Original Article

Screening instruments for identification of vulnerable older adults at the emergency department: a critical appraisal

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Abstract

Background: *Early detection of vulnerable older adults at the emergency department (ED) and implementation of targeted interventions to prevent functional decline may lead to better patient outcomes.*
Objective: *To assess the level of agreement between four frequently used screening instruments: ISAR-HP, VMS, InterRAI ED Screener and APOP.*
Methods: *Observational prospective cohort study in patients ≥ 70 years attending Dutch ED.*
Results: *The prevalence of vulnerability ranged from 19% (APOP) to 45% (ISAR-HP). Overall there was a moderate agreement between the screening instruments (Fleiss Kappa of 0.42 (p<0.001)).*
Conclusion: *Depending on the screening instrument used, either only a small percentage or almost as many as half of the presenting patients will be eligible for targeted interventions, leading to large dissimilarities in working processes, resources and costs.*

Keywords

emergency department, screening, vulnerability, ISAR-HP, VMS, InterRAI ED screener, APOP, older adults

Key points

- Early detection of vulnerability by screening at the ED and targeted interventions may lead to better patient outcomes.
- There is a fair to moderate level of statistical agreement on frailty between four current used screening instruments to identify vulnerable older adults at Dutch EDs.
- A large proportion of patients who are discharged home from the ED are classified as being vulnerable, but nonetheless do not necessary targeted interventions.

Introduction

Emergency departments (ED) experience an increased flow of vulnerable older patients in need of high levels of emergency healthcare.[1,2] These vulnerable older patients are at high risk of adverse outcomes, such as functional decline, increased length of hospital stay and mortality.[2,3] Early detection of vulnerability and targeted interventions may lead to better patient outcomes.[4,5] Current guidelines recommend implementation of the use of screening instruments either at the ED or at hospital admission.[6,7] Screening at the ED has the advantage of identifying all vulnerable patients who may benefit from targeted interventions, rather than only those who will be admitted to the hospital.[2,8] The importance of screening at an early stage is demonstrated by a retrospective cohort study with a sample of more than 170.000 older patients discharged home from EDs, which illustrated several safety concerns in this population.[9]

Although multiple screening instruments exist to identify vulnerable older adults, there is no gold standard to determine vulnerability in the emergency setting.[10] Available instruments focus on different aspects of vulnerability and adverse outcomes, ranging from prediction of the degree of functional decline to institutionalisation and mortality.[11–14] Despite these differences, they are used interchangeably. In the Netherlands the 'Veiligheidsmanagementsysteem' (VMS) and 'Identification of Senior At Risk-Hospitalized Patients' (ISAR-HP) are recommended by guidelines.[15,16] Other frequently used screening tools are the 'Resident Assessment Instrument' (InterRAI ED screener) and the 'Acutely Presenting Older Patient' (APOP).[13,14] Yet, the level of agreement between these four screening instruments and their ability to identify patients at risk in the ED remains unclear.[8]

Therefore, the aim of this study is to explore the level of agreement between four simple and frequently used screening instruments to identify vulnerable older adults at Dutch EDs: VMS, ISAR-HP, InterRAI ED screener and APOP.

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Methods

Design and setting

An observational prospective cohort study was conducted at the ED of the VU University Medical Center Amsterdam, Netherlands (VUmc). VUmc is an urban, tertiary care, academic medical center with approximately 30.000 ED presentations per year. In the period from August until December 2017, data were collected by two researchers during daytime and evenings on weekdays and four Saturdays, during 11 inconsecutively weeks. All subjects provided written informed consent. This study was approved by the medical ethical committee (METc) of the VUmc, and according to the declaration of Helsinki/good clinical practice.

Participants and sample size

All patients aged ≥ 70 years, and attending the ED during the 8 hour inclusion period each day, were screened for eligibility. Exclusion criteria were patients labelled as high urgency (according to the Manchester Triage System – code red), language barrier and inability to give informed consent. If a patient visited the ED more than once, only the first ED presentation was analysed. According to the power analysis, based on a power of 90% and a significance level of 5%, a sample size of 264 patients was needed.

Measurements

Data were collected by chart review and interviews with patients and their caregivers. At baseline, demographic data and care-related data were obtained. This included living situation (independency described as without any home help) and 'The Katz Index of Independence in Activities of Daily Living' (Katz ADL), ranging from 0-6 and independency defined as Katz index 0.[17] Patients and their caregivers were questioned about ED-visits or hospital admissions in the last month and falls in the past 6 months (yes/no). Polypharmacy was defined as ≥ 5 different prescriptions (yes/no). A moderate to high education level was defined as continued education after the age of 14 years.[11]

Patients were classified as vulnerable or non-vulnerable according to the four different screenings instruments: ISAR-HP, VMS, InterRAI ED screener and APOP. For a detailed description of these screening instruments see Supplementary Figure 1.[11–14] Prevalence of vulnerability was described as number of patients classified as at risk according to the instrument.

Statistical analyses

Baseline characteristics and descriptive statistics were described by mean (SD, standard deviation) in case of normal distributed data, or median [IQR, interquartile range] in case of skewed distribution. Differences between groups were tested by independent t-tests and the Chi-square test.

To describe the numeric accordance, the percentage of agreement was calculated. Cohen's Kappa was used in order to correct for chance and therefore a more accurate description. The level of agreement between the screening instruments all together was calculated using the Fleiss Kappa. Interpretation of both Kappa's was conform Landis and Koch,[18] with Kappa score <0 indicating no agreement, 0-0.20 slight, 0.21 – 0.40 fair, 0.41-0.60 moderate, 0.61-0.8 substantial and 0.81 to 1.0 almost perfect agreement.

All statistical analyses were performed with SPSS version 25 (IBM Corp, Armonk, NY, USA). A p-value <0.05 was considered statistically significant.

Results

Study population

In the 11 inclusion-weeks in the period between August 2017 and December 2017, a total of 1195 patients ≥70 years presented at the ED. Of these patients, 506 patients presented during the researchers presence at the ED and were assessed for eligibility. Subsequently, 250 patients were excluded for various reasons (see Figure 1), mainly because of the absence of informed consent. 47 out of 250 (19%) patients were regarded as not approachable by the medical staff, for example due to intoxication or severe illness. Finally, 256 patients were included in this study and were assessed by the four screening instruments.

The baseline characteristics of this study are provided in Table 1. The median age was 76 years (IQR 71-81) and 50% was male. At baseline, 167 out of 256 patients (67%) were independent in performing activities of daily living according to the Katz ADL index (67%). A total of 33 out of 256 patients (13%) already had another ED presentation in the last month and 30 out of 256 patients (12%) had been admitted in the last month. A total of 110

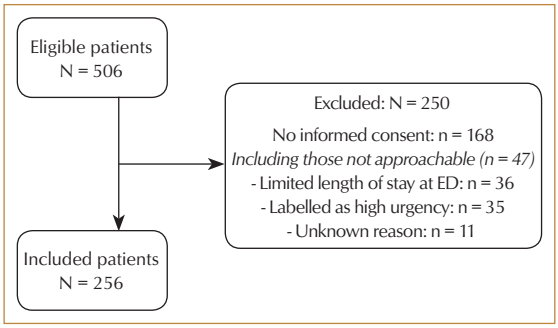

Figure 1. Flow-chart of inclusion

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Table 1. Baseline characteristics

	Total n=256	Not-admitted n = 146 (57)	Admitted n = 110 (43)
Age in years, median (IQR)	76 (71-81)	76 (71-81)	76 (71-81)
Male	128 (50)	70 (48)	58 (53)
Moderate - high education level	206 (81)	121 (83)	85 (77)
Polypharmacy	142 (56)	74 (52)	68 (62)
Living situation independent	171 (67)	107 (73)	64 (59)
Katz ADL independent	172 (67)	111 (76)	61 (56)
Last month presentation ED	33 (13)	20 (14)	13 (12)
Last month admission hospital	30 (12)	15 (10)	15 (14)
Fall in the past 6 months	102 (40)	51 (35)	51 (46)

Results are described as n (%) unless otherwise specified.

out of 256 (43%) patients were admitted to the hospital after ED presentation.

Screening instruments for vulnerability

The prevalence of vulnerability as reported by the screening instruments was lowest with APOP (19%), followed by InterRAI ED screener (22%), VMS (38%), and ISAR-HP (45%).

The lowest level of agreement was found between ISAR-HP and APOP, and was 70% with a Cohen's Kappa of 0.36 (p<0.001). (Table 2). The highest agreement was between InterRAI ED screener and APOP and was 86% with a Cohen's Kappa of 0.55 (p<0.001). The overall agreement as calculated by Fleiss Kappa was 0.42 (p<0.001). For the absolute number on agreement between all screening instruments, see supplementary table 1.

Differences in screening measures between admitted and non-admitted patients

The prevalence of vulnerability in patients that were not admitted after ED presentation varied from 9% (APOP) to 40% (ISAR-HP). (Table 3). While the prevalence of vulnerability in admitted patients ranged from 32% (APOP) to 52% (ISAR-HP). In contrast to ISAR-HP and VMS, APOP and InterRAI ED screener showed significant more negative scores in not-admitted patients compared to admitted patients.

Discussion

In this study, we found a fair to moderate level of statistical agreement between four simple and frequently used screening instruments to identify vulnerable older adults at EDs. Depending on the screening instrument used, the prevalence of vulnerability ranged from 19% to 45%.

These findings are in alignment with a recently performed prospective study comparing the predictive value of four other screening instruments for vulnerability at the ED.[19] The prevalence of vulnerability varied greatly, ranging from 18% by Fried to 66% (SOF-Model, by Ensrud). A similar variance of vulnerability was found by Bongue et al. (2017) in a secondary data analysis from the 'FréLE' cohort study.[20] Here, the prevalence ranged from

Table 2. Level of agreement

	VMS	ISAR-HP	InterRAI ED Screener	APOP
VMS		72% K = 0.43 p= <0.001	75% K = 0.41 p = <0.001	77% K= 0.44 p = <0.001
ISAR-HP	72% K = 0.43 p= <0.001		73% K = 0.42 p= <0.001	70% K = 0.36 p = <0.001
InterRAI ED Screener	75% K = 0.41 p = <0.001	73% K= 0.42 p= <0.001		86% K = 0.55 p = <0.001
APOP	77% K = 0.44 p = <0.001	70% K= 0.36 p = <0.001	86% K = 0.55 p = <0.001	

Numeric percentages of agreement (%), level of agreement as calculated using Cohen's Kappa (K).

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Table 3. High-risk labelled patients versus admission

N = 256	Admitted immediately after ED presentation		Chi-Square
	No n = 146 (57)	Yes n = 110 (43)	
ISAR-HP at risk			
No	88 (60)	53 (48)	p = 0.072
Yes	58 (40)	57 (52)	
VMS at risk			
No	95 (65)	65 (59)	p = 0.397
Yes	51 (35)	45 (41)	
InterRAI ED screener at risk			
No	128 (88)	73 (66)	p = <0.001
Yes	18 (12)	37 (34)	
APOP at risk			
No	133 (91)	75 (68)	p = <0.001
Yes	13 (9)	35 (32)	

Vulnerability versus admission after presentation at the emergency department. Results are described as n (%). Chi-Square is used to compare groups.

15% (Fried) to 52% (VES-13) in community-dwelling older adults at the ED.

These large differences are clinically very relevant, as either only a small percentage or as many as half of the patients will be eligible for targeted interventions, depending on the screening instrument that is used. Hence, if different screening instruments are used across different hospitals, undesirable dissimilarities in working processes, resources and costs will occur.

A second important observation from this study is that, depending on the screening instrument that was used, a third, up to half of the patients who are not-admitted after ED presentation, are classified as being vulnerable. Currently, these patients do not receive early interventions because nowadays screening for vulnerability is done when patients are hospitalised, and not at the ED. The importance of screening in an early stage is demonstrated by an earlier mentioned study in seniors discharged home from EDs, which illustrated several safety concerns.[9] 30-day follow-up showed death in 1%, and a return ED visit in 16%. A third visited their primary physician within 30 days. Only 30% of the EDs systematically screened older adults, with 17% using a standardized screening instrument. These results highlight the magnitude of vulnerable older patients at risk for adverse outcomes, but nonetheless sent home. This emphasizes the need for systematic screening at EDs and appropriate discharge planning.

In our study, the best agreement was found between InterRAI ED Screener and APOP. This is probably explained by the fact that these two instruments were validated at the ED, while ISAR-HP and VMS were validated for hospitalised patients at Internal Medicine wards only.[11–14] Hence, it seems not surprising that the use of APOP and InterRAI ED Screener resulted in significant differences in prevalence of vulnerability between admitted patients and not admitted patients, compared to ISAR-HP and VMS.

Multiple screening instruments have been developed in the past years to facilitate early screening for vulnerability.[8] In order to represent the Dutch circumstances at the ED, we examined these four particular screening instruments, since these are recommended by the guidelines (VMS, ISAR-HP) or developed or validated at Dutch EDs (InterRAI ED screener, APOP).[13,14,16,21]

An important strength of our study is the broad population of older patients included. Thus, the setting of this study closely represents clinical practice. Additionally, in contrast to previous studies, Cohen's Kappa is used and therewith provided better insight into the level of agreement. Cohen's Kappa represents the inequivalence of the screening instruments and implicates that they cannot be used interchangeably.

This study has several limitations, mainly due to selection bias. First, the patients were included over a limited period of time, particularly during daytime. Nonetheless, we think this had minimal effect on the results as a subgroup analyses showed no significant difference in characteristics, nor in the prevalence of vulnerability between patients included during daytime versus those included after office hours (data not shown). Additionally, another limitation of our study is also the relatively low participation rate. However, this is not unusual in studies performed in older patients acutely presenting at the ED.[21]

Thirdly, it should be emphasized that patients presenting with a delirium are not included in this study due to ethical concerns regarding the informed

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consent process. However, a validation study in risk screening for patients with a delirium with VMS showed a sensitivity of 82% with a specificity of 62%, in a cohort with exclusion of known delirium at admission.[23]

Conclusion

Our findings underscore the complexity in allocating targeted interventions given the diverse outcomes across different screening instruments that are used to identify vulnerability in older patients. The differences in prevalence of vulnerability show that tools measure various dimensions of vulnerability. Yet, there is no consensus on what the best measurement is of vulnerability for adverse outcomes as functional decline, nor if this reflects frailty in the absence of a gold standard.

Hence, our observations strengthen the need for a more consistent and validated screening instrument at the ED resulting in more effective and consistent operational services.

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Conflicts of interest

None declared.

Supplementary Data

Supplementary Figure 1. Overview of screening instruments

Screening instrument	Domain	Score		Recommended cut-off point patients at risk
		No	Yes	
ISAR-HP [11]	IADL - assistance Use of walking device Assistance for travelling Education after age 14	0 0 0 1	1 2 1 0	Total score ≥ 2 = at risk for functional decline*
VMS[12]	Delirium (sum of 3 items) Falls in the past 6 months Katz ADL index (sum of 6 items) Nutritional status (sum of SNAQ score[24] (3 items, maximum score 5)	0 0 ≤ 1 ≤ 1	1 1 2 2	Aged 70-80 ≥ 3 items yes = at risk for adverse outcome Aged ≥ 80 years ≥ 1 item yes = at risk for adverse outcome**
InterRAI ED screener [13]	Self-reliance index Self-rated Health Dyspnoea Unstable condition Family overwhelmed Self-rated Mood Support in Personal Hygiene ADL	Algorithm		Score 1-2 = unlikely to require further assessment or follow-up Score 3-4 = further assessment or follow-up when indicated Score 5-6 = further assessment or follow-up recommended
APOP [14]	**Functional decline:** Age Arrival by ambulance Number of different medications Assistance with bathing/showering Hospital admission past 6 months Home-help Dementia **Mortality:** Age Gender Living arrangements Fall prior to ED visit Indication for blood test at ED Needing help in dressing	Algorithm		Percentage ≥ 50 (%) chance to functional decline within 3 months *** Percentage ≥ 25 (%) chance to die within 3 months ***

* Functional decline defined as decline ≥ 1 on the Katz ADL index at 3 months of follow-up

** Adverse outcome defined as: decline ADL function and/or high health-care demand or death after 12 months of follow-up. Functional decline defined as decline ≥ 1 on the Katz ADL index at 3 months of follow-up.

*** Functional decline or mortality at 90-day follow-up.

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Supplementary table 1. Absolute number of agreement

		VMS		ISAR-HP		InterRAI ED screener		APOP		Total (n=256)
		Yes	No	Yes	No	Yes	No	Yes	No	
VMS	Yes			70 (27)	26 (10)	43 (17)	53 (21)	42 (17)	54 (21)	96 (38)
	No			45 (18)	115 (45)	12 (5)	148 (58)	6 (2)	154 (60)	160 (63)
ISAR-HP	Yes	70 (27)	45 (18)			50 (20)	5 (2)	43 (17)	72 (28)	115 (45)
	No	26 (10)	115 (45)			65 (25)	136 (53)	5 (2)	136 (53)	141 (55)
InterRAI ED Screener	Yes	43 (17)	12 (5)	50 (20)	5 (2)			33 (13)	22 (9)	55 (22)
	No	53 (21)	148 (58)	65 (25)	136 (53)			15 (6)	186 (73)	201 (79)
APOP	Yes	42 (16)	6 (2)	43 (17)	5 (2)	33 (13)	15 (6)			48 (19)
	No	54 (21)	154 (60)	72 (28)	136 (53)	22 (9)	186 (73)			208 (81)

Absolute number of agreement on both negative and positive test outcomes: n (%)

References

1. Pines JM, Mullins PM, Cooper JK, *et al.* National Trends in Emergency Department Use, Care Patterns, and Quality of Care of Older Adults in the United States. *J Am Geriatr Soc.* 2013;**61(1)**:12–7.
2. Aminzadeh F, Dalziel WB. Older adults in the emergency department: A systematic review of patterns of use, adverse outcomes, and effectiveness of interventions. *Ann Emerg Med.* 2002;**39(3)**:238–47.
3. Lee L, Heckman G, Molnar FJ. Frailty: Identifying elderly patients at high risk of poor outcomes. *Can Fam physician Médecin Fam Can.* 2015;**61(3)**:227–31
4. Ellis G, Whitehead MA, Robinson D, *et al.* Comprehensive geriatric assessment for older adults admitted to hospital: meta-analysis of randomised controlled trials. *BMJ.* 2011;343
5. Harari D, Martin FC, Buttery A, *et al.* The older persons' assessment and liaison team "OPAL": Evaluation of comprehensive geriatric assessment in acute medical inpatients. *Age Ageing.* 2007;**36(6)**:670–5.
6. Carpenter C, Bromley M, Caterino J, Al. E. Optimal older adult emergency care: introducing multidisciplinary geriatric emergency department guidelines from the American College of Emergency Physicians, American Geriatrics Society, Emergency Nurses Association and Society for Academic Emergency Med. *Acad Emerg Med.* 2014;**21**:806–9.
7. NICE Clinical Guideline. Multimorbidity : clinical assessment and management. 2016.
8. Carpenter CR, Shelton E, Fowler S, *et al.* Risk factors and screening instruments to predict adverse outcomes for undifferentiated older emergency department patients: A systematic review and meta-analysis. *Acad Emerg Med.* 2015;**22(1)**:1–21.
9. McCusker J, Roberge D, Vadeboncoeur A, Verdon J. Safety of discharge of seniors from the emergency department to the community. *Healthc Q.* 2009;12 Spec No(September 2016):24–32.
10. Rodríguez-Mañas L, Féart C, Mann G, *et al.* Searching for an operational definition of frailty: A delphi method based consensus statement. the frailty operative definition-consensus conference project. *Journals Gerontol - Ser A Biol Sci Med Sci.* 2013;**68(1)**:62–7.
11. Hoogerduijn JG, Buurman BM, Korevaar JC, Grobbee DE, De rooij SE, Schuurmans MJ. The prediction of functional decline in older hospitalised patients. *Age Ageing.* 2012;**41(3)**:381–7.
12. Heim N, van Fenema EM, Weverling-Rijnsburger AWE, *et al.* Optimal screening for increased risk for adverse outcomes in hospitalised older adults. *Age Ageing.* 2015;**44(2)**:239–44
13. InterRAI. (n.d.) InterRAI ED assessment system: enabling rapid screening and assessment for older adults in the emergency department. [Internet] 2011. [cited August 2017). Available from: http://www.interrai.org/assets/files/interRAI-ED-- A4.pdf
14. De Gelder J, Lucke JA, De Groot B, *et al.* Predicting adverse health outcomes in older emergency department patients : the APOP study. *Neth J Med.* 2016;**74(8)**:342–52.
15. Molag ML, Golüke-Willemse GAM, Arens AJ, Barneveld TA. De richtlijn "Comprehensive geriatric assessment." *Ned Tijdschr Geneeskd.* 2011;**155**:1–4.
16. Golüke-Willemse G, Arends A, Huinink E *et al.* Richtlijn "Comprehensive geriatric assessment." NVKG. 2010.
17. Katz S, Ford AB, Moskowitz RW, *et al.* Studies of Illness in the Aged. The Index of ADL: a Standardized Measure of Biological and Phychosocial Function. *JAMA.* 1963;**185(12)**: 914-19;
18. Landis J, Koch G. The measurement of observer agreement for categorial data. *Biometrics.* 1977;**33(1)**:159–74.
19. Wou F, Gladman JRF, Bradshaw L, *et al.* The predictive properties of frailty-rating scales in the acute medical unit. *Age Ageing.* 2013;**42(6)**:776–81.
20. Bongue B, Buisson A, Dupre C, *et al.* Predictive performance of four frailty screening tools in community-dwelling elderly. *BMC Geriatr.* 2017;**17(1)**:1–9.
21. VMS. Praktijkgids Kwetsbare Ouderen. VMS Veiligheidsprogramma. 2009.
22. Buurman BM, Hoogerduijn JG, van Gemert EA, *et al.* Clinical characteristics and outcomes of hospitalized older patients with distinct risk profiles for functional decline: A prospective cohort study. *PLoS One.* 2012;**7(1)**.
23. Oud FMM, de Rooij SEJA, Schuurman T, *et al.* Predictive value of the VMS theme "Frail elderly": delirium, falling and mortality in elderly hospital patients. *Ned Tijdschr Geneeskd.* 2015;**159**:A8491.
24. Kruizenga HM, Seidell JC, de Vet HCW, *et al.* Development and validation of a hospital screening tool for malnutrition: The short nutritional assessment questionnaire (SNAQ©). Clin Nutr. 2005;**24(1)**:75–82.

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