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Feature Article

An integrative review on screening for frailty in acute care: Accuracy, barriers to implementation and adoption strategies

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ABSTRACT

Frailty is a multifactorial clinical syndrome associated with increased vulnerability to negative health-related outcomes including disease and disability. Many frailty screening tools are established for use in community settings with few for acute care. An integrative review methodology by Whittemore and Knafl, was adopted to summarise the reliability and validity of different frailty screening tools, barriers to implementation and adoption strategies in acute care settings. Thirteen relevant papers met the inclusion criteria. Validity and reliability of 14 screening tools were reported in 10 studies, whereas barriers identified in implementing frailty screening and potential adoption strategies were reported in 5 studies. Accuracy of screening tools require further improvement before use in hospitalized elderly. Strategies including the improvement of hospital guidelines and practices, promoting early involvement of stakeholders, and choosing a reliable and quick to administer screening tool can be implemented to help improve and facilitate early frailty screening in acute care.

Summary statement of implications for practice

What does this research add to existing knowledge in gerontology?

- There is a lack of established frailty screening tools for use in acute care settings
- Barriers identified included: hospital guidelines and practices, health care system, health care professional challenges, patients and caregiver factors.
- Potential strategies for successful frailty screening included improvement of hospital guidelines and practices, promoting early involvement of stakeholders, and choosing a reliable and feasible frailty screening tool.

What are the implications of this new knowledge for nursing care with older people?

- Strategies can be implemented to address the main barriers to help improve and facilitate early frailty screening in acute care settings.
- Using frailty screening tools with sufficient validity and reliability enable early interventions and optimize overall patient outcomes in acute care settings.

How could the findings be used to influence policy or practice or research or education?

- Future testing should include evaluation of the feasibility and applicability of the tools in a structured and standardized manner.
- It is essential to address barriers to frailty screening, including a knowledge gap of healthcare professionals, as well as educating patients and caregivers on the importance of frailty as a predictor of care outcome.

Background

Frailty is a unique multifactorial clinical syndrome among older people associated with increased vulnerability to negative health-related outcomes such as falls, decreased functional independence, lowered quality of life, long term institutionalisation and mortality.[1] Frailty is also associated with functional decline and increased health care utilisation cost. Common operational definitions of frailty include low muscle strength, overall slowness, reduced balance and

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mobility, exhaustion, and low physical activity.[1] Older people admitted to hospitals are known to be at high risk of functional decline given illness severity and pre-existing frailty.[2] Early recognition allows for timely interventions that may prevent or reduce the effects of frailty. In geriatric medicine, a comprehensive geriatric assessment (CGA) is commonly conducted to evaluate the health status of older people and to detect pre-disposing conditions that may result in frailty. The CGA is a systematic procedure which consists of multiple domains including somatic, functional and psychosocial.[3] Despite its established value and extensive use, conducting a CGA is both time-consuming and restrictive as it can only be administered by geriatricians or specialist nurses.[3] This brings about the shift in focus to tools which are able to screen elderly patients in a shorter time and accurately identify those who require further assessment and interventions.

Multiple screening tools have been developed over the years to identify frailty, which is based on different frailty models. However, definitions of frailty vary, and there is no known gold standard for frailty models or for frailty screening tool. Currently, the most referred to frailty models are the Cardiovascular Health Study (CHS) Phenotype model,[4] and the Canadian Study of Health and Ageing (CSHA) Cumulative Deficit Model.[5] These models measure various variables including disease and disabilities, weight loss, feelings of exhaustion, decrease in the pace of motion, strength as well as activity. Previous reviews conducted indicated a lack of a gold standard screening tool for frailty with few measures being valid and reliable, with most being conducted in the community settings.[1,2,6,7] There is also insufficient evidence at present to determine the best tool for use in research and clinical practice.[1,2,6,7] In this context, the validity of a frailty screening tool is of key importance to enable accurate identification of frail patients.[8] The validity of a screening tool is determined by its sensitivity, specificity, and area under receiver operating curve (AUC) level.[9] It is essential for a frailty screening tool to have high sensitivity to identify patients who are at risk of frailty as well as high specificity to reduce the number of patients who are incorrectly identified as frail and receive unnecessary assessment and interventions. The AUC of the screening tool refers to its degree of accuracy whereby a value of 1.0 indicating a maximum level of sensitivity and specificity, and a value of 0.5 indicated negative discriminative power of the tool. The predictive validity of the screening tools can also be determined with the odds ratios (OR) and relative risk (RR). The OR value represents the likelihood of an individual who is screened at risk to become frail when compared to others who is screened not at risk.[10] The reliability of a tool is commonly reported by the intra- and interrater reliability value, kappa (K). A K value of more than 0.75 represents an excellent agreement between assessors, whereas a value of less than 0.40 represents poor agreement.[11] In addition, Cronbach's alpha is utilised to determine the internal consistency of the tool with accepted values that range between 0.70 and 0.90.[11]

The previous reviews placed a great focus on the evaluation of the overall psychometric quality of the tools used in both acute care and community settings, with a lack of emphasis on the barrier to implementation and adoption strategies of screening tools. Failure in the implementation and adoption of research knowledge have been noted in many domains of health care.[12] By recognising the existence and importance of the barriers experienced in the implementation of frailty screening in the health care context can aid in the development and improvement of adoption strategies. Feasibility is a vital element which needs to be considered in the integration of measurement tools into daily clinical practice.[13] It involved the practicability of the tool itself, patients' understanding of the tool, as well as the adoption attitude of the health care professionals for implementation in an actual clinical setting.[14]

With an aging population, it is important to implement an accurate and efficient screening tool for frailty, and also facilitate the implementation and adoption of the tool to be used in daily practices. Effective screening tools can identify those who are frail and at risk of functional decline upon their admission to an acute hospital. Early recognition allows for timely interventions that may reduce the effects of frailty.

Aim

To evaluate the literature on the accuracy of different screening tools for frailty in acute care, identify barriers in the process of implementation, as well as potential strategies for successful adoption of frailty screening.

Design

An integrative review methodology was adopted, following the structured framework by Whittemore and Knafl.[15] The proposed framework incorporated 5 key phases including the formulation of the key issue, conducting of literature search, data evaluation and analysis, as well as the presentation of findings.

Search methods

The databases of PubMed, CINAHL and Cochrane were used to conduct the search. Key words used included: 'older people OR elderly people', frailty screening, functional decline, acute care, hospitalisation, feasibility, and implementation. The search was conducted in May 2018. Full texts were retrieved. References from each relevant article were searched manually to identify additional references of potential relevance. An overview of the process of studies selection is outlined in Fig. 1.

Search outcome

Inclusion criteria:

- Study participants were aged 65 years or above;
- Studies reported on validity and reliability of frailty screening tools in acute care settings;
- Studies that described the barriers to frailty screening;
- Studies that described strategies to implement frailty screening in acute care settings;
- Studies published in English language; and
- Studies published between 2007 and 2018.

Findings from included studies were processed in a systematic manner utilising the constant comparison approach.[15] In the initial data reduction process, key findings from the included studies were extracted and categorised into two main categories of the accuracy of the frailty screening tools found in acute care settings and barriers and potential strategies in the implementation of frailty screening. The findings were further classified into subcategories based on different screening tools. Details on screening tools and measured outcomes are displayed in Table 1 for clear data visualisation and comparison across studies. A summary of the frailty indicators of included screening tools is also provided in Table 2. An integrated summary of included studies is presented in discussion section to allow drawing conclusions on the accuracy of tools, barriers identified in process of implementation, as well as potential strategies for successful adoption of frailty screening in acute care settings.

Results

A total of 917 studies were identified. Thirteen of these met the inclusion criteria. Three were systematic reviews,[2,6,8] with the latest

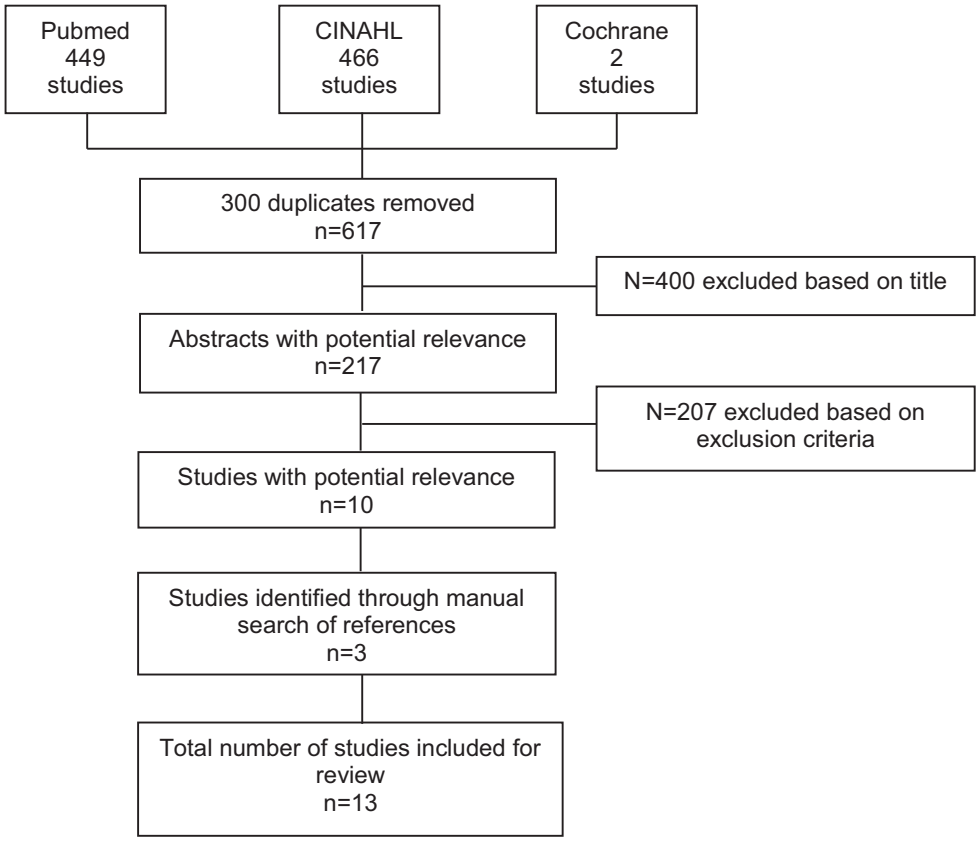

Fig. 1. Process of studies selection.

published in 2016,[8] 1 was an umbrella review published in 2017,[7] 2 were qualitative reviews,[16,17] and 7 were primary studies which were not included in the previous reviews.[18–24] A total of 14 frailty screening tools used in the acute care settings were included in this review. Accuracy of the screening tools was reported in 10 studies (Table 1),[2,6–8,18–23] whereas barriers identified in implementing frailty screening and potential adoption strategies were reported in 5 studies.[16–19,24]

The 14 tools reported in the systematic reviews and umbrella reviews included the hospital admission risk profile (HARP),[2,6,8] identification of seniors at risk (ISAR),[2,6–8] identification of seniors at risk-hospitalized patients (ISAR-HP),[8] reported Edmonton frail scale (REFS),[8] score hospitalier d'evaluation du risque de perte d'autonomie (SHERPA),[2,8] SPICES,[8] predictive index for functional decline by Inouye,[2,8] frailty index based on a comprehensive geriatric assessment (FI-CGA),[8] the multidimensional prognostic index (MPI),[8,23] and the modified multidimensional prognostic index (m-MPI).[8] Other more recently reported tools, which were not included in previous reviews are the Maastricht frailty screening tool for hospitalized patients (MFST-HP),[18,19] Think Frailty,[20] Veiligheids management systeem (VMS) tool,[21] and the Biopsychosocial frailty screening.[22]

Systematic reviews and umbrella review

Two systematic reviews, published in 2007 and 2010 focused on different predictors of frailty as well as screening instruments.[2,6] They compared the AUC of different screening tools including the hospital admission risk profile (HARP) [AUC 0.65], identification of seniors at risk (ISAR) [AUC 0.66] and score hospitalier d'evaluation du risque de perte d'autonomie (SHERPA) [AUC 0.73]. Sensitivity of tools reported ranged from 29% to 88% while specificity ranged from 45% to 98%. Older age, lower functional status and presence of disabilities pre-morbid, altered cognition and lack of social support presented as significant predictors of functional decline. The reviews concluded that, with the screening tools demonstrating a wide range of sensitivity and specificity, there was insufficient evidence to determine the best tool for use in research and clinical practice.[2,6]

An updated systematic review published in 2016 summarised 16 screening tools in the identification of frailty among older adults in hospital settings.[8] The sensitivity of the included tools ranged from 51% to 94%, whereas the specificity ranged from 21% to 79%. Authors concluded that the ISAR (Sensitivity 73% to 94%), ISAR-hospitalized patients (Sensitivity 81% to 89%), together with the Multidimensional Prognostic Index (MPI) [AUC 0.75 to 0.83] were identified to be most sensitive for use in the acute care settings.

An umbrella review published in 2017 included five reviews in the identification of predictive ability of frailty screening tools.[7] Only 1 review included in the umbrella review reported on the use of frailty screening tools acute care setting, while others reported the use of tools in the community settings. The predictive ability of the 13 screening tools included in this review was conducted in older patients admitted to the emergency department, including the ISAR. None of the tools showed sufficient evidence in rigour and sensitivity in assessing frailty appropriately and accurately.

Screening tools for frailty

Hospital admission risk profile (HARP)

The HARP was developed to identify elderly patients' risk of functional decline upon hospitalisation.[25] Patients were assessed of risk

Table 1
Summary of included studies and accuracy of screening tools in screening for frailty in acute care settings.

Name of tool/ Author	Outcomes										
	Hospital re-admission/ Emergency department re-visit	Length of hospital stay	Functional decline/ impairment	Nursing/ residential home admission	Mortality	Hospital adverse events	Validity				Reliability
							Sensitivity	Specificity	AUC	Risk ratio	
HARP		✓	✓	✓			–	–	0.65	–	–
Sager et al[25]			✓				Low risk: 60.5%	Low risk: 68.4%	Low risk: 0.56	–	–
Hoogerduijn et al[27]							Intermediate risk: 39.5%	Intermediate risk: 80.7%	Intermediate risk: 0.60		
							High risk: 31.1%	High risk: 88.6%	High risk: 0.56		
ISAR			✓				93%	39%	0.67	–	–
Hoogerduijn et al[27]		✓	✓	✓	✓		72%	58%	0.71	–	–
	✓		✓	✓	✓		–	–	–	Emergency re-admission OR 4.69	–
McCusker et al[26]										Hospital re-admission OR 2.07	
Salvi et al[29]											
Salvi et al[28]	✓		✓				94%	63%	0.92	Functional decline OR 2.98	
										Mortality HR 6.9	
										Emergency re-admission OR 2.48	–
										Hospital re-admission OR 2.69	
										Functional decline OR 1.65	
ISAR-HP	✓		✓	✓	✓		89%	41%	0.71	–	–
Hoogerduijn et al.[30]											
MFST-HP	✓	✓		✓	✓		–	–	–	–	Intra- and interrater reliability with intraclass correlation coefficient >0.93
Warnier et al[19]											
Warriner et al[18]											
	✓			✓	✓		Hospital re-admission 3.7 to 50.5%	Hospital re-admission 49.3 to 93.9%	0.50 to 0.69	–	–
							Admission to nursing home 10.0 to 64.9%	Admission to nursing home 54.1 to 95.6%			
							Mortality 15.2 to 77.7%	Mortality 50.5 to 94.7%			
REFS			✓				–	–	–	–	-Inter-rater reliability 0.84
Hilmer et al[31]											-Internal validity (Cronbach's alpha = 0.68)
SHERPA			✓				–	–	0.64	–	–
De Brauwer et al[33]			✓				67.9%	70.8%	0.73	–	–
Cornette et al[32]											
	✓				✓	✓	–	–	–		–

(*continued on next page*)

Table 1 (*Continued*)

Name of tool/ Author	Outcomes										
	Hospital re-admission/ Emergency department re-visit	Length of hospital stay	Functional decline/ impairment	Nursing/ residential home admission	Mortality	Hospital adverse events	Validity				Reliability
							Sensitivity	Specificity	AUC	Risk ratio	
SPICES Aronow et al[34]										Hospital re-admission OR 1.24 Mortality OR 1.03 Adverse hospital events OR 3.04	
Think Frailty Drummond et al[39]			✓				100%	84.8%	–	–	–
VMS tool Heim et al[21]			✓	✓	✓		68%	74%	0.58–0.66	RR 2.60 to 3.53	–
Predictive index Inouye et al[40]			✓	✓	✓		–	–	–	Functional decline High risk: RR 12.9 (83%) Intermediate risk: RR 4.6 (29%) Low risk: RR 1.0 (6%) Nursing homeadmission/death High risk: RR 6.9 (67%) Intermediate risk: RR 3.3 (32%) Low risk: RR 1.0 (10%)	–
FI-CGA Evans et al[36]		✓		✓	✓		–	–	–	Mortality RR 0.59 with FI-CGA >0.65	Test-retest reliability 0.78
MPI					✓		–	–	0.751	–	–
Pilotto et al[41] Volpato et al[23]		✓			✓		–	–	–	Mortality Moderate-risk: HR 3.48 Severe-risk: HR 8.31	–
m-MPI Sancarlo et al[38]					✓		–	–	0.748 to 0.7097	–	–
Biopsychosocial Screening Lekan et al[22]	✓				✓		–	–	0.66	Mortality HR 1.77–2.27 *Re*-admission -OR 1.18	–

OR = Odds ratio; RR = Relative risk; HR = Hazard ratio.

Table 2
Summary of frailty indicators.

Name of tool/Author	Frailty Indicators								
	Dependence in basic activities of daily living	Polypharmacy	Bladder incontinence	Mobility status pre-admission	History of falls	Delirium	Cognition	Admission from Nursing/residential home	Others
HARP Sager et al[25] Hoogerduijn et al[27]	✓		✓				✓		- Age
ISAR Hoogerduijn et al[27] McCusker et al[26] Salvi et al[29] Salvi et al[28]	✓	✓	✓	✓			✓		- Impaired memory - Vision - Recent hospitalisation episode
ISAR-HP Hoogerduijn et al[30]	✓	✓	✓	✓			✓		- Impaired memory - Vision - Recent hospitalisation episode - education level
MFST-HP Warnier et al[18] Warnier et al[19]	✓	✓		✓	✓	✓	✓		- Weight loss - Skin integrity - Vision and hearing impairment - Behaviour issues - Loneliness - Depressive symptoms - Caregiver burden
REFS Hilmer et al[31]	✓	✓	✓	✓			✓		- Nutrition - Recent hospitalisation episode - Social support - Mood
SHERPA De Brauwer et al[33] Cornette et al[32]	✓			✓	✓		✓		- Age - Poor self-rated health
SPICES Aronow et al[34]			✓		✓	✓			- Skin integrity - Nutrition - Altered sleep disturbance
Think Frailty Drummond et al[39]	✓	✓			✓	✓		✓	
VMS tool Heim et al[21]	✓				✓	✓			- Nutrition
Predictive index Inouye et al[35]	✓						✓		- Skin integrity - Social activity level
FI-CGA Evans et al[36]			✓					✓	
MPI Pilotto et al[37] Volpato et al[23]	✓	✓	✓	✓			✓	✓	- Social support - Nutrition - Skin integrity - Co-morbidities
m-MPI Sancarlo et al[38]	✓	✓					✓	✓	- Skin integrity - Co-morbidities - Nutrition
Biopsychosocial Screening Lekan et al[22]	✓								

Table 3
Summary of the feasibility of screening tools.

	HARP[25,27]	ISAR[26–29]	ISAR-HP[30]	MFST-HP[18,19]	REFS[31]	SHERPA[32,33]	SPICES[34]	Think Frailty[20]	VMS tool[21]	Predictive index[35]	FI-CGA[36]	MPI[23,37]	m-MPI[38]	Biopsychosocial Screening[22]
Administration time (in minutes)	–	–	–	< 3	< 5	–	–	–	–		20–30	30–40	25–35	–
Instructions provided on administration	✓	✓	–	✓	✓	–	–	–	–		–	–	–	–
Training required for administration	–	–	–	✓	✓	–	–	–	✓	–	–	–	–	–
Availability of tools	✓	✓	✓	✓	✓	✓	✓		–	✓	✓	–	–	–

of developing new disabilities in their activities of daily living functions (bathing, dressing, transferring, walking, toileting and eating) during hospitalization and three months after discharge. The 25-items instrument aimed to stratify patients into low, intermediate and high-risk categories of functional decline. Those who were identified as high risk (i.e. increasing age, lower admission Mini-Mental Status Exam scores, and lower pre-admission instrumental activities of daily living (IADL) function) had subsequent increased in functional decline (Chi-square = 47.9, $p < 0.001$). The area under the receiving-operating characteristic curve (AUC) was found to between 0.56 to 0.65, demonstrating moderate predictive ability.[25] The HARP reported fairly weak sensitivity (21%) but good specificity (89%), indicating a need for improvement in its discriminative ability.

Identification of seniors at risk (ISAR)

Identification of Seniors At Risk (ISAR) was used to identify patients in the emergency department (ED) who were of increased risk of adverse health outcomes.[26] It consisted of six self-report questions with either yes or no responses namely: functional status (premorbid) and acute change in functioning, recent hospitalisation, impaired memory, vision, and polypharmacy. The tool was validated in a few studies,[8] indicating good sensitivity (72% to 94%) but weaker specificity (39% to 58%).[26–28] ISAR was established as a significant predictor of mortality (hazard ratio = 6.9, 95% CI = 1.65 - 29, $p = 0.008$), frequent ED readmissions (OR = 4.69, 95% CI = 1.29 – 17.05, $p = 0.018$), hospital admissions (OR = 2.07, 95% CI = 1.02 – 4.20, $p = 0.043$), as well as functional decline (requiring long term care placement) (OR = 2.98, 95% CI = 1.23 – 7.20, $p = 0.016$) during a 6 months period after an ED visit.[29] The AUC was found to be 0.67, demonstrating moderate predictive ability.[27]

Identification of seniors at risk-hospitalized patients (ISAR-HP)

The ISAR was subsequently modified for use to assess the risk of functional decline among older patients during acute hospitalisation.[30] Out of the 8 variables assessed, those that were predictive of functional decline, including: require regular assistance in instrumental activities daily of living before admission, use of own walking device, require aid in traveling and no education after age 14. The sensitivity and specificity of the ISAR-HP were tested to be 89% and 41% respectively.

Maastricht frailty screening tool for hospitalized patients (MFST-HP)

The MFST-HP is a modified hospital version of the TraZAG tool which is a tool commonly used in Dutch primary care settings. This tool was developed to evaluate the risk of frailty among hospitalized adults above 70 years old.[19] This modified tool contained 15 items with yes or no responses, encompassing three domains of physical, psychological and social. A higher MFST-HP score indicate a higher level of frailty. The items of MFST-HP focused on elderly patients' activities of daily living, instrumental activities of daily living, nutrition, mobility and fall risk, incontinence issue, medication, vision and hearing, cognition, delirium, depression and pressure injuries. The MFST-HP demonstrated good intra- and interrater reliability with intra class correlation coefficient (ICC) of >0.93.[19] The MFST-HP was tested for its predictive ability in determining the length of hospital stay, discharge destination, readmission, and mortality.[18] The AUC was found to be moderate for the different outcomes (0.50 to 0.69). The tool reported high negative predictive value (between 73.5% and 96.7%) in identifying patients who were not frail. Discriminant validity was demonstrated with higher scores in older patients who were 76 years and older ($p = 0.04$) and in those with increased

co-morbidities ($p = 0.05$). Overall, the MFST-HP was considered a reliable tool for screening of frailty among hospitalized older adults.

Reported Edmonton frail scale (REFS)

The 13-item screening instrument was modified from the Edmonton Frail Scale which was initially implemented in both inpatient acute care and outpatient rehabilitation, and clinics.[31] The REFS was developed for frailty screening among hospitalized adults aged over 70 years in Australia and to be carried out by non-geriatricians. The adapted tool included 8 frailty domains namely: cognition, overall health status, functional independence, social support, polypharmacy, nutrition, mood, continence, and self-reported activity level. The REFS was validated against the Geriatrician's Clinical Impression of Frailty (GCIF), Mini-Mental State Examination score, the Charlson Comorbidity Index (CI) and the Katz Daily Living Scale. Correlation were found between REFS and GCIF ($R = 0.61$, $p < 0.01$), Charlson CI Index ($R = 0.51$, $p < 0.001$) and Katz Daily Living Scale ($R = 0.51$, $p < 0.001$). Excellent inter-rater reliability was reported (kappa = 0.84) with moderate internal reliability (Cronbach's alpha = 0.68).

Score hospitalier d'evaluation du risque de perte d'autonomie (SHERPA)

SHERPA is another screening tool developed and used to identify older hospitalized patients who are at risk of functional decline 3 months after discharge.[32] The instrument comprised five domains: age, impairment in premorbid instrumental activities of daily livings, history of fall before admission, cognitive ability, and self-perceived health. A tabulated score served to stratify patients into high, moderate, mild and low-risk groups for risk of functional decline. The tool was first developed and tested among patients in a general hospital in Belgium. Results showed moderate sensitivity (67.9%) and specificity (70.8%). SHERPA demonstrated good intra- and inter-reliability with ICC 0.961 and 0.995.

The predictive ability of SHERPA was re-evaluated with added predictive factors including demographic, comorbidity and laboratory data.[33] As compared to initial testing, SHERPA's ability to predict functional decline 3 months after discharge dropped, even after re-adjustment. The predictors for functional decline remained the same as the 2009 cohort, as the discrimination ability was not further improved with any additional variables. The discriminative ability of SHERPA, however, was found lower in the 2009 sample, as compared previous sample (AUC 0.64 versus AUC 0.73, $p > 0.10$).

*SPICES (Acronym for **s**kin integrity; **p**roblems eating; **i**ncontinence; **c**onfusion; **e**vidence of falls; and **s**leep disturbance)*

SPICES is a brief screening protocol recommended and commonly used by nurses in the Nurses Improving Care for Healthsystem Elders (NICHE) network in USA.[34] SPICES consisted of six risk factors related to caring for older adults namely: skin integrity; eating issues; incontinence; confusion; history of falls; and sleep disturbance. The validity of the protocol was tested among elderly patients above 65 years old admitted in the acute care hospitals within 24 h, against three other measures including the Vulnerable Elders Survey (VES-13), Charlson CI and Patient Health Questionnaire 2 (PHQ-2). The association between SPICES and adverse outcomes including adverse hospital outcomes, re-admission, and mortality were also reported. SPICES demonstrated high correlation with VES-13 (Rho = 0.559, $p < 0.001$), Charlson CI (Rho = 0.250, $p = 0.001$), age (Rho = 0.347, $p < 0.001$) and PHQ-2 (Rho = 0.259, $p = 0.002$). SPICES demonstrated significant association with the occurrence of hospital adverse events, a patient who scored positive on two or more of the SPICES criteria, were 3 times more likely to suffer from hospital-acquired pressure injuries and infections, treatment associated complications and drug reactions (OR = 3.04, 95% CI = 1.527 - 6.054, $p = 0.001$). Overall, the SPICES demonstrated validity in screening for risks which were related to hospital adverse outcomes.

Think frailty

A frailty triage tool from Healthcare Improvement Scotland (HIS) was used to conduct early screening for all admitted patients who were 75 years old and above, and for those above 65 years who were current nursing home residents or admitted from community hospital.[20] The tool aimed to identify those with a high risk of frailty and initiate early referral to geriatric specialty team for further comprehensive geriatric assessment (CGA). The tool included elements of polypharmacy, functional impairment, history of falls, presence of delirium and staying at nursing homes pre-admission. This tool demonstrated good sensitivity (100%) and specificity (84.8%) in identifying frailty patients who require further assessment and referral to geriatric specialists.[20]

Veiligheids management systeem (VMS) tool and VMS±

This tool was developed by members of the Dutch Safety Management Programme Veiligheids Management Systeem (VMS).[21] Older patients above 70 years old were screened for risk of functional decline by evaluating their activities of daily living, history of falls, as well as weight loss and delirium. A VMS total score ranging from 0 to 4 is obtained by adding up the four domains. To evaluate its validity, the VMS tool was tested alongside the ISAR, the 6-item Cognitive Impairment Test and the Mini-Mental State Examination. It was found that the VMS tool had moderate predictive power (AUC 0.58–0.66) and it had the highest score on ≥3 VMS domains in patients aged ≥ 70 years. It also scored positive on ≥1 VMS domains. The prediction power of the tool was later enhanced with a subsequent combination of age to the VMS; i.e. the VMS+ screening tool. This tool demonstrated a moderate sensitivity of 68% and a specificity of 74% with identification of 34% of the patients as frail (AUC 0.71) at the three-month follow-up. Overall, the VMS tool with age (VMS+) enabled identification of elderly who were at risk for functional decline and mortality.[21]

Predictive index for functional decline

The predictive index was developed and tested among hospitalised patients above 70 years old hospitalised in medical wards of a university teaching hospital in Connecticut.[35] The index considered the presence of decubitus ulcer; cognitive impairment; functional impairment; and low social activity level. One point was given to each identified risk factors. Patients were classified as low-risk if they had no risk factor, intermediate-risk if they had one to two risk factors, and high-risk category if they had three to four risk factors. Rates of functional decline for the low-, intermediate-, and high-risk groups were 8%, 28%, and 63%, respectively ($p < 0.0001$). Among the validated cohort (24%), the rates of developing functional decline were 6%, 29%, and 83% ($p < 0.0001$).

Frailty index based on a comprehensive geriatric assessment (FI-CGA)

FI-CGA was a 55-item screening tool derived from the CGA in the assessment of hospitalised geriatric patients, 75 years and above.[36] The geriatrician tabulated the frailty index score from CGA data in the patient records. The scores were categorised into 5 FI-CGA groups: <035; 0.35 to 0.45; 0.45 to 0.55; 0.56 to 0.65; and > 0.65. Testing of the predictive validity of FI-CGA with increased scores demonstrated a significant association with increased days of hospitalisation, higher risk of mortality and less likely to be discharged

home. Those with FI-CGA >0.65 had a 60% risk of 120 days mortality (95% CI = 42 – 78).

Multidimensional prognostic index (MPI)

In another index derived from CGA, the Multidimensional Prognostic Index (MPI) was first used to screen patients over 65 years admitted to acute Geriatric wards in Italy.[37] The 63-item MPI focused on 6 different domains of cognition, functional, nutritional, clinical status, polypharmacy and presence of social support. Scores are categorised into three groups: MPI-1 (low); MPI-2 (intermediate); and MPI-3 (high). Similarly, findings reported a significant association between higher MPI scores and mortality rate ($p < 0.001$). Overall, the MPI demonstrated good sensitivity with an AUC of 0.751 (95% CI 0.70–0.80) at 6 months and 0.751 (95% CI 0.71–0.80) at 1-year follow-up. The MPI was further evaluated for its ability to predict the length of hospital stay and intra-hospital mortality in elderly patients.[23] Patients are classified into three groups with the low-risk group scoring $\leq$ 0.33, moderate-risk group scoring 0.34–0.66 and severe-risk group scoring $\geq$ 0.67. Results demonstrated a higher risk of mortality among the moderate-risk group with a hazard ratio of 3.48 (95% CI 1.02–11.88) and the severe-risk group with a hazard ratio of 8.31 (95% CI 2.54–27.19) ($p < 0.0001$). The reported length of stay was 11.29 in the low-risk group, 13.73 in the moderate-risk group and 15.30 in the severe-risk group ($p < 0.0001$).

Modified-multidimensional prognostic index (m-MPI)

The MPI was further modified to a shorter version (51 items) by replacing the standard Mini Nutritional Assessment with the MNA-Short Form (MNA-SF).[38] Both MPI and m-MPI scores had a significant correlation with higher mortality rates during both 1 month and 1-year follow-up. MPI had an odd ratio of 3.17 ($p < 0.01$) at 1 month and 2.77 ($p < 0.01$) at 1 year. The m-MPI had an odd ratio of 3.18 ($p < 0.01$) at 1 month and 2.82 ($p < 0.01$) at 1 year. Overall, the shorter 51 item m-MPI was able to demonstrate similar sensitivity as compared to the 63 items MPI with an AUC of 0.74 at 1 month and 0.7097 at 12 months in predicting the risk of short- and long-term mortality.[38]

Biopsychosocial frailty screening

In a more recent study, frailty screening was conducted via electronic health records (HER).[22] Sixteen risk factors were retrieved to generate a frailty risk score (FRS), including lethargy, loss of muscle strength, breathlessness, chronic pain, falls, vision issues, urinary continence and nutritional status, the risk factors: C-reactive protein, albumin, haemoglobin and white blood cell count. Results showed a significant correlation between an increased FRS and higher mortality rate for those with stayed between 3 and 7 days (inclusive) in the hospital ($p < 0.001$). There was only a slight association between frailty and re-admission for those who did not die in hospital with an AUC 0.66 ($p = 0.086$). Authors concluded that electronic health records possess essential patient clinical data that could potentially aid in effective frailty screening.[22]

Barriers to implementation and adoption strategies

Two qualitative reviews,[16,17] and one study,[24] reported on barriers to frailty screening and suggested strategies to enhance effective implementation and adoption into daily practices in the clinical setting.

Barriers to implementation of effective frailty screening can be summarised into three main categories: institution related including hospital practices and health care system function; health care professional challenges; and patients and caregiver factors.[24] Hospital-related barriers to frailty screening referred to existing guidelines and practices which included overwhelming workload and staff shortages, lack of incentives and resources including equipment and physical space, difficulties in coordination of patient care among the multidisciplinary team.[16,17,24] Whereas health system barriers referred to broader health care goals which placed emphasis for early patient discharge in acute care setting, resulting in insufficient time and focus on frailty screening. At the same time, insufficient follow-up support services and step-down care also poses a challenge in the geriatric context.[24] Lack of professional knowledge and understanding about the importance of frailty and screening was another significant barrier.[16,24] Nurses and allied health professionals were found more likely to perceive the importance of frailty assessment in the care of older patients as compared to surgeons. Use of a frailty screening tool was also not commonly reported.[24] This may be due to the surgical team being more focused on patients' acute conditions, instead of the holistic care of older patients.[16] Inadequate education and communication with patients and caregivers was also highlighted.[16,17] The lack of awareness and knowledge of frailty, as well as the involvement in care of frail older adults, led to poor compliance and resulted in challenges in overall patient care and delayed hospital discharge.

Potential strategies included the improvement of existing hospital guidelines and practices, promoting early involvement of stakeholders upon hospital admission,[16] and choosing a reliable and quick to administer frailty screening tool in acute environments.[24] The perception of frailty together with the attitudes towards screening practices for frail older adults among the health care professionals need to be improved.[24] Frailty screening should be regarded as one of the care priorities and integrated into the routine care of all geriatric patients, instead of just a refer as necessary process.[16] Additional frailty screening training can be conducted to enhance the competency and confidence of health care professionals in their care of frail patients.[24]

Main stakeholders including the multidisciplinary team of health care professionals, patients and their caregivers should be involved from the time of hospital admission. Early involvement of the multidisciplinary team in the practice of routine frailty screening in acute care settings will improve collaboration and communication in sharing essential patients' information to develop holistic patient care goals.[16,17] Effective sharing of information without duplication and omissions through designated portal in the electronic patient records can also enhance the adoption rate of screening.[17] Involvement of other stakeholders including patients and caregivers through education and dissemination of the importance of frailty screening can improve awareness.[16,17]

The choice of a reliable and efficient screening tool to be adopted successfully into daily practices in the acute health care context depends on the feasibility of the tool. A tool is considered highly feasible with a short administration time, minimum health care professional training required to administer the tool, ready availability of both the tool itself and the instructions required to complete the tool which can be printed in text, attached as an appendix or available online.[8] Overall feasibility of the included screening tools is summarised and outlined in Table 3 to evaluate their practicability to be implemented and adopted into daily practices. The MFST-HP,[19] and VMS tool,[21] reported some form of instructions on instrument administration. Only the MFST-HP, REFS, FI-CGA, MPI and m-MPI provided measurements of average time needed for administration. The 15-items MFST-HP had the shortest administration time of 2.6 min and patients provided feedback that the completion of MFST-HP was not burdensome at all and the length of the screening tool was not long.[19] Another screening tool with a relatively short administration time was the 13-items REFS, which can be completed within 5 min.[31] On the other hand, the 55-items FI-CGA required an average of

25 min (range of 20 to 30 min) of administration time as a geriatrician is required to tabulate the frailty index score from patient health records.[36] The 63-items MPI took an average of 30 min (range of 30 to 40 min) of administration and assessment time.[37] The 51-items m-MPI took an average of 25 to 35 min to complete.[38] It was highlighted that screening with MFST-HP saves time as data from medical records was not required.[19] In addition, if the patient was unable to respond to items, caregivers could also provide the response. The MFST-HP can also be integrated readily into routine admission assessment. The 6-items ISAR is relatively easy to use with dichotomous responses (either yes or no), requiring a minimal amount of effort from nurses.[8,34,35] On the other hand, most of the screening components included in SPICES were already included in the admission nursing assessment and could be easily added in to enable identification of patient care needs for further care interventions.[25] The ISAR, HARP, SHERPA, REFS, SPICES, Predictive index for functional decline, MFST-HP and VMS tool can be administered by nurses or non-medically trained staff. With the use of electronic records, results of MFST-HP screening can be auto-tabulated and linked to patient's nursing care plan records. Only VMS tool needs to be administered by trained nurses. With the exception of the MPI, m-MPI and VMS tool, most screening tools are freely available online.

Discussion

While many screening tools for frailty have been described to identify those who are at high risk of functional decline, there were no established operational definitions or gold standard evaluation methods. This review aimed to provide a summary of the predictive validity of various screening tools available as well as highlighting the various barriers to effective implementation and outlining potential strategies of successful adoption of frailty screening in the clinical settings. It is essential and critical to have an accurate screening tool which is quick in detecting frail older people in the acute care settings during initial admission; who could benefit from a more comprehensive assessment either by the geriatric nurse practitioners or specialists.

Although the predictors associated with frailty are considered essential in the development of preventive interventions, operationalization of frailty factors has been a challenge as definitions of frailty differ across various settings.[1,2] In general frailty encompassed three key domains: the physical, psychological and social dimension.[1] The identified frailty indicators highlighted in various frailty screening tools in this review included dependence in basic activities of daily living, polypharmacy, bladder incontinence, mobility status pre-admission, history of falls, delirium, cognition, and admission from nursing or residential home. Other measured predictors included age, impaired vision, hearing and memory, nutrition, depression, skin integrity, adverse hospital events and recent hospitalisation episode.

This review reported 14 screening tools which are used in acute care to identify older people who are at risk of frailty and adverse outcomes. Only seven tools reported on their sensitivity and specificity (HARP, Think Frailty, ISAR, ISAR-HP, MFST-HP, SHERPA and VMS tool). The Think Frailty triage tool, MFST-HP, and ISAR appeared to have the highest sensitivity with 72 to 94%. The overall specificity of the tools had a lower range from 39% to 95.6%. The reported AUC ranged from 0.56 to 0.92, with ISAR having the highest value of 0.92.

Early frailty screening can be impeded by multiple factors including institutional and broader health care system, health care professionals, as well as patients and caregivers. Recognising the existence and importance of the various challenges experienced in the health care context can enhance the successful rate of implementing and adopting of frailty screening. Several strategies can be undertaken to enhance the effectiveness of adoption of frailty screening, including improvement of hospital guidelines and practices, promoting early involvement of multidisciplinary team, patients and caregivers, as well as selecting a reliable and quick to administer frailty screening tool in acute environments.

For a tool to be deemed useful and feasible to be implemented in the clinical context, it is essential that it does not take too much time to complete and can be carried out easily by different healthcare professionals who are caring for the patients.[23] One of the benefits of MFST-HP and SPICES was their ability to be integrated into routine nursing assessment enhancing their feasibility in daily practice, reducing the administrative burden for nurses. The MFST-HP had the shortest administration time which does not require data from medical records and either the patients or caregivers could respond to the items. The FI-CGA, MPI, and m-MPI, which require a comprehensive assessment by a geriatrician would require a much longer screening time. On the other hand, the biopsychosocial assessment frailty screening in Lekan's study,[22] proposed a practical and clinically relevant approach to identify those who are at risk of functional decline by utilising existing data from electronic hospital records.

Limitations

This integrative review has some limitations. A broad search strategy had been undertaken in this review with an attempt to retrieve all relevant and updated studies between 2007 and 2018, but there are possibilities that some studies may be missed out. Furthermore, the literature sample included only American and European publications, users are encouraged to evaluate the transferability to practice and research.

Conclusion

In conclusion, frailty screening requires a tool which is both valid and reliable in order to accurately identify frail older people in the acute care settings during initial admission. Among the reviewed screening tools, the MFST-HP demonstrated both validity and reliability among hospitalised older patients – this tool contains a comprehensive assessment of 15 frailty indicators covering the physical, psychological and social domains. The MFST-HP was also an ideal tool for screening patients within a short time frame, enabling a rapid assessment. For hospitalised older patients who require a more thorough assessment of health status, the FI-CGA demonstrated sufficient validity and reliability, but required a longer administration time. Finally, the biopsychosocial assessment frailty screening may offer a potentially quick and effective screening approach through automatic tabulation of frailty risk score of those who are at risk of functional decline upon hospitalisation. Future testing of the frailty tools in the clinical setting is required to establish their feasibility and applicability. At the same time, it is vital to recognise and mitigate the impact of existing barriers in current health care system to effective implementation of frailty screening. Various strategies can be undertaken to further improve the effectiveness of adoption of frailty screening in the acute care settings.

Conflict of interest statement

The authors have no conflict of interest to disclose.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.gerinurse.2019.06.005.

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