

REVIEW

A systematic review of predictors and screening instruments to identify older hospitalized patients at risk for functional decline

Jita G Hoogerduijn MScN, RN

Research and Development Fellow, Faculty Chair for Chronically ill, Faculty of Health care, Hogeschool Utrecht, Utrecht, The Netherlands

Marieke J Schuurmans PhD, RN

Associate Professor in Care for Older Persons, Faculty of Health care, Hogeschool Utrecht, Utrecht, The Netherlands

Mia SH Duijnste PhD, RN

Professor in Nursing Science, Faculty of Health care, Hogeschool Utrecht, Utrecht, The Netherlands

Sophia E de Rooij MD

Department Head Geriatric Medicine, The Academic Medical Centre, Department of Internal Medicine, Amsterdam, The Netherlands

Mieke FH Grypdonck PhD, RN

Professor in Nursing Science, The Department of Nursing Science, Utrecht University, Utrecht, The Netherlands

Submitted for publication: 1 June 2005

Accepted for publication: 16 December 2005

Correspondence:

Jita G Hoogerduijn
Faculty Chair for Chronically ill
Hogeschool Utrecht
Bolognalaan 101
3584 CJ Utrecht
The Netherlands
Telephone: +31-30-258-52-01
E-mail: jita.hoogerduijn@hu.nl

HOOGERDUIJN JG, SCHUURMANS MJ, DUIJNSTEE MSH, DE ROOIJ SE & GRYPDONCK MFH (2007) *Journal of Clinical Nursing* 16, 46–57

A systematic review of predictors and screening instruments to identify older hospitalized patients at risk for functional decline

Aims and objectives. To determine a valid, reliable and clinical user-friendly instrument, based on predictors of functional decline, to identify older patients at risk for functional decline. The predictors of functional decline are initially considered and, subsequently, the characteristics and psychometric qualities of existing screening instruments are investigated.

Background. Functional decline is a common and serious problem in older hospitalized patients, resulting in a change in quality of life and lifestyle. Studies have shown that 30–60% of older people develop new dependencies in activities of daily living (ADL) during their hospital stay. Adverse health outcomes such as mortality, a prolonged hospital stay, nursing home placement and increased dependency of older people at home are the results. Not only are the personal costs high but also, in a rapidly growing older population, the impact on health-care costs is also high.

Results. Age, lower functional status, cognitive impairment, preadmission disability in instrumental activities of daily life (IADL), depression and length of hospital stay were identified as predictors of functional decline. Three screening instruments to

identify hospitalized patients at risk for functional decline were found in the literature: the Hospital Admission Risk Profile, the Identification of Seniors at Risk and the Care Complexity Prediction Instrument. The reported validity was moderate. Reliability and the ease of use in the clinical setting were not well described. **Conclusion.** These three instruments should be further tested in a hospitalized older population.

Relevance to clinical practice. Screening is a first step to identify patients at risk for functional decline and this will make it possible to treat patients who are identified so as to prevent functional decline. Because of their ability to observe and to guide the patients and the overall view they have, nurses play a key role in this process.

Key words: elderly, functional decline, hospitalization, nurses, risk assessment instruments, screening

Introduction

Functional decline is a common and serious problem in older hospitalized patients, resulting in a change in quality of life and lifestyle. Many patients of 65 years and older suffer functional decline related to hospitalization and acute medical illness. Studies have shown that almost 30% of older people develop new dependencies in activities of daily living (ADL) during their stay in an acute hospital ward (McVey *et al.* 1989, Sager *et al.* 1996a, Mahoney *et al.* 1999). Others found up to 60% (Lamont *et al.* 1983, Hirsch *et al.* 1990, Murray *et al.* 1993, Hansen *et al.* 1995, Fortinsky *et al.* 1999). Functional decline is described as a loss of independence in self-care activities or as a deterioration in self-care skills. In the literature, a range of terms is used to describe functional decline such as loss of function, ADL decline, declining function, status decline, ADL status decline and functional impairment. Usually it is measured on a basic ADL scale (bathing, dressing, transferring from bed to chair, using the toilet) and/or an instrumental scale (IADL) (shopping, housekeeping, preparing meals, taking medications, handling finances, using public transportation).

Functional decline is not strictly related to the medical problem that caused admission. Several factors play a role in this negative outcome, like the condition of the patient before admission, iatrogenic effects of the treatment, effects of bed rest and comorbidity (Harper & Lyles 1988, Hoenig & Rubenstein 1991, Mobily & Skemp Kelley 1991, Sager & Rudberg 1998).

Functional decline is associated with prolonged hospital stay, nursing home placement, hospital readmission and increasing mortality (Narain *et al.* 1988, Rudberg *et al.* 1996, Satish *et al.* 1996, Covinsky *et al.* 1997b, Carlson *et al.* 1998, Alarcon *et al.* 1999, Fortinsky *et al.* 1999,

Ingold *et al.* 2000). Personal and health-care costs are high and the need to prevent this negative outcome is pressing. Identifying patients at risk is an important step in preventing this event. Because of their ability to observe and to guide the patients, their frequent contact with patients, their involvement in ADL and the overall view they have, nurses play a key role in the prevention of functional decline.

Aims

The aim of this review is to identify a valid, reliable and clinical user-friendly screening instrument to identify older hospitalized patients at risk for functional decline.

To determine the validity of a screening instrument a 'gold standard' should be used. However, there is no currently accepted gold standard to measure functional decline. Identification of predictors for functional decline and comparing these predictors with the items used in the instrument is a way to judge the validity of a screening instrument.

Choosing the best instrument to identify those older patients at risk for functional decline should be based on the scientific qualities of the instrument (Streiner & Norman 2003):

- Internal validity: the instrument is based on predictors known from the research literature.
- Validity: sensitivity and specificity and the positive and negative predictive values are at least moderate.
- Reliability: inter-rater and intra-rater reliability must be high with limited training required for its appropriate use.
- Clinical utility: the instrument must be easy to use in the hospital setting. It must be short and easy to administer and it must be capable of being applied by all nurses on

a ward. The time needed for assessment and administration, the level of knowledge and training of the rater, and the impact on the respondents should be described.

Objectives and methods

Two strategies were used to search relevant articles for this review. First, a computerized search on the period 1990 till February 2005 was carried out, using the following databases: Medline; PsycINFO, CINAHL, Cochrane Library, Cochrane Database of Systematic Reviews (CDSR), Database of Abstracts on Reviews and Effectiveness (DARE) and Cochrane Controlled Trial Register (CCTR); Second, reference lists of all selected articles were reviewed to identify other relevant papers.

Search terms

The Medline database was used to identify Medical Subjects Headings (MeSH) to select search terms. In addition to the MeSH terms we also used text words. Search terms referred to aspects of the population, the intervention and outcome. To maximize the number of retrieved articles, only the filters English and humans were used.

Overview of used MeSH terms and text words to search the electronic databases:

- 1 Population: 'elderly' OR 'elder' OR 'aged' OR 'aged, 80 and over' OR 'frail elderly' AND 'hospitalized patient' OR 'hospital admission' OR 'older patient'.
- 2 Intervention: 'screening' OR 'screening instrument' OR 'risk assessment' OR 'geriatric screening' OR 'predictors' OR 'predicting'.
- 3 Outcome: 'functional decline' OR 'functional status decline' OR 'ADL decline' OR 'decreased physical function' OR 'decreased physical outcome' OR 'impaired physical outcome' OR 'ADL status decline'.
- 4 Combination of (1) and (2) and (3): 122 hits.

Based on title and abstract of the publication we excluded case reports, commentaries and guidelines.

Inclusion criteria

Predictors: the studied variables are predictors of the outcome measurement 'functional decline', predictors are tested in the hospital setting.

Screening instrument: instruments with the objective of identifying older hospitalized patients at risk for functional decline and instruments which have been tested in a hospital population.

Search results

After completing the systematic search, we retrieved 37 articles based on clinical studies of predictors of functional decline and on screening instruments to identify older hospitalized patients at risk for functional decline.

Results

The results are described in two parts. Firstly, an overview is given of the results of predictors of functional decline. Secondly, the results concerning the screening instruments are reported.

Predictors of functional decline

Ten studies were found of which two were reviews and eight were cohort studies.

The review of McCusker *et al.* (2002) focuses on the predictors of four outcomes: functional decline, nursing home admission, a composite outcome and any adverse outcome in hospitalized older people. Studies were included with data from different settings (community and hospital) and with other background problems (prolonged hospital stay because of social circumstances). The most important predictors in this review are age, diagnosis, ADL, cognitive impairment (including delirium) and residence. In the review of Miller and Weissert (2000) the strongest predictors of functional decline and other adverse outcomes are worse performance on physical function measures not based on ADL, greater illness severity and prior hospital use.

Eight studies that met the inclusion criteria were found in the literature with the following outcomes: functional decline (Murray *et al.* 1993, Covinsky *et al.* 2003), decline in ADL function (Inouye *et al.* 1993, Mahoney *et al.* 1999), functional outcome at follow-up (Sager *et al.* 1996a), number of ADL dependencies (Covinsky *et al.* 1997a, Wu *et al.* 2000).

The eight studies were examined to determine the objective, design, setting and patients, measurements and the significant predictors. Table 1 gives an overview of the characteristics. Functional decline was measured mostly in a prospective cohort design, only one study used a secondary analysis of data of a prospective randomized trial (Mahoney *et al.* 1999). One study used two prospective cohorts in tandem, to validate the outcomes of the first cohort (Inouye *et al.* 1993). The number of included persons varied as well as the inclusion criteria, but all studies were focused on older people in a hospital setting.

Different measuring instruments were used in the studies: Katz scale, used in four studies (Murray *et al.* 1993, Covinsky

Table 1 Overview of studies: predictors of functional decline

Author	Objective	Design	Setting/patients	Measurements	Significant predictors
Covinsky <i>et al.</i> (2003)	To describe the changes in ADL function occurring before and after hospital admission in older people hospitalized with medical illness and to assess the effort of age on loss of ADL function	Prospective observational study	The general medical service of two hospitals N = 2293, aged 70 years and older	Two weeks before admission, at admission and at discharge. 5 ADLs and 7 IADLs	Age $P < 0.001$ (23%, 28%, 38%, 50% and 63% in patients aged 70–74, 75–79, 80–84, 85–90 and ≥ 90 years)
Covinsky <i>et al.</i> (1997a)	To determine weather symptoms of depression predict worse health status outcomes in acutely ill older medical patients	Prospective cohort study	Medical service of a teaching hospital N = 572, aged older than 70 years	One week before admission, at admission, at discharge and 30 and 90 days after discharge. Using 5 ADLs and 7 IADLs	Depression six or more symptoms on admission OR 2.47 (odds ratio, OR. 74)
Mahoney <i>et al.</i> (1999)	To determine the association of mobility impairment with adverse outcomes at hospital discharge and 3-month postdischarge	Secondary analysis of a prospective randomized trial	Five hospitals N = 1212, aged 70 years and older	At admission, hospital discharge and three months after discharge. Using Katz scale Lawton scale	Mobility impairment: use of a cane or a walker (adjusted OR 2.77)
Murray <i>et al.</i> (1993)	To determine weather delirium is associated with long-term loss of physical function (performing ADL)	Prospective study	Community acute-care hospital N = 325, aged over 65 years	At hospital admission retrospective three months before admission (interviewing the patients primary caregiver) and at three and six months after hospital discharge. Using Katz scale	Delirium (as sole predictor $P = 0.009$) (Mantel Hantel $\chi^2 = 6.54$ $P < 0.011$ for patients discharged to the community and MH $\chi^2 = 5.82$, $P < 0.016$ for patients discharged to a nursing home) Increased age (age < 75 years compared with 75–84 years adjusted OR 1.9, $P < 0.05$ and ≥ 85 years, adjusted OR 3.5, $P < 0.011$)
Sager <i>et al.</i> (1996b)	To develop and validate an instrument for stratifying older patients at the time of hospital admission according to their risk of developing new disabilities in ADL following acute medical illness and hospitalization	Multicenter prospective cohort study	Five universities affiliated hospitals and one community hospital, $n = 448$ and a validation cohort $n = 379$, aged 70 years and older	At admission (also retrospectively), at discharge and three months after discharge. Using 6 ADLs and 7 IADLs	Lower cognitive functioning (adjusted OR 1.4, $P < 0.05$) Pre-existing IADL functioning (0–5 score compared with score 6 or 7; adjusted OR 2.6, $P < 0.01$)

Table 1 Continued

Author	Objective	Design	Setting/patients	Measurements	Significant predictors
Sager <i>et al.</i> (1996a)	To identify the patient factors associated with an increased risk of developing disability associated with acute illness and hospitalization	Prospective cohort study	Five hospitals (HOPE study) $N = 1279$ community dwelling patients, aged 70 years and older, hospitalized for acute medical illness	At admission (also preadmission), at discharge and three months after discharge. Using 6 ADLs and 7 IADLs	Age (adjusted OR 1.7 $P < 0.050$ ≥ 85 years adjusted OR 2.7 $P < 0.001$ compared with age 70–75 years) Gender (only at discharge) (adjusted OR 1.4, $P < 0.05$) Preadmission IADLs (adjusted OR 0.087, $P < 0.001$) lower admission MMSE (three months after discharge, score 15–20 compared with 0–14 adj. OR 1.8, $P < 0.05$) Cancer (only at discharge) (adj. OR 2.3, $P < 0.05$) loss of ADL during hospitalization (after three months) (adj. OR 3.7, $P < 0.001$) Hospital length of stay (adj. OR 1.07 $P < 0.001$ only at discharge)
Wu <i>et al.</i> (2000)	To develop a model estimating the probability of a patient 80 years or older having functional limitations 2 and 12 months after being hospitalized	Prospective cohort study	Four teaching hospitals (HELP project) $N = 804$, aged 80 years or older, in hospital at least 48 h	Two weeks before admission, on or around the fourth day of study entry, at 2 and 12 months later. Katz scale and DASI	Older Worse baseline functional status and quality of life ADL score at baseline ($\chi^2 = 146.1$, total $\chi^2 = 418.6$) Depth of coma Lower serum albumine level Presence of dementia (OR 1.9) Depression (OR 1.5) Incontinence (OR 1.5) Bedrest (OR 2.4), Medical record Cancer (OR 1.3) Documentation of need for nursing home (OR 1.6)
Inouye <i>et al.</i> (1993)	To prospectively develop and validate a predictive index to identify on admission elderly hospitalized medical patients at risk for functional decline	Two prospective cohort studies in tandem	One hospital $N = 188$ for the development cohort and $N = 142$ for the comparable group, aged 70 years and older	Baseline interview, self-reported IADL two weeks before admission, interviews with nurses twice weekly and at discharge	Decubitus ulcer (RR 2.7) Cognitive impairment (RR 1.7) Functional impairment (RR 1.8) Low social activity (RR 2.4)

et al. 1997a, Mahoney *et al.* 1999, Wu *et al.* 2000) five ADLs (Covinsky *et al.* 2003) or six ADLs were measured (Sager *et al.* 1996a,b, Mehta *et al.* 2002), or seven basic ADL skills were measured by nurses (Inouye *et al.* 1993). The measurement times were self-reported two weeks before admission and mostly shortly after admission, at discharge and/or at a certain point after discharge.

The number of possible predictive variables was different in all studies. Three studies only investigated the effect of one predictor (Covinsky *et al.* 1997a, 2003, Murray *et al.* 1993) one study examined the effect of two predictors (Mahoney *et al.* 1999), four investigated nine or more predictors, some of which were partially overlapping (Sager *et al.* 1996a,b, Inouye *et al.* 1993, Wu *et al.* 2000).

Covinsky *et al.* studied the association with age. The oldest patients are at particularly high risk of poor functional outcomes because they are less likely to recover ADL function lost before admission and are more likely to develop new functional deficits during hospitalization (Covinsky *et al.* 2003). In another study by Covinsky *et al.* symptoms of depression, severity of illness at admission, comorbidity and demographic characteristics, were examined. 'Symptoms of depression' was the strongest predictor. Patients with six or more symptoms of depression on admission were more likely to be dependent in basic ADL than patients with 0–2 symptoms (Covinsky *et al.* 1997a). Mahoney *et al.* (1999) studied only mobility impairment, as indicated by the use of a cane or a walker, and this was significantly associated with functional decline. Murray *et al.* examined delirium, initial level of function and comorbidity as predictors. Delirium was the strongest predictor. The study demonstrates a strong association between the presence of delirium and worsening physical function in two groups: patients discharged in the community and those discharged to a nursing home. Delirium persisted as the sole predictor of loss of function at three months after discharge ($P = 0.009$) (Murray *et al.* 1993). Sager *et al.* investigated several variables such as cognitive function, discharge diagnosis, preadmission ADL and IADL, and demographic characteristics. Increasing age, decreasing levels of independent IADL function before admission and lower Mini-Mental State Examination (MMSE) scores on admission were the strongest predictors of functional decline (Sager *et al.* 1996b). In another study by Sager *et al.* (1996a) increasing age (75–84 years), gender, preadmission IADL's disabilities, lower mental status scores on admission and rehospitalization were significant predictors. In the study by Wu *et al.* (2000), 26 variables were independent predictors, among them ADL score at baseline (the strongest predictor), poorer quality of life at baseline, demographic characteristics, coma, disease group (cancer

being the strongest predictor), geriatric symptoms such as urinary incontinence, dementia, depression, bed rest, serum albumin level and the documented need for nursing home care.

Inouye *et al.* (1993) investigated in a single prospective cohort study in tandem so as to develop and validate a predictive index to identify elderly hospitalized patients at risk for functional decline. Pressure ulcer, cognitive impairment, functional impairment and low social activity level were the predictors of functional decline.

Screening instruments

Three instruments that met the criteria of having been tested in the hospital setting were found in the literature. The Hospital Admission Risk Profile (HARP) identifies older hospitalized patients at risk for functional decline in the hospital setting (Sager *et al.* 1996b). The Identification of Seniors at Risk (ISAR) instrument is part of a two-step intervention developed to be used in the emergency department (McCusker *et al.* 1999). A short Care Complexity Prediction Instrument (COMPRI) detects patients at risk for complex care needs in the hospital setting (Huyse *et al.* 2001). This instrument is also part of a two-step instrument. Table 2 gives an overview of the main characteristics of the screening instruments.

HARP

Hospital Admission Risk Profile is developed in six acute-care hospitals in the US, as an instrument to classify older patients at the time of hospital admission according to their risk of developing new disabilities in ADL. The instrument has a list of 29 questions. In developing the instrument the study population was divided in a development ($n = 448$) and a validation ($n = 379$) cohort. The study was part of a larger study, the Hospital Outcomes Project for the Elderly (HOPE). Elderly patients of 70 years and older were included.

Hospital Admission Risk Profile consists of three types of variables derived from this larger study to determine the strongest predictors of functional decline: age, cognitive function (measured by an abbreviated MMSE, 21 items) IADL (seven functions) prior to admission. These were significantly associated with the presence of new ADL disability at discharge. Functional status was measured by six ADLs (bathing, dressing, transferring, walking, toileting and eating) at admission, discharge and three months after discharge by telephone interview. Three of the six predictors of our review were the basis of HARP (see Table 3).

Table 2 Characteristics of screening instruments

	HARP (Sager <i>et al.</i> 1996b)	ISAR (McCusker <i>et al.</i> 1999)	COMPRI (Huyse <i>et al.</i> 2001)
Objective	To develop and validate an instrument for stratifying older patients at the time of hospital admission according to their risk of developing new disabilities in ADL	To develop a self-report screening tool to identify older people at increased risk of adverse health outcomes	To develop a screening instrument to detect patients in medical ward at risk for complex care needs. It is used with an interdisciplinary instrument Interned to predict poor discharge health status
Setting	4 University and 2 private non-federal acute-care hospitals in the US	4 acute-care hospitals in Montreal (Can). 2 community, 2 tertiary hospitals	2 Dutch hospitals, internal wards
Population	Development cohort N = 448 Validation cohort N = 379 Patients aged 70 years and older	N = 1673 Patients who came to the ED, aged 65 years and older, during three months	N = 275 All patients admitted to a general internal ward
Exclusion	Patients admitted for surgery, living in a nursing home before admission, or dying during hospitalization or during the three months after discharge, terminal illness, severe cognitive impairment, inability to give informed consent and admission to the IC	Patients not to be interviewed because of medical condition or cognitive impairment and no other informant available Patients from a nursing home or chronically disease hospital	Patients admitted for one day, patients from another ward or hospital, patients readmitted within the study period and patients treated by the specialty dermatology or rheumatology
Design	Multicenter prospective cohort study	Prospective follow-up cohort	Cohort study
Measurement time	Within 48 hours after admission, at discharge, and three months after discharge	At admission, discharge, three months after discharge	At admission, within three days after admission for an extensive interview and at discharge
Used predictors	Demographic characteristics 6 ADLs 7 IADLs (self-reported two weeks before admission) MMSE, short version Demographic info LOS	From 27 self-report (including demographic characteristics, ADL, diseases, geriatric problems, mental status, polymedication, alcohol use, social context and depression) to a 6-item scale. Predictive evaluation of each item with chi-square and ROC and goodness-of-fit test. Univariate and multivariate measures	Derived from an extensive list of 117 potential risk factors from another large study in 10 hospitals in Europe ($n = 2158$). Correlations with LOS 0.47, number of medications during hospital stay 0.49, complexity rating by a doctor 0.46, and complexity rating by a nurse 0.49)
Outcome measurements	Diagnostic categories (ICD-9-CM) ADL functioning: bathing, dressing, transferring, walking toileting and eating)	Adverse health outcomes, death, institutionalization, decline in physical function	LOS number of days with laboratory tests number of days with diagnostic procedures medications number of consultations by medical and paramedical specialists number of non-standard nurse interventions medical complexity nursing complexity postdischarge care needs mental health problems

Table 2 Continued

	HARP (Sager <i>et al.</i> 1996b)	ISAR (McCusker <i>et al.</i> 1999)	COMPRI (Huyse <i>et al.</i> 2001)
Items in the instrument	Age Lower MMSE Decreasing levels of independent IADL function before admission	ADL dependence Need for help in the recent past Visual and Cognitive impairment, History of hospitalization, Polymedication	13 items (yes or no) of which 3 items to be rated by a nurse, 4 by a doctor and the 6 remains by a research nurse. expectations of the doctor (4 items) patients health perception walking difficulties during the past three months more than 6 doctor visits during the past three months polymedication planned or unplanned admission retired patient or not Cut-off 5/6 0.71, Cut-off 5/6 0.63, Cut-off 5/6 0.70 Cut-off 5/6 0.64 0.73 Not described A two-step instrument to be used with Intermed which consists of 4 domains: biological, psychological, social and health care, with each 5 variables. Both nurses and doctors have to fill in the form
Sensitivity	Not described	Cut-off 2 71% Cut-off 3 44% Cut-off 4 25% Cut-off 2 57% Cut-off 3 79% Cut-off 4 91% Not described Not described 0.71 Not described	
Specificity	Not described		
Positive predictive value	Not described		
Negative predictive value	Not described		
Area under the ROC curve	0.65		
Reliability			
Clinical utility	Used for identifying older patients at risk for functional decline It stratifies into low, intermediate and high risk	A two-step instrument: screening at risk on a 6-item scale, more detailed assessment in the second step. The first step is a simple, self-report instrument	

Table 3 Overview of the predictors used in the development of the screening instruments

	HARP	ISAR	COMPRI
Age	x	x	x
Lower functional status: ADL or IADL		x	x
Lower cognitive functioning	x	x	
Lower preadmission IADL	x		
Depression			
Hospital length of stay			x

In testing the HARP, the Area Under the Curve (AUC) proved to be moderate (AUC 0.65). The investigators ascribe this moderate predictive ability to the fact that HARP describes the patient variables but not the illness or process of care variables, both of which may be important in the development of disability in frail older patients. No further testing of reliability was found.

According to the authors, HARP can be seen as a simple instrument suitable to identify patients at risk of functional decline who could benefit from comprehensive discharge planning, specialized geriatric care and experimental interventions (Sager *et al.* 1996b). The way the instrument should be used, who can fill in the form, the required time to administer and the effect on the respondents are not described.

ISAR

Identification of Seniors at Risk is developed to identify elderly patients at risk for functional decline in the Emergency Department (ED) in Canada (McCusker *et al.* 1999). Included were patients aged 65 years and older who visited the ED at four hospitals during daytime, during a three-month period ($n = 1854$). From another study of McCusker it is known that only 32% of the emergency department population was admitted to the hospital (McCusker *et al.* 1997).

Identification of Seniors at Risk is developed as a two-step instrument. The first step includes screening to identify elderly patients at risk of adverse outcomes. The second step is a brief nursing assessment to those with an ISAR score of two or more using a checklist. The proposed screening tool (ISAR) consists of six self-report questions on functional dependence, recent hospitalization, impaired memory and vision and polymedication. ISAR identifies older patients in the ED at increased risk of several adverse health outcomes and those with current disability. The items were selected based on face validity and ease of administration and predictive value. The study to validate the tool included patients aged 65 years and over, seen at four urban hospitals.

To develop the scale measures ascertained at the ED to find the most predictive variables were based on literature, an existing instrument and an expert panel. This resulted in 27 self-report screening questions on social, physical and mental risk factors, medical history, use of hospital services, medications and alcohol. Of these the most predictive variables were used for the screening tool. The Older American Resources and Services (OARS) ADL scale was used to measure ADL at admission and by telephone at follow-up. Three of the six predictors of our review were the base of ISAR (see Table 3).

Sensitivity and specificity of ISAR were fair (overall AUC 0.71). No further testing of reliability was found. According to the authors, ISAR is easy to use, it is a short and quick instrument and it can be completed by patients or informants (McCusker *et al.* 1998, 1999, McCusker 2003, Dendukuri *et al.* 2004).

COMPRI

Care Complexity Prediction Instrument is developed to detect hospitalized patients at risk for complex care needs (including older patients at risk for functional decline), measured as poor discharge health status and extended length of stay. It was tested in two Dutch hospitals as part of a large international study. All patients admitted to one of two general internal medicine wards were included ($n = 275$). Patients admitted for one day, readmitted within the study period and treated by the specialties dermatology or rheumatology were excluded. Patients who died were removed from the sample.

Care Complexity Prediction Instrument is part of a two-step instrument, a first screening for patients at risk and a second assessment. COMPRI consists of 13 dichotomized items, four items are rated by the doctor and three by the nurse. The remaining six items were rated by a research nurse based on a patient interview, during the development of the instrument. The outcome variables were the result of a large study to detect indicators for care complexity of patients with combined medical and psychiatric problems. The items were derived from an extensive list of 117 potential risk factors from another large study in 10 hospitals in Europe ($n = 2158$) including hospital-based health-care use, administration status, predictions by the doctor and the nurse, severity of illness, living/working situation, stress/social support, ADL, health perception, relation with doctors, past health-care use, drug abuse, compliance, emotional state.

Care complexity was measured on a scale with 10 complexity indicators. Three of the six predictors of our review were the base of COMPRI (see Table 3).

Sensitivity was good, specificity less AUC is fair (0.73) as well as the positive (0.70) and negative predictive value

(0.64). No further testing of reliability was found. (Huyse *et al.* 2001, de Jonge *et al.* 2001a,b, de Jonge *et al.* 2003, de Jonge *et al.* 2003).

Discussion and conclusion

For older patients hospital admission in itself is a risky event. Many older patients suffer from functional decline related to hospitalization. Identifying patients at risk for functional decline is a first step in assessing the degree of risk, to determine the risk factors and to prevent (further) functional decline by developing a model in which, stepwise, all risk factors are prevented by interventions, which is the aim of this program.

The objective of this review is to identify a screening instrument, based on the predictors of functional decline.

The variables that are most often identified as predictors are age (four studies), lower functional status (ADL or IADL) in four studies, followed by lower cognitive functioning (three studies), lower preadmission IADL, depression and hospital length of stay (each in two studies).

Three valuable screening instruments were identified: HARP, ISAR and COMPRI. Of the six predictors at least three were mentioned in the development of all three instruments.

All three instruments are built on a study to determine the predictors. The number of studied variables is different in the three studies and varies from 13 items (HARP) to 27 items (ISAR) and 117 items (COMPRI).

Identification of Seniors at Risk has been developed and tested in a multicenter study on the emergency department. The validity of ISAR is well described. The overall AUC 0.71 and the instrument has been tested and had a strong correlation with other validated scales. COMPRI was also developed and tested in a multicenter study. In COMPRI the AUC was also fair, 0.73. HARP was tested in a multicenter cohort study, the AUC was 0.65, which is moderate. All three instruments have been tested in a large population.

The reliability of all three instruments was not described, which is a weak point in the development and testing of a screening instrument. However, ISAR is a self-report instrument, (inter-rater) reliability is not an issue for this.

All three instruments are developed to identify patients at risk for functional decline. ISAR is developed and only used in the ED setting which is partly the population of the hospital. COMPRI is developed to predict all patients with complex care needs in the hospital setting and not only older people. Only HARP is developed in the hospital setting to identify older patients at risk for functional decline.

To determine the suitability of an instrument for clinical use in a hospital, the clinical utility must be very well described. It must be short and easy to administer and it must be easy to use for all nurses on a ward. The time needed for assessment and administration, the level of knowledge and training of the rater and the impact on the respondents should be described.

The clinical utility is not described for the HARP. The ISAR screening tool seems very easy to use for all nurses on a ward. This instrument is a self-rating scale. However, the impact on the respondents is not described. COMPRI is a more complex instrument. Because both doctors and nurses have to complete the form and the patients have to be interviewed by a (research) nurse, the clinical utility of the instrument does not seem to be so easy. More detailed information is not available. Possibly ISAR is the most user-friendly instrument because it is short, easy to complete in by the patient or relatives and, therefore, easy to administer.

So as to be valid, predictors of functional decline should be the base of an instrument to identify older patients at risk of functional decline. Few studies with the outcome of functional decline, investigated in the hospital setting, were identified. The studies are very different in methodological approach. Heterogeneity in the goals, different designs, different variables, different analysis, different measurements and measurement times, different numbers of variables make comparison and synthesis difficult.

Four of the eight predictor studies focused on a primary predictor, thus avoiding multiple tests of significant variables, and in this way giving a limited explanation for the phenomenon functional decline. The estimate of the effect of the co-variables is not described, and from other studies it is known that several predictors play an important role. The methods used to adjust the confounders are also not described. These single focused studies have a limited value in finding the strongest predictors of functional decline as a base for a screening instrument.

The exclusion in most of the studies of the patients who died poses problems in the interpretation of the effect of the measured predictors. It hypothesizes that dying does not connect with the determinants of functional decline, which is questionable. Excluding deaths gives a biased view of the effect of the measured variables.

Despite the considerable methodological differences between studies, they all point in the same direction. The strongest predictors of functional decline in the hospital setting are age, cognitive status, (pre)admission ADL and IADL, and depression. This outcome is a little different from McCusker *et al.* (2002) review and the study of Inouye *et al.* (1993). This has to do with the broader perspective and the methodological

differences in these studies. However, cognitive and functional impairment are the common predictors in these studies.

Only a limited number of studies are focused on the outcome of functional decline. More studies focus on nursing home admission, length of stay, mortality and other adverse outcomes. Outcomes like nursing home admission are also dependent on other cultural and social variables like the availability of placements in a nursing home, consequences of living alone and the wishes of the patient and the family (Zureik *et al.* 1997). In those studies functional decline is one of the predictors of these adverse outcomes (Fortinsky *et al.* 1999). Measuring the predictors of adverse outcomes is an indirect way to measure functional decline and these outcomes may share some of the predictors of functional decline. It is important to notice that the findings of these studies are concurrent with the most important predictors of functional decline in this study.

Functional decline is also an important issue in community health care. The findings of this review are different from the findings of studies in the community. Only cognitive impairment and depression are common (Stuck *et al.* 1999). Of course preadmission decline in ADL/IADL is not a variable in these studies.

All three scales were based on a literature study, but the results were very diverse and ended up in different types and different numbers of variables included in the instrument. Validity of all three scales is moderate to fair, but reliability (inter-rater and intra-rater) and ease of use in the clinical setting are not well described, which is a weak point for HARP, ISAR and COMPRI. In the hospital setting many nurses are working on different shifts and that is also a reason why it is important to describe the clinical utility, which was not done for all three instruments. Because of the differences in settings, the differences in investigated populations and the different objectives of the three instruments it is not possible to identify one instrument as being the best to identify older hospitalized patients at risk for functional decline. On the other hand, the validity of these three instruments is moderate to fair which gives a perspective to choose one of them in the hospital setting after a new comparative study.

Suggestions for further research

Based on the findings of this review further study to compare the three instruments in the hospital setting ISAR, COMPRI, HARP is recommended. Further testing should include reliability, validity and clinical utility in the setting of the internal ward of a hospital.

Functional decline in hospitalized older patients is a serious problem with a huge impact on the lives of patients and their

families. To develop an intervention to prevent this event, it is important to start with a valid and reliable screening instrument.

Contributions

JH is the principal author and investigator of this study, responsible for the literature review, MS is the supervisor, MD, SR and MG have contributed and controlled the search strategy, the interpretation of the articles, the conclusions and the preparation and revision of this article.

References

- Alarcon T, Barcena A, Gonzalez-Montalvo JI, Penalosa C & Salgado A (1999) Factors predictive of outcome on admission to an acute geriatric ward. *Age and Ageing* 28, 429–432.
- Carlson JE, Zocchi KA, Bettencourt DM, Gambrel ML, Freeman JL, Zhang D & Goodwin JS (1998) Measuring frailty in the hospitalized elderly: concept of functional homeostasis. *American Journal of Physical Medicine and Rehabilitation* 77, 252–257.
- Covinsky KE, Fortinsky RH, Palmer RM, Kresevic DM & Landefeld CS (1997a) Relation between symptoms of depression and health status outcomes in acutely ill hospitalized older persons. *Annals of Internal Medicine* 126, 417–425.
- Covinsky KE, Justice AC, Rosenthal GE, Palmer RM & Landefeld CS (1997b) Measuring prognosis and case mix in hospitalized elders. The importance of functional status. *Journal of General Internal Medicine* 12, 203–208.
- Covinsky KE, Palmer RM, Fortinsky RH, Counsell SR, Stewart AL, Kresevic D, Burant CJ & Landefeld CS (2003) Loss of independence in activities of daily living in older adults hospitalized with medical illnesses: increased vulnerability with age. *Journal of the American Geriatrics Society* 51, 451–458.
- Dendukuri N, McCusker J & Belzile E (2004) The identification of seniors at risk screening tool: further evidence of concurrent and predictive validity. *Journal of the American Geriatrics Society* 52, 290–296.
- Fortinsky RH, Covinsky KE, Palmer RM & Landefeld CS (1999) Effects of functional status changes before and during hospitalization on nursing home admission of older adults. *Journals of Gerontology. Series A, Biological Sciences and Medical Sciences* 54, M521–M526.
- Hansen FR, Poulsen H & Sorensen KH (1995) A model of regular geriatric follow-up by home visits to selected patients discharged from a geriatric ward: a randomized controlled trial. *Aging (Milano)* 7, 202–206.
- Harper CM & Lyles YM (1988) Physiology and complications of bed rest. *Journal of the American Geriatrics Society* 36, 1047–1054.
- Hirsch CH, Sommers L, Olsen A, Mullen L & Winograd CH (1990) The natural history of functional morbidity in hospitalized older patients. *Journal of the American Geriatrics Society* 38, 1296–1303.
- Hoenig HM & Rubenstein LZ (1991) Hospital-associated deconditioning and dysfunction. *Journal of the American Geriatrics Society* 39, 220–222.

- Huyse FJ, de Jonge P, Slaets JP, Herzog T, Lobo A, Lyons JS, Opmeer BC, Stein B, Arolt V, Balogh N, Cardoso G, Fink P & Rigatelli M (2001) COMPRI – an instrument to detect patients with complex care needs: results from a European study. *Psychosomatics* **42**, 222–228.
- Ingold BB, Yersin B, Wietlisbach V, Burckhardt P, Bumand B & Bula CJ (2000) Characteristics associated with inappropriate hospital use in elderly patients admitted to a general internal medicine service. *Aging (Milano)* **12**, 430–438.
- Inouye SK, Wagner DR, Acampora D, Horwitz RI, Cooney LM Jr, Hurst LD & Tinetti ME (1993) A predictive index for functional decline in hospitalized elderly medical patients. *Journal of General Internal Medicine* **8**, 645–652.
- de Jonge P, Huyse FJ, Herzog T, Lobo A, Slaets JP, Lyons JS, Opmeer BC, Stein B, Arolt V, Balogh N, Cardoso G, Fink P & Rigatelli M (2001a) Risk factors for complex care needs in general medical inpatients: results from a European study. *Psychosomatics* **42**, 213–221.
- de Jonge P, Huyse FJ, Slaets JP, Herzog T, Lobo A, Lyons JS, Opmeer BC, Stein B, Arolt V, Balogh N, Cardoso G, Fink P, Rigatelli M, van Dijk R & Mellenbergh GJ (2001b) Care complexity in the general hospital: results from a European study. *Psychosomatics* **42**, 204–212.
- de Jonge P, Bauer I, Huyse FJ & Latour CH (2003) Medical inpatients at risk of extended hospital stay and poor discharge health status: detection with COMPRI and INTERMED. *Psychosomatic Medicine* **65**, 534–541.
- Lamont CT, Sampson S, Matthias R & Kane R (1983) The outcome of hospitalization for acute illness in the elderly. *Journal of the American Geriatrics Society* **31**, 282–288.
- Mahoney JE, Sager MA & Jalaluddin M (1999) Use of an ambulation assistive device predicts functional decline associated with hospitalization. *Journals of Gerontology. Series A, Biological Sciences and Medical Sciences* **54**, M83–M88.
- McCusker J (2003) A two step intervention for seniors released from hospital emergency departments. Report ISAR guide 2, 1–26 (Ref Type: Generic).
- McCusker J, Healey E, Bellavance F & Connolly B (1997) Predictors of repeat emergency department visits by elders. *Academic Emergency Medicine* **4**, 581–588.
- McCusker J, Bellavance F, Cardin S & Trepanier S (1998) Screening for geriatric problems in the emergency department: reliability and validity. Identification of Seniors at Risk (ISAR) Steering Committee. *Academic Emergency Medicine* **5**, 883–893.
- McCusker J, Bellavance F, Cardin S, Trepanier S, Verdon J & Ardman O (1999) Detection of older people at increased risk of adverse health outcomes after an emergency visit: the ISAR screening tool. *Journal of the American Geriatrics Society* **47**, 1229–1237.
- McCusker J, Kakuma R & Abrahamowicz M (2002) Predictors of functional decline in hospitalized elderly patients: a systematic review. *Journals of Gerontology. Series A, Biological Sciences and Medical Sciences* **57**, M569–M577.
- McVey LJ, Becker PM, Saltz CC, Feussner JR & Cohen HJ (1989) Effect of a geriatric consultation team on functional status of elderly hospitalized patients. A randomized, controlled clinical trial. *Annals of Internal Medicine* **110**, 79–84.
- Mehta KM, Yaffe K & Covinsky KE (2002) Cognitive impairment, depressive symptoms, and functional decline in older people. *Journal of the American Geriatrics Society* **50**, 1045–1050.
- Miller EA & Weissert WG (2000) Predicting elderly people's risk for nursing home placement, hospitalization, functional impairment, and mortality: a synthesis. *Medical Care Research and Review* **57**, 259–297.
- Mobily PR & Skemp Kelley LS (1991) Iatrogenesis in the elderly. Factors of immobility. *Journal of Gerontological Nursing* **17**, 5–11.
- Murray AM, Levkoff SE, Wetle TT, Beckett L, Cleary PD, Schor JD, Lipsitz LA, Rowe JW & Evans DA (1993) Acute delirium and functional decline in the hospitalized elderly patient. *Journal of Gerontology* **48**, M181–M186.
- Narain P, Rubenstein LZ, Wieland GD, Rosbrook B, Strome LS, Pietruszka F & Morley JE (1988) Predictors of immediate and 6-month outcomes in hospitalized elderly patients. The importance of functional status. *Journal of the American Geriatrics Society* **36**, 775–783.
- Rudberg MA, Sager MA & Zhang J (1996) Risk factors for nursing home use after hospitalization for medical illness. *Journals of Gerontology. Series A, Biological Sciences and Medical Sciences* **51**, M189–M194.
- Sager MA & Rudberg MA (1998) Functional decline associated with hospitalization for acute illness. *Clinics in Geriatric Medicine* **14**, 669–679.
- Sager MA, Franke T, Inouye SK, Landefeld CS, Morgan TM, Rudberg MA, Sebens H & Winograd CH (1996a) Functional outcomes of acute medical illness and hospitalization in older persons. *Archives of Internal Medicine* **156**, 645–652.
- Sager MA, Rudberg MA, Jalaluddin M, Franke T, Inouye SK, Landefeld CS, Siebens H & Winograd CH (1996b) Hospital admission risk profile (HARP): identifying older patients at risk for functional decline following acute medical illness and hospitalization. *Journal of the American Geriatrics Society* **44**, 251–257.
- Satish S, Winograd CH, Chavez C & Bloch DA (1996) Geriatric targeting criteria as predictors of survival and health care utilization. *Journal of the American Geriatrics Society* **44**, 914–921.
- Streiner DL & Norman GR (2003) *Health Measurement Scales a Practical Guide to their Development and Use*, 3rd edn. Oxford University Press, ON, Canada.
- Stuck AE, Walther JM, Nikolaus T, Bula CJ, Hohmann C & Beck JC (1999) Risk factors for functional status decline in community-living elderly people: a systematic literature review. *Social Science and Medicine* **48**, 445–469.
- Wu AW, Yasui Y, Alzola C, Galanos AN, Tsevat J, Phillips RS, Connors AF Jr, Teno JM, Wenger NS & Lynn J (2000) Predicting functional status outcomes in hospitalized patients aged 80 years and older. *Journal of the American Geriatrics Society* **48**, S6–S15.
- Zureik M, Lombrail P, Davido A, Trouillet JL, Tran B, Levy A & Lang T (1997) Predicting the outcome in elderly patients of hospital admission for acute care in Paris, France: construction and initial validation of a simplex index. *Journal of Epidemiology and Community Health* **51**, 192–198.