DANISH MEDICAL JOURNAL

Original Article

Dan Med J 2023;70(6):A09220558

Geriatric assessment may prevent readmission in frail medical inpatients

Astrid Heath[1, 2], Seham Shahla[1], Sofie Ran Lindhardt Bossen[1], Bo Løfgren[1, 3], Merete Gregersen[2, 3] & Troels Kjærskov Hansen[1, 2]

1) Medical Department, Randers Regional Hospital, 2) Department of Geriatrics, Aarhus University Hospital, 3) Department of Clinical Medicine, Aarhus University, Denmark

Dan Med J 2023;70(6):A09220558

ABSTRACT

INTRODUCTION. Frailty is common in older adults. Many approaches exist to care of hospitalised older medical inpatients. The objectives of this study were to 1) describe frailty occurrence and 2) explore associations between frailty, type of care, 30-day readmission and 90-day mortality.

METHODS. In a cohort of 75+-year-old medical inpatients with daily homecare or moderate comorbidity, frailty was graded as moderate or severe using the record-based Multidimensional Prognostic Index. The emergency department (ED), internal medicine (IM) and geriatric medicine (GM) were compared. Estimates of relative risk (RR) and hazard ratios were calculated in binary regression and Cox regression models.

RESULTS. Analyses included 522 patients (61%) with moderate frailty and 333 (39%) with severe frailty. A total of 54% were females, and the median age was 84 years (interquartile range: 79-89). In GM, the distribution of frailty grade differed significantly from that of the ED ($p < 0.001$) and IM ($p < 0.001$). GM had the highest occurrence of severely frail patients and the lowest readmission rate. Compared with GM, the adjusted RR for readmission in ED was 1.58 (1.04-2.41), $p = 0.032$; and in IM: 1.42 (0.97-2.07), $p = 0.069$. Between the three specialities, no differences were seen in 90-day mortality hazard.

CONCLUSION. In a regional hospital, frail older patients were discharged from all medical specialities. Admission to geriatric medicine was associated with a lower readmission risk and no increase in mortality. Comprehensive Geriatric Assessment may explain the observed differences in readmission risk.

FUNDING. None.

TRIAL REGISTRATION. Not relevant.

Frailty is associated with chronological age and predicts hospital readmission risk and mortality [1]. Frailty is defined as a state of reduced resilience to stressful events, resulting in an inappropriate response to environmental and health-related changes [2]. Previously, we found that 49% of older (75+ years) medical inpatients were frail at discharge [3]. During hospital admission, several approaches to the treatment and care of frail older patients apply. The Comprehensive Geriatric Assessment (CGA) is offered as a part of standard care in geriatric wards. The CGA is defined as *"a multidisciplinary diagnostic and treatment process that identifies medical, psychosocial, and functional limitations of a frail older person in order to develop a coordinated plan to maximise overall health"* [4]. The effect of CGA on mortality and readmission is disputed [5-7]. A pre-post cohort study compared CGA to standard care in an emergency department (ED) and reported a significant reduction of the 30-day readmission rate [8].

The CGA is offered as a standard component of ED care in some hospitals [7] but is not universally implemented because of political priorities and a shortage of qualified staff. Similarly, geriatric assessment is not a part of usual medical care for frail patients admitted outside geriatric wards. Different approaches to frailty may reflect in frailty-related outcomes. Hence, the presence of frailty among hospitalised older medical patients is of considerable clinical interest.

The objectives of this study were to: 1) describe and compare frailty in older medical patients admitted to a regional hospital and distributed in an ED, a group of medical wards and a geriatric ward; and 2) explore possible associations between three clinical approaches (ED, internal medicine and geriatric medicine) to frailty, risk of 30-day readmission and 90-day mortality.

METHODS

Design

We conducted a post-hoc analysis of a historical cohort of older medical inpatients [3]. Patients were consecutively included in the cohort when discharged from the hospital from 1 January to 21 June 2019. The inclusion and exclusion criteria were similar to those used in the original cohort study [3]: age 75 years or older; discharge from ED or medical departments at Randers Regional Hospital; reliance on daily assistance and/or a Charlson Comorbidity Index [9] ≥ 1; no hip fracture; not declared terminally ill or receiving palliative care upon admission.

The Multidimensional Prognostic Index (MPI) is a validated frailty measure originally developed for bedside use [10]. It includes information on physical functional capacity, cognitive status, co-morbidity, nutritional status, risk of pressure sores, use of medication and cohabitation, producing a tripartite frailty score (range: 1-3) [10]. Recently, the record-based MPI (rMPI) was validated on data collected from the patients' electronic health record for use in research [3, 11]. Like bedside MPI, the rMPI predicts unplanned readmission and mortality [3]. Here, we focused specifically on frail patients, defining frailty as an rMPI score ≥ 2 on the day of discharge. Patients were considered moderately frail with an rMPI score = 2, and severely frail with an rMPI score = 3.

Population and setting

Randers Regional Hospital is a public hospital located in the Central Denmark Region. The hospital covers four municipalities including a total of 227,000 inhabitants, 11% aged 75 years or older [12]. The hospital handles acute assessment, treatment and care of all medical conditions, except patients with ST-segment elevation acute myocardial infarction and stroke who are redirected to a nearby university hospital. In the ED, medical patients are assessed by a team of medical doctors dedicated to emergency medicine, medical doctors dedicated to internal medicine and nurses. Based on the initial assessment, patients are either discharged to primary care or referred for further in-hospital treatment. Patients discharged directly from the ED receive individualised assessment and treatment of their acute condition. The remaining patients are allocated to sub-specialised wards, e.g., cardiology and respiratory medicine, depending on their index diagnosis and the availability of medical beds. They receive sub-specialised medical treatment and care during admission. All patients referred for geriatric medicine receive multidisciplinary CGA. The CGA is performed by a team of doctors (senior geriatrician, registrars in geriatric medicine and junior medical doctors), nurses, occupational therapists and physiotherapists trained in geriatric care. An individualised treatment and care plan is prepared based on the assessment, involving the patient and his/her relatives.

Outcomes

The primary outcome was frailty grade measured by the rMPI. Secondary outcomes were unplanned 30-day readmission and all-cause 90-day mortality.

Data collection

The patients were frailty rated retrospectively by a trained registrar in geriatric medicine (TKH) [3]. Data were stored in a web-based data-recording system [13]. Further descriptive characteristics on sex, age, index diagnosis and outcome measures were collected retrospectively from the electronic health record, which is linked to the Civil Registration System [14].

Statistical analyses

The patients were stratified into three groups based on their allocation at discharge: 1) ED; 2) internal medicine (cardiology, respiratory medicine, infectious medicine, rheumatology, gastroenterology and endocrinology); and 3) geriatric medicine. First, we established and compared the patients' frailty grade across the ED, internal medicine wards and geriatric medicine. Second, comparisons of readmission and mortality risk were made. Inter-ward frailty score comparisons were made using the Kruskal-Wallis nonparametric ANOVA. Pairs of wards were compared using Dunn's test. Relative risk (RR) estimates for 30-day readmission were calculated in a binary regression model. Cumulative incidence of readmission was displayed with mortality as a competing risk factor using the Aalen-Johansen estimator. Hazard ratio (HR) estimates for 90-day mortality were calculated in a Cox regression model. Both models were adjusted for unevenly distributed variables and tested for interaction. The proportional hazards assumption was checked using log-log plots and by plotting the predicted versus the observed values. All assumptions were met.

Calculations were made using Stata version 17.0. The significance level was ≤ 0.05. Multiple comparisons significance levels were corrected using Bonferroni correction.

Ethics

The project was approved as a quality development project by the local hospital administration and the Regional Research Ethics Committee (197/2017). No further approval was required according to Danish law.

Trial registration: not relevant.

RESULTS

Descriptive characteristics

Among the 855 included patients, 54% were female. The median age was 84 years. Age was unevenly distributed between the wards with the oldest patients being discharged from the geriatric ward. The median length of stay (LOS) was four days, ranging from one day in the ED to eight days in geriatric medicine. Though all included patients were frail, patients discharged from geriatric medicine were more likely to be discharged to an institutionalised living facility, had a lower physical functional capacity and a higher degree of comorbidity. The patients are further described in **Table 1**.

TABLE 1 Descriptive characteristics.

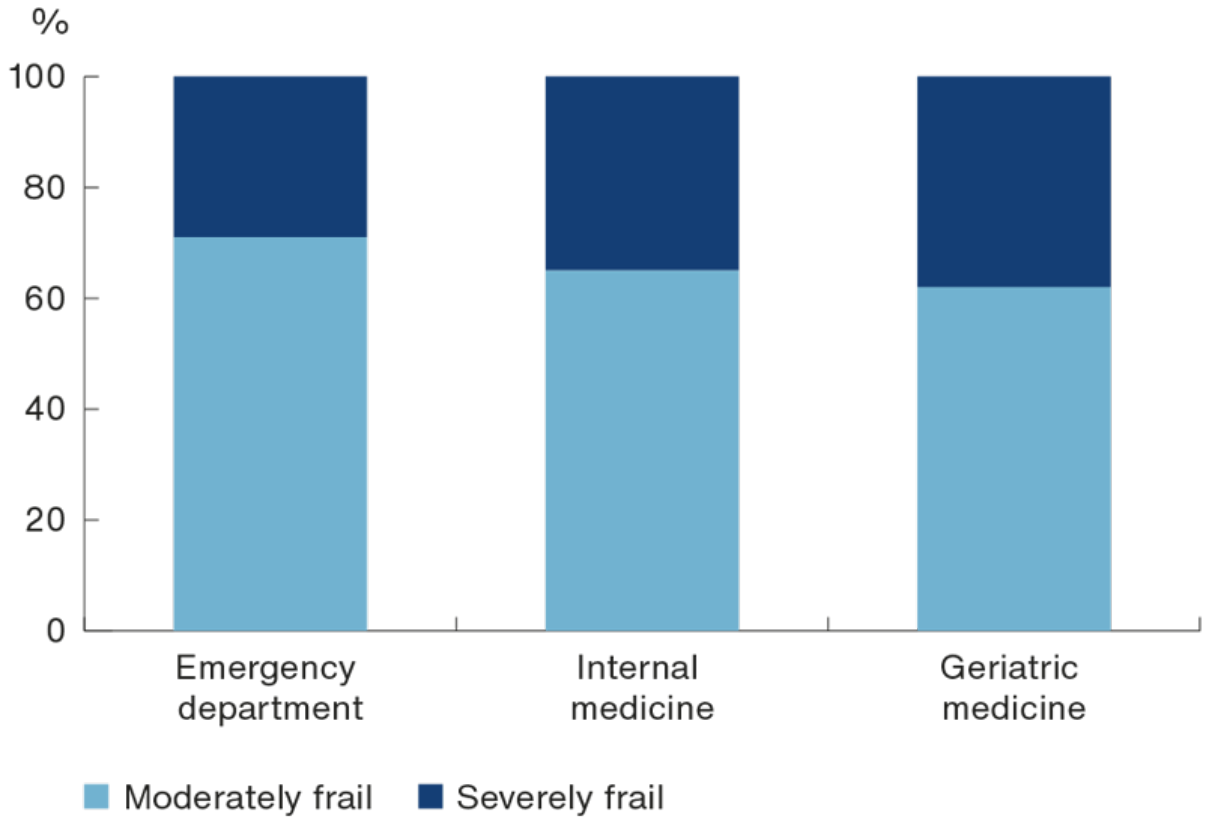
	Emergency department (N_E = 306)	Internal medicine (N_I = 361)	Geriatric medicine (N_G = 188)	Total (N_{tot} = 855)	p value
Sex, n (%)					0.21
Male	131 (43)	179 (50)	85 (45)	395 (46)	
Female	175 (57)	182 (50)	103 (55)	460 (54)	
Age, median (IQR), yrs	84 (79-89)	83 (79-88)	86 (82-91)	84 (79-89)	< 0.001
Length of stay, median (IQR), days	1 (1-1)	5 (3-8)	8 (5-11)	4 (1-7)	< 0.001
Dwelling at discharge, n (%)					
Cohabiting	78 (26)	98 (27)	41 (22)	217 (25)	0.39
Institutionalised living	62 (20)	52 (14)	50 (27)	164 (19)	0.002
Living alone	166 (54)	211 (59)	97 (52)	474 (55)	0.27
Daily use of prescription drugs, n (%)					
0-3	13 (4)	5 (1)	6 (3)	24 (3)	0.08
4-7	53 (17)	74 (21)	38 (20)	165 (19)	0.55
≥ 8	240 (78)	282 (78)	144 (77)	666 (78)	0.88
Physical functional capacity, median (IQR)					
FRS-ADL, range: 0-77	54 (34-69)	43 (31-63)	34 (15-43)	42 (29-63)	< 0.001
FRS-IADL, range: 0-23	13 (4-18)	12 (3-17)	5 (2-12)	10 (3-17)	< 0.001
Cognitive capacity, n (%)					
High	194 (63)	257 (71)	109 (58)	560 (66)	0.006
Moderate	54 (18)	63 (18)	41 (22)	158 (18)	0.41
Low	58 (19)	41 (11)	38 (20)	137 (16)	0.005
Risk of pressure sores, median (IQR)					< 0.001
ESS, range: 5-20	14 (13-15)	14 (12-15)	13 (10-14)	14 (12-15)	
Nutritional status, median (IQR)					< 0.001
MNA-SF, range: 0-14	8 (6-10)	8 (6-9)	6 (4-8)	7 (6-9)	
Comorbidity, CIRS-G, n (%)					
Low	1 (0)	0	0	1 (0)	0.41
Moderate	92 (30)	76 (21)	23 (12)	191 (22)	< 0.001
Severe	213 (70)	285 (79)	165 (88)	663 (78)	< 0.001
Leading cause of admission, n (%)					
Respiratory	58 (19)	143 (40)	75 (40)	276 (32)	< 0.001
Heart	74 (24)	97 (27)	15 (8)	186 (22)	< 0.001
Urinary tract	28 (9)	38 (11)	35 (19)	101 (12)	0.004
Fluid- and electrolyte	21 (7)	19 (5)	16 (9)	56 (7)	0.33
Endocrinology/hepatology	19 (6)	21 (6)	8 (4)	48 (6)	0.64
Neurological	14 (5)	1 (0)	4 (2)	19 (2)	< 0.001
Venous thrombosis	14 (5)	1 (0)	0	15 (2)	< 0.001
Anaemia	18 (6)	3 (1)	1 (1)	22 (3)	< 0.001
Other or unsettled	39 (13)	14 (4)	12 (6)	65 (8)	< 0.001
Other infections	15 (5)	17 (5)	20 (11)	52 (6)	0.01
Intoxication or iatrogenic	6 (2)	7 (2)	2 (1)	15 (2)	0.72

ADL = activities of daily living; CIRS-G = Cumulative Illness Rating Scale – Geriatrics; ESS = Exton Smith Scale; FRS = Functional Recovery Score; IADL = instrumental activities of daily living; IQR = interquartile range; MNA-SF = Mini Nutritional Assessment – Short Form.

Frailty

In total, 61% (n = 522) of the cohort was categorised as moderately frail (rMPI = 2) and 39% (n = 333) as severely frail (rMPI = 3). The highest percentage of severe frailty was seen in patients discharged from geriatric medicine. The distribution of moderate and severe frailty at discharge is presented in **Figure 1**.

FIGURE 1 Distribution of moderate and severe frailty at discharge.



When pairs of wards were compared for rMPI, the Bonferroni-corrected significance level was 0.008. The frailty distribution in the ED was not significantly different from the distribution in internal medicine ($p = 0.04$), whereas the distribution in geriatric medicine was different from both the ED ($p < 0.001$) and internal medicine ($p < 0.001$).

30-day readmission and 90-day mortality

Readmission and mortality rates are displayed in **Table 2**. The overall 30-day readmission rate was 24% (n = 208). Compared with geriatric medicine, the risk of readmission within 30 days after discharge was 61% higher (95% confidence interval (CI): 12-132%) among frail patients discharged directly from the ED ($p = 0.01$) and 50% higher (95% CI: 4-115%) among frail patients discharged from internal medicine. A similar pattern was seen when adjusting the relative risk for age, frailty grade, LOS and index diagnosis. Chronological age was not significantly associated with readmission risk ($p = 0.08$). Using five-year age strata, the analysis showed that higher age was associated with a reduced readmission risk, with a risk difference of –3% (95% CI: –6% to –1%) per five-year age increase ($p = 0.013$). No significant interactions were observed for 90-day mortality.

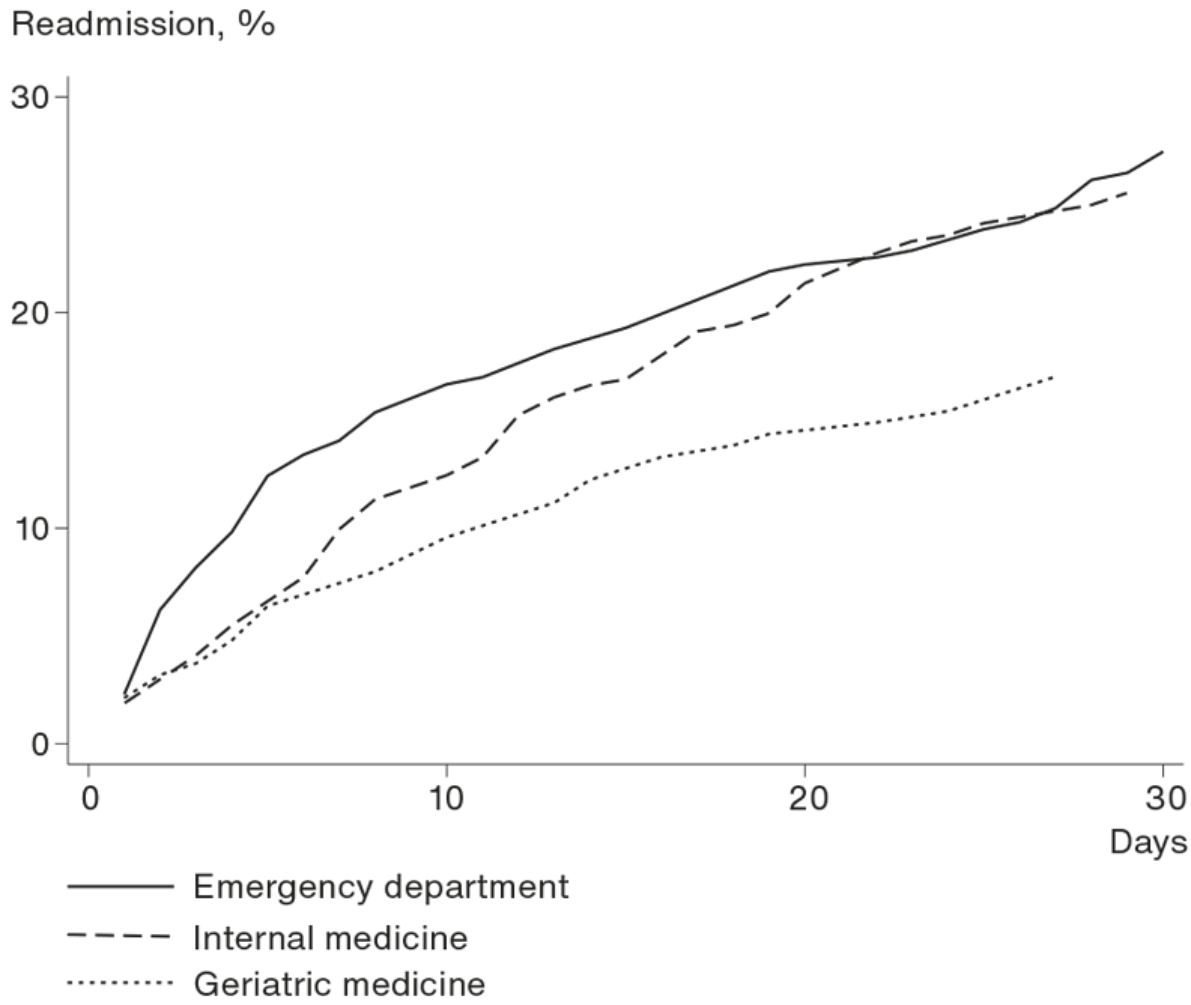
TABLE 2 Readmission and mortality according to degree of frailty.

	Geriatric medicine (N_G = 188)	Emergency department (N_E = 306)	Internal medicine (N_I = 361)
30-day readmission			
Readmission rate, n (%)	32 (17)	84 (28)	92 (26)
RR (95% CI) [p value]:			
Crude	1 (reference)	1.61 (1.12-2.32) [0.010]	1.50 (1.04-2.15) [0.029]
Adjusted[a]	1 (reference)	1.58 (1.04-2.41) [0.032]	1.42 (0.97-2.07) [0.07]
90-day mortality			
Mortality rate, n (%)	40 (21)	47 (15)	57 (16)
HR (95% CI) [p value]:			
Crude	1 (reference)	0.69 (0.54-1.05) [0.08]	0.71 (0.47-1.06) [0.09]
Adjusted[b]	1 (reference)	0.71 (0.43-1.19) [0.19]	0.78 (0.51-1.20) [0.26]
Adjusted[c]	1 (reference)	0.90 (0.53-1.52) [0.69]	0.95 (0.62-1.46) [0.82]

CI = confidence interval; HR = hazard ratio; RR = relative risk.
a) Adjusted for age, length of stay, leading cause of admission and Multidimensional Prognostic Index.
b) Adjusted for age, length of stay and leading cause of admission.
c) Adjusted for age, length of stay, leading cause of admission and Multidimensional Prognostic Index score.

Mortality was a competing risk to readmission, which was not adjusted for in the RR estimates. Instead, the analysis was adjusted for rMPI and thus indirectly for mortality. The 30-day readmission rate with mortality as a competing risk is displayed in **Figure 2**. As far as 90-day mortality is concerned, a non-significant, lower mortality hazard was observed in both the ED and internal medicine than in geriatric medicine. Adjusting the model for age, LOS, leading cause of admission and frailty further reduced the difference in mortality hazard.

FIGURE 2 Cumulative incidence of 30-day readmission by discharge department.



DISCUSSION

The main result was that the risk of readmission was lower among frail patients who received CGA during admission, without any increase in mortality. In line with our results, other studies reported a preventive effect of the CGA on readmission. Conroy et al. [8] compared the CGA to standard care among medical patients in an ED and found lower readmission rates among the oldest patients receiving CGA. Comparing CGA to standard care, Oates et al. [15] observed no difference in readmission risk despite higher degree of frailty among the patients receiving CGA. In contrast, two large randomised controlled trial (RCT)-based systematic reviews [5, 6] reported little or no difference in readmission risk when comparing CGA to standard care. Similarly, Gregersen et al. [7] observed no difference in 30-day readmission risk between 80+ year-old patients receiving CGA in a geriatric department and patients receiving standard medical care.

One possible explanation for the difference between our findings and some previous studies is the inclusion method. The rMPI allowed us to include *all* hospitalised frail older patients regardless of their age and physical

and cognitive capacity. Similarly, we were able to include patients without clearly defined conditions and patients diagnosed with multiple medical conditions. Our data visualised that moderate and severe frailty is a common condition among acutely admitted older medical patients discharged from all types of medical wards, including the ED. Although older, frail patients are the main target group of CGA, they were likely excluded from previous studies. The highest occurrence of severe frailty was observed among patients discharged from geriatric medicine. This result is in line with a previous frailty prevalence study using the Groningen Frailty Indicator at hospital admission [16]. Many moderately and severely frail patients were discharged directly from the ED or referred to other medical specialities, indicating that assessment and care within the framework of frailty should not be confined to older patients admitted to geriatric medicine.

Furthermore, other factors than the consistent offer of CGA to patients admitted to geriatric medicine may have influenced our results. Frail patients discharged from geriatric medicine were older, had longer admissions and were more frequently discharged to institutionalised living. Furthermore, the leading admission causes were unequally distributed across ED, internal medicine and geriatric medicine. However, when adjusting for these factors, our data still suggest a beneficial effect of admission to the geriatric ward. Other potential confounders, such as type of dwelling, physical functional capacity and comorbidity, were accounted for in the analyses by adjusting for frailty grade. The longer LOS among patients discharged from geriatric medicine may, in part, be explained by the CGA, which may be more time consuming than standard medical care. In our data, the return was prevention of a marked number of readmissions. The CGA may require more resources up front, but the real cost-effectiveness of CGA remains an important issue for future studies.

We argue that the CGA played an important role in reducing readmission risk among the frail older patients in our cohort. Multidisciplinary CGA includes tailored care planning and involvement of the patients' relatives, revealing multiple medical and social issues associated with readmission [17]. The CGA offers a systematic approach to uncover all aspects of illness and disease in older patients [18]. Therefore implementing the CGA among *frail* older medical patients may play an important role in future clinical practice. Training of healthcare professionals working outside the context of geriatric medicine in the handling of frail patients is essential as most frail older patients present to other internal medicine specialities during hospitalisation.

We observed no statistically significant difference in 90-day mortality across the wards though a trend of a lower mortality among patients discharged from the ED and internal medicine was observed. This was unsurprising as the rMPI is a well-established predictor of mortality [10]. However, the study did not have the power to make reliable comparisons of mortality.

Strengths and limitations

The strength of our work lies in the record-based frailty assessment and the dichotomous register-based outcomes, reducing the risk of selection bias and avoiding loss to follow-up. Still, the study design and sample size did not allow us to make further analyses of sub-groups, e.g., based on type of dwelling, specific diagnoses or age strata. This may have influenced the results as some dwellings and diagnoses may be associated with higher readmission risk, and readmission risk may be lower among the oldest old (90+ year olds). Despite adjustment for potential confounders, some residual confounding cannot be excluded. Our study was a post-hoc analysis of a previous study based on a cohort from a single medical centre. However, the cohort represents the full load of frail medical patients discharged from the hospital during almost six months, and the cohort is comparable to frail older medical patients elsewhere. The study was not blinded, which may have affected the results as some patients may attract more attention from primary care after discharge than other patients. Furthermore, not all readmissions may be considered unnecessary or preventable [19].

CONCLUSION

Frail older patients are discharged from all medical specialities at regional hospitals. The most severely frail patients were admitted to geriatric medicine in our data. Yet, these frailer patients had a lower 30-day readmission risk without any change in 90-day mortality. CGA was identified as a difference in the evaluation offered exclusively in geriatric medicine. Extending the use of the CGA beyond the geriatric departments may potentially reduce readmission rates among frail older patients in all medical specialities.

Correspondence *Astrid Heath.* E-mail: astrheat@rm.dk

Accepted 17 April 2023

Conflicts of interest Potential conflicts of interest have been declared. Disclosure forms provided by the authors are available with the article at ugeskriftet.dk/dmj

Cite this as Dan Med J 2023;70(6):A09220558

REFERENCES

1. Stillman GR, Stillman AN, Beecher MS. Frailty is associated with early hospital readmission in older medical patients. J Appl Gerontol. 2021;40(1):38-46. doi: 10.1177/0733464819894926.
2. Clegg A, Young J, Iliffe S et al. Frailty in elderly people. Lancet. 2013;381(9868):752-62. doi: 10.1016/s0140-6736(12)62167-9.
3. Hansen TK, Shahla S, Damsgaard EM et al. Mortality and readmission risk can be predicted by the record-based Multidimensional Prognostic Index: a cohort study of medical inpatients older than 75 years. Eur Geriatr Med. 2021;12(2):253-61. doi: 10.1007/s41999-021-00453-z.
4. Ward KT, Reuben DB. Comprehensive geriatric assessment. UpToDate, 2020. www.uptodate.com/contents/comprehensive-geriatric-assessment?search=comprehensive%20geriatric%20assessment&source=search_result&selectedTitle=1~73&usage_type=default&display_rank=1 (11 Jan 2021).
5. Ellis G, Gardner M, Tsiachristas A et al. Comprehensive geriatric assessment for older adults admitted to hospital. Cochrane Database Syst Rev. 2017;2017(9):CD006211. doi: 10.1002/14651858.CD006211.pub3.
6. Conroy SP, Stevens T, Parker SG, Gladman JRF. A systematic review of comprehensive geriatric assessment to improve outcomes for frail older people being rapidly discharged from acute hospital: 'interface geriatrics'. Age Ageing. 2011;40(4):436-43. doi: 10.1093/ageing/afr060.
7. Gregersen M, Pedersen ABL, Damsgaard EM. Comprehensive geriatric assessment increases 30-day survival in the aged acute medical inpatients. Dan Med J. 2012;59(6):A4442.
8. Conroy SP, Ansari K, Williams M et al. A controlled evaluation of comprehensive geriatric assessment in the emergency department: the 'Emergency Frailty Unit'. Age Ageing. 2014;43(1):109-14. doi: 10.1093/ageing/aft087.
9. Charlson ME, Pompei P, Ales KA, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis. 1987;40(5):373-83. doi: 10.1016/0021-9681(87)90171-8.
10. Pilotto A, Ferrucci L, Franceschi M et al. Development and validation of a multidimensional prognostic index for one-year mortality from comprehensive geriatric assessment in hospitalized older patients. Rejuvenation Res. 2008;11(1):151-61. doi: 10.1089/rej.2007.0569.
11. Hansen TK, Damsgaard EM, Shahla S et al. A reliable and record-based frailty assessment method for older medical inpatients. Eur Geriatr Med. 2020;11(5):803-812. doi: 10.1007/s41999-020-00345-8.
12. Statistics Denmark. Population 2019 2nd quarter. www.statistikbanken.dk/statbank5a/Selectout/pivot.asp
13. Harris PA, Taylor R, Thielke R et al. Research electronic data capture (REDCap) - a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42(2):377-81. doi: 10.1016/j.jbi.2008.08.010.

14. The National Centre for Register-based Research. The Danish Civil Registration System (CPR). https://econ.au.dk/the-national-centre-for-register-based-research/danish-registers/the-danish-civil-registration-system-cpr/browse (14 Jan 2021).
15. Oates DJ, Kornetsky D, Winter MR et al. Minimizing geriatric rehospitalizations: a successful model. Am J Med Qual. 2013;28(1):8-15. doi: 10.1177/1062860612445181.
16. Andela RM, Dijkstra A, Slaets JPJ, Sanderman R. Prevalence of frailty on clinical wards: description and implications. Int J Nurs Pract. 2010;16(1):14-9. doi: 10.1111/j.1440-172X.2009.01807.x.
17. Glans M, Ekstam AK, Jakobsson U et al. Risk factors for hospital readmission in older adults within 30 days of discharge - a comparative retrospective study. Article. BMC Geriatr. 2020;20(1):467. doi: 10.1186/s12877-020-01867-3.
18. Parker SG, McCue P, Phelps K et al. What is comprehensive geriatric assessment (CGA)? An umbrella review. Age Ageing. 2018;47(1):149-55. doi: 10.1093/ageing/afx166.
19. Benbassat J, Taragin M. Hospital readmissions as a measure of quality of health care: advantages and limitations. Arch Intern Med. 2000;160(8):1074-81.