Received: 16 May 2019 | Revised: 23 August 2019 | Accepted: 20 October 2019

DOI: 10.1111/jocn.15148

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ORIGINAL ARTICLE

Journal of Clinical Nursing WILEY

Frailty screening in hospitalised older adults: How does the brief Dutch National Safety Management Program perform compared to a more extensive approach?

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Abstract

Aims and objectives: To examine the predictive properties of the brief Dutch National Safety Management Program for the screening of frail hospitalised older patients (VMS) and to compare these with the more extensive Maastricht Frailty Screening Tool for Hospitalised Patients (MFST-HP).

Background: Screening of older patients during admission may help to detect frailty and underlying geriatric conditions. The VMS screening assesses patients on four domains (i.e. functional decline, delirium risk, fall risk and nutrition). The 15-item MFST-HP assesses patients on three domains of frailty (physical, social and psychological).

Design: Retrospective cohort study.

Methods: Data of 2,573 hospitalised patients (70+) admitted in 2013 were included, and relative risks, sensitivity and specificity and area under the receiver operating characteristic (AUC) curve of the two tools were calculated for discharge destination, readmissions and mortality. The data were derived from the patients nursing files. A STARD checklist was completed.

Results: Different proportions of frail patients were identified by means of both tools: 1,369 (53.2%) based on the VMS and 414 (16.1%) based on the MFST-HP. The specificity was low for the VMS, and the sensitivity was low for the MFST-HP. The overall AUC for the VMS varied from 0.50 to 0.76 and from 0.49 to 0.69 for the MFST-HP.

Conclusion: The predictive properties of the VMS and the more extended MFST-HP on the screening of frailty among older hospitalised patients are poor to moderate and not very promising.

Relevance to clinical practice: The VMS labels a high proportion of older patients as potentially frail, while the MFST-HP labels over 80% as nonfrail. An extended tool did not increase the predictive ability of the VMS. However, information derived from

the individual items of the screening tools may help nurses in daily practice to intervene on potential geriatric risks such as delirium risk or fall risk.

KEYWORDS
feasibility, frailty, frailty screening, geriatric assessment, hospitalised patients, nursing assessment, risk screening, safety programme, validity

1 | INTRODUCTION

The percentages of older people are increasing in all western countries. Globally, the percentage of the oldest old, that is those aged 80 years and over, is relatively growing faster than the overall percentages of older people (United Nations Department of Economic and Social Affairs 2017). As societies age, more older and potentially frail patients are admitted to hospitals, making hospitals more and more geriatric institutions (Dent, Chapman, Howell, Piantadosi, & Visvanathan, 2014). Frailty in hospital patients is associated with an increased risk for negative health outcomes, such as falls, more complications, re-hospitalisations, care dependency and mortality (Chen, Mao, & Leng, 2014). Screening may help to detect frailty and underlying geriatric conditions and risks such as cognitive decline and delirium. When these are recognised and tackled in an early admission stage, preventive multidisciplinary and nursing interventions may reduce adverse frailty outcomes (i.e. mortality) (Folbert et al., 2017; Pepersack, 2008). Screening tools may facilitate detecting frail patients, perhaps even better than quick clinical bedside observations (Hii, Lainchbury, & Bridgman, 2015), and may improve awareness on frailty among health professionals (Ament, 2014). Screening results also support decisions for subsequent multidisciplinary comprehensive geriatric assessments (Smith & Kydd, 2017). A geriatric consultation team, for example, may conduct a comprehensive or rapid geriatric assessment and provide proactive consultations based on the screening outcomes (Morley & Adams, 2015).

What does this paper contribute to the wider global clinical community

- Adequate frailty screening tools may help nurses in daily practice to identify frail hospitalised older patients who need more tailored geriatric care.
- Clinical value of the individual items of frailty screening tools may be more useful than the sum scores or cut-off points

2 | BACKGROUND

Frailty is defined as a state of vulnerability due to poor resolution of homeostasis after a stressful event (Clegg, Young, Iliffe, Rikkert, & Rockwood, 2013). In frail older persons, there is an age-related decline in different physiological systems, and the physiologic reserve function has been decreased (Clegg et al., 2013). However, different conceptualisations of frailty have been developed. The three mostly cited perspectives relate to Fried's frailty phenotype (Fried et al., 2001), the deficit model, developed by Rockwood and colleagues (Rockwood & Mitnitski, 2007), and the multidimensional model suggested by Gobbens and colleagues (Gobbens, van Assen, Luijkx, Wijnen-Sponselee, & Schols, 2010).

For hospital settings, numerous frailty screening tools are available. They vary regarding their perspective, number of items and practical use. The overall sensitivity of these tools is fairly too good, but information about feasibility and reliability is lacking for far most tools (Warnier, van Rossum, van Leendert, et al., 2016). Tools need to be brief and feasible in daily hospital care, as nursing and medical staff have to deal with many administrative activities. It is a challenge to develop a screening tool that can be easily implemented in daily clinical practice (Chen et al., 2014).

In the Netherlands, a mandatory national programme for systematic risk screening for adverse hospital outcomes was introduced in 2012, called the (Dutch) National Safety Management Program ("VMS" in Dutch abbreviation) ("VMS Safety Management Program, Frail Elderly 2013). The VMS screens older admitted patients on four geriatric items: delirium, fall risk, malnutrition and functional decline (Heim et al., 2015; Oud, de Rooij, Schuurman, Duijvelaar, & van Munster, 2015; VMS Safety Management Program, Frail Elderly 2013). The VMS was developed by a national expert panel and has recently been evaluated in a cohort of electively admitted older patients with colorectal cancer. Sum scores of the VMS tool had strong associations with negative health outcomes (Souwer et al., 2018).

Although the VMS was introduced in all Dutch hospitals, it is unknown yet how it performs compared to more extended, multidimensional screening tools. One of these latter tools is the Maastricht Frailty Screening Tool for Hospitalised Patients (MFST-HP) (Warnier, van Rossum, van Leendert, et al., 2016). The MFST-HP comprises 15 items in three domains: physical, psychological and social (Warnier et al., 2017; Warnier, van Rossum, van Leendert, et al., 2016). All items are based on routine nursing data and are collected by nurses during the regular initial nursing

VMS	MFST-HP
Delirium risk: 1 Patient is known to have memory problems? 2 Patient needs help in the performance of ADL in the last 24 hours? 3 Patient suffered from disorientation and/or confusion at home or during previous admissions (delirium)? A "yes" score on one of these three questions predicts delirium risk and counts one point on VMS item delirium. ***Fall risk:*** Patient fell more than once in the last 6 month? A "yes" score predicts high fall risk and counts one point on VMS item falls. ***Malnutrition risk:*** MUST screening • Step 1: Count Body Mass Index (BMI): BMI > 20 = score 0 BMI 18.5-20 = score 1 BMI < 18.5 = score 2 • Step 2: Involuntary weight loss over 3 – 6 month? (in percentage): < 5% = score 0 5-10%= score 1 >10%= score 2 • Step 3: Acute diseases can affect risk of malnutrition. If the patient is currently affected by an acute pathophysiological or psychological condition, and there has been no intake for 5 or more days, there is a nutritional risk. Add a score of 2 for these patients. Total MUST score: Establish overall risk of malnutrition after considering all relevant factors. Sum scores from Steps 1, 2 and 3 to calculate overall risk of malnutrition. 0 = Low risk 1 = Medium risk 2 or more = High risk A score of 1 or more counts one point on VMS item malnutrition. ***Functional decline:*** 1 Needs help with bathing more than one part of the body, getting in or out of the tub or shower. Requires total bathing. 2 Needs help with dressing oneself or needs to be completely dressed. 3 Needs help transferring to the toilet, cleaning oneself or uses bedpan or commode. 4 Is partially or totally incontinent of bowel or bladder. 5 Needs help in moving from bed to chair or requires a complete transfer. 6 Needs partial or total help with walking. A positive score on each item scores 1 point. A score of 2 or more on the Katz index predicts high risk on functional decline and counts one point on VMS item functional decline.	***Physical Domain*** 1 Patient needs help performing household chores (cooking, cleaning, shopping, etc.). Yes / No 2 Patient needs help in the performance of ADL (washing, dressing, toileting, etc.). Yes / No 3 Patient fell more than twice in the last 6 month. Yes / No 4 Patient has trouble standing, walking or maintaining balance. Yes / No 5 Patient involuntarily lost weight in the last three months. Yes / No 6 Patient is at high risk of developing pressure sores. Yes / No 7 Patient uses 5 or more different medications including over the counter drugs. Yes / No 8 Patient has visual problems. Yes / No 9 Patient has hearing problems. Yes / No ***Psychological Domain*** 10 Patient suffered from disorientation and/or confusion at home or during previous admissions (delirium). Yes / No 11 Patient is known to have memory problems. Yes / No 12 Patient suffers from a low mood or depression. Yes / No 13 Patient suffers with behavioral problems. Yes / No ***Social Domain*** 14 Patient experiences loneliness. Yes / No 15 Patient and/or caregivers experience a high burden of care or there are care problems. Yes / No Total score ("yes"= 1 point per item)
A summative score of all VMS items ranges from 0–4. A VMS score of ≥ 1 indicates high risk of frailty.	The total score ranges from 0–15 points. A score of ≥6 indicates frailty.

FIGURE 1 Overview of the items of Dutch National Safety Management Program (VMS) and Maastricht Frailty Screening Tool for Hospitalised Patients (MFST-HP). VMS, Safety Management Program; MFST-HP, Maastricht Frailty Screening Tool for Hospitalised Patients; MUST, Malnutrition Universal Screening Tool; ADL, activities of daily living

assessment during hospital admission. Items of the VMS tool are also included in the MFST-HP. Based on MFST-HP scores, nurse practitioners (NP) or geriatric specialised nurses may provide on further proactive care. Figure 1 provides an overview of both the VMS and the MFST-HP items.

In the present study, we examine the predictive properties of the brief mandatory VMS screening tool, compared to those of the more extensive MFST-HP tool, on the following adverse health outcomes: readmissions, mortality, discharge destination and length of hospital stay.

3 | METHODS

3.1 | Design: retrospective cohort study

3.1.1 | Setting

The present study was conducted in the Maastricht University Medical Center (MUMC+), a 715-bed university hospital in the south of the Netherlands. Yearly, almost one-third of the admitted patients is aged 70 years and over, approximately 7,000 patients. These admissions

include one-day admissions, intensive care unit admissions and readmissions. Patients aged 70 years and over are not admitted to specific geriatric but to regular nursing wards. Nurses screened older patients for frailty on routine basis by using the MFST-HP within 48 hr. A specialised geriatric consultation team is available to support the regular medical and nursing teams. Intervention of the specialised geriatric consultation team can be active (based on a referral of medical ward) and proactive (based on the frailty screening).

3.1.2 | Participants

Patient selection was restricted to admissions between 01 January 2013–31 December 2013. Inclusion criteria were as follows: (a) community-living, (b) minimum age of 70 years, (c) admission to a general hospital ward and (d) admission for at least 2 days. In case of readmissions, only the data of the first admission in 2013 were used for the analyses (see Figure 2 for an overview of the included patients).

3.2 | Assessment of frailty

3.2.1 | VMS risk screening

The VMS screening consists of four items: delirium risk, fall risk, risk of under nutrition and functional decline. The risk of delirium was assessed by three questions: (a) "Is the patient known with cognitive problems?" (b) "Did the patient experience an episode of confusion or delirium before?" And (c) "did the patient need help with self-care in the past 24 hr?" An answer "yes" on at least one of these questions suggests a higher risk for delirium. Fall risk was assessed by one question "Did the patient fall at least once in the last six month?"; a score "yes" suggests a high fall risk. The risk for malnutrition was assessed by means of the Malnutrition Universal Screening Tool (MUST) (Cawood, Elia, Sharp, & Stratton, 2012). A MUST score of 1 or more suggests higher risk on malnutrition. The risk on functional decline was measured by means of the six-item Katz scale. The Katz scale screens the patients' functional ability on six items: bathing, dressing, toilet use, incontinence, transferability and walking. A patient is at risk for functional decline when de Katz score is two or higher (Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963). Total VMS scores (0–4) were, according to the national guideline, afterwards dichotomised: "no risk" (score 0) or "at risk" if one or more of the four VMS domains were scored positive (score 1–4) (Heim et al., 2015) (see Figure 1).

3.2.2 | MFST-HP screening

The MFST-HP is a tool that screens for frailty based on data from the initial nursing assessment during hospital admission, including items on the physical, psychological and social domain. If a patient was not able to respond to items, primary family caregivers were requested to complete the questions. The theoretical minimum MFST-HP score is 0, and the theoretical maximum score is 15. A higher score indicates a higher level of frailty (Figure 1). The most optimum cut-off point for frailty was set at ≥ 6 (Warnier et al., 2017). The results of the screening are automatically generated by the electronic (nursing) system and reported in the nursing care plans. Nurses do not need specific training to apply the MFST-HP, and a special protocol is provided to inform about the use of the MFST-HP (Warnier, van Rossum, van Leendert, et al., 2016).

3.3 | Outcomes

Four outcome measures were included in the study. Discharge destination was dichotomised into discharged home (i.e. same location as before admission) or discharged to a long-term care facility (i.e. geriatric rehabilitation, nursing home). Readmissions at 30 and at 120 days postdischarge were dichotomised (yes/no). Mortality was also registered at 30 and at 120 days postdischarge. Discharge destination, readmissions and mortality data were all derived from the electronic records in the hospital. Length of hospital stay was calculated as the difference in days between the admission and discharge date.

Patient characteristics as age, gender, type of hospital admission (i.e. acute or planned) and hospital admission ward were collected via the electronic records of the hospital.

3.4 | Data analysis

Descriptive statistics were computed for patient characteristics and reported as means and standard deviations or as absolute values and percentages. Relative risks (RR) with 95% confidence intervals (CI) were calculated for the association between the frailty or risk status and the various outcomes (Altman, 1991). Also, sensitivity, specificity, positive predictive values and negative predictive values were computed for both frailty screening tools. Sensitivity of a test is the percentage true-positive screened patients among the sick patients. Specificity is the percentage true-negative screened patients among the nonsick patients. Positive predictive value (PPV) is the probability that patients with a positive screening test result truly do have the "disease" (in our study, negative health outcomes, i.e. mortality, readmissions). Negative predictive value (NPV) is the probability that patients with a negative screening test result truly do not have the disease. In addition, we calculated the area under the receiver operating characteristic (AUC) curve using continuous values of both the VMS and the MFST-HP. The AUC quantifies the ability to discriminate between those persons who will experience an adverse outcome, and those who will not. An AUC coefficient of 1.0 indicates a perfect discriminative ability; an AUC coefficient of 0.5 indicates no discriminative ability (Lalkhen & McCluskey, 2008). Additional subgroup analyses were performed for type of admission (acute vs. nonacute, gender and age). Crosstabs were calculated between the dichotomised VMS and MFST-HP test scores, to explore the probable overlap of the indicated groups. The Standards for Reporting Diagnostic accuracy studies (STARD) is followed to assess

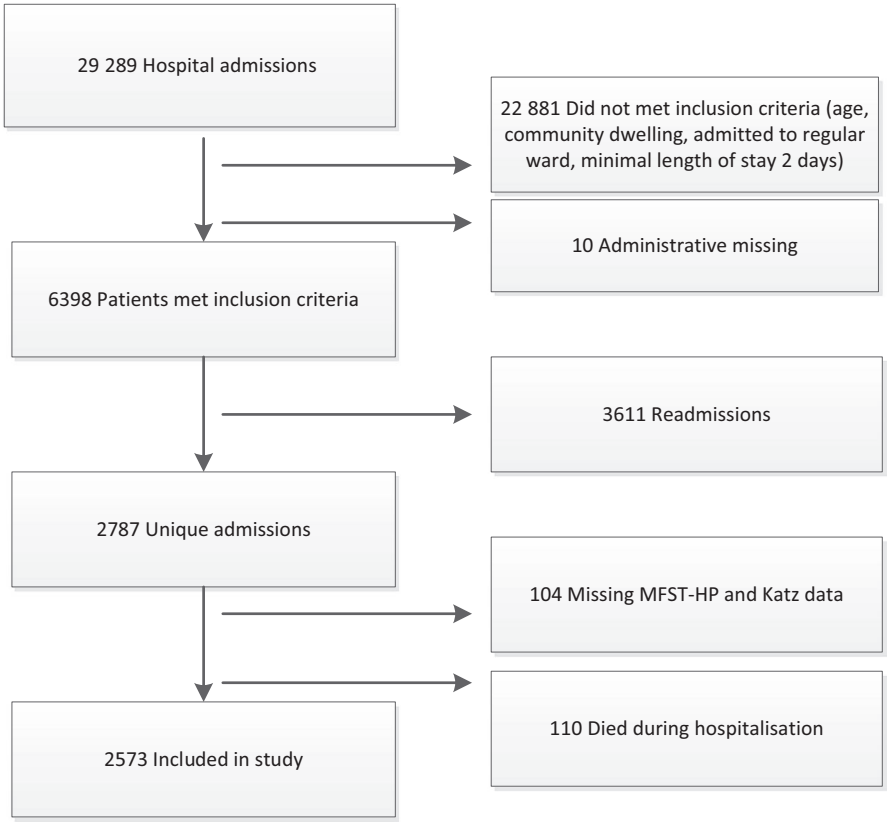

FIGURE 2 Flow chart of the included patients

TABLE 1 Characteristics of hospitalised patients and outcomes according to cut-offs for VMS and MFST-HP

	All *n* = 2,573	VMS = 0 *n* = 1,204 (46.8%)	VMS ≥ 1 *n* = 1,369 (53.2%)	*p* value VMS	MFST-HP ≤ 5 *n* = 2,159 (83.9%)	MFST-HP ≥ 6 *n* = 414 (16.1%)	*p* value MFST-HP
Mean age (*SD*)	78.8 (6.3)	76.9 (5.2)	80.4 (6.7)	≤.0001*	78.0 (5.9)	82.6 (6.8)	≤.0001
Female gender, *N* (%)	1,333 (51.8)	584 (48.5)	749 (54.7)	.002**	1,078 (49.9)	255 (61.6)	≤.0001**
Acute admission, *N* (%)	1,787 (69.5)	704 (58.5)	1,083 (79.1)	≤.0001**	1,444 (66.9)	343 (82.9)	≤.0001**
Mean LOS, *N* days (*SD*)	10.2 (2.4)	8.5 (7.8)	11.6 (10.8)	≤.0001*	9.6 (8.8)	12.9 (12.9)	≤.0001 *
Discharged care facility, *N* (%)	649 (25.2)	209 (17.4)	440 (32.1)	≤.0001**	488 (22.6)	253 (61.1)	≤.0001**
Readmission 30 days, *N* (%)	322 (12.5)	144 (12.0)	178 (13.0)	.425**	278 (12.9)	44 (10.6)	.205**
Readmission 120 days, *N* (%)	667 (25.9)	302 (25.1)	365 (26.7)	.362**	572 (26.5)	95 (22.9)	.131**
Mortality 30 days, *N* (%)	112 (4.4)	10 (0.8)	102 (7.5)	≤.0001**	71 (3.3)	41 (9.9)	≤.0001**
Mortality 120 days, *N* (%)	246 (9.6)	40 (3.3)	206 (15.0)	≤.0001**	164 (7.6)	82 (19.8)	≤.0001**

Abbreviations: VMS, safety management program; MFST-HP, Maastricht frailty screening tool for hospitalised patients; *SD*, standard deviation; LOS, length of hospital stay.

*Student's *t* test.

**Chi-square.

completeness and transparency of our study (Bossuyt et al., 2015) (see File S1). SPSS version 23.0 (IBM Corporation) was used for statistical analyses.

3.5 | Ethical approval

The formal institutional review board of the MUMC confirmed that the Medical Research Involving Human Subjects Act does not apply to the study and that an official approval by their committee was not required (METC #2019-1098).

4 | RESULTS

Data of 2,787 unique patients were available. From 104 patients, the data were incomplete and 110 patients died during hospitalisation. These 214 patients were excluded from the analysis, so a sample

TABLE 2 Crosstabs of number of hospitalised patients as identified as frail/nonfrail according to cut-offs for VMS and MFST-HP

N (%)	MFST-HP non frail	MFST-HP frail	Total
VMS no risk	1,202 (99.8)	2 (0.2)	1,204 (100.0)
VMS risk	957 (69.9)	412 (30.1)	1,369 (100.0)
Total	2,159 (83.9)	414 (16.1)	2,573 (100.0)

Abbreviations: MFST-HP, Maastricht frailty screening tool for hospitalised patients; VMS, Dutch national safety management program.

of 2,573 patients remained for further analysis. See Figure 2 for an overview of the included patients.

The mean age of the patients was 78.8 years (*SD* = 6.3), and 51.8% of them was female. Nearly one-third of the admissions were planned (30.5%), and the patients had an average length of stay of 10.2 days (*SD* = 2.4). After hospitalisation, approximately a quarter of the patients was discharged to a long-term care facility. Within 120 days, 25.9% of the included patients was readmitted to the hospital, and 9.6% died within 120 days (Table 1).

Based on the VMS screening 53.2% of the included patients were labelled as at risk. The VMS scores show that 43.4% of the included patients were at risk for delirium, 14.4% had a risk on malnutrition, 12.7% had a fall risk, and 33.8% had a risk of functional decline. Overall, 1,204 patients (46.8%) had no risk on any of the four VMS items (not tabulated). Patients with at least one VMS risk were significantly older than those with no risk at all (Table 1). They were also more likely acutely admitted, and their mean length of hospital stay was significantly longer than their no-risk counterparts (8.5 days vs. 11.6 days, $p \leq .0001$). Patients with no increased risk on the VMS screening had a significant higher chance to be discharged to home. There was no significant difference in readmission rates between the VMS risk and the VMS nonrisk group at both 30 and 120 days postdischarge. A significant difference in mortality risk was detected between the two VMS subgroups (Table 1).

Based on the MFST-HP screening, 16.1% of the included patients were labelled as potentially frail. Their mean age was significantly higher compared to their nonfrail counterparts. Within the frail group, 61.6% was female and 82.9% of the patients was acutely admitted to the hospital. The mean length of stay of the frail patients was significantly longer compared to the nonfrail patients (12.9 days vs. 9.6 days, $p \leq .0001$). Patients in the frail group were significantly more likely to be admitted to institutional care. There were no significant differences between the frail and nonfrail group in terms of readmission rates at both 30 and 120 days postdischarge. Mortality rates were significant higher in the frail group than in the nonfrail group.

Almost all patients who are classified as frail by means of the MFST-HP (*N* = 414) are also identified as frail in the VMS screening (*N* = 412). However, there is a large group of 957 patients classified as nonfrail by means of MFST-HP scores who have a positive score on one of the VMS risk items (Table 2). In this group, 373 patients had one positive risk item on the VMS, 493 had two positive items, and 91 patients had 3 or 4 items positive (not tabulated). Patients with VMS risk score 0 had on average a lower MFST-HP score than the patients with one or more positive risk items (mean 1.4 vs. 3.3; also not tabulated).

The predictive properties of both the VMS and the MFST-HP for the selected adverse outcomes are presented in Table 3. The relative risk (RR) for the different outcomes for those classified as at risk by means of the VMS varied from 1.06 (95% CI 0.93–1.21) for readmissions within 120 days to 8.97 (95% CI 4.71–17.10) for mortality within 30 days postdischarge. The RR for readmissions are statistically not significant. VMS sensitivity rates regarding the various outcomes varied from 55% to 91% and specificity rates from 47% to 52%. The AUCs varied from 0.50 to 0.76. The RR of the as frail classified patients by means of MFST-HP varied from 0.82 (95% CI 0.61–1.11) for 30-day readmission to 3.01 (95% CI 2.08–4.36) for 30-day mortality. Overall sensitivity was low (below 38%), and the specificity varied from 83% for readmissions to 87% for discharge destination. The AUCs were rather similar to the VMS, varying from 0.49 to 0.69 (Table 3).

4.1 | Subgroup analyses

To study the robustness of our findings, we performed subgroup analyses regarding type of admission (acute vs. nonacute), gender and age. Overall, the results of these analyses showed similar trends in sensitivity, specificity and AUCs in these subgroups as in the total study group (see File S2).

5 | DISCUSSION

In this study, we examined the psychometric properties of the brief VMS screening among hospitalised older patients and compared these findings with the psychometric properties of a more extensive tool, that is the MFST-HP. Both tools have an AUC that varies between 0.49 and 0.76 with respect to the selected outcomes: 30- and 120-day hospital readmission, 30-day and 120-day mortality and discharge destination. These low coefficients suggest that both tools have a low predictive ability. With respect to sensitivity and specificity, the VMS was more able to detect risk patients by means of the sensitivity, while the specificity of the MFST-HP was higher compared to VMS indicating an ability to identify nonfrail patients (Warnier et al., 2017).

Screening according to the VMS resulted in a high percentage of frail patients, more than half of the study sample was labelled as at risk (53.2%). By means of the MFST-HP, only 16.1% of the older

TABLE 3 Relative risk, sensitivity, specificity, positive and negative predictive values and area under the receiver operating characteristic curve of dichotomised VMS and MFST-HP scores and five adverse outcomes

	RR	95% CI	Sensitivity (%)	95% CI	Specificity (%)	95% CI	PPV (%)	95% CI	NPV (%)	95% CI	AUC	95% CI
VMS ≥ 1 (*n* = 1,369/ 53.2%)												
Discharge destination	1.85	1.60–2.14	68	64–71	52	49–54	32	31–34	83	83–84	0.63	0.60–0.65
Readmission 30 day	1.09	0.89–1.34	55	50–61	47	45–49	13	12–14	88	87–89	0.50	0.46–0.53
Readmission 120 day	1.06	0.93–1.21	55	51–59	47	45–50	27	25–28	75	73–77	0.50	0.47–0.52
Mortality 30 day	8.97	4.71–17.10	91	84–97	49	47–51	8	7– 8	99	99–100	0.76	0.72–0.81
Mortality 120 day	4.53	3.26–6.30	84	79–88	50	48–52	15	14–16	97	96–97	0.71	0.68–0.74
MFST-HP ≥6 (*n* = 414/ 16.1%)												
Discharge destination	1.72	1.49–1.99	25	22–28	87	85–88	39	35–43	77	77–78	0.63	0.61–0.66
Readmission 30 day	0.82	0.61–1.11	14	10–18	84	82–85	11	8–14	87	87–88	0.49	0.46–0.53
Readmission 120 day	0.87	0.72–1.05	14	12–17	83	82–85	23	19–27	74	73–74	0.50	0.48–0.53
Mortality 30 day	3.01	2.08–0.4.36	37	28–46	85	83–86	10	8–12	97	96–97	0.69	0.65–0.74
Mortality 120 day	2.61	2.04–3.33	33	27–40	86	84–87	20	17–23	92	92–93	0.68	0.65–0.71

Abbreviations: AUC; area under the receiver operating characteristic curve of continuous score; VMS, Dutch safety management program; CI, confidence interval; MFST-HP Maastricht frailty screening tool for hospitalised patients; NPV, negative predictive value; PPV, positive predictive value; RR, relative risk.

patients were labelled as potentially frail. To prevent frail patients for more geriatric problems or negative health outcomes, a geriatric team can be consulted to assess patients by means of a comprehensive geriatric assessment (CGA) and provide best evidence care. However, as a CGA is time-consuming, it is not feasible to examine a large group of patients extensively based on the VMS screening. The percentage of old people screened as frail by means of the MFST-HP (i.e. 16.1%) is more feasible to be further examined by such a specialised geriatric team. The question arises whether the VMS in original form as mandatory Dutch National Safety Management Program is usable in daily practice. Other researchers in this field modified the VMS to increase the predictive ability of the tool. Heim and colleagues added age as an additional criterion to the original VMS screening. Patients aged 70 –79 years with three or more VMS items screened positive, and patients aged 80 years and over with one or more positive VMS items were assumed to be at risk for negative hospital outcomes (Heim et al., 2015). When this approach is applied to our cohort, 31% of the patients would be labelled as frail. In the study of Heim and colleagues, a similar proportion of frail older patients was identified based on this VMS+ (34%). Souer and colleagues divided the VMS score among colorectal surgical patients in three risk groups: low risk (0 VMS items positive), intermediate risk (1–2 VMS items positive) and high risk (3–4 VMS items positive) (Souwer et al., 2018). This approach would result in our sample in 55% patients with low risk, 40% with intermediate risk and finally 5% with high risk. In summary, modifying the original tool leads to different percentages of potentially frail patients ranging from 53% by means of our original dichotomised VMS to 5% (high risk) by means of the approach of Souer and colleagues.

The predictive ability of both the VMS and the MFST-HP as derived from the AUC was poor to moderate. In a recent review of 16 frailty screening tools for hospitalised older patients were analysed on their predictive value (Warnier, van Rossum, van Leendert, et al., 2016). For discharge destination, only long-term outcomes were used (>3 months), and the prognostic ability varied between AUC 0.77 for the multidimensional frailty score (MFS) (Kim et al., 2014) and 0.82 for the frailty index based on CGA (FI-CGA) (Krishnan et al., 2014). This predictive ability for both tools is considerably better than the outcomes we found for the VMS and the MFST-HP. However, both other tools were evaluated in specific samples: an elective surgical cohort and a cohort of hip fracture patients, respectively. Particularly, the AUC for readmission rates was low in our study (0.49–0.50) indicating that the prediction of readmissions is hard by means of both the VMS and the MFST-HP. In other tools included in the review by Warnier and colleagues, the AUC varied between 0.52–0.78 for readmissions (Warnier, van Rossum, van Leendert, et al., 2016). Probably, other factors than the VMS and MFST-HP items contributed more to readmissions. The prediction of readmissions seems to be difficult, even when data that are more specific are available. Basnet and colleagues, for example, stated that polypharmacy, intensive care admission and cardiovascular diseases were contributing factors to the prediction of readmission (Basnet et al., 2018). Hayward studied emergency department (ED) readmissions in a large cohort. They concluded that ED readmissions were linked with patient factors (age), their disease and healthcare delivery apparatus (i.e. mode of ED arrival, type of hospital) (Hayward et al., 2018).

For short-term and long-term mortality, both the VMS and the MFST-HP perform slightly better in contrast to the other outcomes. Findings were quite similar in studies with other screening tools, although different study samples were included here (i.e. elective admitted patients, or patients with a hip fracture) in contrast to the general older population included in our study. In the previously mentioned review, the AUC varied from 0.43 to 0.82 for the prediction of long-term mortality (>30 days postdischarge) (Warnier, van Rossum, van Velthuijsen, et al., 2016). For short-term mortality, only one study was included in the review: Sancarlo and colleagues reported an AUC of 0.75 for short-term mortality for the modified multiprognostic index (mMPI) (Sancarlo et al., 2011). It seems that screening tools used in more specific and homogeneous geriatric patient populations (i.e. elective surgical) perform somewhat better compared to tools used in general populations.

5.1 | Study strengths and limitations

Strength of our study compared to other studies is that a large cohort of patients (N = 2,573) was included. Further, a general older hospitalised sample of mixed patients was examined: both acutely admitted and electively (nonacute) admitted, surgical and nonsurgical older patients were included. In contrast, in most other studies only acute patients, elective patients or specific surgical patients were included. The data used in the present study were collected in a regular daily hospital care setting and were directly retrieved from the patients' medical files. However, several limitations of our study can be mentioned as well. First, we used a retrospective cohort study design, so we had to deal with the data available in the database. No data were available on reason for admission or about comorbidities. Also, medical care might have an effect on length of stay, mortality and readmissions. That implies that we have studied the predictive power of both screening tools without accounting for possible treatment effects, but the latter holds for both tools. Finally, as CGA seems the best practice to assess frailty and can be considered as golden standard, such data were not available in our database.

6 | CONCLUSION

The predictive ability of the VMS as National Safety Management Program and the more extended MFST-HP on the screening of frailty among older hospitalised patients is not very promising. Based on the AUC, we conclude that the VMS is in these general older hospitalised patients slightly better than the more extensive MFST-HP. Both screening tools have their limitations. The sensitivity of the VMS screening seems to be somewhat better

compared to the MFST-HP, while the specificity of the MFST-HP was better compared to the VMS indicating an ability to identify nonfrail patients.

7 | RELEVANCE TO CLINICAL PRACTICE

Screening older hospitalised patients by means of the VMS compared to the MFST-HP showed different abilities of the tools. The VMS labels a high proportion of older patients as potentially frail (53.2%), while the MFST-HP labels 83.9% as nonfrail. The MFST-HP seems therefore particularly able to rule out approximately 84% nonfrail patients. This leaves a feasible number of patients eligible for further geriatric screening by means of a CGA. Our study further showed that an extended screening tool did not increase the predictive ability of the VMS. However, information derived from the individual items of the screening tools may help nurses in daily practice to intervene on potential geriatric risk such as delirium risk or fall risk.

ACKNOWLEDGEMENTS

Ethical considerations: In the Netherlands, the use of anonymised routine data does not require ethical approval or written informed consent. The authors thank Ralph Hendrikx (Dept. Medical Information Technology; MUMC+) for his support with the database.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Warnier RMJ, van Rossum E, van Kuijk SMJ, Magdelijns F, Schols JMGA, Kempen GIJM. Frailty screening in hospitalised older adults: How does the brief Dutch National Safety Management Program perform compared to a more extensive approach?. *J Clin Nurs*. 2020;29:1064–1073. https://doi.org/10.1111/jocn.15148