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The predictive value of the 'VMS frail older patients' for adverse outcomes in geriatric inpatients

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ABSTRACT

Background/Objective: The Dutch Safety Management system (VMS) screening for frail older patients is used as a predictor for adverse outcomes. We aimed to determine the predictive value of the VMS for adverse outcomes in geriatric inpatients.

Design: Retrospective cohort study in geriatric inpatients. Outcomes were institutionalization, readmission and mortality (3- and 12-months). Logistic regression analysis was performed to assess the predictive value of the number of positive VMS domains, a VMS score ≥1, and individual domains for adverse outcomes.

Results: We included 477 patients. Median age was 85 years (54–99) and 37% were male. Eighty-seven % scored positive on delirium risk, 57% on fall risk, 39% on malnutrition and 64% on physical impairment. One-hundred-thirty-five patients (28%) were institutionalized, 78 patients (16%) were readmitted and mortality rate was 127 (27%) at 3 months and 184 (39%) at one year. The VMS was not predictive for readmission (OR 1.6; 95%-CI 0.2-13.7) and mortality, (OR 0.6 95%-CI 0.2-2.0 and OR 1.1; 95%-CI 0.3-3.7). For institutionalization, delirium risk (OR 2.2; 95%-CI 1.1-4.4), physical impairment (OR 1.8; 95%-CI 1.1-2.9) and a positive score on all four domains were predictive (OR 12.1 95%-CI-1.4-101.7). Malnutrition was predictive for readmission (OR 1.74; 95%-CI 1.05-2.91) and three-month mortality (OR 1.69; 95%-CI 1.11-2.57), delirium risk for one -year mortality (OR 2.0; 95%-CI 1.0-4.0) .

Conclusions: Almost all geriatric inpatients scored positive on at least one domain of the VMS. The number of positive VMS domains had some predictive value for institutionalization. Individual domains were able to predict adverse outcomes.

Impact statement

We certify that this work is novel clinical research. Our study presents some unexpected results. The Dutch VMS (Safety Management System) frail older patients', a multidomain frailty instrument, had limited predictive value for adverse outcomes in geriatric inpatients. In our population of geriatric inpatients almost all patients scored positive on at least one VMS domain and could be considered as frail. This is in contrast with previous literature where a lower percentage of geriatric inpatients was classified as frail and multidomain frailty scores were predictive for adverse outcomes.

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1. Introduction

Geriatric inpatients are at risk for adverse outcomes such as functional decline, readmission or mortality. (Clegg et al., 2013 Feb 7) They tend to be frail, with a high prevalence of geriatric syndromes. Frailty is a syndrome characterised by declined physiologic reserve and function, leading to increased vulnerability for adverse health outcomes. (Clegg et al., 2013 Feb 7) Although we consider all patients at risk, it is still important to identify those at highest risk of adverse outcomes, in order to take preventive measures, guide decision-making and make a tailor-made treatment plan.

A recent study showed that a cumulative multidomain instrument can be used to predict adverse outcomes in geriatric patients. (Gregersen et al., 2020) A Dutch multidomain instrument, the Safety Management System (VMS) for frail older patients, is increasingly used as a prediction instrument for adverse health outcomes, both in clinical practice and in research. The VMS frail older patients was originally implemented to prevent functional decline due to hospitalisation in patients aged 70 year or older. The VMS assesses the risk for four geriatric syndromes: delirium, falls, malnutrition and functional impairment. (de et al., 2009, Oud et al., 2015, Heim et al., 2015 Mar) When a patient scores positive on any of the four domains, preventive measures should be taken according to a standard protocol adjusted to the individual patient. Research in hospitalized older patients showed that the VMS frail older patients can predict adverse outcomes, such as mortality, increased length of hospital stay and discharge to a care facility. (Oud et al., 2015, Heim et al., 2015 Mar, Warnier et al., 2020 Apr 1)

Even though the VMS is implemented in all geriatric departments in the Netherlands, there are no research data available on the ability of the VMS frail older patients to identify patients at risk of adverse outcomes in geriatric inpatients. The aim of this study is to determine the predictive value of VMS frail older patients for institutionalization, readmission and mortality in geriatric inpatients.

2. Method

All patients admitted for at least 24 h to the geriatric ward of a teaching hospital, in the Netherlands, in 2015 were retrospectively included. Patients younger than 70 years were not excluded, because their admission to a geriatric ward implicated that they were frail and at risk for adverse outcomes regardless of their age. If a patient was admitted to the geriatric ward more than once in that year, data of the first admission were used.

Baseline data from the comprehensive geriatric assessment, such as comorbidity, polypharmacy, cognitive impairment, incontinence and pressure ulcers, treatment limitations and VMS scores were collected from the hospital files. Follow up data about institutionalization, readmission (≥24 h) within three months after discharge were also collected from the hospital files. Mortality data within three months and twelve months was extracted from the Municipal Personal Records Database. Diagnoses made during admission were collected from the discharge letter. Comorbidity was scored with the Charlson Comorbidity Index. (Charlson et al., 1987) Polypharmacy was recorded if a patient used five or more medications. Institutionalization was defined as a new admission to a nursing home after hospitalisation.

Fig. 1 shows the VMS frail older patients questionnaire. (de et al., 2009, Kruizenga et al., 2005 Feb 8, Katz et al., 1963) A cumulative score was calculated by adding up the number of positive domains. Patients scored high risk if they were positive on one or more domains. (Warnier et al., 2020 Apr 1, Van Munster et al., 2016)

The medical ethical committee of a University Medical Centre decided no formal ethical assessment of the protocol was necessary. The patient data were analysed anonymously.

2.1. Data analysis

Descriptive statistics were given for all baseline demographic and clinical data. Baseline characteristics were compared between all patients with an adverse outcome (new institutionalization, readmission or mortality) and patients without an adverse outcome. Differences were tested with the Chi Square test for nominal data and with the Mann-Whitney U test for ordinal and non-normally distributed continuous variables.

The predictive values of the VMS cumulative score, the cut-off score (≥ 1 domain positive) and the four individual VMS domains for institutionalization, readmission and mortality were analysed by logistic regression.

Patients who died during admission were excluded for the analysis of institutionalization and readmission. Patients who already lived in an institution were excluded for analysis of new institutionalization and patients who died during three months follow up and had not been readmitted, were excluded from the analysis of readmission.

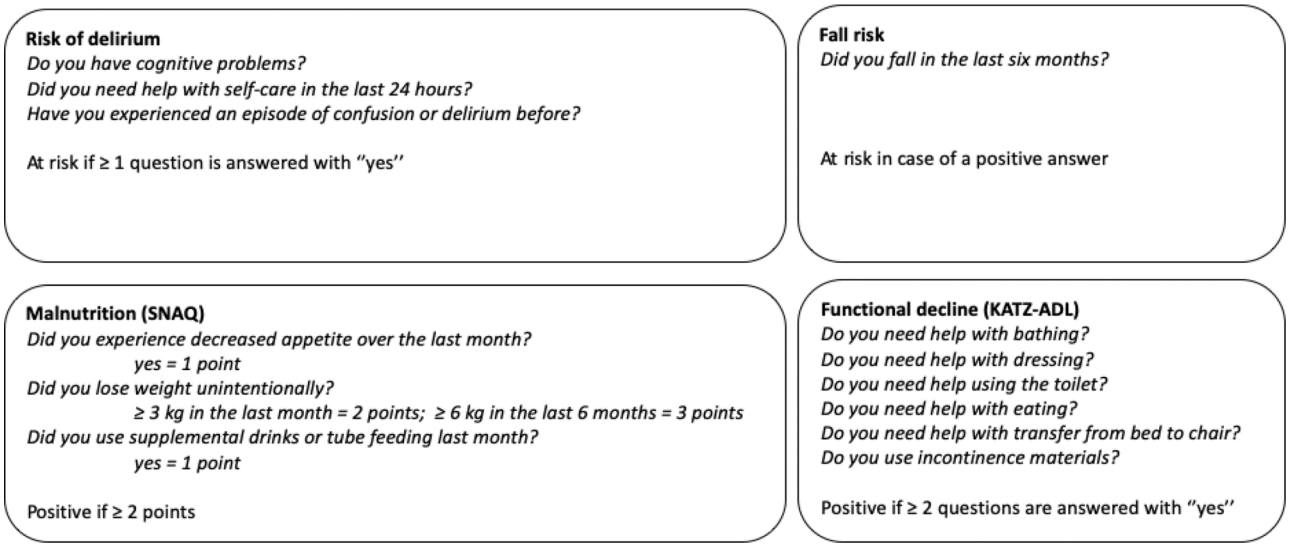

Fig. 1. VMS frail older patients questions
SNAQ: Short Nutritional Questionaire. Katz-ADL6: Katz-Activities of Daily Living 6-item.

Table 1
Patient characteristics.

Variable	Total *n*=477	No adverse outcomes *n*=203	Any adverse outcome *n*=272	*P* -value
Age, years (median, range)	85 (54–99)	83 (54–98)	85 (56–99)	<0.01
Sex, male, n (%)	177 (37)	72 (36)	105 (39)	0.49
CCI (median, range)	1 (0–8)	1 (0–8)	1 (0–8)	0.85
Polypharmacy, n (%)	313 (66)	140 (70)	173 (64)	0.62
Cognitive impairment	135 (28)	64 (32)	71 (26)	0.20
MCI, n (%)	100 (21)	42 (20)	58 (21)	0.87
Dementia, n (%)				
Living independently (%)	356 (76)	137 (68)*	226 (38)*	<0.01*
Pressure ulcers, n (%)	56 (12)	15 (8)	41 (15)	0.08
Urological problems				
Incontinence, n (%)	203 (43)	81 (40)	122 (45)	0.11
Urinary catheter/ urostoma, n (%)	73 (15)	23 (11)	50 (18)	0.02
VMS positive domains (median, range)	3 (0–4)	3 (0–4)	3 (0–4)	0.15
0, n (%)	11 (3)	6 (3)	5 (2)	
1, n (%)	61 (13)	25 (12)	36 (13)	
2, n (%)	123 (26)	59 (29)	64 (24)	
3, n (%)	161 (34)	72 (36)	88 (33)	
4, n (%)	87 (18)	29 (14)	57 (21)	
VMS (≥1), n (%)	430 (90)	185 (91)	245 (90)	0.45
Individual VMS domains				
Delirium risk, n (%)	417 (87)	176 (87)	241 (88)	0.37
Fall risk, n (%)	270 (57)	130 (64)	150 (55)	0.73
Malnutrition, n (%)	188 (39)	66 (33)	122 (45)	0.01
Physical impairment, n (%)	300 (63)	129 (63)	171 (63)	0.79
Diagnoses during admission	290 (61)	112 (55)	178 (65)	0.23
Infectious disease, n (%)				
Water / electrolyte disturbance, n (%)	249 (52)	108 (53)	141 (52)	0.87
Gastrointestinal disease, n (%)	204 (43)	83 (41)	121 (45)	0.41
Cardiovascular disease, n (%)	103 (22)	35 (17)	68 (25)	0.04
Respiratory disease, n (%)	22 (5)	9 (4)	13 (5)	0.86
Problems with balance, n (%)	145 (30)	62 (32)	83 (31)	0.96
Renal insufficiency, n (%)	141 (30)	46 (23)	95 (35)	<0.01
Delirium, n (%)	177 (37)	61 (30)	116 (43)	0.01
Other, n (%)	291 (61)	121 (60)	170 (63)	0.49
Treatment limitations, n (%)	393 (82)	164 (81)	229 (84)	<0.01

Defined by VMS frail older patients, see Fig. 1. Adverse outcome= new institutionalization, readmission or mortality within 3 months. CCI= Charlson Comorbidity Index. MCI= Mild Cognitive Impairment. * 112 patients were not at risk for new institutionalization.

All analyses were performed using the Statistical Package for Social Sciences (SPSS) software, version 26.

3. Results

We included 477 patients. Median age was 85 years (range 54–99) and 37% was male. A complete score on all four domains of the VMS was available in 443 (93%) patients. The baseline characteristics are shown in Table 1. A positive score on delirium risk was found in 87%, 57% scored positive on fall risk, 39% on malnutrition and 63% on physical impairment. Eleven (2%) of the patients did not score positive on any of the VMS domains. The patients who did not score positive on any of the VMS domains, had other frailty characteristics such as polypharmacy and multimorbidity. The median number of positive domains was 3 (*n*=161, 34%).

3.1. Institutionalization, readmission and mortality

At discharge 135 patients (28%) were newly institutionalized. During 3-month follow up 78 patients (16%) were readmitted to hospital. During their hospital admission 39 patients (8%) died, overall mortality after three-month follow up was 27% (127 patients) and after one year 39% (184 patients).

In univariable logistic regression analyses a VMS ≥1 was not predictive for any of the adverse outcomes (institutionalization OR 6.4 (95%-CI 0.8-51.3); readmission OR 1.6 (95%-CI 0.2-13.7); mortality after 3 months OR 0.6 (95%-CI 0.2-2.0); mortality after one year OR 1.1 (95%-CI 0.3-3.7)). The number of domains positive on the VMS frail older patients was not predictive for readmission and mortality. For new institutionalization the odds ratios had an ascending trend, with a statistically significant OR for the group with all 4 domains positive. (ORs 4.3; 5.4; 6.1; 12.1) Also predictive for institutionalization were the individual domains physical impairment and delirium risk (OR 1.8 (95%-CI 1.1-2.9) and 2.2 (95%-CI 1.1-4.4), respectively). Malnutrition was associated with readmission, OR 1.7 (95%-CI 1.1-2.9) and mortality after three months, OR 1.7 (95%-CI 1.1-2.6). Delirium risk was associated with one year mortality, OR 2.0 (95%-CI 1.0-4.0). Fall risk and physical impairment had lower odds for readmission (OR 0.6 (95%-CI 0.3-1.0) and 0.6 (95%-CI 0.4-1.0), respectively). (Table 2)

4. Discussion

In this study in geriatric inpatients we aimed to determine the predictive value of the VMS frail older patients for institutionalization, readmission and mortality.

Our study showed that almost all geriatric inpatients scored positive on at least one domain of the VMS frail older patients. The number of positive VMS domains and the VMS cut-off score of ≥1 were not predictive for hospital readmission or mortality in geriatric inpatients. For institutionalization the number of positive domains had an upward trend in odds ratios.

4.1. Comparison to previous research

In contrast to previous research we found limited predictive value of the VMS frail older patients for adverse outcomes. (Oud et al., 2015, Heim et al., 2015 Mar, Warnier et al., 2020 Apr 1, Van der Ven et al., 2015) This could be attributed to differences in the populations: previous studies examined older hospitalized patients in general, whereas we specifically focused on geriatric inpatients. We expected this population to be frail and at high risk for adverse outcomes and geriatric syndromes. Indeed, only a few patients did not score positive on any of the VMS domains, and those patients still had other frailty characteristics such as polypharmacy, urological problems and multimorbidity. We also found a higher rate of adverse outcomes, for example 16.4% readmission versus 10.9% in a previous study and 27% mortality versus 9.6–17.2% in previous studies. (Gregersen et al., 2020, Oud et al., 2015, Heim et al., 2015 Mar, Warnier et al., 2020 Apr 1, Charlson et al., 1987, Kruizenga et al., 2005 Feb 8, Katz et al., 1963, Van Munster et al., 2016, Van der Ven et al., 2015)

In Denmark, a cumulative multidomain instrument, the Multidimensional Prognostic Index, predicted adverse outcomes in geriatric patients. (Gregersen et al., 2020, de et al., 2009, Oud et al., 2015, Heim et al., 2015 Mar, Warnier et al., 2020 Apr 1, Charlson et al., 1987, Kruizenga et al., 2005 Feb 8, Katz et al., 1963, Van Munster et al., 2016, Van der Ven et al., 2015, Pilotto et al., 2008) Our population, however, turned out to be much more frail (90%) than the geriatric inpatient population in this study (52%). (Gregersen et al., 2020) Thus, all our geriatric inpatients were at high risk and a prediction instrument was not useful.

A remarkable finding was that the domains fall risk and physical impairment had lower odds for readmission. A possible explanation is

Table 2
Univariable logistic regression for institutionalization, readmission and mortality.

VMS	Institutionalization (n= 335)	Readmission (n=366)				
	n	OR (95%-CI)	p-value	n	OR (95%-CI)	p-value
Individual domains						
Delirium risk	122	2.2 (1.1–4.4)	0.03	66	0.8 (0.4–1.7)	0.58
Fall risk	84	1.5 (0.9–2.4)	0.09	38	0.6 (0.3–1.0)	0.04
Malnutrition	62	1.4 (0.9–2.2)	0.13	37	1.7 (1.1–2.9)	0.03
Physical impairment	87	1.8 (1.1–2.9)	0.02	41	0.6 (0.4–1.0)	0.04
Number of domains positive						
0	1	ref.		1	ref.	
1	17	4.3 (0.5–36.3)	0.19	18	3.2 (0.4–28.5)	0.30
2	35	5.4 (0.7–45.5)	0.11	16	1.2 (0.1–10.3)	0.90
3	40	6.1 (0.7–50.0)	0.09	25	1.5 (0.2–13.3)	0.70
4	35	12.1 (1.4–101.7)	0.02	13	1.5 (0.2–13.8)	0.71
VMS $\geq$ 1	127	6.4 (0.8–51.3)	0.08	72	1.6 (0.2–13.7)	0.66
VMS	Mortality 3 months (n=477)			Mortality 1 year (n= 477)		
	n	OR (95%-CI)	p-value	*n*	OR (95%-CI)	p-value
Individual domains						
Delirium risk	114	1.7 (0.8–3.5)	0.19	166	2.0 (1.0–4.0)	0.04
Fall risk	64	0.8 (0.5–1.2)	0.20	100	0.9 (0.6–1.3)	0.49
Malnutrition	61	1.7 (1.1–2.6)	0.01	81	1.4 (1.0–2.1)	0.08
Physical impairment	86	1.6 (1.0–2.5)	0.06	124	1.5 (1.0–2.3)	0.05
Number of domains positive						
0	4	ref.		4	ref.	
1	12	0.4 (0.1–1.7)	0.23	18	0.7 (0.2–2.8)	0.65
2	26	0.5 (0.1–1.7)	0.26	44	1.0 (0.3–3.5)	0.97
3	45	0.7 (0.2–2.4)	0.68	65	1.2 (0.3–4.2)	0.79
4	27	0.8 (0.2–2.9)	0.79	37	1.3 (0.4–4.8)	0.70
VMS $\geq$ 1	110	0.6 (0.2–2.0)	0.42	164	1.1 (0.3–3.7)	0.91

that an advance care planning decision was made not to admit these patients to hospital again. Considering that over 80% of the patients in our population had treatment limitations recorded, it is likely that advance care planning had an important place during hospital admission.

4.2. Limitations and strengths

The results of our study for the VMS cumulative and cut-off scores should be interpreted with caution. The reference group for the analyses was very small, with only eleven patients who scored negative on the VMS, which resulted in large confidence intervals. For example, the upward trend in odds ratios might mean that the number of positive VMS domains would in fact be predictive for institutionalization in a larger study sample.

A limitation is that we collected the data retrospectively, resulting in a small number of missing data. Another limitation is that the outcomes might be positively influenced by preventive measures that may have been taken as a result of the VMS score. The fact that the study was conducted in one hospital might make our results harder to generalize to other hospital populations. It would have been interesting to compare the VMS scores to the results of the Comprehensive Geriatric Assessment that is routinely performed at the geriatric ward. These data were however not available for this study.

A strength of our study is that, to our knowledge, this is the first study to investigate the predictive value of the VMS frail older patients in geriatric inpatients. We were able to include a large sample size.

4.3. Implications for clinical practice

In our opinion the VMS frail older patients should be used for its original purpose, i.e. to identify older hospitalized patients who are at risk for geriatric syndromes and to adjust the treatment plan accordingly. In geriatric inpatients, it should not be applied as a prediction tool for adverse outcomes. Almost all geriatric patients scored positive and the VMS frail older patients had limited added value to identify the patients with higher risk of adverse events. The upward trend in odds ratios for institutionalization may suggest that in a larger sample size, the number of positive VMS domains would be predictive for institutionalization. If this is the case it could help early and more effective discharge planning for geriatric inpatients. However, information from the comprehensive geriatric assessment in the geriatric department might give enough information in itself.

Whether the VMS has added value in a geriatric population as an instrument to identify the risk of geriatric syndromes and prevent functional decline is also questionable. The Safety Management System (VMS) programme for frail older patients is standard care in Dutch hospitals for all patients aged 70 years and older to prevent functional decline. Patients admitted to a geriatric ward are, however, predominantly frail patients at high risk for geriatric syndromes, sometimes even admitted because of delirium or a fall incident. Geriatricians and nurses specialized in geriatric medicine are focused on noticing geriatric syndromes based on comprehensive geriatric assessment, and the standard care for geriatric inpatients in the Netherlands is already aimed at preventing avoidable damage with an integrated multidisciplinary tailored care programme.

5. Conclusion

Our study showed that the VMS frail older patients had limited value to predict adverse outcomes when applied in a geriatric ward. Almost all geriatric inpatients scored positive on the VMS frail older patients. Additionally, the care for this high-risk population, at least in geriatric wards in the Netherlands, is already focused on geriatric syndromes and preventing adverse health care outcomes.

Author contributions

Study concept and design: FMM Oud, NK Wolzak, PE Spies, HJ van der Zaag, BC van Munster

Acquisition of data: FMM Oud, NK Wolzak

Analysis and interpretation of data: FMM Oud, NK Wolzak, HJ van der Zaag

Drafting of the manuscript: FMM Oud, NK Wolzak

Critical revision of the manuscript for important intellectual content: FMM Oud, NK Wolzak, PE Spies, HJ van der Zaag, BC van Munster

Declaration of Competing Interest

The authors have no personal or financial conflicts of interest. (FO, NW,PS,HZ,BM)

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