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The research presented in this thesis was conducted at CAPHRI Care and Public Health Research Institute, Department of Health Service Research of Maastricht University. CAPHRI participates in the Netherlands School of Public Health and Care Research CaRe. The research was co-supported by Maastricht University Medical Center, Envida and Vitala+.

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Content

Chapter 1: General Introduction

Ageing and its impact on daily hospital care

As societies age, the number of people aged 65 and over will increase considerably in the coming decades. Worldwide it is estimated that their proportion will rise from 11% in 2010 to 22% in 2050 (1). In the Netherlands this percentage will increase to 26% in 2040. Within this trend the number of 'oldest old', those aged 80 years and over, also grows steadily (CBS-statline).

The majority of older people age in a healthy way, but despite that, ageing is also associated with an increased risk of one or more chronic diseases (multimorbidity) and secondary disabilities (2). In the Netherlands almost 50% of those aged 75 years and over suffer from more than one chronic condition (1). This impacts their use of health care services, including hospitals. Hospitals become more and more 'geriatric institutions', and in daily practice, nursing staff has to deal with an increasing number of older patients. In the Netherlands, almost 23% of population aged 65 years and over, is admitted to a hospital at least once a year and at this moment approximately one third of the admitted hospital patients is 70 years and over (2). When older people with acute health problems are hospitalized, they are at risk of rapid functional decline both during their hospital stay as well as after discharge. Approximately 30 – 60% of hospitalized older people lose the ability to perform relevant activities of daily living, compared with their pre-admission level of functioning (3, 4). Andela and colleagues reported that 50 – 80% of older hospitalized patients are considered frail (5). Frailty and functional decline contribute to negative short and long-term health outcomes (6) such as prolonged hospital stay (8), frequent readmission to hospital, admission to a nursing home, and increased mortality (7, 8). During acute admission, routine care focuses particularly on diagnostic and therapeutic interventions related to acute problems, while general geriatric problems (e.g. cognitive impairment and functional decline) are often overlooked and seem to be relatively unrecognized (9).

Therefore, an active approach in detecting frailty in hospitalized older patients is considered to be necessary. Based on the outcomes of a frailty screening, a tailormade care plan with preventive interventions should be implemented (10, 11).

Frailty

Frailty is stated as a problematic expression of an aging society and considered as a state of increased vulnerability because of (patho) physiological processes because of aging and accentuated by stressful events such as sickness and hospital admission. Frailty is related to an increased risk of adverse health outcomes (12).

Frailty has been reported in different conceptualizations. The most common conceptualizations are: Fried's (physical) frailty phenotype (11), the deficit model developed by Rockwood and colleagues (14), and the multidimensional frailty approach suggested by, Gobbens (13) and De Witte (9).

In the phenotype model, frailty is defined as a clinical syndrome in which three or more of the following criteria must be present: unintentional weight loss, self-reported exhaustion, weakness, slow walking speed, and low physical activity (13). The deficit accumulation approach assumes that people accumulate health deficits when they age, and that more deficits confer greater risk of being frail (14). The multidimensional approach, labels frailty as a dynamic state in which an individual has deficiencies in one or more domains of human functioning (physical, psychological, social). De Witte et al. added the domain of environmental frailty to this approach (15, 16). These deficiencies increase the chance of unwanted health outcomes.
Frailty has been viewed from a cornerstone of geriatric medicine and a platform of biological vulnerability to a host of other geriatric syndromes and adverse health outcomes (17). Frailty, therefore, may be useful for risk prediction and decision-making in clinical settings (18). Frailty is not a solid state of a patient but it can be considered as a dynamic phenomenon. Factors as resources and abilities can support frail hospitalized patients in becoming less frail and more resilient (19). Various aspects of frailty can be tackled in hospitals. Activating/exercise and nutritional interventions might for instance prevent negative hospital outcomes such as mortality and functional decline (10, 11, 20). Therefore, early screening for frailty at hospital admission may help improve the quality of geriatric care.

Screening for frailty in acute hospital settings

1 Available tools for use in daily practice

Numerous screening tools to identify potentially frail hospitalized older patients are available for daily practice. These have been developed from different points of view, for varying target groups, such as hip fracture patients, cardiac patients, or for users like doctors and nurses (21). The existing tools vary in their predictive quality and often practical information about their feasibility is sparce. Although several systematic reviews have been conducted to evaluate the quality of screening tools to identify frail older people in a hospital setting, these reviews were often not complete. Previous reviews mostly retrieved information on the psychometric quality of frailty screening tools but there was either a lack of information about the feasibility of the tools or feasibility was not assessed in a systematic way. Therefore, it is difficult for health care professionals to choose the best tool for their daily practice. This particularly counts for hospital nurses who often have to apply such tools. A systematic review comparing information about psychometric properties and practical aspects of frailty screeners would be helpful for nurses.

2 Frailty screening in the Netherlands

In Dutch hospitals a mandatory national program for systematic risk screening for adverse hospital outcomes was introduced in 2012, called the (Dutch) National Safety Management Program (22). The VMS screens older admitted patients on four geriatric items: delirium, fall risk, malnutrition and functional decline (22-24). 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 (25). On the other hand, before the VMS project, hospitals already implemented different frailty screening tools to assess older admitted patients for frailty, for example the Groningen Frailty Indicator (GFI), the Identification Seniors at Risk (ISAR) (26) or the Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP) (27).

Frailty screening in the Maastricht University Medical Center (MUMC+)

The Maastricht University Medical Center is a 715 bed university hospital in the south of the Netherlands. Approximately 30 000 patients are admitted to the hospital each year of which about 7000 are aged 70 years and over. These admissions include besides regular admissions also day care, intensive care unit admissions and readmissions. In the Maastricht University Medical Center (MUMC+) frailty screening is conducted since 2014 by means of the Maastricht Frailty Screening Tool for hospitalized patients (MFST-HP)(28).

The MFST-HP is a modified hospital version of the TraZAG tool, which was originally used in Dutch general practice settings to screen and assess older patients (29). The TraZAG comprises ten items on ADLs, IADLs, nutrition, mobility and fall risk, incontinence, medication, vision and hearing impairment, cognition and depressive symptoms. The MFST-HP adds clinical relevant items concerning delirium and pressure sores. All admitted patients, aged 70 and over, are screened at admission by nurses by means of the MFST-HP. The digital nursing system automatically generates a frailty score after the screening. Routine nursing data is used to complete the MFST-HP screening to prevent extra administrative burden by nurses. This nurse-friendly way of screening is less time consuming. Psychometric properties of the MFST-HP, including its predictive abilities, have not been examined yet. We also do not know how the predictive abilities of the more extensive MFST-HP tool compare to those of the aforementioned brief mandatory VMS screening tool. More research is needed on the performance of MFST-HP. In particular, how this tool operates in daily practice, and on the other hand whether it works better or worse than the mandatory brief VMS.

3 Role of nurses in frailty screening

Nurses represent the professionals who are 24-7 in charge for their patients and this makes that nurses may have a prominent role in screening the older patient whether he or she is frail or not. The outcome of an adequate frailty screening can be a starting point for a tailor made care plan in addition to the medical treatment.(10).

Nurses in acute hospital settings have a crucial role in meeting the special care needs of older patients who are at risk of adverse health outcomes such as functional decline (30), prolonged hospital stay and increased mortality (31). In contrast to the often clearly evident, primary medical condition at admission, influencing factors for frailty like cognitive impairment or functional decline, are often masked and therefore less recognized. It is assumed that a systematic screening of these patients for frailty at hospital admission enables early identification and management of potential, complicating geriatric problems (9). Additionally, systematic screening and documentation may promote awareness among nursing staff of potential complications and risks associated with frailty, which enable a proactive care policy in hospitals (10, 32). In our opinion, this systematic screening can be primarily operated by nurses, but less is known about nurses' opinions and experiences regarding the use of frailty screening tools and how this influences their daily work.

Aims and research questions

This PhD thesis focuses on the screening for frailty in daily nursing care for hospitalized older patients. We conducted several studies with three aims: (1) generating an overview of available hospital

screening tools and their psychometric properties, (2) obtaining information regarding the quality and usefulness of the MFST-HP screening tool that we developed for frailty screening at hospital admission, and (3) exploring opinions of hospital nurses on conducting frailty screening.

The following research questions related to these aims guided the studies reported in this thesis:

1) Which frailty screening tools have been described in the literature to detect frailty in elderly people admitted to a medical hospital?
2) What is the predictive ability of the MFST-HP in daily practice? And, how does this tool perform in relation to the VMS tool?
3) What are nurses' opinions and attitudes towards systematic and standardized frailty screening in hospitals?

Outline of this dissertation

Chapter 2 presents a systematic review on frequently used frailty screening tools in hospitals. The psychometric properties of the included tools are presented. Besides, the psychometric properties and aspects of feasibility are presented in.

In **chapter 3** The Maastricht Frailty screening tool for hospitalized patients (MFST-HP), is presented. Psychometric properties as inter-rater and intra-rater reliability are presented. In this chapter some feasibility aspects of the MFST-HP are also reported.

The predictive ability of the MFST-HP on several negative health outcomes, such as mortality, hospital readmissions and discharge to a long-term care facility, is presented in **chapter 4**.

In **chapter 5** we examined the predictive properties of the brief Dutch National Safety Management Program for the screening of frail hospitalized older patients (VMS) compared to the more extensive Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP).

Nurses are the professionals who use the aforementioned screening tools in daily practice. In **chapter 6** we therefore explored the opinions and experiences of nurses on frailty screening among older hospitalized patients in an exploratory qualitative approach. In three Dutch hospitals, nurses are interviewed about how the outcomes of frailty screening tools influence their daily work.

Finally **chapter 7** summarizes the main findings of this dissertation, it discusses the methodical and theoretical aspects and considers the lessons learned followed by the implications for practice and future research.

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Chapter 2: Validity, reliability and feasibility of tools to identify frail older patients in inpatient hospital care: a systematic review

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Abstract

Background

The objective of this study is to identify and review screening tools for frailty in older adults admitted to inpatient hospital care with respect to their validity, reliability and feasibility.

Methods

Studies were identified through systematically searching PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase and PsycINFO and screening reference lists till June 2014. Papers dealing with screening tools aimed at identifying frail older patients in in-hospital care, and including information about validity, reliability or feasibility, were included in the review. The quality of the included studies was critically appraised via the Quality Assessment of Diagnostic Accuracy Studies (QUADAS).

Results

From the originally identified 2001 studies 32 studies met the inclusion criteria, in which 16 screening tools were presented. The screening tools showed different characteristics with respect to the number of items, the method of administration and the domains included. The most frequently studied tools with respect to predictive validity were the Identification Seniors At Risk (ISAR) and Triage Risk Stratification Tool (TRST). Studies retrieved poorer information about reliability and feasibility. Overall sensitivity was fairly good. The ISAR, ISAR-HP (Identification Seniors At Risk Hospitalized Patients) and Multidimensional Prognostic Index (MPI) generally had the best sensitivity.

Conclusions

Many screening tools are available for daily practice. These tools to identify frail older patients in inpatient hospital care could be useful. For no tool, however, is clear evidence available yet regarding validity, reliability and feasibility. The overall sensitivity of the included screening tools was fairly good, whereas information on reliability and feasibility was lacking for most tools. In future research more attention should be given to the latter items.

Introduction

The number of people aged 65 and over will increase in the coming decades. Worldwide it is estimated that the proportion of older people will rise from 11% in 2010 to 22% in 2050 (1).

As the proportion of older people expands, the number of people with one or more chronic illnesses and disabilities will grow as well (2). Due to such an ageing society, the use of health care services – including hospitals – by older people increases. In 2010, 16% of people aged 65 and over in the United States were admitted to hospital (3). In the Netherlands, almost 23% of the older population is admitted yearly to hospital (4). When older people with acute health problems are hospitalized, they are at risk of functional decline both during their hospital stay as well as after discharge. Approximately 30 – 60% of hospitalized older people lose the ability to perform relevant activities of daily living, compared with their pre-admission level of functioning (5). Andela and colleagues reported that 50 – 80% of elderly patients admitted are considered frail (6). Functional decline and frailty contribute to negative short and long-term health outcomes (7), a prolonged hospital stay (8), and readmission to hospital, admission to a nursing home, and increased mortality (9, 10). During acute admission, routine care focuses particularly on diagnostic and therapeutic interventions, while general geriatric problems (e.g. cognitive impairment, functional decline, etc.) are overlooked and seem to be relatively unrecognized (11). This suggests that not only the medical diagnosis but also preexistent levels of daily functioning predict negative outcomes after hospital admission (12). When elderly patients are screened in a systematic way during their admission, potential and additional geriatric problems may be identified and tackled at an early stage (13). Nowadays a substantial number of screening tools to identify potentially frail hospitalized older patients are available (14 - 17).

Although previously several systematic reviews have been conducted to evaluate the quality of screening tools to identify frail older people in a hospital setting, these reviews showed specific characteristics. First, searches for relevant study reports were performed in different databases. Second, different search strategies were applied. Finally, although the previous reviews retrieved information on the psychometric quality of frailty screening tools, there was either a lack of information about the feasibility of the included screening tools or feasibility was not assessed in a systematic way (9, 14 - 17). Therefore, we performed an updated systematic review, and combined the strengths of earlier reviews to reach a systematic evaluation of both psychometric quality and feasibility of a larger number of screening tools.

The aim of this systematic review is to identify and review screening tools for frailty in older adults admitted to inpatient hospital care with respect to their predictive validity, reliability and feasibility.

Methods

Search Strategy

First, a systematic search of the literature was carried out using the following online databases: PubMed, Cumulative Index to Nursing and Allied Health Literature, PsycINFO and Embase. Databases were searched from the start date of the database until 1 June 2014. Second, referent links in the selected articles were searched for possible relevant studies.

Inclusion and Exclusion Criteria

Only full articles dealing with screening tools aimed at identifying frail older patients in in-hospital care, and including information about validity, reliability or feasibility were included in the review; abstracts and symposia proceedings were excluded. The following Mesh terms (or thesaurus-terms) and text words were used in the search:

1) elderly OR aged OR aged 80 and over OR older patient OR elderly patients OR frail elderly OR frailty elderly OR geriatric patient OR older people OR older adults;
2) hospital OR hospital admission OR acute care facility OR emergency department OR emergency service OR acute hospital OR hospitalized OR hospitalization OR hospital admissions OR acute care hospital NOT outpatient clinic OR nursing home OR long-term care;
3) geriatric screening instrument OR risk assessment OR frailty indicator OR screening tool OR Questionnaire OR geriatric risk assessment OR geriatric assessment OR geriatric assessment method OR frailty assessment;
4) frailty OR functional decline OR functional status OR ADL OR activities of daily living OR adverse health outcomes OR health deficits OR geriatric problems OR geriatric syndromes;
5) validity OR validation OR validation study OR reliability OR feasibility OR feasibility study OR psychometric properties OR sensitivity OR specificity OR outcome; assessment OR predictive value test;
6) combination of 1 + 2 + 3 + 4 + 5.

To include the largest number of studies possible, only a language limitation was used: studies had to be published in English, Dutch or German.

Study Appraisals

A stepped approach was used to include potential relevant articles. In the first step articles were selected by the first reviewer (author RMJW) based on the title of the study. Titles needed to refer to both screening and the intended population. The first one-hundred randomly selected titles were

reviewed independently by two reviewers to test the procedure and the agreement between both reviewers (authors RMJW and WJM). In the second step, abstracts of the included studies were independently screened by the same two reviewers. The abstracts had to report on the intended population and setting (older people admitted to a hospital), the use of a screening tool or assessment instrument, and additional information about psychometric properties (i.e. predictive validity, reliability) and/or feasibility. In case of disagreement between both reviewers, a third reviewer (author GIJMK or JMGAS) read the abstract and decided to include or exclude the study from the review process. Finally, the remaining included studies were reviewed full text, again independently by authors RMJW and WJM. If there was disagreement between the two reviewers, a third reviewer (author GIJMK or JMGAS) read the article and decided whether or not to include the article in the study.

Next, the quality of the included studies was assessed independently by two reviewers (authors RMJW and EvV). Disagreement on items related to the latter was discussed afterwards in a consensus meeting. The quality of the reported studies was scored on an assessment scale for psychometric properties by the “quality assessment of diagnostic accuracy studies” (QUADAS) (18). The QUADAS is a validated tool developed to assess the diagnostic accuracy of studies included in systematic reviews. Based on 14 items, the QUADAS assesses different aspects of diagnostic accuracy, for instance “Were withdrawals from the study explained?” Each item has to be scored with “yes”, “no” or “unclear”. QUADAS provides no quantification of the methodological quality of the included studies, but classifies the probable risk of bias.

The predictive validity of the included screening tools had to be reported, when available, by means of sensitivity, specificity, negative predictive value (NPV), positive predictive value (PPV) and area under receiver operating characteristics curve (AUC). If these were not provided by the authors, other measurements like odds ratios (OR) or relative risk were retrieved from the studies. Sensitivity of a screening tool refers to the ability of the tool to correctly identify the patients at risk for negative outcomes. A screening tool with 100% sensitivity correctly identifies all patients at risk. Specificity of a screening tool refers to the ability of the tool to correctly identify those patients without a high risk for negative outcomes. A screening tool with 100% specificity correctly identifies all patients without a risk on negative outcomes. The PPV refers to the percentage of the positive screened patients who were afterwards true at risk. The NPV refers to the percentage of the negative screened patients who were afterwards not at risk for negative outcomes. The AUC represents an overall accuracy of the screening tool. An AUC of 1.0 represents a maximum sensitivity and specificity, an AUC of 0.5 represents no discriminative power of the test (19). The OR is a relative measure of risk, representing how much more likely it is that someone who is screened "at risk" for negative health outcomes will

develop the outcome as compared to someone who is screened "not at risk" (20). Reliability is reported by kappa (K). K refers to the agreement between raters. A kappa of 1 refers to complete agreement. If there is no agreement among raters other than would be expected by chance, the kappa is zero. A kappa > 0.75 refers to excellent agreement, K = 0.40 – 0.75 refers to fair - good agreement, and finally a K < 0.40 refers to poor agreement (21). Internal consistency of a scale is measured by Cronbachs alpha. An accepted guideline for Cronbachs alpha is between 0.70 and 0.90. This parameter indicates whether the items of the screening tool have some degree of relationship with each other (22).

Results are presented with respect to short-term outcomes and long-term outcomes. Long-term outcomes are were defined as the ability of a screening tool to predict negative patient outcomes like prolonged hospital stays and readmissions for a period longer than 30 days. Short term outcomes are defined as the ability of a screening tool to predict the latter negative patient outcomes for a period shorter than 30 days.

In addition, feasibility was assessed with a set of four items used by Stevens and colleagues (23): the average time needed for administration, availability of instructions given to people completing the questionnaire, necessity of training for users and free access to the instrument for users via the article, an addendum or the internet.

Results

The systematic search resulted in a total of 1985 titles. Through reference checking, 16 studies that fulfilled the in- and exclusion criteria were added. After checking for duplicates, the titles of 1844 papers remained. As there was only a difference of 3% in the first 100 titles, author RMJW reviewed the full set of potentially relevant titles. One hundred and twenty-six abstracts were considered relevant, and were independently reviewed. While there was disagreement between both reviewers for 32 articles, a third reviewer was consulted here.

Seventy potentially relevant studies were included in the next step of the selection procedure. Afterwards, 38 studies were excluded as they did not fulfill the in- and exclusion criteria. Finally, 32 studies were included in this review comprising 16 screening tools. An overview of the different steps in the selection procedure is reported in Figure 1. The basic characteristic of the included tools are reported in Table 1.

Figure 1: Flowchart of the selection procedure of articles

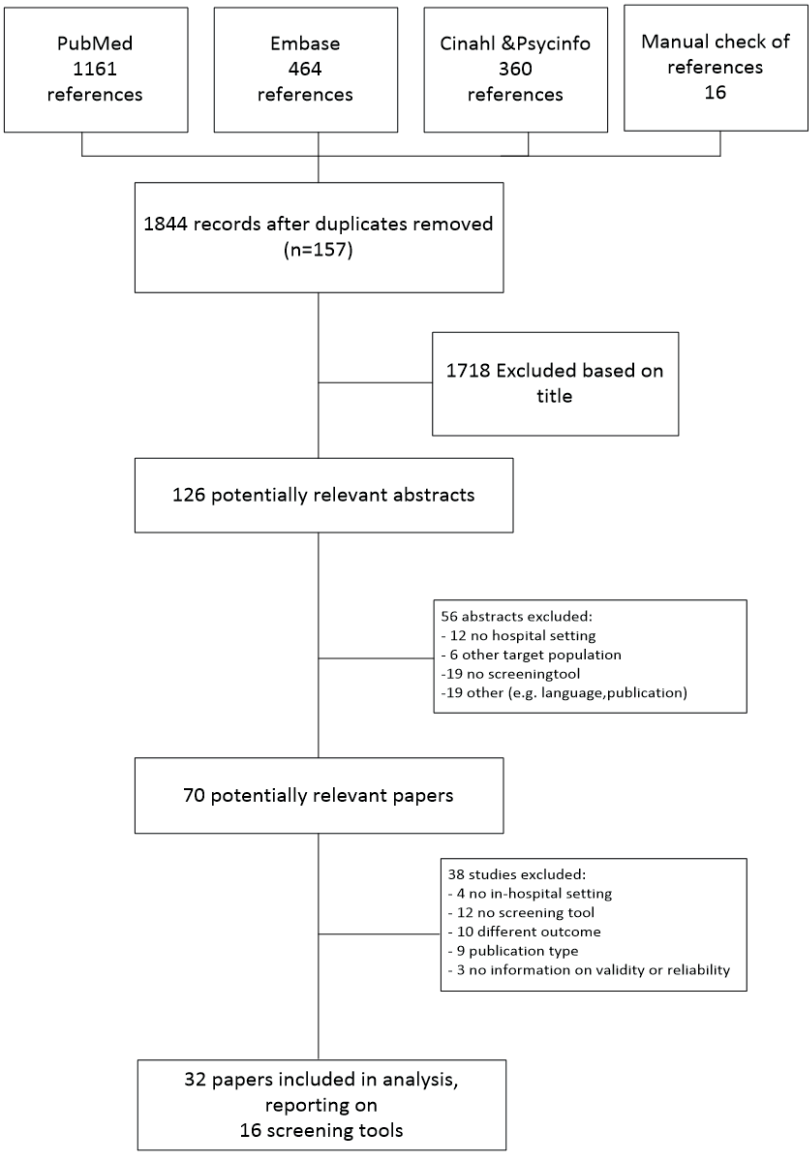

Table 1: Basic characteristics of the included screening tools to identify frail older patients in inpatient hospital care

Abbre-viation	Full name	No. of items	Score-range (cutoff)	Mode of administration	Original Language	Screening domains									
						Cognition	Mood	ADL	IADL	Nutritional-status	Mobility /falls	Comorbidity	Polypharmacy	Social support	Other domains
BRIGHT [44]	Brief Risk Identification for Geriatric Health Tool	11	1 - 11 (≥ 3 = high risk)	Self-reported	English		X	X	X		X				-Shortness of breath -Decision making
COMPRI [27,51,59]	Care complexity prediction instrument	13		Rated by physician (4 items), nurse (3 items) and by patient (6 items)	English						X	X	X		-Predictions by doctor -Predictions by nurse -Unplanned admission -Retirement -Active malignancy -Self perceived health -More than 6 doctor visits /3 month
EGS [40]	Emergency Geriatric Screening	4	0 - 4 (0 = not at risk, 3 < = at risk)	Rated by emergency-physician	English	X		X			X				
FI-CGA [42, 57]	Frailty Index based on CGA	55	0 - 1 (0 = no deficits, 1 = max. deficits)	Data abstracted out of CGA by geriatrician	Not stated	X	X	X	X	X	X	X			-Self perceived health -Peak flow -BMI -Shoulder strength -Grip strength -Pace
HARP [27, 52]	Hospital Admission Risk Profile	3	0 - 5 risk score (0 - 1 = low risk; 2 - 3 = intermediate risk; 4 - 5 = high risk)	Not stated	English	X			X						-Age
Inouye [45]	--	4	0 - 4 (no risk factor = low risk; 2 risk factors = intermediate risk; 3 - 4 risk factors = high risk)	Interview by nurse	English	X		X							-Decubitus -Low social activity level

Abbre-viation	Full name	No. of items	Score-range (cutoff)	Mode of administration	Original Language	Screening domains									
						Cognition	Mood	ADL	IADL	Nutritional-status	Mobility / falls	Comorbidity	Polypharmacy	Social support	Other domains
ISAR [24-33,35]	Identification Seniors at Risk	6	0 - 6 (< 2; 0 = low risk, 6 = high risk)	Self-reported, or reported by nurse	English	X		X	X				x		-Recent hospitalization -Vision impairment
ISAR-HP [41, 55]	Identification Seniors at Risk – Hospitalized patients	4	0 - 5 (score 2 or more = at risk)	Not stated	English				X		X				-Travel assistance needed -Educational level
MFS [48]	Multidimensional Frailty Score	9	0 - 15 (score 5 or more = high risk)	Data abstracted out of CGA by geriatrician	English	X		X	X	X					-Active malignancy -Serum Albumin -Charlson Comorbidity Index -Delirium risk -Mid-arm circumference
MPI [46, 50]	Multi prognostic index	63	0 - 1 (0 – 0.33 = low risk; 0.34 – 0.66 = moderate risk; 0.67 - 1 = high risk)	Data abstracted out of CGA by geriatrician	Not stated	X		X	X	X			X		-Decubitus -Living situation
m-MPI [47]	Modified Multi Prognostic Index	51	0 - 1 (0 – 0.33 = low risk; 0.34 – 0.66 = moderate risk; 0.67 - 1 = high risk)	Data abstracted out of CGA by geriatrician	Not stated	X		X	X	X			X		-Decubitus -Living situation
ProFunction [58]	--	7	0 - 31 0 - 7 (Simplified ProFunction)	Not stated	English			X	X			X		X	-Age
REFS [49]	Reported Edmonton Frail Scale	13	0 - 18 (0 - 5 = not frail; 6 - 7 = apparently vulnerable; 8 - 9 = mild frailty; 10 - 11 = moderate frailty; 12 - 18 = severe frailty)	Self-reported or by proxy	English	X	X		X	X	X		X	X	-General health status -Incontinence
SHERPA [5]	Score Hospitalier d'Evaluation du	5	0 - 11,5 (0 = low-risk; 11.5 = high risk)	Rated by ED-staff	English	X			X		X				-Self perceived health -Age

Abbre-viation	Full name	No. of items	Score-range (cutoff)	Mode of administration	Original Language	Screening domains									
						Cognition	Mood	ADL	IADL	Nutritional-status	Mobility /falls	Comorbidity	Polypharmacy	Social support	Other domains
	Risque de Perte d'Autonomie														
SPICES [43]	--	6	0 - 6 (score 2 or more = at risk)	Rated by nurse	English	X				X	X				-Skin integrity -Incontinence -Sleep disturbance
TRST [24, 26, 30, 33-38]	Triage Risk Stratification Tool	6	0 - 6 (< 2; 0 = low risk; 6 = high risk)	Self-reported and/or administered by nurse	English Italian Dutch	X					X		X	X	-ED use < 30 days or hospitalization < 90 days. -RN professional recommendation

ED= Emergency Department, CGA= Comprehensive Geriatric Assessment

Included Studies

The 16 included screening tools showed different characteristics. Most screening tools showed more or less a multi-domain approach. The number of items ranged from 3 (52) to 63 items (50). Some of the included screening tools were modifications of earlier developed tools, for instance Identification Seniors at Risk (ISAR) (24 – 33, 35) and Identification Seniors at Risk - Hospitalized Patient (ISAR-HP) (41, 55), Multidimensional Prognostic Index (MPI) (46, 50) and modified Multidimensional Prognostic Index (m-MPI) (47).

Most screening tools were reported in one or two studies (i.e. Score Hospitalier d'Evaluation de Risque de Perte d'Autonomie (SHERPA) (5)), some screening tools were reported more often (i.e. ISAR (24 – 33, 35) or Triage Risk Stratification Tool (TRST) (24, 26, 30, 33 - 38)). Studies were performed in different continents, mainly in North America, Europe and Australia. Only one study had Asian origin (Table 2).

Table 2: Psychometric properties of included screening tools to identify frail older patients in inpatient hospital care

Assessment tool	Study and country	Population	Outcome	Predictive validity		Reliability
				Short term (up to 30 days)	Long term (>30 days)	
BRIGHT	Boyd 2008 New Zealand [44]	Patients 75 years and older admitted to ED with non-urgent complaints	IADL deficits Cognitive deficit ADL deficit	Sens. 76% Spec. 79% PPV 87% NPV 65% AUC 0.83 Sens. 78% Spec. 54% PPV 48% NPV 82% AUC 0.73 Sens. 83% Spec. 53% PPV 42% NPV 88% AUC 0.66	Not stated Not stated Not stated	Internal Consistency Cr.alpha = 0.73
COMPRI	Huyse 2001 Netherlands [51] De Jonge 2003 Netherlands [59] Hoogerduijn 2010 Netherlands [27]	Patients admitted to internal medicine ward , (mean age 60 and 62) Patients 65 years and older acutely admitted to general ward	Length of stay Functional decline	AUC 0.73 Not stated	Not stated Sens. 70% Spec. 62% PPV 42% NPV 84% AUC 0.69	Not stated
EGS	Schoenenberger 2014 Switzerland [40]	Patients 75 years and older admitted to ED	ED readmission Length of in hospital stay Institutionalized after discharge	Not stated	OR 2.68 Time ratio 1.26 OR 12.13	Not stated
FI-CGA	Evans 2014 USA [42] Krishnan 2014 UK [57]	Patients 75 years and older admitted to medical hospital Patients admitted with hip fracture (mean age 81)	Mortality Discharge destination	Not stated	Death rate 0.59 (FI > 0.65) AUC 0.82	Test-retest reliability weighted K 0.78

Assessment tool	Study and country	Population	Outcome	Predictive validity		Reliability
				Short term (up to 30 days)	Long term (>30 days)	
HARP	Sager 1996 USA [52] Hoogerduijn 2010 Netherlands [27]	Patients 70 years and older admitted to hospital for acute medical illness; Patients 65 years and older acutely admitted to general ward	Functional decline	Not stated Low Risk Intermediate risk High risk 	AUC 0.65 Sens. 61% Spec. 68% PPV 39% NPV 84% AUC 0.65 Sens. 40% Spec. 81% PPV 41% NPV 80% AUC 0.60 Sens. 21% Spec. 89% PPV 38% NPV 77% AUC 0.56	Not stated
Inouye	Inouye 1993 USA [45]	Patients 70 years and older admitted to general medicine ward	Functional decline Death or nursing home admission	High risk: RR 12.9 Intermediate risk RR 4.6 Low risk RR 1.0 High risk: RR 6.9 Intermediate risk RR 3.3 Low risk RR 1.0		Not stated
ISAR	Mc.Clusker 1999 Canada [29] Mc.Clusker 2000 Canada [28] Dendukuri 2004 Canada [25] Moons 2007 Belgium [30] Geyskens 2008 Belgium [26] Salvi 2009 Italy [32] Hoogerduijn 2010 Netherlands [27] Buurman 2011 [24] Graf 2012 Switzerland [35] Salvi 2012a Italy [31] Salvi 2012b Italy [33]	Patients 65 years and older admitted to ED or discharged from ED; Patients 65 years and over admitted to general internal ward	Functional decline ED-revisit Hospital readmissions 	Sens. 78% - 94% Spec. 41% - 47% PPV 31% - 36% NPV 84% - 96% AUC 0.78 Sens. 73% Spec. 35% PPV 27% NPV 78% Sens. 79% Spec. 37% PPV 22% NPV 89% AUC 0.61	Sens. 92% Spec. 39% PPV 36% NPV 94% AUC 0.67 Sens. 56% - 84% Spec. 39% - 54% PPV 19% - 61% NPV 10% - %78% AUC 0.56 - 0.60 Sens. 73% - 77% Spec. 38% - 51% PPV 36% - 44% NPV 71% - 78% AUC 0.63 - 0.68	Concordance Correlation Coefficient = 0.78

Assessment tool	Study and country	Population	Outcome	Predictive validity		Reliability
				Short term (up to 30 days)	Long term (>30 days)	
			Mortality	Not stated	Sens. 64% - 91% Spec. 37% - 51% PPV 4% - 18% NPV 2% - 96% AUC 0.58 - 0.74	
			Frailty	Not Stated	Sens. 94% Spec. 63% AUC 0.92	
			Composite outcome	Not stated	Sens. 72% - 86% Spec. 47% - 58% PPV 56% NPV 81% AUC 0.71	
			Combined outcome	Not stated	Sens. 65% Spec. 54% PPV 26% NPV 13% AUC 0.60	
ISAR-HP	Hoogerduijn 2012, 2014 Netherlands [41, 55]	Patients 65 years and older admitted to general internal ward Patients 65 years and older admitted for cardiac surgery	Functional decline Mortality	Not Stated Not stated	Sens. 85% - 89% Spec. 39% - 41% PPV 29% - 56% NPV 93% - 89% AUC 0.68 - 0.73 Sens. 81%	Not stated
MFS	Kim 2014, Korea [48]	Patients 65 years and older admitted for elective surgery	Mortality Post-operative complications Nursing home admission	Not Stated	AUC 0.82 AUC 0.73 AUC 0.77	Not stated
MPI	Pilotto 2008 , 2009 Italy [46, 50]	Patients 65 years and older admitted to a geriatric unit; Patients 65 years and older admitted to a geriatric unit with Pneumonia	Mortality	Not stated Sens. 82% Spec. 77% AUC 0.83	AUC 0.75 Sens. 77% Spec. 75% AUC 0.79	Not stated

Assessment tool	Study and country	Population	Outcome	Predictive validity		Reliability
				Short term (up to 30 days)	Long term (>30 days)	
m-MPI	Sancarlo 2011 Italy [47]	Patients 65 years and older admitted to geriatric unit	Mortality	AUC 0.75	AUC 0.71	Not stated
ProFUNCTION	Bernabeu 2012 Spain [58]	Polypathological patients (78 years mean age) admitted to hospital	Functional decline	Derivation cohort: Validation cohort:	AUC 0.57 and AUC 0.59 AUC 0.52 - 0.56	Not stated
REFS	Hilmer 2009 Australia [49]	Patients 70 years and older admitted to acute hospital	Frailty	Not stated	Not stated	Interrater reliability K=0.83 (weighted K=0.84). Internal Consistency Cr.alpha = 0.68
SHERPA	Cornette 2006 Belgium [5]	Patients 70 years and older, admitted to general internal ward	Functional decline	Not stated	Sens. 68% Spec. 71% AUC 0.73	Not stated
SPICES	Aronow 2014 USA [43]	Patients 65 years and older admitted for surgical or medical reasons	Adverse hospital events Readmission Mortality	OR 3.04 OR 1.24 OR 1.03	Not stated	Not stated
TRST	Meldon 2003 USA [38] Fan 2006 Canada [34] Moons 2007 Belgium [30] Hustley 2007 USA [36] Geyskens 2008 Belgium [26] Lee 2008 Canada [37] Buurman 2011 Netherlands [24] Graf 2012 Switzerland [35] Salvi 2012b Italy [33]	Patients 65 years and older admitted to ED or discharged from ED	Functional decline ED revisit Hospital readmission Mortality	Sens. 51% - 82% Spec. 54% - 63% PPV 33% NPV 91% AUC 0.56 - 0.66 Sens. 63% - 76% Spec. 40% - 52% PPV 17% - 21% NPV 89% - 90% AUC 0.61 Sens. 75% - 77% Spec. 33% - 52% PPV 10% - 19% NPV 13% - 97% AUC 0.55 - 0.72	Sens. 53% - 88% Spec. 60% - 63% AUC 0.60 - 0.66 Sens. 56% - 60% Spec. 54% PPV 19% - 36% NPV 10% - 76% AUC 0.56 Sens. 70% Spec. 55% PPV 24% NPV 83% AUC 0.65 Sens. 55 % Spec. 31%	Internal Consistency =0.90 – 0.94

Assessment tool	Study and country	Population	Outcome	Predictive validity		Reliability
				Short term (up to 30 days)	Long term (>30 days)	
					PPV 2% NPV 4% AUC 0.43	
			Composite outcome (ED-revisit, hospital admission or nursing home admission)	Sens. 62% - 87% Spec. 21% - 63% PPV 18% - 26% NPV 83% - 90 AUC 0.57 - 0.65	Sens. 55% - 87% Spec. 23% - 66% PPV 40% - 41% NPV 74% - 76% AUC 0.62	
			Combined outcome (recurrent ED visit, hospitalization and mortality)		Sens. 75% Spec. 33% PPV 22% NPV 16% AUC 0.54	

AUC = Area under the Receiver operating curve; Cr.alpha = Cronbachs Alpha; ED = Emergency Department; IADL = Instrumental Activities of the Daily Living; NPV = negative predictive value; OR = odds ratio; PPV = positive predictive value; RR = relative risk; Sens. = Sensitivity, Spec. = specificity. BRIGHT = Brief Risk Identification for Geriatric Health Tool; COMPRI = Care Complexity Prediction Instrument; EGS = Emergency Geriatric Screening; FI-CGA = Frailty Index based on Comprehensive Geriatric Assessment; HARP = Hospital Admission Risk Profile; IASR = Identification Seniors at Risk; ISAR-HP = Identification Seniors at Risk – Hospitalized Patient; MFS = Multidimensional Frailty Score; MPI = Multi Prognostic Index; mMPI = Modified Multi Prognostic Index; REFS = Reported Edmonton Frail Scale; SHERPA = Score d'Evaluation du Risque de Perte d'Autonomie; TRST = Triage Risk Stratification Tool.

Critical appraisal of the included studies was conducted using the QUADAS score. Generally, all studies were well performed, except for the study on the SPICES with a QUADAS score of 5 (43). The remaining scores varied between 11 and 14. More details about the QUADAS scores are presented in Table 3.

Table 3: Quality assessment of included studies

Index Test (no. studies included)	No. of Studies Scored Positive on QUADAS[18] Items*														Mean Score (Observed Range**)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
BRIGHT (1) [44]	1	1	1	1	0	0	1	1	1	1	1	1	1	1	12
COMPRI (3) [27, 51, 59]	3	3	3	2	3	3	3	2	2	1	1	3	3	3	11 (9 - 14)
EGS (1) [40]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
FI-CGA (2) [42, 57]	2	2	2	2	2	2	1	1	0	1	1	2	2	2	11
HARP (2) [27, 52]	2	2	2	2	2	2	1	2	2	0	0	2	2	2	12
Inouye (1) [45]	1	1	1	1	1	1	1	1	1	0	1	1	1	1	13
ISAR (10) [24-33, 35]	10	10	10	10	10	10	10	10	10	4	4	10	10	10	13 (12 - 14)
ISAR-HP (2) [41, 55]	2	2	2	2	2	2	0	2	2	0	0	2	1	2	11 (10 - 11)
MFS (1) [48]	1	1	1	1	1	1	0	1	1	0	0	1	1	1	11
MPI (2) [46, 50]	2	2	2	2	2	2	2	2	2	2	2	2	2	2	14
m-MPI (1) [47]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
ProFunction (1) [58]	1	1	1	1	1	1	1	0	1	0	0	1	1	1	11
REFS (1) [49]	1	1	1	0	1	1	1	0	1	1	1	1	1	1	12
SHERPA (1) [5]	1	1	1	1	1	1	1	1	1	0	0	1	1	1	12
SPICES (1) [43]	1	0	0	0	1	1	0	0	0	0	0	1	1	0	5
TRST (9) [24, 26, 30, 33-38]	9	9	9	9	9	9	9	9	9	7	7	9	9	7	13 (12 - 14)

* 1: Was the spectrum of patient's representative of the patients who will receive the test in practice? 2: Were selection criteria clearly described? 3: Is the reference standard likely to correctly classify the target condition? 4: Is the time period between reference standard and index test short enough to be reasonably sure that the target condition did not change between the two tests? 5: Did the whole sample or a random selection of the sample, receive verification using the standard of diagnosis? 6: Did patients receive the same references standard regardless of the index test result? 7: Was the reference standard independent of the index test? (i.e. the index test did not form part of the reference standard)? 8: Was the execution of the index test described in sufficient detail to permit replication of the test? 9: Was the execution of the reference standard described in sufficient detail to permit its replication? 10: Were the index test results interpreted without knowledge of the result of the reference standard? 11: Were the reference standard results interpreted without knowledge of the results of the index test? 12: Were the same clinical data available when the test results were interpreted as would be available when the test is used in practice? 13: Were uninterpretable/intermediate test results reported? 14: Were withdrawals from the study explained?

** Theoretical range 0-14. Higher scores indicate higher quality

BRIGHT = Brief Risk Identification for Geriatric Health Tool; COMPRI = Care Complexity Prediction Instrument; EGS = Emergency Geriatric Screening; FI-CGA = Frailty Index based on Comprehensive Geriatric Assessment; HARP = Hospital Admission Risk Profile; IASR = Identification Seniors at Risk; ISAR-HP = Identification Seniors at Risk – Hospitalized Patient; MFS = Multidimensional Frailty Score; MPI = Multi Prognostic Index; mMPI = Modified Multi Prognostic Index; REFS = Reported Edmonton Frail Scale; SHERPA = Score d'Evaluation du Risque de Perte d'Autonomie; TRST = Triage Risk Stratification Tool.

Predictive Validity

Predictive validity was reported in different ways, ranging from likelihood ratios (39) to area under receiver operating characteristic curves (AUC) (40). Table 2 provides detailed information about the predictive validity of the included screening tools.

Short-term Outcomes

Several screening tools were only validated on short-term outcomes (i.e. functional decline, Emergency Department (ED) readmissions and composite outcomes) (43 - 45). The sensitivity of the included screening tools ranged from 51% (26) to 94% (35). The sensitivity of the more often studied tools varied from 73% (32) to 94% (35) for the ISAR, and from 51% (36) to 87% (35) for TRST. In general, screening tools with a higher sensitivity performed more poorly on specificity (Table 2).

Specificity of the included screening tools ranged from 21% (35) to 79% (44). The specificity of the TRST varied between 21% (35) and 63% (38). The specificity of the ISAR ranged between 33% (33) and 47% (32).

Inouye and colleagues reported a higher risk of functional decline (RR 12.9) for patients stratified as "high risk" by their screening tool as compared to their "low risk" counterparts (45). Aronow and colleagues reported an OR of 3.04 on adverse hospital outcomes using the SPICES (43).

Pilotto and colleagues reported an AUC of 0.83 for short-term mortality using the MPI (46). Sancarlo and colleagues redesigned the MPI into the modified-MPI. They found an AUC of 0.75 for short term mortality (47).

Long-term Outcomes

Studies varied in their follow-up from one to 12 months. Sensitivity on long-term outcomes differed from 21% (27) to 94% (31), the majority ranged between 60% and 80%. Lowest sensitivity was reported by Hoogerduijn and colleagues for the Hospital Admission Risk Profile (HARP) tool: 21% for functional decline (27). The highest sensitivity was found for the ISAR: 94% (37). Hoogerduijn and colleagues reported a high sensitivity for both functional decline (85%–89%) and mortality (81%) by the use of the ISAR-HP (41). Sensitivity of the ISAR varied from 56% (24) (ED-readmission) to 94% (30). The sensitivity of TRST varied from 53% (functional decline) to 88% (functional decline) (26).

Specificity for long-term outcomes varied from 23% (35) to 89% (27). The lowest specificity was reported by Graff and colleagues for the TRST (composite outcome): 23% (35). The highest specificity was reported by Hoogerduijn and colleagues for the HARP (functional decline): 89% (27). In general,

the TRST specificity ranged from 23% (35) to 66% (38), both on composite outcomes. The ISAR specificity ranged from 37% (mortality) to 63% (31).

Other studies reported the predictive validity of screening tools with other indicators. Schoenenberger and colleagues reported an OR of 12.13 for the Emergency Geriatric Screening (EGS) on nursing home admission (40). Kim and colleagues reported an AUC of 0.82 for one year mortality for the Multidimensional Frailty Score (MFS) (48).

Reliability

With respect to reliability hardly any psychometric data were reported. The Brief Risk Identification for Geriatric Health Tool (BRIGHT) (44) and TRST (38) showed internal consistency coefficients of 0.73 or higher. In contrast, the internal consistency of the Reported Edmonton Frail Scale (REFS) was shown to be lower (0.68) although interrater reliability by means of Kappa was found to be 0.83 (49). In addition, the test-retest reliability of the Frailty Indicator-based on CGA (FI-CGA) was 0.78 (42).

Feasibility

The authors of the included studies reported in different ways about feasibility but generally not in a systematic way. Often a qualitative approach was used including the general opinions or impressions of the authors. In the conclusions of the studies statements appeared such as: “The scorecard of this model will be easy to use in clinical practice and will be easy to administer (41).”

The screening tools included in the present review can be administered in different ways: self-report assessments such as the REFS (49) and the BRIGHT (44), professional-administered (e.g. nurses, medical doctors) such as the SHERPA (5) and TRST (38), and use of abstracted data out of Comprehensive Geriatric Assessments (CGA) such as the MPI (50) and FI-CGA (42). Some tool used a combination of the three mentioned methods such as the ISAR (29). One screening tool (Care Complexity Prediction Instrument (COMPRI) (51) had to be completed by a nurse, a medical doctor and items collected by interviewing the patient. The number of items per screening tool varied from three (HARP (52)) to 63 items (MPI (50)). More information about the basic characteristics of the included tools is reported in Table 1.

The included studies were assessed on feasibility using four feasibility items (23). First, the time to administer varied from one minute (TRST (38)) to 35 minutes (m-MPI (47)); although for the majority of the screening tools no information was provided about administration time. Second, information about the instructions needed for completing the tool was only provided for six screening tools. Third, the issue of whether staff training was needed was mentioned for five tools. And finally, 13 of the 16

screening tools were free available (presented in the text, added in the appendix or published on the internet). Table 4 provides detailed information about feasibility.

Table 4: Assessment of feasibility items of included screening tools to identify frail older patients in inpatient hospital care

	BRIGHT [44]	COMPRI [27, 51, 59]	EGS [40]	FI-CGA [42, 57]	HARP [27, 52]	Inouye [45]	ISAR [24-33, 35]	ISAR-HP [41, 55]	MFS [48]	MPI [46, 50]	m-MPI [47]	ProFunction [58]	REFS [49]	SHERPA [5]	SPICES [43]	TRST [24, 26, 30, 33-38]
Time to administer (time in minutes)	-	-	5	10 - 25	-	-	-	-	-	30	25 - 35	-	< 5	-	-	1 - 5
Instructions reported	+	-	+	-	+	-	+	-	-	-	-	-	+	-	-	+
Training needed	+	-	+	-	-	-	-	-	-	-	-	-	+	-	-	+
Free available	+	+	+	+	+	+	+	+	+	-	-	-	+	+	+	+

+ Information is provided / - no information provided, unknown; Bright = Brief Risk Identification for Geriatric Health Tool; COMPRI = Care Complexity Prediction Instrument; EGS = Emergency Geriatric Screening; FI-CGA = Frailty Index based on Comprehensive Geriatric Assessment; HARP = Hospital Admission Risk Profile; IASR = Identification Seniors at Risk; ISAR-HP = Identification Seniors at Risk – Hospitalized Patient; MFS = Multidimensional Frailty Score; MPI = Multi Prognostic Index; mMPI = Modified Multi Prognostic Index; REFS = Reported Edmonton Frail Scale; SHERPA = Score d'Evaluation du Risque de Perte d'Autonomie; TRST = Triage Risk Stratification Tool.

Discussion

Previously many screening tools have been described that identify elderly patients at risk of functional decline or other adverse outcomes during and after acute hospitalization. Due to the lack of a gold standard, it was difficult to evaluate and compare these screening tools. In this study we evaluated screening tools on their predictive validity, reliability and feasibility.

Predictive Validity

The included studies reported their predictive validity in different ways. The AUC, sensitivity and specificity were the most frequently used indicators (Table 2). No assessment tool had a perfect discriminative power. In general, the reported AUC varied between insufficient and excellent and ranged from 0.43 (24) to 0.92 (31). Tools with a high sensitivity generally reported a lower specificity and vice versa. Hamaker and colleagues reported similar findings in their systematic review on frailty assessments in older cancer patients (53).

Although TRST and ISAR are the most often studied screening tools, their predictive validity is generally not different from the other included tools. Several studies did not comprise validity information using sensitivity, specificity or AUC at all (40, 42, 45, 49). Sometimes odds ratios or relative risks were then reported. As a result, it is hard to compare outcomes between the tools.

The overall sensitivity of the included screening tools is fairly good and varied from 21% to 94%. The ISAR (24 – 33, 35), ISAR-HP (41, 55) and MPI (46, 50) showed the highest sensitivity. In contrast, their specificity is relatively low. Depending on the purpose of screening, an appropriate balance of sensitivity and specificity is expedient. If the purpose of screening is to decide whether preventive interventions should be considered, lower specificity seems to be acceptable. In this domain high sensitivity seems more important than a high specificity. Classifying non-frail patients as frail has no major impact on patients. Interventions for patients classified as frail generally relate to basic care like reorientation or mobilization and would not harm the falsely positive screened patients. Otherwise, low specificity could lead to problems in health care systems. A high number of false positive screens will lead to inefficient use of care resources such as staff. The latter could limit the willingness of health systems to implement these screening tools.

Reliability

There was hardly any information available with respect to the reliability of the included screening tools such as inter-rater reliability, test–retest reliability and internal consistency. Some studies reported internal reliability in terms of Cronbach's alpha as reliability parameter (38, 44). However, such parameter only suggests that the items of the tool have some degree of relationship with each other and has less to do whether the screening tool is reliable in practice. In this respect, future research should include in-depth analyses of issues related to reliability such as interrater reliability or test-retest reliability.

Feasibility

After aspects of validity and reliability, feasibility may play an important role in the choice of a specific tool in daily practice. Feasibility refers to the practical use of the screening tool by professionals and several aspects of the tool itself (23), for instance the mode of administration or the number of items. In general, there was a lack of information about the feasibility of the included screening tools. Studies including the EGS (40), the REFS (49) and TRST (38) reported information on different feasibility items. The time taken to administer these tools varied from 1 to 5 minutes. Screening tools with a broader scope and a larger number of items (i.e. MPI (50) or FI-CGA (42)) were clearly more time consuming than short form assessments (i.e. ISAR (29) or TRST (38)). Despite their short administration time and small number of items, the sensitivity of these screening tools was fairly good.

Limitations of this Study

We performed a systematic search in different databases and although a broad search strategy was applied, it is possible that some studies were missed in this review. In the first phase of the review process titles were included if they comprised information about the population (elderly patients), the intervention (screening) and setting (in-hospital). Possibly relevant studies could have been missed if the title did not comprise this information (56). Although a comprehensive literature search was performed, 16 studies were found via reference checking. Second, some of the included screening tools were validated in a specific hospital setting like an emergency department (i.e. TRST (38) and ISAR (29)) or internal medicine ward (i.e. ISAR-HP (55)). This should be taken in account when the assessment tools are used in other hospital settings (general wards, long term care, etc.).

Conclusion and Implications of Key Findings

Our review on screening tools to identify frailty in hospitalized older adults included 16 different tools. Through a broad search strategy we included more screening tools as compared to previous reviews (9, 14 - 17). In addition, we assessed the feasibility of the 16 tools on four structured items.

With respect to predictive validity, the sensitivity of the tools is fairly good, but their specificity is rather poor. No systematic differences were found between screening tools that were studied multiple times and tools that were only studied once or twice. Best sensitivity scores were reported in studies on the ISAR (24 – 33, 35), ISAR-HP (41, 55) and MPI (46, 50). Of the most frequently studied tools (the ISAR and the TRST) the predictive validity of the ISAR seems somewhat better than that of the TRST.

A good comparison between studies is hampered because of the variations in the outcome criteria between studies. When similar outcomes or criteria were used, e.g. functional decline, authors used a different definition of the outcome or criterion. In addition hardly any information is reported with respect to reliability of the included screening tools. As such tools may be, for example, applied by different professionals, information about inter-rater reliability is important. And finally, in general little information is reported with respect to feasibility of the screening tools. As feasibility of screening tools is relevant it should be included in future studies in a more structured way.

Screening tools to identify frail older patients in inpatient hospital care could be useful in daily practice. For no tool, however, is clear evidence regarding validity, reliability and feasibility available yet. In future research in this field items like reliability and feasibility should be studied in a structured way.

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Chapter 3: Screening for Frailty in Older Hospitalized Patients: Reliability and Feasibility of the Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP).

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Abstract

As nurses in hospitals are confronted with increasing numbers of older patients, their geriatric nursing skills and knowledge must be integrated into daily clinical practice. Early risk identification via screening tools may help to improve geriatric care. To reduce the assessment burden of nurses, the Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP) was developed, a tool that is fully integrated in the initial nursing assessment. The aim of this study was to explore aspects of reliability, validity and feasibility of the MFST-HP. Intra-rater reliability was assessed by measuring the same patient two times within an interval of 24 hours. Inter-rater reliability was assessed by screening the same patient by two different nurses, blinded for each other's MFST-HP score. Construct validity was studied by the associations between the MFST-HP scores and age and comorbidities. The Intraclass Correlation Coefficients for both intra- and inter-rater reliability were good (ICC above .93). Older patients and those with more comorbidity showed higher scores on the MFST-HP compared to younger patients and those with less comorbidity. Administration time averaged 2.6 minutes (SD = 0.9) and the response burden among patients was acceptable. The MFST-HP shows promise as a reliable, valid and feasible screening tool for frailty among hospitalized older patients.

Introduction

As society ages, acute care hospitalization of older patients will increase (1). Nurses in acute hospital settings have a crucial role in meeting the special care needs of older patients who are at risk of adverse health outcomes such as functional decline (2), prolonged hospital stay and increased mortality (3). On admission, underlying conditions such as cognitive impairment or functional decline, are often masked and therefore less recognized. This is in contrast to the often clearly evident primary medical condition. Systematic screening of these patients for frailty at admission enables early identification and management of potential, complicating geriatric problems (4). Additionally, systematic screening and documentation promote awareness among the nursing staff of potential complications and risks associated with frailty (5). Furthermore, the findings of systematic screening can be used as a starting point for a care plan tailored to the needs of frail older patients.

These findings suggest that early identification at admission of frailty may help improve the quality of geriatric care. Various screening tools to identify frail older patients are available for use in daily practice. These tools have been developed from different conceptualizations of frailty, e.g. Fried's (physical) frailty phenotype (6), the deficit model developed by Rockwood and colleagues (7), and a multidimensional approach (8). Examples of frequently used instruments reported in a recent systematic review of the psychometric properties of screening tools specific for the hospital setting are the Identification Seniors At Risk (ISAR) (9), the Triage Risk Screening Tool (TRST)(10) and SPICES (11, 12). This systematic review showed a variable sensitivity for the 16 available screening tools (between 21% and 94%) and generally a rather poor specificity. Different aspects of reliability were hardly studied (13). In addition none of these previously developed tools were integrated into the initial nursing assessment upon hospital admission which could reduce the time burden associated with conducting assessments.

To address these limitations in available tools, a screening tool that is integrated into daily nursing practice was developed. The multidimensional Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP) is fully integrated into the initial nursing assessment in the hospital. The findings of the nursing assessment are recorded in the hospital digital nursing record and the system generates an overview of the screened domains. On the other hand, nurses may use the answers on the different MFST-HP items as a starting point of care as well. For example, when a patient answers "Yes" on the questions for ADL, memory problems and delirium history, a proactive care plan on delirium prevention can be developed and executed. MFST-HP (Figure 1) is a modified hospital version of the TraZAG tool, which is more frequently used in Dutch general practice settings to screen and assess older patients (14). The TraZAG comprises ten items on ADLs, IADLs, nutrition, mobility and fall risk,

incontinence, medication, vision and hearing impairment, cognition and depressive symptoms. Psychometric properties of the TraZAG have not been examined yet. The MFST-HP expands the hospital version of TraZAG by the addition of clinical relevant items concerning delirium and pressure sores.

The present paper introduces the MFST-HP as a frailty screening tool within a hospital setting as an integral part of the initial nursing assessment. The aim of the current study was to determine the intra- and inter-rater reliability and feasibility of this tool when used as an integral part of the initial nursing assessment to screen hospitalized older patients. In addition, construct validity was analyzed by means of associations between patient characteristics and MFST-HP scores and an exploratory factor analysis was conducted as well.

Figure 1: The items and response options of the Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP)

	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 months	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 4 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

Material and Methods

Design

A cross sectional study was performed with older patients (70 years and older) admitted to the hospital in January and March 2014.

Setting

The study was conducted in the Maastricht University medical Center (MUMC). The MUMC is a 715 bed university hospital in the southern part of The Netherlands. The hospital combines an academic function with a service role for this region. Approximately, 30,000 patients are admitted to the hospital yearly and about 7,000 patients are 70 years and older (www.mumc.nl). These older patients are not admitted to special geriatric wards. A geriatric consultation team is available to support medical and nursing teams who provide care to all hospitalized patients, including older adults.

Sample

Consecutive patients who were 70 years or older and who were non-emergent admitted to a cardio-surgical, orthopedic or internal medicine ward, were invited to participate in the study. Patients were excluded if the length of stay was less than 24 hours, if a diagnosis of dementia was present, if they were unable to speak Dutch, if they had communication difficulties due to vision or hearing disabilities, if they suffered from a terminal illness, or if their medical situation was unstable.

Screening with MFST-HP

The MFST-HP is a short screening tool for older hospitalized patients. It contains 15 items (with yes-no answer options) over three domains: physical (items 1-9), psychological (items 10-13) and social (items 14-15) (see Figure 1). The minimum total MFST-HP score is 0 and the maximum score is 15. Theoretical subscale scores range from 0 to 9 for the physical domain, 0 to 4 for the psychological domain and 0 to 2 for the social domain; the lower the scores on the MFST-HP, the lower the level of frailty.

The MFST-HP is completed by the ward nurse who interviews the patient during the regular initial nursing assessment within 48 hours after admission. Data from the medical records are not used for completion of the MSFT-HP. If a patient is not able to respond to one or more items, family caregivers are asked to answer the questions. The results of the screening are automatically generated by the electronic system used with the digital patient record and transmitted to the nursing plan. This information helps nurses to make evidence-based decisions for the care plan. Otherwise, the hospital-wide geriatric consultation team can provide pro-active consultation, based on the results of the

screening. Nurses do not need extensive training to use the MFST-HP. Information about the use of the MFST-HP is provided in a nursing protocol.

Procedure

With respect to intra-rater reliability, the same student geriatric nurse practitioner (GNP) used the MFST-HP to assess the same patient twice with an interval of 24 hours within 48 hours after admission. Inter-rater reliability was assessed within 48 hours of patients' admission. The MFST-HP was independently assessed twice within a one hour interval either by two GNPs or independently by one of the GNPs and an experienced ward nurse. The GNP's were only scheduled for two days a week during office hours to screen patients for study eligibility.

Measurements

The GNPs and ward nurses were blinded from each other's MFST-HP scores. The intra-rater and inter-rater reliability studies were conducted on different wards of the hospital. Assignment to the inter-rater reliability sample (gynecology ward, short-stay unit surgery, short-stay unit internal medicine) or the intra-rater reliability sample (orthopedic ward, internal medicine ward, cardiac surgery ward) was based on the ward where the patient was admitted.

A stopwatch was used to measure feasibility by registering the time needed to administer the MFST-HP. The stopwatch was operated by the GNP during the second administration of the MFST-HP. Furthermore, the GNP asked patients the following two questions about their perception of the MFST-HP assessment. First, a 4-point scale (very burdensome, burdensome, little burden, not burdensome at all) was used to determine if the patient experienced any burden by completing the interview. Second, using a 5-point scale (from very short to very long), the patient's perception about the length of the questionnaire was measured.

Socio-demographic data were collected via medical records (i.e., sex, age, living situation, marital status and educational level). Comorbidity was assessed by means of the Charlson Comorbidity Index (CCI). The CCI is a method to predict mortality by classifying comorbidities. The index is widely used by health researchers to measure burden of comorbid diseases and to report on case mixes used in research (15, 16). The CCI was based on information from the medical record of the patient. Cognitive status was assessed during the patient interview by using the Mini-Cog because it has a good sensitivity for screening for dementia (17). The assessment consists of two performance tests: the clock drawing test (CDT) and a recall test (3 words). Cognitive impairment (yes/no) is confirmed if the recall is 0 words or if the recall is 1 or 2 words combined with an abnormal CDT. In the present study, the GNP assessed the Mini-Cog.

Data Analysis

SPSS version 20.0 (IBM Corporation, Armonk, NY, USA) was used for the statistical analysis of the data. Descriptive statistics were calculated for patient characteristics. To identify potential differences in time, paired t-tests were used for total and domain MFST-HP scores. To study the intra-rater reliability of the MFST-HP, Intraclass Correlation Coefficients (ICC) were calculated in a two-way mixed model. ICCs for the inter-rater reliability were calculated in a two way random model. Agreement on the individual items of the MFST-HP was calculated by means of Kappa statistics. Construct validity was analyzed by means of associations between several patient characteristics and MFST-HP scores. Age and CCI subgroups were created based on their median scores. Differences in MFST-HP scores were then tested by independent sample t-test according to age, CCI, sex, and cognitive decline. Analysis of variance was used to test differences according to different levels of education. A principal component factor analysis was used to test the structure of the MFST-HP items. Pearson's r coefficients were calculated to describe associations between administration time and the patient's age and cognitive impairment.

Results

In total, all of the 79 consecutive patients were willing to participate and included in the study. Seven patients were not assessed for the second time due to medical procedures i.e. surgery or radio therapeutic interventions at the MFST-HP second measurement time. These patients did not significantly differ from all included patients in terms of age, sex and CCI. Data of 72 patients were included in the reliability analyses (32 patients in the intra-rater study and 44 in the inter-rater study) and 79 patients were included in the analyses of construct validity (first measurement). The mean age of all included patients (n=79) was 76.7 years (SD = 5.4) and 57% were female. The majority (95%) lived independently before admission. Two-thirds of the patients were admitted to a surgical ward.

The mean age of the 32 patients in the intra-rater reliability study was 75.2 years (SD = 4.7); 41% were female. The mean CCI was 8.8 (SD = 1.7). Cognitive impairments were present in 22% of the patients. The mean age of the 40 patients in the inter-rater reliability study was 78.3 years (SD = 5.7) and 65% were female. The mean CCI for this group was 9.6 (SD = 2.0) and 28% of the patients were cognitively impaired. Additional socio-demographic characteristics of the total sample and both subsamples are presented in Table 1.

Table 1: Basic characteristics of included patients according to subgroups for inter-rater and intra-rater reliability

		All participants (n=79)	Intra-rater reliability sample (n=32)	Inter-rater reliability sample (n=40)
Age	Mean (SD)	76.7 (5.4)	75.2 (4.7)	78.3 (5.7)
Sex	Female (%)	45 (57)	13 (41)	26 (65)
Ethnicity	Caucasian (%)	79 (100)	32 (100)	40 (100)
Living situation	At home, alone (%)	28 (35)	10 (31)	16 (40)
	At home, not alone (%)	47 (60)	22 (69)	21 (53)
	Nursing Home/care facility (%)	3 (4)	0	2 (5)
	Other (%)	1 (1)	0	1 (2)
Marital status	Married/living together (%)	49 (62)	22 (69)	23 (58)
	Alone (%)	30 (38)	10 (31)	17 (42)
Educational level†	Primary school	12 (17)	3 (9)	9 (23)
	Secondary school	41 (57)	22 (69)	19 (47)
	Higher Vocational Training/University	19 (26)	7 (22)	12 (30)
Admitted to	Surgical ward	48 (67)	18 (59)	30 (75)
	Medical ward (non-surgical)	24 (33)	14 (41)	10 (25)

Intra-rater and Inter-rater Reliability of MFST-HP

The numbers and percentages for patients on the MFST-HP items are reported in Table 2. All Kappa coefficients were 0.64 or higher, except for falls, pressure sores, and polypharmacy in the intra-rater sample as well as depressive symptoms in the inter-rater sample.

Table 2: Numbers and percentages of patients with scores on MFST-HP items for intra-rater and inter-rater samples

Item	Frequency (%)					
	Intra-rater sample n = 32			Inter-rater sample n = 40		
	Measurement 1	Measurement 2	Kappa	Measurement 1	Measurement 2	Kappa
1: IADL	14 (43.8)	14 (43.8)	1.00	14 (35)	17 (42.5)	0.74
2: ADL	4 (12.5)	2 (6.3)	0.64	7 (17.5)	5 (12.5)	0.81
3: Falls	1 (3.1)	3 (9.4)	0.48	2 (5.0)	0 (0.0)	*
4: Mobility	21 (65.6)	19 (59.4)	0.87	18 (45.0)	17 (42.5)	0.65
5: Weight loss	7 (21.9)	4 (12.5)	0.68	7 (17.5)	7 (17.5)	0.87
6: Pressure sores	2 (6.3)	2 (6.3)	0.47	2 (5.0)	3 (7.5)	0.79
7: Polypharmacy	24 (75.0)	25 (78.1)	0.57	21 (52.5)	21 (52.5)	1.00
8: Visual problems	12 (37.5)	8 (25.0)	0.71	27 (67.5)	22 (55.0)	0.64
9: Hearing problems	11 (34.4)	12 (37.5)	0.80	19 (47.5)	20 (50.0)	0.95
10: History of delirium	4 (12.5)	5 (15.6)	0.87	3 (7.5)	3 (7.5)	0.64
11: Memory problems	1 (3.1)	1 (3.1)	1.00	3 (7.5)	4 (10.0)	0.84
12: Depressive symptoms	5 (15.6)	6 (18.8)	0.89	9 (22.5)	9 (22.5)	0.57

The ICC for the intra-rater reliability for the full MFST-HP score was 0.93 (95% CI: 0.86 - 0.97). The ICC for inter-rater reliability for the full MFST-HP score was 0.95 (95% CI: 0.90 - 0.97). Except for the psychological domain in the inter-rater sample (ICC 0.78), the ICC for the domain scores were comparable to the ICC for the full MFST-HP score. See Table 3 for more details. The ICC for the inter-rater reliability between GNP and ward nurse was 0.89 (95%CI = 0.61 - 0.97).

Additionally, means and standard deviations of the MFST-HP total and domain scores for both samples are presented in Table 3. The mean difference between the first and second measurement for the total MFST-HP scores in the intra-rater sample was 0.14 (SD = 0.77, 95% CI = -0.12 - 0.43). The differences between measurement 1 and 2 were not statistically significant for the total MFST-HP score (p = 0.26) and domain scores (physical: p = 0.11, psychological: p = 0.16 and social: p = 1.0). Average time between measurement 1 and 2 in the intra-rater sample was 23 hours (range 19 - 26 hr.). The mean difference between the first and second measurement for the total MFST-HP scores in the inter-rater sample was 0.10 (SD = 0.96, 95% CI = -0.21 - 0.41). The differences between

measurement 1 and 2 were not statistically significant for the total MFST-HP score (p = 0.51) and domain scores (physical: p = 0.37, psychological: p = 0.74 and social: p = 1.0).

Table 3: Mean scores, standard deviations and intraclass correlation coefficients for total and domain scores of MFST-HP

Domain (theoretical range)	Mean scores on domain (standard deviation/observed range)					
	Intra-rater sample n = 32			Inter-rater sample n = 40		
	Measurement 1	Measurement 2	ICC	Measurement 1	Measurement 2	ICC
Physical	3.0 (1.5/0 - 6)	2.8 (1.5/0 - 5)	0.93	2.9 (1.7/0 - 6)	2.8 (1.7/0 - 6)	0.95
(0 - 9)			(95% CI: 0.86 – 0.97)			(95% CI: 0.90 – 0.97)
Psychological	0.3 (0.6/0 - 2)	0.4 (0.7/0-2)	0.97	0.4 (0.6/0 - 2)	0.4 (0.5/0 - 1)	0.78
(0 - 4)			(95% CI: 0.93 – 0.98)			(95% CI: 0.59 – 0.88)
Social	0.1 (0.3/0 -1)	0.1 (0.3/0 - 1)	1.00	0.2 (0.4/0 - 2)	0.2 (0.4/0 - 2)	0.92
(0 - 2)						(95% CI: 0.86 – 0.96)
Total scores	3.4 (2.0/0 - 8)	3.3 (2.1/0 - 7)	0.93	3.5 (2.1/0 - 8)	3.4 (2.1/0 - 9)	0.95
(0-15)			(95% CI: 0.86 – 0.97)			(95% CI: 0.90 – 0.97)

Construct Validity of MFST-HP

Table 4 shows the associations between the MFST-HP scores and the patient characteristics. Older patients and those with high comorbidity scores had higher MFST-HP scores compared to younger patients (p=.04) and those with low comorbidity scores (p=.05). Patients with low education also scored relatively high on the MFST-HP, although differences among the three educational level groups were not significant. No significant differences for the MFST-HP according to sex and cognitive impairment were found.

Table 4: Associations between MFST-HP scores and patient characteristics

	n = 79		MFST-HP score (0-15)	p
Age	39	70-75 year	2,87 (SD 1,96)	.04‡
	40	76 +	3,80 (SD 1,94)	
Charlson Comorbidity index	34	0-8	2,82 (SD 1,91)	.05‡
	45	9 +	3,73 (SD 2,01)	
Sex	34	Male	3,35 (SD 2,01)	.96‡
	45	Female	3,33 (SD 2,02)	
Cognitive decline*	54	No	3,50 (SD 2,11)	.66‡
	18	Yes	3,22 (SD 0,79)	
Educational level*	12	Low	4,25 (SD 2,18)	.32ŀ
	41	Intermediate	3,22 (SD 1,85)	
	19	High	3,37 (SD 2,41)	

‡ = Independent sample T-test, ŀ = Anova,*=N=72 due to missing values, SD= standard deviation

In addition, we preliminary analyzed the structure of the MFST-HP items. An exploratory factor analysis showed low inter-item correlations. An examination of the Eigenvalues showed 6 components with an Eigenvalue >1, indicating that the scores of the MFST-HP could be better used as a frailty index rather than a frailty scale.

Feasibility

Feasibility was studied at the second measurement (n = 72). No missing values were reported. The administration time averaged 2.6 minutes (range 1.1 - 6.1 minutes; SD = 0.9). Median administration time also was 2.6 minutes and the 25% and 75% percentiles were 2.0 and 3.0 minutes, respectively. In people with cognitive impairment, the mean administration time was slightly higher (2.9 minutes) compared to people with no cognitive impairment (2.5 minutes). The correlation coefficient between cognitive impairment and time to administer was not statistically significant (Pearson's r = 0.18, p =

0.12); additionally not significant for age and administration time (Pearsons r = 0.11, p = 0.35). Most patients (68%) experienced “no burden” at all when completing the MFST-HP and only 32% reported “(a little) burden”. “Very burdensome” was not reported. On the question regarding length of the screening tool, 51% reported “short”, and 3% experienced the questionnaire as “long”.

Discussion

The Maastricht Frailty Screening Tool - Hospitalized Patients (MFST-HP) is a 15-item multidimensional screening tool for frailty among older patients admitted to a hospital. The tool is fully integrated into the initial nursing assessment to avoid extra administrative burden for nurses.

This study shows both high intra-rater reliability (ICC 0.93) and inter-rater reliability (ICC 0.95) coefficients for the total MFST-HP, indicating a high degree of agreement between the two measurements of the MFST-HP. As expected, patients with more comorbidities had a higher MFST-HP score compared to patients with less comorbidities. In addition, older patients (76 years and older) scored higher on the MFST-HP than younger patients (70-75 years). These results are consistent with those of Aronow and colleagues (12). The short administration time and the low reported burden by patients indicate that the MFST-HP is a feasible screening tool. Reliable, valid and feasible screening tools can help nurses in their clinical decision making in the daily complex care for older patients. Screening for frailty can be seen as a starting point of the nursing process for older patients.

The Kappa of the MFST-HP items indicated an acceptable agreement except for four items. Specifically, the Kappa coefficient for the items “pressure sores”, “falls” and “polypharmacy” was moderate in the intra-rater sample (i.e. below 0.60). In addition, the Kappa coefficient for “depressive symptoms” in the inter-rater sample was moderate. This clearly indicates the need for better instruction for particularly these four items. Data on all MFST-HP items were gathered during an interview with the patient. Some of the item information could also be retrieved from the patient’s medical record, or based on the nurses knowledge and expertise (i.g. risk for pressure sores), or could be asked to a family caregiver – particularly when patients are not able to respond due to serious cognitive or sensory impairments which could improve the psychometric properties of the MFST-HP. In future studies, the usefulness of these options will be examined.

Information about the reliability of frailty screening tools for hospitalized older patients is sparse (13). Evans and colleagues reported substantial agreement for their Frailty Indicator (Kappa coefficient = 0.78) in a subsample of 231 hospitalized patients who participated in an inter-rater reliability study. However, as the authors reported, a limitation of the study was that the assessors were not blinded from each other’s findings (18). In a study by Hilmer and colleagues using the Revised Edmonton Frail

scale, the researchers reported a high agreement on inter-rater reliability (Kappa coefficient = 0.84)(19).

No significant associations were found for sex, cognitive impairment and educational level in our study. First, one could assume that patients with cognitive impairment would score higher than patients without cognitive impairment. The absence of significant difference may be attributed to the exclusion of patients with a known dementia. Second, no significant differences were found according to educational level although lower educated patients scored higher on MFST-HP compared to their higher educated counterparts.

Limitations of the Study

Although the MFST-HP assessments were conducted independently, the high level of agreement between the two GNPs might be partly explained by the close collaboration and similar education of both professionals. Both GNPs work with the MFST-HP assessment on a daily basis and their (general) approach is often discussed during patient meetings. The agreement between the GNP and the experienced ward nurse was also high with an ICC of 0.89 (95%CI = 0.61 - 0.97). However, these data should be interpreted with caution as only 15 patients were assessed by both the ward nurse and the GNP. The GNPs are highly trained nurses in geriatric care, whereas the ward nurses receive only general instruction regarding how to complete the initial nursing assessment. The high agreement may indicate that ward nurses do not need intensive training in order to use the MFST-HP tool.

The GNP's were only present two days a week during office hours and therefore probably some frail patients may have been missed in this study. There are no data available of patients who were not included in the study.

The sample in the present study consisted of consecutive, non-emergent patients aged 70 years and above. As mentioned, patients suffering from dementia were excluded. The health care complexity of the patients can be considered moderate based on the number of MFST-HP problems and the CCI scores. Results may be different in an emergent admission setting or in patients with higher levels of comorbidity.

Implications

The MFST-HP can be considered a reliable and feasible tool for the screening of frailty among hospitalized older patients. Due to the incorporation of the screening tool in the initial nursing assessment, the tool is feasible in daily practice, and will result in less administrative burden for nurses. Although no specific extended training (like a course) in the use of MFST-HP is needed for (ward)

nurses, a less extensive protocol is needed. After improving the instructions for completion of the MFST-HP for particularly the items on pressure sores, falls, polypharmacy, and depressive symptoms, we expect that agreement on the MFST-HP between nurses will further improve. This study showed hardly any difference whether the screening was carried out within 24 hours or 48 hours after admission (intra-rater analysis). In addition no significant difference was found in which nurse administered the screening (inter-rater analysis). The MFST-HP can be helpful in the future in detecting frail patients who could benefit from a more extensive geriatric assessment by the GNP.

Future Research

This study reports the reliability, feasibility and construct validity of the MFST-HP screening tool. Because only construct validity was analyzed, future research should provide more information about other aspects of validity and, more specifically, the predictive power of the MFST-HP screening tool. This could help to identify frail patients who are at risk for adverse outcomes and could benefit from further geriatric assessments and consultation. Comparison of the MFST-HP with performance based frailty measures (such as hand-grip strength) could give more insight in the concurrent validity of this tool, particularly with respect to the physical components of the MFST-HP. In addition, future research could focus on the effect of the screening results on nursing interventions and nurses' experiences with using the MFST-HP could be assessed in a more extensive, qualitative way.

Conclusions

The MFST-HP shows promise as a reliable, valid and feasible screening tool for frailty among hospitalized older patients.

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Chapter 4: The Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP) to Identify Non-Frail Patients

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Abstract

Background

The Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP) is a frailty screening tool that is fully integrated in the nursing assessment at admission. This study aims to determine the predictive value of the MFST-HP for the health outcomes length of hospital stay, discharge destination, readmission and mortality.

Methods

Data of 2691 hospitalized patients (70+), admitted between 1-1-2013 and 31-12-2013, were included in the study. The predictive value of the MFST-HP was analyzed by means of receiver operating characteristics curves. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for different MFST-HP cut-off scores were examined.

Results

Mean age of the population was 78,9 years (SD 6,4) and their average length of stay was 10,2 days (SD 9,7). Nearly 75,0% of the patients were discharged to their home and around. Approximately 25% of the patients were readmitted within 120 days. Mortality rates were 4,3% and 9,5% (within 30 or 120 days post discharge, respectively). The area under the curve was moderate and varied from 0,50 to 0,69 for the different outcomes. Due to high values on negative predictive value (between 73,5% and 96,7%) the MFST-HP is able to rule out a large proportion of non-frail patients. In this study 84% of the patients had a MFST-HP score of ≥ 6, suggested as most favorable cut off.

Conclusions

The MFST-HP seems to operate more strongly as a non-frailty indicator than as a frailty indicator and may in this respect help professionals to decide upon subsequent care. The MFST-HP is able to rule out 84% of the non-frail population in this study. The remaining 16% need to be assessed by means of a comprehensive geriatric assessment or rapid geriatric assessment, to gain more insight in the level of vulnerability in the frail-group.

Introduction

In Western countries, almost 10% of all people 65 years and over are admitted yearly to a hospital, and the number will likely increase in the coming decades. An increasingly older patient population leads to challenges in hospital care (1), as older patients have an increased risk of adverse hospital outcomes such as prolonged hospital stay, hospital readmissions, long-term institutionalization and mortality (2, 3).

Frailty is stated as the most problematic expression of an aging society and considered as a state of increased vulnerability after stressful events such as sickness and hospital admission. As a result there is an increased risk of adverse health outcomes (4). Screening for frailty at hospital admission may help to identify people at risk for these adverse health outcomes; when potential geriatric risks are recognized and tackled in an early stage, preventive care may start timely (5). Screening tools may help to detect frail patients, even better than quick clinical bedside observations by clinicians (6). Screening results may be helpful to make decisions for a subsequent multidisciplinary care plan. For example, a geriatric consultation team may conduct a (rapid) geriatric assessment and provide pro-active consultations based on the screening outcomes (7). Various tools to identify frail older patients are available for use in daily practice. These tools have been developed from different conceptualizations of frailty and for different samples (8), e.g. Fried's (physical) frailty phenotype (9), the deficit model developed by Rockwood and colleagues (10), and a multidimensional approach suggested by Gobbens and colleagues (11).

A recent systematic review showed that many screening tools for frailty are available to assess older hospitalized patients. However, particularly information about predictive validity in combination with reliability (e.g. inter- and intra-rater reliability) and feasibility is largely lacking (12). Examples of frequently used instruments identified in this review are the Identification Seniors At Risk (ISAR) (13), the Triage Risk Screening Tool (TRST)(14) and Identification Seniors at Risk – Hospitalized Patients (ISAR-HP)(15). In addition, several (simple) screening tools for frailty among community-dwelling older people have been developed as well (16, 17).

The Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP) is an existing short 15 item multi domain screening tool (with yes-no answer options) for older hospitalized patients. The advantage of this specific tool is that is fully integrated in the initial nursing assessment (18). The tool assesses frailty in three domains: physical (items 1-9), psychological (items 10-13) and social (items 14-15) (see Figure 1).

Figure 1: The items and Response options of the Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP)

	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 months	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)	

In a previous study the MFST-HP showed to be a reliable and feasible tool for screening. Inter-rater and intra-rater reliability was good (ICC 0.93 and 0.95, respectively) (18).

The aim of the present study is to explore the predictive value of the MFST-HP as a frailty indicator with respect to the following adverse frailty outcomes: length of hospital stay, discharge to institutional care, hospital readmissions at 30 and 120 days post discharge and mortality at 30 and 120 days post discharge. In this study the MFST-HP score was evaluated as a non-weighted score, and items as age, gender or comorbidity are not taken in account.

Methods

Design

We conducted a retrospective cohort study.

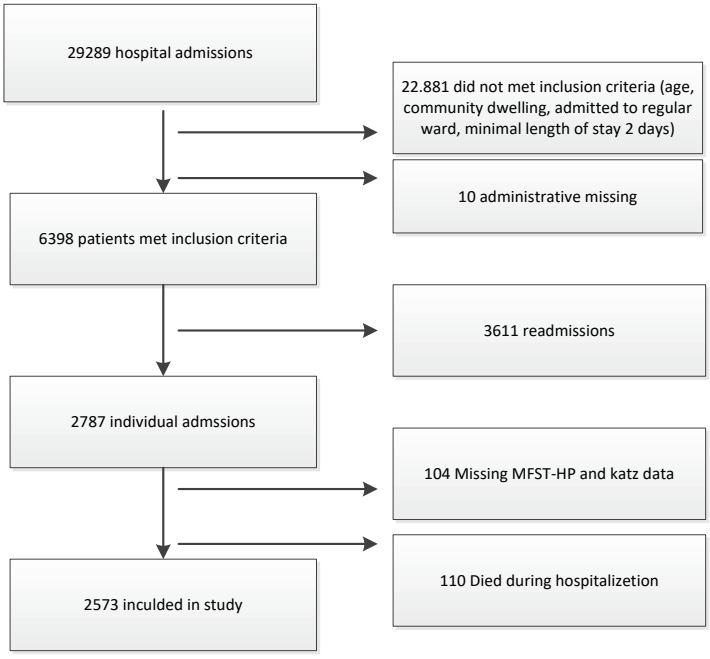
Setting

The Maastricht University Medical Center (MUMC+) is a 715 bed university hospital in the south of the Netherlands. Approximately 30,000 patients are admitted to the hospital each year of which about 7,000 are aged 70 years and over. These admissions include day care, intensive care unit admissions and readmissions. Patients of advanced age are admitted to a regular nursing ward. A specialized geriatric consultation team is available to support the regular medical and nursing teams to provide additional evidence based care. At admission, the ward nurses routinely screen older patients within 48 hours for frailty using the MFST-HP.

Participants

Patient selection was restricted to admissions between January 1 2013 and December 31 2013. Inclusion criteria were: 1) community dwelling, 2) age 70 years and over, 3) admission to a regular hospital ward, and 4) the admission had to be for at least 48 hours. In case of re-admissions, only data of the first admission in 2013 were included in the analysis (see Figure 2 for a flowchart).

Figure 2: Flowchart of patients



Assessment of frailty

At the time of the initial nursing assessment, the ward nurse conducted an interview using the MFST-HP within 48 hours of admission. If a patient was unable to respond to one or more items, primary family caregivers were asked to complete the questions. The minimum total MFST-HP score is 0, the maximum score is 15. Higher scores indicate higher levels of frailty. The results of the screening are automatically generated by the electronic nursing system and reported in the nursing care plan. Nurses do not need special training to apply the MFST-HP. Information about the use of the MFST-HP is provided in a nursing protocol.

Outcomes

Length of stay was calculated as the difference in days between admission and discharge date. Discharge destination was dichotomized into discharged to home (i.e. same as before admission) and discharged to a long-term care facility (i.e. geriatric rehabilitation, nursing home). Readmissions were

dichotomized (yes/no) at a maximum of 30 and 120 days post discharge, similar to mortality (these observation periods are based on a previous systematic review (39)). Length of stay, discharge destination (i.e. home or institutional care), readmission and mortality data were all derived automatically from the electronic hospital records. Patient characteristics such as gender, age, type of hospital admission (i.e. acute, planned), admission ward and MFST-HP scores were also collected via the electronic hospital records.

Data analysis

SPSS version 23.0 (IBM Corporation, Armonk, NY, USA) was used for statistical analyses. Descriptive statistics were calculated for patient characteristics and reported as mean and standard deviation or as absolute value and percentage. Length of stay for different dichotomized MFST-HP scores was quantified by mean scores and tested with Student's t-test for independent samples. For binary outcomes, i.e. discharge destination, readmission and mortality, we computed the area under the receiver operating characteristics (ROC) curve (AUC) using all possible cut-off values of the MFST-HP. The AUC quantifies the ability to discriminate between those who will experience an adverse outcome, and those who will not. An AUC of 1,0 indicates perfect discriminative ability, an AUC of 0,5 indicates no discriminative ability (19). For a number of cut-off values we computed sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). Patients who died during hospitalization were excluded from the analysis of the predictive value of MFST-HP. P-values ≤0.05 were considered to indicate statistical significance.

Results

A total of 2787 patients met the inclusion criteria. 96 of them were excluded due to incomplete MFST-HP data (i.e. one or more MFST-HP questions were not completed by either the patient or the primary family caregiver). Patient characteristics are shown in Table 1. Characteristics of the 96 excluded patients generally did not differ significantly from the remaining 2691 patients. However, excluded patients showed a significantly higher proportion of in-hospital mortality: 12,5% versus 4,1% ($p<0.01$). 122 patients died during hospitalization (Table 1).

Mean age of the included patients (n=2691) was 78,9 years (SD 6,4), half of them was female (51,4%). Seventy percent were admitted on an acute base and their mean length of stay was 10,2 days (SD 9,7). Approximately 75,0% of the patients were discharged to home and about 19,0% were referred to an institutional care facility such as a nursing home. 12,5% of the patients were readmitted to the hospital within 30 days post discharge (n=323). Approximately one quarter of the patients was readmitted

within 120 days post discharge (n=669; 25,9%). Mortality rates at 30 days and 120 days post discharge were 4,3 % (n=112) and 9,5% (n=246), respectively.

Table 1: Characteristics of included patients

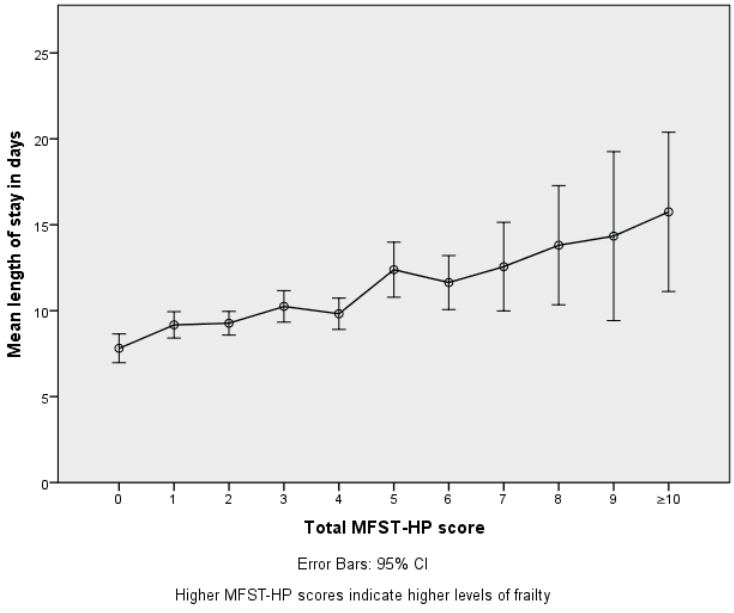
		All participants (n=2787)	All participants with full MFST-HP (n=2691)	Patients with missing MFST-HP data (n=96)	*p*
Age	Mean (SD)	78,9 (6,4)	78,9 (6,4)	78,7 (6,5)	0.69*
Sex	Female (%)	1433 (51,4)	1383 (51,4)	50 (52,1)	0.89†
Admission type	Acute (%)	1956 (70,2)	1891 (70,3)	65 (67,7)	0.60†
	Planned(%)	831 (29,8)	800 (29,7)	31 (32,3)	
Died during hospitalization	(%)	122 (4,4)	110 (4,1)	12 (12,5)	0.001†
LOS index admission‡	Mean (SD)	10,2 (9,7)	10,2 (9,7)	10,0 (10,4)	0.88*
Discharge destination‡	Home (%)	1989 (74,6)	1929 (74,7)	60 (71,4)	0.87†
	Other Hospital (%)	173 (6,5)	166 (6,4)	7 (8,3)	
	Nursing Home (%)	453 (17,0)	438 (17,0)	15 (17,9)	
	Home for older people (%)	50 (1,9)	48 (1,9)	2 (2,4)	
Readmission‡	Within 30 days after discharge (%)	335 (12,6)	323 (12,5)	12 (14,3)	0.63†
	Within 120 days after discharge (%)	687 (25,8)	669 (25,9)	18 (21,4)	0.35†
Mortality‡	Within 30 days after discharge (%)	116 (4,4)	112 (4,3)	4 (4,8)	0.85†
	Within 120 days after discharge (%)	252 (9,5)	246 (9,5)	6 (7,1)	0.46†

SD= standard deviation, LOS = length of stay; * = Student's t-test for independent samples; † Chi square test; ‡ = based on all patients discharged alive

Observed MFST-HP scores ranged from 0 to 14 with a mean score of 3,1 (SD 2,5) and a median score of 3.0. MFST-HP items with a high prevalence were use of 5 or more medications (item 7; 62,6%), gait problems (item 4; 39,8%), deficits in activities of daily living (items 2; 38,4%), deficits in instrumental activities of daily living (item 1; 36,1%) and problems with vision (items 8; 27,7%). The lowest prevalences were identified for the items behavioral problems (item 13; 2,4%), loneliness (item 14; 5,2%) and caregiver burden (item 15; 6,4%).

Length of stay increased with higher MFST-HP scores (see Figure 3). For example, mean length of stay at a MFST-HP score of < 6 was 9,6 days (SD = 8,8), compared to 12,9 days (SD 12,8) for MFST-HP scores ≥ 6 ($p<0.01$). The number of patients with MFST-HP scores of 10 and higher was summarized due to low frequencies.

Figure 3: Mean length of stay for different MFST-HP scores



The ROC curves and AUC of all dichotomized outcomes were calculated for the MFST-HP. The overall AUC of the outcome discharge to institutional care was 0,63. The overall AUC for 30 days and 120 day readmission were both 0,50. An AUC of 0,69 and 0,68 was identified for mortality outcomes at 30 days and 120 days post discharge, respectively.

Sensitivity, specificity, positive predictive values and negative predictive values were calculated for the five outcomes for different MFST-HP cutoff scores (see Table 2).

Sensitivity rates for the different outcomes and different MFST-HP cutoffs varied from 3,7% to 77,7%. Specificity rates varied from 49,3% to 95,6%. Positive predictive values varied from 6,7% to 43,6% and negative predictive values varied from 73,4% to 98,0%.

Table 2: Predictive validity for discharge destination, readmissions and mortality for various MFST-HP cutoff scores

n=2581	**Discharged to institutional care**			
MFST-HP score (n)	Sens.	Spec.	PPV	NPV
≥8 (149)	10,0%	95,6%	43,6%	75,9%
≥7 (247)	14,6%	92,1%	38,5%	76,1%
≥6 (419)†	25,2%	86,8%	39,1%	77,4%
≥5 (636)	37,1%	79,6%	38,1%	78,9%
≥4 (926)	51,1%	69,3%	36,0%	80,7%
≥3 (1308)	64,9%	54,1%	32,3%	82,0%

n=2581	**30 day readmission**				**120 day readmission**			
MFST-HP score (n)	Sens.	Spec.	PPV	NPV	Sens.	Spec.	PPV	NPV
≥8 (149)	3,7%	93,9%	8,1%	87,2%	4,0%	93,6%	18,1%	73,6%
≥7 (247)	7,7%	90,2%	10,1%	87,2%	7,5%	89,7%	20,2%	73,5%
≥6 (419)†	13,9%	83,4%	10,7%	87,1%	14,3%	83,1%	22,9%	73,5%
≥5 (636)	22,9%	75,1%	11,6%	87,2%	23,6%	75,0%	24,8%	73,7%
≥4 (926)	33,7%	63,8%	11,8%	87,1%	34,5%	63,7%	24,9%	73,5%
≥3 (1308)	50,5%	49,3%	12,5%	87,4%	48,7%	49,5%	25,3%	73,4%

n=2581	30 day mortality				120 day mortality			
MFST-HP score (n)	Sens.	Spec.	PPV	NPV	Sens.	Spec.	PPV	NPV
≥8 (149)	15,2%	94,7%	11,4%	96,1%	11,8%	94,9%	19,5%	91,1%
≥7 (247)	24,1%	91,1%	10,9%	96,4%	19,5%	91,5%	19,4%	91,5%
≥6 (419)†	36,6%	84,7%	9,8%	96,7%	33,3%	85,6%	19,6%	92,4%
≥5 (636)	48,2%	76,4%	8,5%	97,0%	45,5%	77,6%	17,6%	93,1%
≥4 (926)	63,4%	65,4%	7,7%	97,5%	59,3%	66,6%	15,8%	94,0%
≥3 (1308)	77,7%	50,5%	6,7%	98,0%	76,0%	52,0%	14,3%	95,4%

Sens.= sensitivity; Spec.= specificity; PPV= positive predictive value; NPV= negative predictive value; MFST-HP= Maastricht Frailty Screening Tool for Hospitalized Patients, †proposed threshold score

Discussion

This study examined the predictive value of the Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP) among nearly 2700 older patients for length of hospital stay, discharge destination, readmissions and mortality at 30 and 120 days post discharge. Sensitivity and positive predicted values turned out to be low for different cutoffs, whereas specificity and negative predicted values were rather good. Overall, a simple unweighted MFST-HP score is able to distinguish between (potentially) frail and non-frail older persons. When using a cutoff score of ≥ 6, about 84% of the population is classified non-frail thereby reducing the caseload for further assessments substantially. At this cutoff score we consider the combination of the NPV and specificity as most optimal (see Table 2). In this non-frail group 73,5% - 96,7% of the negative screened patients appeared to have no adverse health outcomes.

Our findings are not consistent with the outcomes of a recent review on screening tools for measuring frailty in hospitalized older patients which showed generally higher sensitivity rates and lower specificity rates (12). The MFST-HP operates more in the opposite direction and seems to have the ability to detect particularly non-frail patients. This changes the scope from “frailty” to a more positive label of “non-frailty”.

The MFST-HP showed to have the ability to rather safely exclude non-frail patients from the total cohort of older hospitalized patients, in our study a reduction of 84%. This substantial reduction leads to a more manageable risk group for further assessment (16% of all patients). Due to low sensitivity,

several patients could be classified erroneous as non-frail, but seems acceptable in view of the basic high quality of care in most Western countries.

Frail patients with a MFST-HP ≥ 6 could benefit from either a more substantial (CGA) or a rapid geriatric assessment (RGA)(7). A follow-up by means of such geriatric assessment could improve decision-making and patient care of older hospitalized patients (20, 21). Ellis and colleagues defined a CGA as a multidimensional interdisciplinary diagnostic process focused on determining an older patients medical, psychological and functional capability, in order to generate an integrated care plan (22). Particularly a RGA could be applied by professionals with less geriatric expertise and is less time consuming than a CGA (7). The MFST-HP includes three (functional) domains: physical, psychological and social (see Figure 1) and could support the CGA specific in these areas.

Limitations of the study

Several study limitations have to be mentioned. First, in this study 2787 patients met the inclusion criteria. Out of these, 96 patients had missing values on MFST-HP items and were therefore excluded from the analysis. The in-hospital mortality was significantly higher in this latter group compared to the first one which may indicate some selection bias. However, the incompletely observed patients comprised only about 3% of the total cohort. Second, admission diagnoses were not part of the analyses. For example, length of stay coheres with type of admission and complex medical procedures like surgery or trauma (23). Finally, co-morbidities, gender and age were not taken into account as well. Ritt and colleagues reported that frailty indicators that include co-morbidities had a better predictive value than those that did not (21).

Implications for further research

We evaluated the predictive validity of the MFST-HP as a total, non-weighted frailty score. In future research the predictive power of a weighted score of different MFST-HP items or a combination of functional domains could be examined more in detail. This weighting may increase predictive value of the score significantly. In addition, the predictive power of the MFST-HP could probably be improved by including age, admission diagnoses or comorbidity also derived from the electronic hospital records.

Conclusion

In the present study the predictive value of the MFST-HP as a frailty screening tool among hospitalized older patients was examined. In patients with a low score on the MFST-HP (i.e. <6) there is less need for additional attention from geriatric teams or further geriatric assessment. Patients with a higher score on the MFST-HP could benefit from a more substantial geriatric evaluation, such as a CGA or RGA, to screen the patient on probable unmasked geriatric syndromes that could be taken into account in the treatment or nursing plan. The MFST-HP can help professionals reduce the potential frail patient population to a more manageable proportion.

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Chapter 5: Frailty screening in hospitalized older adults: how does the brief Dutch National Safety Management Program perform compared to a more extensive approach?

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Frailty screening in hospitalized 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

The objective of the study is to examine the predictive properties of the brief Dutch National Safety Management Program for the screening of frail hospitalized older patients (VMS) and to compare these with the more extensive Maastricht Frailty Screening Tool for Hospitalized 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 4 domains (i.e. functional decline, delirium risk, fall risk, nutrition). The 15-item MFST-HP assesses patients on 3 domains of frailty (physical, social and psychological).

Design

Retrospective cohort study

Methods

Data of 2573 hospitalized patients (70+) admitted in 2013 were included and relative risks, sensitivity and specificity and area under the receiver operating curve (AUC) 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: 1369 (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 .50 to .76 and from .49 to .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 hospitalized 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 non-frail. 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.

Introduction

The percentages of older people are increasing in all western countries. Globally, the percentage of the oldest old, i.e. those aged 80 years and over, is relatively growing faster than the overall percentages of older people (1). As societies age, more older and potentially frail patients are admitted to hospitals, making hospitals more and more geriatric institutions (2). Frailty in hospital patients is associated with an increased risk for negative health outcomes, such as falls, more complications, re-hospitalizations, care dependency and mortality (3). Screening may help to detect frailty and underlying geriatric conditions and risks such as cognitive decline and delirium. When these are recognized and tackled in an early admission stage, preventive multidisciplinary and nursing interventions may reduce adverse frailty outcomes (i.e. mortality) (4, 5). Screening tools may facilitate detecting frail patients, perhaps even better than quick clinical bedside observations (6), and may improve awareness on frailty among health professionals (7). Screening results also support decisions for subsequent multidisciplinary comprehensive geriatric assessments (8). A geriatric consultation team, for example, may conduct a comprehensive or rapid geriatric assessment and provide pro-active consultations based on the screening outcomes (9).

Background

Frailty is defined as a state of vulnerability due to poor resolution of homeostasis after a stressful event (10). In frail older persons there is an age-related decline in different physiological systems, and the physiologic reserve function has been decreased (10). However different conceptualizations of frailty have been developed. The three mostly cited perspectives relate to Fried's frailty phenotype (11), the deficit model, developed by Rockwood and colleagues (12), and the multidimensional model suggested by Gobbens and colleagues (13).

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 to good, but information about feasibility and reliability is lacking for far most tools (14). 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 (3).

In the Netherlands a mandatory national program for systematic risk screening for adverse hospital outcomes was introduced in 2012, called the (Dutch) National Safety Management Program ("VMS" in Dutch abbreviation) (15). The VMS screens older admitted patients on four geriatric items: delirium, fall risk, malnutrition and functional decline (15-17). 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 (18).

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 Hospitalized Patients (MFST-HP) (14). The MFST-HP comprises 15 items in three domains: physical, psychological and social (14, 21). All items are based on routine nursing data, and are collected by nurses during the regular initial nursing 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 specialized 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.

Methods

Design

Retrospective cohort study

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 hours. A specialized geriatric consultation team is available to support the regular medical and nursing teams. Intervention of the specialized geriatric consultation team can be active (based on a referral of medical ward) and pro-active (based on the frailty screening).

Participants

Patient selection was restricted to admissions between 01-01-2013 and 12-31-2013. Inclusion criteria were: 1) community-living, 2) minimum age of 70 years, 3) admission to a general hospital ward, and 4) admission for at least two days. In case of re-admissions, only the data of the first admission in 2013 were used for the analyses (see Figure 2 for an overview of the included patients).

Assessment of frailty

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: 1) 'is the patient known with cognitive problems?', 2) 'did the patient experienced an episode of confusion or delirium before?', and 3) 'did the patient need help with self-care in the past 24 hours?'. 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) (19). A MUST score of 1 or more suggest 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 6 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 (20). Total VMS scores (0-4) were, according to the national guideline, afterwards dichotomized: "no risk" (score 0) or "at risk" if one or more of the four VMS domains were scored positive (score 1-4) (16) (see Figure 1).

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, the theoretical maximum score is 15. A higher score indicates a higher level of frailty (Figure 1). The most optimum cutoff point for frailty was set at ≥6 (21). 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 (14).

Figure 1: Overview of the items of Dutch National Safety Management Program (VMS) and Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP).

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 months? 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 patho-physiological 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	***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 months. 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)

VMS	MFST-HP
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.	
A summative score of all VMS items ranges from 0 to 4. A VMS score of ≥ 1 indicates high risk of frailty.	The total score ranges from 0 to 15 points. A score of ≥ 6 indicates frailty.

VMS, Safety Management Program; MFST-HP, Maastricht Frailty Screening Tool for Hospitalized Patients; MUST, Malnutrition Universal Screening Tool; ADL, Activities of daily living.

Outcomes

Four outcome measures were included in the study. Discharge destination was dichotomized 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 post discharge were dichotomized (yes/no). Mortality was also registered at 30 and at 120 days post discharge. 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.

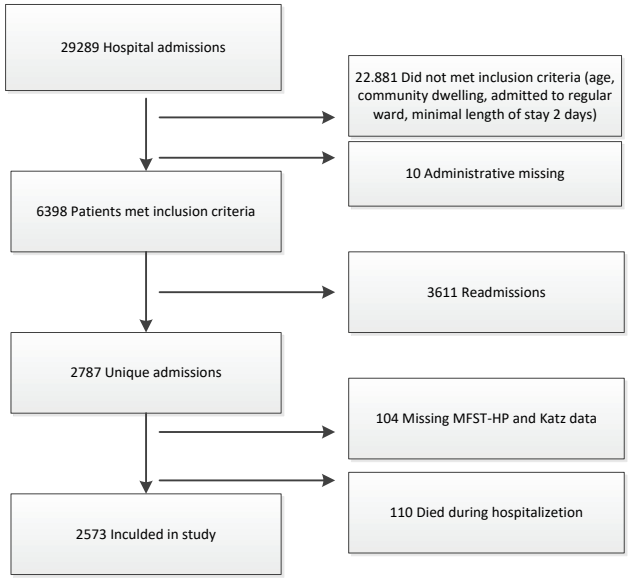
Data analysis

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 (22). 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 non-sick 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 characteristics curve (AUC) using continuous values of both the VMS and 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 (23). Additional subgroup analyses were performed for type of admission (acute versus non acute, gender and age. Crosstabs were calculated between the dichotomized 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 completeness and transparency of our study (24). (See Supplementary File 1). SPSS-version 23.0 (IBM Corporation, Armonk, NY, USA) was used for statistical analyses.

Results

Data of 2787 unique patients were available. From 104 patients the data were incomplete and 110 patients died during hospitalization. These 214 patients were excluded from the analysis, so a sample of 2573 patients remained for further analysis. See figure 2 for an overview of the included patients.

Figure 2: Flowchart 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 hospitalization 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).

Table 1: Characteristics of hospitalized patients and outcomes according to cut offs for Vms† and MFST-HP‡

	All n=2573	VMS† = 0 n=1204 (46.8%)	VMS† ≥ 1 n=1369 (53.2%)	P value VMS†	MFST-HP‡ ≤5 n=2159 (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)	≤0.0001 *	78.0 (5.9)	82.6 (6.8)	≤0.0001
Female gender, N (%)	1333 (51.8)	584 (48.5)	749 (54.7)	.002+	1078 (49.9)	255 (61.6)	≤0.0001 +
Acute admission, N (%)	1787 (69.5)	704 (58.5)	1083 (79.1)	≤0.0001 +	1444 (66.9)	343 (82.9)	≤0.0001 +
Mean LOS¶, N days (sd§)	10.2 (2.4)	8.5 (7.8)	11.6 (10.8)	≤0.0001 *	9.6 (8.8)	12.9 (12.9)	≤0.0001 *
Discharged care facility, N (%)	649 (25.2)	209 (17.4)	440 (32.1)	≤0.0001 +	488 (22.6)	253 (61.1)	≤0.0001 +
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)	≤0.0001+	71 (3.3)	41 (9.9)	≤0.0001 +
Mortality 120 days, N (%)	246 (9.6)	40 (3.3)	206 (15.0)	≤0.0001 +	164 (7.6)	82 (19.8)	≤0.0001 +

†VMS, Safety Management Program; ‡MFST-HP, Maastricht Frailty Screening Tool for Hospitalized Patients; § Sd, standard deviation; ¶LOS, length of hospital stay;* Student T-test ;+ Chi-square

Based on the VMS-screening 53.2% of the included patients were labeled 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 1204 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 versus 11.6 days,p≤0.0001). 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 non-risk group at both 30 and 120 days post discharge. 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 labeled as potentially frail. Their mean age was significantly higher compared to their non-frail 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 non-frail patients (12.9 days versus 9.6 days, p≤0.0001). Patients in the frail group were significantly more likely to be admitted to institutional care. There were no significant differences between the frail and non-frail group in terms of readmission rates at both 30 and 120 days post discharge. Mortality rates were significant higher in the frail group than in the non-frail 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 non-frail 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, 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 versus 3.3; also not tabulated).

Table 2: Crosstabs of number of hospitalized patients as identified as frail/non-frail according to cut offs for VMS† and MFST-HP‡

N (%)	MFST-HP‡ Non frail	MFST-HP‡ Frail	Total
VMS† no risk	1202 (99,8)	2 (0,2)	1204 (100,0)
VMS† risk	957 (69,9)	412 (30,1)	1369 (100,0)
Total	2159 (83,9)	414 (16,1)	2573 (100,0)

†VMS, Dutch National Safety Management Program; ‡MFST-HP Maastricht Frailty Screening Tool for Hospitalized Patients

The predictive properties of both the VMS and 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 post discharge. 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 .50 to .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%), the specificity varied from 83% for readmissions to 87% for discharge destination. The AUCs were rather similar to the VMS, varying from .49 to .69 (Table 3).

Table 3: Relative risk, sensitivity, specificity, positive and negative predictive values and area under the receiver-operating curve of dichotomized 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=1369 / 53.2%)							
Discharge destination	1.85	1.60-2.14	68	64 - 71	52	49 - 54	32	31 - 34	83	83 - 84	.63	.60 - .65
Readmission 30 day	1.09	0.89-1.34	55	50 - 61	47	45 - 49	13	12 - 14	88	87 - 89	.50	.46 - .53
Readmission 120 day	1.06	0.93-1.21	55	51 - 59	47	45 - 50	27	25 - 28	75	73 - 77	.50	.47 - .52
Mortality 30 day	8.97	4.71-17.10	91	84 - 97	49	47 - 51	8	7 - 8	99	99 - 100	.76	.72 - .81
Mortality 120 day	4.53	3.26-6.30	84	79 - 88	50	48 - 52	15	14 - 16	97	96 - 97	.71	.68 - .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	.63	.61 - .66
Readmission 30 day	0.82	0.61-1.11	14	10 - 18	84	82 - 85	11	8 - 14	87	87 - 88	.49	.46 - .53
Readmission 120 day	0.87	0.72-1.05	14	12 - 17	83	82 - 85	23	19 - 27	74	73 - 74	.50	.48 - .53
Mortality 30 day	3.01	2.08-.4.36	37	28 - 46	85	83 - 86	10	8 - 12	97	96 - 97	.69	.65 - .74
Mortality 120 day	2.61	2.04-3.33	33	27 - 40	86	84 - 87	20	17 - 23	92	92 - 93	.68	.65 - .71

* RR, relative risk; **CI, confidence interval; ***PPV, positive predictive value; ****NPV, negative predictive value; *****AUC; area under the receiver-operating curve of continuous score;
† VMS, Dutch Safety Management Program; ‡MFST-HP Maastricht Frailty Screening Tool for Hospitalized Patients

Subgroup analyses

To study the robustness of our findings we performed subgroup analyses regarding type of admission (acute versus non acute), 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 Supplementary file 2).

Discussion

In this study, we examined the psychometric properties of the brief VMS screening among hospitalized older patients and compared these findings with the psychometric properties of a more extensive tool i.e. the MFST-HP. Both tools have an AUC that varies between .49 and .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 non-frail patients (21).

Screening according to the VMS resulted in a high percentage of frail patients, more than half of the study sample was labeled as at risk (53.2%). By means of the MFST-HP only 16.1% of the older patients were labeled 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 specialized 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 (16). When this approach is applied to our cohort, 31% of the patients would be labeled 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) (18). 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 dichotomized 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 hospitalized older patients were analyzed on their predictive value (14). For discharge destination only long-term outcomes were used (>3 month), and the prognostic ability varied between AUC .77 for the Multidimensional Frailty Score (MFS) (25) and .82 for the Frailty Index based on CGA (FI-CGA) (26). 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 were low in our study (.49-.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 and 0.78 for readmissions (14). 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 is more specific is available. Basnet and colleagues, for example, stated that polypharmacy, intensive care admission, cardiovascular diseases were contributing factors to the prediction of readmission (27). 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) (28).

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 previous mentioned review, the AUC varied from .43 to .82 for the prediction of long-term mortality (> 30 days post discharge) (29). For short-term mortality only one study was included in the review: Sancarlo and colleagues reported an AUC of .75 for short-term mortality for the modified Multi Prognostic Index (mMPI) (30). 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.

Study strengths and limitations

Strength of our study compared to other studies is that a large cohort of patients (N=2573) was included. Further, a general older hospitalized sample of mixed patients was examined: both acutely admitted and electively (non-acute) admitted, surgical and non-surgical 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.

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 hospitalized patients is not very promising. Based on the AUC we conclude that the VMS is in these general older hospitalized 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 non-frail patients.

Relevance to clinical practice

Screening older hospitalized 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 non-frail. The MFST-HP seems therefore particularly able to rule out approximately 84% non-frail 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.

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Supplementary file: Relative risk, sensitivity, specificity, positive and negative predictive values and area under the receiver-operating curve of VMS† scores and five adverse outcomes related to subgroups

Subgroup	Outcome	RR*	95% CI**	Sensitivity (%)	95% CI**	Specificity (%)	95% CI**	PPV*** (%)	95% CI**	NPV****(%)	95% CI**	AUC*****	95% CI**
						VMS† ≥1 (n=1369 / 53.2%)							
Acute admission	Discharge destination	2.04	1.70 – 2.45	76	72 - 80	45	43 - 48	35	33 - 36	83	81 - 85	.64	.61 - .66
	Readmission 30 day	1.00	0.77 – 1.29	61	54 - 67	39	37 - 42	12	11 - 13	88	86 - 90	.49	.44 - .53
	Readmission 120 day	0.95	0.81 – 1.12	60	55 - 64	39	36 - 42	26	24 - 28	73	70 - 75	.48	.45 - .51
	Mortality 30 day	9.01	4.21 – 19.28	93	87 - 97	41	39 - 44	9	8 - 10	99	98 - 100§	.73	.69 - .76
	Mortality 120 day	4.34	2.95 – 6.38	87	82 - 91	43	41 - 46	17	16 - 18	96	95 - 97	.69	.65 - .72
Non acute admission	Discharge destination	1.28	0.97 – 1.70	42	35 -51	65	61 - 69	23	20 - 27	82	80 - 84	.55	.49 - .60
	Readmission 30 day	1.43	1.01 – 2.02	45	35 - 55	65	61 - 69	17	14 - 21	88	86 - 90	.54	.49 - .60
	Readmission 120 day	1.32	1.03 – 1.69	43	36 - 50	66	62 - 70	29	25 - 33	78	76 - 80	.54	.50 - .59
	Mortality 30 day	2.91	0.70 – 12.10	63	25 - 92	64	60 - 67	2	1 - 3	99	99 - 100§	.70	.48 - .92
	Mortality 120 day	2.77	1.36 – 5.62	61	42 - 78	65	61 - 68	7	5 - 9	98	96 - 99	.65	.55 - .76
Female	Discharge destination	1.75	1.46 – 2.09	69	64 - 74	50	46 - 53	38	36 - 41	78	75 - 81	.62	.58 - .65
	Readmission 30 day	0.99	0.72 – 1.34	56	47 - 64	44	41 - 47	11	9 - 12	89	87 - 91	.47	.42 - .52
	Readmission 120 day	1.02	0.84 – 1.23	57	51 - 62	44	41 - 47	25	23 - 27	75	73 - 78	.48	.45 - .52
	Mortality 30 day	9.55	3.47 – 26.31	93	82 - 98	45	43 - 48	7	6 - 7	99	98 - 100§	.76	.70 - .82
	Mortality 120 day	4.01	2.52 – 6.40	84	76 - 90	47	44 - 50	14	13 - 15	97	95 - 98	.69	.64 - .74
Male	Discharge destination	1.89	1.48 – 2.41	65	59 - 72	54	50 - 57	25	23 - 27	87	85 - 89	.63	.59 - .67

Subgroup	Outcome	RR*	95% CI**	Sensitivity (%)	95% CI**	Specificity (%)	95% CI**	PPV*** (%)	95% CI**	NPV****(%)	95% CI**	AUC*****	95% CI**
	Readmission 30 day	1.21	0.92 – 1.60	66	59 - 72	54	51 - 57	25	23 - 27	87	85 - 89	.52	.47 - .57
	Readmission 120 day	1.12	0.93 – 1.35	53	47 - 58	51	48 - 54	29	26 - 31	75	72 - 77	.52	.48 - .55
	Mortality 30 day	8.83	3.83 – 20.40	90	79 - 96	52	49 - 55	9	8 - 9	99	98 - 100§	.77	.71 - .83
	Mortality 120 day	5.15	3.23 – 8.21	84	76 - 90	54	51 - 57	17	15 - 18	98	95 - 98	.73	.69 - .78
Aged 70-80 years	Discharge destination	1.64	1.34 – 2.01	56	50 - 62	60	57 - 62	26	23 - 28	84	83 - 86	.60	.56 - .63
	Readmission 30 day	1.20	0.94 – 1.55	48	41 - 55	57	55 - 60	16	14 - 18	87	86 – 87	.51	.48 - .56
	Readmission 120 day	1.24	1.06 – 1.46	49	44 - 54	59	56 - 62	31	29 - 34	75	73 – 77	.53	.51 - .57
	Mortality 30 day	10.72	3.81 – 30.10	89	75 - 97	58	55 - 60	5	4 - 6	100	99 - 100§	.79	.72 - .86
	Mortality 120 day	4.41	2.80 – 6.94	77	68 - 85	59	56 - 62	12	11 - 13	97	96 - 98	.72	.66 - .77
Aged 81 years and over	Discharge destination	1.77	1.42 – 2.21	78	74 - 83	38	35 - 42	38	36 - 40	79	75 - 82	.61	.58 - .65
	Readmission 30 day	1.10	0.75 – 1.61	70	60 - 78	33	30 - 36	11	10 - 12	90	87 - 93	.50	.44 - .55
	Readmission 120 day	0.89	0.71 – 1.12	65	58 - 71	32	29 - 35	23	21 - 24	75	71 - 78	.46	.42 - .50
	Mortality 30 day	5.64	2.47 – 12.85	92	83 - 97	35	32 - 38	10	9 - 11	98	96 - 99	.71	.65 - .76
	Mortality 120 day	3.69	2.26 – 6.02	88	82 - 93	36	33 - 40	18	17 - 19	95	93 - 97	.66	.62 - .71

Supplementary file: Relative risk, sensitivity, specificity, positive and negative predictive values and area under the receiver-operating curve of MFST-HP‡ scores and five adverse outcomes related to subgroups

Subgroup	Outcome	RR*	95% CI**	Sensitivity (%)	95% CI**	Specificity (%)	95% CI**	PPV*** (%)	95% CI**	NPV****(%)	95% CI**	AUC*****	95% CI**
						MFST-HP‡ ≥6 (n=414 / 16.1%)							
Acute admission	Discharge destination	1.59	1.35 – 1.86	27	24 - 32	84	82 - 86	39	35 - 44	75	74 - 76	.62	.59 - .65
	Readmission 30 day	0.80	0.57 – 1.13	16	11 – 22	80	78 - 82	10	7 - 13	88	87 - 88	.49	.45 - .53
	Readmission 120 day	0.79	0.64 – 0.98	16	13 - 19	80	77 - 82	22	18 - 26	72	71 - 73	.49	.46 - .52
	Mortality 30 day	2.53	1.73 – 3.69	38	28 - 48	82	80 - 84	11	9 – 14	96	95 - 96	.68	.63 - .73
	Mortality 120 day	2.25	1.75 – 2.91	35	29 - 42	83	81 - 85	22	19 - 26	90	89 - 91	.67	.63 - .71
Non acute admission	Discharge destination	2.01	1.43 – 2.84	16	11 - 23	93	91 - 95	37	27 - 48	82	81 - 83	.64	.59 - .69
	Readmission 30 day	0.58	0.32 – 1.04	9	5 - 16	91	89 - 93	14	8 - 24	86	85 - 87	.51	.45 - .57
	Readmission 120 day	1.16	0.79 – 1.73	10	7 - 16	91	89 - 94	28	19 - 39	76	75 – 77	.52	.47 - .57
	Mortality 30 day	3.36	0.69 – 16.32	25	3 - 65	91	89 - 93	3	1 - 9	99	99 - 99§	.64	.46 - .81
	Mortality 120 day	2.94	1.31 – 6.58	23	10 - 41	92	89 - 93	10	5 - 18	97	96 - 97	.63	.53 - .73
Female	Discharge destination	1.45	1.22 – 1.72	26	21 - 30	84	81 - 86	42	36 - 47	71	70 - 73	.61	.58 - .64
	Readmission 30 day	0.72	0.46 – 1.11	15	9 - 21	80	78 - 83	8	6 - 12	89	88 - 89	.48	.43 - .52
	Readmission 120 day	0.73	0.56 – 0.96	15	11 - 19	79	77 - 82	19	15 - 24	74	73 - 75	.48	.45 - .52
	Mortality 30 day	4.07	2.42 – 6.85	49	35 - 63	82	80 - 84	10	8 - 13	98	97 - 98	.72	.66 - .79
	Mortality 120 day	2.80	2.00 – 3.91	40	31 - 49	83	81 - 85	19	16 - 23	93	92 - 94	.68	.64 - .73

Subgroup	Outcome	RR*	95% CI**	Sensitivity (%)	95% CI**	Specificity (%)	95% CI**	PPV*** (%)	95% CI**	NPV****(%)	95% CI**	AUC*****	95% CI**
Male	Discharge destination	2.09	1.63 – 2.69	23	18 - 30	90	88 - 92	35	28 - 42	83	83 - 84	.64	.60 - .68
	Readmission 30 day	1.02	0.68 – 1.52	13	8 - 19	87	85 - 89	15	10 - 20	86	85 - 87	.53	.48 - .57
	Readmission 120 day	1.08	0.83 – 1.41	14	10 -18	88	85 - 90	29	23 - 36	73	72 - 74	.53	.49 - .56
	Mortality 30 day	2.32	1.32 – 4.07	25	15-38	88	86 - 90	9	6 - 14	96	95 – 97	.68	.62 - .75
	Mortality 120 day	2.49	1.73 – 3.58	26	19 - 36	89	87 - 91	21	16 - 27	92	91 - 93	.68	.64 - .73
Aged 70-80 years	Discharge destination	2.08	1.64 – 2.64	18	14 – 23	93	91 – 94	38	31 – 45	82	81 - 83	.61	.58 - .65
	Readmission 30 day	1.14	0.77 – 1.70	11	7 - 16	91	89 - 92	16	11 - 22	86	86 - 87	.54	.49 - .58
	Readmission 120 day	1.18	0.92 – 1.52	11	8 – 15	91	89 - 93	32	26 – 40	73	72 - 74	.55	.52 - .58
	Mortality 30 day	2.19	0.98 – 4.89	19	8 - 35	91	89 - 92	5	3 - 9	98	98 - 98§	.64	.56 - .72
	Mortality 120 day	2.46	1.57 – 3.86	21	13 – 30	91	90 - 93	14	10 - 20	94	94 - 95	.65	.59 - .70
Aged 81 years and over	Discharge destination	1.30	1.09 – 1.56	31	26 - 36	77	74 - 80	40	35 - 45	70	68 – 71	.60	.56 - .64
	Readmission 30 day	0.70	0.44 – 1.10	20	12 - 28	74	71 - 77	8	5 - 11	89	88 – 90	.46	.41 - .52
	Readmission 120 day	0.71	0.53 – 0.94	19	15 - 25	73	70 - 76	18	14 - 22	75	73 - 76	.45	.41 - .49
	Mortality 30 day	2.44	1.59 – 3.77	45	34 – 57	76	73 - 79	13	10 - 16	95	94 - 96	.67	.61 - .73
	Mortality 120 day	2.14	1.59 – 2.89	42	34 - 51	77	75 – 80	23	19 - 27	89	88 - 91	.66	.61 - .70

* RR, relative risk; **CI, confidence interval; ***PPV, positive predictive value; ****NPV, negative predictive value; *****AUC; area under the receiver-operating curve of continuous score;
† VMS, Dutch Safety Management Program; ‡MFST-HP Maastricht Frailty Screening Tool for Hospitalized Patients, §due to use of round numbers.

Chapter 6: The opinions and experiences of nurses on frailty screening among older hospitalized patients. An exploratory study

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Abstract

Background

Routine screening for frailty at admission by nurses may be useful to detect geriatric risks and problems at an early stage. However, the added value of this screening is not clear yet. Information about the opinions and attitudes of nurses towards this screening is also lacking. As they have a crucial role in conducting this screening, an exploratory study was performed to examine hospital nurses' opinions and perspectives about this screening and how it influences their daily work.

Methods

A qualitative, exploratory approach was employed, using semi-structured interviews with 13 nurses working on different general medical wards (surgical and internal medicine) in three Dutch hospitals. Frailty screening had been implemented for several years in these hospitals.

Results

The participating nurses reported that frailty screening can be useful to structure their work, create more awareness of frail older patients and as starting point for pro-active nursing care. At the same time, they assess their clinical view as more important than the results of a standard screening tool. The nurses hardly used the overall screening scores, but were particularly interested in information regarding specific items, such as delirium or fall risk. Screening results are partly embedded systematically and in daily nursing care, e.g., in team briefings or during transfer of patients to other wards. The majority of the nurses had received little training about the background of frailty screening and the use of screening tools.

Conclusions

Most nurses stated that frailty screening tools are helpful in daily practice. However, nurses did not use the frailty screening tools in the referred way; tools were particularly used to evaluate patients on separate items of the tool instead of the summative score of the tool. When frailty screening tools are implemented in daily practice, training needs to be focused on. Additional research in this field is necessary to gain more insight into nurses' opinions on frailty screening.

Background

Due to our ageing society, more older patients will be admitted to acute hospitals in the near future. Nowadays, in the Netherlands, approximately one third of admitted hospital patients are aged 70 years and over(1). As a result, acute care hospitals are becoming more and more geriatric services, approximately one third of the admitted patients is 70 years and over (2). This affects the work of the nursing staff are responsible for the care of these older patients at all times(3).

Acute hospital admissions are not without risks for older patients. They are associated with an increased risk of negative health outcomes such as iatrogenic complications, delirium, and functional decline (4-6). These risks are even higher in frail older patients. Approximately 30 – 60% of hospitalized older people lose the ability to perform relevant activities of daily living, compared with their pre-admission level of functioning (7, 8). Andela and colleagues reported that 50 – 80% of older hospitalized patients are considered frail (9). Functional decline and frailty contribute to negative short and long-term health outcomes (10), such as a prolonged hospital stay (11), frequent readmission to hospital, admission to a nursing home, and increased mortality (12, 13). Frail patients have a higher risk for functional decline compared with their nonfrail counterparts (RR 1.32). Frail patients have a relative risk for in-hospital mortality and mortality in medium- and long-term compared to nonfrail (in-hospital RR: 8.20, medium RR: 9.49 and long RR: 7.94). The overall mortality risk in frail individuals is 3.49 times compared to nonfrail, respectively. Length of hospital stay was higher for frail older adults (13.5 days) compared with nonfrail (8.3 days) (14, 15).

During acute admission, routine care focuses particularly on diagnostic and therapeutic interventions, while general geriatric problems (e.g. cognitive impairment and functional decline) are often overlooked and seem to be relatively unrecognized (16). Parke and colleagues suggested that early detection of geriatric risks and problems can improve functional outcomes in these patients (3). Early identification of patients at risk can help nurses to start preventive care in combination with good basic care and additional tailored geriatric care (4, 17). Multidimensional interventions on physical, nutritional, psychological and social domains are effective and can prevent negative health outcomes (18). Screening results can be seen as a starting point for comprehensive geriatric assessment (CGA) an can also support decisions for CGA (19). In most Dutch hospitals, systematic screening on frailty is performed by nurses at hospital admission (20), for which different screening tools are used.

Many studies have been published on the psychometric properties of different frailty screening tools for use in hospitals (21). Data about their applicability, feasibility and usefulness is scarce and there is still debate on the added value of these screening tools(21). Also, hardly any information is available yet about the opinions and attitudes of nurses towards systematic and standardized frailty screening

in both community and hospital settings. These data are important because nurses are often the professionals who conduct the screening, assess the screening data and initiate preventive interventions based on screening outcomes.

Coker and colleagues explored the view of care staff on frailty and frailty screening in community dwelling older persons (22). Nurses stated that multi-domain frailty screening (e.g., on physical, mental health and psychological, social, environmental, and economic factors) is necessary to support interdisciplinary working for older patients in the community. They mentioned that, in addition to observing and asking questions, screening tools are necessary to assess frailty. Nurses stated that an optimal frailty tool would help them to understand frailty in its different domains. On the other hand, they considered that more training was needed on the understanding of frailty in general and the use of frailty screening tools specifically (22). Nursing perceptions on screening tools for delirium risk were studied in a clinical palliative setting (23). Nurses stated here that screening tools could support the documentation of observations of patient symptoms. Although delirium is a common problem in palliative care, screening tools were not routinely used to ensure early recognition by nurses. Nurses mentioned that screening is only one step in the complex care for delirious patients and that the follow-up step (initiating preventive and pro-active care) is even more important than the screening tool itself.

As information on frailty screening by nurses in acute hospital practice is scarce, so we conducted an explorative study to examine their opinions on frailty screening and how it impacts their daily work. These findings may contribute to optimizing pro-active care for older frail hospitalized patients.

Methods

Design

We used an exploratory qualitative approach using semi-structured interviews with nurses working on different wards in acute hospitals.

Setting

Nurses working in three hospitals in the south of The Netherlands were included in the study: one moderate sized general hospital (hospital 1, about 300 beds), one large general hospital (hospital 2, 600 beds) and one large university hospital (hospital 3, over 700 beds). In all three hospitals, initial screening by nurses during admission for frailty had been implemented for several years and older patients were admitted to almost all wards throughout the hospital. We did not include hospital sites with specific geriatric wards as a broader geriatric knowledge and approach in such wards could bias

our findings. Nurses on geriatric wards receive additional geriatric training, whereas we were primarily interested in the opinions of general nurses.

Screening for frailty in the included hospitals

In hospital 1, all older patients are screened at admission by means of the 13-item RISK scale. This scale was developed by the geriatric team of the hospital based on the Dutch National Safety Management Program for the screening of frail hospitalized older patients (in Dutch abbreviated as "VMS"). The RISK scale has not been validated yet and is integrated in the nursing assessment. The screening consists of four domains: delirium risk (three questions), fall risk (one question), malnutrition (three questions) and risk of functional decline (six questions) (20). Geriatric consultation by a specialized geriatric nurse is provided when frailty is identified (a score ≥ 4 on the RISK scale).

All admitted older patients In hospital 2 are screened by means of the validated 15-item Groningen Frailty Indicator (GFI)(24). The GFI consists of four domains: physical (nine items), cognitive (one item), social (three items) and psychological (two items). The items of the screening tool are fully integrated in the nursing assessment, which is assessed during admission. Based on the outcome of the GFI assessment (score ≥4), members of the specialized geriatric team first check the patient file and decide upon whether a further geriatric assessment of the patient is necessary.

In hospital 3, all admitted patients of 70 years and over are screened by means of the validated Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP)(25). This 15-item tool consists of three domains: physical (nine items), psychological (four items) and social (two items). The MFST-HP is fully integrated in the initial nursing assessment, and afterwards the digital system generates a frailty score. Digital standardized nursing protocols for each of the MFST-HP items are available within the nursing system. A patient is labelled as frail when the MFST-HP score is 5 or higher (2). A specialized geriatric team pro-actively visits all patients with a specific cut-off score on the frailty screening for further comprehensive geriatric assessment.

Participants

Nurses were included in the study if they were employed at general wards (internal or surgery wards) in each of the selected hospitals; many older patients are admitted to particularly these wards. Nurses working on 'high-care departments' such as emergency departments or intensive care units or nurses working on a geriatric ward were excluded from the study. A variety of nurses according to gender, age and educational level (i.e., secondary vocational education or higher professional education) was recruited for this study by geriatric nurse practitioners of the included hospitals by means of purposive sampling. In view of the qualitative approach, we limited recruitment to approximately four to five

nurses per hospital. After selection, an information letter on the study and content of the interview was handed over to the participants. Informed consent was provided by all participants. Interviews were conducted at the hospital sites.

Data collection

Nurses were interviewed in a semi-structured way by two members of the research team (authors RMJW and MvL). The interviews in hospital 1 were conducted with individual nurses (n=4), the interviews in hospital 2 and 3 were conducted in small groups: one individual interview, two pairs, and one group of four nurses. Differences in group composition was due to practical issues. In total, eight individual or group interviews were conducted (i1 t/m i8). Author MvL served as moderator of all interviews, author RMJW observed the interviews and made additional notes. An interview guide was constructed based on literature and expert consultation and pre-tested in a hospital ward that was not included in the present study (see supplementary files). No major adjustments of the interview guide were necessary. Nurses in all hospitals were asked the same series of open-ended questions regarding two main topics related to our research question. The first topic was about the nurses' opinions of screening and screening tools in general of frailty screening among older patients, the second topic was about the nurses' perceptions on the impact of the frailty screening on daily nursing practice. Based on the responses in-depth follow-up questions were asked to further clarify and expand on areas that seemed to be of interest or concern of the participants. All interviews were recorded. At the end of the interview the researcher summarized the findings of the interview as a part of member checking. Transcriptions were checked by the participating nurses. Socio-demographic and background data such as age, gender and educational level were collected at the end of the interview.

Data analysis

All interviews were transcribed verbatim by two members of the research team (authors RMJW and MvL) and two authors (MFMTD and RMJW) analysed the data via qualitative content analysis using open coding (26) . They were both blinded for each other's coding and initial codes were discussed afterwards. In the second step, codes were edited via axial coding; some codes were divided, some other were combined. In the last step, selective coding was used to combine different issues. Illustrative quotations for specific opinions were selected by authors MFMTD and RMJW and were labelled with a specific code to ensure anonymity. Pair and group interviews were labelled as one unit of interview. The COREQ checklist was used to report the data (27).

Results

All 13 invited registered nurses in the three hospitals agreed to participate. Their ages varied from 21 to 63 years, and ten of them were female (see Table 1). Their experience as a registered nurse in hospital care ranged from less than one year to 45 years. Four nurses indicated that they had no specific experience in nursing older patients, but all others did have this experience, varying between 6 and 45 years. The nurses had different levels of education: six nurses graduated secondary vocational education while seven had a bachelor's degree. The majority of the nurses (10) had no specific geriatric education, while two had received specific training such as clinical lessons from a geriatrician or an e-learning program on geriatric care.

Table 1: Characteristics of the sample N=13

Female (%)	10 (77)
Age (SD)	38 (11,8; median 38; IQR 19)
Highest education level (%)	
Secondary vocational education (%)	7 (54)
Higher Professional (Nurse) Education (%)	6 (46)
Course in geriatric care (%)	3 (23)
Years of experience as a nurse, mean (SD)	17 (13,0; median 12; IQR 20)
Hospital experience, mean (SD)	17 (12,8; median 11; IQR 20)
Full time employment (%)	13 (100)
Experience taking care for older patients (SD)	11,6 (14,1; median 10; IQR 23,5)

SD: standard deviation, igr interquartile range

After the first analyses and discussion between the two authors MFMTD and RMJW, 15 initial codes were extracted from the interview data. These codes were then renamed or combined by both authors, resulting in two main themes corresponding with the interview guide: (1) the nurses' (general) opinion about screening and (2) the experiences and impact of screening on their daily work. Finally, six subthemes were derived from these two main themes. Four of them relate to the nurses' opinions: (1.1) nurses' attitudes towards frailty screening; (1.2) the importance of their clinical view versus the outcomes of screening tools; (1.3) advantages and disadvantages of frailty screening in general; (1.4) prerequisites and suggestions for improvement. The other two subthemes relate to their experiences: (2.5) the use of and knowledge about frailty screening in daily care and briefings within and between teams; and (2.6) follow-up actions after screening.

Nurses' opinions about screening (subthemes 1.1 to 1.4)

1.1: Attitude towards screening

In two hospitals nurses stated that frailty screening is part of their job: "It's just part of our job. It is part of it just like pain assessments for example" [i1]. Some nurses thought that the use of a certain screening tool could be helpful. "It (use of screening, authors) must increase your alertness, especially for frail patients, and also generate a to-do list for us which actions have to be taken. That's why these screening tools are created, I think" [i2]. Some experienced nurses stated that screening tools in general could be helpful for younger (and less experienced) nurses. One said: "If you are just starting out in the nursing profession, it is sometimes helpful to have some tools" [i3].

1.2: Clinical view versus screening results

All nurses stated that their clinical view and professional observations are more important than the overall summative score of a frailty screening tool. In one hospital, a nurse said that she always added her observations to the frailty scores. Two nurses [i5, i4] stated that the outcome of the frailty screening tool was used to substantiate or to confirm their clinical view. Another nurse mentioned that she felt that screening is sometimes considered more important than her own knowledge and expertise with respect to taking care for older adults: "I sometimes feel that a score on the list is considered as expertise on itself by others, and I think that it has to be perceived as an aid, and not as a strict guide" [i4]. Most nurses stated that the outcomes of a screening tool cannot replace the clinical expertise and view of the nurse. Two nurses on a surgical ward stated: "Let me put it this way: when I get an overview of the patients on the screen, I cannot see who is a vulnerable older person. I can see whether someone should be resuscitated or not, but there is no indication of a colour or a certain sign that the patient is a vulnerable older person. I have to visit the patient at his bed for to see if he is vulnerable, huh…" [i4]. Another nurse stated that the screening tool could be complementary for her as a professional: "Sometimes an assessment instrument is very helpful, but hey, I think it must always be combined with what you see and what you observe as a nurse. A score cannot express this. So yes, it is helpful" [i3]. Most nurses mentioned that the score on the individual items of the screening tool could be more helpful than the summative total frailty score. The individual items could help nurses with focusing on several geriatric items as for instance delirium, fall risk or malnutrition [i2].

1.3: Advantages and disadvantages of screening

All nurses stated that due to screening nursing interventions in general were started more pro-actively at an earlier stage after admission. Furthermore, screening and screening results can create more awareness for potential risks when older patients are admitted to the hospital. One nurse stated:

”Every time when I screen older patients, the screening triggers me again and again” [i6]. Another one mentioned: ”It is surely a helpful tool, and it is also good that the screening is mandatory to complete. I think if it had been a separate form, it would be easier to ignore it, but now you cannot ignore it. So, it is definitely a tool that assesses the physical and psychological functioning of the patient at admission” [i2]. Screening can help nurses to visualize the older patients’ risks or problems when admitted according to two nurses. Two other nurses stated that, due to early interventions on potential risks, the tool was considered as a kind of preventive tool. Screening can therefore substantiate the clinical view of nurses. The tools can help nurses to structure their work in taking care of older patients. One of them stated: “For example, if you are reading the patients’ file and you do not know the patient at all (after some days off duty, authors), then you must have actually visited the patient to know the patient’s level of functioning; in that case the items of the screening tool could be helpful as a sort of overview” [i2]. Nurses stated that using the tool may help to create uniform structure in patient reports within nursing teams and could be helpful to monitor the patients functioning during the hospital stay.

None of the interviewed nurses reported specific disadvantages of frailty screening as such. However, they perceived some disadvantages of the used screening procedure. One nurse mentioned that, due to automatically generated screening results and follow-up actions (i.e., automatic generated consultation request for the geriatric team) in the background of the digital patient file, the actual frailty status of the patients remains unaware: “Yes, it actually happens so automated that you perhaps do it without knowing it” [i4]. One nurse mentioned that the completion of the frailty screening increases her workload: “Screening for frailty provides a structure for our daily activities. But because it has to (it is mandatory, authors), it gives an increased workload, because you have to finish everything for the end of the shift” [i1].

1.4: Prerequisites and suggestions for improvement

Nearly none of the nurses received a specific instruction at the time when the frailty screening tool was implemented in daily practice. Only one nurse mentioned that she received information on the screening during a more general geriatric training. Four nurses stated explicitly the need for training and instructions; this would improve the quality of the screening and follow-up in their view. In contrast, not all nurses mentioned this; only one nurse mentioned that the screening was introduced via a meeting years ago. This in contrast to the information of the geriatric nurse practitioners, in all hospitals the screening was introduced via courses, meetings or e-learnings. In addition, almost all nurses stated that an automatically generated alert in the digital nursing file via a pop-up would be helpful. “I would prefer that the score is communicated via a pop-up notification in our digital nursing

system, which you can't ignore. You have to take action and then the alert stops" [i7]. Some nurses thought that a sort of traffic light ('alarm light') in the patient file could also be helpful.

Experiences and impact in daily practice (subthemes 2.5 and 2.6)

In all three hospitals, a systematic screening for frailty at admission had been implemented for more than two years and protocols were available regarding its conduct. Not all nurses were aware of this protocol though. One nurse stated: "There is a protocol in our quality portal about this topic, but unfortunately this is only used in the other hospital site of our organization, but I think that would also be ideal for our site" [i6]. Half of the nurses mentioned that the screening was conducted according to protocol. Although the screening results are automatically generated in the electronic patient file, not all nurses did know the screening results or could find the reported screening results in the digital file. One nurse mentioned: "It is only a few mouse clicks on the computer, but it is not done at our ward" [i8]. Nurses in one hospital stated that when a patient was screened as frail, this was not reported in the patient file.

2.6 Briefing and knowledge

Nurses in one hospital stated that the screening results were not used during briefings between nursing shifts or transfers of patients between wards. These results were not checked before the briefing and the score itself was no topic during the briefing. The nurses in the other two hospitals reported that they used information about the frailty status only occasionally in their briefing between shifts and wards. Then it mostly was about specific items of the screening tools. "If someone has fallen or has an increased risk of falling, that is sometimes used during briefings. Or if the patient was known with delirium last night, things like that are passed on, yes" [i4].

Only one of the nurses could mention the name of the frailty screening tool, as well as the cut-off score that is used to classify patients as frail. One nurse stated: "I think that there is a bit of a knowledge gap on the screening tool. It is unclear what the screening score could mean for me as a nurse. But on the other hand, we generally know what to do in the next steps" [i7]. Despite the daily use of the screening tools, nurses were not always aware of the screening. ''We use it (frailty screening; author) daily, but we were unaware about it''

[i6]. One nurse stated: "I do not necessarily think that this is a lack of knowledge. I think we all know how to deal with frail older people and what we should do and ehmm ... I think it's more the awareness" [i7].

2.6 Actions after screening

Based on the cut off score of the frailty screening, consultation of a specialized geriatric team is available in all three included hospitals. In two hospitals, an order for consultation is automatically generated by the electronic nursing system based on the frailty sum score or on scores on specific items (i.e., in case of delirium or fall risk). On one ward, a geriatric consultant (nurse) performs consultation rounds based on the screening results: "Every morning on weekdays there is a round of the geriatric nurse who visits patients with a high screening score" [i1]. In some cases, an additional comprehensive assessment is used as follow-up. All nurses mentioned the Delirium Observation Scoring Scale (DOSS) (15) as a routine follow-up after a positive score on the delirium items of the frailty screening. Further assessments are also available for risk items such as malnutrition and functional decline. Almost all nurses mentioned that the outcome of the frailty score was presented in the daily medical consultation rounds, despite the daily nursing briefings. In one hospital, a tailor-made care plan based on the screening (conducted by a geriatric nurse) is used at the transfer between nursing wards (e.g., from acute admission unit to regular ward). In the other hospitals, a multi-disciplinary care plan was developed by ward nurses themselves, based on the score on different items of the screening tool (not the summative frailty score). Multidisciplinary interventions based on the outcomes of the frailty screening were reported, such as consultation of a physiotherapist, a dietician, activity teams and social service (transfer nurse). In all three hospitals, one nurse stated that family participation was encouraged in the case of frailty, to assist the patient during hospitalization. All nurses mentioned potential environmental actions if screening scores these warranted, such as transfer to a single room.

Discussion

The aim of this exploratory study was to examine nurses' experiences with and opinions about frailty screening at hospital admission and how this screening impacts their daily work. The participating nurses report that this screening can be useful to structure their work, create more awareness of frail older patients, serve as a starting point for pro-active nursing care and could encourage interdisciplinary collaboration in complex care for these patients. At the same time, they assess their clinical view as more important than the results of a standard tool, and the automatically generated recommendations based on these results may interrupt their 'clinical alertness'. The nurses barely used the sum score of the screening but were particularly interested in the information from separate items of the screening, such as delirium or fall risk. Screening results are only partly embedded systematically in daily nursing care, e.g., in team briefings or during transfer of patients to other wards. Screening results on item level are used for the development of tailor-made care plans for frail older

patients. The majority of the nurses received hardly any of training during implementation about the backgrounds of frailty screening and the use of the tools themselves.

The participants mentioned that frailty screening tools could be helpful for nurses, but neither these tools nor their summative scores were used during daily routines such as patient briefings or medical rounds. Nurses were more interested in the item scores of the tools. Perhaps this use of the screening tools is not that bad as the predictive power of summative scores is not convincing yet (21). Focus on the item level seems to help nurses to structure their work and create awareness of frailty. Another explanation could be that misuse of the screening tools is due to the nurses' lack of understanding about frailty in general and its implications for patients and care. Nurses mentioned their commonly known aspects of frailty at admission (i.e. delirium or falls), but seem to have less attention for other aspects or domains and the interaction between these domains.

It seems that the summative score and proposed cut-off points of the tools are probably more important for specialized geriatric teams, such as for case finding and related pro-active follow-up geriatric consultation.

Participants assessed their clinical view as more important than the results of standard tools, although these tools are considered helpful for less experienced nurses. These findings are partly in line with those of Hosie and colleagues who studied the perceptions of nurses with delirium screening in palliative care (23). In contrast to our study, the nurses in Hosie's study reported that, due to early screening, safety interventions were started pro-actively at an early stage. The screening tool was therefore helpful for them. Similar to our study, nurses also expressed their need for more tailored guidance and training in using screening tools. In Hosie et al.'s study, experienced nurses reported that the screening was not needed by 'highly qualified nurses'. This is also consistent with our findings. Coker and colleagues studied frailty screening in multidisciplinary teams working in the community. They also concluded that education on frailty screening and training in the use of screening tools are necessary. All participants in their study expressed a desire for more training on frailty and the use of frailty screening tools (22).

The implementation of frailty screening needs careful consideration. Nurses stated that there was no training program at the time the frailty screening was implemented in the hospital. In our opinion, this has to be taken in account when implementing screening tools in daily practice. And in this implementation, educations should play a major role. Education has to be repeated every year and has to be an issue during structural peer reviews between nurses in general. Nurses need to learn about the relevance of frailty screening for their daily work. Education and training have to be delivered via different channels. In a study on frailty screening in nephrology services, the relevance of frailty

screening was communicated via departmental presentations and ad-hoc one-on-one sessions. Animated videos on the purpose of frailty screening were displayed on TV screens in the department (28). Educational interventions should not only focus on the nursing staff, but also on physicians, as they have the final say about patient treatment. Finally, unit leaders in hospitals should encourage the implementation of the learned material for optimal results (29).

Dedicated nurses could also take a part in this training. For instance, ward champions could be helpful in the implementation of screening and quality assurance on the nursing ward. Hospital specialized geriatric teams could take a part in coaching those dedicated nurses or champions in providing best evidenced care for frail older patients. Lim et al. suggest that the main stakeholders, including the multidisciplinary team of healthcare professionals, patients and their caregivers, should be involved from the time of hospital admission. Early involvement of the multi-disciplinary team in the practice of routine frailty screening in acute care settings will improve collaboration and communication in sharing essential patient information to develop holistic patient care goals (30).

Finally, digital nursing files could be more helpful for nurses. The results of the frailty screening were difficult to find in the files. Nurses could be more supported by the use of pop-ups or automatically generated alerts in case of frailty.

Methodological reflection

This study is, as far as we know, the first one reporting on nurses' opinions and experiences with frailty screening in hospital. We used an exploratory approach, gathering information in a variety of hospital settings among nurses from both internal and surgery wards. A limitation of this study is that, due to practical issues, not all interviews could be conducted in small groups as planned (in one hospital, individual nurses were interviewed instead). On the other hand a small sample size is a limitation. We think, however, that this variation had no large impact on our findings.

Implications

It would be helpful when digital nursing files or systems were more supportive for nurses. Many data for frailty screening are already available in the digital system and this data could be automatically used in creating the frailty screening. In addition, alerts or popups could be helpful for nurses to create more alertness regarding frailty and useful for improving the quality of care.

In the hospitals that were included in our study, a systematic screening for frailty at admission was implemented for more than two years and protocols were available as to how the screening has to be executed. However, not all nurses were aware of this protocol. It is unclear from our results whether

and how nurses were involved in the implementation process. In this process, it is necessary to claim time for training and education.; nurses need to learn why they have to screen older patients for frailty and what the benefits of screening are in their own daily work.

Further research is needed to gain more insight into the implementation of screening tools, including how the screening is conducted by nurses. Also, a more quantitative approach is needed to study the impact of screening in daily geriatric care.

Conclusion

Most nurses stated that frailty screening tools are helpful in daily practice. However, nurses did not use the frailty screening tools in the referred way; tools were particularly used to evaluate patients on separate items of the tool instead of the summative score of the tool. When frailty screening tools are implemented in daily practice, training needs to be a focus. Additional research in this field is necessary to gain more insight in nurses' opinions on frailty screening.

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Supplementary file: Interview guide

Introduction:

- Start-up
- Introduction of persons
- Purpose of study
- Duration of interview
- Confidentiality and anonymity
- Use of recordings
- Information about member checking

Start of the interview (record on).

This interview is about frail elderly patients and focuses on the use of frailty screening tools in a hospital setting. In your hospital, a screening tool for frailty is used at admission to map vulnerability in older patients. We are interested in your experiences with this tool.

1) About the screening and screening tool:

- What do you in general think of screening for frailty in older patients admitted to your hospital?
- How is screening executed in your hospital? What is your target population?
- What happens with the outcome of frailty screening?
- How does frailty screening get attention during the doctor's rounds?
- How was the screening tool explained to you? Did you get any instructions on using the tool?
- What role does screening play within the nursing care process?
- How is the score interpreted?
- How is the geriatric consultation team involved?
- How is screening performed when a patient is known to be in cognitive decline?

2) Impact of the use of the screening instrument on daily nursing practice:

- In what way is frailty screening helpful in the daily care for older patients?
- Do you think frailty screening offers you a structure your work? If yes/no, why?
- What would you change in the current frailty screening tool or the screening process to improve the quality?
- Can you tell something about screening versus work pressure? How much time does it take to perform screening? What do you get in return?

Help/in-depth questions

- Can you explain that further for me?
- Can you give me an example of what you mean?
- Can you say something more about it?
- I don't quite understand ...

3) Are there any important issues that you would like to address in the context of screening for frail older patients that have not been discussed during this interview?

4) End of the interview. Recording stop. Hand out form for epidemiological data.

Thank you for your participation, openness and thinking about this subject. The results of our study will be forwarded to you later on via email. Please check it for factual inaccuracies.

Chapter 7: General discussion

General discussion

The concept of frailty is gaining more and more attention in daily hospital care. Acutely hospitalized frail older adults show a range of physical, cognitive and psychosocial problems and are at risk for adverse outcomes during hospitalization (1). Systematic screening of these patients for frailty at admission aims at early identification and management of potential, complicating geriatric problems (2). Numerous frailty screening tools are available for daily practice in hospitals (3).

The general aims of this thesis were (1) generating an overview of available hospital screening tools and their psychometric properties, (2) exploring the quality and usefulness of the Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP), developed for frailty screening at hospital admission, and (3) exploring opinions of hospital nurses on conducting frailty screening in daily clinical practice.

In this chapter the main findings are discussed. Thereafter, a reflection on the main results and some methodological issues of our studies are presented. Finally, recommendations for daily practice and future research are given.

Main results

Available frailty screening tools

Our systematic review regarding available screening tools for the hospital setting rendered 16 tools with a variation in domains, number of items and method of administration (chapter 2). The most frequently studied tools were the Identification Seniors At Risk (ISAR) and the Triage Risk Stratification Tool (TRST). Overall, sensitivity was fairly good. The ISAR, ISAR-HP (Identification Seniors At Risk Hospitalized Patients) and Multidimensional Prognostic Index (MPI) showed the best sensitivity. Information about reliability and feasibility of the 16 tools was scarce. The review concluded that many frailty screening tools are available for daily practice. For none of these tools, however, clear evidence is available yet regarding validity, reliability and feasibility.

Screening in practice with the MFST-HP

As a next step we studied the psychometric characteristics of The Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP), a screening tool administered by nurses at admission in the hospital.

In our first study, aspects of reliability, validity and feasibility of the MFST-HP were explored in a sample of 79 consecutive older patients (Chapter 3). Reliability of the MFST-HP was fairly good; the Intraclass Correlation Coefficients for both intra- and inter-rater reliability were promising (ICC above .93). Older

patients and those with more comorbidity showed higher scores on the MFST-HP compared to younger patients and those with less comorbidity. Due to a low administration time (averaged 2.6 minutes), and no need for extended training, we considered the MFST-HP as a feasible tool in nursing care.

Next we studied the predictive value of the MFST-HP on negative hospital outcomes as length of hospital stay, discharge destination, hospital readmission and mortality (data of 2691 hospitalized older patients). Surprisingly, it appeared that the MFST-HP operated more strongly as a non-frailty indicator than as a frailty indicator; ruling out 84% of the non-frail population, a group that does not seem to need additional attention from a specialized geriatric team or further geriatric assessment. The remaining 16% is probably frail and needs to be assessed more thoroughly by means of a comprehensive geriatric assessment to gain more insight in their level of frailty.

We also compared the predictive properties of the brief Dutch National Safety Management Program for the screening of frail hospitalized older patients (VMS) with the more extensive MFST-HP. Different proportions of frail patients were identified by means of both tools: 53.2% of a population of 2573 older persons were classified as frail on the VMS and 16.1% based on the MFST-HP. We found a low specificity for the VMS and a low sensitivity for the MFST-HP. Overall the predictive properties of both the VMS and the MFST-HP appeared to be poor to moderate.

Nurses' opinions and attitudes towards frailty screening

Semi-structured interviews with 13 nurses working on different general medical wards (surgical and internal medicine) in three Dutch hospitals showed that they perceived frailty screening as useful to structure their work. It created more awareness of frailty and the risks older hospitalized patients face after admission. In addition, outcomes of the frailty screening or the items of the screening may be used as starting point for a more pro-active nursing care. Despite this, they assessed their clinical view still as more important than the results of a standard screening tool. The nurses hardly used the overall summative screening scores, but were particularly interested in information regarding specific items, such as delirium or fall risk. It seemed that screening tools like the MFST-HP are used more as a checklist than as a summative score. The majority of the nurses had received little training about the background of frailty screening and the use of frailty screening tools.

Reflection on results

After conducting our review, we hoped that our MFST-HP instrument would perform better on validity, reliability and feasibility than the instruments included in the review. Yet this turned out not to be the case. The MFST-HP did not actually identify frail patients, but turned out to detect their non-frail counterparts.

Frailty tools: what does the MFST-HP add?

One of the strengths of the MFST-HP is that the tool is fully integrated into the digital nursing anamnesis. As a result, nurses do not experience any extra work-load and the digital nursing file creates the summative frailty score. The reliability is good as well as its feasibility. The weakness, however, is that the MFST-HP does not perform better than other frailty screening tools in terms of detection and prognosis of negative health outcomes, such as mortality, hospital readmission and post-discharge care needs. The MFST-HP also does not have better predictive abilities than the nationwide implemented short Dutch VMS tool.

Our review also showed that in general the overall sensitivity of the included tools was reasonable. The Identification Seniors at Risk (ISAR) (4), the Identification Seniors at Risk-hospitalized patients (ISAR-HP) (5) and the Multidimensional Prognostic Index (MPI) (6) showed the best sensitivity, especially the ISAR-HP and MPI. These three tools also scored better on sensitivity than the MFST-HP. These findings were consistent with a review by Lim and colleagues (7).

However, striking as well is that, in the absence of a gold standard for frailty, almost every instrument is validated in relation to different outcomes or combined outcomes. Moreover, our review also revealed that information about reliability and feasibility is often scarcely published (3). The administration time of the various instruments fluctuated between 1 minute for the Triage Risk Stratification Tool (TRST) (8) and 35 minutes for the MPI (6). The MFST-HP has an average test time of 2.6 minutes (9).

Lim and colleagues therefore conclude that the MFST-HP represents a rapid screening that can work towards a more comprehensive assessment (7). We can share their view, but as the MFST-HP in particular excludes non-frail patients, it is desirable that in case of a high score (i.c. high vulnerability) a further geriatric assessment should be performed (10).

A tool that was not included in Lim et al.'s review is the Clinical Frailty scale (CFS)(11). During the recent Covid-19 pandemic, a lot of (international) research has been conducted in frail old people with Covid-19 in which the CFS was frequently used as basic frailty screening instrument. This instrument works

with a frailty stratification based on icons or patient vignettes. It combines good validity with an adequate feasibility. Using pictograms and clinical descriptions, the nurse can stratify the vulnerability of the patient at a glance. Unfortunately, the interrater reliability of the CFS is not optimal (K 0.32)(11) as well, but with the support of an additional decision making tool, the reliability improves substantially (12). This extra decision tool however increases the time to complete the tool (12).

Because we have clearly shown that none of the current frailty tools, including the MFST-HP, is perfect regarding to the different frailty outcomes (e.g. readmissions, mortality) the question arises whether we should continue to screen older patients for frailty at admission? In our opinion, screening for frailty still may have sense to target tailored nursing and medical care for admitted older often frail patients. Therefore, approaches like the promising CFS should be more optimized for daily nursing care.

On the other hand, a different look at the dynamics of frailty may also support future screening strategies.

Classic frailty screening tools mainly look at deficiencies of patients and they deny the phenomenon of patient resilience as countervailing power to frailty. Today, however, frailty is more and more considered as a dynamic status of the patient. For example, in the studies of the D-Scope consortium, a status of frailty is considered as a temporary and possibly reversible disturbance of the balance between frailty and resilience. Such an approach does not only look at problems in the overall functioning of a patient, but also at countervailing factors such as psychological and social support, which can compensate for existing problems thereby preventing frail older patients getting more frail (13). This new approach also fits perfectly within the principles of positive health, described by Huber et al. (14). Positive health also means that the focus is based more on the remaining abilities of the older patient to gain or preserve a status of autonomy (13).

Nurses' perspectives

Our qualitative study among nurses in the hospital shows that nurses do not have a strong need for rigid (summative) cut-off scores which are common for the frailty tools used in their practice. It is preferable to have useful checklists or signaling lists that help nurses in detecting and tackling potential, specific geriatric, care problems in patients at an early stage. However, our qualitative study is a first small study in this area and future research should further confirm this.

Even though it turned out that nurses knew that screening was taking place in their hospital, they did not know the name of the screening tool, nor its cut-off point (15). Nurses also clearly indicated that they could rely better on their own clinical view and experience than on summative scores of frailty tools. In addition, some nurses used the instrument more as an alert checklist, in which the sub scores

on the domains or parts of the tool are mainly used in the care plans. Nevertheless, screening with an adequate tool could add something to the care for older patients in the hospital. A study by Blomaard and colleagues who surveyed emergency department (ED) nurses about their experiences with geriatric screening found that in half of the cases there was a difference between the clinical view of the ED nurses on the patients frailty status versus the actually measured frailty (16).

Paradoxically, most nurses in our study indicated that frailty screening tools can be useful in daily practice but despite this, they did not use the applied screening tool in accordance with its original usage instruction. This clearly shows that the applied frailty instrument is not primarily suited to the initial needs of the nurses to achieve good care for older patients and that brings us directly to the implementation process. Implementing and adopting a new instrument in nursing care requires a good introduction, whereby an initial consensus must be reached about the added value for the nursing care process. This also means that nurses should be involved in this process from the onset and that new instruments should not be imposed. Only in this way the foundation can be laid for a good adoption attitude.

Avgerinou and colleagues investigated the attitudes of healthcare professionals in primary care in identifying and managing frailty (16). Their study showed that healthcare professionals (including nurses) can play a very important role in identifying and caring for frail older people. However, many of the professionals surveyed already felt overwhelmed and indicated that it all takes (too) much time. A scoping review by Zhao and colleagues also showed that knowledge deficits, lack of skills and resources, as well as unclear procedures in daily practice were the strongest barriers to the implementation of EBP in daily care practice. Support from experts and leadership were mentioned as possible facilitators (17). These findings are in line with what nurses indicated in our qualitative study.

Methodological reflection

For our studies on the MFST-HP, we used a retrospective cohort design. An advantage of this was that relevant data were already available. A disadvantage was that important variables were possibly missing. However, in our opinion, we did not miss essential outcome measures because our measures are in line with those used in other validation studies in this domain. Regarding the predicting factors we had no information available on for instance the patient's admission indication and frailty was only measured once upon admission. This may have decreased the precision of our prediction estimates.

In our qualitative study, we interviewed nurses from three different hospitals about their experiences with frailty screening. The number of interviewed nurses may have been too small. In addition, the interviews were conducted in different ways, individually and in small groups. The question remains whether we have obtained a sufficient picture of the nursing perspective, despite the fact that the findings in the different hospitals were consistent. Although saturation occurred quickly, our study should be considered as a first exploration of nursing experiences with regard to frailty screening in hospital.

Implications

Implications for practice

Implications for frailty screening:

There is currently no perfect screening tool to detect frailty in hospitalized older patients. Given the moderate predictive value of the MFST-HP, investigated in this thesis, we would strongly advise against (continuing of) using this instrument for the detection of frail old people in hospital. In fact, this also applies to the other tools described in our review.

Implications for nursing care:

Although nurses indicate that they are satisfied with the frailty screening tools used, these tools are not used as intended by the developers. They are predominantly used as an item-level checklist. Nurses indicate however that using them as a checklist can support their clinical view.

Nevertheless, to achieve further professionalization of the nursing profession, we think it is necessary that valid (evidence based), handy and easy-to-use practical instruments become available for daily practice. Such instruments must directly support the nursing process. This implies the involvement of nurses from the early beginning in the process of development and implementation of these instruments. Appropriate and tailored education and training are also essential

Implications for further research

With regard to frailty screening in hospitals:

Striking so far is that frailty instruments are validated against different outcomes or combined outcomes. It is important to arrive at instruments that can be used to monitor patients for relevant outcomes, appropriate within the context in which these screenings are performed. More studies are needed on testing other approaches of screening, such as working with the modified CFS or on the development and validation of an instrument that can properly measure the 'frailty balance'. The latter instrument include the resilience of a patient, for instance, as this also influences the frailty status.

Moreover, as frailty seems to be a more dynamic phenomenon, more frequent measurements probably might be relevant. And perhaps this should start before hospital admission, for example in general practice? After all, there are numerous frailty instruments available for use in primary care, validated on different outcomes such as hospitalization or contacts with healthcare providers (75). In addition, studies have revealed that general practitioners are quite capable of indicating which patient is frail or not (76). Research on frailty screening should focus more on the total care chain.

With regard to research focused on the role of nurses in frailty screening:

In future research more attention should be paid to implementation and evaluation of frailty screening tools for nursing care in hospitals and the timely involvement of nurses in this process. Research should focus more on the needs of the nursing profession itself regarding frailty screening, and on what the research results should bring about for nurses to improve the care they offer to their potentially frail patients.

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Summary

Many people get old in a healthy way but for a considerable group, ageing is also associated with an increased risk of one or more chronic diseases (multimorbidity) and secondary disabilities. In the Netherlands almost 50% of those aged 75 years and over suffer from more than one chronic condition. This impacts their use of health care services, including hospital care. Hospitals become more and more 'geriatric institutions' and in daily practice, nursing staff has to deal with an increasing number of older patients. When older people with acute health problems are hospitalized, they are at high risk of rapid functional decline both during their hospital stay as well as after discharge.

Frailty and functional decline contribute to negative short and long-term health outcomes such as prolonged hospital stay, frequent readmissions to hospital, admission to a nursing home, and increased mortality. Therefore, an active approach in detecting frailty in hospitalized older patients is considered to be necessary, as a starting point for proactive interventions.

This thesis focuses on the screening for frailty in daily nursing care for hospitalized older patients. We conducted several studies with three aims: (1) generating an overview of available hospital screening tools for frailty and their psychometric properties, (2) obtaining information regarding the quality and usefulness of the Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP screening tool) that we developed ourselves for frailty screening at hospital admission, and (3) exploring opinions of hospital nurses on conducting frailty screening.

After a general introduction (chapter 1), chapter 2 addresses the first aim. A systematic review was performed to identify and review screening tools for frailty in older adults admitted to inpatient hospital care with respect to their validity, reliability and feasibility. Studies were identified through systematically searching PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase and PsycINFO and screening reference lists till June 2014. The quality of the included studies was critically appraised via the Quality Assessment of Diagnostic Accuracy Studies (QUADAS).

The included screening tools showed different characteristics with respect to the number of items, the method of administration and the domains included. The most frequently studied tools with respect to predictive validity were the Identification Seniors At Risk (ISAR) and Triage Risk Stratification Tool (TRST).

The review concluded that many screening tools are available for daily practice. None of these tools, however, demonstrated clear evidence on both validity, reliability and feasibility. The overall sensitivity of the included screening tools was fairly good, whereas information on reliability and feasibility was lacking for most tools. In future research more attention should be given to these latter aspects.

Chapter 3, 4 and 5 address our second aim. Our research focused on the performance of the Maastricht Frailty Screening tool for Hospitalized Patients (MFST-HP). With this 15-item frailty tool, nurses can assess older patients at admission on 3 domains of frailty (physical, social and psychological). In our first study, aspects of reliability, validity and feasibility of the MFST-HP were explored in a sample of 79 consecutive patients. Reliability of the MFST-HP was fairly good; the Intraclass Correlation Coefficients for both intra- and inter-rater reliability were promising (ICC above .93). Older patients and those with more comorbidity showed higher scores on the MFST-HP compared to younger patients and those with less comorbidity. Due to a low administration time (averaged 2.6 minutes), and no need for extended training, we considered the MFST-HP as a feasible tool in nursing care.

In chapter 4 we describe a study on the predictive value of the MFST-HP for the health outcomes length of hospital stay, discharge destination, readmission and mortality. Data of 2691 hospitalized patients (70+) were included in the study. The predictive value of the MFST-HP was analyzed by means of receiver operating characteristics curves. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for different MFST-HP cut-off scores were examined.

Mean age of the population was 78,9 years (SD 6,4) and their average length of stay was 10,2 days (SD 9,7). Nearly 75,0% of the patients were discharged to their home and around. Approximately 25% of the patients were readmitted within 120 days. Mortality rates were 4,3% and 9,5% (within 30 or 120 days post discharge, respectively). The area under the curve was moderate and varied from 0,50 to 0,69 for the different outcomes. Due to high values on negative predictive value (between 73,5% and 96,7%) the MFST-HP showed to be able to rule out a large proportion of non-frail patients. In this study 84% of the patients had a MFST-HP score of ≥ 6, suggested as most favorable cut off.

The MFST-HP seems therefore to operate more strongly as a non-frailty indicator than as a frailty indicator and may in this respect help professionals to decide upon subsequent care. The MFST-HP was able to rule out 84% of the non-frail population in this study. The remaining 16% needs to be assessed by means of a more comprehensive geriatric assessment to gain more insight in the level of vulnerability in the frail-group.

In chapter 5 the MFST-HP was compared to the commonly used Dutch VMS hospital tool. The objective of the study was to examine the predictive properties of the brief Dutch National Safety Management Program for the screening of frail hospitalized older patients (VMS) and compare these with the more extensive MFST-HP. The VMS screening assesses patients on 4 domains (i.e. functional decline, delirium risk, fall risk, nutrition). Data of 2573 hospitalized patients (70+) were included and relative risks, sensitivity and specificity and area under the receiver operating curve (AUC) of both tools were calculated for discharge destination, readmissions and mortality.

Different proportions of frail patients were identified by means of both tools: 53.2% based on the VMS and 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 .50 to .76 and from .49 to .69 for the MFST-HP. We concluded that the predictive properties of the VMS and the more extended MFST-HP with regard to the screening of frailty among older hospitalized patients are poor to moderate and not very promising.

Chapter 6 addresses the third aim of this thesis. In this chapter, the impact of frailty screening on daily nursing care is reported.. Information about the opinions and attitudes of nurses about frailty screening is lacking, although they have a crucial role in conducting this screening. We performed an exploratory study to examine hospital nurses' opinions and perspectives about this screening and how it influences their daily work. A qualitative, exploratory approach was employed, using semi-structured interviews with 13 nurses working on different general medical wards (surgical and internal medicine) in three Dutch hospitals. Frailty screening had been implemented for several years in these hospitals.

The participating nurses reported that frailty screening might be useful to structure their work, it might create more awareness of frail older patients and it might be used as starting point for pro-active nursing care. Paradoxically, at the same time, they assessed their clinical view as more important than the results of a standard screening tool. The nurses hardly used the overall screening scores, but were particularly interested in information regarding specific items, such as delirium or fall risk. Furthermore, screening results are partly embedded in the daily nursing care process, e.g., in team briefings or during transfers of patients to other wards. The majority of the nurses had received little training about the background of frailty screening and the use of screening tools.

Although nurses stated that frailty screening tools may be helpful in daily practice, they did not use the frailty screening tools in the preferred way; tools were particularly used to evaluate patients on separate items of the tool instead of the summative score of the tool. Therefore, when frailty screening tools are implemented in daily practice, nursing staff should be involved from the beginning, become aware of the meaningfulness of this screening and get adequate training. Additional research in this field is necessary to gain more insight into nurses' perspectives and activities regarding frailty screening.

In chapter 7 we discuss our main findings for each of the three aims of this dissertation, including methodological reflections and implications for daily practice and future research. We concluded that nowadays plenty screening tools are available for daily practice, all with different (reported) psychometric properties. Our own developed tool did not perform better on predictive ability than the already known tools. Alternative and practical approaches on frailty screening , like the Clinical Frailty

Scale, should be explored in daily practice. And last but not least, when implementing these tools in daily practice, nurses should be involved right from the beginning; as they are the key figures in using these tools.

Samenvatting

Hoofdstuk 1 van dit proefschrift geeft een overzicht van de vergrijzende samenleving en de impact van veroudering op ziekenhuizen. De meerderheid van de ouderen wordt gezond oud, maar desondanks gaat veroudering ook gepaard met een verhoogd risico op een of meer chronische ziekten (multimorbiditeit) en secundaire beperkingen. In Nederland heeft bijna 50% van de 75-plussers meer dan één chronische aandoening. Dit heeft gevolgen voor hun gebruik van gezondheidsdiensten, waaronder ziekenhuizen. Ziekenhuizen worden steeds meer 'geriatrische instellingen' en in de dagelijkse praktijk heeft het verplegend personeel te maken met steeds meer oudere patiënten. Wanneer ouderen met acute gezondheidsproblemen in het ziekenhuis worden opgenomen, lopen ze het risico op snelle functionele achteruitgang, zowel tijdens hun verblijf in het ziekenhuis als na ontslag.

Kwetsbaarheid en functionele achteruitgang dragen bij aan negatieve gezondheidsuitkomsten op korte en lange termijn, zoals langdurig verblijf in het ziekenhuis, frequente heropname in het ziekenhuis, opname in een verpleeghuis en verhoogde mortaliteit. Daarom wordt een actieve aanpak bij het opsporen van kwetsbaarheid (screening) bij gehospitaliseerde oudere patiënten noodzakelijk geacht. Op basis van de uitkomsten van een kwetsbaarheidsscreening dient een zorgplan op maat met preventieve interventies te worden uitgevoerd.

Het doel van dit proefschrift is gericht op het screenen op kwetsbaarheid in de dagelijkse verpleegkundige zorg voor in het ziekenhuis opgenomen oudere patiënten. We hebben verschillende onderzoeken uitgevoerd met drie doelen: (1) het genereren van een overzicht van beschikbare screeningtools in ziekenhuizen en hun psychometrische eigenschappen, (2) het verkrijgen van informatie over de kwaliteit en bruikbaarheid van de door ons ontwikkelde screeningstool MFST-HP voor kwetsbaarheidsscreening bij ziekenhuisopname, en (3) het onderzoeken van meningen van ziekenhuisverpleegkundigen over het uitvoeren van screening op kwetsbaarheid.

In hoofdstuk 2 kwam het eerste doel aan de orde. Er is een systematische review uitgevoerd om screeningsinstrumenten voor kwetsbaarheid bij ouderen die zijn opgenomen in een ziekenhuis te identificeren en te beoordelen op validiteit, betrouwbaarheid en haalbaarheid.

Studies werden geïdentificeerd door middel van systematisch zoeken in de literatuur. Studies over screeningtools gericht op het identificeren van kwetsbare oudere patiënten in de ziekenhuiszorg, inclusief informatie over validiteit, betrouwbaarheid of haalbaarheid, werden in de review opgenomen. De kwaliteit van de geïncludeerde onderzoeken is kritisch beoordeeld via de Quality Assessment of Diagnostic Accuracy Studies (QUADAS).

Van de oorspronkelijk 2001 geïdentificeerde onderzoeken voldeden 32 onderzoeken aan de inclusiecriteria; hierin werden 16 verschillende screeningsinstrumenten gepresenteerd. De

screeningsinstrumenten vertoonden verschillende kenmerken met betrekking tot het aantal items, de wijze van toediening en de opgenomen domeinen. De meest bestudeerde instrumenten met betrekking tot voorspellende validiteit waren de Identification Seniors At Risk (ISAR) en Triage Risk Stratification Tool (TRST). Studies leverden slechte informatie op over betrouwbaarheid en feasibility. De ISAR, ISAR-HP (Identification Seniors At Risk Hospitalized Patienten) en Multidimensional Prognostic Index (MPI) hadden over het algemeen de beste sensitiviteit.

Voor de dagelijkse praktijk zijn veel frailty screeningsinstrumenten beschikbaar. Deze hulpmiddelen om kwetsbare oudere patiënten in de ziekenhuiszorg te identificeren, kunnen nuttig zijn. Er is echter nog geen duidelijk bewijs voor validiteit, betrouwbaarheid en feasibility. De algehele sensitiviteit van de opgenomen screeningtools was redelijk goed, terwijl informatie over betrouwbaarheid en feasibility voor de meeste tools ontbrak. In toekomstig onderzoek zou meer aandacht moeten worden besteed aan de laatste items.

In hoofdstuk 3, 4 en 5 kwam ons tweede doel aan de orde. Ons onderzoek richtte zich op de prestaties van het door ons ontwikkelde instrument, Maastricht Frailty Screening tool voor gehospitaliseerde patiënten (MFST-HP). In hoofdstuk 3 hebben we aspecten van betrouwbaarheid, validiteit en haalbaarheid van de MFST-HP onderzocht. De intra-beoordelaarsbetrouwbaarheid werd beoordeeld door dezelfde patiënt twee keer te meten binnen een interval van 24 uur. De inter-beoordelaarsbetrouwbaarheid werd beoordeeld door dezelfde patiënt te screenen door twee verschillende verpleegkundigen, geblindeerd voor elkaars MFST-HP-score. Constructvaliditeit werd bestudeerd door de associaties tussen de MFST-HP-scores en leeftijd en comorbiditeiten. De intraklasse-correlatiecoëfficiënten voor zowel intra- als interbeoordelaarsbetrouwbaarheid waren goed (ICC boven .93). Oudere patiënten en patiënten met meer comorbiditeit lieten hogere scores zien op de MFST-HP in vergelijking met jongere patiënten en patiënten met minder comorbiditeit. De gemiddelde afname tijd was 2,6 minuten (SD = 0,9) en de responslast onder patiënten was acceptabel. We concludeerden dat de MFST-HP een betrouwbaar, valide en praktisch screeningsinstrument was om kwetsbaarheid bij opgenomen oudere patiënten te meten. In hoofdstuk 4 is de MFST-HP uitgebreider beoordeeld. Het doel van deze studie was om de voorspellende waarde van de MFST-HP te bepalen voor de uitkomsten opnameduur, ontslagbestemming, heropname en mortaliteit. Gegevens van 2691 opgenomen patiënten (70+) werden in de studie meegenomen. De voorspellende waarde van de MFST-HP werd geanalyseerd door middel van area under the receiver operating curve. Sensitiviteit, specificiteit, positief voorspellende waarde (PPV) en negatief voorspellende waarde (NPV) voor verschillende MFST-HP cut-off scores werden onderzocht.

De gemiddelde leeftijd van de populatie was 78,9 jaar (SD 6,4) en hun gemiddelde ligduur was 10,2 dagen (SD 9,7). Bijna 75,0% van de patiënten werd naar de eigen woonomgeving ontslagen. Ongeveer 25% van de patiënten werd binnen 120 dagen opnieuw opgenomen. De sterftecijfers waren 4,3% en 9,5% (respectievelijk binnen 30 of 120 dagen na ontslag). Het AUC was matig en varieerde van 0,50 tot 0,69 voor de verschillende uitkomsten. Door hoge waarden op negatief voorspellende waarde (tussen 73,5% en 96,7%) kan de MFST-HP een groot deel van de niet-kwetsbare patiënten uitsluiten. In deze studie had 84% van de patiënten een MFST-HP-score van ≥ 6, wat wordt voorgesteld als de gunstigste afkapwaarde.

De MFST-HP lijkt sterker te werken als non-frailty screener dan een frailty screener; dit kan in dit opzicht professionals helpen om te beslissen over follow-up in zorg. De MFST-HP kan in dit onderzoek 84% van de niet-kwetsbare populatie uitsluiten. De overige 16% moet worden beoordeeld door middel van een uitgebreide geriatrische beoordeling of een snelle geriatrische beoordeling, om meer inzicht te krijgen in de mate van kwetsbaarheid in de kwetsbare groep. In hoofdstuk 5 werd de MFST-HP vergeleken met de veelgebruikte Nederlandse VMS-tool.

Het doel van het onderzoek was om de voorspellende eigenschappen van het beknopte National Safety Management Program voor de screening van kwetsbare gehospitaliseerde oudere patiënten (VMS) te onderzoeken en te vergelijken met de uitgebreidere MFST-HP.

De VMS-screening beoordeelt patiënten op 4 domeinen (functieverlies, deliriumrisico, valrisico en voeding). De 15-item MFST-HP beoordeelt patiënten op 3 domeinen van kwetsbaarheid (fysiek, sociaal en psychologisch). Gegevens van 2573 gehospitaliseerde patiënten (70+) werden opgenomen en relatieve risico's, sensitiviteit en specificiteit en oppervlakte onder de receiver operating curve (AUC) van beide instrumenten werden berekend voor ontslagbestemming, heropnames en mortaliteit.

Met beide instrumenten werden verschillende proporties kwetsbare patiënten geïdentificeerd: 53,2% op basis van de VMS en 16,1% op basis van de MFST-HP. De specificiteit was laag voor de VMS en de sensitiviteit was laag voor de MFST-HP. De totale AUC voor de VMS varieerde van 0,50 tot 0,76 en van 0,49 tot 0,69 voor de MFST-HP. We concludeerden dat de voorspellende eigenschappen van de VMS en de meer uitgebreide MFST-HP op de screening van kwetsbaarheid bij oudere ziekenhuispatiënten slecht tot matig zijn en niet erg veelbelovend.

In hoofdstuk 6 werd het derde doel van dit proefschrift behandeld. De impact van kwetsbaarheidsscreening op de dagelijkse verpleegkundige zorg werd gerapporteerd. Routinematige screening op kwetsbaarheid bij opname door verpleegkundigen kan nuttig zijn om geriatrische risico's en problemen in een vroeg stadium op te sporen. De meerwaarde van deze screening is echter nog

niet duidelijk. Ook ontbreekt informatie over de meningen en attitudes van verpleegkundigen ten aanzien van deze screening. Omdat zij een cruciale rol spelen bij het uitvoeren van deze screening, hebben we een verkennend onderzoek uitgevoerd om de meningen en perspectieven van ziekenhuisverpleegkundigen over deze screening en de invloed ervan op hun dagelijkse werk te peilen. Er is gekozen voor een kwalitatieve, verkennende benadering door middel van semi-gestructureerde interviews met 13 verpleegkundigen die werkzaam waren op verschillende algemene medische afdelingen (chirurgische en interne geneeskunde) in drie Nederlandse ziekenhuizen. In deze ziekenhuizen wordt al enkele jaren fragiliteitsscreening toegepast.

De deelnemende verpleegkundigen gaven aan dat kwetsbaarheidsscreening nuttig kan zijn om hun werk te structureren, meer bekendheid te geven aan kwetsbare oudere patiënten en als startpunt voor proactieve verpleegkundige zorg. Tegelijkertijd vinden ze hun klinische visie belangrijker dan de resultaten van een standaard screeningsinstrument. De verpleegkundigen maakten nauwelijks gebruik van de overall screeningscores, maar waren vooral geïnteresseerd in informatie over specifieke items, zoals delirium of valrisico. Screeningsresultaten worden deels systematisch en in de dagelijkse verpleegkundige zorg ingebed, bijvoorbeeld in teambriefings of bij overplaatsing van patiënten naar andere afdelingen. Het merendeel van de verpleegkundigen had weinig training gehad over de achtergronden van screening op kwetsbaarheid en het gebruik van screeningsinstrumenten.

De meeste verpleegkundigen geven aan dat screeningsinstrumenten voor kwetsbaarheid nuttig zijn in de dagelijkse praktijk. Verpleegkundigen gebruikten de instrumenten voor kwetsbaarheidsscreening echter niet op de genoemde manier; instrumenten werden met name gebruikt om patiënten te evalueren op afzonderlijke items van de tool in plaats van de summatieve score van de tool. Wanneer instrumenten voor het screenen van kwetsbaarheid in de dagelijkse praktijk worden geïmplementeerd, moet er aandacht zijn voor training. Aanvullend onderzoek op dit gebied is nodig om meer inzicht te krijgen in de mening van verpleegkundigen over kwetsbaarheidsscreening.

Impact

This dissertation describes studies that aimed: (1) to generate an overview of available hospital frailty screening tools and their psychometric properties, (2) to obtain information regarding the performance and usability of the Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP), and (3) to explore opinions of hospital nurses on conducting frailty screening in hospitalized older patients.

The current chapter reflects on the societal and scientific impact of this thesis, as well as the efforts made to disseminate the results.

Societal impact

As a result of the aging population, the number of older people will increase considerably in the Netherlands and the rest of the world in the coming years (1). This trend will also lead to more older persons with frailty, comorbidities and disabilities and therefore a growing group of older hospitalized patients.

Up to now, the care for this vulnerable group in the total care chain is not optimal (2). This also counts for the care they receive in hospitals, the focus of this thesis. In order to provide more tailored care for this target group, it is important for hospital staff to know which older patient is frail and which is not. This enables them to provide care in a more proactive way. The Dutch Council of Geriatricians (NVKG) e.g. considers the detection of frailty and associated risks as the starting point of personalized geriatric care (3).

Screening tools may help hospital staff to detect potentially frail older patients. This requires that valid (evidence based) and easy-to-use instruments for daily hospital care. In this thesis we reviewed the currently available frailty screeners for hospitalized older patients with particular attention for the Maastricht Frailty Screening Tool for Hospitalized Patients (MFST-HP).

It appeared that the optimal frailty screening tool is not available yet. For the Dutch context it can be doubted whether use of the current VMS tool, which has been implemented in many Dutch hospitals, should be continued. Given the moderate predictive value of the MFST-HP, investigated in this thesis, we would advise against (continuing of) using this tool in its current form for the detection of frail old people in hospital.

Our study on the perspective of nurses regarding frailty screening with the MFST-HP, Groningen Frailty Indicator (GFI) and Risk-score showed that they viewed a supporting screening tool as helpful. Paradoxically, they did not use the instrument appropriately, partly because they considered their own clinical view as more important. Moreover, it seemed that the implementation of these screening tools

in the three hospitals had several flaws. This implies the involvement of nurses from the early beginning in the process of development and implementation of these instruments.

Scientific impact

Our studies have shown that many frailty screening tools exist for daily hospital practice, but none of the current tools is perfect regarding to the different frailty outcomes. This also counts for our MFST-HP that rather seems to filter out non-frail patients instead of frail patients. These findings urge for more research towards a better screener. Future studies on the Clinical Frailty Scale (CFS), which was used in many hospitals all over the world during the Covid pandemic, could be promising in this respect.

Moreover, future studies should explore these instruments more from a care chain perspective, making it possible to validly assess an older person's frailty in different contexts (e.g. at home, in hospital, in long-term care, et cetera) and throughout the total care trajectory. Such studies might also look more broadly to the frailty balance, meaning that they do not only assess frailty but also resilience of people. This may enable better monitoring of older persons as well (4).

Our studies also underline the importance of adequate implementation of nursing (diagnostic) interventions and therefore there remains an additional need for implementation studies that might improve the evidence base of nursing care (6).

Activities for further dissemination

All studies in this dissertation have been published in peer-reviewed international scientific journals. The results have also been discussed at several national and international scientific and professional conferences, including the Annual Scientific Meeting of the Gerontological Society of America, IAGG World Congress of Gerontology & Geriatrics and the Dutch Geriatric Days (Geriatriedagen). Results have been made available for researchers and healthcare professionals via the World Wide Web in scientific and professional platforms.

Knowledge and skills regarding the care for frail older patients is important. We provided several trainings for hospital nurses of various hospital departments. In addition, lectures on frailty and frailty screening were provided in different nursing educational programs. Our results will be further incorporated in nursing education, among others in bachelor of nursing programs. Results of some studies were also discussed during an expert meeting of the Dutch Council of Nurses (V&VN in Dutch).

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Ron

About the author

Ron Warnier was born in Eijsden, the Netherlands, on March 17, 1970

He completed secondary school at Sint Maartenscollege in Maastricht. He received his propaedeutic year in Nursing at Zuyd University of Applied Sciences in Sittard in 1990 and graduated as a registrated nurse in 1997 at Maastricht University Hospital. In 2009, Ron received his Master's degree in Advanced Nursing Practice at Zuyd University of Applied Sciences in Heerlen.

In 2014, Ron started as a part-time PhD candidate at the department of Health Services Research at Maastricht University.

In his work as a specialized nurse in geriatrics and later on as Nurse Practitioner, Ron was involved in several projects in Elderly Care and care transitions. He was lead-developer of the Transmuraal Zorg Assessment Geriatrie Maastricht (TraZAG), an assessment tool for practice nurses in general practice, widely used in the Netherlands. In 2015, he received the "Van Lin Stimulerings Prijs", an award for nurses in the South of the Netherlands for his work in geriatrics.

Nowadays Ron is stationed as a Nurse Practitioner in Geriatric Rehabilitation Care at Vitala+, the centre of expertise for acute and short-term elderly care in Maastricht. Ron is a board member of the Dutch Geriatric Giants, an innovative, enduring regional Network for Nurses and Nursing –aides in elderly care in South Limburg, the Netherlands. He was also involved in organizing the "Geriatriedagen" (conference on geriatric care) on behalf of the Dutch Council of Gerontological Nurses (V&VN geriatrie / gerontologie) for many years.

Ron lives in Eijsden, with his wife and family. In his spare time, he runs a small craft Beer Brewery called The Breuster Brouwers in Eijsden.

LIVING LAB IN AGEING AND LONG-TERM CARE

LIVING LAB IN AGEING AND LONG-TERM CARE

This thesis is part of the Living Lab in Ageing and Long-Term Care, a formal and structural multidisciplinary network consisting of Maastricht University, nine long-term care organizations (MeanderGroep Zuid-Limburg, Sevagram, Envida, Cicero Zorggroep, Zuyderland, Vivantes, De Zorggroep, Land van Horne & Proteion), Intermediate Vocational Training Institutes Gilde and VISTA college and Zuyd University of Applied Sciences, all located in the southern part of the Netherlands. In the Living Lab we aim to improve quality of care and life for older people and quality of work for staff employed in long-term care via a structural multidisciplinary collaboration between research, policy, education and practice. Practitioners (such as nurses, physicians, psychologists, physio- and occupational therapists), work together with managers, researchers, students, teachers and older people themselves to develop and test innovations in long-term care.

ACADEMISCHE WERKPLAATS OUDERENZORG LIMBURG

Dit proefschrift is onderdeel van de Academische Werkplaats Ouderenzorg Limburg, een structureel, multidisciplinair samenwerkingsverband tussen de Universiteit Maastricht, negen zorgorganisaties (MeanderGroep Zuid-Limburg, Sevagram, Envida, Cicero Zorggroep, Zuyderland, Vivantes, De Zorggroep, Land van Horne & Proteion), Gilde Zorgcollege, VISTA college en Zuyd Hogeschool. In de werkplaats draait het om het verbeteren van de kwaliteit van leven en zorg voor ouderen en de kwaliteit van werk voor iedereen die in de ouderenzorg werkt. Zorgverleners (zoals verpleegkundigen, verzorgenden, artsen, psychologen, fysio- en ergotherapeuten), beleidsmakers, onderzoekers, studenten en ouderen zelf wisselen kennis en ervaring uit. Daarnaast evalueren we vernieuwingen in de dagelijkse zorg. Praktijk, beleid, onderzoek en onderwijs gaan hierbij hand in hand.

PHD-THESES LIVING LAB IN AGEING AND LONG-TERM CARE/ PROEFSCHRIFTEN ACADEMISCHE WERKPLAATS OUDERENZORG LIMBURG

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