-method designs. Study I was a prospective observational multicentre study conducted in three EDs in the council of Östergötland, Sweden. Study II was a secondary analysis of Study I. Study III, a mixed-method study, was carried out in the same three EDs as Study I. Study IV was a single-centre observational before-and-after

study conducted in the Emergency department of University Hospital of Linköping, Sweden.

Study I investigated the prognostic ability of CFS assessments made by regular ED staff during real-life clinical work. All assessed patients aged 65 years and above were eligible for inclusion. The primary outcome was mortality at 30 days, and secondary outcomes were mortality at 7 and 90 days, admission rate, ED and hospital length of stay (LOS). Outcomes were compared between patients living with frailty (CFS>4) and robust patients (CFS<5). Confounders were adjusted for using logistic regression.

Study II investigated the prognostic performance of CFS alone or in connection with the existing warning scores: national early warning score (NEWS), triage early warning score (TEWS) or the rapid emergency triage and treatment system (RETTS) triage tool. The prognostic ability was analysed using logistic regression and the primary and secondary outcomes were the same as Study I and are reported as area under the receiver operating curve (AuROC) scores with 95% confidence intervals (CIs).

Study III was a mixed-method study that examined the feasibility and acceptability of CFS in ED by collecting completion rate of assessed patients and by analysing staff experience gathered via an electronic questionnaire. Open-ended questions in the questionnaire rendered free-text comments which were analysed using qualitative content analysis. Quantitative data were analysed to identify patient-related and organisational factors and reported as descriptive data.

Study IV was a before-and-after observational study of the effects of a frailty-informed routine where patients with CFS >4 were recommended to be prioritised for physician assessment among patients with the same acuity after triage. The primary outcome was ED LOS, and secondary outcomes were time to physician and admission rate. Outcomes were compared between a pre-implementation group (control) and a post-implementation group (intervention).

Results

Mortality was significantly higher in patients with CFS >4 at 30 days (7.9% vs 0.9%) with an adjusted odds ratio of 6.0 (95% CI 3.0-12.2, $p < 0.001$) in the total of 1840 ED visits

that were included in the analysis. There were significant differences in mortality at 7 and 90 days, where mortality was higher for patients living with frailty. The differences remained even after adjusting for confounders. Patients living with frailty also had higher admission rates, longer ED LOS, and longer in-hospital LOS, compared to the robust patients.

A total of 1832 patients were included in Study II, where the association between mortality at 30 days and CFS >4 showed a significant association with an odds ratio of 6.0 (CI 95% 3-12, $p < 0.01$). Prognostication models demonstrated better prognostic ability in those models with CFS compared to those without and were overall similar in AuROC-values ranging from 0.82-0.83 (95% CI 0.77-0.88, $p < 0.05$).

Feasibility investigation showed a completion rate of 47% in 4235 ED visits. Assessments were made more frequently if the patients were aged >80 years, arrived by ambulance or during the forenoon. The questionnaire revealed that CFS was thought to be a relevant tool but high workload, unclear purpose for use and critical illness, were barriers for usability in the ED.

A total of 542 ED visits were analysed in the before-and-after study with 248 patients in the pre-implementation and 294 in the post-implementation group). Post-implementation showed a reduction in *Time to physician* from 44 min (IQR 20, 94) to 31 min (IQR 15, 65) ($p < 0.001$). *ED LOS* was shortened from 352 (IQR 266, 515) to 319 (IQR 240, 458) minutes ($p = 0.014$). There was no change in *admission rate* at 59% versus 60% ($p = 0.4$).

Conclusion

This thesis confirms the robustness and validity of CFS as a prognostic tool outside of controlled research settings and demonstrates that addition of frailty to conventional triage tools captures risk and vulnerability not reflected in vital signs and chief complaint alone. The CFS provides a more accurate risk prognosis which is valuable for establishing realistic goals-of-care and individualising medical planning. A clear ED routine including early frailty identification and connected actions could improve ED flow and decrease avoidable risks associated with prolonged ED stays, which in turn would benefit both the patients and the ED organisation as a whole.

LIST OF PAPERS

The following papers are included in this thesis:

◆ Study I

Munir Ehrlington, S., Hörlin, E., Toll John, R., Wretborn, J., & Wilhelms, D. (2024). Frailty is associated with 30-day mortality: a multicentre study of Swedish emergency departments. *Emergency medicine journal : EMJ*, 41(9), 514–519. <https://doi.org/10.1136/emmermed-2023-213444>

◆ Study II

Wretborn, J., **Munir-Ehrlington, S.**, Hörlin, E., & Wilhelms, D. B. (2024). Addition of the clinical frailty scale to triage tools and early warning scores improves mortality prognostication at 30 days: A prospective observational multicenter study. *Journal of the American College of Emergency Physicians open*, 5(5), e13244. <https://doi.org/10.1002/emp2.13244>

◆ Study III

Hörlin, E., **Munir Ehrlington, S.**, Toll John, R., Henricson, J., & Wilhelms, D. (2023). Is the clinical frailty scale feasible to use in an emergency department setting? A mixed methods study. *BMC emergency medicine*, 23(1), 124. <https://doi.org/10.1186/s12873-023-00894-8>

◆ Study IV

Ehrlington, S. M., Wretborn, J., & Wilhelms, D. (2026). Frailty Alerts Reduce Waiting Time and Length of Stay in the Emergency Department. *Academic emergency medicine : official journal of the Society for Academic Emergency Medicine*, 33(2), e70239. <https://doi.org/10.1111/acem.70239>

CONTENTS

INTRODUCTION	18
The Ageing Population and Emergency Care	19
ED Crowding and Triage.....	20
Ethical Frameworks for Resource Allocation in the ED	22
Ageing and Concepts of Frailty	22
Frailty Assessment Tools in the Emergency Department	24
The Clinical Frailty Scale	24
RATIONALE AND KNOWLEDGE GAPS	27
AIMS.....	29
Overall Aim	29
Specific Aims	29
METHODS	31
Study Design Overview	31
Study Setting and Context.....	32
Study I – CFS and 30-Day Mortality in Three General EDs	33
Study II – Mortality Prognostication by Adding CFS to Warning Scores	33
Study III – Feasibility and Acceptability of CFS by Staff Members.....	34
Study IV – Before and After Implementing Frailty Alert as a Clinical Routine.....	35
Statistical and Qualitative Analysis	36
<i>Sample Size Calculations</i>	36
<i>Descriptive Statistics and Group Comparisons</i>	36
<i>Regression Analysis</i>	37
<i>Predictive Modelling</i>	37
<i>Qualitative Content Analysis</i>	38
Ethical Approvals	39

RESULTS.....	40
CFS as a Risk Prognosticator (Studies I and II).....	40
<i>Mortality Risk</i>	40
<i>Risk of Admission and Length of Stay</i>	45
Practical Use of CFS in the ED (Studies III and IV)	46
<i>Feasibility and Completion Rate</i>	46
<i>Acceptability – Barriers and Facilitators</i>	46
<i>Effect of Frailty Alerts on ED Outcomes</i>	48
DISCUSSION	50
Main Findings in Relation to Previous Research.....	50
<i>CFS and Mortality Prediction</i>	50
<i>CFS in Combination with Triage and Early Warning Scores</i>	50
<i>Implementation – Feasibility and Clinical Impact</i>	52
Ethical Considerations of Frailty Screening.....	54
Methodological Considerations	57
<i>Strengths</i>	57
<i>Limitations</i>	57
Clinical Implications.....	59
CONCLUSIONS.....	61
FUTURE PERSPECTIVES	61
ACKNOWLEDGEMENTS	63
REFERENCES.....	65

INTRODUCTION

The emergency department (ED) serves as a critical interface between the community and the hospital, providing initial assessment and stabilisation to an increasingly complex patient population around the clock. In Sweden, as in most high-income countries, the demographic shift toward an ageing population has profoundly transformed the landscape of emergency care. Currently, patients aged 65 years and older account for approximately one-quarter of all ED visits, yet represent a disproportionate share of hospital admissions, prolonged ED stays, and adverse outcomes including in-hospital and short-term mortality.

A central challenge in emergency medicine is the accurate identification of patients at high risk for deterioration and adverse events, usually done through the triage process. Conventional triage systems, developed in an era where the typical ED patient differed substantially from today's complex older population, rely predominantly on presenting complaint and vital signs. While effective for detecting acute physiological derangement, these systems were not designed to capture the cumulative burden of aging, multimorbidity, and functional decline that characterise vulnerability in older adults – a concept increasingly understood through the lens of frailty.

Frailty, defined as a state of diminished physiological reserve and heightened vulnerability to stressors, has emerged as a powerful predictor of adverse outcomes across different clinical settings. Among the growing number of frailty assessment instruments, the Clinical Frailty Scale (CFS) has attracted particular attention in emergency care due to its ease of use, intuitive visual design, and demonstrated predictive validity. International consensus now recommends frailty screening in the ED, yet fundamental questions remain regarding how well CFS performs when integrated into routine clinical workflows, how it compares to and complements existing risk stratification tools, and whether its implementation can translate into tangible improvements in patient care and ED efficiency.

This thesis addresses these questions through four studies conducted in Swedish EDs, progressing from establishing the predictive value of CFS when used by regular ED staff (Studies I and II), through exploring the practicalities of its clinical use (Study III), to evaluating the impact of a CFS-based frailty alert on ED processes (Study IV). Together, the

studies span the translational pathway from prognostic validation to clinical implementation, contributing evidence that may inform how EDs adapt their systems to better serve an aging population.

The Ageing Population and Emergency Care

Even though different medical specialties provide care in their own unique ways and clinical routines, they all strive to adhere to the ethical framework comprised of the four pillars of medical ethics: beneficence, nonmaleficence, autonomy, and justice¹. Given that there are laws governing healthcare all over the world, the principle of justice may appear to be uncontroversial. In reality though, it may be difficult to determine what is actually just and for whom.

Each independent link in the healthcare system has their own focus area of interest and separate guidelines for how to provide high-quality care in a timely manner; they must also maintain operations with the limited resources they have. In order to decide how to utilize available resources, a just structure for prioritising resources must exist, and depending on the goal of the system, distribute them accordingly. The medicoethical principle of justice called Utilitarianism², advocates for the maximum good for the greatest number of people, which is the foundation of the distribution of resources in health care where the resources are limited.

More resources are usually required for patients with many comorbidities, compared to patients without, which is why the growing aging patient group is a major challenge for EDs. The growth can be explained by life expectancy more than doubling in the last 100 years, and that the life expectancy has further increased even for those that already survived to older age before. The life expectancy for someone aged 65 years in 1816 was 76 years, and by 2021 this would have increased to 86 years³. If the expected age for mortality is displaced, it is only natural to assume that expected age-related morbidity advances in its place. The fast increase in morbidity in this growing patient group with complex care needs presents a challenge for an underprepared health care system, not to mention the EDs, where risk assessment and care processes unfortunately have not evolved in the same pace as the ageing population⁴.

ED Crowding and Triage

In EDs, where the mission is to provide urgent care for both life-threatening and non-life-threatening conditions at all hours of the day, with limited resources, the structure to prioritise resources is typically the triage process. Since all incoming patients unfortunately can't receive help upon arrival at the ED, the triage is a way to manage the inflow by categorising patients at high risk of critical illness and those that are deemed able to wait for examination and subsequent treatment. The triage process is therefore a form of initial risk assessment which all patients presenting at the ED undergo and is mainly based on chief complaint and vital signs. Based on the information gathered the patients are assigned an acuity, which signals the urgency to receive treatment. The origin of the term triage stems from the French word "trier" (meaning "to sort"), which described the process military medics used to quickly identify critical injuries in need of intervention⁵. In this manner, the patients with the highest risk of serious events receive the most attention and focus is turned to problems that need "fixing". The triage process originally evolved due to scarcity of resources during wartime and is applied due to limited resources, adhering to the medicoethical principle of utilitarianism. This is reflected in disaster medicine triage⁶ as well as in medical decisions that were made during the Covid-19 pandemic where patients with lower chance of recovery, based on comorbidities and age, were denied access to the limited number of ICU ventilators⁷.

The most widely used triage system in Sweden is RETTS, an algorithm-based system where an acuity is assigned based on vital signs and assessment of symptoms, according to the ESS. The acuity ranges on a scale from 1 (immediate) to 5 (non-urgent) and the RETTS system has been retrospectively validated regarding in-hospital mortality looking at arrival by ambulance⁸. Another recommended risk stratifying system used in Sweden is the NEWS (National Early Warning Score), which was designed for early recognition of clinical deterioration⁹ by hospital care teams in order to identify patients with increased mortality risk in the following 48 hours¹⁰.

The proposition that the sickest and most severely injured patients in the ED should receive medical attention first is not controversial, but obstacles arise when there is an

unforeseen need of ED resources or when demands of emergency care exceed the ED's ability to provide high-quality care, especially within a certain time frame¹¹. This mismatch problem is notoriously known as ED crowding and is theorised as due to three main parts: excess of patient input, the inefficient patient throughput, and slow or absent patient output. For instance, a slow patient output could be due to patients waiting in the ED for in-hospital beds that are currently occupied, a quandary referred to as boarding. Even if boarding is linked to high occupancy rates, the relation of boarding to unavailable in-hospital beds have in practice been weaker than in theory, suggesting other contributing factors such as hospital resource utilisation as an underlying cause for the boarding problem^{12,13}.

The issue of crowding in the ED has been declared a global health crisis and a threat to patient safety due to the numerous negative effects, both directly and indirectly, on emergency care¹⁴. A driving factor for ED crowding has been deduced to be the increasing number of older patients with complex presentations¹⁵.

With the current triage system, older patients with comorbidities and complex presentations are assessed with the same protocol as the rest of the population. Older patients' risk being undertriaged due to altered physiology, which occurs naturally with aging as well as due to pharmacological causes¹⁶. The RETTS triage system has shown improved ability to predict short-term mortality when age¹⁷ and comorbidities⁸ are included, highlighting the complexity of assessing mortality risk in older patients using a conventional triage system—a challenge also reflected in the lower performance of EWS in older adults¹⁸.

Incorrect assessment of acuity in the ED¹⁹, along with atypical presentations^{20,21}, could be the reason older patients are thought to be a driving factor for ED crowding. Underestimating acuity could cause a delay in workup, diagnosis, and treatment, resulting in an unnecessary long ED LOS²². Prolonged ED LOS exposes older patients to further risks associated with the ED visit itself, and is associated with delirium²³, longer in-hospital LOS²⁴, and mortality²⁵. This aggravates the issue of available beds (patient output) even further and consequently contributes to ED crowding by increasing the wait-time in the ED.

The current ED system might aim to adhere to Beneficence but in reality, harm is unintentionally caused in many instances instead.

Ethical Frameworks for Resource Allocation in the ED

Circling back to the question of justice —and for whom—the current utilitarian triage process does not appear to be a just method for assessing risk among older, vulnerable patients in the ED, and it is indirectly harming ED operations as well. Given the issue of ED crowding, as well as the rise in ED presentations by older patients with atypical vital signs and complex presentations, an improved ED triage and care process is required. An adapted triage where actual vulnerability is weighed in would mean a triage process inspired by the principle of justice called Prioritarianism, which states that priorities should be aimed at individuals that are worse-off in order to achieve maximum wellbeing for the society as a whole²⁶. It may be difficult to see how this would benefit EDs, but perhaps a more prioritarian approach would result in more proactive resource utilisation, with vulnerability identification potentially reducing disease severity underestimations. This might lead to actions that decrease exposure of avoidable risk (Beneficence), thereby minimising overall suffering (Nonmaleficence) and achieving a more just and resource-efficient triage system in the ED.

Ageing and Concepts of Frailty

Older age does not necessarily equal vulnerability since older individuals differ in functional capacity as well as in comorbidities, which is not directly correlated to their age. Therefore, it is unfortunately not enough to identify vulnerable patients at risk for serious outcomes by incorporating age into ED triage. The ability to withstand stressors — resilience — can differ greatly between older individuals of the same age²⁷. In order to address the inherent differences in resilience, the term frailty was founded. Frailty is an age-related state of decreased physiological reserve capacity in which an individual is more

vulnerable to stressors such as an injury or illness and is associated with a higher risk of disability, hospitalisation, institutionalisation and mortality²⁸. Even if the risk of developing frailty increases with higher age, it is not a natural part of getting older but rather the final phase of aging, even if this process is somewhat dynamic²⁹.

There is no universal consensus regarding the precise definition of frailty but two main conceptual models have emerged: the phenotype model³⁰ and the cumulative deficit model³¹. The phenotype model, originally proposed by Fried et al., states that frailty is present when at least three out of five criteria are met: reduced grip strength, reduced energy, reduced walking speed, reduced physical activity, and/or unintentional weight loss. The cumulative deficit model of frailty was developed based on symptoms of health issues found in data extracted to study the epidemiology and burden of dementia in older persons in Canada. A total of 92 variables — deficits developing with time — were found and a Frailty Index (FI) could be calculated by adding up the number of deficits divided by total number of categories³¹.

Irrespective of the frailty model, the association between frailty and all-cause mortality has been shown to be significant in community-dwelling older individuals³². It has been proposed that the two models should be used complementary to each other and that the purpose of the frailty assessment should dictate the model chosen³³⁻³⁵.

For busy clinical work, the phenotype model has been considered less practical³⁶ as several of its required components—such as grip strength and walking speed—must be specifically measured for this purpose and are not routinely assessed or documented in health records.

The cumulative deficiency model allows for a finer grading in diagnosing the level of frailty, rather than simply determining whether frailty is present, and is based on signs of disease that are already documented, enabling information to be extracted from existing health records³⁷, making screening for frailty more attainable for medical specialities whose main forte is not frailty. The cumulative deficit model has shown to better predict mortality compared to the phenotype model³⁸⁻⁴⁰, probably due to accounting for comorbidities and psychosocial factors as well⁴¹, rendering the model as relevant for

emergency care as mortality risk assessment being the core of the triage process. An international Delphi study reached a consensus regarding frailty screening in the ED stating that frailty screening should take less than 5 minutes to complete, reflect the baseline in function during the previous 2–4 weeks and be performed within 4 hours of ED admission⁴².

Frailty Assessment Tools in the Emergency Department

Various frailty assessment tools in the ED have been compared with the evaluation focusing on different outcomes, such as risk prognostic ability⁴³ and ease of use³⁶. A scoping review show that instruments such as the CFS, Identification of Seniors at Risk (ISAR), and the Study of Osteoporotic Fracture (SOF) frailty index, have demonstrated prognostic ability regarding risk of admission, both to in-hospital care as well as nursing home, increased risk of prolonged in-hospital stay, and risk of mortality. In spite of the prognostic performance, the authors conclude that investigations on frailty-informed interventions in the ED environment are still scant and that the usefulness of frailty assessments in emergency care is still largely unknown⁴⁴.

The Clinical Frailty Scale

The CFS evolved from the Frailty Index and includes the domains: cognition, function and comorbidities to evaluate the level of frailty⁴⁵. The instrument was created in 2005 and initially contained a scale ranging from 1 (very fit) to 7 (severely frail). It underwent a modification in 2007 to include the points for very severely frail and terminally ill. In 2020 the instrument was updated regarding the labels and with more descriptions of each level of frailty (Figure 1). The level of frailty increases with each point and has a visual chart comprising a pictogram corresponding to each frailty score^{46,47}.

Research on the CFS in ED settings has gained increasing attention in recent years and has been evaluated as an exposure, a potential predictor, and an outcome⁴⁸. As frailty

screening is recommended in the ED—and given the demonstrated predictive ability of the CFS^{49,50}, along with its user-friendly design even in busy environments³⁶—the key takeaway is that the CFS should be both a useful and a usable tool in the ED.

Figure 1. Clinical Frailty Scale (CFS)© Printed with permission from copyright holder.

CLINICAL FRAILTY SCALE

	1	VERY FIT	People who are robust, active, energetic and motivated. They tend to exercise regularly and are among the fittest for their age.
	2	FIT	People who have no active disease symptoms but are less fit than category 1. Often, they exercise or are very active occasionally , e.g., seasonally.
	3	MANAGING WELL	People whose medical problems are well controlled , even if occasionally symptomatic, but often not regularly active beyond routine walking.
	4	LIVING WITH VERY MILD FRAILITY	This category marks early transition from complete independence. While not dependent on others for daily help, often symptoms limit activities . A common complaint is being "slowed up" and/or being tired during the day.
	5	LIVING WITH MILD FRAILITY	People who often have more evident slowing , and need help with high order instrumental activities of daily living (finances, transportation, heavy housework). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation, medications and begins to restrict light housework.
	6	LIVING WITH MODERATE FRAILITY	People who need help with all outside activities and with keeping house . Inside, they often have problems with stairs and need help with bathing and might need minimal assistance (cuing, standby) with dressing.
	7	LIVING WITH SEVERE FRAILITY	Completely dependent for personal care , from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~ 6 months).
	8	LIVING WITH VERY SEVERE FRAILITY	Completely dependent for personal care and approaching end of life. Typically, they could not recover even from a minor illness.
	9	TERMINALLY ILL	Approaching the end of life. This category applies to people with a life expectancy <6 months , who are not otherwise living with severe frailty . Many terminally ill people can still exercise until very close to death.

SCORING FRAILITY IN PEOPLE WITH DEMENTIA

The degree of frailty generally corresponds to the degree of dementia. Common **symptoms in mild dementia** include forgetting the details of a recent event, though still remembering the event itself, repeating the same question/story and social withdrawal.

In **moderate dementia**, recent memory is very impaired, even though they seemingly can remember their past life events well. They can do personal care with prompting.

In **severe dementia**, they cannot do personal care without help.

In **very severe dementia** they are often bedfast. Many are virtually mute.

Rockwood K et al. A global clinical measure of fitness and frailty in elderly people. *CMAJ* 2005;173:489-495.

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RATIONALE AND KNOWLEDGE GAPS

When evaluating a risk assessment tool, an important question is not whether the instrument can predict *any* risk, but whether it can predict the *intended* risk. As the CFS was originally created for epidemiological studies to enable comparisons between large cohorts through a standardised classification of frailty, its purpose was not to assess mortality risk. However, the association between frailty level and mortality was later found to be evident. Thus, to determine whether the CFS can be used as a prognostic risk tool in the ED, the frailty score must first be evaluated in relation to the intended target—in other words, mortality risk in older ED patients.

When the association between CFS and adverse outcomes has previously been investigated, the majority of studies have been conducted in hospitalised patients⁴⁸ or in select patient groups in the ED⁵¹, rendering it difficult to extrapolate the results and judge if the instrument is usable in an unselected general ED. The studies that have looked into CFS and adverse outcomes for older patients in general EDs have used research personnel for the CFS assessments^{52,53}, thus making it uncertain if similar results would be achieved with assessments made by clinical staff, the intended users in those contexts.

In order to understand if using CFS in the ED would improve risk prediction or rather could be performed during in-hospital care, the predictive ability should be compared with and against the existing risk stratifying systems, such as triage and early warning scores. When evaluating prediction of 30-day mortality, combining CFS with NEWS showed improved risk prediction compared to either scoring system alone⁵⁴. The prognostic ability of CFS in conjunction with a triage system has yet to be evaluated.

Another key question is whether CFS can be used in the ED. When previously evaluating the practicality of CFS, the studies have either used research nurses³⁶ or clinical vignettes⁵⁵, or been conducted in specific clinical contexts such as palliative care consultants for patients with advanced heart failure⁵⁶. Studies indicate that only about 50% of patients eligible for CFS screening are actually assessed⁵⁷⁻⁵⁹, and which raises the question of whether the CFS can realistically be used in everyday ED practice, where time

pressures may not allow for detailed inquiries about housing situations or activities of daily living.

Without exploring the factors that affect or impede frailty screening, the use of the CFS in the ED may appear sound in theory but may not be fully compatible with the realities of the clinical ED environment.

Even though guidelines emphasise the importance of considering frailty in critical illness and adopting a holistic perspective, there remains a knowledge gap regarding whether—and in what ways—assessed frailty actually influences clinical trajectories in the ED^{44,51}. This uncertainty weakens the strength of current recommendations to perform frailty assessments in the ED. To draw meaningful conclusions about the usability of the CFS in this setting, a clear proposition for how the frailty score should be used by ED clinicians must first be articulated and evaluated.

AIMS

Overall Aim

The overall aim of this thesis was to investigate the predictive ability, feasibility, and clinical utility of the Clinical Frailty Scale when used by regular emergency department staff in Swedish EDs, with the purpose of improving risk stratification and care processes for older patients.

Specific Aims

Based on the knowledge gap in predictive capability of CFS when used by regular ED staff during clinical work, the actual usability and potential of use of the instrument in the ED, this thesis aims to answer the following research questions specified for each study:

- ◆ What can CFS assessed by regular ED staff say about the risk of adverse events that conventional triage tools cannot?
 - ◆ Study I — Specific research aim: Can CFS assessed in the ED predict 30-day mortality?
 - Hypothesis: Based on current knowledge about the accuracy and user-friendliness of CFS, the hypothesis is an expected association between assessed frailty and mortality, even when clinical staff perform the assessments.
 - ◆ Study II — Specific research aim: Does the addition of CFS to triage tools and early warning score improve risk prognostication regarding short- and medium-term mortality?
 - Hypothesis: Since age-adjusted triage has been more specific in regard to risk prognosis, adding CFS scores should improve the accuracy even further.

- ◆ What would enable staff to use CFS in the ED and how could this improve outcomes?
 - ◆ Study III — Specific research aim: Is CFS feasible and acceptable to use in the ED?
 - Hypothesis: Based on previous research, the instrument is expected to be acceptable and relevant for use in the ED since the information needed for assessment is routinely collected as part of the nursing care
 - ◆ Study IV — Specific research aim: Can frailty alerts decrease length of stay in the ED?
 - Hypothesis: Implementation of a frailty-informed clinical routine, in which patients assessed as CFS >4 are identified at triage and recommended for expedited physician assessment within their triage category, will reduce ED length of stay for older patients living with frailty, compared with standard care without systematic frailty-based prioritisation.

METHODS

Study Design Overview

An overview of the study designs and methods for each study is presented in Table 1.

Table 1. Overview of the studies included in the thesis

	Study I	Study II	Study III	Study IV
Research question	Can CFS assessed in the ED predict 30-day mortality?	Does addition of CFS to triage tools and early warning score improve risk prognostication regarding short- and medium-term mortality?	Is CFS feasible and acceptable to use in the ED?	Can frailty alerts decrease length of stay in the ED?
Study setting, Emergency Departments	Linköping, Norrköping, Motala, Sweden	Linköping, Norrköping, Motala, Sweden	Linköping, Norrköping, Motala, Sweden	Linköping, Sweden
Study design	Observational, prospective	Secondary analysis of Study I	Mixed-method	Observational, before-and-after
Data collection period	2021	2021	2021	2024-2025
Number of inclusions	1840 ED visits	1832 ED visits	4235 ED visits, 48% response rate from staff on survey	542 ED visits (248 pre-imp and 294 post-imp)
Outcomes	7-, 30-, and 90-day mortality, admission rate, ED- and in-hosp LOS	7-, 30-, and 90-day mortality, admission rate, ED- and in-hosp LOS	Completion rate, staff's experience of use and relevance	ED LOS, time to physician, and admission rates
Data analysis	Logistic regression, Mann-Whitney U test	Predictive modelling	Descriptive statistics, qualitative content analysis	Mann-Whitney U, Pearson's Chi-squared/Fisher's exact test

Study Setting and Context

The studies were executed in three Swedish EDs in Region Östergötland: Linköping (university hospital) with 50 000 annual visits, Norrköping (urban community hospital), with 50 000 annual visits and Motala (rural community hospital) with 25 000 annual visits.

The implementation of CFS was decided by the Region Östergötland council in 2020. An e-learning course on CFS — including clinical vignettes and basic theoretical concepts of frailty — was therefore promoted for all ED staff. Data collection for Study I began approximately one year after the start of the e-learning course and documentation of CFS assessments began at the start of the study period.

In January 2025, a new clinical frailty-informed routine was introduced in the ED of Linköping. The routine recommended that all patients aged > 64 years of age were to receive an early CFS assessment as early during the ED-visit as possible and, if the patient was assessed as living with frailty (CFS > 4), a frailty alert would be documented in the electronic ledger where all current patients in the ED are displayed for the clinicians. Patients with frailty alert were to be prioritised for assessment by physicians and a plan for care to prevent possible iatrogenic complications such as delirium and falls was to be established according to guideline recommendations and patients' current status.

Study I – CFS and 30-Day Mortality in Three General EDs

This was an observational prospective multicentre study. All patients aged > 64 years with a complete CFS assessment were included in the study cohort. Descriptive data as well as outcome measures were collected from the electronic health records.

Primary outcome measure was 30-day mortality and secondary outcomes were 7- and 90-day mortality, hospital admission rate, and LOS in the ED and in-hospital.

The patients assessed as CFS 9 were included, even if they are by definition not showing signs of frailty but are regarded as having a lower life expectancy⁶⁰. This was due to the fact that the instrument was newly implemented and that 30% of all staff members did not complete the e-learning course, reflecting a realistic setting where staff members might have different understandings and experiences with a new assessment tool. Since the aim of Study I was to investigate the association between assessed frailty score by regular ED staff and mortality rate in a real-world setting, CFS 9 patients were included in this study as well.

The study was approved by the Swedish Ethical Review Authority, reference no: 2021-00875, and the study protocol was registered on ClinicalTrials.gov before study start, trial registration no: NCT04877028.

Study II – Mortality Prognostication by Adding CFS to Warning Scores

This was a secondary analysis of study I that investigated whether the ability to predict 30-day mortality for conventional triage systems and early warning scores was improved by adding frailty. Predictors for mortality were frailty (assessed with CFS), alone and in combination with NEWS, TEWS and RETTS. The study also aimed to validate the risk prognostic tool FaP-ED, which combines NEWS and CFS. When evaluating FaP-ED, patients with the frailty score of 9 were excluded since they, according to the definition, are assessed to have a reduced life expectancy but otherwise show no signs of frailty. Based on this,

patients assessed as CFS 9 were excluded in this cohort as well. NEWS version 1 was used to recreate the methods by the developers of FaP-ED.

The study was approved by the Swedish Ethical Review Authority, reference no: 2021-00875, and registered on ClinicalTrials.gov, trial registration no: NCT04877028.

Study III – Feasibility and Acceptability of CFS by Staff Members

This was a prospective mixed-methods study that investigated the feasibility and acceptability of CFS as a tool in the ED. When studying feasibility, the recommended areas are Demand and Acceptability. Demand includes frequency and patterns of use, while acceptability includes user contentment, facilitators and barriers⁶¹. The data collection process was divided into two stages: demand and acceptability. Demand was analysed by looking at completion rate of CFS assessments along with descriptive data on both patient- and organisational-related factors, during the data collection period for Study I, acceptability was studied by exploring staff experience of CFS via an electronic survey that was sent out to all ED staff by email. Thus, the study was conducted on the same three EDs as Study I and II.

The questions in the survey were based on acceptability areas previously probed and considered relevant for this study^{52,53,55}. The survey underwent a process of content validity by being tested on both healthcare- and non-healthcare professionals, which led to questions being clarified before part two of the data collection was initiated. Areas of interest in the survey were: experience of relevance, ease of use, time consumption, and both facilitators and barriers for using the instrument. The survey also had additional open-ended questions with the possibility for the participant to write elaborate answers on additional barriers, facilitators, and the perceived importance of identifying frailty in the ED.

The study was approved by the Swedish Ethical Review Authority, reference no: 2021-00875, and registered on ClinicalTrials.gov, trial registration no: NCT04931472.

Study IV – Before and After Implementing Frailty Alert as a Clinical Routine

This was a retrospective observational before-and-after study evaluating the implementation of frailty alerts as a clinical routine. The intervention consisted of early frailty identification using CFS, preferably during triage, with prioritised targeted care planning by the treating team. Patients assessed as CFS >4 would receive a frailty alert in the electronic health ledger, and the goal of the routine was to expedite the workup for older ED patients living with frailty to decrease the risks associated with prolonged stay in the ED.

Data collection was conducted in the ED of Linköping University Hospital during two study periods: a pre-implementation control period and a post-implementation intervention period. Data for the pre-implementation group was collected over 6 weeks in October–December 2024, and over 6 weeks in January–March for the post-implementation group.

All patients aged > 64 years visiting the ED during the study periods with a documented CFS assessment were eligible for inclusion. Written information about the study with the possibility to opt out was sent out by mail to all patients. Opting out was possible either by mail, email, or by telephone and could be done by a proxy (such as a next of kin) as well.

The primary outcome was ED LOS, and secondary outcomes were time to assessment by a physician, admission rate, and difference in ED LOS between triage categories. To investigate possible displacement effects on the robust patients (CFS <5) caused by the clinical routine, outcome data was collected on this group as well. All outcomes were compared between the pre-implementation group and the post-implementation group.

The study protocol was prospectively registered on ClinicalTrials.gov, trial registration no: NCT06869148, and the study was approved by the Swedish Ethical Review Authority, registration no: 2024-05740-01.

Statistical and Qualitative Analysis

Sample Size Calculations

Sample size calculations were done for Study I, II, and IV. The sample size estimation, which was done for Study I was based on the overall mortality of 10% at 90 days post ED visit in patients aged 65 years and older, information collected from the Swedish Emergency Care Register. Based on this number, the assumption of a 90-day mortality of 12% in patients with CFS > 4 and 8% in patients with CFS < 5, was made. Exclusions and loss to follow-up, were estimated to be around 10%. With a 95% CI and a power of 0.8, a sample size of at least 1800 patients was calculated to be required.

In study II, the sample size was based on the estimated prognostic accuracy of CFS for 30-day mortality, measured by the area under the receiver operating curve (AuROC) score. With an estimated AuROC of 0.82, a 30-day mortality of 4% and a 95% confidence interval (CI) width of 0.14, a total number of 1163 patients were required for this secondary analysis.

Sample size for Study IV was based on the aim of the intervention to equal the ED LOS between acuity 3 patients living with frailty with robust patients in acuity 2. A difference of 60 minutes based on data from study I. In that dataset, acuity category 3 consisted of the largest proportion of older patients living with frailty where approximately 50% of patients were assessed as CFS >4. The assumption was that the reduction in LOS would realistically land on a reduction of 45 minutes, given that ED LOS varies less in the most and least urgent acuity categories. With an α -level of 0.05, a power of 0.8 and an effect size of 45 minutes with a standard deviation of 150 minutes, a total of 175 patients were needed in both the pre-implementation and post-implementation groups. To account for 20% due to loss to follow-up/opting-out, a total of 240 patients with CFS >4 were aimed to be included in both groups, respectively.

Descriptive Statistics and Group Comparisons

Descriptive statistics were reported as medians with IQR (Study I, III, IV), means with SD (Study II), and as frequencies and percentages (all studies). All descriptive statistics were

anonymised and general demographic as well as data from the ED visit was reported in a summarised manner.

Statistical associations were examined between ED LOS and frailty by comparing medians with Mann-Whitney U/Wilcoxon-rank-sum in Study I and IV, and between in-hospital LOS and frailty in Study I. Chi2-test, or Fisher's exact test when the outcome was below the number of 5, were used for comparison of admission rate in Study IV and for categorical variables in Study III.

Regression Analysis

Logistic regression was used to analyse risk of mortality and hospital admission in Study I. The risk was calculated both with and without adjusting for predefined confounders: age (continuous), sex (male/female), mode of arrival (ambulance, recumbent transport, walk-in, or other), and acuity level. In the multivariate analysis, confounders were adjusted for, and reference for a significant p-value was set to 0.003 to account for multiple comparisons based on a Bonferroni correction of $m=15$. Data was imported into Pandas (V.0.23) and analysed with Python using the Scipy library (V.1.17) and the Statsmodels library (V.0.12).

Predictive Modelling

Predictive modelling was done in Study II to explore the predictive performance of CFS, alone and in combination with an early warning score and a triage tool. The calculations were done both including cases with missing vital signs (with the assumption of normal vital signs) and excluding cases with missing vital signs. Logistic regression was used to test model predictions regarding 30-day mortality, and classifications were reported as AuROC scores with 95% CIs and were statistically compared using the deLong method. A p-value less than 0.05 or a 95% CI not including 1 was considered statistically significant and an AUC-value of 1 marks a perfect discernment of the prediction model. An AuROC score below 0.8 was deemed to have limited clinical usability when it comes to the predictive performance based on the value alone. To account for varying factors affecting applicability in a clinical context, sensitivity and specificity must be accounted for as well. To identify the optimal cutoff for each model, Youden index was used, which determines the threshold with

the highest combined sensitivity and specificity for each model⁶². Model predictions were tested by logistic regression using the `roc_auc_score` and `accuracy_score` functions in the scikit-learn statistical package in Python (version 3.7) programming language.

Qualitative Content Analysis

Open-ended response options from the questionnaire in Study III yielded almost 200 comments, which underwent conventional content analysis according to Hsieh and Shannon⁶³. Both authors EH and SME (author of this thesis) conducted the analysis. The author EH had previous experience in qualitative analysis, and both authors had completed university-level courses in basic and advanced qualitative methodology. As both authors had professional backgrounds as clinical staff in the ED, there was naturally a risk of biases. According to recommendations to ensure trustworthiness in qualitative research, one strategic and precautionary step is the stage of reflexivity, in which the goal for the authors is to become more self-aware of one's preconceptions before the start of analysis, in order to retain objectivity⁶⁴. The authors' pre-understandings were therefore first reflected on and discussed to acknowledge potential biases.

The first step in the analysis was to merge all the answers from the open-ended questions from the survey and then read and reread them as a continuous text as a way to be familiarised with the content and possibly gain an understanding of the message. Sentences perceived as relevant for the aim of the study were first coded as "interesting" and then labeled according to the authors' understanding of the inherent meaning. These labels were then categorised into subgroups and later attributed to a main category. The text was reread several times throughout the process, as iteration is recommended⁶⁵, to make sure that the responders' viewpoint had come across in our results. The results were discussed and reanalysed by the authors until agreement was reached regarding the interpretations of the text as well as the assigned labels and categories. Experienced barriers/facilitators regarding ED use of CFS and perceived importance of frailty assessment in the ED were then mapped in relation to facilitators and perceived additional barriers.

Ethical Approvals

The following ethical approvals were obtained from the Swedish Ethical Review Authority:

- Studies I, II, III: reference no. 2021-00875; ClinicalTrials.gov registration no. NCT04877028 (Studies I and II) and NCT04931472 (Study III).
- Study IV: registration no. 2024-05740-01; ClinicalTrials.gov trial registration no. NCT06869148.

RESULTS

CFS as a Risk Prognosticator (Studies I and II)

Mortality Risk

In Study I, a total of 1840 index visits were included after excluding 435 ED visits, mainly based on missing data or return visits. The number of missed inclusions were 2240 ED visits where the patient was aged > 64 years, but frailty had not been assessed by CFS. In the study cohort, 606 (32.9%) were assessed as living with frailty with a cut-off of CFS > 4.

The 30-day mortality was significantly higher in the group living with frailty: 7.9% died in the group living with frailty versus 0.9% in the robust group (difference 7%, 95% CI for the difference 4.8% to 9.2%). Mortality was higher at 7 days (2.6% vs 0.2%, difference 2.4%, 95% CI for the difference 1.2% to 3.8%), and at 90 days (15.5% vs 2.4%, difference 13.1%, 95% CI for the difference 10.2 to 16.2%) as well (Figure 2) and (Table 2).

Figure 2. Mortality at 7-, 30, and 90-days

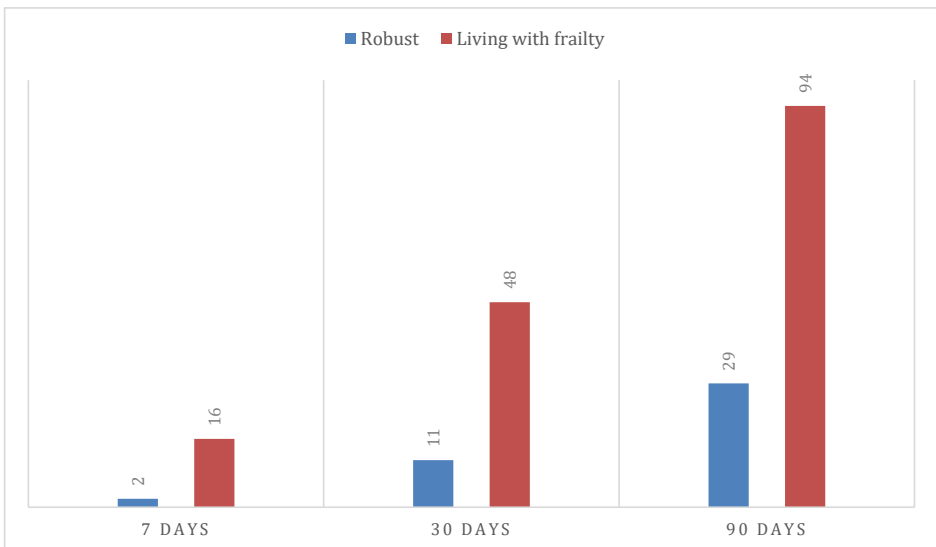


Table 2. Mortality, admission and ED and in-hospital length of stay.

	Robust (CFS<5) n=1234	Living with frailty (CFS≥5) n=606	Difference (95% CI)	Unadjusted OR (95% CI)	P value
Mortality					
7 days	2 (0.16%)	16 (2.6%)	2.4% (1.2% to 3.8%)	16.7 (3.8 to 72.9)	<0.001*
30 days	11 (0.9%)	48 (7.9%)	7% (4.8% to 9.2%)	9.6 (4.9 to 18.6)	<0.001*
90 days	29 (2.4%)	94 (15.5%)	13.1% (10.2% to 16.2%)	7.6 (5 to 11.7)	<0.001*
Admission					
	448 (36%)	352 (58%)	22% (17% to 26%)	2.4 (2.0 to 3.0)	<0.001*
ED length of stay in hours and minutes, median (IQR)					
	4 hours:36 min (3 hours:04 min – 6 hours:17 min)	5 hours:08 min (3 hours:40 min – 6 hours:45 min)	31 min (14–50)	–	<0.001†
Hospital length of stay in days (median, IQR)					
	2.7 days (1.2–5.1 days)	4.8 days (1.9–8.8 days)	2.2 days (1.2–3.0)	–	<0.001†

- *Regression analysis.
- †Mann-Whitney U test.
- CFS, Clinical Frailty Scale; ED, emergency department.

Odds ratio was calculated with and without adjusting for confounders. The unadjusted ORs for mortality in patients living with frailty compared with robust patients were 16.7 (95% CI 3.8 to 72.9), 9.6 (95% CI 4.9 to 18.6) and 7.6 (95% CI 5.0 to 11.7) for 7-day, 30-day and 90-day mortality, respectively. The difference remained after adjusting for confounders where adjusted ORs for mortality for those living with frailty compared to robust patients were 10.7 (95% CI 2.3 to 50.5) for 7-day, 6.0 (95% CI 3.0 to 12.3) for 30-day, and 6 (95% CI 3.6 to 9.1) for 90-day mortality (Table 3). The rate of mortality at 30 days increased with increasing frailty, with an increased OR by 2.1 for each additional frailty score (Figure 3).

Figure 3. Mortality for each Clinical Frailty Scale score at 30 days.

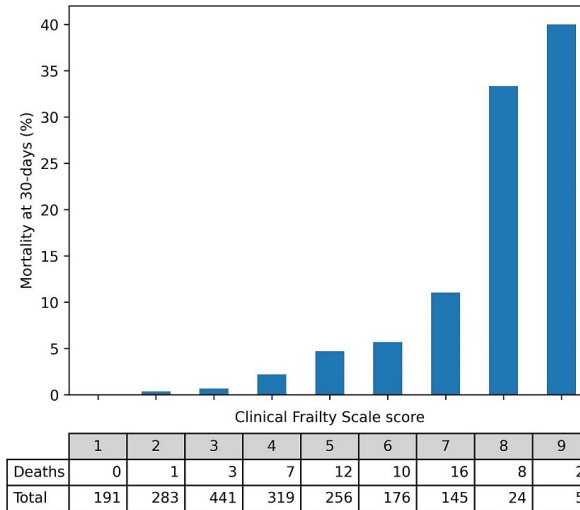


Table 3. Multivariate logistic regression results for mortality.

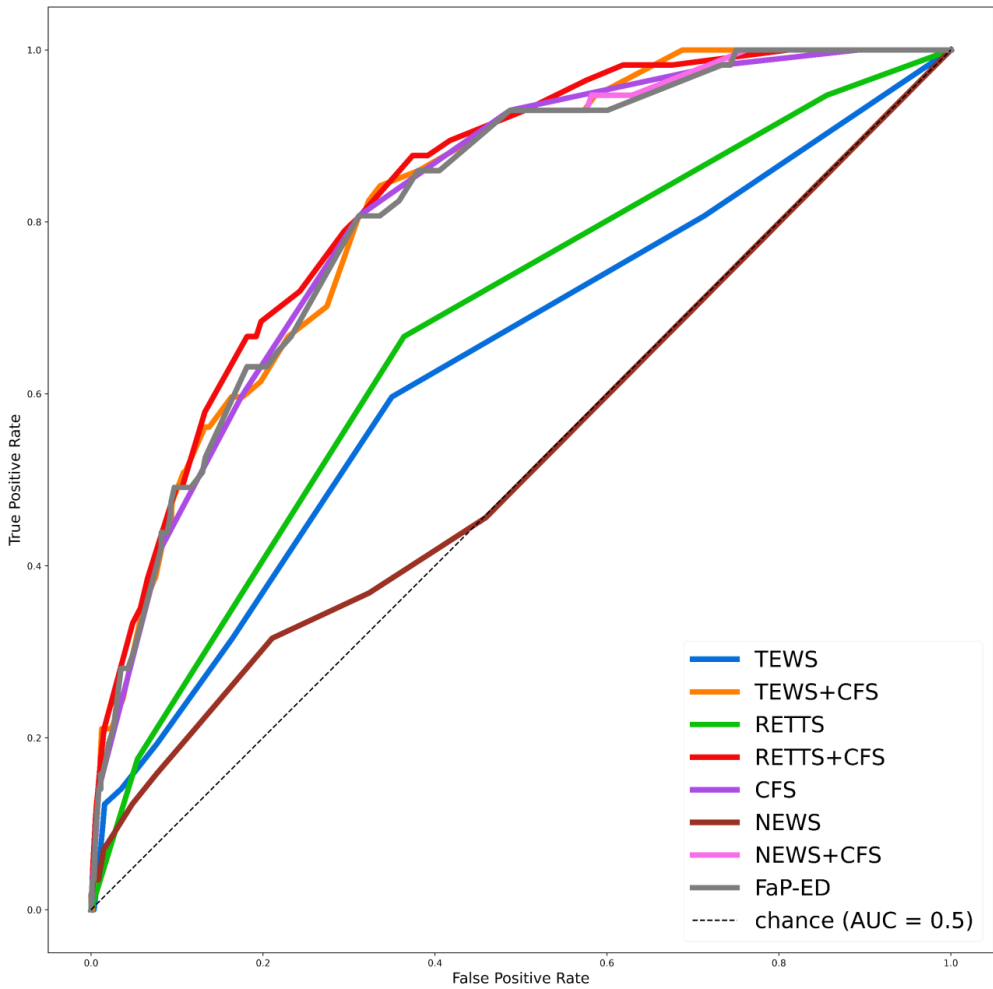
Mortality	7-day n=16 Follow-up 100%		30-day n=48 Follow-up 100%		90-day n=94 Follow-up 100%	
	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Acuity						
1	2.9 (1.0 to 8.8)*	0.06	4.9 (1.3 to 19.3)	0.02	2.7 (1.2 to 6.2)	0.02
2			2.5 (0.7 to 8.6)	0.2	1.3 (0.6 to 2.6)	0.5
3	Referent		1.2 (0.3 to 4.2)	0.8	0.8 (0.4 to 1.6)	0.5
4			Referent		Referent	
CFS≥5	10.7 (2.3 to 50.5)	0.003	6.0 (3.0 to 12.3)	<0.001	6 (3.6 to 9.1)	<0.001
Age	1.1 (1.0 to 1.1)	0.1	1.04 (1.0 to 1.1)	0.02	1.03 (1.0 to 1.1)	0.05
Arrival by ambulance	1.2 (0.3 to 4.8)	0.8	1.5 (0.7 to 3.3)	0.3	1.4 (0.9 to 2.4)	0.2
Sex	2.01 (0.77 to 5.22)	0.2	1.6 (0.9 to 2.7)	0.1	1.6 (1.1 to 2.4)	0.01

- *Acuity levels combined due to few outcomes for 7-day mortality.
- CFS, Clinical Frailty Scale.

In Study II, for the purpose of predictive modelling regarding mortality risk and to validate FaP-ED, the patients with CFS 9 were excluded. 1840 patients were originally included in the study, and after excluding 8 patients with CFS 9, a total of 1832 patients were included in the primary analysis. Vital signs were missing in 532 cases, rendering 1250 patients in the complete-case analysis cohort.

The AuROC scores improved for all models when adding CFS, including RETTS triage model and the early warning scores (NEWS and TEWS) (Figure 4). The addition of CFS to RETTS improved AuROC from 0.67 (95% CI 0.61–0.74) to 0.83 (95% CI 0.79–0.88) ($p = 0.008$). Adding CFS to NEWS increased the AuROC to 0.82 (95% CI 0.77–0.87) ($p < 0.001$) from 0.53 (95% CI 0.45–0.61), and TEWS combined with CFS resulted in an AuROC of 0.82 (95% CI 0.77–0.87) ($p = 0.002$) compared to 0.63 (95% CI 0.55–0.71). The AuROC differed little in the primary analysis compared to the complete-case analysis, where patients with one or more missing vital signs were excluded.

Figure 4. Area under the receiver operating curve (AuROC) curves for 30-day mortality models.



A prediction model with an AuROC value that surpasses 0.8 conveys that the model has good discriminatory ability at least 80% of the time, which does not automatically entail clinical relevance. In order to estimate the degree of clinical relevance, sensitivity and specificity for the models are needed as well, which is shown in Table 4.

Table 4. Cutoff values for optimal sensitivity, specificity, likelihood ratios, and predictive values for each model.

Model	Sensitivity	Specificity	Accuracy	PPV	NPV	LR+	LR-
TEWS: 3	0.41	0.83	0.82	0.83	0.98	2.33	0.72
TEWS: 1; CFS: 5	0.72	0.74	0.74	0.74	0.99	2.73	0.38
RETTS: 3	0.63	0.67	0.67	0.67	0.99	1.89	0.56
RETTS: 2; CFS: 5	0.75	0.75	0.75	0.75	0.99	2.98	0.33
CFS: 5	0.75	0.72	0.72	0.72	0.99	2.68	0.35
NEWS: 3	0.56	0.69	0.69	0.69	0.98	1.83	0.63
NEWS: 1; CFS: 5	0.69	0.78	0.78	0.78	0.99	3.20	0.40

Risk of Admission and Length of Stay

Admission rate was higher for patients with frailty: 58% versus 36%, a difference of 22% (95% CI 17% to 26%). A larger proportion of patients arrived by ambulance in the same group, and LOS for both ED and in-hospital was longer for CFS >4: ED LOS at 5 hours 08 minutes versus 4 hours 36 minutes, a difference of 31 minutes (95% CI 14 to 50); and in-hospital LOS at 4.8 days versus 2.7 days, a difference of 2.2 days (95% CI 1.2 to 3.0).

The group living with frailty had a higher number of nonspecific chief complaints, which has been shown to be more represented in the presence of frailty⁶⁶.

Practical Use of CFS in the ED (Studies III and IV)

Feasibility and Completion Rate

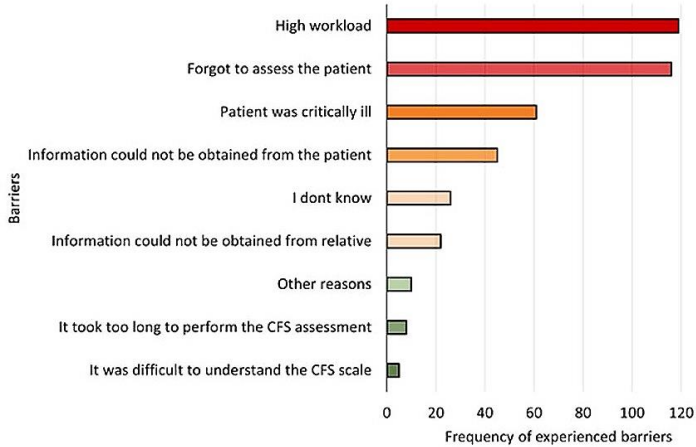
In Study III, a measure of feasibility was analysed based on the completion rate of CFS assessments that were done during data collection of Study I. The completion rate of all patients aged > 64 years visiting the ED during the study period was 47.0%. A higher proportion of patients were assessed if they arrived by ambulance (56.3%) or belonged to triage acuity group 2 (51.3%) or 3 (51.2%). Lower proportions of patients were assessed in triage acuity group 1 (41.8%), triage acuity group 4 (42.5%), and triage acuity group 5 (24.0%). Patients aged >80 years were more often assessed (>50%) and the completion rate increased with higher age.

There was a diurnal pattern in the completion rate of CFS assessments: the highest completion rate was during the forenoon between 6 a.m. and 12 p.m. (58.1%) while the largest proportion of patients in the group with missed assessments arrived during 12:01 p.m.–18:00 p.m. (45.3%). The proportion of patients arriving as walk-ins was 44.1% in the assessed group and 59.9% in the not-assessed group. The proportion of assessments in the youngest age interval (65–70 years) was 37.5%.

Acceptability – Barriers and Facilitators

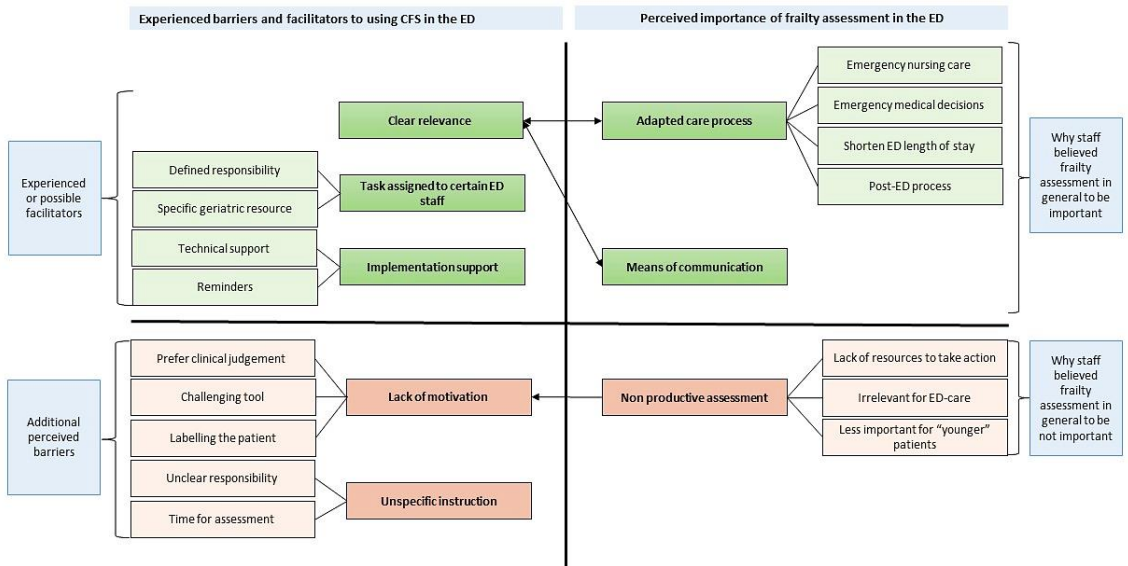
The results from the survey on staff experience of CFS showed that the ease of use as well as perceived relevance was ranked between 1 and 7 and had a median of 5 (IQR 2). Perceived barriers for assessing a patient with CFS were concluded via qualitative content analysis on the answers from the three open-ended questions. The three most frequent reported barriers were high workload, forgetting to assess the patient, and the patient being critically ill (Figure 5).

Figure 5. The frequency of ED staff reported barriers to assess patients with CFS. The number of times each barrier was selected. More than one option could be selected as a barrier to CFS assessment.



The open-ended answers were condensed into 8 categories and 16 subcategories and categorised under 'Perceived barriers and facilitators' and 'Perceived importance of frailty assessment in the ED'. Among the perceived barriers for using CFS in the ED were "lack of motivation", wherein "prefer clinical judgement" was one subgroup. The category 'Perceived importance of frailty assessment in the ED' contained the subgroup "not important for younger patients". The facilitator category 'Clear relevance' was connected to 'Adapted care process' as a category under importance of use. Two of the subgroups under the Adapted care process were "Emergency medical decisions" and "Shorten ED stay". The subcategory "Irrelevant for ED care" was also identified. The category 'Means of communication' was deduced as connected to relevance (Figure 6).

Figure 6. The result of the qualitative analysis: the eight categories and 16 subcategories.



Effect of Frailty Alerts on ED Outcomes

A total of 248 ED visits were analysed in the pre-implementation (control) group and 294 ED visits in the post-implementation (intervention) group. The overall ED LOS decreased from a median of 352 minutes for the pre-implementation group to 319 minutes for the post-implementation group ($p=0.01$). Time to physician decreased from 44 minutes (IQR 20, 94) to 31 minutes (IQR 15, 65) ($p<0.001$). The admission rate was unchanged at 59% in the pre-implementation group and 60% in the post-implementation group ($p=0.4$) (Table 6). Both ED LOS and time to physician were reduced in triage acuity 1–3 (immediate, very urgent, urgent) but increased in triage acuity 4 (less urgent) patients. The difference was only statistically significant in time to physician for triage acuity 3 where it decreased from 74 minutes (IQR 34, 122) to 49 minutes (IQR 21, 99) ($p=0.006$) (Table 7).

Table 6. Emergency Department length of stay, admission and waiting time to physician

Outcome	Pre-imp group ¹ (CFS >4)	Post-imp group ¹ (CFS >4)	Difference (95%CI)	p-value ²
ED length of stay in minutes, median (IQR)	352 (266, 515)	319 (240, 458)	33 (33-43)	0.014
Waiting time to physician	44(20, 94)	31 (15, 65)	13 (12-19)	<0.001
Admission	145 (59%)	175 (60%)	1 (-7 - 9)	0.4

¹ Median (Q1, Q3); n (%)

² Wilcoxon rank sum test; Pearson's Chi-squared test; Fisher's exact test

Table 7. Emergency Department length of stay and waiting time to physician across different acuity categories

Acuity Category	Outcome	Pre-imp ¹ (CFS >4)	Post-imp ¹ (CFS >4)	p-value ²
1 (Immediate)	ED length of stay in minutes, median (IQR)	308 (235, 792)	260 (176, 362)	0.3
	Wait time in minutes, median (IQR)	18 (3, 72)	14 (1, 44)	0.9
2 (Very urgent)	ED length of stay in minutes, median (IQR)	350 (259, 487)	308 (240, 432)	0.09
	Wait time in minutes, median (IQR)	30 (12, 67)	24 (13, 52)	0.2
3 (Urgent)	ED length of stay in minutes, median (IQR)	378 (283, 530)	342 (238, 505)	0.1
	Wait time in minutes, median (IQR)	74 (34, 122)	49 (21, 99)	0.006
4 (Less urgent)	ED length of stay in minutes, median (IQR)	285 (179, 584)	402 (318, 1090)	0.4
	Wait time in minutes, median (IQR)	69 (21, 92)	71(16,129)	0.5

¹Median (Q1, Q3); n (%)

² Wilcoxon rank sum test; Pearson's Chi-squared test; Fisher's exact test

DISCUSSION

Main Findings in Relation to Previous Research

CFS and Mortality Prediction

The ability of CFS to predict mortality risk in older ED patients, both dichotomized and by score, is consistent with current knowledge^{43,49}. Confirming that clinicians in the time-pressured ED environment can use the CFS with similar results as in the hospital ward^{67,68} and when done by research personnel^{36,69}. Of those assessed as CFS 9, 2 out of 5 patients had died within 30 days, signalling that ED staff were able to determine when the mortality risk was high.

Inter-rater reliability regarding CFS has been studied in the same three EDs and has been shown to be moderate to good⁷⁰ which is likely realistic for a recently implemented instrument. Importantly, the frailty scores of the assessed patients are clearly associated with mortality risk as well as the risk for longer ED stay and admission, adding useful information to account for in the ED.

CFS in Combination with Triage and Early Warning Scores

Similar to the results in this thesis, adding CFS to early warning scores at ICU-admission have shown improved in-hospital mortality prediction⁷¹. Indicating that current warning score systems fail to account for the complexities of patients' physiology into risk calculation, similar to the RETTS triage system, which had worse AuROC-values than the model with CFS. While the AuROC-values were highest for RETTS in combination with CFS, they were not perfect and should be used judiciously and within the clinical context.

The sceptic could argue that ED triage tools should not account for medium-term mortality but instead focus on patients in need of prompt medical attention. While the CFS, when added to a triage tool, has been shown to predict ICU admission and in-hospital mortality⁷², there is a more subtle risk for these patients. By not accounting for CFS, there is a considerable risk of undertriage, causing delayed workups and subsequently prolonged ED length of stay, which in turn increases the risk of mortality, particularly in the older

population²⁵. Hence, including frailty in the initial risk stratification would account for both short- and medium-term mortality and perhaps better estimate resource demands in the ED, such as workup, nursing care, and possibly the admission process.

Studies investigating the prognostic value of CFS in combination with triage have shown better risk prediction regarding 30-day mortality, as well as regarding in-hospital mortality and ICU-admission, even in lower acuity groups. Taş et al demonstrated that 30-day mortality could be better predicted for patients living with frailty with a relative risk of 7.08, a sensitivity of 95% and a specificity of 30%⁶⁹. Ng et al. showed that incorporation of CFS into their triage system TTAS improved risk prediction regarding in-hospital death and ICU admission by an increased AuROC from 0.64 to 0.82, and an increased sensitivity from 42% to 81%⁷². However, the specificity in their study decreased from 81% to 70%, exemplifying that perhaps sensitivity should be regarded higher than specificity in mortality risk prediction in the ED.

While the addition of CFS may improve resource allocation in the ED, the association with in-hospital mortality⁷³ has implications for the treatment plan in the near future, beyond the ED. In patients living with frailty this may prompt early discussion around goals of care and patient preferences. For robust patients, it might entail an earlier and more aggressive treatment plan since the physiological reserves are likely to be able to withstand a serious illness and necessary interventions.

A hazard of decision support tools as well as risk profiling is when over-standardisation occurs, and health-care workers solely rely on the result rather than taking account for the complexity in risk stratification. This is highlighted by Ku et al., who argue that CFS should not be used alone to decide the medical and logistical planning due to its low positive likelihood ratio for 30-day mortality, in spite of balanced sensitivity and specificity⁷⁴. A consequence of over-standardisation might result in limiting care purely based on frailty score, describing the discriminating issue of frailism⁷⁵. Therefore, it is imperative for clinicians to understand that, while a frailty assessment may reasonably predict adverse outcomes on the group level, it should always be interpreted in the clinical context for any individual patient. And that the purpose and implications of the assessment should be tailored to the patient.

Implementation – Feasibility and Clinical Impact

Perhaps feasibility and demand in the clinical context should be evaluated differently than in the research context, depending on their purpose. The conclusion to be drawn is that CFS could be useful in predicting risk for those who were assessed and based on the similar demographic characteristics of the non-included patients compared to the included ones, a higher completion rate should not alter the results from Study I greatly. The completion rate itself still indicates that it might be an over-reach to try to assess every patient aged >64 years. Looking at the ability of CFS as a risk prognosticator for mortality, one might say that in the ED, the true potential of the frailty assessment tool could be entirely missed if the completion rate is the primary goal for the clinic.

Completion rates were lowest in the group triaged as “non-urgent”. But perhaps this may be one of the more relevant groups to do frailty assessments in. This is typically a patient group with extremity injuries where knowledge about functional status would impact management. Particularly for the robust patients where a low CFS score may counteract the risk of ageism and promote a more active treatment plan.

The qualitative analysis showed that CFS is perceived as more relevant for patients evidently living with frailty according to clinical judgement, or in need of admission or follow-up where the medical plan needs to be communicated to the next responsible health facility. CFS appears to lose its purpose when used in seemingly well and robust patients that have no apparent need of ED care. Perhaps clinical judgement guides staff in which patients would benefit from being CFS assessed, which somewhat defeats the purpose of an actual frailty assessment but supports the notion of clinical judgement being more sensitive for ruling-in the presence of frailty.

The acceptability of CFS in the ED depends on how clearly the purpose of the instrument has been communicated beforehand, which is an important lesson for future EDs that may want to go down the same path. The authors of the implementation review recommend, when implementing new practices, that barriers first be explored in order to convert these into facilitators for a more efficient implementation process⁷⁶. The conclusion drawn from this is that face-to-face educational sessions on the goal of CFS assessments as

well as implications for the clinical work would probably have been helpful before implementing frailty screening as a routine.

In the calculation made for the sample size in study IV, the expected decrease in ED LOS was 45 minutes. Looking at the upper limit of the 95% confidence interval (43 minutes) and the median decrease in time being 33 minutes, one could argue that even if the decrease in ED LOS was statistically significant, it might not be clinically significant or important⁷⁷. Perhaps the significance of 33 minutes is subjective, depending on whether you ask a patient or a staff member. A more substantial reduction in ED LOS has been seen when implementing specialized geriatric teams in the ED, where ED LOS was reduced from 19.1 to 12.7 hours, however with a significant increase in admission rate from 67% to 70%. On evaluating the efficiency of a low-resource routine to reduce ED LOS in a general ED, the results might not seem convincing at first glance, as a 33-minute reduction may appear to be a small gain relative to the effort invested. However, when those 33 minutes are multiplied across every waiting patient living with frailty, the cumulative effect quickly adds up to several hours. Anyone who has ever waited in line would likely agree that 33 minutes can feel like an eternity—even without being ill.

Even if it is known that patients living with frailty have longer in-hospital stays⁴³ and are more likely to be readmitted during revisits^{78,79}, admission rate and length of in-hospital stay are affected by external factors that are difficult to account for. This could be the number of inpatient beds or whether the patient was admitted due to the need for domestic services. In research contexts, admission rate or in-hospital LOS are therefore problematic to be seen as a measure of morbidity but still convey data on resource utilisation. Interventions targeting avoidable admissions of older ED patients have shown varying results and have required a geriatric specialist⁸⁰⁻⁸², hinting at the complexity of measuring admission as an outcome as well.

Ethical Considerations of Frailty Screening

The patient's perspective is an important aspect to consider when debating the usefulness of frailty screening in everyday clinical practice. A qualitative study focused on both patients' and staff's perspective on frailty in a lung cancer clinic found that patients' perception of frailty revealed negative connotations, which was highlighted as a challenge for incorporating frailty assessment into clinical practice⁸³. This was noted in another qualitative study that explored hospital-based staff's perceptions of frailty: staff did not think that a frailty label would make much difference for the care of the patient and that there was a stigma associated with the word⁸⁴. When frailty perceptions of older adults living in the community and residential care were investigated, answers revealed scepticism of the necessity of frailty assessments unless they led to action⁸⁵. The essence of these studies describes the overall ethical challenge of "labelling" a patient as living with frailty, without concrete measures connected to the assessment, which is also concluded as an important factor for acceptability in Study III.

A scoping review of the public's perception of frailty in the UK found that the stigma of being classified as "frail" could be attenuated with positive reframing and coping strategies, such as accepting support from caregivers and next of kin in order to retain the sense of self-determination⁸⁶. Areas important for older patients living with frailty have been found to be 'Autonomy' during acute care⁸⁷ and 'Abilities and emotions' when asked during ED stay⁸⁸. If a patient assessed as "living with frailty" understands that the level of frailty could correlate with the length of the convalescence period, incorporating frailty scores into the treatment plan may help with logistical planning (such as accepting caregivers' help) as well as the medical follow-up and rehabilitation plan.

Since the word frail is defined as "weak/easily damaged" in the Cambridge dictionary, it is not surprising that the word seems to have a negative undertone in general. The same can obviously not be applied for an ED triage category as they probably lack preconceived notions about them. To see frailty as an important factor in triage/treatment planning, a reframing — even among health care staff — has to occur. For example, when a patient with chest discomfort seeks medical care, a high pulse signals the risk of serious

outcomes, but the verdict is not a simple "you are probably sick" but perhaps "our assessment signals that we need to keep you for observation". A similar shift in mindset is required from health care when discussing and implementing frailty assessments. By explicitly stating the goal following a frailty assessment, the focus is shifted to actions rather than the label "frailty". For example, as in Study IV, this would entail clear communication regarding prioritising patients with CFS >4 for physician assessment or workup. Even if patients might dislike the general tenor of the word frailty, they might not object to the implications for the clinical routine.

Would the knowledge of avoidable risk as well as expected health consequences affect the wishes and goals with care for the patient? Establishing goals of care together with the patient might be challenging in the ED, especially during critical illness⁸⁹. There might also be a dissensus between patients' goals and the physicians' goals of care⁹⁰. A quality-improvement initiative in Leeds, UK—aimed at increasing the number of advance care planning discussions—found that more advanced frailty was one of the key factors prompting clinicians to initiate these conversations in the ED⁹¹. This argues for having a scale, such as the CFS, as a frailty assessment instrument rather than a simplified dichotomised tool. The grading of frailty facilitates the individual adapted care and could aid in monitoring the possible ascent of frailty. If the patient cannot communicate their wishes, realistic expectations and goals for the current medical care event could still be set by the responsible physician and reported to the next instance of care.

High-risk care plans—developed with the involvement of emergency physicians—have been shown to reduce ED resource utilisation, largely by targeting avoidable radiological investigations⁹². Even if the study population were not older patients with frailty, the possibility to avoid unnecessary over-investigation via interdisciplinary discussions still applies. The regular advanced care plans are written in Sweden by primary care physicians, which might be problematic considering that knowledge about what ED and in-hospital care might contribute to the patient's health is most likely outside of the scope of general medicine. Involving emergency physicians and hospitalists in the care planning might render more reasonable care plans where the specific goal of ED visits and subsequent care would be discussed beforehand. For patients living with severe frailty, this

could facilitate recognising early signs of a patient approaching the end-stage of life in case of lack of improvement, and the care could focus on alleviating interventions rather than the patient experiencing a protracted period of repeated testing and investigations causing possible suffering.

A major problem with lacking care plans involves the issue of undocumented patients' wishes. A systematic review revealed that the current status of the proportion of documented patient wishes in the geriatric ED patient group was generally much less than 50%⁹³ and the ED has been described as an underused setting for discussions regarding advanced care planning⁹⁴. Triage in conjunction with CFS could provide a more accurate prognosis of mortality risk, opening the possibility of discussing patients' wishes with realistic expectations of the goals of care, either directly with the patient or with a health proxy. By increasing the number of documented wishes and goals of care, the ED would be responsible in aiming care and interventions towards what is important for the patient.

A systematic review revealed that unscheduled hospital admissions have shown to be reduced by advance care planning and administration of high-dose influenza vaccines, both of which are preventive measures outside of the scope of emergency medicine⁹⁵. Visade et al. illustrate that while advance care plans are typically expected in the end-stage of terminal illness, they are often not prioritised for patients with repeated hospital admissions—despite these admissions representing situations in which advance care planning would have been warranted⁹⁶. Since frailty has been repeatedly associated with hospital admission, ED revisits, and subsequent readmissions, identifying frailty in the ED could include routinely sending referrals to signal the need for advance care planning, thereby helping to reduce avoidable admissions.

To avoid confusion and the risk of stigma, a different term may eventually be adopted for patients with diminished physiological reserve. Until then, it is important to focus on the purpose of frailty assessments and to strengthen clinicians' willingness to clearly communicate what frailty implies for risk prediction and for establishing goals of care in line with patients' wishes.

Methodological Considerations

Strengths

Study I: A major strength was the multicentre design with regular ED staff performing the assessments on non-selected patients, reflecting the applicability of the results in other ED settings.

Study II: A strength for this study was the focus of decreasing the knowledge gap by investigating the predictive performance of ED triage tools in connection with CFS, which had previously never been done. The multicentre design amplifies the robustness of the study design and favours the reproducibility of the results.

Study III: A paramount strength was the mixed-methods design, where the qualitative analysis allowed for a deeper insight in the experience and perceived relevance of CFS/frailty screening of staff members. Additionally, a strength was the collection of data from three different EDs, providing diversity in the study setting as well as in the backgrounds of personnel. This increases the chances of transferability of the results to other EDs which might aid in the process of implementing CFS or another frailty screening instrument. The large patient cohort of 4235 ED visits on which the demand analysis was performed enables transferability even further, making the results realistic and plausible.

Study IV: The main strength of this study was the real-world setting where the effects of an actual clinical routine were evaluated in relation to the setting of intended use, an authentic ED. Even if premises might differ, such as experience of CFS and characteristics of patients, the overall unselected patient flow in combination with ordinary working staff allows the setting to be generalisable and results to be credible.

Limitations

The following limitations apply across the four studies and should be considered when interpreting the findings:

Study I: A limitation was not probing for previous experience with CFS or other frailty assessment instruments, considering that a difference in experience can affect how a staff

member uses the instrument and thereby the frailty scores. Additionally, 30% of all staff members did not complete the e-learning course. The number of missed inclusions (2240 visits) means that results apply to those who were assessed, not all older ED patients. Selection bias may therefore affect generalisability.

Study II: Vital signs were missing in 532 cases (approximately 29% of the original cohort), which required assumptions about normal vital signs in the primary analysis. While the primary and complete-case analyses showed little difference in AuROC-values, missing vital signs remain a potential source of bias.

Study III: The response rate of the survey was approximately 50%, which could lead to a reporter bias where negative opinions are more likely expressed than neutral or positive ones. Data was also not collected on whether the anonymous survey respondent had previously used CFS in the ED, which would have provided insight into whether perceptions were preconceived notions or actual experiences.

Another limitation was the structure of the survey in which optional pre-stated barriers were displayed before the possibility to write open-response answers was available in the questionnaire. This may have affected the participants' perception of the barriers beforehand and, subsequently, the results. Since the open-ended questions specified "additional barriers", the qualitative analysis might not fully capture the participants' perceptions, even if the main approach was to conduct a mixed-method study in order to analyse the facilitators/barriers from different perspectives.

The figure used to represent the main categories and subgroups may have appeared confusing to the reader, which could hinder the message of the findings to be reached out. The authors had continuous dialogue about the format in which the results would be presented as it was not quite clear how a figure would be representative for the subgroups and main categories, as both purpose and unclear instructions affected the perceived relevance as well as motivation to perform assessments. Presenting findings in a visual way has been mentioned as one of the limitations in qualitative research since it can be both challenging and time consuming⁹⁷.

Study IV: The before-after design without concurrent controls is the primary methodological limitation, as secular trends and confounders cannot be fully accounted for. The lack of data on investigations conducted, the number of consults, and the trajectory of care after admission means that ED LOS is a crude proxy for care quality. The study was conducted in a single ED and may not generalise to other settings.

General limitations across all studies: The studies were conducted in a single region (Region Östergötland), limiting generalisability to other Swedish and international EDs. The studies capture the experience of a single implementation of CFS in a specific healthcare context.

Clinical Implications

Reflecting on the premise of ED operations and why the prioritarianistic approach might be more beneficial, this thesis concludes that frailty screening with CFS in the ED provides valuable information that could aid in both the medical and logistical planning. Since day-to-day ED work rarely resembles real conditions for disaster medicine, it is theoretically and practically misleading to assess the need for resources by using a replication of a distribution system that was developed on and for the battlefield. By including frailty as a measure of probable resource utilisation as well as mortality risk, the concept of maximising the number of patients receiving resources turns into the concept of maximising utilisation of limited amounts of ED resources. Based on Study IV, this could also improve ED flow and, in the long term, lead to more patients being seen, which would surely appeal to proponents of a utilitarian framework for healthcare who find it hard to abandon the idea of conventional ED triage.

Recommendations for other EDs inspired by this thesis and eager to implement CFS or another frailty screening:

- ◆ Map out possible barriers for using CFS or another frailty screening tool of choice — this could enable and facilitate the implementation process.

- ◆ Assign clear responsibility for performing the assessments — if it is nobody's responsibility, there is a risk that nobody does it.
- ◆ Completion rate is unfortunately not a motivator for performing the assessments. A clear purpose with actions connected to the level of frailty is recommended if the instrument is intended to be used at all. Perhaps a better indicator is the number of assessments done on patients coming from residential care facilities, who are admitted to the hospital, or who have had repeated ED visits in the last months. For these patients, who are at risk for worse outcomes, a frailty screening would be more relevant as it would probably have more impact on the medical planning.
- ◆ Assigning frailty scores without being able to explain why screening is performed can be ethically problematic — especially if the assumption is to limit care, the danger of frailism. A frailty score is relevant within its context and a vital component in risk prognosis; staff should be informed of this and ideally understand it before initiation of frailty assessments.
- ◆ With clear purpose and right timing (preferably in triage), CFS can be and should be used by ED staff as part of the prediction of risk and resource utilisation.

In practice, early identification of patients with a high probability of admission may improve operational planning by enabling timely initiation of diagnostic workup and bed coordination. Although many determinants of admission and length of stay lie beyond ED control, EDs can mitigate harm by prioritising the disposition of patients most vulnerable to the adverse effects of prolonged boarding — notably those living with frailty. Recurrent ED visits and hospital readmissions should be recognised as markers of progressive clinical decline and should prompt referral for structured advance care planning.

CONCLUSIONS

This thesis confirms the validity of CFS as a prognostic tool regarding short- and medium-term mortality, even outside of controlled research settings. It has also demonstrated that the addition of frailty screening to triage improves the accuracy of risk prediction in older ED patients, which is otherwise missed when basing triage acuity on vital signs and chief complaint alone. Unclear instructions of the purpose of frailty assessments in combination with high workload could, however, obstruct utilisation of CFS. If concrete guidance exists, CFS could be used to decrease waiting time in the ED. As improved ED operating metrics do not automatically reflect enhanced care, the potential of reducing ED crowding could serve as a motivator for assessing and taking the level of frailty into account for medical and care planning, thereby improving and individualising the ED care in the longer term.

FUTURE PERSPECTIVES

Since the improvement of ED care given to older patients cannot progress without considering the patients' perspective, future research should evaluate how implemented routines aiming to improve standard care actually affect the patients. This includes the patients' perspective on frailty alerts as well as experiences of frailty-attuned care. A study conducted in the ED in Linköping showed that patients who had been assessed with CFS mostly had positive or neutral experiences from the assessment. One problem was, however, the lack of information on the necessity of the probing questions⁹⁸, which obviously plays a part in how truthfully and exhaustively the patient answers. Investigating the patient's perspective further would also shed light on the ethical challenges of frailty screening that have previously been expressed by staff.

Another aspect that is important in developing geriatric emergency medicine is how the notion of frailty affects current medical planning for physicians in the ED. Without understanding this, new guidelines can have thorough recommendations that are hardly

followed since the present-day clinical work and possible barriers for frailty-attuned care are not accounted for.

A logical next step would also be to investigate if direct inquiry in the ED regarding goal-of-care — with information regarding possible risk, either directly to the patient or a proxy, with subsequent documentation — would affect the care trajectory and the establishment of advanced care plans. Considering the rate of increasing older patients, it would be beneficial to evaluate outcomes of advanced care plans where emergency physicians have been part of the process of concluding realistic goals of hospital care. Based on the risk of more pronounced loss of function, earlier initiation of assessment of functional status and rehabilitation might decrease the number of in-hospital days, which could be evaluated in a future project focusing on the feasibility and effect of frailty alerts for admissions.

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REFERENCES

1. Beauchamp TL, Childress JF. *Principles of Biomedical Ethics*. Oxford Univ. Press; 1979.
2. Bentham J. *An Introduction To The Principles Of Morals And Legislation*. Oxford: Clarendon Press; 1789.
3. Dattani S, Rodés-Guirao L, Ritchie H, Ortiz-Ospina E, Roser M. Life Expectancy. Published online 2023. <https://ourworldindata.org/life-expectancy>
4. Jones CH, Dolsten M. Healthcare on the brink: navigating the challenges of an aging society in the United States. *Npj Aging*. 2024;10(1):22. doi:10.1038/s41514-024-00148-2
5. Yancey CC, O'Rourke MC. Emergency Department Triage. *Treasure Isl FL StatPearls Publ*. 2023. Accessed July 4, 2025. <https://www.ncbi.nlm.nih.gov/books/NBK557583/>
6. Kennedy K, Aghababian R, Gans L, Lewis C. Triage: Techniques and Applications in Decisionmaking. *Ann Emerg Med*. 1996;28(2):136-144. doi:10.1016/S0196-0644(96)70053-7
7. Joebges S, Biller-Andorno N. Ethics guidelines on COVID-19 triage—an emerging international consensus. *Crit Care*. 2020;24(1):201, s13054-020-02927-1. doi:10.1186/s13054-020-02927-1
8. Wireklint SC, Elmqvist C, Fridlund B, Göransson KE. A longitudinal, retrospective registry-based validation study of RETTS©, the Swedish adult ED context version. *Scand J Trauma Resusc Emerg Med*. 2022;30(1):27. doi:10.1186/s13049-022-01014-4
9. National Early Warning Score (NEWS) 2 Standardising the assessment of acute-illness severity in the NHS. Published online London: RCP 2017. Accessed January 27, 2026. https://www.rcp.ac.uk/media/a4ibkbbf/news2-final-report_0_0.pdf
10. Smith MEB et al. Early Warning System Scores: A Systematic Review. Published online January 2014. Accessed December 15, 2025. <https://www.ncbi.nlm.nih.gov/books/NBK259029/>
11. Affleck A, Parks P, Drummond A, Rowe BH, Ovens HJ. Emergency department overcrowding and access block. *CJEM*. 2013;15(06):359-370. doi:10.1017/S1481803500002451
12. Wretborn J, Henricson J, Ekelund U, Wilhelms DB. Prevalence of crowding, boarding and staffing levels in Swedish emergency departments - a National Cross Sectional Study. *BMC Emerg Med*. 2020;20(1):50. doi:10.1186/s12873-020-00342-x

13. Chang AM, Cohen DJ, Lin A, et al. Hospital Strategies for Reducing Emergency Department Crowding: A Mixed-Methods Study. *Ann Emerg Med.* 2018;71(4):497-505.e4. doi:10.1016/j.annemergmed.2017.07.022
14. Pearce S, Marchand T, Shannon T, Ganshorn H, Lang E. Emergency department crowding: an overview of reviews describing measures causes, and harms. *Intern Emerg Med.* 2023;18(4):1137-1158. doi:10.1007/s11739-023-03239-2
15. Morley C, Unwin M, Peterson GM, Stankovich J, Kinsman L. Emergency department crowding: A systematic review of causes, consequences and solutions. Bellolio F, ed. *PLOS ONE.* 2018;13(8):e0203316. doi:10.1371/journal.pone.0203316
16. Chester JG, Rudolph JL. Vital signs in older patients: age-related changes. *J Am Med Dir Assoc.* 2011;12(5):337-343. doi:10.1016/j.jamda.2010.04.009
17. Malmer G, Åhlberg R, Svensson P, Af Ugglas B, Westerlund E. Age in addition to RETTS triage priority substantially improves 3-day mortality prediction in emergency department patients: a multi-center cohort study. *Scand J Trauma Resusc Emerg Med.* 2023;31(1):55. doi:10.1186/s13049-023-01123-8
18. Bae SJ, Chung HS, Choi Y, et al. Comparison of early warning scores for predicting outcomes in adult and older patients in emergency department: Multicenter study. *Am J Emerg Med.* 2025;96:91-97. doi:10.1016/j.ajem.2025.06.033
19. Koch DA, Becker L, Schweigkofler U, et al. Undertriage in geriatric trauma: insights from a multicentre cohort study. *Scand J Trauma Resusc Emerg Med.* 2025;33(1):123. doi:10.1186/s13049-025-01432-0
20. Limpawattana P, Phungoen P, Mitsungnern T, Laosuankoon W, Tansangworn N. Atypical presentations of older adults at the emergency department and associated factors. *Arch Gerontol Geriatr.* 2016;62:97-102. doi:10.1016/j.archger.2015.08.016
21. Hofman MR, van den Hanenberg F, Sierevelt IN, Tulner CR. Elderly patients with an atypical presentation of illness in the emergency department. *Neth J Med.* 2017;75(6):241-246.
22. Kurhayati K, Emaliyawati E, Trisyani Y. An Updated Scoping Review of Factors Associated with Length of Stay in Emergency Department. *J Multidiscip Healthc.* 2025;Volume 18:3191-3203. doi:10.2147/JMDH.S525451
23. Elder N, Tyler K, Mumma B, Maeda M, Tancredi D. Emergency Department Length of Stay Is Associated with Delirium in Older Adults. *West J Emerg Med.* 2023;24(3). doi:10.5811/WESTJEM.59383
24. Ma KJ, Hsu YC, Pan WW, Chou MH, Chung W, Wang JY. Effects of emergency department length of stay on inpatient utilization and mortality. *Health Econ Rev.* 2025;15(1):11. doi:10.1186/s13561-025-00598-8

25. Roussel M, Teissandier D, Yordanov Y, et al. Overnight Stay in the Emergency Department and Mortality in Older Patients. *JAMA Intern Med.* 2023;183(12):1378. doi:10.1001/jamainternmed.2023.5961
26. Holtug N. Prioritarianism. In: *Oxford Research Encyclopedia of Politics.* Oxford University Press; 2017. doi:10.1093/acrefore/9780190228637.013.232
27. Ji L, Jazwinski SM, Kim S. Frailty and Biological Age. *Ann Geriatr Med Res.* 2021;25(3):141-149. doi:10.4235/agmr.21.0080
28. Morley JE, Vellas B, Abellan Van Kan G, et al. Frailty Consensus: A Call to Action. *J Am Med Dir Assoc.* 2013;14(6):392-397. doi:10.1016/j.jamda.2013.03.022
29. Dent E, Hanlon P, Kowal P, Hoogendijk EO. Frailty measurement in research and clinical practice: An updated review. *Eur J Intern Med.* Published online November 2025:106595. doi:10.1016/j.ejim.2025.106595
30. Fried LP, Tangen CM, Walston J, et al. Frailty in Older Adults: Evidence for a Phenotype. *J Gerontol A Biol Sci Med Sci.* 2001;56(3):M146-M157. doi:10.1093/gerona/56.3.M146
31. Mitnitski AB, Mogilner AJ, Rockwood K. Accumulation of Deficits as a Proxy Measure of Aging. *Sci World J.* 2001;1:323-336. doi:10.1100/tsw.2001.58
32. Ekram ARMS, Woods RL, Britt C, Espinoza S, Ernst ME, Ryan J. The Association Between Frailty and All-Cause Mortality in Community-Dwelling Older Individuals: An Umbrella Review. *J Frailty Aging.* 2021;10(4):320-326. doi:10.14283/jfa.2021.20
33. Cesari M, Gambassi G, Abellan Van Kan G, Vellas B. The frailty phenotype and the frailty index: different instruments for different purposes. *Age Ageing.* 2014;43(1):10-12. doi:10.1093/ageing/aft160
34. Buta BJ, Walston JD, Godino JG, et al. Frailty assessment instruments: Systematic characterization of the uses and contexts of highly-cited instruments. *Ageing Res Rev.* 2016;26:53-61. doi:https://doi.org/10.1016/j.arr.2015.12.003
35. Deng Y, Sato N. Global frailty screening tools: Review and application of frailty screening tools from 2001 to 2023. *Intractable Rare Dis Res.* 2024;13(1):1-11. doi:10.5582/irdr.2023.01113
36. Lewis ET, Dent E, Alkhouri H, et al. Which frailty scale for patients admitted via Emergency Department? A cohort study. *Arch Gerontol Geriatr.* 2019;80:104-114. doi:10.1016/j.archger.2018.11.002
37. Cesari M, Calvani R, Marzetti E. Frailty in Older Persons. *Clin Geriatr Med.* 2017;33(3):293-303. doi:10.1016/j.cger.2017.02.002

38. Kulminski AM, Ukraintseva SV, Kulminskaya IV, Arbeev KG, Land K, Yashin AI. Cumulative deficits better characterize susceptibility to death in elderly people than phenotypic frailty: lessons from the Cardiovascular Health Study. *J Am Geriatr Soc*. 2008;56(5):898-903. doi:10.1111/j.1532-5415.2008.01656.x
39. Rockwood K, Andrew M, Mitnitski A. A Comparison of Two Approaches to Measuring Frailty in Elderly People. *J Gerontol A Biol Sci Med Sci*. 2007;62(7):738-743. doi:10.1093/gerona/62.7.738
40. Widagdo IS, Pratt N, Russell M, Roughead EE. Predictive performance of four frailty measures in an older Australian population. *Age Ageing*. 2015;44(6):967-972. doi:10.1093/ageing/afv144
41. Rockwood K, Mitnitski A. Frailty in Relation to the Accumulation of Deficits. *J Gerontol A Biol Sci Med Sci*. 2007;62(7):722-727. doi:10.1093/gerona/62.7.722
42. Moloney E, O'Donovan MR, Carpenter CR, et al. Core requirements of frailty screening in the emergency department: an international Delphi consensus study. *Age Ageing*. 2024;53(2):afae013. doi:10.1093/ageing/afae013
43. Falk Erhag H, Guðnadóttir G, Alfredsson J, et al. The Association Between the Clinical Frailty Scale and Adverse Health Outcomes in Older Adults in Acute Clinical Settings – A Systematic Review of the Literature. *Clin Interv Aging*. 2023;Volume 18:249-261. doi:10.2147/CIA.S388160
44. Wolf LA, Lo AX, Serina P, et al. Frailty assessment tools in the emergency department: A geriatric emergency department guidelines 2.0 scoping review. *JACEP Open*. 2024;5(1):e13084. doi:10.1002/emp2.13084
45. Rockwood K. A global clinical measure of fitness and frailty in elderly people. *Can Med Assoc J*. 2005;173(5):489-495. doi:10.1503/cmaj.050051
46. Mendiratta P, Schoo C, Latif R. Clinical Frailty Scale. Published online April 23, 2023. Accessed December 15, 2025. <https://www.ncbi.nlm.nih.gov/books/NBK559009/>
47. Dalhousie University. Clinical Frailty Scale. Accessed May 18, 2023. <https://www.dal.ca/sites/gmr/our-tools/clinical-frailty-scale.html>
48. Church S, Rogers E, Rockwood K, Theou O. A scoping review of the Clinical Frailty Scale. *BMC Geriatr*. 2020;20(1):393. doi:10.1186/s12877-020-01801-7
49. Lin JW, Lin PY, Wang TY, Chen YJ, Yen D, Huang HH. The Association Between Frailty Evaluated by Clinical Frailty Scale and Mortality of Older Patients in the Emergency Department: A Prospective Cohort Study. *Clin Interv Aging*. 2024;Volume 19:1383-1392. doi:10.2147/CIA.S472991

50. Lee JH, Park YS, Kim MJ, et al. Clinical Frailty Scale as a predictor of short-term mortality: A systematic review and meta-analysis of studies on diagnostic test accuracy. *Acad Emerg Med.* 2022;29(11):1347-1356. doi:10.1111/acem.14493
51. 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.* 2022;17(8):2407-2418. doi:10.1007/s11739-022-03042-5
52. Blomaard LC, Mooijaart SP, Bolt S, et al. Feasibility and acceptability of the 'Acutely Presenting Older Patient' screener in routine emergency department care. *Age Ageing.* 2020;49(6):1034-1041. doi:10.1093/ageing/afaa078
53. Liu X, Le MK, Lim AYC, et al. Perspectives on frailty screening, management and its implementation among acute care providers in Singapore: a qualitative study. *BMC Geriatr.* 2022;22(1):58. doi:10.1186/s12877-021-02686-w
54. Kabell Nissen S, Rueegg M, Carpenter CR, et al. Prognosis for older people at presentation to emergency department based on frailty and aggregated vital signs. *J Am Geriatr Soc.* 2023;71(4):1250-1258. doi:10.1111/jgs.18170
55. Elliott A, Phelps K, Regen E, Conroy SP. Identifying frailty in the Emergency Department—feasibility study. *Age Ageing.* 2017;46(5):840-845. doi:10.1093/ageing/afx089
56. Lehto HR, Jain N, Bernacki RE, Landzberg MJ, Desai AS, Orkaby AR. Feasibility of frailty screening among patients with advanced heart failure. *BMJ Open Qual.* 2023;12(4):e002430. doi:10.1136/bmjopen-2023-002430
57. Ellis HL, Dunnell L, Eyres R, et al. What can we learn from 68 000 clinical frailty scale scores? Evaluating the utility of frailty assessment in emergency departments. *Age Ageing.* 2025;54(4):afaf093. doi:10.1093/ageing/afaf093
58. Elliott A, Hull L, Conroy SP. Frailty identification in the emergency department—a systematic review focussing on feasibility. *Age Ageing.* 2017;46(3):509-513. doi:10.1093/ageing/afx019
59. Knight T, Atkin C, Martin FC, et al. Frailty assessment and acute frailty service provision in the UK: results of a national 'day of care' survey. *BMC Geriatr.* 2022;22(1):19. doi:10.1186/s12877-021-02679-9
60. Moorhouse P, Rockwood K. Frailty and its quantitative clinical evaluation. *J R Coll Physicians Edinb.* 2012;42(4):333-340. doi:10.4997/JRCPE.2012.412
61. Bowen DJ, Kreuter M, Spring B, et al. How We Design Feasibility Studies. *Am J Prev Med.* 2009;36(5):452-457. doi:10.1016/j.amepre.2009.02.002

- 62.Çorbacioğlu ŞK, Aksel G. Receiver operating characteristic curve analysis in diagnostic accuracy studies: A guide to interpreting the area under the curve value. *Turk J Emerg Med.* 2023;23(4):195-198. doi:10.4103/tjem.tjem_182_23
- 63.Hsieh HF, Shannon SE. Three Approaches to Qualitative Content Analysis. *Qual Health Res.* 2005;15(9):1277-1288. doi:10.1177/1049732305276687
- 64.Ahmed SK. The pillars of trustworthiness in qualitative research. *J Med Surg Public Health.* 2024;2:100051. doi:https://doi.org/10.1016/j.glmedi.2024.100051
- 65.Braun V, Clarke V. One size fits all? What counts as quality practice in (reflexive) thematic analysis? *Qual Res Psychol.* 2021;18(3):328-352. doi:10.1080/14780887.2020.1769238
- 66.Van Dam CS, Peters MJL, Hoogendijk EO, Nanayakkara PWB, Muller M, Trappenburg MC. Older patients with nonspecific complaints at the Emergency Department are at risk of adverse health outcomes. *Eur J Intern Med.* 2023;112:86-92. doi:10.1016/j.ejim.2023.03.018
- 67.Ellis HL, Wan B, Yeung M, et al. Complementing chronic frailty assessment at hospital admission with an electronic frailty index (FI-Laboratory) comprising routine blood test results. *CMAJ Can Med Assoc J J Assoc Medicale Can.* 2020;192(1):E3-E8. doi:10.1503/cmaj.190952
- 68.Chua XY, Toh S, Wei K, Teo N, Tang T, Wee SL. Evaluation of clinical frailty screening in geriatric acute care. *J Eval Clin Pract.* 2020;26(1):35-41. doi:10.1111/jep.13096
- 69.Taş GN, Pekdemir M, Özturan İU, Doğan NÖ, Yaka E, Yılmaz S. Evaluating the Prognostic Value of Adding Frailty to Triage Assessment in Elderly Patients With Lower Acuity Presentations in the Emergency Department. *J Emerg Med.* 2025;73:1-11. doi:10.1016/j.jemermed.2024.12.005
- 70.Hörlin E, Munir Ehrlington S, Henricson J, John RT, Wilhelms D. Inter-rater reliability of the Clinical Frailty Scale by staff members in a Swedish emergency department setting. *Acad Emerg Med.* 2022;29(12):1431-1437. doi:10.1111/acem.14603
- 71.Chung HS, Choi Y, Lim JY, et al. The clinical frailty scale improves risk prediction in older emergency department patients: a comparison with qSOFA, NEWS2, and REMS. *Sci Rep.* 2025;15(1):12584. doi:10.1038/s41598-025-97764-z
- 72.Ng CJ, Chien LT, Huang CH, et al. Integrating the clinical frailty scale with emergency department triage systems for elder patients: A prospective study. *Am J Emerg Med.* 2023;66:16-21. doi:10.1016/j.ajem.2023.01.002
- 73.Walker E, Winter R, Hodgson LE. Frailty in older adults admitted to hospital: a six-year dual-centre retrospective study of over 53 000 clinical frailty scale assessments. *Age Ageing.* 2025;54(6):afaf137. doi:10.1093/ageing/afaf137

74. Ku NW, Hsu YC, Mudhur J, et al. The Prognostic Accuracy of Frailty and Vulnerability Screening for Older Adults in the Emergency Department: A Systematic Review and Meta-analysis. *Ann Emerg Med.* 2025;86(5):496-510. doi:10.1016/j.annemergmed.2025.05.018
75. Braude P, Lewis EG, Broach Kc S, et al. Frailism: a scoping review exploring discrimination against people living with frailty. *Lancet Healthy Longev.* 2025;6(1):100651. doi:10.1016/j.lanhl.2024.100651
76. Ayoubian A, Nasiripour AA, Tabibi SJ, Bahadori M. Evaluation of Facilitators and Barriers to Implementing Evidence-Based Practice in the Health Services: A Systematic Review. *Galen Med J.* 2020;9:e1645. doi:10.31661/gmj.v9i0.1645
77. Man-Son-Hing M, Laupacis A, O'Rourke K, et al. Determination of the clinical importance of study results: A review. *J Gen Intern Med.* 2002;17(6):469-476. doi:10.1046/j.1525-1497.2002.11111.x
78. Bourriquen M, Couderc AL, Bretelle F, Villani P. Effect of frailty on unplanned readmission in older adults: A systematic review. *J Epidemiol Popul Health.* 2024;72(5):202774. doi:10.1016/j.jep.2024.202774
79. Johansson H, Fahlander S, Hörlin E, et al. Revisits and frailty in older patients in the emergency department - a prospective observational multicenter study. *BMC Emerg Med.* 2024;24(1):205. doi:10.1186/s12873-024-01123-6
80. Alakare J, Kemp K, Strandberg T, et al. Systematic geriatric assessment for older patients with frailty in the emergency department: a randomised controlled trial. *BMC Geriatr.* 2021;21(1):408. doi:10.1186/s12877-021-02351-2
81. Fernández-Montalbán P, Martínez-Flores S, Mir-Montero M, Arribas López JR, Bibiano-Guillén C, Brañas F. Impact of a geriatric intervention based on the Comprehensive Geriatrics Assessment on avoidable admissions in older patients at risk evaluated in the Emergency Department. *Rev Esp Geriatria Gerontol.* 2024;59(5):101512. doi:10.1016/j.regg.2024.101512
82. Chong E, Zhu B, Tan H, et al. Emergency Department Interventions for Frailty (EDIFY): Front-Door Geriatric Care Can Reduce Acute Admissions. *J Am Med Dir Assoc.* 2021;22(4):923-928.e5. doi:10.1016/j.jamda.2021.01.083
83. Warnock C, Ulman J, Skilbeck J, Tod A. Patient and staff perspectives on the concept of frailty and its role in assessment and decision making in treatment for older people with lung cancer. *Eur J Oncol Nurs.* 2024;71:102611. doi:10.1016/j.ejon.2024.102611
84. Manuel K, Crotty M, Kurrle SE, et al. Hospital-Based Health Professionals' Perceptions of Frailty in Older People. Roberts TJ, ed. *The Gerontologist.* 2024;64(7):gnae041. doi:10.1093/geront/gnae041

85. Archibald MM, Lawless MT, Ambagtsheer RC, Kitson AL. Understanding consumer perceptions of frailty screening to inform knowledge translation and health service improvements. *Age Ageing*. 2021;50(1):227-232. doi:10.1093/ageing/afaa187
86. Shafiq S, Haith-Cooper M, Hawkins R, Parveen S. What are lay UK public perceptions of frailty: a scoping review. *Age Ageing*. 2023;52(4):afad045. doi:10.1093/ageing/afad045
87. Van Oppen JD, Coats TJ, Conroy SP, et al. What matters most in acute care: an interview study with older people living with frailty. *BMC Geriatr*. 2022;22(1):156. doi:10.1186/s12877-022-02798-x
88. Griese JA, Ünlü L, Van Oppen J, et al. Assessing what matters most in older emergency department patients. *Age Ageing*. 2025;54(11):afaf334. doi:10.1093/ageing/afaf334
89. Ouchi K, George N, Schuur JD, et al. Goals-of-Care Conversations for Older Adults With Serious Illness in the Emergency Department: Challenges and Opportunities. *Ann Emerg Med*. 2019;74(2):276-284. doi:10.1016/j.annemergmed.2019.01.003
90. Swenson A, Hyde R. Understanding patients' end-of-life goals of care in the emergency department. *J Am Coll Emerg Physicians Open*. 2021;2(2):e12388. doi:10.1002/emp2.12388
91. Kondo M, Stothard C, Nair S, et al. 1998 Advance care planning on the Same Day Emergency Care Older People's Unit - a quality improvement initiative. *Age Ageing*. 2024;53(Supplement_1):afad246.055. doi:10.1093/ageing/afad246.055
92. Ablaihed L, Barrueto F, Pimentel L, Comer A, Browne BJ, Hirshon JM. 8 High Risk Care Plans Effectively Decrease Emergency Department Resource Utilization. *Ann Emerg Med*. 2014;64(4):S4. doi:10.1016/j.annemergmed.2014.07.033
93. Weber V, Hübner A, Pflock S, et al. Advance directives in the emergency department - a systematic review of the status quo. *BMC Health Serv Res*. 2024;24(1):426. doi:10.1186/s12913-024-10819-1
94. Asiaban JN, Patel S, Ormseth CH, et al. Advance Care Planning Among Patients With Advanced Illness Presenting to the Emergency Department. *J Emerg Med*. 2023;64(4):476-480. doi:10.1016/j.jemermed.2022.12.011
95. Searle B, Barker RO, Stow D, Spiers GF, Pearson F, Hanratty B. Which interventions are effective at decreasing or increasing emergency department attendances or hospital admissions from long-term care facilities? A systematic review. *BMJ Open*. 2023;13(2):e064914. doi:10.1136/bmjopen-2022-064914
96. Visade F, Prod'homme C, Beuscart JB. Hospital readmissions of frail older individuals: the challenge of anticipating end-of-life care. *Front Med*. 2025;12:1624555. doi:10.3389/fmed.2025.1624555

97. Anderson C. Presenting and evaluating qualitative research. *Am J Pharm Educ.* 2010;74(8):141. doi:10.5688/aj7408141

98. Hörlin E, Ekermo D, Wilhelms D, Eldh AC. Being screened for frailty in the emergency department: the voice of patients in an exploratory qualitative study. *BMC Geriatr.* Published online January 16, 2026. doi:10.1186/s12877-026-06990-1

PAPER I



OPEN ACCESS

Frailty is associated with 30-day mortality: a multicentre study of Swedish emergency departments

Samia Munir Ehrlington , Erika Hörlin, Rani Toll John, Jens Wretborn, Daniel Wilhelms

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Emergency Department, Linköping University Hospital, Linköping, Östergötland, Sweden

Correspondence to Dr Samia Munir Ehrlington; samia.munir.ehrlington@regionostergotland.se

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ABSTRACT

Background Older patients living with frailty have an increased risk for adverse events. The Clinical Frailty Scale (CFS) is a 9-point frailty assessment instrument that has shown promise to identify frail emergency department (ED) patients at increased risk of adverse outcomes.

The aim of this study was to investigate the association between CFS scores and 30-day mortality in an ED setting when assessments are made by regular ED staff.

Method This was a prospective multicentre observational study carried out between May and November 2021 at three EDs in Sweden, where frailty via CFS is routinely assessed by ED staff. All patients ≥ 65 years of age were eligible for inclusion. Mortality at 7, 30 and 90 days, admission rate, ED and hospital length of stay (LOS) were compared between patients living with frailty (CFS ≥ 5) and robust patients. Logistic regression was used to adjust for confounders.

Results A total of 1840 ED visits of patients aged ≥ 65 years with CFS assessments done during the study period were analysed, of which 606 (32.9%) were patients living with frailty. Mortality after the index visit was higher in patients living with frailty at 7 days (2.6% vs 0.2%), 30 days (7.9% vs 0.9%) and 90 days (15.5% vs 2.4%). Adjusted ORs for mortality for those with frailty compared with more robust patients were 9.9 (95% CI 2.1 to 46.5) for 7-day, 6.0 (95% CI 3.0 to 12.2) for 30-day and 5.7 (95% CI 3.6 to 9.1) 90-day mortality. Patients living with frailty had higher admission rates, 58% versus 36%, a difference of 22% (95% CI 17% to 26%), longer ED LOS, 5 hours:08 min versus 4 hours:36 min, a difference of 31 min (95% CI 14 to 50), and longer in-hospital LOS, 4.8 days versus 2.7 days, a difference of 2.2 days (95% CI 1.2 to 3.0).

Conclusion Patients living with frailty, had significantly higher mortality and admission rates as well as longer ED and in-hospital LOS compared with robust patients. The results confirm the capability of the CFS to risk stratify short-term mortality in older ED patients.

Trial registration number NCT04877028.

BACKGROUND

Worldwide, the proportion of adults aged over 65 is expected to increase from 8.5% in 2015 to nearly 25% by 2050.¹ This demographic shift affects all parts of the healthcare system, including the emergency department (ED). In the ED, increased numbers of older patients with extensive medical histories and a need for functional support, known as a syndrome of frailty, pose complex challenges.² Frail individuals are in a state of vulnerability and carry an increased risk for adverse events,

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Assessed frailty has been associated with adverse outcomes in various settings. However, frailty assessments have primarily been made by research personnel. There has been no multicentre evaluation of whether Clinical Frailty Scale (CFS) assessment, conducted exclusively by emergency department (ED) personnel as part of their clinical work, is associated with adverse events in non-selected ED patients.

WHAT THIS STUDY ADDS

⇒ This prospective observational study was conducted in three emergency departments in Sweden where staff routinely assess CFS. Frailty (CFS ≥ 5) was associated with increased mortality at 7, 30 and 90 days, higher admission rates and longer ED and hospital length of stay compared with robust patients.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Frailty assessments made by ED personnel can identify those at higher risk of poor outcomes, and could be used to enable more appropriate and individualised interventions.

including falls or other accidents, hospitalisation and mortality.³ Unfortunately, many EDs fail to identify and address the specific needs of patients living with frailty.⁴ Importantly, chronological age is not necessarily accompanied by frailty;⁵ therefore, identification of older patients at risk of adverse events based on frailty assessment is an appealing concept to guide ED care and resource utilisation. Robust older patients may tolerate, and benefit from, advanced medical interventions, while care for those living with severe frailty may focus more on improving the quality of life.⁶

Out of the many existing tools for frailty assessment,⁷ the Clinical Frailty Scale (CFS)⁸ has been recommended for use in the ED due to its practicality in a busy environment.⁹ The CFS was developed to screen for frailty in patients ≥ 65 years of age and assess the patient's morbidity, cognitive status and functional level in daily life. The scale ranges from 1 point (very fit) to 9 points (terminally ill). The cut-off for frailty was set at 5 points;⁸ those with a CFS ≥ 5 points are considered frail.¹⁰ Further, a stepwise increase in the risk of 1-year mortality



for each additional frailty level on the CFS has been shown in ED patients,¹¹ but, there is no data on whether, compared with dichotomisation, the CFS score further differentiates patients regarding short-term mortality.

The ability of the CFS to determine which ED patients are most likely to have poor outcomes has previously been investigated. However, these studies have largely only investigated specific patient groups.¹² In studies with non-selected patients, the assessors of frailty have primarily been research personnel;^{9,13,14} this methodology could affect the generalisability of the results to routine clinical practice. The two pre-existing studies where ED staff exclusively performed the frailty assessments were both single-centre with one of the studies focusing specifically on a patient group living with frailty under low socioeconomic circumstances.^{15,16}

This multicentre study determined whether there is an association between CFS, as assessed by regular ED staff in a non-select population of patients of older age with short and long-term mortality, hospital admission and ED length of stay (LOS).

MATERIALS AND METHODS

Study design and setting

This was a prospective multicentre study carried out in three Swedish EDs: Linköping ED (university hospital), Norrköping ED (urban community hospital) and Motala ED (rural community hospital). Annual visits in Linköping and Norrköping are approximately 50 000 each while Motala has around 25 000. The collection period was May/June in Linköping, and October/November in Norrköping and Motala.

The council of Region Östergötland in Sweden had previously decided to implement CFS for clinical use, and the instrument had recently been introduced in the participating EDs. During the year leading up to the introduction and study start, all clinical staff at the included EDs, that is, physicians, registered nurses and assistant nurses, were encouraged to complete an e-learning educational course on the CFS as part of their continuing medical education. The content of the course was based on the online training module developed by the Aging Innovation in perioperative Medicine & Surgery (AIMS) research group at Ottawa Hospital, Canada.¹⁷ Three clinical vignettes were included, along with the basic theoretical concept of frailty and its consequences for patients' health and function. Staff began performing the CFS assessments and collecting the data on a worksheet at the start of the study period.

The study was registered on ClinicalTrials.gov.

Selection of participants

Patients ≥ 65 years of age were eligible for the study and included if the data collection worksheet was complete.

Methods of measurement

A worksheet (online supplemental appendix 1) was added to the ED records for all patients ≥ 65 years old when admitted to the ED. The CFS assessments were performed at all hours and were done by one of the members of the clinical team responsible for the patient (typically a physician, registered nurse or assistant nurse) and could be carried out at any time during the patient's stay in the ED. The CFS assessment date, the patient's social security number and the clinical role of the assessor were all compulsory fields on the assessment sheet for the patient's inclusion in the study. A member of the research team manually collected and reviewed the worksheets. If the worksheet was incomplete, the patient was excluded from the study.

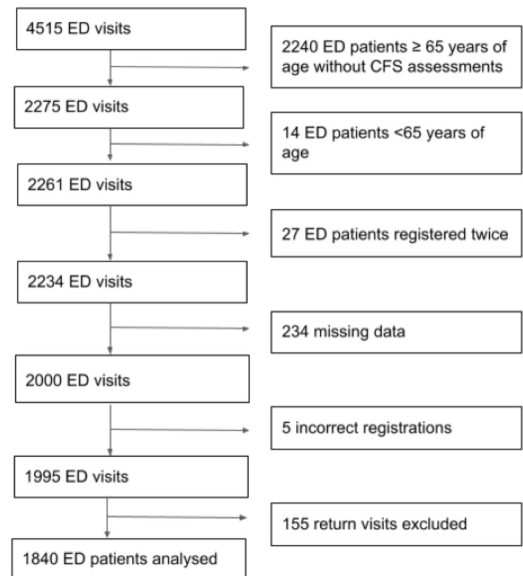


Figure 1 Flowchart describing the inclusion process. CFS, Clinical Frailty Scale; ED, emergency department.

We used the validated Swedish version of the CFS (CFS-9),¹⁸ and included the pictograms from the original version.¹⁹ Inter-rater reliability (IRR) was not assessed in this study, but our group has previously evaluated CFS and shown 'good' IRR.²⁰

As the assessment was part of clinical care, staff had access to standard clinical information (eg, patient, relative or caregiver, and notes from the electronic medical records) and were allowed to discuss the CFS score within the treatment team.

The worksheets were stored in a locked space without access for unauthorised personnel and the digital data recorded from the documents were kept in a protected network storage space.

Outcome measures

The primary outcome was 30-day mortality. Secondary outcomes were 7-day and 90-day mortality, hospital admission and LOS in the ED and hospital.

Statistical analysis

The sample size was estimated prior to data collection using G*Power.²¹ The calculation assumed a 90-day mortality of 12% in patients living with frailty (defined as CFS ≥ 5) and 8% in robust patients ≥ 65 years, based on an overall mortality of 10% at 90 days in patients ≥ 65 years (calculated from the Swedish Emergency Care Register). With a 95% CI, a power of 0.8, and a 10% margin to account for exclusions, loss to follow-up etc, a sample size of at least 1800 patients was required.

Outcome data based on the patient's social security number was exported after all patients completed the follow-up period, from the electronic health records, which crosslinks mortality data from the national patient registry. The study cohort was divided into living with frailty (CFS ≥ 5) or robust (CFS < 5). Descriptive statistics were reported as medians for continuous variables and percentages for categorical variables. Mortality risk and hospital admission were analysed using logistic regression

Table 1 Descriptive characteristics of the study cohort

	Robust (CFS<5)	Living with frailty (CFS≥5)
n	1234	606
Age, median (IQR)	76 (71–82)	83 (77–89)
Women (%)	642 (52)	364 (60)
CFS, median (IQR)	3 (2–4)	6 (5–7)
Mode of arrival		
Ambulance	513 (41.5%)	463 (76.4%)
Walk-in	692 (56.1%)	128 (21.1%)
Recumbent patient transport	9 (0.7%)	10 (1.7%)
Other	2 (0.2%)	–
Missing data:	18 (1.5%)	5 (0.8%)
Triage category		
1 (immediate)	50 (4%)	57 (9.4%)
2 (very urgent)	347 (28%)	234 (38.6%)
3 (urgent)	633 (51.3%)	257 (42.4%)
4 (non-urgent)	203 (16.5%)	56 (9.2%)
Missing data	1 (0.08%)	2 (0.17%)
ED discharge diagnosis		
Injury*	250 (20.3%)	141 (23.3%)
Fever	28 (2.3%)	33 (5.5%)
Dyspnoea	46 (3.7%)	28 (4.6%)
Chest pain	91 (7.4%)	29 (4.8%)
Abdominal pain	61 (4.9%)	17 (2.8%)
Pneumonia	14 (1.1%)	14 (2.3%)
Heart failure	17 (1.4%)	19 (3.1%)
Vertigo	49 (4.0%)	18 (3.0%)
Syncope	22 (1.8%)	10 (1.7%)
Disorientation	4 (0.3%)	11 (1.8%)
Fatigue	11 (0.9%)	12 (2.0%)
Other	640 (51.9%)	273 (45.1%)

CFS, Clinical Frailty Scale; ED, emergency department.

with and without adjusting predefined confounders; age (continuous), sex (male or female), mode of arrival (ambulance/recumbent patient transport or walk-in) and acuity (1 through 4, with 1 being immediate) based on the Rapid Emergency Triage and Treatment System triage system used in all three EDs.²² The mortality risk is reported as ORs for living with frailty versus robust (1 df) and in a secondary analysis for each score of the scale (8 df).

The association between frailty and LOS in the ED and hospital, treated as medians, was assessed with frailty as a dichotomous variable using the Mann-Whitney U test. CIs for LOS were estimated using bootstrapping with replacement for 1000 iterations. A *p* value <0.05 with a 95% CI not crossing 1 was classified as statistically significant for the main analysis. In the secondary multivariate analysis, when adjusting for confounders, a *p* value <0.003 was classified as statistically significant to account for multiple comparisons based on a Bonferroni correction of *m* = 15. Data was imported into Pandas (V.0.23)²³ and analysed with Python using the Scipy library (V.1.17)²⁴ and the Statsmodels library (V.0.12).²⁵

Patient and public involvement

Patients were not involved in the planning of this study.

RESULTS

Characteristics of the study subjects

There were 2275 ED visits with CFS assessments during the study period. Of these, 435 were excluded, leaving 1840 index visits eligible for analysis (figure 1). The main reasons for exclusion were missing data (234) or return visits (155). Most assessments were made by nurses or assistant nurses (53.5% and 43.0%, respectively), with 3.4% by physicians.

The median age of the study cohort was 78 (IQR 73–85), and 54.6% were women. During the study period, an additional 2240 visits by patients ≥65 years of age were registered at the EDs but were not assessed for CFS. The eligible but missed patients had a median age of 76 (71–82), and 51% were women.

Of the 1840 patients, 606 (32.9%) were living with frailty. Patients living with frailty were older (mean age 83 years vs 76 years in robust patients), higher proportion arrived by ambulance (76.4% vs 41.5%) (table 1). A higher proportion of patients living with frailty had triage levels 1 (immediate) and 2 (very urgent) compared with robust patients.

Main results

Mortality

All patients in the cohort had follow-up until 90 days. The crude 30-day mortality was 3.2%; no patients died during the ED stay. Mortality at 30 days was significantly higher in patients living with frailty compared with robust patients: 7.9% versus 0.9% (diff 7%, 95% CI for the difference 4.8% to 9.2%), as well as at 7 and 90 days (table 2). The unadjusted ORs for mortality in patients living with frailty compared with robust patients were 16.7 (95% CI 3.8 to 72.9), 9.6 (95% CI 4.9 to 18.6) and 7.6 (95% CI 5.0 to 11.7) for 7-day, 30-day and 90-day mortality, respectively. The increased risk persisted after adjusting for confounders, with ORs of 10.7 (95% CI 2.3 to 50.5), 6.0 (95% CI 3.0 to 12.3) and 6 (95% CI 3.6 to 9.1) for 7-day, 30-day and 90-day mortality, respectively (table 3). The OR for 30-day mortality increased by 2.1 (95% CI 1.7 to 2.4, *p*<0.001), with each additional step in CFS, in the regression analysis (figure 2).

Admission and length of stay

The overall admission rate was 43.5% in the cohort. Patients living with frailty had significantly higher admission rates compared with robust patients (58% vs 36%, diff 22%, 95% CI 17% to 26%) with an unadjusted OR of 2.4 (95% CI 2.0 to 3.0) (table 2). Patients living with frailty had a higher admission rate and longer lengths of ED and hospital stay (figure 3A,B).

Patients living with frailty had longer ED LOS and hospital LOS compared with robust patients (table 2).

DISCUSSION

In this multicentre study conducted in three EDs in Sweden, patients living with frailty (CFS≥5) had a significantly higher risk of death at 7, 30 and 90 days compared with robust patients. Patients living with frailty also had a higher admission rate and longer lengths of ED and hospital stay. These results are in line with previous data when trained research personnel assessed frailty^{14,26} and confirm that frailty assessments can be made by regular ED staff.

The ORs for mortality changed little when adjusting for confounding predictors of death, like triage acuity, arrival by ambulance and age. This suggests that CFS carries prognostic information beyond common indicators for worse outcomes and may be missed if not considered. Furthermore, the mortality risk increased with the CFS score. Hence, the concept of frailty, using

Table 2 Mortality, admission and ED and in-hospital length of stay

	Robust (CFS<5) n=1234	Living with frailty (CFS≥5) n=606	Difference (95% CI)	Unadjusted OR (95% CI)	P value
Mortality					
7 days	2 (0.16%)	16 (2.6%)	2.4% (1.2% to 3.8%)	16.7 (3.8 to 72.9)	<0.001*
30 days	11 (0.9%)	48 (7.9%)	7% (4.8% to 9.2%)	9.6 (4.9 to 18.6)	<0.001*
90 days	29 (2.4%)	94 (15.5%)	13.1% (10.2% to 16.2%)	7.6 (5 to 11.7)	<0.001*
Admission	448 (36%)	352 (58%)	22% (17% to 26%)	2.4 (2.0 to 3.0)	<0.001*
ED length of stay in hours and minutes, median (IQR)	4 hours:36 min (3 hours:04 min – 6 hours:17 min)	5 hours:08 min (3 hours:40 min – 6 hours:45 min)	31 min (14–50)	–	<0.001†
Hospital length of stay in days (median, IQR)	2.7 days (1.2–5.1 days)	4.8 days (1.9–8.8 days)	2.2 days (1.2–3.0)	–	<0.001†

*Regression analysis.
†Mann-Whitney U test.
CFS, Clinical Frailty Scale; ED, emergency department.

the CFS, are potentially useful tools to risk-stratify older patients in the ED that current triage tools may miss. This has been investigated in a study from Taiwan where Ng *et al* found the risk of undertriage in older adults in the ED decreased when incorporating CFS into the triage assessment.²³ Kaeppli *et al* also found that CFS outperformed the Emergency Severity Index model in predicting 30-day mortality.²⁶

A considerable proportion of the observed mortality is likely to be non-preventable.²⁴ Therefore, interventions implemented based on frailty should not mainly aim to prevent death but to possibly preserve function and improve quality of life. Higher frailty scores could point out the need for Comprehensive Geriatric Assessment (CGA) in the ED, which assesses fall risk more accurately²⁵ and has been shown to reduce the progress of frailty through early initiation of rehabilitation.²⁷ Early identification of the ED patients with the highest risk of mortality, may allow ED staff to prioritise establishing realistic goals of care and avoid possible over-investigation and inappropriate interventions²⁸ and perhaps also earlier initiation of medical workup.

Further research should focus on investigating ways to decrease barriers to frailty assessments, possible interventions in the ED to improve the quality of care for older patients living with frailty and potential interventions to reduce 'avoidable' mortality, possibly by targeting high-risk older patients by means of adding frailty assessment to triage scores.

Limitations

Although 50% of eligible patients arriving during the study period did not have a CFS, the completion rate of assessment (50%) compares well to previous feasibility studies.²⁹ We previously found that high workload, critical illness and simply forgetting to do the assessment were the most common reasons patients were not assessed.³⁰ There may also be selective recruiting by staff. In this study, eligible but not assessed patients had a slightly lower mean age, similar to the age of robust patients. Staff may be less inclined to include younger or robust-appearing patients as the intention of the CFS is to identify frailty rather than robustness. Since the majority of included patients were robust, including more robust-appearing patients might have affected the overall mortality rate, but not the difference between groups.

The mortality rate was lower compared with the estimated rates in the sample size calculation. However, the difference between the groups was also larger than expected, and so the net effect on the power of the study was negligible.

We did not collect data on staff experience with the CFS prior to our study, and we did not have an expert reference for the assessments, which could affect the validity and reproducibility of CFS scores. However, the aim of this study was to investigate the association of CFS with adverse outcomes in a clinical ED setting where the amount of staff training familiarity, and awareness of specific procedures will inevitably vary.

Table 3 Multivariate logistic regression results for mortality

Mortality	7-day n=16 Follow-up 100%		30-day n=48 Follow-up 100%		90-day n=94 Follow-up 100%	
	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Acuity						
1	2.9 (1.0 to 8.8)*	0.06	4.9 (1.3 to 19.3)	0.02	2.7 (1.2 to 6.2)	0.02
2			2.5 (0.7 to 8.6)	0.2	1.3 (0.6 to 2.6)	0.5
3	Referent		1.2 (0.3 to 4.2)	0.8	0.8 (0.4 to 1.6)	0.5
4			Referent		Referent	
CFS≥5	10.7 (2.3 to 50.5)	0.003	6.0 (3.0 to 12.3)	<0.001	6 (3.6 to 9.1)	<0.001
Age	1.1 (1.0 to 1.1)	0.1	1.04 (1.0 to 1.1)	0.02	1.03 (1.0 to 1.1)	0.05
Arrival by ambulance	1.2 (0.3 to 4.8)	0.8	1.5 (0.7 to 3.3)	0.3	1.4 (0.9 to 2.4)	0.2
Sex	2.01 (0.77 to 5.22)	0.2	1.6 (0.9 to 2.7)	0.1	1.6 (1.1 to 2.4)	0.01

*Acuity levels combined due to few outcomes for 7-day mortality.
CFS, Clinical Frailty Scale.

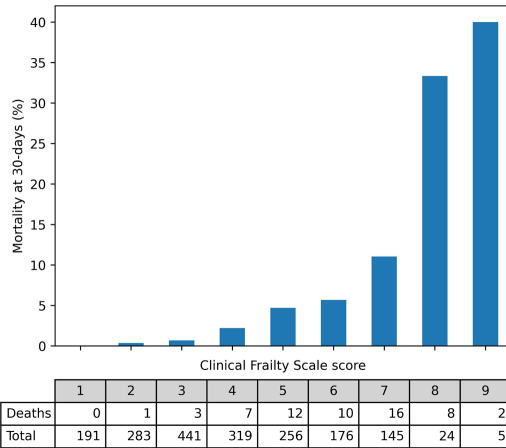


Figure 2 Mortality for each Clinical Frailty Scale score at 30 days.

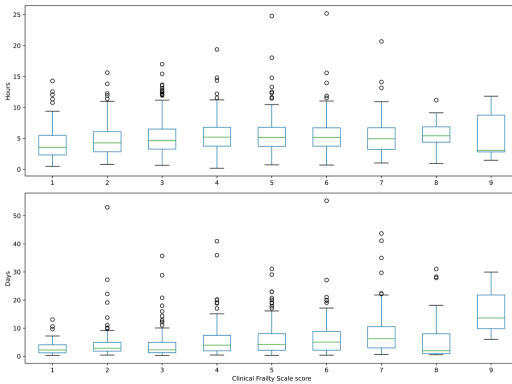


Figure 3 (A) Emergency department length of stay in hours by CFS score; (B) Hospital length of stay in days by CFS score, of all admitted patients in the study cohort. CFS, Clinical Frailty Scale.

The CFS assessment was not done at a prespecified time in the ED. If completed prior to admission, the CFS could have potentially affected the admission decision. However, the CFS was not a routine part of the admission process before or during the study and the overall admission rate in the study did not differ from the historical admission rate in this patient group which indicates little or no impact.

CONCLUSION

In this multicentre study from Sweden, patients living with frailty, as assessed with CFS by ED providers, had notably higher hospital, 7-day and 30-day mortality. The rate of admission and ED and in-hospital LOS were also higher compared with robust patients. This suggests that frailty can be assessed routinely in the ED and may be a useful additional tool in risk-stratifying patients.

Correction notice In September 2024, this paper was resupplied under a CC-BY open access licence.

Contributors SME and DW conceived and designed the study. DW, RTJ, EH and SME obtained permits. EH, RTJ and SME conducted the data collection. SME and JW analysed the data. SME and JW drafted the manuscript. DW, EH and RTJ contributed to its revision. DW acted as guarantor.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Name of the Ethics Committee: Swedish Ethical Review Authority. Reference no: 2021-00875. Informed consent was waived by the Ethical Review Authority as Clinical Frailty Scale assessment already was introduced into clinical routine.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. There is no plan to share individual participant data. Personal data related to this study is available upon request. Electronic data is stored in a protected network storage space. The worksheets are stored in a locked space without access for unauthorised personnel.

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ORCID iD

Samia Munir Ehrlington <http://orcid.org/0000-0001-6769-106X>

REFERENCES

- He W, Goodkind D, Kowal P. *An aging World: 2015*. National Institute on Aging, 2016.
- Samaras N, Chevalley T, Samaras D, et al. Older patients in the emergency department: a review. *Ann Emerg Med* 2010;56:261–9.
- Xue QL. The frailty syndrome: definition and natural history. *Clin Geriatr Med* 2011;27:1–15.
- Shankar KN, Magauran BG, Kahn JH. Geriatric emergencies. *Emerg Med Clin North Am* 2016;34:xvii–xviii.
- Khan KT, Hemati K, Donovan AL. Geriatric physiology and the frailty syndrome. *Anesthesiol Clin* 2019;37:453–74.
- Cesari M, Calvani R, Marzetti E. Frailty in older persons. *Clin Geriatr Med* 2017;33:293–303.
- Theou O, Campbell S, Malone ML, et al. Older adults in the emergency department with frailty. *Clin Geriatr Med* 2018;34:369–86.
- Rockwood K. A global clinical measure of fitness and frailty in elderly people. *Can Med Assoc J* 2005;173:489–95.
- Lewis ET, Dent E, Alkhouiri H, et al. Which frailty scale for patients admitted via emergency department? A cohort study. *Arch Gerontol Geriatr* 2019;80:104–14.
- Church S, Rogers E, Rockwood K, et al. A scoping review of the clinical frailty scale. *BMC Geriatr* 2020;20:393.
- Rueegg M, Nissen SK, Brabrand M, et al. The clinical frailty scale predicts 1-year mortality in emergency department patients aged 65 years and older. *Acad Emerg Med* 2022;29:572–80.
- Fehlmann CA, Nickel CH, Cino E, et al. Frailty assessment in emergency medicine using the clinical frailty scale: a scoping review. *Intern Emerg Med* 2022;17:2407–18.
- Falk Erhag H, Guðnadóttir G, Alfredsson J, et al. The association between the clinical frailty scale and adverse health outcomes in older adults in acute clinical settings - a systematic review of the literature. *Clin Interv Aging* 2023;18:249–61.
- Cardona M, O'Sullivan M, Lewis ET, et al. Prospective validation of a checklist to predict short-term death in older patients after emergency department admission in Australia and Ireland. *Acad Emerg Med* 2019;26:610–20.
- Clark S, Shaw C, Padayachee A, et al. Frailty and hospital outcomes within a low socioeconomic population. *QJM* 2019;112:907–13.

- 16 Elliott A, Taub N, Banerjee J, et al. Does the clinical frailty scale at triage predict outcomes from emergency care for older people? *Ann Emerg Med* 2021;77:620–7.
- 17 AIMS. Clinical frailty scale (CFS) training module. n.d. Available: <https://rise.articulate.com/share/deb4rT02lvONbq4AfcMNRUudcd6QMts3#/>
- 18 Ekerstad N. Clinical frailty scale. 2017. Available: <https://janusinfo.se/download/18.54c15e0616f53615ae5882fd/1578400633984/Clinical-Frailty-Scale-svensk.pdf>
- 19 Dalhousie University. Clinical frailty scale. 2023. Available: <https://www.dal.ca/sites/gmr/our-tools/clinical-frailty-scale.html>
- 20 Hörlin E, Munir Ehrlington S, Henricson J, et al. Inter-rater reliability of the clinical frailty scale by staff members in a Swedish emergency department setting. *Acad Emerg Med* 2022;29:1431–7.
- 21 Faul F, Erdfelder E, Lang AG, et al. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods* 2007;39:175–91.
- 22 Widgren BR, Jourak M. Medical emergency triage and treatment system (METTS): a new protocol in primary triage and secondary priority decision in emergency medicine. *J Emerg Med* 2011;40:623–8.
- 23 Ng C-J, Chien L-T, Huang C-H, et al. Integrating the clinical frailty scale with emergency department triage systems for elder patients: a prospective study. *Am J Emerg Med* 2023;66:16–21.
- 24 Goodacre S. Using clinical risk models to predict outcomes: what are we predicting and why? *Emerg Med J* 2023;40:728–30.
- 25 Appeadu MK, Bordonni B. *Falls and fall prevention in older adults*. Treasure Island, FL: StatPearls Publ, 2023.
- 26 Kaeppli T, Rueegg M, Dreher-Hummel T, et al. Validation of the clinical frailty scale for prediction of thirty-day mortality in the emergency department. *Ann Emerg Med* 2020;76:291–300.
- 27 Ekerstad N, Dahlin Ivanoff S, Landahl S, et al. Acute care of severely frail elderly patients in a CGA-unit is associated with less functional decline than conventional acute care. *Clin Interv Aging* 2017;12:1239–49.
- 28 Hogervorst VM, Buurman BM, De Jonghe A, et al. Emergency department management of older people living with frailty: a guide for emergency practitioners. *Emerg Med J* 2021;38:724–9.
- 29 Elliott A, Hull L, Conroy SP. Frailty identification in the emergency department—a systematic review focussing on feasibility. *Age Ageing* 2017;46:509–13.
- 30 Hörlin E, Munir Ehrlington S, Toll John R, et al. Is the clinical frailty scale feasible to use in an emergency department setting? A mixed methods study. *BMC Emerg Med* 2023;23:124.

PAPER

II

ORIGINAL ARTICLE

Geriatrics

Addition of the clinical frailty scale to triage tools and early warning scores improves mortality prognostication at 30 days: A prospective observational multicenter study

Jens Wretborn PhD  | Samia Munir-Ehrlington MD | Erika Hörlin MSc | Daniel B. Wilhelms PhD

Department of Emergency Medicine and Department of Biomedical and Clinical Sciences, Linköping University, Linköping, Sweden

Correspondence

Jens Wretborn, Akutkliniken, Universitetssjukhuset, 581 85 Linköping, Sweden.
Email: jens.wretborn@liu.se

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Abstract

Objectives: Frailty, assessed with clinical frailty scale (CFS), alone or in combination with aggregated vital signs, has been proposed as a measure to better predict mortality of older patients in the emergency department (ED), but the added predictive value to conventional triage is unclear.

Methods: This was a secondary analysis of a prospective observational study in three EDs in Sweden that evaluated the prognostic performance of the CFS alone or in combination with the national early warning score (NEWS), triage early warning score (TEWS) or the rapid emergency triage and treatment system (RETTS) triage tool using logistic regression. The primary outcome was 30-day mortality with 7- and 90-day mortality and admission as secondary outcomes reported as area under the receiver operating curve (AuROC) scores with 95% confidence intervals (CIs). The sensitivity, specificity, accuracy, predictive values, and likelihood ratios are reported for all models.

Results: A total of 1832 patients were included with 17 (0.9%), 57 (3.1%), and 121 (6.6%) patients dying within 7, 30, and 90 days, respectively. The admission rate was 43% (795/1832). Frailty (CFS > 4) was significantly associated with 30-day mortality (odds ratio 6, 95% CI 3–12, $p < 0.01$). Prognostication of 30-day mortality was similar for all CFS-based models and better compared with models without CFS. The AuROC (95% CI) improved for RETTS from 0.67 (0.61–0.74) to 0.83 (0.79–0.88) ($p = 0.008$), for NEWS from 0.53 (0.45–0.61) to 0.82 (0.77–0.87) ($p < 0.001$), and for TEWS from 0.63 (0.55–0.71) to 0.82 (0.77–0.87) ($p = 0.002$).

Conclusion: Frailty measured with the CFS in combination with RETTS or structured vital sign assessment using NEWS or TEWS was better at prognosticating 30-day mortality compared to RETTS or early warnings score alone. Improved prognostication provides more realistic expectations and allows for informed discussions with patients and initiation of individualized treatment plans early in the ED process.

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1 | INTRODUCTION

1.1 | Background

Structured risk assessment in patients of older age in the emergency department (ED) is challenging. Initial risk stratification is conventionally done with a triage tool^{1,2} to direct resource allocation and prioritization in the ED. Triage tools should indicate the need for urgent interventions in the ED but also serve as a prognostication tool to guide decision of care. The most commonly used triage tool in Sweden, the rapid emergency triage and treatment system (RETTs), was derived against 7-day mortality and hospital admission.^{3,4} However, many triage tools have performed variably in patients of older age,⁵⁻⁹ potentially due to altered physiology,¹⁰ diminished physiological reserves, and atypical presentations,¹¹ which increase with advancing age.¹² As life expectancy increases, so do resource utilization and proportion of older patients in ED,¹³ stressing the need for better risk stratification in this time- and resource-limited environment.

Frailty, a state of diminished physiological reserve¹⁴ and a measure of functional, rather than chronological age¹⁵ is a potential risk predictor in the ED,¹⁶ although it is not commonly screened for.¹⁷ Several frailty assessment tools exist, such as the clinical frailty scale (CFS), a nine-point scale with cutoff at five points for frailty, which has been suggested for use in an ED setting.¹⁸ The CFS has been shown to prognosticate 30-day mortality in ED patients of older age.¹⁹⁻²² When CFS was combined with aggregated vital signs based on the national early warning score (NEWS)²³ in the frailty-adjusted prognosis in ED tool (FaP-ED), Nissen et al could show improved prediction of 30-day mortality compared with NEWS or CFS alone.²⁴ However, this model was not compared with a triage tool and the results have not been replicated. The NEWS score has shown inferior performance in the ED compared to other early warning scores.²⁵ We hypothesized that the triage early warning score (TEWS)²⁶ may be more suitable for use in older patients in the ED. TEWS uses the same vital signs as NEWS but with slightly different score weights. Importantly, it also incorporates mobility, an independent predictor of prognosis in patients of older age.^{27,28}

1.2 | Importance

Identifying frail patients early in the ED process may facilitate more appropriate resource allocation and discussions about goals of care based on mortality risk and patients' wishes, potentially reducing crowding, length of stay, and boarding, which are known to increase mortality in older patients.^{29,30} The CFS has been suggested to be suitable for assessing frailty in triage.²⁰ There are two studies investigating CFS and triage tools. One study reported an improved 1-year mortality prognosis with the emergency severity index (ESI)³¹ and other showed improved in-hospital mortality prognostication with the Taiwan triage score (TTS).³² Both studies were single-center with different follow-up periods, limiting generalizability. The CFS has been studied most fre-

The Bottom Line

It is unknown if assessing frailty, a syndrome of increased vulnerability in the elderly, improves mortality prognostication in patients of older age compared to normal triage alone in the emergency department (ED). In this multicenter study from Sweden we found that frailty, measured by the Clinical Frailty Scale, improved prognostication of death at 7-, 30- and 90days after an ED visit compared to normal triage or vital signs alone. Results were consistent when considering age, triage acuity, sex and arrival by ambulance suggesting that frailty carries important information not captured by other prognostic information in the ED.

quently for 30-day mortality, including the derivation of the FaP-ED tool.

1.3 | Goals of this investigation

The objective of this study was to evaluate the ability of frailty, as determined by the CFS, to predict 7-, 30-, and 90-day mortality, as well as admission rate, alone or in combination with a conventional triage tool and the NEWS and TEWS score. Secondly, we also aimed to validate the previously proposed FaP-ED tool for risk assessment in patients of older age.

2 | METHODS

2.1 | Study design and setting

This was a secondary analysis of a prospective observational study on outcomes of frail patients in the ED. The study was approved by the Swedish Ethical Review Authority (permit no. 2021-00875) and registered on ClinicalTrials.gov (identifier: NCT04877028, 2021-05-03). This study was carried out in accordance with the Declaration of Helsinki. The study is reported according to the TRIPOD guideline for prediction model validation.³³ The study enrolled a convenience sample of patients from the three EDs in Östergötland County in south-eastern Sweden: one urban tertiary care center, one urban community hospital, and one rural community hospital with a combined census of around 125,000 visits per year, and approximately 720 patients >65 years of age per week. These EDs serve a population of approximately 465,000 inhabitants in a publicly funded unified healthcare system. Access to nursing homes is regulated by the municipalities in Sweden and granted for patients with the greatest needs, whereas the majority of older patients receive even relatively advanced care in their own homes. In 2022, about 16% of the population in Sweden was over the age of 65 years and this group accounted for approximately 45% of adult ED visits.³⁴ The admission rate in the included

EDs was about 21% overall and around 40% in patients over 65 years of age.

2.2 | Selection of participants

Patients with Swedish citizenship over the age of 65 years who presented to any one of the EDs in the study were eligible for inclusion. The clinical staff included patients around the clock during 6 weeks at each ED. All visits by a patient over the age of 65 years were retrieved from the electronic health records (EHR) at the end of the study and visits with no case report form and no specified reason for exclusion were deemed as missed inclusion.

2.3 | Measurements

The CFS score (Figure S1) and mobility status were documented on paper-based case report form at assessment by a member of the care team (physician, registered nurse, or assistant nurse), which also does vital sign collection for the majority of patients at the study sites and then transcribed to a digital spreadsheet. Aside from the researchers, who were part of the care team for some of the patients as part of their clinical work, assessors were blinded to the hypothesis of this study. Prior to the study, CFS was introduced into clinical routine. As a part of continuing medical education, all staff members were encouraged to undergo a 30-min e-learning course based on the online training module developed by AIMS research group of Ottawa Hospital, Canada.³⁵ Outcome data, demographic data, acuity, and vital signs were exported from the EHR as comma-separated files.

2.4 | Outcomes

The primary outcome was 30-day mortality, with 7- and 90-day mortality and admission to hospital as secondary outcomes. Thirty-day mortality was chosen as primary outcome since effect size estimates for appropriate sample size calculation were known prior to initiation of the study. Mortality data were gathered from the EHR that links death dates from the national tax registry and captures all deaths in Sweden. The predictors were frailty, as assessed by the CFS, NEWS, TEWS, and FaP-ED scores. Patients with a score of 9 on the CFS were excluded from the analysis as described elsewhere^{19,24} as these patients, by definition, are non-frail due to their high level of function and lack of limiting symptoms but have a life expectancy <6 months.³⁶ The NEWS scores each vital sign on a scale from 0 to 3, depending on the deviation from normal, and generates a total score (max 20) where higher score is worse. There are two versions of NEWS, NEWS and NEWS2 (version 2), where saturation is scored differently if the patient has a type II respiratory failure. We used version 1 of NEWS (Table S2) to replicate the methods by the FaP-ED investigators. TEWS is similar to NEWS but adds scores for mobility (0–2) and trauma (0–1) and

does not score oxygen saturation (Table S3). We did not calculate the score from trauma in TEWS as this was not noted in the prospective data calculation and could not be assessed with certainty retrospectively (Table S3). Triage acuity was assessed with the RETTS triage tool, the most commonly used triage tool in Sweden,³⁷ on a scale from 1 (emergent) to 5 (non-urgent), which is based on vital signs and chief-complaint-specific questions. Triage is mandatory at all recruiting EDs and is done at first encounter with a provider. The RETTS triage tool allows providers to forgo vital signs assessment under certain circumstances, such as low acuity presentations, if deemed appropriate by the provider.

2.5 | Analysis

Based on CFS having an area under the receiver operating curve (AuROC) of 0.82,²⁴ a 30-day mortality of 4% and a 95% confidence interval (CI) width of 0.14 for a sample of 1163 patients were estimated for this secondary analysis.

A considerable proportion of patients had one or more missing vital sign data. A majority of these were missing all vital sign data. We did not exclude patients who were missing all vital sign data in the primary analysis as this is allowed by our triage tool. Prediction analysis was performed with the full dataset assuming normal vital signs for those missing vital signs and with sensitivity analysis where patients missing all vital sign data were excluded and remaining patients with missing data were imputed. Missing data were randomly distributed with an overweight of level on consciousness values. Mean-value imputation with random imputation order was done using the *IterativeImputer* in the scikit-learn package.

Patients with a CFS >4 were considered living with frailty, which is the conventional cutoff.³⁶ We combined triage scores of 4–5 (low acuity) as previously described³⁸ and inverted the scale in the regression analysis, with 1 being low acuity. In addition, we calculated NEWS and TEWS from the vital sign data and the FaP-ED score as described by Nissen et al., combining CFS 1–2 into one group.²⁴ The CFS and RETTS scores were treated as categorical variables and the early warning scores as numerical in the predictions analysis. We compared NEWS, 1 degree of freedom (df), and CFS (7 df) to the FaP-ED score (NEWS = 1 df, CFS = 6 df).

Descriptive data are reported as the means with standard deviations (SDs) or medians with interquartile range (IQR) as appropriate. Logistic regression was used to test model predictions, which are evaluated with the *roc_auc_score* and *accuracy_score* functions in the scikit-learn statistical package for python.³⁹ The classification was reported as AuROC scores with 95% CIs and were compared using the deLong method.⁴⁰ Calibration was assessed using the *CalibrationDisplay* function in scikit-learn. We report the sensitivity, specificity, negative predictive value (NPV), positive predictive value (PPV), accuracy, precision, and likelihood ratios for all tested prediction models. A *p*-value less than 0.05 or a 95% CI not including 1 was considered statistically significant. Analysis was done using the Python (version 3.7) programming language.⁴¹

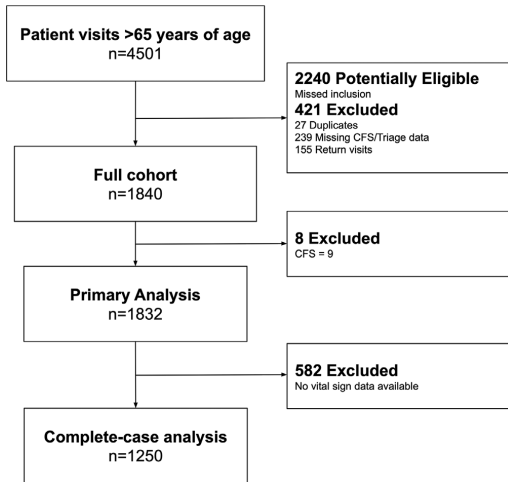


FIGURE 1 Flowchart of included patients.

3 | RESULTS

3.1 | Characteristics of study subjects

A total of 1840 patients were included in the study. After excluding eight (0.4%) patients with CFS 9, 1832 (99.6%) patients were included in the primary analysis (Figure 1). The mean age was 78.8 (SD 8) years and 55% were female (Table 1). The median CFS score was 4 (IQR 2–5) and 970 (53%) arrived via ambulance. The median scores were 0 (IQR 0–2), 1 (IQR 1–2), and 5 (IQR 3–7) for NEWS, TEWS, and FaP-ED, respectively. There were no vital sign data recorded for 532 (32%) patients (Table 1). Inclusion was carried out by clinical staff and an additional 2240 ED visits were deemed as potentially eligible but were missed inclusions in the study (Figure 1). The median age of the missed inclusion patients was 76 (71–82) and 51% were female.

A total of 17 (0.9%), 57 (3.1%), and 121 (6.6%) patients died within 7, 30, and 90 days, respectively, and the admission rate was 43% (795/1832) (Table 1). Mortality at 30 days was higher in patients living with frailty (CFS > 4) (7.7% [46/599] vs. 0.9% [11/1233]). Patients living with frailty (CFS > 4) had an increased risk of death at 30 days (odds ratio [OR] 6, 95% CI 3–12, $p < 0.01$) when adjusted for age (OR 1.04, 95% CI 1.01–1.08, $p = 0.02$), male sex (OR 1.53, 95% CI 0.89–2.63, $p = 0.12$), arrival by ambulance (OR 1.51, 95% CI 0.71–3.21, $p = 0.28$), and triage acuity (OR 1.91, 95% CI 1.32–2.76, $p < 0.01$).

3.2 | Main results

In general, models including frailty using the CFS scale, or the CFS scale alone, showed better classification ability according to the AuROC

scores compared to triage (RETTS) or vital signs alone (NEWS and TEWS) (Figure 2 and Table 2). AuROC improved for RETTS from 0.67 (95% CI 0.61–0.74) to 0.83 (95% CI 0.79–0.88) ($p = 0.008$), for NEWS from 0.53 (95% CI 0.45–0.61) to 0.82 (95% CI 0.77–0.87) ($p < 0.001$), and for TEWS from 0.63 (95% CI 0.55–0.71) to 0.82 (95% CI 0.77–0.87) ($p = 0.002$). The FaP-ED had an AuROC of 0.82 (95% CI 0.76–0.87). Calibration curves for 30-day mortality showed a slight overestimation in the low-risk groups and overestimation in the high-risk groups, similar in all models (Figure 2, Supporting Information). There were small increases in AuROC scores for the early warning scoring models when excluding patients without recorded vital signs with little or no difference in models including CFS and CFS alone (Table 3, Supporting Information). Multiple imputations had little effect on model performance.

The optimal cutoffs for each model were estimated based on the Youden index⁴² and the diagnostic properties of the different models were calculated based on 30-day mortality (Table 3). Using the suggested cutoff for the FaP-ED model of NEWS = 3 and CFS = 5 resulted in a more specific and less sensitive model compared to the Youden-based cutoffs (Table 3). A patient with NEWS 3 and CFS 5 had a 9.8% probability of death within 30 days.

4 | LIMITATIONS

We did not have vital signs collected for all patients, which may have affected the performance of the scoring systems using vital signs, such as the NEWS and TEWS. Since vital signs are not mandated for all patients in the triage procedure of the RETTS system, we believe it is important to include these patients to investigate the validity of the triage process. However, the results of the sensitivity analysis, which excluded patients missing all vital sign data, were similar in terms of AuROC scores and we believe that this has little effect on our overall results and conclusions. We did not collect data on resource utilization, such as urgent need for interventions in the ED, and cannot speak to the utility of CFS in this aspect of ED operations.

5 | DISCUSSION

In this study, we showed improved prognostic performance for 30-day mortality when adding frailty, measured with the CFS score, to structured vital sign assessment (NEWS or TEWS) or triage (RETTS triage tool). This is the first multicenter study evaluating the prognostic ability of the CFS combined with triage data or vital signs in the ED. Frailty was an independent prognosticator of 30-day mortality even when adjusting for several known confounders, such as age, sex, arrival by ambulance, and triage acuity. Furthermore, the AuROC scores for 7-day mortality were higher for all models based on the CFS compared to models without, including the RETTS triage tool, suggesting added value in short-term prognosis as well (Table 2). While frailty instruments, such as the CFS, have the potential to show an urgent

TABLE 1 Descriptive data of included patients and calculated predictors with missing data.

	Primary analysis (n = 1832)		Complete case analysis (n = 1250)	
		Missing		Missing
Age (SD)	78.8 (8)	0 (0%)	78.4 (7.8)	0 (0%)
Female (%)	55%	0 (0%)	53%	0 (0%)
Respiratory rate	18.6 (4)	606 (33%)	18.6 (4)	24 (2%)
Heart rate	84.8 (18.8)	614 (34%)	84.8 (18.8)	32 (3%)
AVPU (IQR)	0 (0-0)	889 (49%)	0 (0-0)	307 (25%)
Temperature	36.8 (0.7)	625 (34%)	36.8 (0.7)	43 (3%)
Saturation	97.1 (3)	605 (33%)	97.1 (3)	23 (2%)
Systolic blood pressure	147.2 (25.1)	610 (33%)	147.2 (25.1)	28 (2%)
Diastolic blood pressure	81 (15.6)	625 (34%)	81 (15.6)	43 (3%)
CFS	4 (2-5)	0 (0%)	3 (2-5)	0 (0%)
RETTS	2 (2-3)	0 (0%)	2 (2-3)	0 (0%)
7-Day mortality (%)	0.9%	0 (0%)	0.6%	0 (0%)
30-Day mortality (%)	3.1%	0 (0%)	2.6%	0 (0%)
90-Day mortality (%)	6.6%	0 (0%)	6.0%	0 (0%)
Admission (%)	43%	0 (0%)	43%	0 (0%)
TEWS (median, IQR)	1 (1-2)	0 (0%)	2 (1-3)	0 (0%)
NEWS (median, IQR)	0 (0-2)	0 (0%)	1 (0-3)	0 (0%)
Fap-ED (median, IQR)	5 (3-7)	0 (0%)	5 (3-7)	0 (0%)

Abbreviations: AVPU, alert = 0, verbal = 1, pain = 2, unconscious = 3; CFS, clinical frailty scale; FaP-ED, frailty-adjusted prognosis in emergency department tool; IQR, interquartile range; NEWS, national early warning score; RETTS, rapid emergency triage and treatment system; SD, standard deviation; TEWS, triage early warning score.

need of care in the ED,³² they are likely better for short- to medium-term prognostication^{19,24} and should not replace conventional triage. Hence, assessment of frailty should be used in conjunction with, rather than instead of, a conventional triage tool.

Frailty assessment may influence ED workups by identifying potential mortality risk increases, guiding medical decisions, nursing care, and establishing care goals. In our study, the 30-day mortality rate was markedly higher in patients living with frailty in all triage categories. The proportion of preventable mortality is unknown and there are currently no investigations on whether interventions, guided by CFS assessment in the ED, affect length of stay or mortality. For some of these patients, one of the most important interventions may be to establish clear goals of care and a treatment plan,⁴³ whereas advanced procedures or treatments aiming at long-term extension of the lifespan may be unrealistic. Although time and resources are limited in the ED, the time frame to create and act on a treatment plan is short for a considerable part of our frail patients (7.7% 30-day mortality in our cohort), which may necessitate initiating a treatment plan in the ED.

The non-frail, robust patients, on the other hand, had a 30-day mortality rate that was lower than that of a Swedish general ED population (0.9% vs. 1.5% in a study of 2.4 million ED visits⁴⁴), which confirms that age in general should not be a limiting factor when making treatment decisions in the ED.¹⁶ In this context, frailty assessment may support

further medical interventions that could otherwise be deemed futile based on the patient's age. Thus, we argue that frailty should be considered an independent prognosticator in the ED and a core component for patient-centered care where accurate risk-benefit prognostication is essential to guide informed discussions around the patients' goals of care.

This is the first external validation of the newly published FaP-ED score by Nissen et al.,²⁴ which showed improved prognostic ability, as measured by the AuROC score (0.86, 95% CI 0.83-0.90), compared to CFS (0.82, 95% CI 0.78-0.86) or NEWS alone (0.80, 95% CI 0.76-0.85). The FaP-ED score had a similar AuROC score in this dataset (0.84, 95% CI 0.77-0.91) for 30-day mortality, and it showed high accuracy and high PPV while still maintaining a high NPV (Table 3), suggesting better calibration compared to other models (Table 4, Supporting Information). Hence, the FaP-ED score holds external validity in this study.

In this multicenter study in Sweden, frailty measured by CFS alone, or in combination with the Swedish triage tool RETTS or structured vital sign assessment with NEWS or TEWS was better at predicting 30-day mortality compared to RETTS or structured vital sign assessment alone. Further studies should expand on the implications of incorporating frailty into the decision making in the ED as well as the ability of interventions, based on frailty assessments in triage or the ED, to improve patient outcomes.

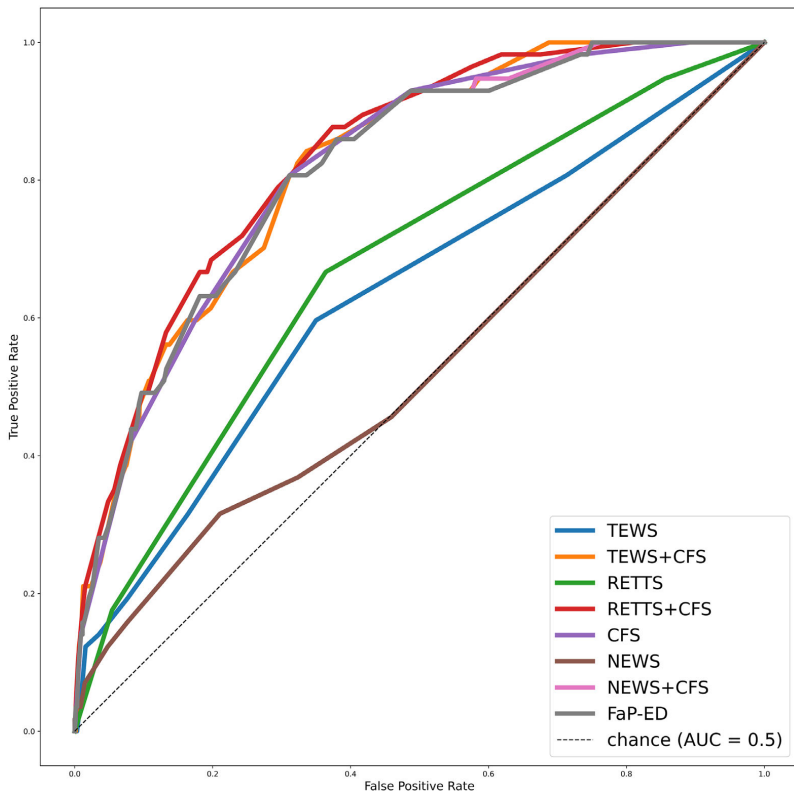


FIGURE 2 Area under the receiver operating curve (AuROC) curves for 30-day mortality models. CFS, clinical frailty scale; FaP-ED, frailty-adjusted prognosis in emergency department tool; NEWS, national early warning score; RETTS, rapid emergency triage and treatment system; TEWS, triage early warning score.

TABLE 2 Area under the receiver operating curve (AuROC) scores with 95% confidence intervals for each model and 7-, 30-, and 90-day mortality and admission, respectively.

Model	7-Day mortality	30-Day mortality	90-Day mortality	Admission
TEWS	0.44 (0.31–0.58)	0.63 (0.55–0.71)	0.61 (0.56–0.67)	0.63 (0.60–0.65)
TEWS + CFS	0.82 (0.72–0.93)	0.82 (0.77–0.87)	0.79 (0.76–0.83)	0.68 (0.65–0.70)
RETTS	0.71 (0.60–0.82)	0.67 (0.61–0.74)	0.63 (0.58–0.68)	0.69 (0.67–0.71)
RETTS + CFS	0.87 (0.79–0.94)	0.83 (0.79–0.88)	0.80 (0.76–0.84)	0.73 (0.71–0.76)
CFS	0.83 (0.75–0.92)	0.82 (0.77–0.87)	0.79 (0.75–0.83)	0.64 (0.62–0.67)
NEWS	0.54 (0.41–0.67)	0.53 (0.45–0.61)	0.56 (0.51–0.61)	0.58 (0.55–0.60)
NEWS + CFS	0.83 (0.76–0.91)	0.82 (0.77–0.87)	0.80 (0.76–0.83)	0.66 (0.64–0.69)
FaP-ED	0.84 (0.77–0.91)	0.82 (0.76–0.87)	0.80 (0.76–0.83)	0.66 (0.64–0.69)

Abbreviations: CFS, clinical frailty scale; FaP-ED, frailty-adjusted prognosis in emergency department tool; NEWS, national early warning score; RETTS, rapid emergency triage and treatment system; TEWS, triage early warning score.

TABLE 3 Cutoff values for optimal sensitivity, specificity, likelihood ratios, and predictive values for each model.

Model	Sensitivity	Specificity	Accuracy	PPV	NPV	LR+	LR-
TEWS: 3	0.41	0.83	0.82	0.83	0.98	2.33	0.72
TEWS: 1; CFS: 5	0.72	0.74	0.74	0.74	0.99	2.73	0.38
RETTs: 3	0.63	0.67	0.67	0.67	0.99	1.89	0.56
RETTs: 2; CFS: 5	0.75	0.75	0.75	0.75	0.99	2.98	0.33
CFS: 5	0.75	0.72	0.72	0.72	0.99	2.68	0.35
NEWS: 3	0.56	0.69	0.69	0.69	0.98	1.83	0.63
NEWS: 1; CFS: 5	0.69	0.78	0.78	0.78	0.99	3.20	0.40
FaP-ED (NEWS: 1; CFS: 5) ^a	0.69	0.78	0.78	0.78	0.99	3.20	0.40
FaP-ED (NEWS: 3; CFS: 5)	0.50	0.88	0.87	0.88	0.99	4.17	0.57

Abbreviations: CFS, clinical frailty scale; FaP-ED, frailty-adjusted prognosis in emergency department tool; LR+, positive likelihood ratio; LR-, negative likelihood ratio; NEWS, national early warning score; NPV, negative predictive value; PPV, positive predictive value; RETTS, rapid emergency triage and treatment system; TEWS, triage early warning score.

^aCutoffs suggested by Youden index.⁴²

AUTHOR CONTRIBUTIONS

Jens Wretborn and Daniel B. Wilhelms designed the study. Samia Munir-Ehrlington, Erika Hörlin, and Daniel B. Wilhelms acquired the ethical permit. All the authors facilitated the data collection. Jens Wretborn performed the analysis and wrote the draft of the manuscript. All the authors contributed to the final version of the manuscript. Jens Wretborn took responsibility for the study as a whole.

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CONFLICT OF INTEREST STATEMENT

The authors declare they have no conflicts of interest.

DATA AVAILABILITY STATEMENT

The datasets generated during the current study are available from the corresponding author upon reasonable request.

ORCID

Jens Wretborn PhD  <https://orcid.org/0000-0002-0549-6805>

REFERENCES

- Robertson-Steel I. Evolution of triage systems. *Emerg Med J*. 2006;23(2):154-155. doi:10.1136/emj.2005.030270
- Farrhoknia N, Castrén M, Ehrenberg A, et al. Emergency department triage scales and their components: a systematic review of the scientific evidence. *Scand J Trauma Resusc Emerg Med*. 2011;19:42. doi:10.1186/1757-7241-19-42
- Widgren BR, Jourak M. Medical Emergency Triage and Treatment System (METTS): a new protocol in primary triage and secondary priority decision in emergency medicine. *J Emerg Med*. 2011;40(6):623-628. doi:10.1016/j.jemermed.2008.04.003
- Pérez N, Nissen L, Nielsen RF, Petersen P, Biering K. The predictive validity of RETTS-HEV as an acuity triage tool in the emergency department of a Danish Regional Hospital. *Eur J Emerg Med*. 2016;23(1):33-37. doi:10.1097/MEJ.000000000000173
- Kuriyama A, Ikegami T, Nakayama T. Impact of age on the discriminative ability of an emergency triage system: a cohort study. *Acta Anaesthesiol Scand*. 2019;63(6):781-788. doi:10.1111/aas.13342
- Brouns SHA, Mignot-Evers L, Derckx F, Lambooi SL, Dieleman JP, Haak HR. Performance of the Manchester triage system in older emergency department patients: a retrospective cohort study. *BMC Emerg Med*. 2019;19(1):3. doi:10.1186/s12873-018-0217-y
- Chung HS, Namgung M, Lee DH, Choi YH, Bae SJ. Validity of the Korean triage and acuity scale in older patients compared to the adult group. *Exp Gerontol*. 2023;175:112136. doi:10.1016/j.exger.2023.112136
- Hinson JS, Martinez DA, Cabral S, et al. Triage performance in emergency medicine: a systematic review. *Ann Emerg Med*. 2018;74(1):140-152. doi:10.1016/j.annemergmed.2018.09.022
- Kemp K, Alakare J, Kätäkä M, Lääperi M, Lehtonen L, Castrén M. Accuracy of emergency severity index in older adults. *Eur J Emerg Med*. 2022;29(3):204-209. doi:10.1097/MEJ.0000000000000900
- Alvis BD, Hughes CG. Physiology considerations in geriatric patients. *Anesthesiol Clin*. 2015;33(3):447-456. doi:10.1016/j.anclin.2015.05.003
- Eichinger M, Robb HDP, Scurr C, Tucker H, Heschl S, Peck G. Challenges in the PREHOSPITAL emergency management of geriatric trauma patients—a scoping review. *Scand J Trauma Resusc Emerg Med*. 2021;29(1):100. doi:10.1186/s13049-021-00922-1
- Hofman MR, van den Hanenberg F, Siersevelt IN, Tulner CR. Elderly patients with an atypical presentation of illness in the emergency department. *Neth J Med*. 2017;75(6):241-246.
- Burkett E, Martin-Khan MG, Gray LC. Comparative emergency department resource utilisation across age groups. *Aust Health Rev*. 2017;43(2):194-199. doi:10.1071/AH17113
- Cesari M, Prince M, Thiagarajan JA, et al. Frailty: an emerging public health priority. *J Am Med Dir Assoc*. 2016;17(3):188-192. doi:10.1016/j.jamda.2015.12.016
- Ji L, Jazwinski SM, Kim S. Frailty and biological age. *Ann Geriatr Med Res*. 2021;25(3):141-149. doi:10.4235/agmr.21.0080
- Carter B, Short R, Bouamra O, et al. A national study of 23 major trauma centres to investigate the effect of frailty on clinical outcomes in older people admitted with serious injury in England (FITR 1): a mul-

- ticentre observational study. *Lancet Healthy Longev.* 2022;3(8):e540-e548. doi:[10.1016/S2666-7568\(22\)00122-2](https://doi.org/10.1016/S2666-7568(22)00122-2)
17. Elliott A, Hull L, Conroy SP. Frailty identification in the emergency department—a systematic review focussing on feasibility. *Age Ageing.* 2017;46(3):509-513. doi:[10.1093/ageing/afx019](https://doi.org/10.1093/ageing/afx019)
 18. Lewis ET, Dent E, Alkhoury H, et al. Which frailty scale for patients admitted via emergency department? A cohort study. *Arch Gerontol Geriatr.* 2019;80:104-114. doi:[10.1016/j.archger.2018.11.002](https://doi.org/10.1016/j.archger.2018.11.002)
 19. Kaeppli T, Rueegg M, Dreher-Hummel T, et al. Validation of the clinical frailty scale for prediction of thirty-day mortality in the emergency department. *Ann Emerg Med.* 2020;76(3):291-300. doi:[10.1016/j.annemergmed.2020.03.028](https://doi.org/10.1016/j.annemergmed.2020.03.028)
 20. Elliott A, Taub N, Banerjee J, et al. Does the clinical frailty scale at triage predict outcomes from emergency care for older people? *Ann Emerg Med.* 2020;77(6):620-627. doi:[10.1016/j.annemergmed.2020.09.006](https://doi.org/10.1016/j.annemergmed.2020.09.006)
 21. Pulok MH, Theou O, van der Valk AM, Rockwood K. The role of illness acuity on the association between frailty and mortality in emergency department patients referred to internal medicine. *Age Ageing.* 2020;49(6):1071-1079. doi:[10.1093/ageing/afaa089](https://doi.org/10.1093/ageing/afaa089)
 22. Huh JY, Matsuoka Y, Kinoshita H, Ikenoue T, Yamamoto Y, Ariyoshi K. Premorbid Clinical Frailty Score and 30-day mortality among older adults in the emergency department. *J Am Coll Emerg Physicians Open.* 2022;3(1):e12677. doi:[10.1002/emp2.12677](https://doi.org/10.1002/emp2.12677)
 23. Royal College of Physicians. *National Early Warning Score (NEWS): standardising the assessment of acute-illness severity in the NHS.* Updated report of a working party. London: Royal College of Physicians. 2012. https://www.ombudsman.org.uk/sites/default/files/National%20Early%20Warning%20Score%20%28NEWS%29%20-%20Standardising%20the%20assessment%20of%20acute-illness%20severity%20in%20the%20NHS_0.pdf
 24. Nissen SK, Rueegg M, Carpenter CR, et al. Prognosis for older people at presentation to emergency department based on frailty and aggregated vital signs. *J Am Geriatr Soc.* 2023;71(4):1250-1258. doi:[10.1111/jgs.18170](https://doi.org/10.1111/jgs.18170)
 25. Lee SB, Kim DH, Kim T, et al. Emergency Department Triage Early Warning Score (TREWS) predicts in-hospital mortality in the emergency department. *Am J Emerg Med.* 2020;38(2):203-210. doi:[10.1016/j.ajem.2019.02.004](https://doi.org/10.1016/j.ajem.2019.02.004)
 26. Gottschalk SB, Wood D, DeVries S, Wallis LA, Bruijns S. Cape triage group. The cape triage score: a new triage system South Africa. Proposal from the cape triage group. *Emerg Med J.* 2006;23(2):149-153. doi:[10.1136/emj.2005.028332](https://doi.org/10.1136/emj.2005.028332)
 27. Chien CY, Chau CH, Yeh CC, Hsu KH, Gao SY, Ng CJ. Using mobility status as a frailty indicator to improve the accuracy of a computerised five-level triage system among older patients in the emergency department. *BMC Emerg Med.* 2022;22(1):86. doi:[10.1186/s12873-022-00646-0](https://doi.org/10.1186/s12873-022-00646-0)
 28. Hope AA, Hsieh SJ, Petti A, Hurtado-Sbordoni M, Verghese J, Gong MN. Assessing the usefulness and validity of frailty markers in critically ill adults. *Ann Am Thorac Soc.* 2017;14(6):952-959. doi:[10.1513/AnnalsATS.201607-538OC](https://doi.org/10.1513/AnnalsATS.201607-538OC)
 29. Roussel M, Teissandier D, Yordanov Y, et al. Overnight stay in the emergency department and mortality in older patients. *JAMA Intern Med.* 2023;183(12):1378-1385. doi:[10.1001/jamainternmed.2023.5961](https://doi.org/10.1001/jamainternmed.2023.5961)
 30. Guttman A, Schull MJ, Vermeulen MJ, Stukel TA. Association between waiting times and short term mortality and hospital admission after departure from emergency department: population based cohort study from Ontario, Canada. *BMJ.* 2011;342:d2983. doi:[10.1136/bmj.d2983](https://doi.org/10.1136/bmj.d2983)
 31. Rueegg M, Nissen SK, Brabrand M, et al. The clinical frailty scale predicts 1-year mortality in emergency department patients aged 65 years and older. *Acad Emerg Med.* 2022;29(5):572-580. doi:[10.1111/acem.14460](https://doi.org/10.1111/acem.14460)
 32. Ng CJ, Chien LT, Huang CH, et al. Integrating the clinical frailty scale with emergency department triage systems for elder patients: a prospective study. *Am J Emerg Med.* 2023;66:16-21. doi:[10.1016/j.ajem.2023.01.002](https://doi.org/10.1016/j.ajem.2023.01.002)
 33. Collins GS, Reitsma JB, Altman DG, Moons KGM. Transparent reporting of a multivariable prediction model for individual prognosis or diagnosis (TRIPOD): the TRIPOD statement. *BMJ.* 2015;350:g7594. doi:[10.1136/bmj.g7594](https://doi.org/10.1136/bmj.g7594)
 34. National Board of Social Affairs and Health. *Swedish National Registry of ED Visits.* Accessed August 24, 2023. https://sdb.socialstyrelsen.se/ift_avt_manad/
 35. AIMS. *Clinical Frailty Scale (CFS) Training Module.* Accessed December 1, 2023. <https://rise.articulate.com/share/deb4rT02lvONbq4AfcMNRUudcd6QMts3#/>
 36. Moorhouse P, Rockwood K. Frailty and its quantitative clinical evaluation. *J R Coll Physicians Edinb.* 2012;42(4):333-340. doi:[10.4997/JRCPE.2012.412](https://doi.org/10.4997/JRCPE.2012.412)
 37. Farrokhnia N, Göransson KE. Swedish emergency department triage and interventions for improved patient flows: a national update. *Scand J Trauma Resusc Emerg Med.* 2011;19:72. doi:[10.1186/1757-7241-19-72](https://doi.org/10.1186/1757-7241-19-72)
 38. Wretborn J, Starkenberg H, Ruge T, Wilhelms DB, Ekelund U. Validation of the modified Skåne emergency department assessment of patient load (mSEAL) model for emergency department crowding and comparison with international models; an observational study. *BMC Emerg Med.* 2021;21(1):21. doi:[10.1186/s12873-021-00414-6](https://doi.org/10.1186/s12873-021-00414-6)
 39. Pedregosa F, Varoquaux G, Gramfort A, et al. Scikit-learn: machine learning in Python. *J Mach Learn Res.* 2011;12:2825-2830.
 40. DeLong ER, DeLong DM, Clarke-Pearson DL. Comparing the areas under two or more correlated receiver operating characteristic curves: a nonparametric approach. *Biometrics.* 1988;44(3):837-845.
 41. Millman KJ, Aivazis M. Python for scientists and engineers. *Comput Sci Eng.* 2011;13(2):9-12. doi:[10.1109/MCSE.2011.36](https://doi.org/10.1109/MCSE.2011.36)
 42. Youden WJ. Index for rating diagnostic tests. *Cancer.* 1950;3(1):32-35. doi:[10.1002/1097-0142\(1950\)3:1<32::AID-CNCR2820030106>3.0.CO;2-3](https://doi.org/10.1002/1097-0142(1950)3:1<32::AID-CNCR2820030106>3.0.CO;2-3)
 43. Borekic KF, Hay JL, Borekic PE, Arora RC, Duhamel TA. Frailty-aware care: giving value to frailty assessment across different healthcare settings. *BMC Geriatr.* 2022;22(1):13. doi:[10.1186/s12877-021-02722-9](https://doi.org/10.1186/s12877-021-02722-9)
 44. Af Ugglas B, Lindmarker P, Ekelund U, Djärv T, Holzmann MJ. Emergency department crowding and mortality in 14 Swedish emergency departments, a cohort study leveraging the Swedish Emergency Registry (SVAR). *PLoS One.* 2021;16(3):e0247881. doi:[10.1371/journal.pone.0247881](https://doi.org/10.1371/journal.pone.0247881)
 45. Flaatten H, De Lange DW, Morandi A, et al. The impact of frailty on ICU and 30-day mortality and the level of care in very elderly patients (≥ 80 years). *Intensive Care Med.* 2017;43(12):1820-1828. doi:[10.1007/s00134-017-4940-8](https://doi.org/10.1007/s00134-017-4940-8)

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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PAPER **III**

RESEARCH

Open Access



Is the clinical frailty scale feasible to use in an emergency department setting? A mixed methods study

Erika Hörlin^{1*}, Samia Munir Ehrlington¹, Rani Toll John¹, Joakim Henricson¹ and Daniel Wilhelms¹

Abstract

Background The Clinical Frailty Scale (CFS) is a frailty assessment tool used to identify frailty in older patients visiting the emergency department (ED). However, the current understanding of how it is used and accepted in ED clinical practice is limited. This study aimed to assess the feasibility of CFS in an ED setting.

Methods This was a prospective, mixed methods study conducted in three Swedish EDs where CFS had recently been introduced. We examined the completion rate of CFS assessments in relation to patient- and organisational factors. A survey on staff experience of using CFS was also conducted. All quantitative data were analysed descriptively, while free text comments underwent a qualitative content analysis.

Results A total of 4235 visits were analysed, and CFS assessments were performed in 47%. The completion rate exceeded 50% for patients over the age of 80. Patients with low triage priority were assessed to a low degree (24%). There was a diurnal variation with the highest completion rates seen for arrivals between 6 and 12 a.m. (58%). The survey response rate was 48%. The respondents rated the perceived relevance and the ease of use of the CFS with a median of 5 (IQR 2) on a scale with 7 being the highest. High workload, forgetfulness and critical illness were ranked as the top three barriers to assessment. The qualitative analysis showed that CFS assessments benefit from a clear routine and a sense of apparent relevance to emergency care.

Conclusion Most emergency staff perceived CFS as relevant and easy to use, yet far from all older ED patients were assessed. The most common barrier to assessment was high workload. Measures to facilitate use may include clarifying the purpose of the assessment with explicit follow-up actions, as well as formulating a clear routine for the assessment.

Registration The study was registered on ClinicalTrials.gov 2021-06-18 (identifier: NCT04931472).

Keywords Clinical frailty scale, Feasibility, Frailty, Implementation, Emergency medicine, Geriatric medicine, Mixed methods

*Correspondence:

Erika Hörlin

erika.horlin@regionostergotland.se; KfAkutenUs@regionostergotland.se

¹Department of Emergency Medicine, Department of Biomedical and Clinical Sciences, Linköping University, Linköping, Sweden



Background

Frailty assessment of older patients presenting to the Emergency Department (ED) may help to estimate the risk of adverse events [1] and to deliver proper care [2]. Frailty has been shown to increase the risk of delirium, a serious alteration in cognition and attention, which has a significant association with morbidity and mortality [3]. The risk of delirium is also associated with length of stay in the ED [4]. Therefore, it is crucial to the care given to older patients in the ED that frailty is identified, and that care is provided properly, to mitigate the risks for adverse events.

Implementation of frailty assessment has been advocated as part of emergency care [5, 6]. Research on frailty assessment tools in the ED has grown in recent years, and some tools have been introduced in clinical practice [7, 8]. Yet, the feasibility of using frailty screening tools in an ED setting is not fully understood [9]. For a tool to ultimately add value to patient care, it must be feasible to use in the intended context. For this reason, knowledge of feasibility is crucial for decisions and planning concerning a broader introduction [10].

The Clinical frailty scale (CFS) is a frailty assessment tool that has been introduced to some ED settings, for example in the United Kingdom [7]. The CFS is a judgement based 9-point scale (1-9) and was originally developed within the Canadian Study of Health and Aging [11]. It is made up of pictograms combined with clinical descriptions to help assign scores based on the assessment of a person's function in daily life and cognitive status [12]. The tool has been evaluated for validity and reliability in the ED setting [13, 14], which together with its simplicity and the rapid deployment [15, 16] of approximately one minute [17, 18] has led to its recommended use in an ED setting.

However, our current understanding of how CFS is used in ED clinical practice remains limited. Tools can be both valid and reliable, but they will be of no benefit for patients if they are not used in clinical practice as intended. Some studies have reported the feasibility of applying CFS on older patients in the ED. Emergency department staff from the United Kingdom have reported feasibility measures in terms of experiences; that the CFS was easy to use on vignette cases [17], and that they feel confident using the tool in clinical practice [19]. Another way to assess feasibility is the completion rate, which in this context is defined as the proportion of completed

CFS assessments to the total number of ED visits made by older people. Completion rates for CFS assessments have been investigated in Europe with reported levels as high as 98.9% [20] and 96.0% [21] when study personnel completed the assessments, but with results around 50% when the assessments were made during clinical work [7, 19]. From an implementation perspective, the need thus remains to identify which factors influence the use of CFS in the ED when it is performed as part of standard care [10, 22]. Therefore, this study aims to evaluate the feasibility of CFS in a standard care ED-setting by investigating how the CFS is used during clinical work, in combination with exploring ED staff's experiences of using it.

This study had two approaches: "investigate completion rate" and "understand staff experiences". To investigate completion rates, the following research question was shaped: 1) What is the overall completion rate of CFS assessments among ED staff, and how is this affected in relation to patient- and organisation related factors (e.g., age; triage priority; day of week and time of day)? To explore staff experiences, the questions were; 2) What are the ED staff's experiences with: relevance; ease of use; time consumption; barriers and facilitators when using CFS in clinical practice? and; 3) What are the ED staff's experiences of relevance of frailty assessment (not specifically with CFS) in the ED?

Methods

Study design and setting

This was a prospective mixed methods study carried out in three Swedish EDs, all located within the same region and organisation (Region Östergötland). The combination of an observational and survey design with analysis of both quantitative and qualitative data was chosen for the possibility of obtaining both a broader and deeper understanding of the research questions [23]. The study was approved by the Swedish Ethical Review Authority (permit 2021-00875) and registered on ClinicalTrials.gov (identifier: NCT04931472).

The characteristics for the three EDs and their respective recruitment periods are specified in Table 1: one University Hospital (UH), which also is the regional trauma centre and one of few EDs in Sweden run exclusively by emergency physicians, one community hospital ED (CH 1), and one rural community hospital ED (CH 2). None of the EDs operate a specific pathway or unit for older people.

Table 1 Characteristics and recruitment periods for the three participating EDs

	UH	CH 1	CH 2
Annual ED visits	50 000	50 000	25 000
Type	University Hospital	Urban Community Hospital	Rural Community Hospital
Data collection periods	- Demand: May/June 2021 - Acceptability: June-July 2021	- Demand: October/November 2021 - Acceptability: November/December 2021	- Demand: October/November 2021 - Acceptability: November/December 2021

Swedish emergency care organisations typically involve physicians (either emergency physicians or interns/residents from the specialties internal medicine; surgery; or orthopaedics), registered nurses and assistant nurses, all with varying experience [24]. There are no national guidelines regarding frailty assessment for Swedish EDs. However, a number of EDs assess frailty in some way, and of those using an established tool the CFS is the most common [8].

At the time for data collection, the CFS had recently been introduced as a clinical routine in the participating EDs but none of the institutions had established a system for monitoring the outcomes of the assessments. Prior to its introduction, all staff members were encouraged to participate in an e-learning course on the use of CFS. The content of the e-learning course was derived from the online training module developed by AIMS research group of Ottawa Hospital, Canada [25]. Three clinical vignettes were included along with the basic theoretical concept of frailty and its consequences for the patients' health and functional aspects. Approximately 30 min were required to complete the course. Among ED staff, the completion rate for the e-learning course was 77%. Physicians employed elsewhere were not asked to complete the course but may still have performed it as the education was open to everyone in the organisation.

Methods of measurements

Data for this study were collected in two phases:

1. Data about patient- and organisational related factors for patients with and without a CFS-assessment were collected over a period of six weeks. The start of the collection periods differed between the hospitals as the e-learning course could be completed at slightly different times, and we wanted to ensure the same conditions for all hospitals before data collection began. Data collection was performed at all hours during the study period. The team members who were responsible for the patient (typically a physician, registered nurse, and assistant nurse) were instructed that someone on the team should assess the patient during the ED visit. As the study was undertaken in a clinical context, the staff had access to standard clinical information such as the patient, relative/caregiver, and notes from the electronic medical records (EMR). We used the Swedish version of the Clinical Frailty Scale (CFS-9) [26], the CFS score was registered in a worksheet attached to the patients' ED records.
2. Immediately after completion of the first phase, the ED staff received a survey (Webropol version 3, Webropol Oy, Helsinki, Finland) by email, with two reminders in the absence of a response within 14 days. The survey investigated staff experiences

and was developed specifically for this study. We selected previously studied acceptability areas [17, 18, 27, 28] of relevance to the current study. The recommendations made by Statistics Sweden [29] for fundamental elements like wording, questioning style, and response options served as our guide during the survey's structuring. To confirm content validity, it was pre-tested by five persons (clinicians and non-health professionals) who were interviewed about the perceived meaning of the questions. This generated some adjustments to improve clarity. The survey (available as supplemental material) consisted of Likert scales, multiple-choice questions, and open textboxes.

Inclusion of participants

For phase one, informed consent was waived by the Ethical Review Authority. For phase two, staff provided their consent by answering the survey. All physicians, registered nurses, and assistant nurses who had been working clinically in the EDs during phase one were invited to anonymously answer the survey.

Outcomes and data analysis

Bowen et al. [10] present eight general focus-areas suitable for feasibility studies, of which the two areas "demand" (frequency of assessment and patterns of use) and "acceptability" (user satisfaction, barriers, and facilitators) are investigated in this study. For the area demand, we calculated the completion rate of CFS-assessments, both overall and relative to patient-related factors and organisational factors. Acceptability was examined by investigating the staff's experience of relevance, ease of use, time consumption, barriers to use, facilitators to use, and the importance of frailty assessment in general. The data sources and analyses for each outcome are further presented in Table 2. All statistics are descriptive and reported as frequencies, median and interquartile ranges (IQR), or as number and percentages (%). Significant analyses for categorical variables were calculated with the Chi2-test or Fisher's exact test when the number of outcomes were lower than 5 in any group, and with independent samples median test for continuous measures like age. All statistical analysis was done in IBM SPSS Statistics for Windows, version 27.

In addition, we performed a conventional qualitative content analysis according to Hsieh and Shannon [30] to outline the meanings of the comments in the open textboxes. The analysis was performed by two authors (EH and SME), and the first author (EH) led the analysis. EH has previous experience with the method. Both researchers have also completed basic and advanced courses in qualitative methodology. The pre-understanding for both the authors consisted of a specific interest in the

Table 2 Description of the outcomes

	Feasibility outcomes	Data source	Data analysis
Demand	<ul style="list-style-type: none"> - Completion rate of CFS-assessments, overall - Completion rate relative to patient-related factors - Completion rate relative to organisation factors 	<ul style="list-style-type: none"> - Worksheet: CFS-assessments - EMIR: age; sex; mode of arrival; triage priority; discharge destination; day of week and time of day 	<ul style="list-style-type: none"> Descriptive statistics
Acceptability	<ul style="list-style-type: none"> - Staff's perception of relevance - Staff's perception of ease of use - Staff's perception of time consumption - Staff's perception of barriers to use - Staff's perception of facilitators to use - Staff's perception of importance of frailty assessment in general 	<ul style="list-style-type: none"> - Survey answered by ED staff (physicians, registered nurses, and assistant nurses) 	<ul style="list-style-type: none"> Descriptive statistics of quantitative data, and qualitative content analysis of comments in the open textboxes

condition of frailty, and in addition many years of experience of emergency care. The analysis thus began with the personal pre-understanding being written down and reflected on; this was further repeated during the analysis process. The data were treated as a uniform text and read through repeatedly to obtain a sense of the whole. All sentences related to the research questions were first marked as “interesting” and then coded with a label describing their meaning. The coded sentences were organised into categories and subcategories (Table 3). The authors repeatedly returned to the text, both individually and jointly, to understand what the participants were communicating. The results were continuously discussed by the two authors and revised until an agreement was reached. The analysis involved a certain degree of interpretation, but the purpose of the study and the nature of the data resulted in a manifest analysis.

Results

A total of 4515 ED visits by patients ≥65 years were made during the data collection period. Of these, 280 were excluded, mostly due to missing data. There were 1995 visits with completed assessments and 2240 non-assessed visits, which together comprise the sample of 4235 visits analysed in this study (Fig. 1).

Demand

The overall completion rate of CFS-based assessments was 47.0%. The completion rate increased with the age of the patients, and for the oldest (≥96 years of age) it was 76.9%. The completion rate exceeded 50% for those who arrived by ambulance (56.3%) or by recumbent transport (63.2%). Patients with triage priorities 2 (very urgent) and 3 (urgent) had CFS completion rates of just over 50%, while patients with minor injuries had the lowest proportion of completed assessments (24.0%) (Table 4). There were minor differences in completion rates between the days of the week, with the lowest on Sundays (43.5%). During the day, the completion rate was highest (58.1%) for patients who arrived at the ED between 06:00 and 12:00 am.

Acceptability

In total, 475 ED staff (216 physicians, 148 registered nurses, and 111 assistant nurses) received the survey on perceived user satisfaction, barriers, and facilitators, and 229 (48.0%) responded. Eight declined participation, leaving 221 answers to analyse. The number of respondents was similar between professions, with 78 physicians (divided into 50 emergency physicians, and 28 interns/residents from other specialties), 73 registered nurses, and 70 assistant nurses. The distribution of the percentage of respondents between the hospitals was: UH, 48.9%; CH 1, 28.5% and; CH2, 22.6%. Most

<p>Table 3 Example of the qualitative analysis process</p>	<p>Meanings marked with the label “No need for specific tool”</p>	<p>Subcategory</p>	<p>Category</p>
<p>However, I believe that evaluation of frailty is already included in the medical assessment and have difficulty seeing how a score would change my handling.</p>	<p>Prefer clinical judgement</p>	<p>Lack of motivation</p>	
<p>Anyone with a medical or nursing education should automatically be able to assess frailty in a patient without the use of CFS. I request the information in the assessment anyway, without making an estimate according to a specific tool.</p>			

participants (70.0%) were women; the all-over median age was 35 years (IQR 17), and median work experience was 8 years (IQR 12).

Information on perceived user satisfaction, barriers, and facilitators was collected using a 7-point Likert scale. Most respondents had positive experiences with the relevance of CFS assessments, relevance to frailty assessments in general, ease of use of the CFS, and perceived time required for CFS assessments (Table 5).

To identify barriers to using the CFS, we asked: “In cases where you did not assess patients ≥ 65 years of age, what was the reason?”. Participants could select one or more predefined answers, as well as provide free comments regarding other barriers to CFS assessment (Fig. 2). High workload and forgetfulness were the most frequently selected barriers to assessing the patient with CFS, while difficulty understanding the scale or time-consuming assessment were the least reported barriers.

Qualitative analysis

The three open text boxes yielded 194 comments, written by 124 unique ED staff, divided between 41 physicians, 48 registered nurses, and 35 assistant nurses. The questions and subsequent comments were about: additional perceived barriers to CFS assessment; existing or potential facilitators; and perceived importance of identifying frailty (in general) in the ED. The analysis resulted in a total of eight categories and 16 subcategories. The categories and subcategories are illustrated in Fig. 3 and presented in more detail below. Illustrative quotes are marked with profession (Physician=Ph, Registered nurse=RN and Assistant nurse=AN) and hospital (University hospital=UH, Community hospital=CH 1 or CH 2).

Additional barriers to CFS-assessment

Unspecific instruction

The description that assessments were not made because the respondents did not feel responsible for it, resulted in the subcategory “Unclear responsibility”. The instruction to the staff was that someone on the team should do the CFS assessment during the patient’s stay in the ED. It may be that the imprecise wording contributed to fewer assessments being made. The subcategory “Time for assessment” was formed by respondents’ descriptions of the fact that the assessments were postponed, which resulted in the patient being discharged without the assessment being carried out.

“...as well as when a patient had been quickly discharged home or to a ward” (AN, CH 1).

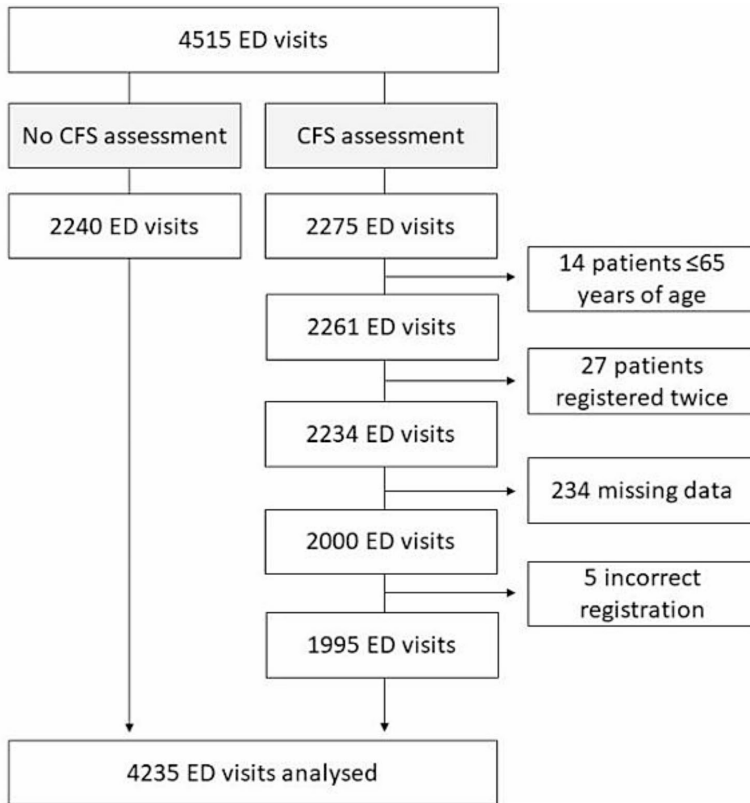


Fig. 1 Flow chart describing the inclusion process for ED visits made by patients ≥ 65 years old

Lack of motivation

The subcategory “Preferring clinical judgement” stemmed from the view that the use of a specific assessment tool is unnecessary, as frailty can be assessed using clinical judgement alone. The experience that the use of CFS is challenging was partly based on the need to understand the patient’s usual ability to cope with daily activities, and partly on the difficulty of knowing which questions to ask. This was framed in the subcategory “Challenging Tool”.

“Assessment of frailty is important, but CFS is challenging as there are many questions about the patients’ everyday life...difficult to evaluate the steps in the assessment...” (RN, CH 1).

The third subcategory “Labelling the patient” involves the experience of labelling the patient in a definitive way by grading the person on a scale.

“It feels as if I put a stamp on the patient...that the assessment is definitive in some way” (RN, UH).

Existing or potential facilitators for CFS-assessment
Clear relevance

The category “Clear relevance” was based on the expressions that it was facilitating to maintain, or obtain a sense that a CFS assessment leads to something significant for the patient.

“To continue having the feeling that it is something significant and worth making time for” (Ph, UH).

Tasks assigned to certain ED staff

Another facilitator is described in the subcategory “Defined responsibility”, and would be to dedicate the assessment to specific personnel. Either within each care team (e.g., the registered nurse is always responsible) or at a specific position (e.g. triage). The proposal in

Table 4 The completion rate of CFS-assessments in relation to patient- and organisation related factors

	Total	Patients with CFS assessment	Patients without CFS assessment	P-value
Number, n (%)	4235	1995 (47.1)	2240 (52.9)	
Women, n (%)	2234 (52.8)	1091 (54.7)	1143 (51.0)	
Age, median (IQR)	77 (12)	78 (12)	76 (11)	0.000
Age, five years strata				
65–70, n (%)	882	331 (37.5)	551 (62.5)	0.000
71–75, n (%)	925	423 (45.7)	502 (54.3)	0.009
76–80, n (%)	902	415 (46.0)	487 (54.0)	0.017
81–85, n (%)	740	373 (50.4)	367 (49.6)	0.825
86–90, n (%)	500	283 (56.6)	217 (43.4)	0.003
91–95, n (%)	234	130 (55.6)	104 (44.4)	0.089
96+, n (%)	52	40 (76.9)	12 (23.1)	0.000
Triage priority at arrival				
1 (immediate), n (%)	275	115 (41.8)	160 (58.2)	0.007
2 (very urgent), n (%)	1233	632 (51.3)	601 (48.7)	0.377
3 (urgent), n (%)	1901	973 (51.2)	928 (48.8)	0.302
4 (non-urgent), n (%)	511	217 (42.5)	294 (57.5)	0.001
5 (minor injuries), n (%)	229	55 (24.0)	174 (76.0)	0.000
Missing, n (%)	86	3 (3.5)	83 (96.5)	
Mode of arrival				
Walk in, n (%)	2221	880 (39.6)	1341 (60.4)	0.000
Ambulance, n (%)	1891	1065 (56.3)	826 (43.7)	0.000
Recumbent patient transport, n (%)	38	24 (63.2)	14 (36.8)	0.105
Missing or other, n (%)	85	26 (30.6)	59 (69.4)	
Discharge destination				
Home, n (%)	2447	1104 (45.1)	1343 (54.9)	0.000
Admitted, n (%)	1679	879 (52.4)	800 (47.6)	0.054
Primary care, n (%)	58	7 (12.1)	51 (87.9)	0.000
Left without being seen, n (%)	39	5 (12.8)	34 (87.2)	0.000
Deceased in the ED, n (%)	12	0 (0.0)	12 (100.0)	0.000
Day of arrival				
Monday, n (%)	705	338 (47.9)	367 (52.1)	0.275
Tuesday, n (%)	590	300 (50.8)	290 (49.2)	0.681
Wednesday, n (%)	601	299 (49.8)	302 (50.2)	0.903
Thursday, n (%)	611	271 (44.4)	340 (55.6)	0.005
Friday, n (%)	644	287 (44.6)	357 (55.4)	0.006
Saturday, n (%)	542	264 (48.7)	278 (51.3)	0.548
Sunday, n (%)	542	236 (43.5)	306 (56.5)	0.003
Time of arrival				
24.00–06.00, n (%)	336	141 (42.0)	195 (58.0)	0.003
06.01–12.00, n (%)	1214	705 (58.1)	509 (41.9)	0.000
12.01–18.00, n (%)	1840	826 (44.9)	1014 (55.1)	0.000
18.01–23.59, n (%)	845	323 (38.2)	522 (61.8)	0.000

Table 5 Emergency department staff's responses to their experiences of using the CFS

Variable	Responses, n	Results, median (IQR)
CFS, relevance	221	5 (2)
Frailty assessment in general, relevance	221	6 (2)
CFS, ease of use	178	5 (2)
CFS, time consumption	178	3 (2)

the subcategory “Specific geriatric resource” concerned an exclusive geriatric resource that operates on all care teams.

“Assessment could perhaps take place during triage so that it is always done; standardisation often improves this sort of procedures” (Ph, CH 1).



Fig. 2 The frequency of ED staff reported barriers to assess patients with CFS. The number of times each barrier was selected. Participants could select all available options that they perceived as a barrier to CFS assessment. The question was answered by 209 respondents

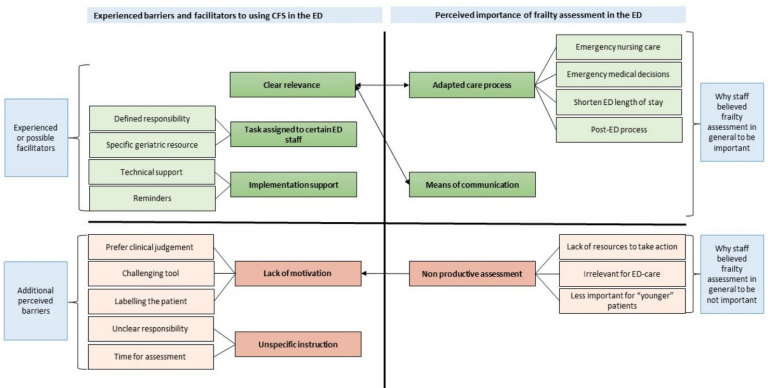


Fig. 3 The result of the qualitative analysis: the eight categories and 16 subcategories

Implementation support

It was further described that continued and additional implementation support would facilitate assessments. Suggestions for verbal or visual reminders formed the “Reminders” subcategory, while integrating the CFS into the EMR formed the “Technical Support” subcategory.

Perceived importance of frailty assessment (in general) in the ED

The perceived importance of frailty assessment in general interacts to a certain degree with the experience of barriers and facilitators. This is illustrated in Fig. 3.

Adapted care process

Those who considered frailty assessment to be important in the ED described it as providing significant information about the patient, leading to an adapted care process. The subcategory “Emergency nursing care” included adapted nursing interventions in the ED. Examples given were increased attention to nutritional and elimination needs; position changes; “real” beds and; more frequent nursing rounds.

“Many older people with frailty are in greater need of nursing rounds as they can rapidly deteriorate, as a result of decreased reserves” (RN, CH 2).

In the subcategory “Emergency medical decisions” the importance of taking frailty into account in medical reasoning was described. Frailty was considered to influence the acute illness, and decisions about: drug treatment; the planned content of care and whether the patient should be admitted to hospital or discharged home.

“...to be extra attentive and think broadly due to underlying frailty” (Ph, CH 2).

Within the subcategory “Shorten the ED length of stay”, the risk of patient harm during waiting times was commented on, as was the importance of rapid care processes for patients living with frailty. Comments in the subcategory “Post-ED process” showed identification of frailty in the ED being considered to influence care, or support, after the emergency visit.

Means of communication

This category involves expressions that frailty assessment is a way to a concordant view of the concept and thus facilitate communication when discussing the patient on the team or at hand-off, but also as a means to follow the degree of frailty over time.

Non-productive assessment

Informants who stated that frailty assessment was unimportant expressed that it did not affect the care provided. In the subcategory “Lack of resources to take action”, respondents voiced a lack of either time or personnel to act on the obtained information. In the subcategory “Irrelevant to emergency care” the perspective was that the information about frailty was of no use in emergency care.

“The patients are here for a short time, and I don't think that it (frailty assessment) helps the work” (AN, CH 1).

The subcategory “Less important for younger patients” included experiences of that 65 years was too low an age limit, as many people of that age are still fit.

Discussion

The recommendation to identify frailty in older patients in acute care settings, is well-founded in extensive literature [31]. In comparison to traditional triage systems, CFS can effectively identify the risk of adverse outcomes in older individuals [32, 33]. Therefore, with this study, we aimed to understand how the CFS is used in a standard care ED setting, and what constitutes barriers and facilitators to using it. We found an overall completion rate of 47%, and most responders reported a positive attitude towards the CFS regarding its relevance, ease of use

and time consumption. The qualitative analysis contributed to a better understanding of what can influence the motivation for frailty assessment.

Demand

Regarding completion rate, results similar to ours have been reported for both CFS [19] and other frailty assessment tools [9]. A recent national survey in the UK [7] found a mean compliance rate of 50% for frailty assessment, but with a significant variation of 2.2–100%. McGrath et al. [19] reported an overall completion rate of 47%, although 73% for patients arriving by ambulance. These findings resonate well with our data, since staff were more likely to assess patients who arrived by ambulance and patients who belonged to the older age groups. These factors have previously been shown to be related, with patients over the age of 80 being the group most often arriving by ambulance [34].

The proportion of CFS assessments was mainly consistent with the daily pattern of occupancy in the ED [35], i.e., a lower proportion of patients were assessed with CFS during hours when workload is at its highest. Therefore, if an ED could allocate specific geriatric resources, as suggested as one of the facilitators in this study, it would likely be most beneficial during periods of peak workload. However, in this study, completion rates remained low even after midnight, indicating that other factors, in addition to workload, may be influencing the rates, especially as patient occupancy gradually decreases during the night [35].

The findings of this study, as well as previous reports, raise the question of what constitutes an acceptable completion rate? As emergency care staff find themselves in an environment characterised by fast pace and sometimes with a workload exceeding the available resources, reasoning is required about when and how frailty assessment is most effectively performed. One of the opinions expressed in this study was that 65 years of age is too young to serve as the cut-off for frailty assessment. Still, the potential benefit of a frailty assessment is to identify increased risk of adverse events regardless of chronological age [36], which would then be lost for many patients if too high an upper age limit was applied. Based on the age difference between the groups “patients with CFS-assessments” and “patients without CFS-assessments” (median 78 versus 76), one could hypothesise that staff in the present study prioritised assessing patients of older age because they are more likely to live with frailty. Alternatively, staff simply used their clinical judgement as a “first check”, before prioritising to use the CFS. Previous reports indicate that clinical judgement can be more sensitive but less specific to frailty, than both the CFS [14] and a Dutch tool screening for vulnerability for 1-year mortality (Veiligheids Management Systeem)

[37]. It would be worthwhile to assess the accuracy of an approach where ED staff first rely on their clinical judgement to identify potential frailty and then conduct a standardised CFS assessment, primarily for patients suspected of having frailty.

Acceptability

Relevance

Respondents in the current study rated the relevance of CFS in the ED at a median of five on a seven-point scale. Further, like in the study by Liu et al. [28], our qualitative analysis indicated that some staff adapted both nursing and medical management for patients living with frailty, and that whether a person was living with frailty or not was seen as important knowledge for adapting the continued care process to the person's needs. Although the low response rate precludes any definite conclusions, the results still suggest that the information obtained by CFS assessment has the potential to contribute to a more person-centred care in an ED-setting.

However, our analysis also showed that frailty assessment was perceived as irrelevant by the staff due to perceived lack of impact on care. Similar results of ED staff questioning the usefulness of frailty assessment have previously been reported [27, 28, 38]. The lack of precise knowledge about the effect of interventions for patients living with frailty may be a contributing factor to the experience that frailty assessment does not add value to patient care in the ED. Interventions such as geriatric assessment, discharge management and post discharge follow-up have been evaluated in an ED context, but with inconsistent results [39]. Based on the results from this and previous studies, and on our own experience from clinical ED settings, we believe that perceived relevance is a factor with major impact on the propensity to perform frailty assessments. Thus, going forward, significant efforts should be made to evaluate various ED-based interventions for older people living with frailty, as the triggering of effective interventions will most likely reduce the feeling among ED staff of a non-productive assessment.

Ease of use

CFS was rated as easy to use by the respondents (median 5 on a scale of 7), which is consistent with results from Elliot et al. [17] where CFS also scored well after being used on vignette cases. Nonetheless, it is likely a topic that should be revisited during implementation, as this study demonstrates that the CFS can be perceived as challenging, with difficulty posing the right questions. Perhaps a lack of self-perceived competence contributes to uncertainty and leads to the experienced barrier of "labelling the patient". The concern for categorising patients through frailty assessment has previously been

described [17, 38] and highlights the need for continuous ethical reflection and competence development regarding this complex patient group. As part of the training, the classification tree based on the CFS levels, developed by Theou et al. [40] may be used to assist in asking questions.

Barriers

This study identified "high workload," "forgetfulness," and "critically ill patient" as the perceived top three barriers to CFS assessment, all of which have been described as impediments to frailty screening [17, 27]. In addition, it was also voiced that an unspecific instruction had contributed to missed CFS assessments. In line with this, respondents expressed that clear instructions would facilitate. Conditions naturally vary among different EDs, but the result of this study suggests the completion rate would probably benefit from specifying the role/profession responsible for the assessment and/or the timing during the ED visit for when to do the assessment.

Strengths and limitations

This multicentre study's primary strength lies in its inclusion of personnel from EDs of varying sizes, organisational structures, and medical staffing, providing a diverse perspective. Additionally, the study conducted a demand analysis on a substantial number of patients, and its mixed-method design further adds to its robustness. While the detail and depth of data from open-text comments may be somewhat limited compared to data obtained from interviews, we contend that the experiences shared by a large number of participants serve the study's intended purpose. The breadth and descriptive nature of the results offer valuable insights for future research and clinical development in a relatively unexplored area. To enhance credibility, despite the inability to ask clarifying questions to anonymous respondents, the qualitative analysis involved two authors who diligently revisited the data to clarify its meaning.

Our study also had limitations. The CFS had recently been introduced into the participating EDs which may negatively affect the generalisability. Further, the study would have been enhanced if we had recorded which staff members conducted the assessments, allowing us to compare the profiles of CFS assessors and non-CFS assessors. The survey was designed for the current study, and even though it was tested and adjusted before its use, this may have affected the validity of the results. The survey was designed to be anonymous so that employees would feel comfortable answering it, hopefully resulting in a high response rate. However, the response rate was just under 50%, which may have biased the results, as it is possible that individuals who were explicitly positive or negative to frailty screening responded more

frequently than others. Although the pre-understanding was reflected on through the analysis process, it cannot be ruled out that our professional roles as ED care providers biased the synthesis of the results in the qualitative analysis. Finally, we aimed to study the time consumption for CFS assessment and therefore measured the time needed for completing the worksheet. However, as this only measures time taken to complete the paperwork rather than the actual time required for assessment, the data was excluded.

Conclusion

This study implies that the CFS shows potential for being effectively implemented in an ED setting because most participants found it relevant and easy to use. Yet, far from all older ED patients were assessed with CFS which points to challenges for implementation in clinical practice. The most common barrier to assessment was high workload. Measures to facilitate use may include clarifying the purpose of the assessment with explicit follow-up actions, as well as formulating a clear routine for the assessment.

Abbreviations

CFS	Clinical Frailty Scale
ED	Emergency department
UH	University hospital
CH	Community hospital
EMR	Electronic medical records
Ph	Physician
RN	Registered nurse
AN	Assistant nurse

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12873-023-00894-8>.

Supplementary Material 1

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Authors' contributions

E.H. and D.W. conceived and designed the study. D.W., R.T.J., S.M.E. and E.H. obtained permits. E.H., R.T.J. and S.M.E. conducted the data collection. E.H., S.M.E. and J.H. analysed the data. E.H. drafted the manuscript, D.W., J.H. and S.M.E. contributed to its revision.

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Data Availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki 2002 and approved by the Swedish Ethical Review Authority (permit 2021 – 00875). For phase one, informed consent was waived by the Swedish Ethical Review Authority. For phase two, staff provided their informed consent by answering the survey.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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References

1. Church S, Rogers E, Rockwood K, Theou O. A scoping review of the clinical Frailty Scale. *BMC Geriatr*. 2020;20(1):1–18.
2. Dent E, Martin FC, Bergman H, Woo J, Romero-Ortuno R, Walston JD. Management of frailty: opportunities, challenges, and future directions. *The Lancet*. 2019;394(10206):1376–86.
3. Kwak MJ. Delirium in Frail older adults. *Ann Geriatr Med Res*. 2021;25(3):150–9.
4. Elder NM, Mumma BE, Maeda MY, Tancredi DJ, Tyler KR. Emergency Department length of Stay is Associated with Delirium in older adults. *West J Emerg Med*. 2023;24(3):532–7.
5. Rosenberg MS, Carpenter CR, Bromley M, et al. Geriatric emergency department guidelines. *Ann Emerg Med*. 2014;63:e7–25.
6. Bellou A, Conroy SP, Graham CA. The European curriculum for geriatric emergency medicine. *Eur J Emerg Med*. 2016;23(4):239.
7. Knight T, Atkin C, Martin FC, et al. Frailty assessment and acute frailty service provision in the UK: results of a national 'day of care' survey. *BMC Geriatr*. 2022;22(1):1–9.
8. Ekermo D, Ronnäs M, Muntlin Å. Fundamental nursing actions for frail older people in the emergency department: a national cross-sectional survey and a qualitative analysis of practice guidelines. *J Adv Nurs*. 2023;79(8):3115–26.
9. Elliott A, Hull L, Conroy SP. Frailty identification in the emergency department—a systematic review focussing on feasibility. *Age Ageing*. 2017;46(3):509–13.
10. Bowen DJ, Kreuter M, Spring B, et al. How we Design Feasibility studies. *Am J Prev Med*. 2009;36(5):452–7.
11. Rockwood K, Song X, MacKnight C, et al. A global clinical measure of fitness and frailty in elderly people. *CMAJ Can Med Assoc J J Assoc Medicale Can*. 2005;173(5):489–95.
12. Rockwood K, Theou O. Using the clinical Frailty Scale in allocating Scarce Health Care resources. *Can Geriatr J CGJ*. 2020;23(3):210–5.
13. 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*. 2022;17(8):2407–18.
14. Hörlin E, Munir Erlingsson S, Henricson J, John RT, Wilhelms D. Inter-rater reliability of the clinical Frailty Scale by staff members in a Swedish emergency department setting. *Acad Emerg Med*. 2022;29(12):1431–7.
15. Preston L, Chambers D, Campbell F, Cantrell A, Turner J, Goyder E. What evidence is there for the identification and management of frail older people in the emergency department? A systematic mapping review. *NIHR Journals Library*; 2018.
16. Lewis ET, Dent E, Alkhouri H, et al. Which frailty scale for patients admitted via Emergency Department? A cohort study. *Arch Gerontol Geriatr*. 2019;80:104–14.
17. Elliott A, Phelps K, Regen E, Conroy SP. Identifying frailty in the Emergency Department—feasibility study. *Age Ageing*. 2017;46(5):840–5.
18. McIsaac DI, Taljaard M, Bryson GL, Beaulé PE, Gagné S, Hamilton G. m.fl. Frailty as a predictor of death or new disability after Surgery: a prospective cohort study. *Ann Surg*. 2020;271(2):283–9.

19. McGrath J, Almeida P, Law R. The Whittington Frailty Pathway: improving access to comprehensive geriatric assessment: an interdisciplinary quality improvement project. *BMJ Open Qual.* 2019;8(4):e000798.
20. Jarman H, Crouch R, Baxter M et al. Feasibility and accuracy of ED frailty identification in older trauma patients: a prospective multi-centre study. *Scand J Trauma Resusc Emerg Med* 2021;29.
21. Checa-Lopez M, Rodriguez-Laso A, Carnicero JA, et al. Differential utility of various frailty diagnostic tools in non-geriatric hospital departments of several countries: a longitudinal study. *Eur J Clin Invest.* 2023;53:e13979.
22. Bauer MS, Kirchner J. Implementation science: what is it and why should I care? *Psychiatry Res.* 2020;283:112376.
23. Schoonenboom J, Johnson RB. How to construct a mixed methods Research Design. *Kolner Z Soziol Sozialpsychologie.* 2017;69(Suppl 2):107–31.
24. Socialstyrelsen. Kompetensförsörjning och patientsäkerhet. Hur brister i bemanning och kompetens påverkar patientsäkerheten. [Internet]. 2018 [cited 2022 Mar 9]. Available from: <https://www.socialstyrelsen.se/globalassets/sharepoint-dokument/artikelkatalog/ovrigt/2018-2-15.pdf>.
25. The Ottawa Hospital. Clinical Frailty Scale (CFS) Training Module [Internet]. 2019. Accessed February 22, 2022. <https://rise.articulate.com/share/deb4rT02lvONbq4AfcmNRUudcd6QMts3#/>.
26. Ekerstad N. Den svenska versionen av Clinical Frailty Scale (CFS-9). Accessed June 27, 2023. <https://liu.se/artikel/instrument-att-skatta-skorhet>.
27. Blomaard LC, Mooijaart SP, Bolt S, et al. Feasibility and acceptability of the acutely presenting older patient screener in routine emergency department care. *Age Ageing.* 2020;49(6):1034–41.
28. Liu X, Le MK, Lim AYC, Koh EJ, Nguyen TN, Malik NA, editors. m.fl. Perspectives on frailty screening, management and its implementation among acute care providers in Singapore: a qualitative study. *BMC Geriatr.* december 2022;22(1):1–10.
29. Statistiska Centralbyrån [Internet]. [citerad 27 september 2023]. Questions and answers – question design in self-administered- and interview questionnaires. Tillgänglig vid: <https://www.scb.se/en/finding-statistics/statistics-by-subject-area/other/other-publications-non-statistical/pong/publications/questions-and-answers-question-design-in-self-administered-and-interview-questionnaires/>.
30. Hsieh H-F, Shannon SE. Three approaches to qualitative content analysis. *Qual Health Res.* 2005;15(9):1277–88.
31. Boucher EL, Gan JM, Rothwell PM, Shepperd S, Pendlebury ST. Prevalence and outcomes of frailty in unplanned hospital admissions: a systematic review and meta-analysis of hospital-wide and general (internal) medicine cohorts. *eClinicalMedicine.* 2023;59:101947.
32. Kappel Nissen S, Rueegg M, Carpenter CR, Kaeppli T, Busch JM, Fournaise A. m.fl. Prognosis for older people at presentation to emergency department based on frailty and aggregated vital signs. *J Am Geriatr Soc.* 2023;71(4):1250–8.
33. Ng CJ, Chien LT, Huang CH, Chauo CH, Gao SY, Chiu SYH. m.fl. Integrating the clinical frailty scale with emergency department triage systems for elder patients: a prospective study. *Am J Emerg Med.* 2023;66:16–21.
34. Henricson J, Ekelund U, Hartman J, Ziegler B, Kurland L, Björk Wilhelms D. Pathways to the emergency department - a national, cross-sectional study in Sweden. *BMC Emerg Med.* 2022;22:58.
35. Wretborn J, Henricson J, Ekelund U, Wilhelms DB. Prevalence of crowding, boarding and staffing levels in Swedish emergency departments - a National Cross Sectional Study. *BMC Emerg Med.* 2020;20(1):50.
36. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. *Lancet Lond Engl.* 2013;381(9868):752–62.
37. Calf AH, van den Lubbers S, Jansen CJ, van Munster BC. m.fl. Clinical impression for identification of vulnerable older patients in the emergency department. *Eur J Emerg.* 2020;27(2):137.
38. Pascall Jones P, Tomkow L. The value of qualitative data in Quality Improvement projects in the care of older adults: the case of frailty scores in the emergency department. *Age Ageing.* 2022;51(3):afac057.
39. Preston L, van Oppen JD, Conroy SP, Ablard S, Buckley Woods H, Mason SM. Improving outcomes for older people in the emergency department: a review of reviews. *Emerg Med J.* 2021;38(12):882–8.
40. Theou O, van der Pérez-Zepeda MU, Searle SD, Howlett SE, Rockwood K. A classification tree to assist with routine scoring of the clinical Frailty Scale. *Age Ageing.* 2021;50(4):1406–11.

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PAPER **IV**

Frailty Alerts Reduce Waiting Time and Length of Stay in the Emergency Department

Samia Munir Ehrlington^{1,2} | Jens Wretborn^{1,2} | Daniel Wilhelms^{1,2}

¹Clinical Department of Emergency Medicine, Linköping University, Linköping, Sweden | ²Department of Biomedical and Clinical Sciences, Linköping University, Linköping, Sweden

Correspondence: Samia Munir Ehrlington (kfakutenus@regionostergotland.se)

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ABSTRACT

Background: Prolonged emergency department waiting times are associated with increased mortality among older patients. In January 2025, the ED of Linköping University Hospital, Sweden, implemented a low-resource routine to expedite the workup of older patients living with frailty by prioritized physician assessment and subsequent workup.

Aim: To investigate if a frailty alert using the Clinical Frailty Scale followed by prioritized clinical assessment influences ED operating metrics.

Design: This was an observational before and after study of a pre-implementation group (control) and a post-implementation group (intervention) between October 2024 and February 2025.

Setting/Participants: Consecutive patients aged >64 years, with a documented CFS assessment during the ED visit at the Linköping University Hospital, Sweden, who consented to participation, were included.

Method: Standard ED operating metrics, *Time to physician*, *ED length of stay* (LOS), and *admission rates* were compared between a pre-implementation group and a post-implementation group.

Results: A total of 542 ED visits were analyzed (248 pre-implementation, 294 post-implementation). *Time to physician* was shorter in the post-implementation group at 31 min (IQR 15, 65) versus 44 min (IQR 20, 94) ($p < 0.001$). *ED LOS* was reduced from 352 (IQR 266, 515) to 319 (IQR 240, 458) minutes ($p = 0.014$). The *admission rate* was unchanged at 59% and 60% ($p = 0.4$).

Conclusion: Frailty alerts based on the CFS with prioritized workup reduced *ED LOS* and *time to physician* in older patients living with frailty in this single center study and may be a low-resource intervention to reduce the risks of adverse events in the ED.

Trial Registration: [ClinicalTrials.gov](https://clinicaltrials.gov) identifier: NCT06869148

1 | Background

Emergency departments (ED) face challenges from an increasingly aging population with an expected fivefold increase of ED presentations among those aged ≥ 86 years between 2010 and 2050 [1–3]. In Sweden, patients aged ≥ 65 years constitute around 20% of the population whilst accounting for 40% of all ED visits [4]. Older patients often wait longer for physician initial assessment [5, 6] more commonly display complex clinical presentations, and generally utilize more ED resources [7, 8],

partly due to atypical presentations and multiple comorbidities [7] requiring extensive workup [9–11]. Atypical presentations with nonspecific complaints recur frequently in older patients living with frailty [12], a syndrome characterized by decreased physiological reserve capacity [13]. Frailty has consistently been shown to predict adverse outcomes in the ED across diverse healthcare settings. Older adults living with frailty experience prolonged ED length of stay (ED LOS) [14–16], higher admission rates and longer hospital stay [13, 14, 16, 17], functional decline [12, 13, 17] and short-term mortality [14, 16, 17].

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There is an association between extended ED LOS and higher rates of in-hospital mortality in patients with limited autonomy and who are living with frailty [16, 18–20]. Prolonged ED LOS among older adults may be precipitated by the exclusive reliance on standard triage systems for initial risk assessment, as these tools have a well-documented bias toward undertriage in this patient population [21–23], thereby delaying both initial physician evaluation and subsequent diagnostic workup. This creates a downstream of delays that compounds in time, causing unnecessary delays and ultimately increasing the risk of adverse effects.

Among ED interventions aimed to reduce adverse events in older patients, specialized geriatric teams in the ED have been shown to reduce avoidable hospital admissions, ED re-attendance, and functional decline [24, 25]. Most interventions, however, fail to improve operational or patient related outcomes [26, 27]. Despite recommendations for early frailty assessment in emergency care settings [28], implementation and effectiveness of frailty alert systems remain insufficiently investigated. While whiteboard flagging using the Clinical Frailty Scale has facilitated staff prioritization of care [29], and electronic Clinical Frailty Scale alerts have enhanced timeliness of Comprehensive Geriatric Assessment for direct admissions to frailty assessment units [30], the impact of frailty alerts in a general ED without specialized geriatric resources remains a gap in our current knowledge.

At our general ED, at the Linköping University Hospital in Sweden, frailty assessments for elderly patients have been a clinical routine since 2021 and we have shown that frailty is associated with mortality, hospital admission and increased length of stay [14]. As a result, an addition to the clinical routine was introduced in January 2025 to act on the frailty assessment. The routine recommends that all patients aged > 64 years of age were recommended to receive an early CFS assessment and, if the patient was assessed as living with frailty (CFS > 4), a frailty alert would be documented in the electronic ledger where all current patients in the ED are displayed for the clinicians. Patients with frailty alert were to be prioritized for assessment by physicians and a plan for care to prevent possible iatrogenic complications such as delirium and falls was to be established according to guideline recommendations and patients' current status.

This study investigated whether the intervention of a frailty alert system with prioritized clinical workup affected emergency department length of stay and time to physician assessment in older patients living with frailty. The study also examined potential displacement effects on robust older patients attending the emergency department during the same period.

2 | Method

2.1 | Study Design and Setting

This was an observational, retrospective, before-after study comparing outcomes between a pre-implementation control period and a post-implementation intervention period. The study was carried out in the ED at Linköping University hospital, an urban tertiary care center serving a population of

approximately 170,000 inhabitants in Sweden. The ED receives around 50,000 visits annually. Patients aged > 64 years of age contribute to around 30% of these visits and approximately 50% of all hospital admissions from the ED. The intervention comprised early frailty identification using the Clinical Frailty Scale (CFS), preferably during triage, with documentation of frailty alerts (CFS > 4) in the electronic ED ledger, followed by prioritized physician assessment and targeted care planning by the treating team consisting of an emergency physician, a registered nurse, and an assistant nurse. Clinical outcomes were compared between a pre-implementation group (control period) and post-implementation group (intervention period). The data collection period occurred over 6 weeks in October–December, 2024 (pre-implementation group) and over 6 weeks in January–March, 2025 (post-implementation group). The study protocol was prospectively registered on ClinicalTrials.gov and the study was approved by the Swedish Ethical Review Authority (reference no: 2024-05740-01). No other relevant changes in ED operations were made during the study period.

2.2 | Selection of Participants

All patients visiting the ED during the study period aged > 64 years with a CFS score documented in the electronic health records were eligible for inclusion. Written information about the study and the possibility to opt out was sent by mail to all eligible patients. The patient or a proxy (a caretaker/next of kin) could opt out either by mail, email, or by telephone. In addition, patients were excluded who did not receive the opt out information (written information returned to the research team) and were not deceased according to the Swedish population registry.

2.3 | Outcome Measures

The primary outcome was ED length of stay. Secondary outcomes were: time to the first assessment by a physician, admission rate, and difference in ED length of stay between patients in different triage categories. All outcomes were compared between the pre-implementation and post-implementation period for the robust patients as well to investigate potential displacement effects.

2.4 | Statistical Analysis

2.4.1 | Data Analysis and Sample Size Calculation

Sample size calculation aimed to reduce length of stay for patients living with frailty in triage category 3 (urgent) to match that of robust patients aged > 64 years in triage category 2 (very urgent). Previous data collection in the same setting showed that triage category 3 contained the largest proportion of older patients living with frailty [14]. In the previous study cohort, 50% of patients > 64 years of age were assessed as CFS > 4 and the difference in ED LOS between patients with frailty in triage category 3 compared to robust patients in triage category 2 was 60 min. Given that the ED LOS varies less in the highest and lowest triage categories, we estimated that a realistic target in

effect size would be a 45-min reduction in LOS for patients living with frailty.

With an α level of 0.05, power of 0.8, an effect size of 45 min with a standard deviation of 150 min, a total of 176 patients were needed for follow-up in the post-implementation group. To account for approximately 20% loss to follow up and sub-group analysis, we aimed to include 240 patients with CFS > 4 in the pre- and post-implementation groups respectively. To explore possible secondary displacement effects of the clinical routine on robust ED patients (CFS < 5), the outcome measures were investigated for this group as well. With patients aged > 64 living with frailty constituting one third of assessed patients with 50% being CFS > 4, we aimed for 960–1440 for the total study population [14]. Data collection was finalized when the targeted number of patients with CFS > 4 was reached and no opting-out had been made within 5 weeks of receiving the study information, as stated in the ethics approval.

Descriptive statistics were reported as medians for continuous variables and percentages for categorical variables. Median for LOS was compared using the Wilcoxon rank sum test, and the admission rate was compared using Pearson's Chi-squared test or Fisher's exact test when the number of outcomes was lower than five in any group.

2.4.2 | Patient and Public Involvement

Research partners aged ≥ 65 years from a local patient involvement organization contributed to study design review and outcome selection. Further into the planning process, the research partners participated in the development of patient information materials, provided advice, and contributed information material and method of delivery.

3 | Results

3.1 | Characteristics of the Study Subjects

After exclusion of 228 patients, a total of 542 ED visits of patients living with frailty with > 64 years of age were included in the study, with 248 visits in the pre-implementation group and 294 visits in the post-implementation group (Figure 1). The proportion of patients assessed as CFS > 4 was 43.2% in the pre-implementation group and 45% in the post-implementation group. The mean age was similar for patients living with frailty in both cohorts (85 and 84 years) and the proportion of women was similar at 57% in the pre-implementation group and 55% in the post-implementation group (Table 1). In the robust groups, women constituted 47% in the pre-implementation group and 50% in the post-implementation group.

3.2 | Main Results

Overall ED LOS decreased for patients living with frailty from a median of 352 min for the control group to 319 min for the post-implementation group ($p=0.01$). Time to physician assessment decreased in the post-implementation group, from 44 to 31 min in the post-implementation group ($p<0.001$) (Table 2). The admission rate was unchanged at 59% in the control group and 60% in the post-implementation group ($p=0.4$) (Table 2). Both ED LOS and time to physician was reduced in triage acuity 1–3 subgroups, but increased in triage acuity 4 (less urgent) patients (Table 3).

3.3 | Displacement Effects

There were a total of 675 robust (CFS < 5) patients in the study with 323 pre-implementation and 352 post-implementation

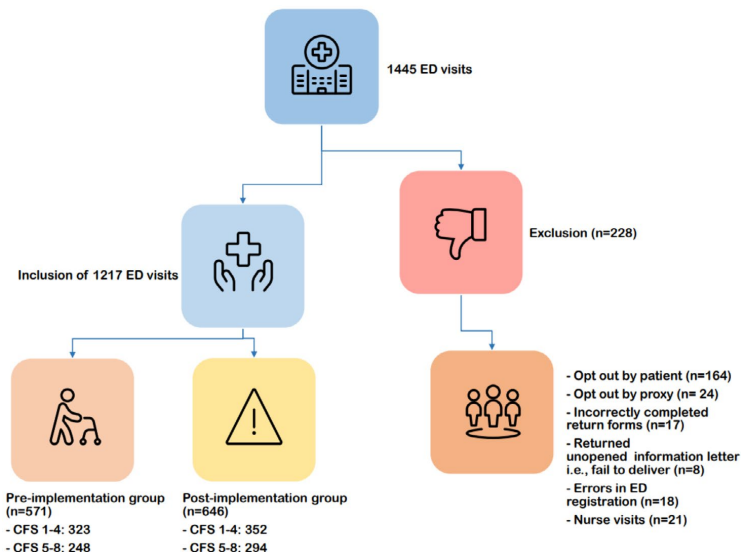


FIGURE 1 | Flowchart describing the inclusion process. CFS, Clinical Frailty Scale; ED, emergency department.

respectively. The mean age was 79 years of age and did not differ between the groups. There was a decrease in ED LOS from 317 to 303 min ($p=0.12$) and a significant decrease in time to physician, from 54 min in the pre-implementation group to 46 min for the post-implementation group ($p=0.02$). The admission rate was unchanged for robust patients at 41%.

TABLE 1 | Basic characteristics of the study cohort.

	Pre-implementation group ^a	Post-implementation group ^a
	Living with frailty (CFS > 4)	Living with frailty (CFS > 4)
<i>n</i>	248	294
Age, median (IQR)	84 (79, 89)	85 (79, 90)
Women (%)	142 (57%)	163 (55%)
CFS		
5	114 (46%)	142 (48%)
6	78 (31%)	78 (27%)
7	54 (22%)	72 (25%)
8	2 (0.8%)	2 (0.7%)
Mode of arrival		
Ambulance	162 (65%)	203 (69%)
Walk-in	77 (31%)	76 (26%)
Recumbent patient transport	6 (2.4%)	11 (3.7%)
Other	3 (1.2%)	3 (1%)
Triage category		
1 (Immediate)	8 (3.5%)	17 (6.3%)
2 (Very urgent)	102 (45%)	124 (46%)
3 (Urgent)	109 (48%)	123 (46%)
4 (Non-urgent)	8 (3.5%)	4 (1.5%)
Missing data	21 (9.2%)	26 (9.7%)

^aMedian (Q1, Q3); *n* (%).

4 | Discussion

In this observational before and after study in a single-center general ED, a clinical routine prioritizing patients based on CFS reduced ED LOS by 33 min and time to physicians by 13 min in frail patients. For patients in triage category 3 (urgent), the group with the largest proportion of patients living with frailty, the ED LOS was reduced by 25 min.

Reducing emergency department length of stay is particularly important for older patients, as prolonged stays increase mortality risk and hospital length of stay, creating further ED boarding [18, 20]. Decreases in ED LOS have been demonstrated in specialized geriatric EDs compared to ordinary EDs [31] and following interventions connected to geriatric teams where ED LOS significantly decreased from 19.1 to 12.7 h [32]. The first older people's Emergency Department in England demonstrated significantly lower ED LOS and waiting time to physician of 63 and 75 min respectively, compared to a main ED [33]. However, not all EDs have the resources to organize dedicated spaces and teams for geriatric patients, as is the case for our ED in Linköping, Sweden. These findings are therefore particularly relevant for general EDs operating without specialized geriatric resources, demonstrating that targeted frailty interventions can achieve meaningful improvements even in standard care settings.

The American College of Emergency Physicians' geriatric emergency department guidelines provide recommendations across six domains: staffing, equipment, education, policies and procedures, follow-up care, and performance improvement measures [34]. However, the feasibility of the recommendations has been questioned considering most EDs worldwide lack the resources to provide the level of service described [35]. In the present study, we could observe reduced ED LOS by prioritizing patients living with frailty without the addition of specialized geriatric resources. Even if the existing evidence to support ED interventions to reduce adverse events for older ED patients is limited [26, 27], interventions during hospital stay have shown promise in improving functional status, decreasing in-hospital length of stay, and readmissions [36]. Hence, reducing ED LOS may reduce morbidity by limiting the time spent in the ED and facilitating transfer to the hospital where the conditions to improve outcomes may be more favorable [20].

TABLE 2 | Emergency Department length of stay, admission, and waiting time to physician.

	Pre-implementation group ^a	Post-implementation group ^a	Difference (95% CI)	<i>p</i> ^b
	Living with frailty (CFS > 4)	Living with frailty (CFS > 4)		
ED length of stay in minutes, median (IQR)	352 (266, 515)	319 (240, 458)	33 (33 to 43)	0.014
Waiting time to physician	44 (20, 94)	31 (15, 65)	13 (12 to 19)	<0.001
Admission	145 (59%)	175 (60%)	1 (-7 to 9)	0.4

^aMedian (Q1, Q3); *n* (%).

^bWilcoxon rank sum test; Pearson's Chi-squared test; Fisher's exact test.

TABLE 3 | Emergency Department length of stay and waiting time to physician across different triage categories.

Triage category	Pre-implementation group ^a		Post-implementation group ^a		<i>p</i> ^b
	Living with frailty (CFS > 4)		Living with frailty (CFS > 4)		
1 (Immediate)					
ED length of stay in minutes, median (IQR)	308 (235, 792)		260 (176, 362)		0.3
Wait time in minutes, median (IQR)	18 (3, 72)		14 (1, 44)		0.9
2 (Very urgent)					
ED length of stay in minutes, median (IQR)	350 (259, 487)		308 (240, 432)		0.09
Wait time in minutes, median (IQR)	30 (259, 487)		24 (13, 52)		0.2
3 (Urgent)					
ED length of stay in minutes, median (IQR)	378 (283, 530)		342 (238, 505)		0.1
Wait time in minutes, median (IQR)	74 (34, 122)		49 (21, 99)		0.006
4 (Less urgent)					
ED length of stay in minutes, median (IQR)	285 (179, 584)		402 (318, 1090)		0.4
Wait time in minutes, median (IQR)	69 (21, 92)		71 (16, 129)		0.5

^aMedian (Q1, Q3).^bWilcoxon rank sum test; Pearson's Chi-squared test; Fisher's exact test.

The prioritization of specific patient groups inherently raises concerns regarding potential adverse effects on care delivery to other patient groups. Our findings, however, indicate the opposite of a displacement effect with waiting time for physician being reduced post-implementation and a trend toward shorter ED LOS for robust older patients as well. This may be caused by a phenomenon known as within-unit spillover. Within-unit spillover occurs when healthcare interventions targeting specific patients modify provider behavior throughout the unit, thereby affecting outcomes for non-targeted patients receiving care from the same providers [37]. In this instance, knowledge about the new routine could have influenced staff members and ED work up was prioritized in older patients in general, even when they were not assessed as living with frailty. Thus, our study highlights that frailty alerts may improve lead times for vulnerable patients, without causing a negative displacement effect on robust older patients.

Our results suggest that reductions in LOS can be achieved through simple measures in a general ED, making way for implementing similar routines in other EDs. This simple intervention, along with targeted actions to decrease the risk of short-term complications, could improve emergency care of older patients and additionally facilitate the overall ED patient flow.

In line with improving care for older ED patients, the patient aspect is vital to focus and build on. When Hörlin et al. [38] explored patient attitudes of being screened for frailty with CFS in our ED in Linköping, the results showed overall positive or

neutral experiences. The purpose of the frailty assessment was however not perceived as entirely clear, highlighting the need for future research to investigate if a low-resource frailty attuned routine has an impact on patient experience and reported outcomes, as well.

4.1 | Limitations

We did not collect data on the remaining patients in the ED, nor some confounding factors affecting the LOS, such as the number of consult requests or radiology requests during the stay. To minimize the effect of external factors such as staffing, the data collection periods for the control- and post-implementation groups were deliberately set in time periods with "ordinary" workflow, that is, not during holidays or extended vacations.

We did not find any displacement effects on robust patients, partly targeted by the intervention, which are also vulnerable to long ED LOS [19, 20]. However, we cannot fully exclude displacement effects in other, less vulnerable patient groups. It was deemed unfeasible to collect data on other groups as the Swedish Review Authority requested patient consent for displacement analysis as well.

There is a risk of selection bias as more than a third of the intended inclusion opted out ($n=188$, 39%). To counteract consistent exclusion of older patients in research, specifically involving routine data, the European Taskforce of Emergency Medicine advises ethics committees to carefully weigh the requirement

for informed consent against the need for developed guidelines and improved care for older patients living with frailty [39].

There was a nonsignificant increase in ED LOS and waiting times for older patients living with frailty in triage category 4 (less urgent), but this group was small (4 patients pre-implementation and 8 patients post-implementation), which limits any conclusions about this group.

We did not measure the impact of the clinical routine on individual clinicians and hence we do not know if there were other confounding factors influencing prioritization between the pre-implementation and post-implementation period. This was a pragmatic study and the recommendation to prioritize older patients living with frailty was inherently vague to clinicians as there may be many aspects to consider when prioritizing ED patients.

5 | Conclusion

Our study showed that frailty alerts, in a general ED without frailty units and geriatric teams, led to a significant decrease in ED LOS and waiting time to physician, without causing displacement effects on other older ED patients who did not have a frailty alert. Electronic frailty alerts as a clinical routine may improve ED flow whilst reducing adverse outcomes for vulnerable older patients.

Author Contributions

S.M.E. and D.W. conceived and designed the study. D.W. and S.M.E. obtained permits. S.M.E. and J.W. conducted the data collection. S.M.E. analyzed the data and drafted the manuscript, J.W. and D.W. contributed to its revision.

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Ethics Statement

The study was approved by the Swedish Ethical Review Authority (permit no. 2024-05740-01).

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data are available upon reasonable request. There is no plan to share individual participant data. Personal data related to this study are available upon request. Electronic data are stored in a protected network storage space. The signed consent forms are stored in a locked space without access for unauthorized personnel.

References

1. M. Ukkonen, E. Jämsen, R. Zeitlin, and S. L. Pauniah, "Emergency Department Visits in Older Patients: A Population-Based Survey," *BMC Emergency Medicine* 19, no. 1 (2019): 20.

2. G. George, "Effect of Population Ageing on Emergency Department Speed and Efficiency: A Historical Perspective From a District General Hospital in the UK," *Emergency Medicine Journal* 23, no. 5 (2006): 379–383.

3. E. Burkett, "Emergency Medicine and Population Ageing: A Call to Action," *Emergency Medicine Australasia* 36, no. 1 (2024): 4–5.

4. Swedish Council on Health Technology Assessment, "Omhändertagande av äldre som inkommer akut till sjukhus—med fokus på sköra äldre" [Internet], accessed July 1, 2025, https://www.sbu.se/contentassets/5f0e7213e73b4369acd4874fd3dcbf89/akutvard_aldre.pdf.

5. D. McIntyre and C. K. Chow, "Waiting Time as an Indicator for Health Services Under Strain: A Narrative Review," *Inquiry: The Journal of Health Care Organization, Provision, and Financing* 57 (2020): 46958020910305.

6. G. Malmer, A. Fällman, R. Åhlberg, P. Svensson, E. Westerlund, and B. A. Uggas, "Individual Patient Sociodemographic Characteristics Are Associated With Waiting Time to Physician Assessment in Seven Swedish Emergency Departments: An Observational 5-Year Cohort Study of Emergency Department Visits in the Stockholm Region," *JACEP Open* 6, no. 6 (2025): 100250.

7. M. R. Hofman, F. van den Hanenberg, I. N. Siersevelt, and C. R. Tulner, "Elderly Patients With an Atypical Presentation of Illness in the Emergency Department," *Netherlands Journal of Medicine* 75, no. 6 (2017): 241–246.

8. K. Erwander, K. Ivarsson, M. L. Olsson, and B. Agvall, "Elderly Patients With Non-Specific Complaints at the Emergency Department Have a High Risk for Admission and 30-Days Mortality," *BMC Geriatrics* 24, no. 1 (2024): 5.

9. E. Burkett, M. G. Martin-Khan, and L. C. Gray, "Comparative Emergency Department Resource Utilisation Across Age Groups," *Australian Health Review* 43, no. 2 (2019): 194–199.

10. G. Ogliairi, F. Coffey, L. Keillor, et al., "Emergency Department Use and Length of Stay by Younger and Older Adults: Nottingham Cohort Study in the Emergency Department (NOCED)," *Aging Clinical and Experimental Research* 34, no. 11 (2022): 2873–2885.

11. C. L. Shenvi and T. F. Platts-Mills, "Managing the Elderly Emergency Department Patient," *Annals of Emergency Medicine* 73, no. 3 (2019): 302–307.

12. N. R. Simon, A. S. Jauslin, R. Bingisser, and C. H. Nickel, "Emergency Presentations of Older Patients Living With Frailty: Presenting Symptoms Compared With Non-Frail Patients," *American Journal of Emergency Medicine* 59 (2022): 111–117.

13. A. Clegg, J. Young, S. Iliffe, M. O. Rikkert, and K. Rockwood, "Frailty in Elderly People," *Lancet (London, England)* 381, no. 9868 (2013): 752–762.

14. S. Munir Ehrlington, E. Hörlin, R. Toll John, J. Wretborn, and D. Wilhelms, "Frailty Is Associated With 30-Day Mortality: A Multicentre Study of Swedish Emergency Departments," *Emergency Medicine Journal* 41, no. 9 (2024): 514–519.

15. G. A. Solakoglu, "Evaluation of Factors Affecting the Length of Stay of Geriatric Patients in the Emergency Department" [Internet] (North Clinics of Istanbul, 2023), https://jag.journalagent.com/nci/pdfs/NCI-59319-RESEARCH_ARTICLE-SOLAKOGLU.pdf.

16. P. Iozzo, N. Spina, G. Cannizzaro, et al., "Association Between Boarding of Frail Individuals in the Emergency Department and Mortality: A Systematic Review," *Journal of Clinical Medicine* 13, no. 5 (2024): 1269.

17. H. L. Ellis, L. Dunnell, R. Eyres, et al., "What Can We Learn From 68 000 Clinical Frailty Scale Scores? Evaluating the Utility of Frailty Assessment in Emergency Departments," *Age and Ageing* 54, no. 4 (2025): afaf093.

18. J. W. Joseph, N. Elhadad, M. L. P. Mattison, et al., "Boarding Duration in the Emergency Department and Inpatient Delirium and Severe Agitation," *JAMA Network Open* 7, no. 6 (2024): e2416343.

19. L. Burgess, G. Ray-Barruel, and K. Kynoch, "Association Between Emergency Department Length of Stay and Patient Outcomes: A Systematic Review," *Research in Nursing & Health* 45, no. 1 (2022): 59–93.
20. M. Roussel, D. Teissandier, Y. Yordanov, et al., "Overnight Stay in the Emergency Department and Mortality in Older Patients," *JAMA Internal Medicine* 183, no. 12 (2023): 1378–1385.
21. A. Alshibani, M. Alharbi, and S. Conroy, "Under-Triage of Older Trauma Patients in Prehospital Care: A Systematic Review," *European Geriatric Medicine* 12, no. 5 (2021): 903–919.
22. C. Poncet, P. N. Carron, V. Darioli, T. Zingg, and F. X. Ageron, "Pre-hospital Undertriage of Older Injured Patients in Western Switzerland: An Observational Cross-Sectional Study," *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* 32, no. 1 (2024): 100.
23. K. Jang and Y. H. Seo, "Characteristics of Undertriaged Older Patients in the Emergency Department: Retrospective Study," *International Emergency Nursing* 75 (2024): 101477.
24. E. Chong, B. Zhu, H. Tan, et al., "Emergency Department Interventions for Frailty (EDIFY): Front-Door Geriatric Care Can Reduce Acute Admissions," *Journal of the American Medical Directors Association* 22, no. 4 (2021): 923–928.e5.
25. E. Chong, B. Zhu, S. H. X. Ng, et al., "Emergency Department Interventions for Frailty (EDIFY): Improving Functional Outcomes in Older Persons at the Emergency Department Through a Multicomponent Frailty Intervention," *Age and Ageing* 51, no. 2 (2022): afab251.
26. A. Memedovich, B. Asante, M. Khan, et al., "Strategies for Improving ED-Related Outcomes of Older Adults Who Seek Care in Emergency Departments: A Systematic Review," *International Journal of Emergency Medicine* 17, no. 1 (2024): 16.
27. M. Conneely, S. Leahy, L. Dore, et al., "The Effectiveness of Interventions to Reduce Adverse Outcomes Among Older Adults Following Emergency Department Discharge: Umbrella Review," *BMC Geriatrics* 22, no. 1 (2022): 462.
28. E. Moloney, M. R. O'Donovan, C. R. Carpenter, et al., "Core Requirements of Frailty Screening in the Emergency Department: An International Delphi Consensus Study," *Age and Ageing* 53, no. 2 (2024): afae013.
29. L. Brennan, K. Bentley, L. Edge, et al., "Flagging Frailty in the Emergency Department: A System to Identify and Visualise Frailty," *Age and Ageing* 53, no. S4 (2024): afae178.151.
30. C. McInnes, N. Moultrie, A. Wells, F. Campbell, E. Macdonald, and E. Tan, "1613 Improving Electronic Frailty Alerting in University Hospital Monklands: A Whole System Approach," *Age and Ageing* 52, no. S2 (2023): afad104.027.
31. C. J. Gettel, U. Hwang, A. T. Janke, et al., "An Outcome Comparison Between Geriatric and Nongeriatric Emergency Departments," *Annals of Emergency Medicine* 82, no. 6 (2023): 681–689.
32. P. Heeren, E. Devriendt, S. Fieuws, et al., "Unplanned Readmission Prevention by a Geriatric Emergency Network for Transitional Care (URGENT): A Prospective Before-After Study," *BMC Geriatrics* 19, no. 1 (2019): 215.
33. C. Meechan, N. Navaneetharaja, S. Bailey, et al., "Evaluation of the First Older People's Emergency Department in England—A Retrospective Cohort Study," *Journal of Emergency Medicine* 65, no. 1 (2023): e50–e59.
34. ACEP Geriatric, "Geriatric Emergency Department Guidelines" [Internet] (American College of Emergency Physicians, 2013), <https://www.acep.org/siteassets/sites/geda/media/documnets/geda-guidelines.pdf>.
35. R. D. Shih, C. R. Carpenter, V. Tolia, E. F. Binder, and J. G. Ouslander, "Balancing Vision With Pragmatism: The Geriatric Emergency Department Guidelines-Realistic Expectations From Emergency Medicine and Geriatric Medicine," *Journal of Emergency Medicine* 62, no. 5 (2022): 585–589.
36. Y. C. Wang, C. K. Liang, M. H. Chou, et al., "The Effectiveness of Frailty Intervention for Older Patients With Frailty During Hospitalization," *Journal of Nutrition, Health & Aging* 27, no. 6 (2023): 413–420.
37. I. Francetic, R. Meacock, J. Elliott, et al., "Framework for Identification and Measurement of Spillover Effects in Policy Implementation: Intended Non-Intended Targeted Non-Targeted Spillovers (INTENTS)," *Implementation Science Communications* 3, no. 1 (2022): 30.
38. E. Hörlin, D. Ekermo, D. Wilhelms, and A. C. Eldh, "Being Screened for Frailty in the Emergency Department: The Voice of Patients in an Exploratory Qualitative Study," *BMC Geriatrics* 26, no. 144 (2026), <https://doi.org/10.1186/s12877-026-06990-1>.
39. European Taskforce of Geriatric Emergency Medicine, "Promoting Uniform Data Reporting in Research on Older Individuals Living With Frailty in the Emergency Department: The Uststein Approach," *European Journal of Emergency Medicine*, ahead of print, September 16, (2025), <https://doi.org/10.1097/MEJ.0000000000001275>.



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Department of Biomedical and Clinical Sciences

Linköping University
SE-581 83 Linköping, Sweden

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