Screening, Geriatric Assessment and Intervention Strategies to Prevent Functional Decline in Hospitalized Older Patients Bianca M. Buurman

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PhD thesis, University of Amsterdam, The Netherlands

Lay-out & Cover: J.W. Broek
Printed by: Gildeprint (www.gildeprint.nl)

The printing of this thesis is financially supported by: Nutricia Advanced Medical Nutrition, Novartis Pharma B.V., Lundbeck B.V.

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ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad van doctor
aan de Universiteit van Amsterdam
op gezag van de Rector Magnificus
prof. dr. D.C. van den Boom
ten overstaan van een door het college voor promoties ingestelde
commissie, in het openbaar te verdedigen in de Aula der Universiteit

op vrijdag 16 september 2011, te 11.00 uur

door

Bianca Maria Van Es

geboren te Rotterdam

Promotiecommissie

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Faculteit der Geneeskunde

Contents

Chapter 1

General Introduction

Excerpt of the introduction and general discussion submitted for publication

'Acute hospitalization and disability'

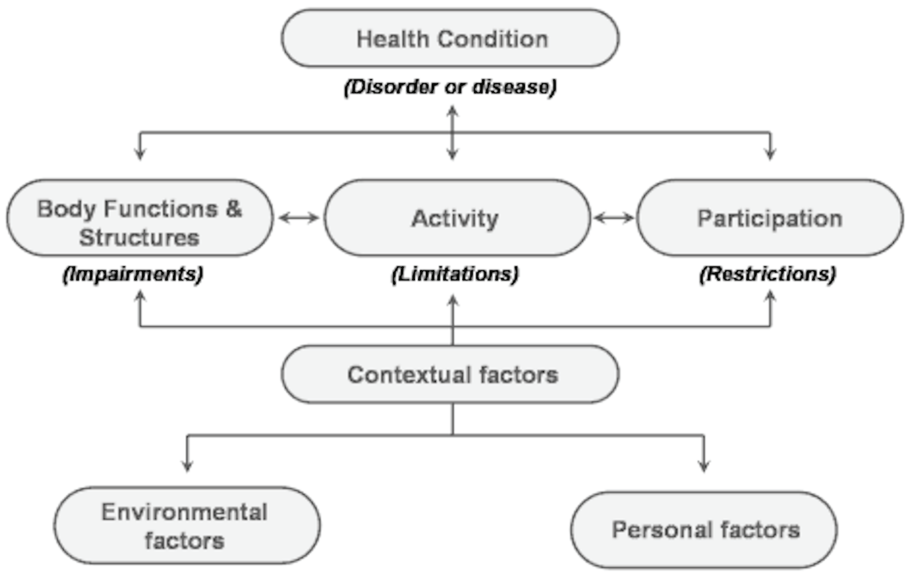
Chronic diseases and the onset of disability

The prevalence of chronic diseases gradually increases with age and has shown an overall growth in the past decades [1]. This is partly due to early recognition of chronic diseases by screening programs and to aging of the population. Compared to patients younger than 65 years, older patients more frequently have a combination of chronic diseases. This co-occurrence of two or more diseases is defined as multimorbidity [2] and its prevalence in community-dwelling patients ranges from 35-65% in patients aged 60-69 years, to 80-99% in patients aged 80 years and older [3;4].

Chronic diseases are often accompanied by disability. In order to structure and describe disease outcomes in a systematic and hierarchical manner the World health Organization developed the International Classification of Functioning, Disability and Health (ICF, Figure 1) [5 6]. According to this scheme the disablement process starts with a certain disease or health condition in the body. The specific disease can lead to impairments in body functions and structures, such as retinopathy (impairment) in diabetes patients (underlying disease). Impairments can be clinically silent or can be detectable and may lead to functional limitations (disabilities) which in turn may result in societal disadvantages (restrictions in participation or handicap). Important components of the ICF are the environmental and personal factors of the patients that can speed up or slow down the disablement process.

Environmental factors concern the presence of primary care givers, social support, technological devices and financial resources which can compensate a persons' individual inability to perform certain activities. Personal factors such as personality traits**,** coping styles, educational level, and lifestyle are far more difficult to influence.

Figure 1: the International Classification of Functioning, Disability and Health



Although chronic diseases can lead to disability, there is evidence that the onset of disability is generally postponed to advanced age [1]. Better treatment options have strongly contributed to this "compression" of years with disability. About 20-30% of older people experiences disabilities in performing (instrumental) activities of daily living ((I)ADL) [7]. Around 50 % of these disabilities develop progressively, in combination with underlying chronic disease such as arthritis, diabetes or chronic obstructive pulmonary disease. The other half develops as consequence of an acute event, such as hospital admission, stroke, or hip fracture.

Acute hospital admission and disability

Acute hospitalization is a hazardous event for elderly people. Older people that are hospitalized have an increased risk to develop new disabilities compared to those never

been admitted [8;9]. The disease where the patient is admitted for is often accompanied by a decrease in functional capacities before the start of the hospital admission [10]. During the first days of hospitalization, many patient are bed ridden, which further decreases mobility and functional abilities [11]. Activities of daily living that have been lost and are not recovered at hospital discharge are difficult to regain again [12].

Functional decline, mainly defined in terms of physical disability, is a common adverse outcome of hospitalization in older patients. Rates of functional decline after hospital admission in older patients vary between 15-60%, depending on the definitions applied, the setting of the research and related casemix of patients present on the inpatient wards [13;14].

Not all acutely admitted older patients are at equal risk for functional decline and mortality after hospitalization. Several clinical factors, especially multimorbidity, are related to an increased risk for poor outcomes [15]. Current disease-related, evidence-based guidelines do generally not consider the presence of other morbidities, leading to conflicting advices concerning medication use and life style advices [15]. Moreover, at hospital admission, frail older patients frequently attend to the emergency department or hospital with atypical disease presentation [16]. Examples of atypical disease presentation are amongst others incontinence when patients have a urinary tract infection, falls and delirium. These conditions are poorly recognized by health professionals [17] and mainly present in more frail older patients [18;19].

Besides multimorbidity, also patients' premorbid functional status is predictive for hospital outcomes [13;20-22]. Limitations in ADL, mobility difficulty, nutritional status, cognitive impairment, and depression are all part of functional status. Especially pre-existing disability in performing (instrumental) ADL [7] frequently occurs in old age and is a strong predictor of further functional decline.

Towards prevention of functional disabilities: the DEFENCE-care model

In the last decade a clear shift has been demonstrated worldwide concerning outcomes of hospital admission in older patients. Several international reports on patient safety in older patients have contributed to this new focus on patient-related health outcomes [23;24]. Maintaining functional abilities and preventing decline in functioning during and after hospital admission have gained more and more attention as an important and relevant outcome of hospital admission, instead of only focusing on the treatment of the disease the patient is admitted for [25;26]. The ICF model demonstrates that to prevent (further) limitations or disabilities, a multifactor approach is needed, not only focusing on a patients' diseases, impairments and risk factors, but extending the approach to environmental and personal factors that can affect or enhance functioning.

For the patients themselves the prevention of further disability is an essential outcome. Recent qualitative research revealed that older patients who expected to return home in a better condition than they had entered the hospital were actually disappointed by the fact that they were not informed about the effect of hospital admission on ADL functioning and were not actively rehabilitated during their hospital stay [27].

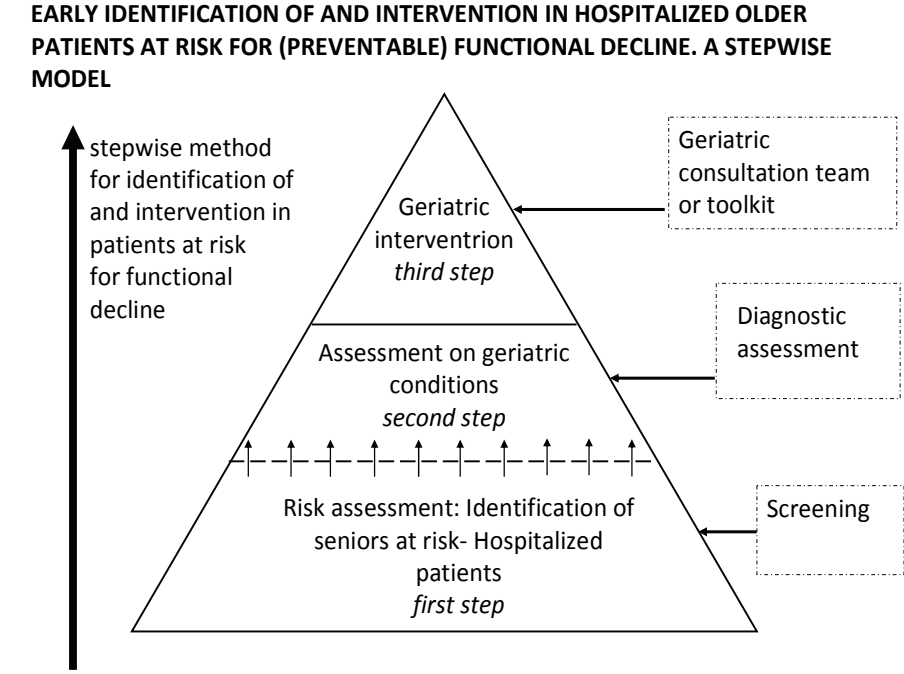
With a clear rise in the number of elderly people that are hospitalized annually and the knowledge that this patient group already accounts for half of all days spent in the hospital, a strategy for older hospital patients should at least take into the principles of efficiency and effectiveness: one should select those patients that are increased risk for adverse health outcomes and select those patients benefiting most from geriatric interventions. Furthermore, early recognition of patients at risk for functional decline was considered important, as this enables health care workers to both initiate preventive interventions, as well as interventions focused on rehabilitation.

In the recent past a geriatric in-hospital consultation team performing detailed geriatric assessments followed by patient tailored intervention programs was relatively scarce in the Netherlands. In 2006 the Develop strategies Enabling Frail Elderly New Complications to Evade (DEFENCE-II) study started in three hospitals in the Netherlands, with the aim of developing a geriatric screening- and consultation model to prevent functional decline. Figure 2 demonstrates the DEFENCE-care model, consisting of three steps:

1. The first step comprises the screening of patients at risk for functional decline. Identified patients at risk should enter the second step.
2. This step consists of a diagnostic assessment on 18 commonly encountered geriatric conditions, and personal and environmental factors.
3. Those patients that are supposed to benefit from geriatric intervention by a consultation team should enter the third step: the intervention by the multidisciplinary geriatric consultation team

Steps 1 and 2 together form the comprehensive geriatric assessment (CGA), which is a multidimensional, multidisciplinary diagnostic process on four domains of functioning (somatic, psychological, functional and social) leading to an integrated care plan and long-term follow up [28].

Figure 2: The DEFENCE-care model



Study cohorts

In this thesis three study cohorts are described. Data of the DEFENCE-II study cohort, on which most studies in this thesis rely on, were collected from 2006-2008. In total 639 patients were included into this cohort. All patients were acutely hospitalized and admitted for 48 hours or more, receiving a diagnostic assessment on 18 geriatric conditions. Follow-ups took place three and twelve months after hospital admission.

Two other cohorts preceded the DEFENCE-II study. Data collection on the first cohort started in 2002 when the geriatric team in the Academic Medical Center was founded. The main aim of the study was to describe the functional status of acutely hospitalized patients and the outcomes three and twelve months after hospital admission. All patients

had to be hospitalized for at least 48 hours. In total 461 patients were enrolled in the period between 2002 and 2005.

The third cohort study started in 2005 and included patients attending to the emergency department (ED) for any reason and who were subsequently discharged home. This study had a duration of 11-months and was aimed to optimize health care in the ED for older patients. All patients were interviewed one day after their visit to the ED and followed up one and three months after the ED visit.

Aim and content of this thesis

The general aim of this thesis was to investigate strategies for screening and diagnostic assessment on geriatric conditions to prevent functional decline and other hospital related complications in acutely hospitalized patients. One of these strategies is the DEFENCE-care model, a three-step systematic approach to prevent functional decline, which was developed as part of this thesis.

The thesis consists of nine chapters. As functional decline is the main outcome parameter in the studies presented **Chapter 2** starts with a systematic review on the measurement instruments of activities of daily living and the applied definitions of functional decline in hospitalized older patients.

The chapters 3, 4 and 5 focus on the screening of patients at risk for adverse health outcomes.

Chapter 3 compares the prognostic abilities of four screening instruments to detect patient at increased risk of readmission, hospitalization and mortality of older patients discharged home after an emergency department visit (data based on ED cohort). **Chapter 4** covers a study on prognostication of physicians and nurses concerning mortality in acutely hospitalized older patients. The hypothesis tested in this study, was that the clinical impression of physicians' and nurses would enhance prognostication, compared to

a prediction only based on objective measurable factors (data based on 'first' cohort). **Chapter 5** presents the development and validation of the Identification of Seniors at Risk-Hospitalized Patients (ISAR-HP), a brief screening instrument to detect patients at increased risk for functional decline. This study represents Step one of the DEFENCE-care model.

The chapters 6 and 7 describe the results of two studies on the diagnostic assessment of 18 geriatric conditions and their association with functional decline and other adverse health outcomes. Together they provided information for Step two of the DEFENCE-care model. **Chapter 6** evaluates the prevalence of geriatric conditions and related outcomes in terms of mortality, functional decline and cognitive impairment. **Chapter 7** is related to the effectiveness principle. Growing evidence shows that not all patients equally benefit from geriatric intervention. In this study three subgroups of patients are identified with distinct clinical characteristics and outcomes. The results of the ISAR-HP are studied in more detail, relating the score on the ISAR-HP to the presence of geriatric conditions and functional trajectories until one year after admission.

Chapter 8 focuses on an intervention to prevent functional decline in hospitalized older patients and is the workout of Step three of the DEFENCE-care model. The chapter describes the design of a randomized clinical trial using the DEFENCE-care model followed by a nurse led transitional care program, the Transitional Care Bridge.

Finally, **Chapter 9** presents a general discussion on the results of the studies in this thesis. A summary in English and Dutch concludes this thesis.

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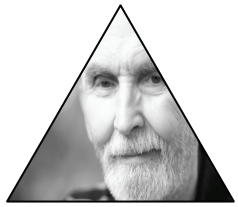


Chapter 2

Variability in Measuring (I)ADL Functioning and Functional Decline in Hospitalized Older Medical Patients: a Systematic Review

Journal of Clinical Epidemiology, 2011 Jun; 64(6):619-27

B.M. Buurman, B.C. van Munster, J.C. Korevaar, R.J. de Haan, S.E de Rooij

Abstract

Objective: to study instruments used and definitions applied in order to measure (Instrumental) Activities of Daily Living (ADL) functioning and functional decline in hospitalized older medical patients.

Study design: We systematically searched Medline, Embase and the Cochrane Database of Systematic Reviews from 1990- January 2010. Articles were included if they (1) focused on acute hospitalization for medical illness in older patients; (2) described the instrument used to measure functioning; (3) outlined the clinical definition of functional decline. Two reviewers independently extracted data.

Results: In total, 28 studies were included in this review. Five different instruments were utilized to measure functioning: the Katz ADL index, the IADL scale of Lawton and Brody, the Barthel index, Functional Independence Measure (FIM), and Care Needs Assessment (CNA). Item content and scoring between and within the instruments varied widely. The minimal amount for decline, as defined by the authors, referred to a decrease in functioning between 2.4% and 20.0%.

Conclusion: This review shows there is a large variability in measuring (I)ADL functioning of older hospitalized patients and a large range of clinical definitions of functional decline. These conceptual and clinimetric barriers hamper the interpretation and comparison of functional outcome data of epidemiological and clinical studies.

Introduction

Acute hospitalization in older patients is not without risk, as these patients are more prone to adverse events as compared to younger patients [1;2]. An important negative health outcome in this population is functional decline. Functional decline can lead to (permanent) disability and may lead to a prolonged hospital stay, institutionalization, and even death [3-5]. Medical patients are a vulnerable group for functional decline. They often present to the hospital with deterioration in functioning, as a result of an acute exacerbation of chronic multimorbid conditions. Not only in daily practice, but also in clinical research, functional decline has become a key outcome after hospitalization in older patients, supported by the working group on functional outcome measures in clinical trails [6]. Activities of daily living (ADL) and instrumental activities of daily living (IADL) are an essential part of patients' functional status, as is also demonstrated in the International Classification of Functioning from the World Health Organization (WHO). ADL and IADL functioning are located centrally in this model and affected by disease, impairment, personal factors and environmental factors [7].

Many studies focus on functional decline after acute hospitalization in older patients. A review of McCusker et al. already pointed out that there is a large variability in studies on functional decline, in terms of study design, analysis and time of follow-up [8]. In this article, however, relative little attention has been given to the measurement itself and the applied definitions of functional decline. Uniformity in measuring functional decline is essential for appraising study results and conducting meta-analyses. To achieve this uniformity, researchers should use reliable and valid instruments with clinically comparable item contents. Moreover, it is essential that there be agreement between what level of deterioration should be defined as 'decline' and at what time point this should be assessed.

The objective of this systematic review was to study the instruments used to measure (I)ADL functioning and functional decline in acutely hospitalized older medical patients.

Methods

Search strategy

We conducted a systematic literature search from 1990 – January 2010 in Medline, Embase and the Cochrane Database of Systematic Reviews (CDSR) to identify English articles on older hospitalized medical patients and functional decline. The following search terms were entered as independent terms, text words or MESH terms and later combined with Boolean term 'and': (1) *older patient* or *aged* or *elderly* or *senior*; (2*) acute hospitalization* or *medical illness* or *internal disease*; and (3) *functional decline* or *functional recovery* or *loss of independence* or *functioning* or *activities of daily living* or *disability* or *functional status*. Additionally, hand searches of reference lists of selected articles for this review were conducted to identify other relevant articles. The search strategy was performed by one of the authors (BB).

Study selection

Articles were included if they 1) focused on acute hospitalization for medical illness; 2) described which instrument was used to measure patients' functioning; and 3) outlined the clinical definition of functional decline. For this third point, articles had to describe two time points to measure functioning and had to indicate when a loss of function was defined as decline. All research designs were accepted except for case studies. As the main purpose of this review was to study the instruments used to measure functioning and the applied clinical definitions, we included all studies that reported on these topics, even if a study group published more than once on the same topic.

Studies which reported on a specific medical condition or diagnosis were excluded. For example, if an article solely focused on COPD and functioning, this was an exclusion criterion, as many disease-specific functional measurement instruments exist that can not be applied to a general population of acutely hospitalized older patients. Studies which reported on patients less than 60 years old were excluded as well. Studies conducted on geriatric ward were only included if the majority of patients were admitted for acute medical illness.

Data extraction

Data were independently abstracted by two investigators (BB and BM) in terms of study characteristics (patients' age, study group size, study setting and design) and properties of the measures used (type of instrument, item content, scoring procedure [patient, proxy or professional], scaling of the items, and score range). Additionally, we registered the time points of assessments and the (statistical) definition of functional decline applied. Baseline assessments were defined as *premorbid* in case the scoring referred to the situation two weeks or more before hospital admission, and were scored as *at admission* if the assessment took place at admission.

Disagreements in the abstracting of the data were solved by discussion. If no consensus could be reached, the final decision was made by a third reviewer (JK).

We intended to conduct a purely descriptive review on measurements and therefore did not screen the articles on study quality in itself.

Statistical analysis

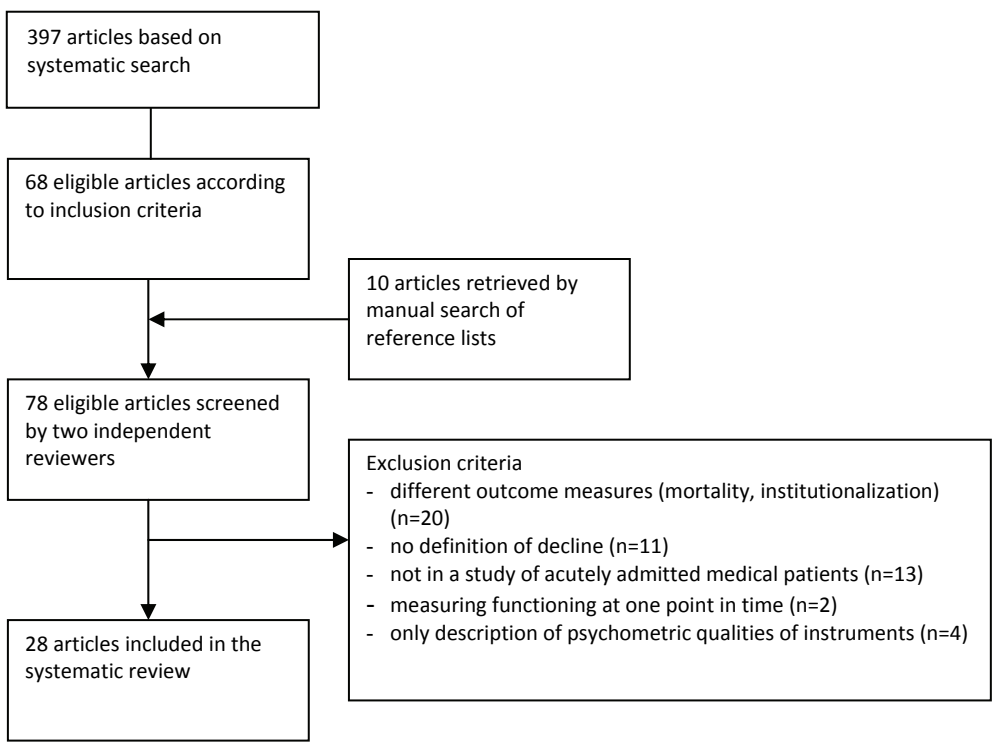
Study characteristics and properties of the measures were summarized using simple descriptive statistics. To compare the definition of functional decline applied in the different studies, minimal amount for decline as defined in the article was expressed in percentage change. Therefore, if an original range of scores was from 0-5 and the minimal amount for decline as indicated by the authors was one point, a patient 'declined' 20% of his ADL capacities.

Results

Search results

Combining all search terms resulted in 397 articles, of which 68 were eligible for the review based on title and abstract (Figure 1). Main reasons for initial exclusion were: functional decline or recovery was not the outcome measure, article did not concern acutely hospitalized medical patients, or studies that focused on specific diseases. A manual search of the reference lists of selected articles resulted in an additional ten studies.

Figure 1: Flow diagram of search strategy and study selection



The 78 studies that initially met the inclusion criteria were completely reviewed by the two reviewers. Of these studies, 20 were additionally excluded because they had

other outcomes (e.g. nursing home admission, functional status rather than decline or recovery), 11 studies did not described the measurement instrument used or did not yield a definition of functional decline or recovery, 13 studies were in other populations (community-dwelling elderly, patients from the Emergency Department), two studies reported on functioning at a certain time point and not compared functioning between two time points, and four studies focused solely on the psychometric properties of instruments. Finally, 28 articles were included for analysis. (Reference list of the complete search strategy available on request).

Characteristics of the studies

Table 1 presents the main characteristics of the included studies. There were three randomised clinical trials [9-11], one non-randomised clinical trial [12], all other studies were prospective cohort studies [4;13-35]. A total of 23 studies were conducted on medical wards [4;9-12;14;15;17;19-27;29-33;35], three studies on combined medical and geriatric wards [4;13;28] and two studies on geriatric wards [16;34]. The number of included patients varied from 45 to 5675 patients and weighted mean age across the studies was 78.4 years (range 73-84 years), percentage of included females was 57.2%.

All studies focused on (I)ADL functioning of patients. Twenty out of 28 studies use premorbid functioning as the baseline measurement in defining change over time [4;9;11-14;16-18;20;21;24-27;29-31;34;35]. Although most studies used more than one endpoint for decline, ADL function during hospital admission or at hospital discharge was identified as the primary endpoint in 20 studies [4;9;10;14-16;19-25;27;28;30;31;33;34]; the remaining eight studies used a two weeks after admission to six month period after discharge [11-13;17;18;26;29;32;35].

In 17 studies, the instruments were scored by patients or by proxies for patients with cognitive impairment [4;9-14;18-20;22;28;30-34]. In seven studies, the instruments were scored by professionals [15-17;21;23-25]. In the remaining studies the instruments were filled in by either the patient or the proxy [26;27;29;35].

Table 1: Main characteristics of the included studies

Study no	Author	Year	Setting	No of pts	Mean age	Instrument	Baseline functioning	Primary outcome decline	Scored by
1	Corsonello [19]	2009	medical	506	80	Katz ADL	Admission	discharge	patient or proxy
2	Leff [12]	2009	medical	214	77	Katz ADL	Premorbid	2 weeks after admission	patient or proxy
3	Inouye [23]	1993a	medical	330	78	Katz ADL	Admission	discharge	professional
4	Brown [15]	2004	medical	498	79	Katz ADL	Admission	discharge	professional
5	Murray [29]	1993	medical	325	81	Katz ADL	Premorbid	3 months	proxy
6	Chaudry [17]	2004	medical	862	80	Katz ADL	Premorbid	6 months	professional
7	Sager [31]	1996a	medical	827	79	Katz ADL	Premorbid	discharge	patient or proxy
8	Inouye [24]	1993b	medical	216	81	Katz ADL	Premorbid	discharge	professional
9	Cornette [18]	2005	medical/ geriatric	550	80	Katz ADL	Premorbid	3 months	patient or proxy
10	Maraldi [28]	2006	medical/ geriatric	5675	81	Katz ADL	Admission	discharge	patient or proxy
11	Landefeld [10]	1995	medical	651	80	Katz ADL	Admission	discharge	patient or proxy
12	Inouye [25]	1998	medical	727	79	Katz ADL	Premorbid	discharge	professional
13	Counsell [9]	2000	medical	1531	80	Katz ADL	premorbid	discharge	patient or proxy
14	Covinsky [20]	2003	medical	2293	80	Katz ADL	Premorbid	discharge	patient or proxy
15	Lindenberger [27]	2003	medical	1557	78	Katz ADL	Premorbid	discharge	patient
16	Holroyd-leduc [22]	2007	medical	535	82	Katz ADL	Admission	Discharge	patient or proxy
17	Lang [26]	2007	medical	619	83	Katz ADL	Premorbid	1 month	patient
18	Boyd [14]	2008	medical	2279	80	Katz ADL	Premorbid	discharge	patient or proxy
19	Sands [32]	2003	medical	193	80	Katz ADL/IADL Lawton/ mobility	Admission	3 months	patient or proxy
20	Sager [30]	1996b	medical	1279	79	Katz ADL/ IADL Lawton	Premorbid	discharge	patient or proxy
21	Sands [33]	2005	medical	2364	80	Katz ADL/ IADL Lawton	Admission	discharge	patient or proxy
22	Mahoney [15]	1999	medical	1212	79	Katz ADL/ IADL lawton	Premorbid	3 months	patient or proxy
23	Sleiman [34]	2009	geriatric	1119	81	Barthel index	Premorbid	discharge	patient or proxy
24	Jarrett [4]	1995	medical	193	78	Barthel index	Premorbid	discharge	patient or proxy
25	Andrew [13]	2005	medical/ geriatric	77	79	Barthel index	Premorbid	6 months	patient or proxy
26	Hirsch [21]	1990	medical	71	84	CNA*	Premorbid	discharge	professional
27	Carlson [16]	1998	geriatric	122	73	FIM †	Premorbid	discharge	professional
28	Wakefield [35]	2007	medical	45	74	FIM	Premorbid	day 4 of admission	patient

* CNA= Care Needs Assessment

† FIM= functional independence measure

Instruments used to measure functioning

We identified five different instruments which were used to measure the functioning of patients (Table 1): The Katz ADL index (22 studies) [9-12;14;15;17-20;22-33], Barthel index (three studies) [4;13;34], Care Needs Assessment (CNA; one study) [21] and Functional Independence Measure (FIM; two studies) [16;35]. Four studies that used the Katz ADL index also measured Instrumental Activities of Daily Living (IADL) by Lawton and Brody and used the combination of ADL and IADL in the definition of functional decline [11;30;32;33]. Most other studies did measure IADL functioning, but this type of functioning was not included in the definition of functional decline. See Table 2 for a short description of measurement instruments included in this review.

Table 2: Short description of instruments included in the review

Instrument	Number of items	Scaling	Range of scores	Complete independence
Katz ADL index [38]	6	Dichotomous	0-6	6
IADL by Lawton and Brody [47]	8	Dichotomous	0-8	8
Barthel index [48]	15	Likert scale, scaling differs per item	0-100	100
Functional Independence Measure [49]	18	7-point Likert scale	18-126	126
Care Needs Assessment [21]	7	3-point Likert scale	0-14	14

Content of the instruments

The fourth column of Table 3 shows the content of the identified scales. Only one out of the 22 studies that referred to the original Katz ADL scale actually used the complete original content of this scale [25]. Four studies that also assessed IADL as part of functional decline, measured this concept according to the original content of the scale [11;30;32;33]. This was also true for the three studies that used the Barthel index [4;13;34]. For the only study that utilized the CNA, judgment of the original content was not relevant, as this

instrument was developed in this study [21]. Both studies that applied the FIM did not use the original items completely [16;35].

Table 4 shows the items of the different versions of the Katz ADL index as was used in the 22 studies [9-12;14;15;17-20;22-33]. The original content of the scale is highlighted in grey. The item content varied widely between studies, although some items were measured in all studies. Based on the original content, 100% uniformity was found on the items: dressing, bathing, eating and toileting [9-12;14;15;17-20;22-33]. Transferring from bed-chair was measured in 82% of the studies [9-12;14;17;19;20;22;25-29;31-33;36] and incontinence in 14% of the studies [18;19;25].

Definition of functional decline

The minimal amount of decline, as defined in the different studies, varied between 2.4% and 20% (Table 3, last 2 columns). In studies where functioning was measured with the Katz ADL index , the minimal amount of decline referred to a decrease in the level of functioning between 3.6% and 20% [9;10;12;14;15;17-20;22-29;31]. In studies that also incorporated IADL functioning, the minimal decline referred to a decrease between 5.9% and 8.3% [11;30;32;33]. Two studies with the Barthel index used the same definition of a minimal amount of decline (10%) [4;13], one only described return to baseline functioning [34]. In the two studies using the FIM, the minimal level of decline ranged from 2.4% to 7.7% [16;35]. In the study with the CNA, decline was not defined with a cut-off score measure, but as a restoration to baseline functioning [21].

Table 3: Instrument content and definition of decline of included studies

Study No	Author	Instrument	Original Content	Original item scaling	Range of total scores	Original Cut off for decline	Standardized cut off for decline
1	Corsonello [19]	Katz ADL			0-28	1 point	3.6 %
2	Leff [12]	Katz ADL			0-25	1 point	4.0 %
3	Inouye [23]	Katz ADL			0-10	1 point	10.0%
4	Brown [15]	Katz ADL			0-10	1 point	10.0%
5	Murray [29]	Katz ADL		X	0-7	1 point	14.3%
6	Chaudry [17]	Katz ADL		X	0-7	1 point	14.3%
7	Sager [31]	Katz ADL		X	0-6	1 point	16.7%
8	Inouye [24]	Katz ADL	X	X	0-6	1 point	16.7%
9	Cornette [18]	Katz ADL		X	0-6	1 point	16.7%
10	Maraldi [28]	Katz ADL		X	0-6	1 point	16.7 %
11	Landefeld [10]	Katz ADL		X	0-5	1 point	20.0%
12	Inouye [25]	Katz ADL		X	0-5	1 point	20.0%
13	Counsell [9]	Katz ADL		X	0-5	1 point	20.0 %
14	Covinsky [20]	Katz ADL		X	0-5	1 point	20.0%
15	Lindenberger [27]	Katz ADL		X	0-5	1 point	20.0%
16	Holroyd-leduc [22]	Katz ADL		x	0-5	1 point	20.0%
17	Lang [26]	Katz ADL		x	0-5	1 point	20.0%
18	Boyd [14]	Katz ADL		x	0-5	1 point	20.0 %
19	Sands [32]	Katz ADL / IADL/mobility	only IADL	x	0-17	1 point	5.9%
20	Sager [30]	Katz ADL/ IADL	only IADL	x	0-13	1 point	7.7%
21	Sands [33]	Katz ADL/ IADL	only IADL	x	0-13	1 point	7.7 %
22	Mahoney [15]	Katz ADL / IADL	only IADL	x	0-12	1 point	8.3%
23	Sleiman [34]	Barthel index	X	x	0-100	return to BL score †	-
24	Jarrett [4]	Barthel index	X	x	0-100	10 points	10.0%
25	Andrew [13]	Barthel index	X	x	0-100	10 points	10.0%
26	Hirsch [21]	CAN	NA *	NA *	0-14	return to BL score †	-
27	Carlson [16]	FIM		x	7-49	1 point	2.4%
28	Wakefield [35]	FIM			0-13	1 point	7.7%

NA= not applicable
BL= baseline score

Discussion

This systematic review showed that there is to some extent conceptual uniformity in measuring functioning of patients in terms of ADL, but far less uniformity in the operationalisation of this concept and the definition of functional decline. Only three out of 28 studies applied the complete original content of the instrument they referred to, whereas the cut-off scores reflecting functional decline ranged from about 2% to 20% of the instruments' total score range.

This review stresses a strong need for standardization in measuring functioning of hospitalized older medical patients and the use of clinical definitions of functional decline. As long as no consensus is reached regarding this subject, it would be difficult or even impossible to compare research outcomes of studies reporting the incidence of functional decline and its predictors, or to perform systematic reviews and meta-analyses. This finding adds to the conclusion of an earlier review regarding predictors of functional decline [8]. In the road to standardization in measuring functioning several questions needs to be answered.

One of the first questions is how broad the disability continuum should be defined. The International Classification of Functioning, disability and health (ICF), published by the World Health Organisation provides an internationally adapted framework on functioning of patients. Hébert already discussed the importance of this theoretical framework in relation to the functional decline syndrome [37]. In our review almost all articles on functional decline however, have operationalised functional decline solely in terms of ADL functioning of patients. Some researchers extend this continuum by also measuring patients' ability to perform complex activities in terms of IADL, but, only few did include this type of activity in their definition of functional decline.

The Katz ADL index instrument was applied in the vast majority of the studies included in our review. However, there was a substantial difference between the studies with regard to the encompassed scale items and scoring. Bathing, dressing, toileting, eating and, to some extent, transfer turned out to be the core of the instruments, but this was less true for the assessment of incontinence.

Table 4: Variability of items within Katz ADL

			ADL items						Mobility		
Study no	**Author**	**Measure**	**Bathing**	**Dressing**	**Toileting**	**Eating**	**Continence**	**Grooming**	**Transfer**	**Walking**	**Stairs**
1	Corsonello [19]	Katz ADL	x	X	X	x	x		x	x	
2	Leff [12]	Katz ADL	x	X	X	x			x		
3	Inouye [23]	Katz ADL	x	X	X	x		x			
4	Brown [15]	Katz ADL	x	X	X	x		x			
5	Murray [29]	Katz ADL	x	X	X	x		x	x	x	
6	Chaudry [17]	Katz ADL	x	X	X	x		x	x	x	
7	Sager [31]	Katz ADL	x	X	X	x			x	x	
8	Inouye [24]	Katz ADL	x	X	X	x		x			
9	Cornette [18]	Katz ADL	x	X	X	x	x			x	
10	Maraldi [28]	Katz ADL	x	X	X	x		x	x		
11	Landefeld [10]	Katz ADL	x	X	X	x			x		
12	Inouye [25]	Katz ADL	x	X	X	x	x		x		
13	Counsell [9]	Katz ADL	x	X	X	x			x		
14	Covinsky [20]	Katz ADL	x	X	X	x			x		
15	Lindenberger [27]	Katz ADL	x	X	X	x			x		
16	Holroyd-leduc [22]	Katz ADL	x	X	X	x			x		
17	Lang [26]	Katz ADL	x	X	X	x			x		
18	Boyd [14]	Katz ADL	x	X	X	x			x		
19	Sands [32]	Katz ADL	x	X	X	x			x	x	X
20	Sager [30]	Katz ADL	x	X	X	x			x	x	
21	Sands [33]	Katz ADL	x	X	X	x			x		
22	Mahoney [11]	Katz ADL	x	X	X	x			x		
	% of studies measuring this item		**100**	**100**	**100**	**100**	**14**	**27**	**82**	**32**	**5**

Some studies did not incorporate incontinence in the Katz, because of the low reliability when asked in self reports. However, both in the original version [38] and in the modified version [39], incontinence was included when validating the index. Inouye et al. suggested that the presence of geriatric syndromes, such as incontinence, reveal the frailty or vulnerability of a patient [40]. In the clinical setting measuring the presence of incontinence might bring up some difficulties, as part of the patients get an indwelling urinary catheter at the time of hospital admission. This could be resolved by consensus on how to handle this question at the time of hospital admission.

An important feature is the reliability, validity and responsiveness of the measurement instruments. This problem is amplified by the ordinal nature of summated scores, meaning that a given difference in scores at one point on the scale does not necessarily represent the same amount of functional change as an identical difference at another point on the scale. Modern clinimetric methods, based on item response theory (IRT) can overcome these problems. An advantage is that not all items of an instrument have to be assessed in all patients to determine their level of functioning. This allows the user to obtain a sufficiently detailed clinical picture using a small number of items. It not only leads to more efficient data collection, but the scores of different subgroups are comparable as the difficulty of each item has been estimated beforehand. Two examples of scales that use IRT are the Amsterdam Linear Disability scale and interRAI Acute Care instrument [41;42]. Although the interest in the use of this promising measurement paradigm has grown, and IRT is gaining acceptance in various fields of medical research [43;44] , IRT is not yet been widespread implemented in patient care and clinical outcome research.

We also aimed to study the clinical definitions of functional decline used in studies among older hospitalized medical patients. Twenty out of 28 studies used premorbid functioning as the starting point to measure functional decline. One important argument to focus on premorbid functioning as starting point, is that there is evidence that many acutely hospitalized patients declined in the short period before hospital admission [16;20]. A major purpose of interventions should be to bring patients back to their initial premorbid level of functioning.

The majority of the studies selected functioning at hospital discharge as the endpoint of interest. However, one can challenge the rational of this time point. A study in community dwelling older patients demonstrated that the process of functional decline and recovery is a dynamic process. Gill et al. measured ADL functioning of patients monthly and showed that up to six months after patients declined in functioning, they were able to recover, but were also more vulnerable to decline again after six months [45]. This might suggest that after hospital discharge, patients have the capacity to further recover. More studies on this process are needed, also to discuss if an appropriate time

point for the measurement of functional decline can be identified. This might also depend on patient group, treatment and rehabilitation goals.

Next to the definition of the appropriate time frame in which functional decline is measured, more discussion is needed regarding the optimal scale cut-off scores used to define decline. We demonstrated that a minimal decline score as applied in different studies varied substantially. The question remains when we should speak of a clinical relevant decline in functioning. This could be defined objectively, by deciding clinical relevant decline is if a patient declines for example 5% of its actual functioning, or 20%. And should this deterioration be measured in absolute scoring terms or in relative terms by incorporating patient's initial level of functioning?

Additionally, the patient perspective on functional decline has not been described frequently, which hampers a well-balanced definition of clinical relevant decline. Winograd et al reported that patients' self report of functioning is an essential predictor of actual decline 12 months after hospitalization [46]. Further studies on this topic are lacking.

In summary, our review showed that there is a large variability in measuring (I)ADL functioning of older hospitalized medical patients and a large range of clinical definitions of functional decline. These conceptual and clinimetric barriers hamper the interpretation and comparison of functional outcome data of epidemiological and clinical studies. In view of the range of complex methodological questions to be answered on the road to standardization of measuring functioning of older (hospitalised) patients, we propose that a task force with key informants will pick up these questions. This could for example be done by the Working Group on Functional Outcomes, as ADL functioning forms an important part of patients' functional status. Furthermore, focus group sessions with patients could give important additional information, regarding the patients' perspective on how they appraise functional decline and the acceptable boundaries.

The agenda of this taskforce should at least consist of the following topics; 1) which activities of daily functioning should be incorporated in the disability continuum; 2) which psychometrically sound instrument(s) should be used to measure the functioning of patients; 3) what should be the optimal time frame in which functional decline is assessed;

and 4) which clinical and scale-score related statistical definition of functional decline should be used, according to both the medical and patient perspective.

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Chapter 3

Risk for Poor Outcomes in Older Patients Discharged from an Emergency Department: Feasibility of Four Screening Instruments

European Journal of Emergency Medicine.
(in press)

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Abstract

Objectives: To compare the prognostic value of four screening instruments used to detect risk for poor outcomes (in terms of likelihood of recurrent emergency department (ED) visits, hospitalizations, or mortality) for older patients discharged home from an ED in the Netherlands.

Methods: Prospective cohort study. All consecutive patients of 65 years and older discharged from the ED of an university teaching hospital in the Netherlands, between December 1st, 2005, and November 1st, 2006 were included. Four screening instruments were tested: the Identification of Seniors At Risk (ISAR), the Triage Risk Screening Tool (TRST), and the Runciman and Rowland questionnaires. The cut-off of the Runciman questionnaire was adapted and age cut-off was adapted for the other instruments. Recurrent ED visits, subsequent hospitalization and mortality within 30 and 120 days after the index visit were collected from administrative data.

Results: In total, 381 patients were included, with a mean age of 79.1 years. Within 120 days, 14.7 % of the patients returned to ED, 17.2 % were hospitalized, and 2.9 % died. The area under the curve was low for all instruments (between 0.43 and 0.60), indicating poor discriminatory power.

Conclusion: Older ED patients discharged home are at high risk for poor outcomes. None of the instruments were able to clearly discriminate between patients with and without poor outcomes. Differences in organisation of health care systems might influence the prognostic abilities of screening instruments.

Introduction

The percentage of people of 65 years and older will nearly double in the next 25 years. In the Netherlands this percentage will increase from 13% in 2005 to 24% in 2030 [1]. The ageing of the population will be accompanied by a rise in the absolute number of patients with multimorbidity (defined as the presence of two or more chronic conditions) and disabilities. Consequently, older patients will place a higher burden on health care systems.

At present, older patients are already overrepresented among emergency department (ED) admissions, and they use ED services more frequently than younger patients [2]. Due to their multimorbid conditions and concomitant disabilities, older patients are at higher risk for recurrent visits to the ED, subsequent (preventable) hospital admissions, (preventable) adverse drug events, functional decline, and institutionalisation [3-7]. These negative outcomes may require a different approach toward older patients admitted to the ED. Systematic screening to identify high risk patients may help professionals apply appropriate interventions and protect this vulnerable patient group from adverse outcomes [8].

For this purpose, four screening instruments aimed at detecting high risk patients in the ED have been developed and validated: the Identification of Seniors At Risk (ISAR) [9], the Triage Risk Screening Tool (TRST) [10], the Runciman questionnaire [11], and the Rowland questionnaire [5]. These instruments have been developed for the Canadian, North American and United Kingdom health care environments. The health care systems differ significantly between these countries, however, and the use of these instruments in other (Western) countries necessitates not only cross-cultural validation, but also proof of feasibility due to differences in the organisation of the national systems of care as well as regulatory barriers. Moreover, these screening instruments have never been compared directly in a single sample using more than one adverse outcome [12] and have not been validated in the Dutch health care setting.

The aim of this study was to compare the four screening instruments in terms of their ability to predict poor outcomes in older ED patients, defined as recurrent ED visits,

hospitalisations, or mortality 30 and 120 days after discharge from an ED in the Netherlands.

Methods

Study design

This prospective cohort study was conducted during an 11-month period starting December 1st, 2005, until November 1st 2006, in a 1024-bed tertiary university teaching hospital in the Netherlands. All community living older patients aged 65 years and over visiting the ED and subsequently discharged home were invited to participate. Patients were excluded if we were unable to contact them shortly after discharge (defined as not able to contact them within four days), if they were unable to speak or understand Dutch, or if they did not provide informed consent. Due to logistic reasons, we could not cover a 24-hour presence on the ED during the study period and therefore included patients within two days after discharge from the ED. The Institutional Review Board of our hospital approved the study.

The Emergency Department in the Netherlands [13]

An ED visit in the Netherlands does not exceed a stay of more than 24 hours. Within this maximum timeframe, patients are hospitalised, discharged to their homes, or discharged to special care outside the hospital (e.g., nursing home or intermediate care). The ED is staffed by staff specialists, residents and interns. Emergency Medicine is a board specialty in the Netherlands. Nurses employed in the ED are registered nurses with additional training in emergency nursing. Neither the nursing nor the medical education provided special training in geriatric nursing or geriatric medicine. There is universal health coverage for patients by the Health Care Insurance Act and all patients have a general practitioner who is able to follow-up patients after discharge from an ED.

Baseline assessment

All charts of patients who were discharged home after an ED visit were reviewed by the research team (a research nurse and geriatrician) within two days after discharge to identify patients eligible for inclusion. After inclusion, a trained research nurse in geriatrics performed telephone interviews to assess functional status at the time of the ED visit. Fall risk was assessed by asking patients if they had been fallen one or more times in the past six months. Hearing impairment and/or visual impairment was present if a patient expressed that (s)he had hearing or vision problems, irrespective of the use of a hearing aid or glasses. Physical functioning was assessed using the original Katz ADL index score [14;15]. The presence of depressive symptoms was measured with a shortened version of the Geriatric Depression Scale (GDS) [16]. This version measures two symptoms of depression: a lack of interest in activities that used to be pleasurable and persistent feelings of sadness or anxiety. If both symptoms were present, patients were scored as having depressive symptoms. Socio-demographic data, including educational level, marital status, and living arrangement were collected as well.

Number and type of medications used by patients was collected from the medical ED chart. Diagnosis at ED discharge was also registered from the medical ED chart and classified into eight ICD-9 based categories: infectious disease, cardiovascular disease, digestive system disease, renal/urological problem, neurological disease, trauma, orthopaedic problem, and 'other' diagnoses.

Screening instruments

The four screening instruments were completed in the telephone interview by the research nurse, together with the baseline assessment. Table 1 gives a brief overview of the item content and scoring of the instruments.

Briefly, the ISAR is a six-item questionnaire administered to patients of 65 years and older and is aimed at assessing risk for functional decline and other adverse health outcomes [9]. The TRST is also a six-item questionnaire. The TRST has been validated in patients of 75 years and older, at risk for functional decline [17], repeat ED visits, and

rehospitalisation [10]. The Runciman questionnaire consists of 11 items and was developed for patients of 75 years and older and assesses risk for functional decline [11]. The cut off score of the Runciman questionnaire was adapted, as with the original cut off score of ≥ 2, 98% of the patients were at increased risk for negative outcomes on this screening instrument. The Rowland questionnaire consists of seven items and focuses on the patients of 75 years and older who are at high risk for ER readmission [5].

Table 1: Item Content and Scoring of the Four Screening Instruments

Instrument	Cut off score	Year	Country of development	Number of items	Age (years)	Items	Developed or Validated to detect patients at risk for
ISAR [9]	≥ 2	1999	Canada	6	≥ 65	1. Activities of daily living 2. Instrumental activities of daily living 3. Recent hospitalisation 4. Visual impairment 5. Cognitive problems 6. Use of 3 or more different medications	Functional decline Readmission Hospitalisation Depression Mortality Institutionalisation
TRST [10]	≥ 2	2003	United States	6	≥ 75	1. Cognitive impairment 2. Difficulty walking 3. Recent fall or transfer problems 4. Living alone 5. Five or more different medications 6. Recent hospitalisation or recent ED visit 7. Nurse concerns	Functional decline Recurrent ED visits Hospitalisation
Runciman [11]	≥ 3*	1996	United Kingdom	11	≥ 75	1. Presence of soft tissue injury 2/3 Travelling alone before and after ED visit 4/5 Needing help with shopping before and after ED visit 6/7 Needing help with dressing before and after ED visit 8. Use of diuretics 9. Problems with 'water works' 10. Use of a walking aid 11. Remember an address earlier given	Functional decline Readmissions
Rowland [5]	≥ 2	1990	United Kingdom	7	≥ 75	1. Use of walking aid 2. Needing help with dressing 3. Needing help with finance 4. Needing help with grocery shopping 5. Use of day care 6. Use of meal device 7. Needing professional home care	Readmissions

*Cut off score was adapted; original cut off was ≥ 2

Poor outcome at follow up

Outcomes were registered at two points in time: at 30 days and 120 days. Within 120 days, problems associated with the reason for the ED visit will often become visible;

following patients longer increases the likelihood of significant, new medical events and can, therefore, bias results.

The "recurrent visit to the ED" was the first visit to the ED after the index visit within 30- 120 days. "Hospitalisation" was the first hospital admission after the initial discharge from the ED within 30- 120 days. Patients who were hospitalised directly after the index visit were excluded from our study. We only registered unplanned readmissions to the hospital. If patients were hospitalised after a recurrent ED visit, they were both scored as recurrent visitors to the ED and also scored as "hospitalised." Mortality was registered up to 30- 120 days after discharge from the ED; this information was abstracted from the municipal data registry system. A combined endpoint "poor outcome" was also calculated which was defined as a recurrent visit to the ED and/or hospital admission and/or mortality within 30- 120 days.

Statistical analyses

Baseline characteristics, screening test results, and the prevalence of poor outcome indicators were summarised using descriptive statistics. Analyses of the prognostic value of the four screening instruments were performed with the aid of 2x2 tables, with poor outcome indicators and positive screening test results included as either present or absent. Prognostic abilities were expressed in terms of sensitivity, specificity, and the a**rea** under the ROC curve (AUC) with 95% confidence intervals (CI). We also calculated the positive predictive and 1-negative predictive values, indicating the chance of a poor outcome given a positive and negative test result, respectively. All analyses were performed in SPSS, version 16.

Results

In total, during the study period 2368 patients of 65 years and older visited the ED of which 505 patients were eligible (Figure 1). Of these patients, 124 (25%) were excluded because we were unable to contact them after ED discharge (n=76), because they declined to participate (n=36), or because they had insufficient Dutch language capabilities (n=12). A total of 381 patients were included in the study. Of all older patients (n=2368) visiting the ED, 79% was hospitalised, whereas 21% was discharged home. The latter group was the eligible patients for inclusion. After inclusion, there was attrition of patients in the follow up period. There were no significant differences between included and excluded patients with regard to age, sex, social status and living arrangement [data available on request]

Figure 1 Flow diagram of patient selection and inclusion

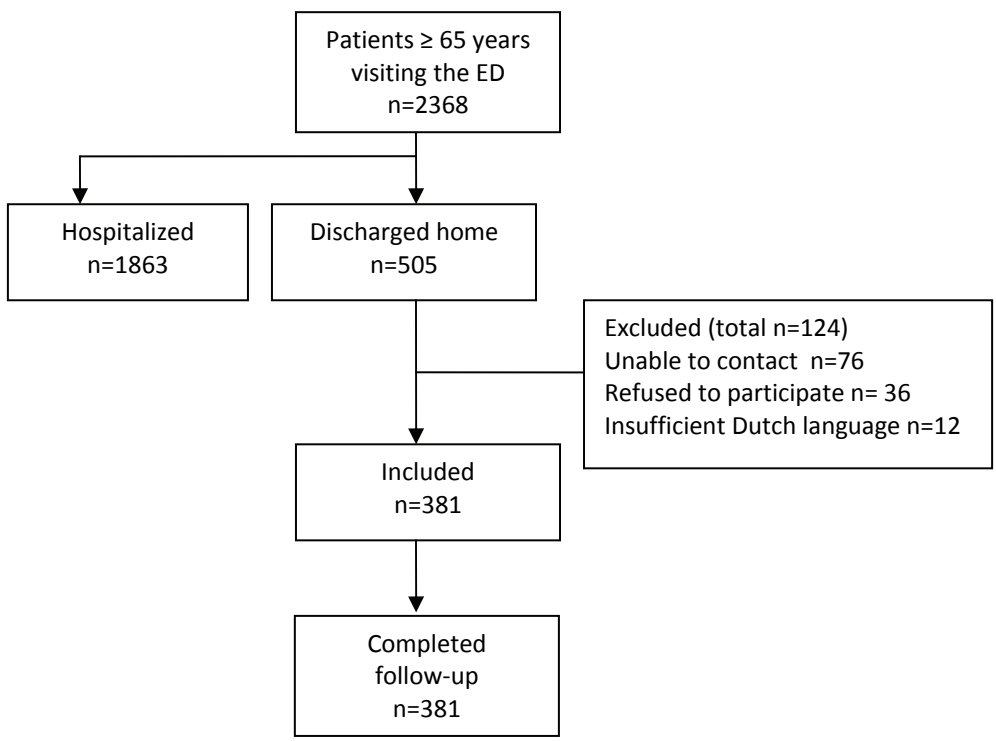

Table 2 presents the baseline characteristics of the study population. The mean age was 79 years (standard deviation (SD) 6 years), 39% were male and 73% had no functional limitations at the time of their ED visit.

After 30 days, the return rate to the ED was 6.3%; a total of 7.6% of the patients were hospitalised and 0.8% of the patients died. Within 120 days, 14.7 % of the discharged patients returned to the ED, 17.2 % were hospitalised, and 2.9 % died. Overall, 9.2% of the patients had a poor outcome within 30 days and 19.7% within 120 days (Table 2).

Table 2: Baseline Characteristics of Older Patients Discharged from the Emergency Department (n=381)

Variable	Patients
Demographic	
Age*	79.1 (6.3)
Male (%)	38.8
Years of education	8.4 (2.8)
Caucasian (%)	93.4
Marital status	
Alone (%)	52.2
Living arrangement	
Living independently (%)	79.0
Senior residence (%)	14.2
Other (%)	6.8
Functional status at admission	
1 or more fall(s) in the past 6 months (%)	7.3
Hearing impairment (%)	10.8
Visual impairment (%)	8.4
Depression symptoms (%)	19.1
Limitations on KATZ-ADL index	
0 limitations (%)	73.2
1-3 limitations (%)	21.5
4-6 limitations (%)	5.3
Status at ED visit	
Number of medications*	3.8 (2.9)
Diagnosis at ED Discharge	
Infectious disease (%)	10.8
Cardiovascular disease (%)	8.1
Disease of the digestive system (%)	8.4
Renal/urological disease (%)	4.2
Neurological disease (%)	5.8
Trauma and orthopedic problems (%)	48.2
Other (%)	14.4

* Mean and SD are given for continuous variables

Table 3 indicates the prognostic abilities of the ISAR, the TRST, the Runciman questionnaire, and the Rowland questionnaire in relation to recurrent visits to the ED, hospitalisation, mortality, and overall poor outcomes 120 days after ED discharge. Positive test results for the ISAR, TRST, Runciman and Rowland questionnaire were: 49.1%, 68.2%, 76.1% and 18.6%, respectively. Sensitivity and specificity rates across the different poor outcome indicators varied between the screening instruments. The Runciman questionnaire showed high sensitivity but low specificity, whereas the Rowland questionnaire suggested a contrasting picture. Changing cut off points for both instruments did not improve prognostic abilities. With the exception of the mortality endpoint, the TSRT was more sensitive and less specific than the ISAR. However, the AUC values of all screening instruments indicated poor overall discriminatory power. None of the instruments were able to clearly discriminate between patients with and without poor outcomes. This could also be observed by the predictive values: post-test probabilities of poor outcome indicators were only slightly changed by the results on the screening tests. Analyses on the 30-day outcomes had the same results [data available on request].

Table 3: Prognostic Value of Four Screening Instruments, 120 days after Discharge from the Emergency Department (n=381)

Instrument	Prevalence Poor Outcomes (%)	Sensitivity	Specificity	Positive Predictive Value (%)	1-Negative Predictive Value (%)	AUC (95 % CI)
Recurrent visit to the ED						
ISAR	14.7	0.56	0.54	19	10	0.59 (0.51 to 0.67)
TRST		0.79	0.33	17	10	0.56 (0.48 to 0.64)
Runciman		0.85	0.12	14	17	0.49 (0.40 to 0.58)
Rowland		0.23	0.82	18	14	0.53 (0.44 to 0.61)
Hospitalisation						
ISAR	17.2	0.65	0.54	22	12	0.59 (0.52 to 0.67)
TRST		0.77	0.33	19	13	0.55 (0.49 to 0.63)
Runciman		0.85	0.12	17	18	0.48 (0.40 to 0.57)
Rowland		0.23	0.83	23	16	0.54 (0.46 to 0.62)
Mortality						
ISAR	2.9	0.64	0.51	4	2	0.58 (0.41 to 0.74)
TRST		0.55	0.31	2	4	0.43 (0.25 to 0.61)
Runciman		0.78	0.12	2	5	0.44 (0.25 to 0.65)
Rowland		0.27	0.82	4	3	0.54 (0.36 to 0.73)
Poor outcomes (combined)						
ISAR	19.7	0.65	0.54	26	13	0.60 (0.53 to 0.67)
TRST		0.75	0.33	22	16	0.54 (0.47 to 0.61)
Runciman		0.86	0.12	19	23	0.49 (0.41 to 0.57)
Rowland		0.25	0.83	27	18	0.54 (0.47 to 0.62)

Discussion

This study of discharged older ED patients demonstrated that poor outcomes after an ED visit are a common problem. Fifteen percent of non-hospitalised older patients returned to the ED within 120 days, and almost all of the returning patients were subsequently hospitalised. When combining the different outcome indicators, about one-fifth of the patients suffered from a poor outcome. None of the screening instruments studied were sufficiently able to predict and discriminate between patients with and without poor outcomes.

The prognostic properties of these screening instruments were mostly in disagreement with other studies. The ISAR was developed and validated to detect a broad range of adverse health outcomes. Focusing on health care utilisation, the AUCs were higher in previous studies, ranging from 0.61 to 0.71 [18;19]. Studies on the TRST showed conflicting results. Two studies indicated that the TRST had moderate to acceptable AUCs, ranging from 0.64 (functional decline and composite endpoint health care utilisation) to 0.72 (hospitalisation) [10;17], whereas another study concluded that the TRST should not be used as a screening tool because it lacks clinically meaningful diagnostic abilities [20]. The Runciman and Rowland questionnaires were developed to detect patients at high risk for functional decline and readmission to the ED. One small study compared both instruments on their predictive power in detecting patients at risk for readmission to the ED and found much higher AUCs (0.63- 0.74) than those in our study [21].

There could be some explanations for the differences found between the diagnostic abilities of the four instruments used in this study as compared with earlier studies. The ISAR has been developed and validated in Canada. In Canada, patients can stay for up to three days in the ED, whereas in the ED in most European countries, this stay is limited to a maximum of 24 hours (usually 2-6 hours). This might influence the case mix of patients on the ED.

The TRST was developed in the US, where the insurance policies are different and the system of general practitioners (GP) does not provide for all US inhabitants. In the Netherlands, as in most other European countries, all inhabitants are obligated to have

health care insurance and, moreover, all civilians have a GP. Patients are supposed to contact their GP in the case of (sub)acute health problems, and the GP decides whether a patient should be referred to ED. Only on weekends, in the evenings, during the night and in an emergency, can patients go directly to the ED. Of all older patients visiting the ED in this study, 79% were hospitalised, whereas 21% were discharged to their homes. This percentage of hospitalisations is higher than in the United States, where hospitalisation rates after an index ED visit varied between 33% and 50% 2;4. The 100% availability of a GP might influence the hospitalisation rate after the index ED visits, as only seriously ill patients will be sent in. This could also explain why the studied screening instruments did not perform well. The patients admitted to an ED in the Netherlands might be more ill due to selection by their GP. Additionally, a GP can provide the patient with a follow-up after the ED visit, which might prevent ED readmission. Rates of return visits to the ED and subsequent hospital admissions were higher in the US and Canada [2;4]; this might be attributed to a lack of a GP who can treat the patient.

Differences in the organisation of health care cannot, however, be the only explanation, as the Runciman and Rowland questionnaires were developed in Europe and were also unable to identify patients at risk. We also found significant differences in the prognostic abilities of the screening instruments compared to a Belgian study [21]. Although this study focused solely on readmissions, much higher AUCs were found for the screening instruments. The organisation of health care in Belgium is quite similar to the Netherlands. The Belgian study represents a small sample, with a lower median age compared to our study (74 years vs 78 years) and found much higher readmission rates at 120 days (33% vs 15%). This could be an explanation for the differences in prognostic abilities.

Several shortcomings of our study should be recognized. Due to logistic reasons we were not capable to cover a 24-hour presence on the ED to screen patients. We therefore had to choose either to see patients on weekdays in daytime or to contact all discharged patients by telephone after discharge. As the primary health care is well organized, we expected to see a selection of patients if we would only include patients on weekdays. In evening and night shifts more self-referral patients attend to the ED and this

could have given bias. Therefore we decided to phone all discharged patients. Our approach however could have introduced selection bias, as patients with for example cognitive impairment or many disabilities were not able to answer the telephone call.
Our study was a single centre study, in a tertiary university teaching hospital, which could have influenced the case mix of patients seen on the ED. Furthermore, we registered only return visits to the ED and hospitalisations in our own hospital. This could lead to an underestimation of the actual number of visits to the ED and hospitalisations.

The TRST and the Runciman and Rowland questionnaires were validated for patients of 75 years and older at risk for functional decline or readmissions, whereas we included patients of 65 years and older. This could have influenced the prognostic value of these instruments. In our study, only discharged patients after an ED visit were included, whereas the ISAR was validated to screen all ED patients either hospitalised or discharged after an ED visit. This might influence the a priori likelihood of a poor outcome. All other screening instruments were developed and validated to detect older patients at risk for poor outcomes after discharge from an ED.

Screening at the ED can be a helpful first step in preventing adverse outcomes in older, non-hospitalised patients. A systematic review of McCusker on geriatric interventions to reduce ED visits showed that interventions were most effective when they were based in primary care and targeted on patients at high risk for adverse outcomes [8]. The organisation of primary care in the Netherlands —including comprehensive coverage and strong organisation— provides a solid infrastructure for these types of interventions.

Further research should focus on improving and validating screening instruments for the European situation. Demographic changes in the population will increase the burden on the health care system in general, and the ED system specifically, in a few years time. Because timeliness is critical for EDs, an effective and efficient choice has to be made between those older patients that are vulnerable and require extra care and those patients needing merely standard care.

In conclusion, older patients discharged after visiting the ED include a large group of vulnerable patients at high risk for poor outcomes. None of the studied screening instruments was capable of detecting older patients at risk for recurrent ED visits, subsequent hospitalisations, or mortality. Demographic changes have increased the need to identify, at an early stage, which patients are at higher risk for poor outcomes, highlighting the need to develop a screening instrument with high discriminative power.

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Chapter 4

Prognostication in Acutely Admitted Older Patients by Nurses and Physicians

Journal of General Internal Medicine. 2008 Nov;23(11):1883-9

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Abstract

Background: The process of prognostication has not been described for acutely hospitalized older patients.

Objective: to investigate (1) Which factors are associated with 90-day mortality risk in a group of acutely hospitalized older medical patients? And (2) does adding a clinical impression score of nurses or physicians improve the discriminatory ability of mortality prediction?

Design: prospective cohort study

Participants: 463 medical patients 65 years or older acutely admitted from November 1, 2002, through July 1, 2005, to a 1024-bed tertiary university teaching hospital.

Measurements: At admission, the attending nurse and physician were asked to give a clinical impression score for the illness the patient was admitted for. This score ranged from 1 (high possibility of a good outcome) until 10 (high possibility of a bad outcome, including mortality). Of all patients baseline characteristics and clinical parameters were collected. Mortality was registered up to 90 days after admission.

Results: In total, 23.8 % (n=110) of patients died within 90 days after admission. Four parameters were significantly associated with mortality risk; functional impairment, diagnosis malignancy, co-morbidities and high urea nitrogen serum levels. The AUC for this model (model 1) was 0.76 (95 % CI 0.71 to 0.82). The AUC for this model including the clinical impression score of the physician (model 2) was 0.77 (0.71 to 0.82). The AUC for the baseline model completed with the clinical impression score of the nurse (model 3) was 0.76 (0.71 to 0.82) and the AUC for model 1 including a clinical impression score of both nurses and physicians was 0.77 (0.72 to 0.82). Adding clinical impression scores to model 1 did not significantly improve the accuracy of model 1.

Conclusion: A set of four clinical variables predicted mortality risk in acutely hospitalized older patients quite well. Adding clinical impression scores of nurses, physicians or both did not improve the discriminating ability of the model.

Introduction

Acute hospitalization is a hazardous event for older patients, as it is associated with functional and cognitive decline, in-hospital mortality and short-term mortality [1, 2]. In the next 20 years, the percentage and absolute number of people of 65 years and older in the Dutch population will almost double [3]. Therefore, early recognition of patients at high risk for mortality and other negative health outcomes is needed, not only for advanced care planning and informing patients about prognosis and treatment perspectives, but also to control health care costs.

Although prognostication is a core element of medical practice, it is also the part where physicians feel most insecure about [4]. However, it is unclear whether this feeling of uncertainty is justified with acutely hospitalized older patients. Research on prognostication has mainly focused on (terminally ill) cancer patients and patients in the Intensive Care Unit (ICU). These studies revealed several issues on prognostication. First of all, physicians were able to differentiate which groups of patients had a higher mortality risk, but the individual patient prognosis was usually inaccurate [5]. Second, physicians were in general too optimistic in the prognosis of their patients, even in patients with a very short life expectancy [5, 6]. And third, the predictive ability of physicians in the ICU was better than standardised prediction models [7].

In the process of prognostication, the role of nurses has mainly been studied in ICU patients showing conflicting results when compared with physicians [7-11]. One study showed that nurses could predict survival rate better [10], whereas other studies indicated that physicians were better predictors better [7, 8, 12]. Only one study combined scores of both disciplines, and it was found that this improved prognostication [7]. It is likely that nurses have a different point of view on older patients' severity of illness and risk of mortality, as they spend more time at the bedside of patients than the physicians.

Therefore, the aim of this study was to answer the following two clinical questions using a prospective cohort design (i) Which factors are associated with 90-day mortality risk in a group of acutely hospitalized older medical patients? And (ii) does

adding a clinical impression score of nurses or physicians improve the discriminatory ability of mortality prediction?

Methods

Study Population

This prospective cohort study was conducted during a 32-month period starting November 1st 2002 until July 1st 2005 at the Academic Medical Centre (AMC) in Amsterdam, The Netherlands, a 1024-bed tertiary university teaching hospital. All consecutive patients aged 65 years or older acutely admitted to the Department of Internal Medicine were enrolled. Patients were excluded if (a) they were unable to speak or understand Dutch, (b) if they or their relatives did not gave informed consent for the study, (c) if they came from or were transferred to another ward than the medical ward, (d) or were discharged from the hospital within 48 hours after admission. Inclusion had to take place within 48 hours after admission and informed consent was obtained before inclusion. The study was approved by the Medical Ethics Committee of the AMC.

Data collection on prognostication by nurses and physicians

The attending nurse and physician were employed on the medical wards where patients were admitted. A member of our research team interviewed both the attending nurse and physician independent of each other before the assessment of the patient, but within 48 hours after admission of the patient. In the Netherlands, one nurse is responsible for a patient's total nursing care during one shift, on average the nurse takes care of four to five patients in one day shift. The physicians work on a ward and have a case load of about six to seven patients daily. Physicians change wards every two to three months, because they are still in training.

The attending nurse and physician were blinded to the data collection of the patient by the research nurse and were interviewed during a day shift. On average they would have seen the patient for four hours during their shift and sometimes even on a shift the day before the interview. So they knew their patient for at least three hours to a maximum of sixteen hours. They were asked to label the clinical impression of illness where the patient was admitted for, in relation to mortality, expressed in a global clinical score ranging from 10 (high possibility of a bad outcome including mortality) until 1 (high

possibility of a good outcome). There were no other special instructions to nurses and physicians apart from the above information. Thus, every patient had one clinical impression score from the attending nurse and one clinical impression score from the attending physician.

All attending nurses were Registered Nurses with at least a Bachelor's degree, with a wide range of experience ranging from 1-35 years and all attending physicians were residents, who were still in training, with a clinical experience ranging from 1-3 years. We did not choose to interview faculty members, as they are present on the wards on an irregular basis, which made it difficult to 1) compare their clinical impression scores and 2) to complete data collection. We did not register personal details of nurses and physicians, details of experience were gathered from the personnel department and were general information. During the study, approximately 110 different nurses and 28 different residents were employed in the department of Internal Medicine.

Data Collection on patients

An initial multidisciplinary evaluation of the patient was performed by members of the geriatric research team. The team was composed of two physicians in geriatric medicine, a fellow in geriatric medicine, a clinical nurse specialist and five research nurses trained in geriatric nursing.

Eligible patients were screened by research nurses for the following factors associated with short-term mortality as described in the literature: functional status, cognitive impairment, delirium, severity of illness, diagnosis at admission, co-morbidities and age [2, 13-18]. Within 48 hours after admission, the data collection had to be completed.

In-hospital functional status was assessed by the Barthel index [19], this questionnaire assesses actual Activities of Daily Living (ADL) functioning at the time of admission. Patients were scored on 10 items (defecation, bladder function, external care, toileting, eating, transfer, mobility, dressing, climbing stairs and bathing) and scores ranged from 0-20. A high score reflects more intact ADL functions. The presence and degree of global cognitive impairment were assessed using the 30-item Mini Mental State

Examination (MMSE) [20]. Global cognitive functioning of the patient was also assessed from the closest relative using the Informant Questionnaire on Cognitive Decline in the Elderly-short form (IQCODE-SF) [21, 22]. In this 16-item questionnaire, relatives were asked to compare cognitive functioning two weeks before admission with cognitive functioning of the patient ten years ago. Relatives could indicate on a five-point scale if cognition had improved, slightly improved, did not change, slightly decreased or decreased. Possible range of scores varies between 16 and 80. Cognitive impairment was defined as earlier diagnosed dementia by a physician in geriatric medicine or neurologist or a score of 23 or less on the MMSE. If the MMSE was not available or the patient was delirious (see below), we used the IQCODE-SF. Patients with a mean IQCODE-SF score of 3.9 or more were considered as having pre-existing cognitive impairment.

One of the two physicians in geriatric medicine assessed the presence of delirium with the Confusion Assessment Method (CAM) [23]. The CAM rates patients based on the presence of symptoms of delirium (acute start, decreased attention, unorganised thinking and level of consciousness). Patients were rated as delirious if both the acute start and decreased attention were present in combination with either unorganised thinking or changed level of consciousness, or both unorganised thinking and changed level of consciousness. The physician in geriatric medicine also reviewed the patient's medical chart for medical problems at admission, expressed in the differential diagnosis. This means that one patient could have more than one diagnosis. We grouped the differential diagnosis in major internal problems based on ICD-9 codes: infectious disease, malignancy, disease of the digestive system, cardiovascular disease, pulmonary complaints, endocrine problems (including diabetes) and neurological disease. The patients' first laboratory results after admission were collected from the patient data system (PDS), which included sodium, creatinin, urea nitrogen, haemoglobin and leucocytes serum levels. Furthermore, the Charlson co-morbidity index was scored, indicating the number and severity of co-morbidities [24]. Possible range of scores of the Charlson co-morbidity index varies between 0 and 31, with a higher score indicating more and more severe co-morbidities.

Living arrangement was collected and was divided in several categories. A senior residence is a complex were older people live independently. They are not provided with meals or with personal care, but people can ask for assistance if needed in an emergency situation. An old peoples home is a care provision for older people were they have their own room, but are provided with meals, household assistance and, if needed, personal care. In a nursing home older people need assistance with all personal care, such as washing, toileting and eating. We also collected demographic data and marital status.

Registration of mortality

Survival time was registered up to 90 days after hospital admission. It was expected that in this period the acute disease leading to admission will affect survival status, but after 90 days other factors may also contribute, such as a new episode of illness. Date of death was verified in the PDS, if the exact date of death was not registered or unclear, we contacted the general practitioner of the patient to verify the date of death.

Statistical analysis

Standard descriptive statistics were used. Differences in scores of continuous variables were tested with a Student t-test. The Chi-square test was used to compare the distribution of categorical data. A correlation coefficient was calculated for clinical impression scores given by the nurses or physicians. To answer our research questions, data-analyses were divided into two steps.

The first step was to identify factors independently associated with mortality 90 days after the patient's admission. For this purpose, we performed a Cox regression analysis. We started with a univariable Cox regression analysis. Time between admission and actual death was considered as survival time. Risk factors known to be associated with mortality, as described above were included in the regression analysis, completed with laboratory results (haemoglobin, urea nitrogen, creatinine, sodium, leucocytes) living arrangement and marital status. All variables with a $p \leq 0.2$ in the univariable Cox regression analysis were included in the multivariate analysis. A backward selection

procedure was used, accepting a p-value of ≤ 0.05. This resulted in a set of clinical variables that were significantly associated with mortality, named model 1. These analyses were performed in Statistical Package for Social Sciences (SPSS), version 14.0.2.

In order to estimate the additional value of the clinical impression scores we added this impression to model 1. In total three additional multivariable Cox regression analyses were performed. Model 2 consisted of model 1 plus the clinical impression score of the physician. Model 3 consisted of model 1 plus the clinical impression score of the nurse, and in model 4 both clinical impression scores were added to model 1. For all four models an Area under the curve (ROC) was computed along with its 95% confidence interval. Next, differences between these four models were calculated based on 1000 bootstrap samples, with 95 % confidence intervals. All models were then set out in ROC curves. The analyses regarding estimation of the additional value of clinical impression score was performed in the statistical package R version 2.0.0.

Table 1: Baseline characteristics for acutely admitted medical patients

Variable	Patients
	(n=463)
Demographic	
Age	78.1 (7.8)
Male (%)	42.5
Yrs of education	9.2 (3.6)
Social status	
Marital status (%)	45.6
Widowed / divorced (%)	44.4
Single (%)	10.0
Living arrangement	
Independent (%)	65.8
Senior residence (%)	17.9
Old peoples home (%)	12.3
Nursing home (%)	3.2
Intermediate care (%)	0.8
Functional status at admission	
Cognitive impaired (%)	47.1
Barthel score*	11.6 (6.7)
Delirium (%)	29.9
Charlson co-morbidity index †	3.5 (2.3)
Differential diagnosis at admission	
Neurological problem (%)	1.1
Infectious disease (%)	52.1
Malignancy (%)	23.1
Endocrine problem (%)	7.4
Disease of the digestive system (%)	32.0
Cardiovascular disease (%)	10.5
Pulmonary complaint	7.6
Number of problems at admission	1.3 (0.7)
Laboratory results	
Sodium (mmol/L)	135.0 (6.3)
Creatinine (µmol/L)	149.3 (167.3)
Urea nitrogen (mmol/L)	13.5 (10.9)
Haemoglobin (g/dL)	11.9 (2.6)
Leucocytes (10^9/L)	12.9 (13.9)
Clinical impression score	
Clinical impression score nurse	6.3 (1.9)
Clinical impression score physician	6.4 (1.9)

* Barthel index range of scores 0-20, 0 indicating complete independence and 20 complete dependence

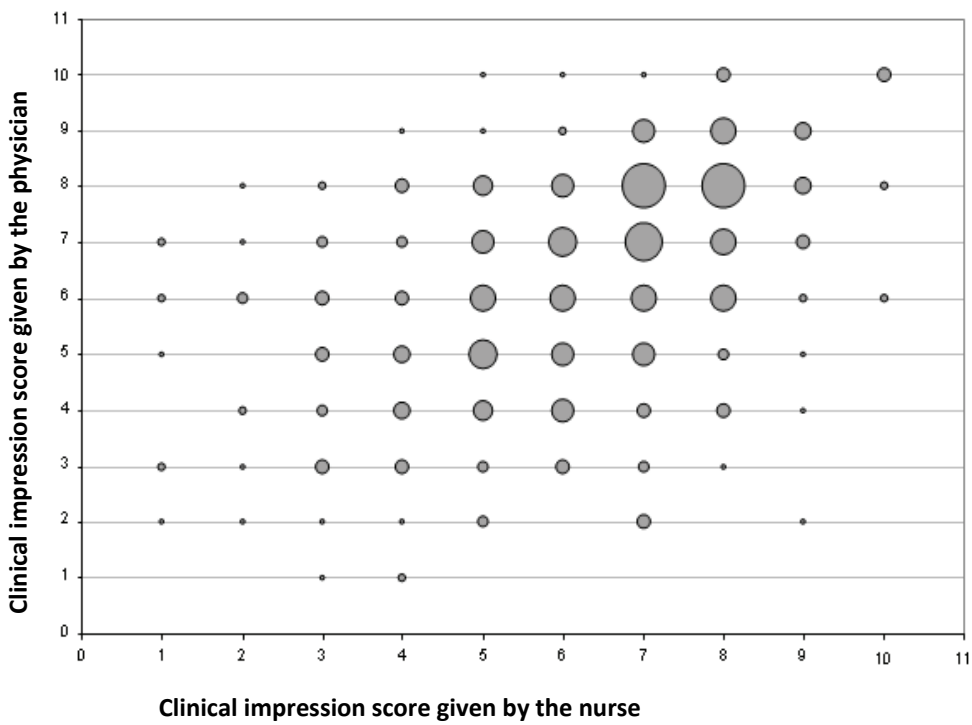
† Charlson co-morbidity index range of scores 0-31, 0 indicating no comorbidities, 31 indicating presence of severe comorbidities

Results

Study population

There were 785 eligible patients. We excluded 173 patients (22.1%) because they did not give informed consent, 26 patients (3.3 %) because they were too ill, 28 patients (3.6 %) because they were not able to speak or understand Dutch, and 95 patients (12.1%) because they were screened for eligibility more than 48 hours after admission. In total, 463 patients were included in this study. Table 1 presents the baseline characteristics of the study population.

Figure 1: Clinical impression scores of nurses and physicians (n=463)



Note: Size of the bubble indicates the number of times a specific combination of nurse and physician score was given. The smallest bubble indicates a frequency of 1; the largest bubble indicates a frequency of 36

Mean age was 78.1 years (SD 7.8) and 42.5 % were male. Mean clinical impression score given by the nurses and physicians was 6.3 (1.9) and 6.4 (1.9) (p= 0.1), respectively.

Figure 1 shows a scatter plot of combined clinical impression scores of nurses and physicians. The correlation between these scores was r=0.45 (p<0.001).

Factors associated with 90-day mortality

In total, 110 patients (23.8 %) died within 90 days after admission. We analysed factors associated with 90-day mortality in acutely hospitalized older patients (Table 2).

Table 2: Unadjusted and adjusted hazard ratio's for 90 days survival of acutely admitted older patients

Variable	Univariable			Multivariable		
	HR	95 % CI	p	HR	95 % CI	P
Age (in years)	1.01	0.99 to 1.03	0.48			
Sex	1.08	0.74 to 1.58	0.69			
Social status			0.98			
……Married (ref)	1.00					
……Single	1.02	0.53 to 1.97				
……Widowed/divorced	0.92	0.61 to 1.40				
Living arrangement			0.93			
…… Independent (ref)	1.00					
……Senior residence	0.99	0.60 to 1.65				
……Old peoples home	1.00	0.56 to 1.81				
……Nursing home	1.28	0.47 to 3.55				
……Intermediate care	1.21	0.17 to 8.74				
Barthel index (per point)	0.93	0.90 to 0.96	<0.001	0.93	0.90 to 0.96	<0.001
Cognitive impaired	1.14	0.76 to 1.71	0.53			
Delirium	2.22	1.52 to 3.24	<0.001	-	-	-
Charlson co-morbidity index (per point)	1.24	1.15 to 1.33	<0.001	1.14	1.05 to 1.25	0.01
Differential Diagnosis at admission						
Neurological problem	0.88	0.12 to 6.27	0.89			
Infectious disease	0.77	0.53 to 1.13	0.18	-	-	-
Malignancy	2.38	1.62 to 3.51	<0.001	2.30	1.41 to 3.74	<0.001
Endocrine problem	0.84	0.39 to 1.82	0.67			
Disease of the digestive system	1.04	0.70 to 1.55	0.85			
Cardiovascular disease	1.08	0.59 to 1.97	0.80			
Pulmonary complaint	0.83	0.39 to 1.78	0.63			
Laboratory results						
Sodium (mmol/L)	1.01	0.98 to 1.04	0.73			
Creatinine (μmol/L)	1.01	1.00 to 1.02	0.09	-	-	-
Urea nitrogen (mmol/L)	1.02	1.01 to 1.04	<0.001	1.02	1.00 to 1.04	0.02
Haemoglobin (g/dL)	0.96	0.85 to 1.08	0.48			
Leucocytes (10^9/L)	1.01	0.99 to 1.02	0.19	-	-	-
Clinical impression score nurse	1.16	1.04 to 1.30	0.01	-	-	-
Clinical impression score Physician	1.26	1.12 to 1.40	<0.001	-	-	-

In the multivariable analysis four risk factors were significantly associated with mortality of acutely hospitalized older patients within 90 days after admission; Barthel index, diagnosis malignancy, urea nitrogen and Charlson co-morbidity index. Delirium was significant in the univariate analysis, but not in the multivariate analysis. We checked for collinearity between delirium and other variables entered in the multivariate analysis. Delirium and Barthel index were highly correlated ($r=0.48$, $p<0.001$), no further significant correlations were found with other variables.

Baseline prediction model of mortality

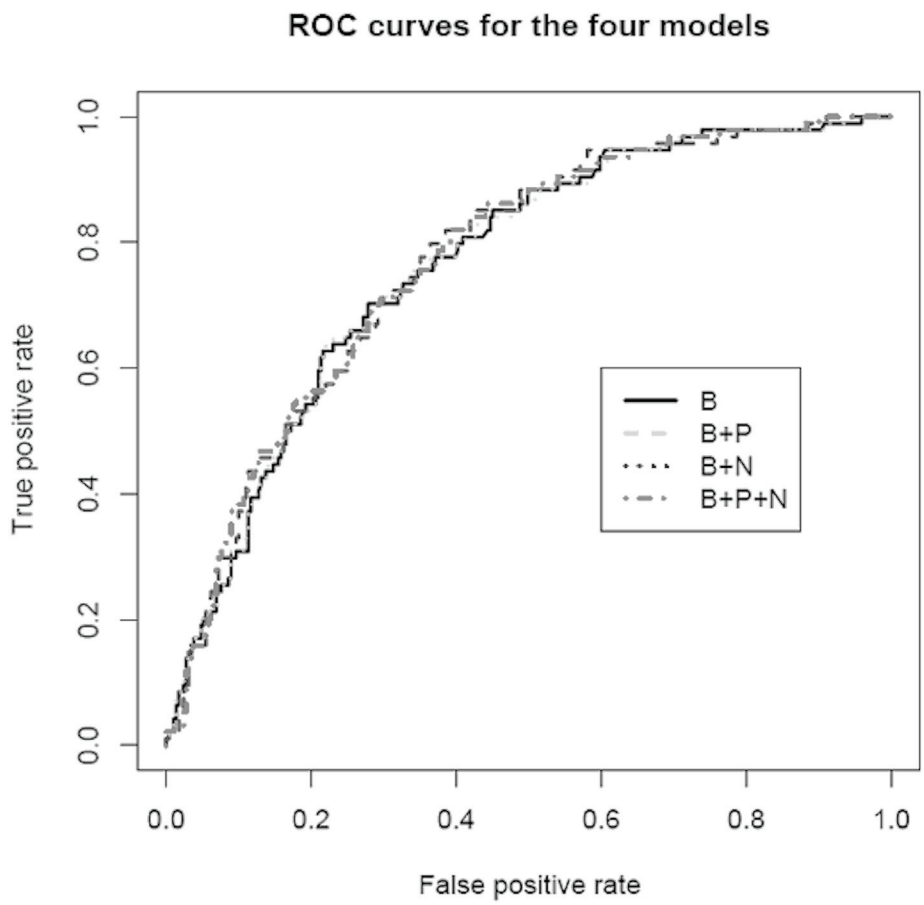
Model 1 represents the baseline set of clinical variables. A higher score on the Barthel index, indicating a patient is more independent, was associated with a decreased risk of dying within 90-days after admission. An increase of one point on the Barthel index was significantly associated with a 10 % decreased risk of dying. A higher score on the Charlson comorbidity index was associated with an increased risk of dying within 90-days after admission. An increase of one point was significantly associated with a 20 % increased risk of dying. Diagnosis malignancy at admission was significantly associated with a 300 % increased risk of dying within 90-days after admission. An increase of 1 mmol per liter in urea nitrogen serum level was associated with a 2 % increased risk of dying. The area under the curve for this model was 0.76 (95% CI 0.71 to 0.82).

Adding clinical impression scores of physicians and nurses

Next, the clinical impression score of the physician was added to the baseline set of clinical variables (model 2). This did not significantly contribute to the overall model's performance. Furthermore, when adding this clinical impression score of the physician, urea nitrogen did not contribute significantly to the overall model anymore. The area under the curve (AUC) for this model was 0.77 (95% CI 0.71 to 0.82).

Adding a clinical impression score of the nurse also did not improve the overall model's performance (model 3). The AUC for model 3 was 0.76 (95% CI 0.71 to 0.82). Finally, we added both the clinical impression score of the physician and nurse to model 1.

Figure 2 ROC curves for four models predicting mortality



Note: B is baseline set of clinical variables (model 1), B+P is model 1 with clinical impression score of physician (model 2), B+N is model 1 with clinical impression score of nurse (model 3) and B+P+N is model 1 with clinical impression score of both physicians and nurses (model 4)

This did not improve the performance of model 1 as well. The AUC for this model was 0.77 (95% CI 0.72 to 0.82). The four models were set out in Figure 2.

To determine whether adding clinical impression score to model 1, models 2 to 4 were compared with model 1 by applying 1000 bootstrap samples. Adding clinical impression score did not significantly improved the discriminating value of model 1; model

1 versus model 2, absolute difference in AUC was -0.004 (95 % CI -0.017 to 0.008), Model 1 versus model 3 difference in AUC was 0.0004 (-0.003 to 0.002). Model 1 versus model 4, absolute difference in AUC was -0.006 (-0.02 to 0.01).

Because of colinearity between delirium and Barthel index, we replaced the Barthel index covariate with delirium, the AUC values of the 4 models were slightly worse (model 1: 0.747521, model 2: 0.7530511, model 3: 0.7507818, model 4: 0.7533944) and bootstrapping the differences between any two of the AUCs could not show any statistically significant differences.

Table 3: Adjusted hazard ratio's for 90 days survival of acutely admitted older patients and the area under the curve of four different models

Variable	Clinical variables (model 1)	Clinical variables and physician score (model 2)	Clinical variables and nurse score (model 3)	Clinical variables and physician and nurse score (model 4)
	OR (95 % CI)	OR (95 % CI)	OR (95 % CI)	OR (95 % CI)
Barthel index (per point)	0.90 (0.87 to 0.94)	0.90 (0.87 to 0.94)	0.90 (0.86 to 0.94)	0.90 (0.86 to 0.94)
Charlson score (per point)	1.20 (1.08 to 1.37)	1.20 (1.06 to 1.35)	1.22 (1.07 to 1.36)	1.20 (1.07 to 1.36)
Malignancy	2.97 (1.57 to 5.65)	2.73 (1.42 to 5.24)	3.00 (1.57 to 5.74)	2.76 (1.44 to 5.29)
Urea nitrogen (mmol/Liter)	1.02 (1.01 to 1.05)	1.02 (0.99 to 1.05)	1.02 (1.01 to 1.05)	1.02 (0.99 to1.05)
Clinical impression score physician	-	1.11 (0.96 to 1.28)	-	1.14 (0.98 to 1.34)
Clinical impression score nurse	-	-	0.98 (0.84 to 1.14)	0.93 (0.78 to 1.09)
Area under the curve	0.76 (0.71 to 0.82)	0.77 (0.71 to 0.82)	0.76 (0.71 to 0.82)	0.77 (0.72 to 0.82)

Discussion

In this study among 463 acutely admitted older medical patients, the 90-day mortality risk was found to be increased in acutely admitted medical patients with more functional impairment expressed in a lower score on Barthel index, more comorbidities expressed in a higher score on the Charlson co-morbidity index, malignancy and an elevated urea nitrogen levels. With these four clinical variables the mortality risk of acutely admitted older patients could be predicted quite well. Adding a clinical impression score from attending physicians, from attending nurses or from both disciplines did not contribute significantly to the accuracy of mortality prediction in this patient group.

To our knowledge this is the first study adding clinical impression score of physicians or nurses or both on prediction of mortality among acutely admitted older medical patients. The clinical risk factors for mortality we found were in concordance with the literature. High score on Charlson co-morbidity index [15, 18, 25, 26], more functional impairment [17, 18, 25, 27], diagnosed malignancy [18, 25, 28] and high urea nitrogen serum levels [29] were all factors identified in literature as risk factors for mortality in this population. We did however not find age and delirium as risk factors for mortality in our study. Nevertheless, in patients who died within 90 days after admission, prevalence of delirium was almost twice as high as in patients who survived. Delirium was, however, only an independent risk factor for mortality in the univariate analysis. Delirium was strongly correlated with Barthel index in the multivariate analysis. This indicates that delirious patients were those patients with more functional impairment. In other studies delirium was a risk factor for mortality, but these studies measured pre-morbid functional status, whereas we measured functional status at admission [30, 31]. We, however, did only measure prevalent delirium and not the incidence rate during hospitalization. Other studies have revealed that the incidence rate of delirium in medical patients varied widely, between 3 % and 29 % [32]. Replacing the Barthel index for delirium worsened the baseline model for mortality. So, functioning is a more valid indicator for mortality and should be used when implementing this model. It is also easier for nurses and physicians to screen on daily functioning, as it is known there is a large underrecognition of delirium in daily practice [33]

The four simple to measure variables we found as risk factors for mortality were fairly good in predicting mortality risk. Physicians and nurses should therefore be encouraged to use these variables in the process of prognostication. In a large study on prognostication in a sample of internists, the majority pointed out that prognostication was stressful to them and they waited until patients asked them about prognosis [4]. They also indicated they did not feel well trained in prognostication during their professional education. Using the variables identified in this study as a starting point in the process of prognostication could strengthen this process and enhance difficult decision making.

Interestingly, adding a clinical impression score from attending physicians, from attending nurses or from both disciplines did not significantly improve accuracy of mortality prediction. This is in contrast to some studies performed on the ICU where predictions of both physicians and nurses were sometimes even better than standardized prediction models [7]. Notwithstanding the inherent differences between the predictive ability of models in these two settings there might also be some other explanations. One possible explanation is that both physicians and nurses on ICUs were better trained and physicians had more clinical experience. In our study we asked residents, who were still in training, to give a clinical impression score of patients' disease. And although nurses working on general medical wards in the Netherlands do have a Bachelor's degree in nursing, they often do not follow an extra training or specialization as ICU nurses have. It is fair to assume that, with extra training and for physicians also having extra years of clinical experience, prognostication might be improved. At least this was shown in studies in cancer patients were faculty members gave more accurate predictions. Thus, it would be of surplus value to know if faculty members or geriatricians are better in predicting mortality risk than residents. If so, their opinion should be more actively used in the prognostication process.

A second possible explanation is that physicians and nurses working on an ICU have more information on clinical variables, as patients on these wards are monitored continuously. This gives a continuous stream of prognostic information to physicians and nurses, which might improve the mortality prediction.

Further research on prognostication and risk factors for mortality in this population should focus on several points. First, more possible modifiable risk factors for mortality should be studied, such as malnutrition, decubitus, depression, functional decline just before the acute hospitalization and polypharmacy. These are common problems in geriatric patients which might be related to mortality and may be taken care of during hospitalization. Secondly, research should further focus on methods to improve prognostication performance. What could be beneficial in this process is developing risk profiles for patients. This could assist nurses and physicians in prognostication, but it is also useful in the communication with patients and relatives about hospital outcomes, expectations and burden of treatment. Finally, aside from discrimination measure such as the area under the ROC curve, also accuracy and calibration measures should be investigated. While the area under the ROC curve reveals the ability to discriminate between survivors and non-survivors, it is not sensitive to calibration. Measures such as the Hosmer-Lemeshow statistics and the Brier score should be investigated as well.

Our results could have been biased due to selective inclusion of patients as not all patients gave informed consent or were not included within 48 hours. However, the short term mortality rate we found of acutely hospitalized elderly (23 %) was within the range reported by other studies, between 15% and 48 % [2, 15, 18]. In our study we only interviewed nurses and physicians separate from each other, but it could be interesting to know how discussions would affect the opinion of both disciplines, especially in patients were both opinions diverge extensively. This might improve prognostication.

In conclusion, this study showed that a baseline set of four clinical variables; functioning, co-morbidity, malignancy and urea nitrogen serum level, can predict mortality of acutely hospitalized older patients quite well. Adding the clinical impression score of nurses or physicians did not improve the discriminating ability of the prediction model. Nurses and physicians should be encouraged to use these four factors in the process of prognostication and clinical decision making as it gives patients more clarity about their prognosis. These factors are easy to collect and therefore useful for the clinical practice, where the group of older medical patients is rapidly increasing.

Acknowledgement: We received an unrestricted grant from the Academic Medical Center, Amsterdam, the Netherlands. The authors wish to thank Marjolein van der Zwaan, Caroline van Rijn and Arja Giesbers for data collection.

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Chapter 5

The Prediction of Functional Decline in Older Hospitalized Patients

Submitted for publication

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Abstract

Context: 30% to 60% of older patients experience functional decline after hospitalization. This is associated with a decrease in quality of life and autonomy and an increase of readmission, nursing home placement and mortality. A first step in prevention is the identification of patients at risk.

Objective: To develop and validate a prediction model to assess the risk of functional decline in acute hospitalized older patients.

Design: Development study: a cohort study (n=492) with follow up three months after hospital admission (April 2006 to April 2008). Validation study: a secondary data analysis of a cohort study (n=484) in an independent population with follow up after three months (November 2002- April 2006).

Setting: Development study: the general internal medicine wards of two university teaching hospitals and one regional teaching hospital. Validation study: the general internal wards of a university teaching hospital

Participants: All consecutive patients of 65 years and older acutely admitted and hospitalized for at least 48 hours.

Main outcome measure: Functional decline was defined as a decline of at least one point on the Katz ADL index at follow-up compared to pre-admission status.

Results: 35% of all patients in the development cohort and 32% in the validation cohort suffered functional decline. The prediction model could accurately predict functional decline with only four items. The AUC was 0.71. At threshold 2 sensitivity, specificity, positive and negative predictive values were 87%, 39%, 43% and 85%, respectively. This positive outcome was supported by the results in the validation study which were respectively 0.68 89%, 41%, the 41% and 89%.

Conclusion: Pre-admission need for assistance in instrumental activities of daily living, use of a walking device, need for assistance in traveling, and no education after age 14, are the predictors in a model to identify older patients at risk for functional decline following hospital admission. This prediction model was translated into a scorecard: Identification of Seniors At Risk-Hospitalized Patients.

Background

Between 30% and 60% of older patients experience functional decline after hospitalization, resulting in a decline in health-related quality of life and autonomy [1, 2]. This is associated with increased risk of readmission, nursing home placement and mortality [3-5]. Several factors play a role in the high occurrence of functional decline, such as the physical and cognitive condition of the patient before hospital admission, multimorbidity and iatrogenic complications [6, 7]. The first step in prevention is identifying the patients at risk [8]. This can be followed by a comprehensive geriatric assessment (CGA) to guide preventive interventions throughout the hospital stay [8-10].

Some instruments to predict adverse health outcomes have been described in the literature [11-15]. However, these were not specifically developed to predict functional decline or have not been validated in acutely hospitalized patients.

We compared the discriminative ability of three of these instruments in a population of older patients acutely admitted to internal wards: Identification of Seniors At Risk (ISAR), Hospital Admission Risk Profile (HARP) and Complexity Prediction Instrument (COMPRI) [13-16]. None of these instruments showed good discriminative values in the targeted population. Therefore, the objective of this study is to develop and validate a prediction model to assess the risk of functional decline in acutely hospitalized older patients.

Methods

Participants

First a cohort study was conducted between April 2006 and April 2008 to develop and internally validate a prediction model. Patients aged 65 years and older who were acutely admitted to the internal medicine department of two university hospitals and one regional teaching hospital and who could be interviewed within 48 hours after admission were invited to participate in the study. Of 1031 eligible patients, 809 gave informed consent to participate. Patients were excluded for the following reasons: too ill to participate (n=20); transferred from another ward (n=36); transferred to the ICU within 48 hours after admission(n=28) and unable to speak or understand the language (n=86). After data collection, 147 patients were excluded who were not able to demonstrate functional decline: 19 patients (3%) with a maximum score on the Katz index at baseline (who could not decline further) and 128 patients (20%) who died within three months after admission. Finally, 492 patients were included in the analysis.

Second an external validation study was conducted: a secondary data analysis of a cohort study in an independent population (November 2002-April 2006) of 484 patients admitted to the internal medicine wards of a university teaching hospital, using the same inclusion and exclusion criteria as in the development study.

For both studies written informed consent was obtained before inclusion.

The Medical Ethics Committee of the three hospitals approved the studies.

Measurements

Development study: within 48 hours after admission and three months after admission, data were assessed by specially trained research nurses and geriatricians. Baseline data included the following: demographic data (age, sex, race, living and social situation, number of years of education), premorbid functional status (patients were asked to describe the situation two weeks before admission to eliminate possible effects of the illness causing hospital admission), Activities of Daily Living (ADL) and Instrumental ADL

(IADL) and potential predictors chosen from the literature including items of existing instruments as well as predictors suggested by experienced medical and nursing geriatric specialists. Potential predictors included cognitive status, previous delirium, nutritional status, use of devices, sensory impairments, continence, number of falls in the past three months and presence of a pressure ulcer. Medical data were obtained from the medical records.

The cognitive competence of the patient was verified at admission. In cases of severe cognitive problems (MMSE score <16 points), patient information was gathered from the patient's proxy. In patients with mild cognitive problems (MMSE score 16-20 points), the patient's answers were verified with the proxy; if the answers were different, the proxy's answers were used.

Three months after admission, functional status was recorded again by telephone interviews. The respondent was the same as the one interviewed at baseline (either the patient or the proxy).

Validation study: the measurements were equal to the development study. For the validation were used: demographic data (age, sex, race, living and social situation) data to compose the prediction model, functional status (pre admission and three months after admission) and cognitive status.

Functional decline was defined as a decline of at least one point on the Katz ADL index at three months after admission compared to premorbid ADL status [17].

Measurement instruments

Functional status was measured using the Katz ADL index (six items: bathing, dressing, toileting, transferring, eating and the use of incontinence materials) [17]. The Lawton scale was used to measure IADL: grooming, walking, making telephone calls, traveling, shopping, preparing meals, housekeeping, medication intake and organizing financial matters [18]. In both scales, each item was scored 0 (independent) or 1 (dependent).

Cognitive function was measured using the Mini Mental State Examination (MMSE) on a scale of 0 (poor) to 30 (excellent), where a score < 24 indicated cognitive

impairment [19]. Nutritional status was measured using the validated Short Nutritional Assessment Questionnaire (SNAQ). This scale consists of four questions: >6 kg weight loss in the prior six months (3 points); >3 kg weight loss in the prior month (2 points); decreased appetite (1 point); and the use of supplemental food or tube feeding (1 point). Patients with a score of 3 points out of 7 were considered malnourished [20].

Data analysis

Percentages, means and standard deviations were calculated to describe both study cohorts. Student's t-test (continuous variables) and chi-square test (dichotomous variables) were used to test differences between groups of patients.

In the development study potential predictors associated with functional decline were identified using univariate logistic regression. Categorical and continuous variables were dichotomized. Items of existing screening instruments, of the IADL index and of the SNAQ were analyzed as individual predictors. Next, a multivariate logistic regression was conducted (backward procedure, accepting P-values ≤ 0.05) with predictors based on three criteria: the number of cases (per ten cases, one predictor), P-value ≤ 0.15 [21] and suggestions of clinically relevant predictors mentioned by geriatric specialists. The four best models were compared and validated in a bootstrap procedure (1000 samples drawn randomly with replacement) using the AUC with 95% CI to determine the discriminative value. The best model was recalibrated by shrinkage of the betas to prevent over-fitting using the formula of van Houwelingen [22]. This was followed by recalculating the intercept in such a way that the total prediction of all cases of the recalibrated model was equal to the incidence of functional decline in the dataset. Finally, the prediction model was transferred into a scorecard by dividing the beta coefficients by the smallest predictor beta and rounding. Sensitivity, specificity and positive and negative predictive values were calculated. These were also measured in the external validation cohort as well as the AUC to determine the discriminative value.

In both databases several patients had values missing for one or more of the variables and these were imputed per database separately using the single linear regression method [23].

The analyses were performed using SPSS, version 15 (Statistic Package for Social Studies, Inc. Chicago, IL, USA) and the statistical package R version 2.8.1 for bootstrap procedures.

Table 1: Demographic and Clinical Characteristics of Older Patients Acutely Admitted to a General Internal Ward, Development and Validation Cohort

Variable	Development cohort (n=492)	Validation cohort (n=484)
Age, mean (SD)	78 (8)	78 (8)
Male, % (n)	44 (218)	47 (226)
Caucasian, % (n)	92 (452)	
Living situation, % (n)		
Dependent	24 (116)	30 (147)
Social situation, % (n)		
Living alone	49 (241)	54 (259)
MMSE at admission, mean (SD)	24 (7)	23 (6)
< 24 points (cognitive impaired) % (n)	34 (166)	43 (207)
Admission reason, % (n)		
Infectious disease	43 (189)	54 (260)
Diseases of the digestive system	21 (92)	33 (159)
Malignancy	6 (26)	17 (81)
Cardiovascular diseases	6 (24)	9 (45)
Other	24 (104	17 (81)
Functional status 2 weeks before admission		
Independent, % (n)	54 (267)	51 (249)
Functional status 3 months after admission		
Independent, % (n)	44 (216)	47 (228)
Difference in functional status pre admission/ three months later, % (n)		
-4 – -1 (improved function)		
0 no difference	11 (53)	15 (73)
≥1 point decline (functional decline)	55 (269)	53 (257)
	35(170)	32 (154)

Results

Baseline characteristics of both studies are shown in Table 1. In the development cohort mean age was 78 years, 44% were male, and 35% experienced functional decline. In the validation cohort this was respectively also 78 years, 47% male and 32% of all patients suffered a functional decline of at least 1 point measured on the Katz index.

Development study: 35 variables were used in the univariate regression. Overall, 12 variables showed significant predictive values in the univariate analysis. Based on the 170 patients that showed functional decline, 17 predictors were selected for multiple logistic regression analysis: 15 predictors with P-values <0.15 and two clinically relevant predictors (previous delirium and visual impairment) with P-values >0.15. The multiple logistic regression resulted in a model with six predictors independently associated with functional decline: premorbid need of assistance in IADL on a regular basis, hearing impairment, visual impairment, use of a walking device, need of assistance for traveling and no education after age 14. With these six predictors, four models were compared using a bootstrap with 1000 samples. Because there were no relevant differences between the AUCs of these models (range between 0.71 – 0.72), we preferred the model that was easiest to use in clinical practice with only four predictors. After shrinkage of the beta coefficients (factor 0.936), the intercept was recalculated. The result was a prediction model with the following probability of risk for functional decline: 1/1+exp (-(-1.93 + 0.48 x “pre-admission need for assistance in IADL on a regular base” + 0.81 x “use of a walking device” + 0.57 x “need for assistance in traveling” + 0.42 x “no education after age 14”)).

Table 2: Independent Predictors of Functional Decline (n=492)

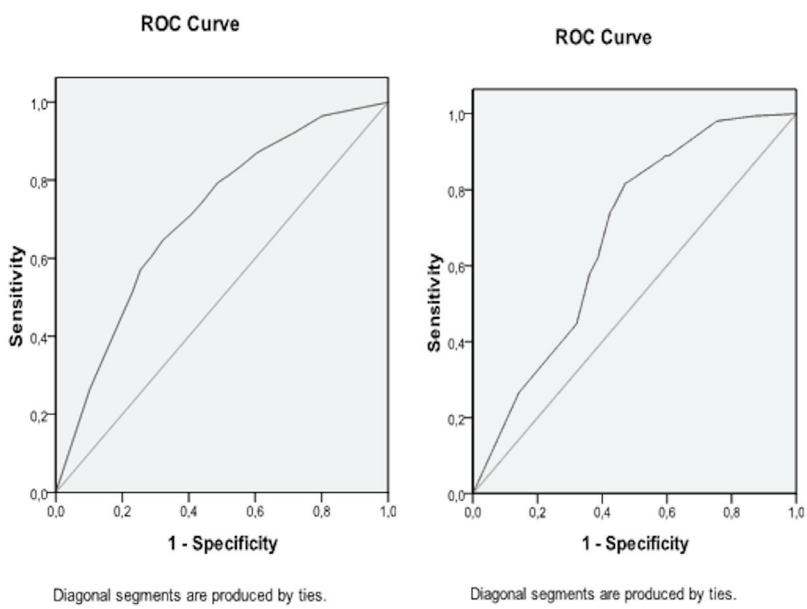
Variable	Beta	Beta after shrinkage	P-value	OR (95%CI)
Pre-admission need for assistance in IADL	.52	.48	0.03	1.7 (1.1-2.6)
Use of a walking device	.87	.81	<0.01	2.4 (1.5-3.7)
Need for assistance in traveling	.61	.57	<0.01	1.8 (1.2-2.9)
No education after age 14	.45	.42	0.03	1.6 (1.0-2.3)

The AUC of this model was 0.71 (95% CI 0.66 - 0.76) and the Hosmer Lemeshow test showed a P-value 0.95 which indicates a good fitting model, see also Figure 1. A

scorecard, Identification of Seniors At Risk – Hospitalized Patients (ISAR-HP), was developed based on this prediction model by dividing the beta coefficients by the smallest predictor beta and rounding (Figure 2). At threshold 2 (score ≥2 indicating high risk for functional decline) the sensitivity, specificity and positive and negative predictive values were 87%, 39%, 43% and 85%, respectively. In total 70% of the patients were identified as patients at risk. Of this group 43% developed functional decline. Comparison of the true and false positives showed similarity in all aspects (predictors and IADL's) except length of stay (LOS), which was similar for false positives and patients not at risk. For true positives LOS was nearly 1.5 times more.

Validation study: the AUC of the prediction model was 0.68 (95% CI 0.63-0.73), see also Figure 1. At the recommended threshold of 2 of the score card ISAR-HP sensitivity specificity, positive and negative predictive values were respectively 89%, 41%, the 41% and 89%.

Figure 1: Receiver Operating Characteristic Curve and Area Under the Receiving Operating Curve with 95% Confidence Interval



ROC of the prediction model in the development cohort : AUC 0.71 (0.66-0.76)

Discussion

Older patients acutely admitted to an internal ward who are at risk for functional decline after hospitalization can be identified with only four predictors: pre-admission need for assistance in IADL on a regular basis, use of a walking device, need for assistance in traveling and no education after age 14. This prediction model was internally validated and in a second step validated in an independent population to establish that it can be generalized to a different population of patients. Based on the beta's of the prediction model a scorecard was developed, the Identification of Seniors At Risk - Hospitalized Patients (ISAR-HP).

To appreciate this study some aspects need to be addressed. In our study we missed some data (at random). Missing data will end up as missing cases in a multiple regression analysis. To decrease bias and increase statistical efficiency, it is better to impute missing values than to perform complete-case analysis. So we optimized the dataset by imputation [23, 24].

To enhance internal validity, we cross-checked the outcome of the multiple regression model in two ways: a forward procedure (entry P-value ≤0.05, removal P-value ≥0.10) and a 1000-samples bootstrap procedure (drawn randomly with replacement, using a forward and backward procedure accepting a P-value ≤0.05 and a selection of >50% in the 1000 samples). In these analyses, the results were equal, supporting the idea that the predictors used in the final model are the strongest for predicting functional decline after hospitalization. We also validated the best fitting model with a second 1000-samples bootstrap procedure. The bootstrap procedure is a method to see if the model is valid and not too optimistic in another population. This procedure has been shown to be superior to split-sample or cross-validation methods [24]. The AUC in the bootstrap samples was higher than in the prediction model, thus supporting the validity of the model. The general applicability of the prediction model is also supported by the differences in the population of the development study: the populations of the three hospitals in our development study were significantly different with respect to age, years of education, need for assistance in traveling, and functional decline. Finally we applied a secondary

data analysis in an independent cohort study to externally validate the model. The prediction model and the score card showed a good performance with only slightly differences in the discriminative values. All these positive measurements show that the prediction model can be generalized to a different population.

We excluded the deceased patients from the analysis (n=128 in the development cohort and n=148 in the validation cohort) because we did not want to confuse the predictors of functional decline with those of mortality. The outcome of this study is relevant to patients at risk for functional decline rather than those at risk for mortality. Patients with a maximum score on the Katz index at baseline (n=19 for the development and n=12 for the validation cohort) were also excluded. Our aim was to prevent functional decline by identifying those at risk at hospital admission; it is open to discussion whether these vulnerable groups of patients should have been included as well. Therefore, we also measured the predictive value of the ISAR-HP in these groups of patients. In the development study for predicting mortality sensitivity was 81%; for identifying patients with a maximum Katz index score at baseline as at risk sensitivity was 100%; and for the combined group including the deceased and patients with a maximum score at baseline sensitivity was 85%. Also in the validation cohort the ISAR-HP showed good results for the combined group: sensitivity, specificity, positive and negative predictive values were 85%, 41%, 56% en 57% respectively.

Thus, in both cohorts the ISAR-HP can identify patients that are vulnerable at admission, including those who will die and those who are already dependent in six ADL's. In translating the prediction model to the scorecard, the choice of a threshold was based on the balance between the acceptable proportion of missed cases (false negatives) and reducing the number of patients unnecessarily qualified as at-risk (false positives). In general, a higher cut-off point leads to fewer subjects in the at-risk group. Because risk assessment can be seen as the first step in prevention that should be followed by a CGA, we preferred a high sensitivity (87%). This results in a relatively high percentage of false positives. A comparison of the false and true positives showed that the false positives

were very similar to the true positives, which indicates that all these patients were meeting the criteria of frailty [25].

The predictors identified in our model were also relevant in previous studies, thereby supporting the face validity of the prediction model. Mahoney et al. concluded that using a cane or walker was the best predictor of adverse health outcomes [26]. In studies of Marengoni, Dendukuri and Cigolle, a limited number of years of education was a strong predictor for functional decline and other adverse health outcomes [7, 27, 28]. Functional status, measured in different ways and in different populations, was also a strong predictor for further functional decline in several studies [7, 14, 29, 30]. The predictors 'need for assistance in activities of IADL on a regular basis' and 'need for assistance in traveling' are both reflections of premorbid functional status.

Finally, all items of existing screening instruments were included as potential predictors. Only one item of the ISAR was a valid predictor in this study. This might be explained by the major differences between the ISAR population (patients in the emergency department in Canada) and our study population. The ISAR is a widely known instrument, and we thank the developer of the ISAR for permission to denominate our scorecard ISAR-HP. We believe this will enhance implementation in clinical practice.

Figure 2: Scorecard: Identification of Seniors At Risk - Hospitalized Patients (ISAR-HP)

ISAR-HP		
	YES	NO
1. Before hospital admission, did you need assistance for IADL (e.g., assistance in housekeeping, preparing meals, shopping, etc.) on a regular basis?	1	0
2. Do you use a walking device (e.g., a cane, rollator, walking frame, crutches, etc.)?	2	0
3. Do you need assistance for traveling?	1	0
4. Did you follow education after age 14?	0	1
Total score (circled figures)		
Total score 0 or 1 = not at risk Total score ≥2 = patient is at risk for functional decline		

Conclusion

Based on this study in 492 older patients acutely admitted to the internal wards of three hospitals, functional decline after hospital admission can be adequately predicted by a model with four variables. The results of the validation in an independent population support this conclusion. The scorecard of this model, the ISAR-HP, will be easy to use in clinical practice as it consists of only four questions which are easy to administer.

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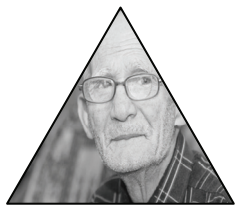

Chapter 6

Geriatric Conditions in Acutely Hospitalized Older Patients: Prevalence and One-year Survival, Functional Decline and Cognitive Impairment

Submitted for publication

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Abstract

Background: In acutely hospitalized patients, geriatric conditions are not systematically screened at admission, which might lead to adverse health outcomes during and after hospital admission.

Objective: To study the prevalence of frequently encountered geriatric conditions in older patients at admission and the impact of these conditions on poor outcome one year after admission.

Design: A prospective multicenter cohort study conducted between 2006 and 2008.

Setting: Eleven general internal medicine wards located in two tertiary university teaching hospitals and one regional teaching hospital in the Netherlands.

Participants: Patients of 65 years and older who were acutely admitted and hospitalized for at least 48 hours.

Measurements: Eighteen geriatric conditions were assessed at hospital admission, and outcomes (mortality, functional decline and cognitive impairment) were assessed one year after admission.

Results: 639 patients were included, with a mean age of 78 years. IADL impairment (83%), polypharmacy (61%), mobility difficulty (59%), high levels of primary caregiver burden (53%), and malnutrition (52%) were most prevalent. One year after admission, 35% had died, 33% suffered from functional decline and 26% had cognitive impairment. Malnutrition (Odds Ratio 1.8, 95% CI 1.2-2.4), obesity (0.5, CI 0.3-0.9), fall risk (1.5, CI 1.1-2.1) and IADL impairment (1.1, CI 1.1-1.2) were associated with mortality. An indwelling urinary catheter (1.5, CI 1.0-2.2) was associated with functional decline; fall risk (1.6, CI 1.0-2.7) and IADL impairment (1.3, CI 1.1-1.4) were associated with cognitive impairment.

Conclusion: Geriatric conditions were highly prevalent and associated with poor health outcomes after admission. Early recognition of these conditions in acutely hospitalized older patients could lead to better health outcomes and reduce the burden of hospital admission for older patients.

Introduction

Approximately ten percent of people over 65 years old are admitted to the hospital annually, and these patients' hospital visits account for half of all days spent in the hospital [1]. Acute illness leading to hospital admission is often accompanied by multiple chronic diseases and conditions such as decreased ability to perform Activities of Daily Living (ADL), cognitive impairment, delirium, falls and malnutrition [2-7]. The clinical importance of these health problems, in this article defined as geriatric conditions, should not be underestimated because their presence reflects reduced functional and physiological reserves [8;9]. The combination of diseases and geriatric conditions is an important predictor of adverse events during hospital admission, and it is also associated with functional and cognitive decline, institutionalization and mortality after discharge [10-15].

The clinical relevance of screening for geriatric conditions at hospital admission not only involves decisions, such as preventing or actively treating geriatric conditions, during and after the hospital stay, but also contributes to decisions of whether or not to begin with invasive treatment for the acute illness that led to admission. From a patient perspective, information on the presence of geriatric conditions and their negative impact on health outcomes assists patients and their primary caregivers in making a well-informed decision concerning preferred treatment goals. Moreover, some studies have shown that, in specific patient populations, early recognition of geriatric conditions by means of a comprehensive geriatric assessment (CGA) might reduce adverse events during and after hospital stay [16-18]. Early recognition of geriatric conditions may also contribute to better health status after hospitalization in terms of functional and cognitive abilities [18-20].

Despite this knowledge, current medical practice in hospitals is mainly performed according to the traditional disease model of medicine, which mainly focuses on the presence of diseases, and geriatric conditions may be overlooked or ignored in the care of older patients. Therefore, we performed a prospective cohort study on acutely hospitalized older persons to investigate the prevalence of frequently encountered geriatric conditions at hospital admission and to assess the impact of geriatric conditions

on one-year health outcomes in terms of mortality, functional decline and cognitive impairment.

Methods

Design and setting

This multicenter prospective cohort study, the DEFENCE (Develop strategies Enabling Frail Elderly New Complications to Evade) study, was conducted between April 1, 2006 and April 1, 2008 in eleven general internal medicine wards in three hospitals in The Netherlands: the Academic Medical Center (AMC) in Amsterdam; the University Medical Center Utrecht (UMCU) in Utrecht; and the Spaarne Hospital (SH) in Hoofddorp. The AMC (1024 beds) and UMCU (1042 beds) are tertiary university teaching hospitals. The SH (455 beds) is a large regional teaching hospital.

In total, five wards in the AMC, three wards in the UMCU and three wards in the SH participated. The staff on the general medical wards consisted of residents, physicians and registered nurses. They were not specialists trained in geriatric medicine or geriatric nursing. All hospitals had a geriatric consultation team available that consisted of at least one clinical nurse specialist in geriatrics and one geriatrician. The study was approved by the centers' Medical Ethics Committees.

Patients

All patients aged 65 years and older who were acutely admitted to one of the general internal medical wards of the three hospitals were enrolled in the study. Patients were excluded because of any of the following: 1) they or their relatives did not provide informed consent, 2) they were unable to speak or understand Dutch, 3) they came from another ward inside or outside the hospital, 4) they were transferred to the Intensive Care Unit, the Coronary Care Unit or another ward in or outside the hospital within 48 hours of admission or 5) they were terminally ill. Patients had to be enrolled in the study within 48 hours of hospital admission, and informed consent was obtained prior to enrollment.

Data collection

A research nurse visited the participating wards on a daily basis (except for the weekends)

to identify eligible patients for the study. After the patient's informed consent (or that of the patient's primary caregiver in case of cognitive impairment) was obtained, the patient received a systematic comprehensive geriatric assessment (CGA), which was administered by a research nurse. The CGA of the patient had to be completed within 48 hours of admission. The primary caregiver was also interviewed. To obtain uniformity in conducting

Appendix 1 Content of the Comprehensive Geriatric Assessment

Geriatric condition	Measurement instrument	Range of scores	Cut-off score
Somatic domain			
Polypharmacy	Counting the number of different medications	Continuous	≥5
Malnutrition	Short Nutritional Assessment questionnaire (SNAQ) [44]	0-7	≥2 moderately malnourished ≥3 severely malnourished
Obesity	Body Mass index	Continuous	≥30
Pain *	Visual analogue scale [45]	0-10	≥4
Fall risk	Have you fallen two or more times in the past three months? [46]	Yes or no	Yes
Presence of a pressure ulcer	Observation by the research nurse	Yes or no	Yes
Indwelling urinary catheter	Presence of a catheter at admission	Yes or no	Yes
Incontinence	Self-report of incontinence for urine or feces at admission	Yes or no	Yes
Constipation	Self-report of constipation at admission	Yes or no	Yes
Psychological domain			
Cognitive impairment	Mini-Mental State Examination [21]	0-30	≤ 24 is cognitive impairment
Depressive symptoms *	Two questions, namely: [47] 1. Did you feel sad, depressed or hopeless in the past month? 2. Did you lose interest in daily activities?	0-2	2
Delirium	Confusion Assessment Method [22]	0-4	Item 1 and 2 and item 3 and/or 4 are present
Functional domain			
Premorbid ADL functioning	Katz ADL index score [24]	0-6	≥1
Premorbid IADL functioning	IADL questions of the modified Katz ADL index score [48]	0-8	≥1
Vision impairment	Do you have problems with your vision, regardless of the use of glasses?	Yes or no	Yes
Hearing impairment	Do you have problems with hearing, regardless of the use of a hearing aid?	Yes or no	Yes
Mobility difficulty	Are you using a walking device?	Yes or no	Yes
Social domain			
High perceived burden of caregivers	Experienced burden of primary care givers (EDIZ) [49]	0-9	≥4

*Only assessed in patients with MMSE ≥ 16

the CGA, the research nurses were trained in interviewing patients and primary caregivers before the start of the study, and ten patients were assessed simultaneously by the research nurse and geriatrician to control for observer variability.

Systematic Comprehensive Geriatric Assessment of geriatric conditions

The CGA in the current study consisted of a systematic assessment of geriatric conditions and focused on four domains of the patient's function (somatic, psychological, functional and social). The CGA evaluated 18 health problems that are frequently observed in older persons, defined in this article as geriatric conditions. Appendix 1 shows the content of the CGA, including applied measurement instruments, score ranges and the cut-off scores used. Data collection began with the 11-item Mini-Mental State Examination (MMSE), to assess the presence and degree of global cognitive impairment [21]. Patients with a MMSE score of ≥21 points were interviewed. The responses of patients with a MMSE score of 16-20 points, indicating moderate global cognitive impairment, were cross-checked with those of their primary caregiver concerning baseline characteristics and ADL performance. In case of a disagreement, the response of the primary caregiver was selected. Data from patients with a MMSE score of ≤ 15 points were obtained from their primary caregiver. This latter group was not screened for pain or depressive symptoms, as the measurement instruments we used have not been validated in cognitively impaired patients.

After enrolling a patient and completing the main part of the CGA, the research nurse reported her findings to the geriatrician. The geriatrician also visited the patient within 48 hours and paid special attention to evaluating potential psychiatric problems, such as delirium. The patient was screened for delirium using the Confusion Assessment Method (CAM) [22].

After discharge, a geriatrician studied the discharge letter on medical diagnoses present at admission, new conditions that developed during the hospital stay, co-morbidities and medication. The Charlson co-morbidity index was also derived from this information [23], indicating the number and severity of co-morbidities. The possible scores on the Charlson co-morbidity index range from 0 to 31, with a higher score indicating a

greater number of co-morbidities and/or more severe co-morbidities. The ICD-9 diagnostic criteria were used to determine the presence of all medical diagnoses.

Follow-up and outcome assessments

One year after admission, a research nurse examined the municipal data registry to determine whether patients were alive. The exact date of death was registered if a patient had died. The nurse then contacted all other patients and their primary caregivers by telephone to assess the patients' present functional status, in terms of functional decline and cognitive impairment. All outcome data were collected from the same person (patient or primary caregiver) who responded at baseline.

Functional decline was defined as a loss of at least one point on the original Katz ADL index score [24] one year after hospital admission compared to the premorbid Katz ADL index score, which was assessed based on patients' performance two weeks prior to hospital admission.

Cognitive impairment one year after hospital admission was defined as a score of 3.9 or more on the Informant Questionnaire on Cognitive Decline in the Elderly-Short Form (IQCODE-SF), which was completed by the primary caregiver of the patient [25].

Statistical analysis

Patient and clinical baseline characteristics, the prevalence of geriatric conditions and health outcomes were summarized using descriptive statistics. Because the dataset suffers from missing data on the independent variables (geriatric conditions), we performed multiple imputation as implemented by SPSS, version 18.0.2. In this approach, all geriatric conditions were entered into the imputation model, together with sex, age, the Charlson co-morbidity score and mortality and functional decline. Five imputation datasets were used. Because depression and pain were not systematically assessed in severely cognitive impaired patients, these geriatric conditions were not imputated and were not analyzed further.

The independent impact of geriatric conditions on mortality, functional decline, and cognitive impairment was analyzed using Cox regression models. Geriatric conditions with a p<0.20 in the univariate analyses were entered into the multivariable models. All multivariable models were adjusted for sex, age, and Charlson comorbidity scores, as these variables are known risk factors for mortality, functional decline and cognitive impairment. Besides mortality, two analytical approaches were used to assess functional decline. One of the approaches included patients who died (defined as 'poor outcome', combined endpoint of functional decline and mortality), and one approach excluded patients who died and those with a maximum score on the premorbid Katz ADL index because there is little to no room for further decline within these patients. For cognitive impairment one year after admission, all patients with a confirmed dementia diagnosis in their patient record were excluded from these analyses were excluded from the analyes. Effect sizes were expressed in hazard ratios with their corresponding 95% confidence intervals. The Cox models were checked for collinearity between independent variables; the proportional hazards assumption was verified using log-minus-log plots.

Table 1 Baseline Characteristics of Patients

Variable	**Total group (n=639)**
Age in years, mean (SD)	78.2 (7.8)
Sex	
Male, % (No.)	46.2 (295)
Ethnicity	
Caucasian, % (No.)	92.8 (593)
Living arrangement	
Independent, % (No.)	72.4 (463)
Social status	
Living with partner or child, % (No.)	47.9 (306)
Education in years, mean (SD)	9.9 (3.9)
Medical reason for admission, %, (No.)	
Infectious disease	40.9 (261)
Gastrointestinal disease	22.8 (146)
Malignancy	6.2 (40)
Cardiovascular disease	4.3 (27)
Water and electrolyte disturbance	10.5 (67)
Other	15.4 (98)
Charlson comorbidity index score*, mean (SD)	3.7 (2.4)

* Range 0-31; a higher score indicates more and/or more severe comorbidities

Results

There were 1031 consecutive patients eligible for participation in this study, of whom 639 (62%) were enrolled after providing informed consent. The reasons for exclusion were refusal to participate (n=222), insufficient Dutch language capacities (n=86), transfer from another ward (n=36), transfer to another ward such as an ICU or CCU within 48 hours (n=28) and terminal illness (n=20). Follow-up concerning mortality was completed for 100% of the patients. Functional and cognitive outcome was completed for 92% and 77% of included patients, respectively.

Table 2 Prevalence of Geriatric Conditions in Acutely Hospitalized Older Patients (n=639)

Geriatric condition	Overall prevalence % (Number of patients/total number of observations)
Somatic domain	
Polypharmacy	60.7 (386/636)
Malnutrition	51.5 (322/635)
Obesity	13.5 (77/569)
Pain*	42.6 (206/483)
Fall risk	23.3 (142/609)
Pressure ulcer	3.6 (19/582)
Indwelling urinary catheter	23.8 (150/631)
Incontinence	22.2 (137/618)
Constipation	19.5 (123/630)
Psychological domain	
Cognitive impairment	40.1 (256/639)
Depressive symptoms*	21.1 (101/479)
Delirium	19.0 (118/622)
Functional domain	
Premorbid ADL impairment	50.9 (324/637)
Premorbid IADL impairment	82.5 (527/639)
Vision impairment	22.3 (137/613)
Hearing impairment	20.3 (120/590)
Mobility difficulty	58.5 (373/638)
Social	
High perceived burden on caregivers	52.7 (267/507)

ADL= activities of daily living, IADL= instrumental activities of daily living
*Only assessed in patients with MMSE ≥ 16 (n=483)

Compared to included patients, excluded patients were significantly younger (75 years vs. 78 years, p<0.001) and died more frequently within one year of discharge (48% vs. 35%, p<0.001).

Table 1 presents the baseline characteristics of the study population. The mean age was 78 years, and 72% of patients lived independently prior to hospital admission. The primary reason for hospital admission was infectious disease (41%).

The mean (SD) number of geriatric conditions at hospital admission was six (3). Table 2 shows the prevalence of each geriatric condition. Overall, impairment in Instrumental Activities of Daily Living (IADL) (83%), polypharmacy (61%), mobility difficulties (59%), perceived burden on caregivers (53%), malnutrition (52%) and ADL impairments were the most common geriatric conditions. Cognitive impairment at admission was present in 40% of study patients; of these patients, 6% had a diagnosed dementia. All conditions were apparent in at least 13% of the patients, except for pressure ulcers (4%). Table 2 also provides information on the total number of observations that were present before the imputation of the dataset.

Follow-up

Impaired outcomes were common one year after admission. The mortality rate one year after hospital admission was 35%. Of those patients who were alive after one year, 33% encountered functional decline and 26% experienced cognitive impairment. Overall, 54% exhibited a poor outcome in terms of mortality or functional decline.

Table 3 shows the Cox regression models for mortality and functional decline one year after admission. After adjusting for age, sex, and comorbidity, the geriatric conditions of malnutrition, fall risk and IADL impairment had a significant impact on higher mortality rates. Obesity was associated with lower mortality. The analysis for poor outcome (functional decline including mortality) showed the same risk profile, except that delirium at admission was also associated with poor outcome. In the survivors, the presence of older age and an indwelling urinary catheter had a significant impact on functional decline.

The analysis of cognitive impairment one year after admission was restricted to those patients without a baseline dementia diagnosis (94% of the included population). Besides older age, fall risk and IADL impairment were (borderline) significantly associated with cognitive impairment (Table 4).

Table 3 Cox Regression Analyses for Mortality, Poor Outcome and Functional Decline One Year after Hospital Admission

Variables	Mortality (n= 639)		Poor outcome (mortality or functional decline*) (n = 639)		Functional decline* (n = 380)	
	HR (95% CI)	p-value	HR (95% CI)	p-value	HR (95% CI)	p-value
Known risk factors						
Female sex	1.46 (1.10-1.93)	0.01	1.20 (0.96-1.50)	0.11	0.86 (0.59-1.26)	0.44
Age (per year)	1.02 (1.00-1.04)	0.06	1.03 (1.01-1.04)	0.01	1.04 (1.02-1.07)	0.01
Charlson comorbidity score (per point)	1.19 (1.13-1.26)	<0.001	1.15 (1.10-1.21)	<0.001	1.05 (0.96-1.14)	0.28
Geriatric conditions						
Somatic domain						
Number of different medications (per additional medicine)						
Malnutrition	1.78 (1.33-2.38)	<0.001	1.42 (1.14-1.76)	0.01		
Obesity	0.49 (0.26-0.94)	0.03	-	-		
Fall risk	1.52 (1.13-2.05)	0.01	1.33 (1.04-1.71)	0.01	-	-
Presence of a pressure ulcer	-	-	-	-		
Indwelling urinary catheter			-	-	1.48 (1.01-2.16)	0.04
Incontinence						
Constipation	-	-				
Psychological domain						
Cognitive impairment (per MMSE point)	-	-	-	-	-	-
Prevalent delirium	-	-	1.47 (1.10-1.97)	0.01	-	-
Functional domain						
ADL impairment (per point)	-	-	-	-		
IADL impairment (per point)	1.14 (1.08-1.20)	<0.001	1.08 (1.03-1.14)	0.01		
Vision impairment						
Hearing impairment	-	-	-	-	-	-
Mobility difficulty	-	-	-	-	-	-

Field marked with a – indicates that the variable had a p<0.20 in the univariate Cox regression analysis and was entered into the multivariable Cox regression model

HR= Hazard Ratio / CI= confidence interval / MMSE= Mini-Mental State Examination, range of scores between 0-30, a higher score indicates better global cognitive functioning / ADL= activities of daily living, range of scores between 0-6, a higher score indicates more dependence in ADL / IADL= instrumental activities of daily living, range of scores between 0-8, a higher score indicates more dependence in IADL

*Functional decline was defined as a loss of 1 point on the Katz ADL index score one year after admission compared to premorbid functioning two weeks prior to hospital admission.

Discussion

This multicenter prospective cohort study demonstrated that geriatric conditions are highly prevalent in acutely hospitalized older medical patients, and some of these geriatric conditions are associated with negative health outcomes one year after admission. Older patients presented with an average of six geriatric conditions. IADL impairment, polypharmacy, mobility difficulty, high levels of perceived caregiver burden, malnutrition and ADL impairment were all present in more than 50% of the patients.

The systematic screening procedure to identify geriatric conditions revealed that the prevalence of geriatric conditions in this patient group is high. The prevalence of some conditions, such as malnutrition [6], cognitive impairment [4;5], delirium [3;26], (I)ADL impairment [2;10;27], incontinence [28] and visual impairment [29], is comparable to the prevalence rates reported in other studies of acutely hospitalized older patients. For many of these geriatric conditions, (preventive) interventions can be initiated at the time of hospital admission, which might lead to better health outcomes, as has been demonstrated for the delirium [30], incontinence [31], and malnutrition [32].

Mortality one year after admission was substantial, as one-third of the patients died. Adjusting for sex, age, and level of comorbidity; malnutrition, fall risk and IADL dysfunction were significantly associated with higher mortality rates one year after hospital admission. Obesity showed a negative association with mortality, which is difficult to explain based on the literature [33;34] or clinical reasoning. Malnutrition is a known risk factor for mortality, whereas fall risk is a geriatric condition that is most often observed in very vulnerable patients [9]. Analyzing the aggregate outcome of functional decline and mortality results in the same risk profile of poor outcome found when analyzing mortality only. Delirium was an additional independent risk factor for poor outcome, which has also been described in previous research [9;26;35].

One year after admission, further functional decline was found in one-third of the survivors. Rates of functional decline after acute hospitalization ranged between 10-50% in the literature [14;36]. Accounting for older age, only an independent association between an indwelling urinary catheter and impaired functional health was found. The impact of

urinary catheters has been less studied, and these catheters have not been identified as a risk factor for functional decline [37]. This risk factor may be a proxy for acute illness or for patient vulnerability. In contrast to other studies, baseline (I)ADL impairment was not associated with functional decline, probably because (I)ADL impairment is also associated with age and the model was controlled for age.

Table 4 Cox Regression Analysis for Cognitive Impairment* One Year after Hospital Admission in Patients without Known Dementia at Baseline (n = 321)

Variables	Cognitive impairment	
	HR (95% CI)	p-value
Known risk factors		
Sex	1.47 (0.91-2.39)	0.12
Age (per year)	1.05 (1.02-1.09)	<0.001
Charlson comorbidity score (per point)	1.03 (0.92-1.15)	0.59
Geriatric conditions		
Somatic domain		
Number of different medications (per additional medicine)		
Malnutrition		
Obesity		
Fall risk	1.63 (0.99-2.67)	0.06
Presence of a pressure ulcer	-	
Indwelling urinary catheter	-	
Incontinence		
Constipation		
Psychological domain		
Cognitive impairment (per MMSE point)	-	
Prevalent delirium	-	
Functional domain		
ADL impairment (per point)	-	
IADL impairment (per point)	1.25 (1.13-1.38)	<0.001
Vision impairment		
Hearing impairment		
Mobility difficulty	-	

HR= Hazard Ratio, CI= confidence interval

MMSE= Mini-Mental State Examination, range of scores between 0-30, a higher score indicates better cognitive functioning

ADL= activities of daily living, range of scores between 0-6, a higher score indicates more dependence in ADL, IADL= instrumental activities of daily living, range of scores between 0-8, a higher score indicates more dependence in IADL

*Cognitive impairment was defined as an IQCODE-SF score of 3.9 or more one year after admission. Patients with a baseline dementia diagnosis were excluded from this analysis.

Cognitive impairment at one year was present in approximately one-quarter of the patients. For this analysis, patients presenting with a baseline dementia diagnosis (6%) were excluded. The rate of cognitive impaired patients after one year was lower than the 34% of patients who demonstrated cognitive dysfunction at admission. This result indicates that individuals can recover from diminished cognitive function at admission, as a result of delirium for instance, after hospital admission [4]. Adjusting for known risk factors, including older age, both fall risk and IADL impairment were identified as independent risk factors for cognitive impairment after one year. Research on cognitive impairment after hospital admission is sparse, and the identified geriatric conditions were not previously identified as predictors in this population. Most research focuses solely on delirium as a risk factor for cognitive disturbances; however, the current analysis did not demonstrate this effect.

Some limitations of the study should be stated. First, a portion of the eligible patients declined to participate in the study. Limitations of this type are frequently encountered in studies of acutely hospitalized older patients and could account for lower inclusion rates than in other studies involving older patients [38]. Compared to some randomized clinical trials, the current study achieved higher rates of inclusion and had lower drop-out rates [17;39;40]. Furthermore, the research team did not record the invasive diagnostic and treatment procedures patients received during their hospital stay. These procedures could have affected negative health outcomes after discharge. Third, cognitive impairment one year after admission was measured by interviewing the primary caregiver about the patients' global cognitive functioning. This approach might not be as objective as directly testing cognitive function in patients. The IQCODE-sf has been shown to be a valid and reliable instrument for detecting global cognitive impairment and decline in a similar population [41].

The strength of the present study is that it was a multicenter study that included patients with mild to severe cognitive impairment, a group of patients that is often excluded from studies despite being at high risk for many negative outcomes. Approximately 40% of the included patients presented with a cognitive impairment, partly

due to delirium, or had concentration and memory problems caused by the acute illness at admission. The majority of the eighteen conditions were diagnosed by questioning the primary caregiver, screening the patient or relying on observations made by the research nurse.

The present study might have clinical implications for the care provided in hospitals and after discharge. Many geriatric conditions associated with poor health outcomes require extra attention to prevent further decline and poor outcome. A systematic assessment of geriatric conditions at the time of hospital admission should, therefore, result in an appropriate treatment plan with realistic goals. Treatment goals should be tailored to the individual needs of patients. This strategy might vary from prevention and improving physical functioning in patients without disabilities to maintaining quality of life in older patients with many comorbidities, disabilities and geriatric conditions [42;43].

In conclusion, the current study demonstrates that acutely hospitalized older patients are a vulnerable patient group. In addition to acute illnesses, these patients often present with many geriatric conditions at hospital admission. Poor outcomes, in terms of mortality, functional decline and cognitive impairment, were substantial and were associated with geriatric conditions. Proactive recognition of these conditions could lead to better health outcomes and reduce the burden of hospital admission for older patients.

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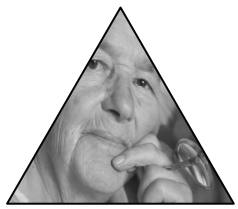

Chapter 7

Clinical Characteristics and Outcomes of Hospitalized Older Patients with Distinct Risk Profiles for Functional Decline: a Prospective Cohort Study

Submitted for publication

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Abstract

Background: The aim of this research was to study the clinical characteristics and mortality and disability outcomes of patients who present distinct risk profiles for functional decline at admission.

Methods: Multicenter, prospective cohort study conducted between 2006 and 2009 in three hospitals in the Netherlands in consecutive patients of ≥ 65 years, acutely admitted and hospitalized for at least 48 hours. Nineteen geriatric conditions were assessed at hospital admission, and mortality and functional decline were assessed until twelve months after admission. Patients were divided into risk categories for functional decline (low, intermediate or high risk) according to the Identification of Seniors at Risk-Hospitalized Patients.

Results: A total of 639 patients were included, with a mean age of 78 years. Overall, 27%, 33% and 40% of the patients were at low, intermediate or high risk, respectively, for functional decline. Low-risk patients had fewer geriatric conditions (mean 2.9 [standard deviation [SD] 1.7]) compared with those at intermediate (mean 5.7 [SD 2.2]) or high risk (mean 7.2 [SD 1.9]) ($p<0.001$). Twelve months after admission, 39% of the low-risk group had an adverse outcome, compared with 50 % in the intermediate risk group and 69% in the high risk group ($p<0.001$).

Conclusion: By using a simple risk assessment instrument at hospital admission, patients at low, intermediate or high risk for functional decline could be identified, with distinct clinical characteristics and outcomes. This approach should be tested in clinical practice and research and might help appropriately tailor patient care.

Introduction

Functional decline, defined as a loss of activities of daily living (ADL), is experienced by 30 to 60% of hospitalized older patients [1;2]. In acutely hospitalized patients, functional decline often precedes hospital admission [3], and hospitalization itself further increases the risk of worsening ADL disabilities [4]. Patients with functional decline are also at risk for other adverse health outcomes, such as institutionalization and death [5].

Acutely hospitalized older patients are often less able to recover from functional decline than community-dwelling older patients [6-8]. Preventing functional decline during and after hospitalization is therefore an increasingly important health-care focus in older hospital patients [9;10]. Not all patients are at equal risk of developing functional decline because decline is dependent on (among other factors) patients' premorbid status, including geriatric conditions present at admission [1;11]. The aggregate number of geriatric conditions present at hospital admission determines a patient's individual risk for functional deterioration [1;12].

In studies focusing on assessing the risk of functional decline, the study population is often crudely dichotomized into a low-risk and a high-risk group [5]. Both the International Classification of Functioning (ICF) and expert opinion suggest the need for patient care and research to adopt a more tailored approach, in which different subgroups or categories of older patients are identified.[10;13-15]. The added value of such an approach is that it might help clinicians define subtle treatment goals at an early stage (for instance, at hospital admission) and discuss preferred and expected hospital care outcomes with their patients. Although some studies have attempted to develop such a tailored approach [12;16], their assumptions and outcomes have not been studied thoroughly [17].

The objectives of this multicenter, prospective, observational study were therefore to investigate 1) differences in the clinical characteristics of patients at low, intermediate or high risk for functional decline, 2) the different functional trajectories from baseline to one year after discharge in the risk groups and 3) the association between risk categories and mortality and functional decline at three and twelve months after hospital admission.

Methods

Design and setting

This multicenter prospective cohort study, the DEFENCE study (Develop strategies Enabling Frail Elderly New Complications to Evade) was conducted between April 1, 2006 and April 1, 2008 in three hospitals in The Netherlands: the Academic Medical Center (AMC) in Amsterdam, the University Medical Centre Utrecht (UMCU) in Utrecht and the Spaarne Hospital (SH) in Hoofddorp. The AMC (1,024 beds) and UMCU (1,042 beds) are tertiary university teaching hospitals. The SH (455 beds) is a regional teaching hospital.

In total, five wards in the AMC, three wards in the UMCU and three wards in the SH participated in this study. The staff on the general medical wards consisted of residents, physicians and registered nurses who did not specialize in geriatric medicine or geriatric nursing. A geriatric consultation team consisting of at least one clinical nurse specialist and one geriatrician was available in all hospitals.

The study was approved by the Medical Ethics Committees of the centers.

Patients

The study enrolled all consecutive patients aged 65 years and older who were acutely admitted to one of the three participating hospitals' medical wards and hospitalized for at least 48 hours. Patients were excluded if 1) they or their relatives did not give informed consent; 2) they were too ill to participate, as determined by their attending medical doctor; 3) they came from another ward in or outside the hospital; 4) they were transferred to the Intensive Care Unit of the Coronary Care Unit or another ward in or outside the hospital within 48 hours after admission; or 5) they were unable to speak or understand Dutch. Enrollment had to take place within 48 hours after admission, and informed consent was obtained before inclusion.

Data collection

A research nurse visited the participating wards every weekday seeking eligible patients for the study. After obtaining informed consent from the patient or, in case of cognitive impairment, from the primary caregiver, the patient received a risk assessment, followed by a systematic geriatric assessment on four domains of functioning (somatic, psychological, functional and social) performed by the research nurse. The primary caregiver was also interviewed. The patient assessment had to be completed within 48 hours after admission.

Risk assessment for functional decline

The Identification of Seniors at Risk–Hospitalized Patients (ISAR-HP) was applied to determine which patients were at low, intermediate or high risk for functional decline. The ISAR-HP is based on the original ISAR for the Emergency Department (ED) [18]. The ISAR has been extensively validated to detect a broad range of adverse outcomes after ED discharge and has been shown to be a clinimetrically sound screening instrument [18-20] . The ISAR-HP was adapted for use with acutely hospitalized patients and focuses on four aspects: 1) the need for assistance with instrumental activities of daily living (IADL) two weeks prior to hospital admission, 2) eight years or fewer of formal education, 3) the inability to travel alone two weeks prior to hospital admission and 4) the use of a walking device. The first three items scored one point each, and the last item scored two points. Patients with a score of 0-1 are classified as at low risk for functional decline, whereas scores of 2-3 and 4-5 indicate intermediate and high risk, respectively.

Systematic geriatric assessment

At admission, patients' baseline and clinical characteristics were assessed with a comprehensive geriatric assessment (CGA). Appendix 1 shows the measurement tools, score ranges and cut-off scores used during this assessment.

Appendix 1: Content of the systematic comprehensive geriatric assessment, including measurement tools, score ranges and applied cut-off scores

Geriatric condition	Measurement tool	Range of scores	Cut-off score
Somatic domain			
Polypharmacy	Counting the number of different medications	Continuous	≥5
Malnutrition	Short nutritional assessment questionnaire (SNAQ) [38]	0–7	≥2 moderately malnourished ≥3 severely malnourished
Obesity	Body mass index	Continuous	≥30
Pain *	Visual analogue scale [39]	0–10	≥4
Fall risk	Have you fallen two or more times in the past three months?	Yes or no	Yes
Presence of a pressure ulcer	Research nurse observation	Yes or no	Yes
Indwelling urinary catheter	Research nurse observation of a catheter at admission	Yes or no	Yes
Incontinence	Self-report of incontinence at admission	Yes or no	Yes
Constipation	Self-report of constipation at admission	Yes or no	Yes
Psychological domain			
Premorbid cognitive impairment	Informant Questionnaire COgnitive DEcline, Short Form (IQCODE-SF) [40]	16–80	Mean score ≥3.9
Depressive symptoms *	Two questions: [41] 1. Did you feel sad, depressed or hopeless in the past month? 2. Did you lose interest in daily activities? When patients answered "yes" to both questions, the GDS-15 screening instrument was administered [42]	0–2	2
Delirium	Confusion assessment method [22] (CAM)	0–4	Items 1 and 2 and Items 3 and/or 4 are present
Functional domain			
Premorbid ADL Functioning	Katz ADL index score [24]	0–6	≥1
Premorbid IADL functioning	IADL questions on the modified Katz ADL index score [43]	0–8	≥1
Vision impairment	Do you have problems with your vision, regardless of the use of glasses?	Yes or no	Yes
Hearing impairment	Do you have problems with hearing, regardless of the use of a hearing aid?	Yes or no	Yes
Use of a walking device	Do you use a walking device?	Yes or no	Yes
Low health status score*	Euroqol (EQ-5D) VAS-score [44]	0–100	<55
Social domain			
High perceived caregiver burden	Experienced burden of primary caregivers (EDIZ) [45]	0–9	≥4

*Only assessed in patients with an MMSE score ≥ 16

The CGA started with the eleven-item Minimal Mental State Examination (MMSE) [21] to assess the presence and degree of global cognitive impairment. Patients with a MMSE score ≥ 21 were interviewed; patients with a MMSE score of 16–20 were also interviewed, but their answers concerning baseline characteristics and ADL performances were cross-checked with their caregiver. In case of a disagreement, the caregiver's answer was included. Data for patients with an MMSE score ≤ 15 were obtained from their primary caregiver. This latter group was not screened for pain, depression or perceived health status, as the instruments we used have not been validated with cognitively impaired patients.

After administering the CGA, the research nurse reported her findings to the geriatrician. The geriatrician also visited each patient within 48 hours and paid special attention to diagnosing potential psychiatric problems. The patient was screened for delirium using the confusion assessment method (CAM) [22].

After discharge, a geriatrician reviewed the discharge letter to determine the medical diagnoses presented at admission, new diagnoses developed during the patient's hospital stay, comorbidities and medication. Charlson comorbidity index scores were derived from this information [23], indicating the number and severity of comorbidities. Charlson comorbidity index scores range from 0 to 31, with a higher score indicating an increased number of severe comorbidities. ICD-9 diagnostic criteria were used to score these diagnoses.

Follow-up and definition of outcomes

Three and twelve months after admission, a research nurse from each center phoned the patient and/or primary caregiver to assess the patient's current ADL functioning. ADL status was collected from the same person (patient or informal caregiver) from whom the baseline information was obtained. Functional decline was defined as a loss of at least one point on the original Katz ADL index score [24] three or twelve months after admission, compared with the premorbid Katz ADL index score two weeks prior to hospital admission.

The mortality rate at three months and twelve months after admission was based on information from the Municipal Data Registry.

Functional trajectories were defined as the course of functioning from admission up to one year after discharge and were constructed using mortality and functional decline data at each time point. Patients who were still alive at three and twelve months and did not demonstrate decreased ADL functioning remained at their baseline level of function.

Statistical analysis

Baseline characteristics and outcomes were summarized using descriptive statistics. To determine the differences in the prevalence of geriatric conditions and outcomes among patients at low, intermediate and high risk for functional decline, dichotomous variables and categorical data were tested with a chi-squared test, and continuous variables were tested using ANOVA. Missing data in the tables are reported as the number of patients with the observed condition or outcome in contrast with the total number of patients in which the condition was assessed.

The number of patients in each risk category with premorbid impairments in individual activities of daily living was calculated from the Katz ADL index and presented in a figure. To establish functional trajectories at three and twelve months, the number of patients who had died and who demonstrated functional decline in each risk group was calculated. Patients who improved in activities of daily living were added to the group that remained at baseline functional levels.

To determine the relationship between risk category and mortality and functional decline at three and twelve months, regression analyses were performed. For mortality, Cox regression analyses were performed. Crude and adjusted (for age, sex and Charlson comorbidity index) models were calculated. For functional decline, logistic regression analyses were conducted and crude and adjusted models were computed, adjusting for the same factors. Patients in the low-risk group were used as a reference category.

Results

There were 1,031 consecutive patients eligible for participation in this study, 639 (62%) of whom were included after informed consent. Reasons for exclusion were refusal to participate (n=222), insufficient Dutch language capabilities (n=86), transfer from another ward (n=36), transfer to ICU or CCU within 48 hours (n=28) and terminal illness (n=20). Compared with included patients, excluded patients were significantly younger (75 years vs. 78 years, p<0.001) and died more frequently within one year (48% vs. 35%, p<0.001).

Table 1 Baseline characteristics of acutely hospitalized older patients in three risk categories for physical functional decline

	Patients (n=639)	Low risk (n= 175)	Intermediate risk (n=211)	High risk (n=253)	p-value
Age in years	78.2 (7.8)	73.8 (6.4)	77.4 (7.1)	82.0 (7.5)	<0.001
Male (%)	46.2	60.0	46.9	36.0	<0.001
Education in years	9.9 (3.9)	11.4 (3.8)	10.2 (3.9)	8.6 (3.6)	<0.001
Caucasian (%)	92.8	95.4	91.9	91.7	0.35
Social status (%)					<0.001
Living alone	47.9	37.1	46.7	56.3	
Living arrangement (%)					<0.001
Independent	72.4	93.7	78.6	52.6	
Senior residence	10.3	4.6	9.0	15.4	
Supported living community	10.3	0.6	6.7	20.2	
Nursing home/intermediate care	7.0	1.1	5.8	11.8	
Diagnosis at admission (%)					0.76
Infectious disease	40.9	42.9	45.5	35.9	
Digestive system disease	22.8	23.8	21.8	22.9	
Malignancy	6.2	8.3	4.5	6.1	
Cardiovascular disease	4.3	4.8	2.7	5.3	
Water and electrolyte disturbance	10.5	9.5	8.2	13.0	
Other	15.4	10.7	17.3	16.8	
Charlson comorbidity index *	3.5 (2.3)	3.9 (2.7)	3.8 (2.4)	3.5 (2.2)	0.27
Length of hospital stay in days (median [range])	7 (2-100)	5 (2-100)	7 (2-77)	8 (2-80)	0.01

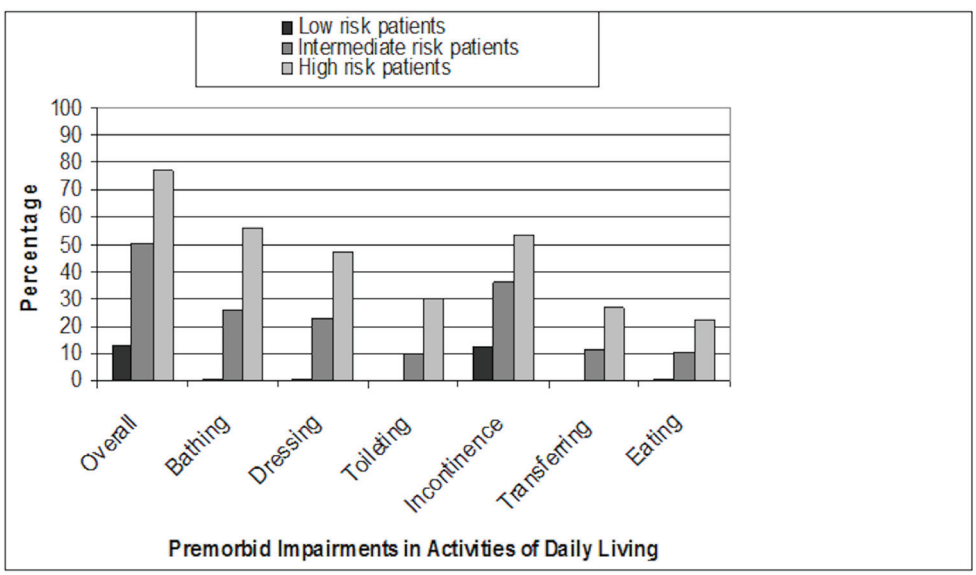
Mean (SD) are given for continuous variables.
*Range 0–31; a higher score indicates more or more severe comorbidities.

Baseline characteristics of the three risk groups

Table 1 presents the baseline characteristics of the complete study population. The mean age was 78 years; 72% lived independently before hospital admission and approximately

half the patients lived alone. The most common reason for admission was infection (41%). ISAR-HP scores showed that 27%, 33% and 40% of the patients were at low, intermediate or high risk for functional decline, respectively. There was a significant relationship between higher risk levels and older age, female sex, fewer years of education/lower social status, living alone, and care dependency.

Figure 1 Premorbid impairments in individual activities of daily living in the three risk groups



"Premorbid" refers to the situation two weeks prior to hospital admission. "Overall" refers to the percentage of patients with one or more impairments in activities of daily living on the Katz ADL index score.

Clinical characteristics

Table 2 shows the clinical characteristics of patients at low, intermediate or high risk for functional decline. Patients at high risk for functional decline had more geriatric conditions (mean 7.2 [SD 1.9]) than those at low risk (mean 2.9 [SD 1.7]) or intermediate risk (mean 5.7 [SD 2.2]) for decline ($p<0.001$). In the high-risk group, patients frequently presented geriatric syndromes, such as fall risk, incontinence, premorbid cognitive impairment and delirium. As expected, there was also a substantial caregiver burden in the high-risk group.

Additionally, there was a significant association between risk profiles and level of ADL functioning disability, with more disabling factors in the higher risk groups. Most patients in the low-risk group had no disabilities in ADL functioning. In the intermediate group, 20% had premorbid disabilities related to bathing and dressing. In the high-risk group, 50% had two or more ADL impairments (Figure 1).

We could not demonstrate clear differences between the subgroups with regard to malnutrition, obesity, pain, constipation or depressive symptoms.

Table 2 Clinical characteristics of acutely hospitalized older patients in the three risk categories for physical functional decline

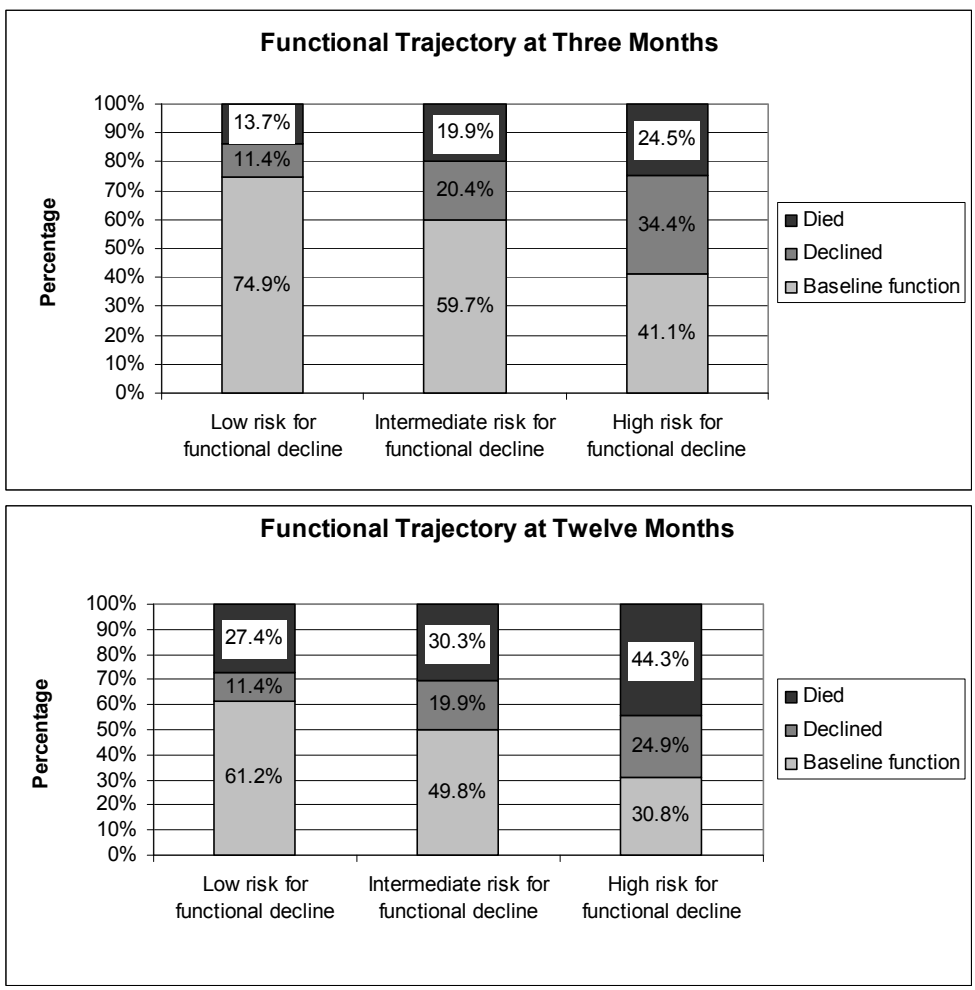
	Low risk n=175 % (n/total number of observations)	**Intermediate risk n=211 % (n/total number of observations)**	**High risk n= 253 % (n/total number of observations)**	**p-value**
Somatic domain				
Polypharmacy	46.6 (81/174)	64.8 (136/210)	66.3 (167/252)	<0.001
Malnutrition	45.2 (76/168)	50.5 (105/208)	54.6 (136/249)	0.17
Obesity	8.9 (15/168)	13.8 (26/188)	12.7 (27/213)	0.33
Pain *	42.3 (58/137)	44.5 (77/173)	42.8 (74/173)	0.91
Fall risk	4.2 (7/165)	27.9 (57/204)	30.0 (72/240)	<0.001
Presence of a pressure ulcer	0.0 (0/141)	3.6 (7/196)	4.1 (10/245)	0.06
Indwelling urinary catheter	7.6 (13/172)	20.0 (42/210)	37.3 (94/252)	<0.001
Incontinence	14.5 (24/165)	23.8 (49/206)	24.3 (60/247)	0.04
Constipation	20.3 (35/172)	14.9 (31/208)	22.0 (55/250)	0.15
Psychological domain				
Premorbid cognitive impairment	7.4 (9/121)	24.7 (43/174)	42.1 (91/216)	<0.001
Cognitive impairment at time of admission	10.9 (19/175)	34.6 (73/211)	64.8 (164/253)	<0.001
Depressive symptoms *	18.2 (25/137)	20.3 (35/172)	24.7 (42/170)	0.36
Prevalent delirium	2.3 (4/175)	19.2 (40/208)	29.7 (71/239)	<0.001
Functional domain				
Premorbid ADL impairment	13.1 (23/175)	50.2 (106/211)	77.3 (194/251)	<0.001
Premorbid IADL impairment	50.9 (89/175)	88.6 (187/211)	99.2 (251/253)	<0.001
Vision impairment	9.5 (16/169)	20.7 (41/198)	30.5 (75/246)	<0.001
Hearing impairment	13.0 (21/161)	18.1 (35/193)	23.3 (55/236)	0.04
Mobility difficulty	0.0 (0/174)	56.4 (119/211)	100.0 (253/253)	<0.001
Low health status score *	31.1 (42/135)	38.0 (65/171)	44.0 (74/168)	0.07
Social domain				
High perceived caregiver burden	26.3 (31/118)	41.7 (70/168)	50.2 (111/221)	<0.001
Total number of geriatric conditions (mean (SD))	2.9 (1.7)	5.7 (2.2)	7.2 (1.9)	<0.001

*Only assessed in patients without severe cognitive impairment, defined as an MMSE score ≥ 16
ADL=activities of daily living, IADL=instrumental activities of daily living

Functional trajectories at three and twelve months

Outcomes three and twelve months after hospital admission differed significantly between the groups (Figure 2). After three months, 25% of the low-risk group had a poor outcome (mortality or functional decline), compared with 40% and 59% in the

Figure 2 Functional trajectories for patients at low, intermediate or high risk for functional decline three and twelve months after admission



"Baseline function" refers to the level of premorbid functioning on the Katz ADL index score two weeks prior to hospital admission. A decline in function was defined as a loss of at least one point at three or twelve months on the six-item Katz ADL index compared with premorbid functioning.

intermediate- and high-risk groups, respectively (p<0.001). At twelve months, these rates were 39%, 50% and 69% for the low-, intermediate- and high-risk group, respectively (p<0.001). Only 30% of the patients in the high-risk group remained at their baseline level of functioning at twelve months. Although the high-risk patients had the most premorbid impairments in ADL, they also deteriorated the most at three and twelve months.

Risk profiles in relation to mortality and functional decline

Tables 3a and 3b show that in both the crude and adjusted models, being at high risk for functional decline was significantly associated with mortality and poor functional health at both time points. Among patients at intermediate risk, the only significant association was found for functional decline at three and twelve months. However, when adjusting for age, sex and level of comorbidity, we could not demonstrate an association between moderate risk and functional decline one year after discharge.

Discussion

This multicenter study showed that by applying a simple risk assessment instrument at admission, three subgroups of older patients with distinct clinical characteristics and outcomes could be identified. Twenty-seven percent of the patients were at low risk for functional decline, 33% were at intermediate risk and 40% were at high risk for disability. Patients at high risk for further functional decline presented with the highest number of geriatric conditions. High-risk patients were also at the highest risk for poor outcomes in terms of mortality and deterioration in ADL functioning.

The low-risk group, as expected, presented with the fewest geriatric conditions and ADL impairments at admission but still had an average of three geriatric conditions. The number of geriatric conditions and premorbid ADL impairments gradually increased in the intermediate- and high-risk groups. The findings on the differences between the subgroups are consistent with other studies that used a more detailed risk classification for functional decline or frailty [12;16].

The geriatric conditions most often present in the high-risk group (cognitive impairment, delirium, premorbid ADL impairment, urine incontinence and fall risk) reflect the patients' frailty [25;26] and are known risk factors for future functional decline [1;11;27;28] . The high-risk group presented with the most baseline impairments and the greatest deterioration of ADLs over the follow-up period. Lost functions are difficult to recover, and new disabilities or impairment reported at discharge that are still present at one month of follow-up are especially difficult to rehabilitate [6]. Patients discharged with new or additional disabilities also have the highest probability of dying in the year after admission [6]. The severity of the acute illness leading to admission is an important risk factor for mortality [29;30]. This risk factor might explain the still relatively high mortality rates of 27% and 30% in the low- and intermediate-risk groups, respectively, up to one year after admission.

Compared with the low-risk group, the intermediate group showed an increased risk for functional decline at three months, but this increased risk disappeared at one year. A clear association between the high-risk group and mortality and functional decline was

Table 3a Cox regression models for three- and twelve-month mortality in relation to risk categories

Risk category	Three-month mortality Unadjusted HR (95% CI)	Three-month mortality Adjusted * HR (95 % CI)	Twelve-month mortality Unadjusted HR (95 % CI)	Twelve-month mortality Adjusted * HR (95% CI)
Low risk	Ref	Ref	Ref	Ref
Intermediate risk	1.49 (0.90-2.45)	1.43 (0.85-2.42)	1.15 (0.79-1.67)	1.10 (0.75-1.62)
High risk	1.82 (1.13-2.91)	1.71 (1.01-2.90)	1.81 (1.29-2.54)	1.62 (1.11-2.35)

HR=hazard ratio; CI=confidence interval

*Adjusted for age, sex and Charlson comorbidity index at hospital admission

Table 3b Logistic regression models for functional decline at three and twelve months in relation to risk categories

Risk category	Functional decline at three months Unadjusted OR (95% CI)	Functional decline at three months Adjusted * OR (95 % CI)	Functional decline at twelve months Unadjusted OR (95 % CI)	Functional decline at twelve months Adjusted * OR (95 % CI)
Low risk	Ref	Ref	Ref	Ref
Intermediate risk	2.19 (1.21-3.95)	2.07 (1.11-3.89)	2.07 (1.13-3.80)	1.60 (0.81-3.14)
High risk	5.31 (3.04-9.27)	4.48 (2.41-8.35)	4.29 (2.38-7.75)	3.22 (1.63-6.36)

OR=odds ratio; CI=confidence interval

*Adjusted for age, sex and Charlson comorbidity index at hospital admission

demonstrated at both time points. Only one-third of this group maintained baseline function one year after admission. This finding could indicate that the intermediate group has more potential for further rehabilitation after admission compared with the high-risk group, which might be too frail. Research has demonstrated that once patients begin to decline, they are more prone to further decline, even if they have regained their initial level of functioning [8;31].

An important question is whether risk status can identify the patients most likely to benefit from multidisciplinary intervention by a geriatric consultation team. Results of a metaanalysis of inpatient geriatric rehabilitation argued that subgroup evidence in favor of providing geriatric rehabilitation during and after hospital admission is warranted [32] and that more tailored approaches to patient selection still need to be tested. A recent randomized clinical trial (RCT) focusing on disease management in older heart failure

patients divided participants into three risk groups and found that there was a difference in intervention benefits, in terms of both outcomes and costs, in favor of the intermediate-risk group [33]. The authors argued that the low-risk group was too healthy and that the high-risk group too ill to profit from the intervention.

Further research should focus on testing this risk-based approach in acutely hospitalized older patients. This research could be implemented in two ways. The first is an impact study, testing the clinical usefulness of the approach by determining whether the risk assessment outcomes influence decision making and goal setting in both physicians and patients [34]. The second study that could be performed is an RCT using the three risk groups as a basis for goal setting and intervention. The ICF rehabilitation model could inform goals for the low-, intermediate- and high-risk groups [15].

Some limitations need to be addressed. First, in our study, we made a predefined selection with one risk assessment instrument, the ISAR-HP. Our main purpose was to demonstrate that a risk assessment instrument can be helpful to detect low-, intermediate- and high-risk patients. Although our study is a multicenter study, using the ISAR-HP for this purpose in other settings might produce different arising from differences in the case mix of patients, leading to a different distribution of the outcome and predictive factors [34]. We clearly demonstrated that this risk-based approach revealed differences in baseline (clinical) characteristics and health outcomes, further enhancing the validity of this screening instrument.

Second, functional decline was operationalized as a one-point decline at follow-up functioning compared with premorbid functioning. For further analyses, we dichotomized the outcome as present or absent. Although this approach is used in most studies of functional decline in hospitalized older patients [2], it leads to a loss of information about the ADL functioning level after hospitalization.

Third, the inclusion percentage was 62%. Although this rate is low, it is a common problem in studies of acutely hospitalized older patients, and most trials conducted in this population demonstrated equal or lower participation rates [35-37].

Conclusion

In conclusion, by using an easily applied risk assessment instrument at hospital admission, three patients groups (low, intermediate and high risk for functional decline) with distinct clinical characteristics could be distinguished. This approach might contribute to better defining of treatment goals at hospital admission, earlier initiation of appropriate (preventive) interventions and better communication with patients and caregivers about the preferred outcomes of admission. The application of this approach and the effectiveness of risk-based clinical interventions should further be tested in clinical practice and randomized clinical trials.

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Chapter 8

A Randomised Clinical Trial on Comprehensive Geriatric Assessment and Intensive Home Follow-up After Hospital Discharge: the Transitional Care Bridge

BMC Health Services Research. 2010 Oct 29;10:296.

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Abstract

Background

Older patients are at high risk for poor outcomes after acute hospital admission. The mortality rate in these patients is approximately 20%, whereas 30% of the survivors decline in their level of activities of daily living (ADL) functioning three months after hospital discharge. Most diseases and geriatric conditions that contribute to poor outcomes could be subject to pro-active intervention; not only during hospitalization, but also after discharge. This paper presents the design of a randomised controlled clinical trial concerning the effect of a pro-active, multi-component, nurse-led transitional care program following patients for six months after hospital admission.

Methods/Design

Three hospitals in the Netherlands will participate in the multi-centre, double-blind, randomised clinical trial comparing a pro-active multi-component nurse-led transitional care program to usual care after discharge. All patients acutely admitted to the Department of Internal Medicine who are 65 years and older, hospitalised for at least 48 hours and are at risk for functional decline are invited to participate in the study. All patients will receive integrated geriatric care by a geriatric consultation team during hospital admission. Randomization, which will be stratified by study site and cognitive impairment, will be conducted during admission. The intervention group will receive the transitional care bridge program, consisting of a handover moment with a community care Care Nurse (CN) during hospital admission and five home visits after discharge. The control group will receive 'care as usual' after discharge. The main outcome is the level of ADL functioning six months after discharge compared to premorbid functioning measured with the Katz ADL index. Secondary outcomes include; survival, cognitive functioning, quality of life, and health care utilization, satisfaction of the patient and primary care giver with the transitional care bridge program. All outcomes will be measured at three, six and twelve months after discharge. Approximately 674 patients will be enrolled to either the intervention or control group.

Discussion

The study will provide new knowledge on a combined intervention of integrated care during hospital admission, a proactive handover moment before discharge and intensive home visits after discharge.

Trial registration number: NTR 2384

Background

Hospitalisation is a hazardous event for patients of 65 years and older. Many older people are acutely admitted to the hospital for reasons like an infection or gastrointestinal bleeding. This acute disease is often accompanied by other chronic diseases as well as other impaired health conditions such as delirium, falls and malnutrition which complicate treatment during and after hospital admission [1-4]. The complexity of diseases and other health conditions make older patients prone for adverse hospital outcomes including mortality, institutionalization and functional decline [5,6]. Improving patient safety and prevention of adverse hospital outcomes are considered priorities in these patients.

Functional decline is defined as a deterioration of one or more activities of daily living (ADL) after discharge compared to premorbid ADL functioning, has become an increasingly important focus of care during and after hospital admission as it is experienced by 15-50 % of acutely hospitalized patients [7-9]. Decline in ADL function frequently precedes acute hospital admission [10] and once ADL function is lost, it is difficult to recover [11].

Several approaches to prevent functional decline have been studied. The effect of comprehensive geriatric assessment (CGA), an intervention consisting of screening on the risk for adverse outcomes, a diagnostic assessment on the presence of geriatric conditions and tailor-made interventions provided by a multidisciplinary team has most often been studied, showing mixed results. Studies conducted on specialised geriatric units have demonstrated the effectiveness of the CGA approach [12]. However, in studies on inpatient geriatric consultation services where a multidisciplinary team visits patients on different units, effects differ [13]. Main components of successful studies were targeting interventions to patients at risk for adverse outcomes and following patients after discharge.

Other approaches often studied are 1) intensive discharge planning and home follow-up after discharge [14,15] and 2) transitional care [16]. These approaches demonstrated to be effective to prevent rehospitalisation and length of hospital stay. Most of these studies did not focus on functional outcomes. Studies combining CGA and intensive follow up after discharge are still scarce.

All patients that are included in the present study will receive CGA during their hospital stay. The aim of the present study is to investigate whether a transitional care bridge program following discharge leads to a preservation of physical functioning. The current paper describes the methods that will be used in conducting the study.

Methods

Design and setting

Three hospitals in the Netherlands will participate in this multicentre, double-blind, randomised clinical trial (RCT): the Academic Medical Center in Amsterdam (AMC), a 1024-bed university teaching hospital, the Onze Lieve Vrouwe Gasthuis in Amsterdam (OLVG), a 555-bed teaching hospital and the Flevo Hospital in Almere, a 386-bed regional teaching hospital. The transition from hospital to home and home follow-up will be provided by registered nurses affiliated with three home care organisations connected to the hospitals; Cordaan Home Care, Buurtzorg Nederland and Zorggroep Almere. The study is scheduled to start June 1, 2010 and will end after the last patient has been followed up for six months. We expect the study to end May 31, 2013.

Participants

All patients of 65 years and over acutely admitted to the department of internal medicine of the three participating hospitals and hospitalised for at least 48 hours are invited to participate. These patients are screened for the risk for functional decline using the Identification of Seniors at Risk-Hospitalized Patient (ISAR-HP, table 1, in review). Patients with a score of two or more on this screening instrument are at high risk for functional decline and eligible for inclusion.

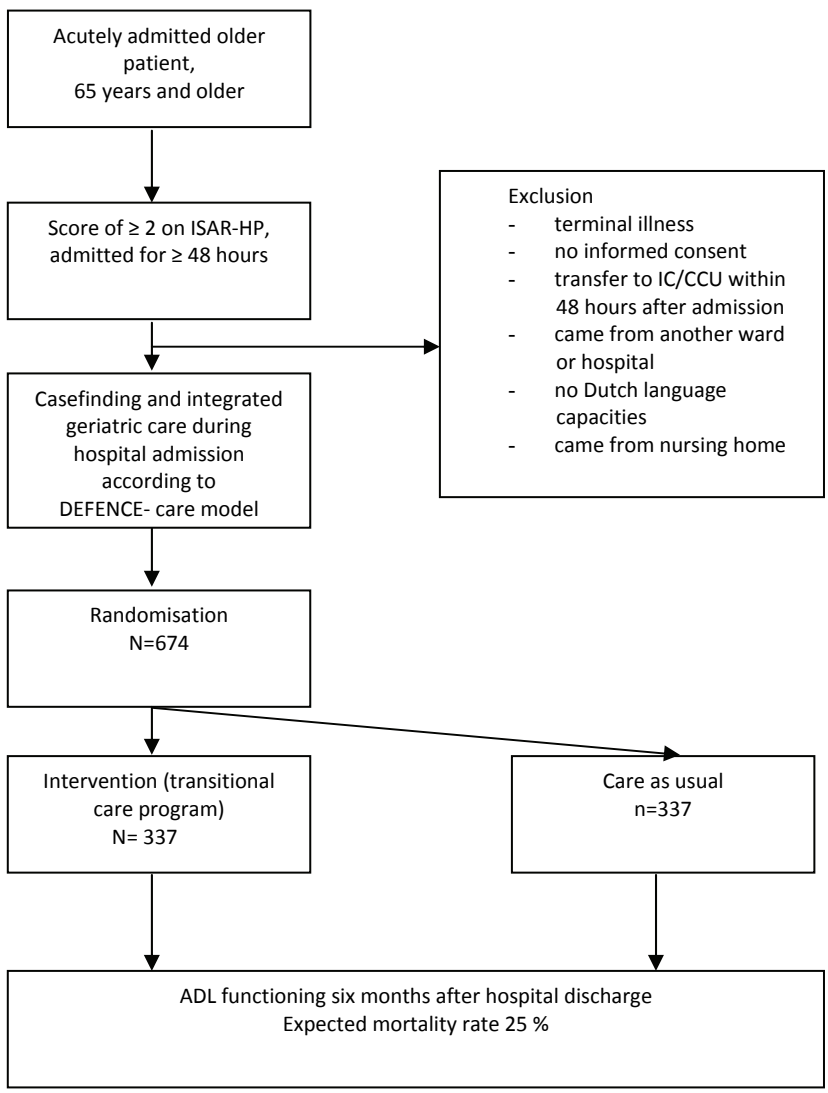
Patients are excluded if they are 1) terminally ill**,** 2) do not give informed consent 3) transferred to Intensive Care, Coronary Care Unit or to another ward within 48 hours after hospital admission, 4) came from another department or another hospital 5) not fluent in the Dutch languages or 5) came from a nursing home. Patients presenting with cognitive impairment may participate in the study.

Approvals

The study was approved by the AMC's Medical Ethics Committee which forms part of the University of Amsterdam in the Netherlands (protocol ID MEC10/082). Participants will

provide written informed consent prior to enrolment. In case of cognitive impairment written informed consent will be obtained by the patients' primary care giver. Recruitment procedures will be conducted in accordance with the Dutch Medical Research Involving Human Subjects Act and the WMA Declaration of Helsinki.

Figure 1: Flow chart of patient selection and randomisation



Randomisation and blinding

After obtaining informed consent and baseline assessments, patients will be randomised into the intervention or control group (figure 1). The randomisation procedure will be website-based, using permuted blocks and stratified by study centre and level of cognitive functioning (Mini-Mental State examination of ≥ 24 versus MMSE scores of <24).

The study will be double- blinded as patients will be blinded to the intervention by using a postponed informed consent procedure described by Boter *et al* [17]. This informed consent procedure is chosen because we expect to introduce bias by informing all patients about the intervention of study. Patients in the control group could be unsatisfied with not being allocated to the intervention group, whereas patients in the intervention group could give better ratings to the intervention. For example, patients might score higher out of loyalty to the community care nurse that helped them. Patients in the intervention group are further informed about the care coordination after discharge but not about that this is the actual intervention to be studied. The control group is not informed about the intervention. After termination of the study, patients in both study groups will receive written information concerning the complete research question by means of a letter.

A research nurse blinded to the intervention will conduct all follow up assessments. The multidisciplinary teams in the hospitals and the community care nurses are not blinded to randomization.

Hospital care provided to all patients included in the study

The geriatric consultation team in each of the hospitals will consist of a geriatrician, Clinical Nurse Specialist (CNS) in Geriatrics, Registered Nurse (RN), physiotherapist and a dietician. The RN will visit the participating wards on a daily basis (except for the weekends) to screen patients for eligibility. Patients at high risk for functional decline, as determined by the ISAR-HP, will receive a systematic comprehensive geriatric assessment initially performed by the RN (table 2). The assessment will start with screening on delirium, malnutrition, ADL functions, mobility and fall risk. In cognitive impaired patients,

part of the CGA will be conducted by interviewing the primary care giver. The primary care giver will always be interviewed about burden of care givers and the amount of time spent helping the patient at home before admission.

Table 1: Scorecard: Identification of Seniors At Risk - Hospitalized Patients (ISAR-HP)

ISAR-HP		
	YES	NO
1. Before hospital admission, did you need assistance for IADL (e.g., assistance in housekeeping, preparing meals, shopping, etc.) on a regular basis?	1	0
2. Do you use a walking device (e.g., a cane, rollator, walking frame, crutches, etc.)?	2	0
3. Do you need assistance for traveling?	1	0
4. Did you follow education after age 14?	0	1
Total score (circled figures)		
Total score 0 or 1 = not at risk Total score ≥2 = patient is at risk for functional decline		

Empowerment of patients and primary care givers is an important topic in this study. After the CGA, patients or their primary caregiver will be asked to indicate which problems should be given highest priority for treatment. Furthermore, attention will be given to patients' most important goals to be achieved during and after hospital admission. This information will be taken into account when discussing the outcome of the CGA with the geriatrician and CNS.

A team meeting with the geriatric consultation team will result in a tailor-made care- and treatment plan which will be discussed with the patient and primary care giver. If patients did not give priority to a certain problem and the geriatric consultation team considers the problem relevant to treat, the patient and primary care giver will be informed about why the team advices to have a certain condition treated and what are the treatment options. Thus, the patient and primary care giver can make a well-informed decision about the care and treatment plan.

The care and treatment plan will be carried out during admission in accordance with the medical and nursing care at the ward where the patient is admitted. If necessary, other disciplines will be consulted, such as a pharmacist or occupational therapist.

The intervention

The transitional care bridge program

The overall transitional care bridge program consists of two steps; 1] the discharge procedure concerning the transition of care and 2] the continuation of the integrated care in the primary care by a community care nurse.

Step 1: The experimental discharge procedure including transition of care

This step concerns the transfer of care from hospital to primary care. The care during this phase and the second phase will be provided by a community care nurse (CN). The CN is a bachelor level educated nurse with a special focus on the elderly. The CN can work in a general practice, within a home care organisation or can be affiliated to a nursing home.

The transition from hospital to home consists of the following sub-steps:
(a) A handover for the care and treatment plan is made by the geriatric consultancy team and is coordinated by the CNS as part of the integrated care plan at least two days before discharge from hospital. This plan includes the ongoing interventions and recommendations for care in the primary care setting.
(b) The transition of care-plan made by the CNS will be offered to the primary care CN of the patient who is visiting the patient in hospital before discharge.
(c) After visiting patient in the hospital, the CN will discuss the care plan with the (substitute) General Practitioner (GP) of the patient.
(e) Guided by the care and treatment plan handed over from the hospital and depending on the needs of the patients and caregiver, additional support will be enabled by the CN (for example consisting of dietician, occupational therapist, the elderly welfare consultant, physiotherapist and / or pharmacist).

It is expected that approximately 6% of the patients leaving hospital are not discharged home but will be admitted in an intermediate care facility or rehabilitation care in a nursing home. In this subgroup a CN from the nursing home or rehabilitation centre will visit the patient in the hospital.

Step 2: Experimental continuation of care in primary care

The intervention consists of the following steps and will mainly be provided by the CN after discharge.

(a) The CN visits the patient within two days after hospital discharge at home. In this first visit, special attention is paid to medication and appropriateness of care arranged during hospital admission.

(b) The second visit is two weeks after hospital discharge where the CN (re)assesses the care- and treatment plan and where needed the CN makes adaptations to the plan and discusses clarity of the medication regimen from the hospital. In this visit, social functioning, participation and existing care needs will be discussed with the patient.

(c) The CN will ensure continuation at home of the interventions started in the hospital. When necessary, the CN also coordinates indications for new interventions.

(d) The CN maintain contacts with other practitioners (e.g. occupational therapy, dieticians, pharmacists, physiotherapy, elderly welfare consultant etc.) in consultation with the general physician.

(e) The CN identifies new care / treatment needs (e.g. imminent (re) admission to hospital) in consultation with the GP.

(f) The CN as transition coach also promotes the empowerment of patients and carers by including the provision of psycho-education on the identified geriatric conditions and providing ancillary services such as leisure, day treatment and care [18].

For patients discharged to a nursing home or rehabilitation centre, the same steps will be conducted but the CN visit the patients in these settings and contacts the Nursing Home Physician (NHP) for consultation

After 2, 6, 12 and 24 weeks, the CN visits the patients and evaluates the care- and treatment plan, the impact and the (intended) results. The results are discussed in regular meetings of the primary care geriatric consultancy team. This team consist of the GP (or NHP) and the CN, and depending on patients care needs it is complemented with a consultant pharmacist, a primary care physiotherapist, occupational therapist, elderly welfare consultant, dietician and/or a social worker. An in-hospital consultant (geriatrician) is appointed at hospital discharge that can also easily be consulted by the CN, GP or NHP.

The GP or the NHP remains the final responsible director for the medical care of the patient.

Control group

Patients allocated to the control group will receive 'care as usual' after discharge. This consists of a discharge home after admission. The medical resident of the hospital will send a discharge letter to the GP of the patient that most often is received two weeks after discharge. Additional care can be arranged with a home care organisation and consists of help in conducting ADL. Most patients are followed up six weeks after discharge at the outpatient department. The consult mainly consists of laboratory testing and focuses on the disease(s) patients were discharged with.

Evidence based care and uniformity of care provided

The currently applied interventions in the integrated care plan are all evidence based or based on current best practice in the hospital and in the community. For the purpose of the present study an evidence based toolkit has been constructed which describes the present state-of-the-art in care and treatment of the geriatric conditions. All geriatric conditions in this toolkit are worked out in the same structure: goal to achieve with a certain condition, the theoretical background (prevalence, risk factors), screening in the hospital and community care (which question or validated instrument can be applied),

action plan, further diagnostics and how to apply these, evidence based interventions (including when to consult other disciplines) and financing care.

The toolkit will be used to create uniformity in screening, diagnostics and interventions and is the basic for the tailor-made care plan (available at www.defencestudy.nl) [in Dutch].

Efforts to decrease the burden for very ill patients and cognitive impaired patients

Attrition of frail older persons is a problem frequently met in trials conducted in this patient population [7]. In this randomised clinical trial, we have made efforts to decrease all possible burden for these frail patients in order to make it possible to include this group and to minimize drop-outs.

At admission, the inclusion procedure for very ill patients and cognitive impaired patients is limited. This short assessment consists of screening on five geriatric conditions: delirium, malnutrition, activities of daily living functioning, mobility and fall risk. This assessment is chosen because these geriatric conditions contribute most to adverse outcomes can be easily observed or screened and are most prone to early intervention. If patients are not able to answer question, the primary care giver will be interviewed.

To build a strong and trusting relationship between the CN and the patient and family, the starting point of the intervention will be during hospital admission by visiting patients during hospital admission. That way the CN is a person more familiar to the patient and primary care giver and they both know that the CN is informed about the care provided in the hospital.

After discharge, all patients in the intervention group will be visited in their own home to minimize the burden of the visits.

Outcomes

Primary outcome

The primary outcome measure is the level of ADL functioning six months after discharge from the hospital compared to premorbid functioning two weeks prior to hospital admission. The level of ADL functioning will be measured with the Katz ADL index score [19]. The Katz ADL index score consists of 6 items, with score range from 0 to 6, with a higher score indicating more impairment in ADL. At both time points, the questionnaire will be filled in by the same person (patient or proxy, depending on cognitive impairment).

Secondary outcomes

Secondary outcomes will be measured at baseline, three months, six months and one year after discharge from hospital by a research nurse who was blinded to the nature of the transitional care program. Secondary outcomes include:

(1) Mortality

(2) ADL functioning, as measured with the ALDS, a validated, Item Response Theory-based generic and validated continuous scale with a score range between 0 and 100, with a lower score expressing more impairment in daily functioning [20].

(3) Cognitive functioning and health-related quality of life (IQCODE-SF [21] and EQ-6D [22])

(4) Experiences with providing care by primary care givers and burden of primary care givers (with the primary care giver extension of the minimal dataset)

(5) Satisfaction of patients and primary care givers with the care provided

(6) Health care utilization (economic extension of the Minimal Dataset with care issues such as institutionalization, rehospitalisation and / or visits to the emergency department of the hospital, amount of care provided by professional care and primary care giver)

Process evaluation

In addition to the primary and secondary outcomes additional (semi-) qualitative data will be collected that will give an insight in the feasibility of the transitional care bridge

intervention at the professional and AMC geriatric network level. Qualitative data will be analyzed in relation to primary care and hospital derived factors that the future implementation of the care (might) impede or promote.

Sample size calculation

In determining the appropriate group size in order to demonstrate a significant intervention effect on the primary endpoint, we used Cohen's effect size *d* to determine the difference between the patients' KATZ ADL index scores on the before and after measurement and divided by the SD of the difference scores of the control group as a benchmark for assessing the relative magnitude of ALDS score differences between both strategies. Although an effect size of 0.25 can be defined as small, such a difference in Katz ADL scores may be clinically important.

We have demonstrated that with a total of 506 patients (253 patients per treatment arm) we are able to statistically detect (power 80%, two-sided alpha of 5%) a minimal effect size on the Katz ADL index score. To allow for attrition due to mortality, which is expected to be 25 % six months after admission, a total of 674 patients will be included in the trial.

Data analysis

Statistical analyses will be based on an intention-to-treat principle. Baseline assessments and outcome parameters will be summarized using simple descriptive statistics. The main analysis focuses on a comparison between the trial intervention and control group of the primary outcome, the Katz ADL index score. The same approach will be used with regard to the secondary outcome parameters, including survival rates. Survival data will be additionally analyzed using Kaplan-Meier survival curves and the log-rank test.

We will perform a predefined subgroup analysis for discharge destination (patients discharged to home versus nursing home). In all analyses statistical uncertainties will be quantified via corresponding 95% confidence intervals. Separate subgroup analysis will also be conducted on patients at intermediate (ISAR-HP score of two or three) and high

risk for functional decline (ISAR-HP score of four or five). Finally, process outcome data will be analyzed qualitatively within the theoretical framework of the adaptive implementation model [23].

Discussion

With an ageing population in many countries and increasing life expectancy, there is an urgent need to improve outcomes of hospital admission. Preservation of decline in ADL functions and preventing institutionalization have become a more important focus of care, rather than only minimizing mortality rates. Several approaches to improve hospital outcomes have been studied focusing on comprehensive geriatric assessment and intensive home follow up after discharge. The present RCT combines these approaches to provide optimal care during hospital admission and to improve ADL functioning after discharge.

The study is conducted as part of the National Care for the Elderly program in which special emphasis is given to regional geriatric care networks. The current study will provide information on the feasibility of the intervention, collaboration between hospitals and primary care as well as on structural funding of care.

Abbreviations

(ADL): activities of daily living ; (ALDS): AMC linear disability scale; (ISAR-HP): Identification of Seniors at Risk-Hospitalized Patient; (CGA): comprehensive geriatric assessment ; (CN): community care nurse; (CNS): clinical nurse specialist in geriatrics; (DEFENCE): Develop strategies Enabling Frail Elders New Complications to Evade; (EQ-6D) Six-Dimensional EuroQol instrument; (ES): effect size; (GEM): Geriatric Evaluation and Management units; (GP): general practitioner; (IADL): Instrumental Activities of Daily living; (IQCODE): informant questionnaire on cognitive decline in the elderly; (MMSE): Minimal Mental State Examination; (RCT): randomised clinical trial; (RN): registered nurse; (NHP): nursing home physician; (SD): standard deviation.

Table 2 Content of the Comprehensive Geriatric Assessment (CGA) performed at hospital admission

Domain	Question or instrument in CGA	Condition/Disease
SOMATIC		
1.Mobility and stability	Have you been fallen once or more in the past six months? Do you experience dizziness? Have you ever had a fracture?	Falls Dizziness Osteoporosis risk
2. Medication	Only if patients use medication Do you experience difficulties or side effect with medication use? Polypharmacy defined as the use or five or more different medications Medication adherence with the questionnaire of Aburuz [24]	Medication safety and side effects Polypharmacy Medication adherence
3.Nutrition	Short Nutritional Assessment Questionnaire (SNAQ) [25] Was the patient dehydrated at admission? Difficulties with swallowing? Body mass index Do you have pain in your mouth?	Malnutrition Dehydration Swallowing disturbance Obesity or underweight Oral hygiene
4. Urine and fecal problems	Do you experience urine incontinence? Do you experience fecal incontinence Do you experience obstipation? Do you have an indwelling urinary catheter? Did you already have this at home?	Incontinence Obstipation Indwelling urinary catheter use
5. Skin	Do you have pressure ulcer(s)?	Pressure ulcer
6. Pain	Visual analogue scale for pain [26]	Pain
7. Allergy	Are you allergic?	Allergy
PSYCHOLOGICAL		
1.Delirium	Have you ever experienced a delirium? Confusement Assessment Method [27]	Delirium
2. Depression	Geriatric depression Scale [28,29]	Depression
3.Cognition	Mini- Mental State Examination [30]	Cognitive impairement
4. Anxiety	Do you feel anxious?	Anxiety
5. Dependency	Do you smoke? Do you use alcohol Do you use benzodiazepines?	Alcohol, smoking and medication use
FUNCTIONAL		
1. ADL functioning	Katz ADL index score [19]	ADL dependency
2. IADL functioning	IADL questions of Lawton and Brody [31]	IADL dependency
3. mobility difficulty	Are you using a walking aid?	Mobility difficulty
4. Hearing	Do you experience difficulties with hearing, despite the use of a hearing aid?	Hearing impairment
5. Visual	Do you experience difficulties with your vision, despite the use of glasses?	Visual impairment
6. Sleep	Do you experience problems with sleeping? Do you use sleeping medication? If yes, how often?	Sleeping disorder
SOCIAL		
1. Loneliness	De Jong Gierveld-questionnaire [32]	Loneliness
2.Burden of care giver	Care giver extension of the Minimal Data set	Burden of care giver
3. Health related quality of life	EQ-6D [22]	Health related quality of life

The questions or instruments are a starting point for further diagnostics or treatment; if necessary a more intensive screening will be conducted by the multidisciplinary team

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Chapter 9

General Discussion

General Discussion

The general aim of this thesis was to investigate strategies for screening and diagnostic assessment on geriatric conditions to prevent functional decline and other hospital related complications in acutely hospitalized patients. One of these strategies is the DEFENCE-care model, a three-step systematic approach to prevent functional decline, which was developed as part of this thesis. In this General Discussion chapter the main findings will be summarized and placed in a broader perspective related to three components of the DEFENCE-care model: screening, diagnostic assessment on geriatric conditions, and geriatric intervention. Furthermore, the implications for daily practice and recent developments in the care for older people will be discussed. The thesis concludes with directions for further research within the context of the Netherlands National Care for the Elderly Program.

Activities of daily living and functional decline

The thesis started with a systematic review on measuring (instrumental) activities of daily living ((I)ADL) and definitions of functional decline **(chapter 2)**. We demonstrated that there is some uniformity in measuring patient's functioning, but there is far less uniformity in the definitions of functional decline. Some studies defined functional decline solely in terms of ADL, wheras some studies incorporated elements of IADL. Most studies also excluded items of the validated Katz ADL index. This heterogeneity in definition and operationalisation may partly explain the differences in incidence of functional decline found in different studies.

The results of our systematic review stipulate some methodological issues concerning the measurement of functional health. Most important are the need for consensus regarding the activities of daily living that should be incorporated into the disability continuum, the measurement instrument that should be used, the optimal time frame to assess functional decline, and the definitions of cut-off scores on outcome scales .

In our studies we used the complete version of the validated Katz ADL index score to measure ADL functioning and defined functional decline as a loss of one point or more on the Katz at three and twelve months after admission compared to premorbid functioning.

Screening for expected adverse health outcomes

Developing and validating screening instruments to detect patients at risk was described in three studies (**chapters 3, 4 and 5)**. Screening is considered an efficient method to roughly divide patients in low and high risk for a certain health outcome and can assist health professionals or patients to select those people needing extra care during hospital admission or those benefiting most from intervention [1]. There are many screening instruments available to detect high risk patients. A first step should be to test the prognostic ability of these instruments in new populations to support their external validity [2;3]. We followed this strategy in older patients attending to the emergency department in which we tested the prognostic properties of four screening instruments. Our results showed that all four measures performed poorly **(chapter 3)**.

The instruments were developed in specific health care environments (United Kingdom, USA and Canada) and it is generally acknowledged that the application of screening instruments in other populations or health care environments is often difficult because of differences in case mix of patients and subsequently results in more or less events and a other distribution of candidate predictors [4]. This seemed to be confirmed in our study.

If current instruments do not perform well, the next step then is to develop and validate new screening models **(chapters 4 and 5)**. A consistent finding in our studies was that the accuracy of these models was rather moderate, with areas under the ROC curves ranging between 0.72 and 0.77. This can be explained by several factors. First of all, in the ISAR-HP development and validation study [5] **(chapter 5)** candidate predictors, such as age and years of education, were dichotomized which might have reduced sensitive assessments.

Secondly, using less candidate predictors also decreases the ROC, due to information loss [6].

However, both strategies enhance the face validity of the screening instrument which is also essential and is mainly based on clinicians' judgement of clinical relevance of the screening instrument and can be a strong factor during implementation[2;4]. The Framingham risk index and the APACHE-II score also have an AUC between 0.70-0.80 and are widely utilized in daily practice. Both screening models from our studies comprise four variables that are easy to use in clinical practice. This enhances the clinical usefulness of the screening instrument into daily practice.

Diagnostic assessment on geriatric conditions

A second step in the DEFENCE-care model, in patients with an increased risk for poor health outcomes, is to perform a diagnostic assessment on geriatric conditions. We described this step in two ways; for a complete population of included patients and for a subgroup of patients identified at risk for functional decline. The first study confirmed that geriatric conditions were highly present in acutely hospitalized patients **(chapter 6**). Older patients presented with a mean of six geriatric conditions of which ADL and IADL impairment, mobility difficulty, polypharmacy, malnutrition, and high level of care giver burden and were all present in more than 50% of the patients. We also demonstrated that geriatric conditions were significantly associated with functional decline, cognitive impairment, and mortality one year after admission **(chapter 6)**

In **chapter 7** we focused on the geriatric conditions in relation to the risk status of the patients. The study showed that patients at low, intermediate and high risk for functional decline have distinct clinical profiles and health outcomes. In the low risk group, mainly conditions related to multimorbidity and acute phase of the disease were present, such as polypharmacy, pain and malnutrition. In the high risk group, which presented with an average of seven geriatric conditions, a high percentage of the patients also had geriatric

syndromes, such as delirium, frequent falls, incontinence and pressure ulcers. Geriatric syndromes are highly prevalent in frail elders and have a major impact on quality of life and disability [7;8]. In addition, geriatric syndromes are multifactorial conditions with many underlying risk factors and interacting pathogenetic pathways [9]. Only 30 % of the high risk group remained their baseline level of functioning.

An important issue related to the in-depth assessment of geriatric conditions is which patient group benefits most from geriatric intervention. The comprehensive geriatric assessment (CGA) approach, consisting of screening, diagnostic assessment, and geriatric intervention, has demonstrated mixed results in preventing negative health outcomes [10-12]. A recent meta-analysis on inpatient rehabilitation suggested that evidence on subgroups of patients benefiting from inhospital intervention is needed [10]. Dividing the patient population in a low, intermediate and high risk group clearly stipulates that these subgroups have different clinical characteristics and outcomes **(chapter 7).** At present, there is little evidence supporting the applicability of this approach in hospitalized older patients and this strategy should mainly be employed for screening [13-15]. Expert opinion strongly suggests approaching the older patient group in a more differentiated way in order to develop effective interventions [16;17]. Relatively healthy older patients, with some chronic diseases will not be in need of specialised geriatric care but should be educated how to prevent deterioration in functioning. The middle group, patients with some chronic diseases and few functional limitations, is probably to expect the most benefit from a rehabilitative approach, focusing on restoration of functional impairments. High risk patients, represented by the presence of (multiple) chronic diseases, functional impairments and limited rest capacity, will presumably favour most from an approach focused on preventing further complications and retaining an acceptable level of quality of life.

Geriatric intervention

The third step of the DEFENCE-care model is to provide patients at risk for functional decline and prevalent geriatric conditions with an integrated care- and treatment plan during and after hospital admission. In this step the geriatric consultation team will advice nurses and physicians on the inpatient wards with this care and treatment plan. To enhance the use of the DEFENCE-care model in daily practice, an evidence-based toolkit has been created, containing information on screening, diagnostic assessment and intervention strategies for nurses and physician on 25 common geriatric conditions. Available practice protocols should further enhance implementation. The toolkit is accessible at www.effectieveouderenzorg.nl.

Outside the Netherlands several hospital-based studies have been conducted to evaluate prevention of adverse outcomes after hospital admission using a combination of comprehensive geriatric assessment [10-12], intensive home follow up [18], and transitional care [19]. These studies have shown mixed results in preventing poor health outcomes. The only type of intervention that demonstrates a clear benefit for geriatric patients in terms of preventing functional deterioration is the implementation of a Geriatric Evaluation and Management Unit wards (GEMU) within the hospital organisation [20]. GEMU's are specially designed for frail older persons [11], with personnel that are specialized in providing care to geriatric patients. Successful ingredients of all effective intervention studies are: targeting the intervention to high risk subgroups, performance of a multidimensional and multidisciplinary diagnostic assessment and intervention and long-term follow up.

These ingredients are all used in the *Transitional Care Brigde*. A recently initiated randomized clinical trial investigates the efficacy of comprehensive geriatric assessment in combination with home follow up after discharge **(chapter 8)**. All enrolled patients receive care according to the DEFENCE-care model. Before discharge, patients are randomly allocated to either the intervention or control group. Patients in the intervention group receive care by a transitional care nurse, who visits the patient during

hospital admission and furthermore two days, two, six, twelve and twenty-four weeks after hospital discharge. The transitional care nurse closely collaborates with the general practitioner of the patient. The control group will receive 'care as usual' after discharge.

Methodological issues

We encountered several methodological problems in our studies. Around 40 % of the included patients presented with (temporary) cognitive impairment and many patients were very ill in the first 48 hours of hospital admission. There is a need for minimally invasive strategies to maximize inclusion rates. We tried to achieve this by interviewing the nearest proxy and by minimizing the diagnostic assessments during the first 48 hours of admission **(chapters 5- 8)**.

A substantial number of our patients died within the first year after admission, resulting in missing data when building prognostic models to predict functional decline **(chapter 6)**. Most studies in acutely hospitalized older patients simply exclude these patients from further outcome analysis, leading to biased prognostic models..To solve this statistical problem, several strategies can be followed, such as patient's last observation carry-forward using a Cox proportional hazards model, considering deceased patients as patients experiencing the ultimate functional decline, or imputation of missing outcome data. In this thesis we applied the first two approaches. Imputation of missing outcome data in this population is not preferable [21], as patients at low risk for functional decline and survivors generally have a better functional status at admission **(chapter 7).**

Another methodological issue emerging from this thesis is the use of functional decline as a continuous or dichotomous outcome variable. In line with the international literature, we dichotomized functional decline after comparing post-discharge functioning with premorbid functioning **(chapter 2)**. A decline of one point or more was considered as functional decline. Undoubtly with such an approach clinical information is lost [5;22].

A final challenge are the in- and exclusion criteria used in clinical studies in older patients. At the moment, the inclusion criteria are quite broadly defined, focusing on patients at risk for functional decline. As mentioned before, being at high risk for functional decline, is not synonymous to benefiting from geriatric intervention. However, to date, none of the studies using the CGA approach, clearly separates patients that can be rehabilitated and patients that are so frail that maintaining quality of life should be the major goal.

Implications for daily practice

The College voor de Beroepen en Opleidingen in de Gezondheidszorg (CBOG) [23] and the Koninklijke Nederlandse Maatschappij ter Bevordering van de Geneeskunst (KNMG) [24] have proposed far reaching innovative strategies to reform current medical and nursing practice in order to be prepared for the demands of older people. To reach the goals described, such as the need for a tailored approach to the care of older people, a better transfer of patients from hospital, or early detection of patients at high risk for adverse health outcomes, there is an urgent need for more and better trained professionals that are dedicated to care for elderly people. Hopefully, some of the practice-based tools developed in our study, including our ten day post-bachelor training for nurses in general practice, will contribute to better equipped health care professionals.

In the Netherlands the '*VeiligheidsManagementSysteem zorg praktijkgids kwetsbare ouderen*' [25] should be implemented in the 93 participating hospitals. This practice guide consists of four geriatric conditions; delirium, falls, malnutrition and disability that should be assessed at admission and monitored during hospital stay. It contributes to a systematic screening and early recognition of geriatric conditions. However, in our view this is a only a minimal strategy that should be implemented. The DEFENCE-care model is a far more optimal and efficient approach, as it selects those patients at increased risk for functional decline, followed by an in-depth assessment of geriatric conditions.

National Care for the Elderly Programme

In April 2008 the National Care for the Elderly Programme (NCEP) was set up by the Ministry of Health, Welfare and Sports with the main purpose to improve care for elder people with complex care needs [26]. The programme is coordinated by ZonMW, the Netherlands Organisation for Health Research and Development. The eight academic hospitals in the Netherlands were asked to establish a geriatric network in their region, consisting of hospitals, general practitioners, home care services, nursing homes, welfare organisations, knowledge-based organisations, educational organisations and older people themselves. Proceeding from this geriatric network and the needs of older people, transition experiments, research projects and implementation projects were set up. Transition experiments are large scale projects, in which there is (financial and organisational) space to test the efficacy and efficiency of new care. This type of experiments should also link welfare, primary care based care and hospital based care. The transitional care bridge **(chapter 8)** is one of the Transition experiments in the Kring Ouderenzorg AMC and partners geriatric network that is currently running in three hospitals.

The primary outcome in all of the projects and studies within the framework of NCEP is the maintenance of functioning of older people.

Directions for further research

Activities of daily living and functional decline

More clinimetric studies are needed concerning the measurement of ADL functioning. The crude Katz ADL scale, which at the moment is considered as the gold standard, has a number of limitations related to its responsiveness to measure health change over time. A new and promising approach is the Item Response Theory (IRT). The advantage of this psychometric techniqueis that not all the same items of an instrument have to be assessed in all patients to determine their level of functioning, as is the case with the classical health instruments. Using their clinical judgment, researchers / care professionals can make their own selections of items from an IRT item bank that are applicable to the

population they are investigating. By using a small number of items tailored to the expected ADL level of patients, a detailed clinical picture can be obtained without the need to have all the questions answered by the patient [27].

Recent research activities in the field of measuring ADL functioning are moving towards more objective measurements, such as gait speed and balance, instead of using patient-self-reports. Studies are needed to investigate if this approach is also applicable to acutely hospitalized older patients. Safety and the use of these tests in cognitive impaired should be key components. Moreover, as acutely hospitalized older patients often already decline before hospital admission, an important question should be if these measurements have clinical surplus value above self-reports.

The patient perspective on functioning and functional decline has not been given sufficient attention. In contrast to the highly valued objective measurement, patients own valuation of function is underrepresented in many studies, including our studies. This concerns not only the question which items should be included into the disability continuum, but also what older patients consider as a significant decline. In the view of empowerment and self management, patients' own perspective deserves further research attention. It could provide new directions for interventions based on stimulating rest capacities and teaching patient's adequate self management skills.

Another scope for further research in the field of functional health is the role of environmental factors in preventing, delaying or compensate disability in hospitalized older patient. Topics to focus on could be: technological support and devices for use during and after hospital admission, supporting the primary care giver to provide optimal care after hospital admission and the role of social support.

Screening and diagnostic assessment on geriatric conditions

Related to screening and the use of screening instruments several studies would be useful. The first study is an impact study, testing if using the ISAR-HP changes clinical decision making of health care professionals.

In addition, testing the clinical applicability of the three risk profiles for functional decline should be tested. In most RCTs to prevent functional decline a large subgroup of patients at risk for adverse outcomes is currently targeted. As already discussed before, the question remains if all patients need to be and can be rehabilitated during and after hospital admission. The World Health Organisation rehabilitation strategy framework provides an overview of rehabilitation goals for different patient groups which might be useful for clinical practice [28].

The diagnostic assessment in the DEFENCE-care model currently consists of preselected geriatric conditions. Further research should focus on which geriatric conditions are most important for patients to be treated during and after their hospital stay.

Interventions to improve outcomes

Several intervention studies, based on the DEFENCE-care model, have already been started up in the Netherlands. The Transitional Care Bridge has already been described in this thesis **(chapter 8)** and is part of the NCEP. Maintain Functioning In Transition (FIT) is another large scale transition experiment from the NCEP (8000 community-dwelling older people), using an RCT design, in which the effect of nurse-led care coordination on the level of daily functioning in community-dwelling older persons in the general practice is studied. Both transition experiments are linked together, using a comparable method of screening, diagnostic assessment and intervention, and should provide an effective strategy to prevent functional decline in community-dwelling older people and hospitalized older people.

Furthermore the DEFENCE-III study is currently runnning, testing the efficacy and efficiency of implementing the DEFENCE-care model in seven hospitals in the Netherlands. A pre-test post-test design is used to assess the effect of care model on ADL functioning three months after hospital discharge.

Conclusion

In conclusion, this thesis demonstrated that in the field of measuring ADL functioning and functional decline, substantial differences exist in the methods of measurement and applied definitions of functional decline. Older people that are acutely hospitalized are at high risk for mortality, functional decline and cognitive impairments three and (up to) twelve months after hospital admission. We developed a geriatric screening- and consultation model, the DEFENCE-care model that can be applied in daily practice consisting of screening, diagnostic assessment on geriatric conditions and geriatric interventions. Several practice- based tools have been developed to enhance implementation in daily medical and nursing care. Further study should focus on testing the efficacy of the DEFENCE-care model in preventing functional decline and other adverse health outcomes. Studies should also comprise issues related to the impact of screening on decision-making of health professionals and on clinimetrics of ADL functioning.

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Chapter 10

Summary

Summary

Approximately 20-30% of all older people experiences disabilities in performing (instrumental) activities of daily living. Around 50% of these disabilities develop progressively, in combination with an underlying chronic disease such as arthritis, diabetes or chronic obstructive pulmonary disease. The other 50% develops as a consequence of an acute event, such as hospital admission, stroke, or hip fracture. Acute hospitalization itself is a hazardous event for elderly people. Older people that are hospitalized have an increased risk to develop new disabilities compared to those never admitted. Activities of daily living lost and not recovered by hospital discharge are often difficult to regain. Approximately a 100,000 Dutch older people annually experience new disabilities after hospitalization, defined as functional decline. Not all acutely admitted older patients are at equal risk for functional decline and mortality after hospitalization. Several clinical factors, in particular, the presence of multiple morbidities and the presence of geriatric conditions, are related to an increased risk for poor outcomes.

The general aim of this thesis was to investigate strategies for screening and diagnostic assessment on geriatric conditions to prevent functional decline and other hospital related complications in acutely hospitalized patients. One of these strategies is the DEFENCE-care model; a three-step systematic approach to prevent functional decline that was developed as part of this thesis.

Chapter 1 starts with an introduction on chronic diseases, the related onset of disability and the effect of hospitalization on daily functioning. The hypotheses and basic assumptions for the development of the DEFENCE-care model are expressed and the three study cohorts of this thesis are further described. As functional decline is the main outcome parameter in the studies presented, **chapter 2** starts with a systematic review on instruments to measure activities of daily living and the applied definitions of functional decline in hospitalized older patients. In total, 28 studies were included in the systematic review and there was a large variability in item content and scoring between and within

the measurement instruments. The minimal amount for decline, as defined by the authors, referred to a decrease in functioning between two and twenty percent. This signifies that most cohort studies and clinical trials that are conducted on prevention of functional decline cannot be properly compared on effectiveness because of the divergent operationalization of functional decline.

Chapters 3, 4 and 5 focus on the screening of patients at risk for adverse health outcomes. **Chapter 3** compares the prognostic abilities of four screening instruments to detect patients at increased risk of readmission, hospitalization and mortality of older patients discharged home after an emergency department visit. In total, 381 patients were included in this cohort. Three months after the visit, 15% of the patient returned to the emergency department, 17% were hospitalized and 13% died. Of the screening instruments studied, none were able to clearly discriminate between patients with and without poor outcomes. Differences in organization of health care systems might influence the prognostic abilities of screening instruments.

Chapter 4 covers a study on prognostication of physicians and nurses concerning mortality in acutely hospitalized older patients. The hypothesis tested in this study in 463 patients, was that the clinical impression of physicians and nurses would enhance prognostication, compared to a prediction only based on objective measurable factors. In total, 24% of patients died within three months after admission. Four parameters were significantly associated with mortality risk; functional impairment, diagnosis malignancy, co-morbidities and high urea nitrogen serum levels. The AUC for this model was 0.76 (95 % CI 0.71 to 0.82). Adding a clinical impression of physicians or nurses did not significantly improve the accuracy of the model, signifying that prognostication should be based on objective measurements.

Chapter 5 presents the development and validation of the Identification of Seniors at Risk-Hospitalized Patients (ISAR-HP), a brief screening instrument to detect patients at

increased risk for functional decline. Approximately 35% of all patients in the development cohort and 32% in the validation cohort suffered functional decline. The prediction model could accurately predict functional decline with only four items: pre-admission need for assistance in instrumental activities of daily living, use of a walking device, need for assistance in travelling and no education after age 14. This simple measurement instrument can easily be used in daily practice. This study represents step one of the DEFENCE-care model; a quick assessment at hospital admission to select patients that need further diagnostic assessment on the presence of geriatric conditions.

Chapters 6 and 7 describe the results of two studies on the diagnostic assessment of 18 geriatric conditions, their association with functional decline and other adverse health outcomes. Together they provided information for step two of the DEFENCE-care model. **Chapter 6** evaluates the prevalence of geriatric conditions and related outcomes in terms of mortality, functional decline and cognitive impairment. In this study, 639 patients from three hospitals in the Netherlands were included. Patients presented with a mean of six geriatric conditions at hospital admission. Instrumental activities of daily living impairment (83%), polypharmacy (61%), mobility difficulty (59%), high levels of primary caregiver burden (53%), and malnutrition (52%) were most prevalent. One year after admission, 35% had died, 33% suffered from functional decline and 26% had cognitive impairment. Higher age, severe comorbidity, malnutrition, obesity, fall risk and IADL impairment were associated with mortality. Higher age, comorbidity and the presence of an indwelling urinary catheter were associated with functional decline. The results indicate that screening for geriatric conditions reveal many health problems that can be either prevented or treated during the hospital stay. This might lead to better health outcomes after hospital discharge and reduce the burden of hospital admission for older patients.

Growing evidence shows that not all patients equally benefit from geriatric intervention. **Chapter 7** describes a study, in which three subgroups of patients are identified with distinct clinical characteristics and outcomes. Patients were divided into risk categories for

functional decline (low, intermediate or high risk) according to the Identification of Seniors at Risk-Hospitalized Patients. Overall, 27%, 33% and 40% of the patients were at low, intermediate or high risk, respectively, for functional decline. Low-risk patients had fewer geriatric conditions (mean of three conditions) compared with those at intermediate (mean of six conditions) or high risk (mean of seven conditions). Approximately 12 months after admission, 39% of the low-risk group had an adverse outcome compared with 50 % in the intermediate risk group and 69% in the high risk group ($p<0.001$). The categorization of patients into risk profiles is becoming more and more propagated by expert opinion and the Health Council of the Netherlands. It might assist health care professionals to select patient in need for active rehabilitation or supportive care.

Chapter 8 focuses on an intervention to prevent functional decline in hospitalized older patients and is the workup to Step three of the DEFENCE-care model. This chapter describes the design of a randomized clinical trial using the DEFENCE-care model followed by a nurse led transitional care program, the Transitional Care Bridge. Three hospitals in the Netherlands participate in this multi-centre, double-blind, randomised clinical trial comparing a pro-active multi-component nurse-led transitional care program to usual care after discharge. All patients acutely admitted to the Department of Internal Medicine who are 65 years and older, hospitalised for at least 48 hours and are at risk for functional decline are invited to participate in the study. All patients will receive integrated geriatric care by a geriatric consultation team during hospital admission. Randomization, which will be stratified by study site and cognitive impairment, will be conducted during admission. The intervention group will receive the transitional care bridge program, consisting of a handover moment with a community care nurse during hospital admission and five home visits after discharge. The control group will receive ‘care as usual’ after discharge. The main outcome is the level of ADL functioning six months after discharge compared to premorbid functioning measured with the Katz ADL index.

The general discussion in **Chapter 9** elaborates on the observed results and discusses both methodological issues in research in hospitalized older patients as well as implications for daily practice and further research. In conclusion, this thesis demonstrated that in the field of measuring ADL functioning and functional decline, substantial differences exist in the methods of measurement and applied definitions of functional decline. Older people that are acutely hospitalized are at high risk for mortality, functional decline and cognitive impairments three and (up to) twelve months after hospital admission. We developed a geriatric screening- and consultation model, the DEFENCE-care model that can be applied in daily practice consisting of screening, diagnostic assessment on geriatric conditions and geriatric interventions. Several practice-based tools have been developed to enhance implementation in daily medical and nursing care. Currently, the DEFENCE-care model is tested out in eight hospitals in the Netherlands.

Chapter 11

Summary in Dutch (Samenvatting)

Samenvatting

Ongeveer 20-30 % van alle ouderen heeft beperkingen in het dagelijks functioneren. Deze beperkingen worden vaak uitgedrukt in activiteiten van het dagelijks leven (ADL), zoals baden, aankleden, lopen en eten. Vijftig procent van deze beperkingen ontstaan langzaam progressief, in combinatie met een chronische ziekte, zoals artrose, diabetes of chronisch hartfalen. De andere 50 % ontstaat als gevolg van een acute gebeurtenis, zoals een cerebraal vasculair accident, heupfractuur of acute ziekenhuisopname. Een ziekenhuisopname op zich is een schadelijke gebeurtenis voor een oudere patiënt. In vergelijking met ouderen die niet in het ziekenhuis opgenomen zijn, is de kans op nieuwe beperkingen aanzienlijk groter. Nieuwe ADL-beperkingen die tijdens ziekenhuisopname ontstaan en bij ziekenhuisontslag nog aanwezig zijn, zijn moeilijk te revalideren. Jaarlijks hebben ongeveer 100.000 ouderen in Nederland te maken met een achteruitgang in functioneren na ziekenhuisopname. Niet alle ouderen hebben echter een even grote kans op deze functionele achteruitgang. Een aantal klinische kenmerken bij opname zijn geassocieerd met functieverlies, zoals de aanwezigheid van meerdere ziekten en de aanwezigheid van geriatrische condities.

Het doel van dit proefschrift was het onderzoeken en ontwikkelen van strategieën voor screening, diagnostiek en interventies bij ouderen die acuut in het ziekenhuis worden opgenomen, om functieverlies en andere slechte uitkomsten na ziekenhuisopname te voorkomen. Een van deze strategieën is het DEFENCE-zorgmodel, een 3-staps benadering ter preventie van functieverlies. Dit zorgmodel is ontwikkeld als onderdeel van dit proefschrift.

Hoofdstuk 1 start met een inleiding rondom chronische ziekten, het ontstaan van beperkingen in relatie tot chronische ziekten en de effecten van ziekenhuisopname op het dagelijks functioneren van ouderen. De hypotheses en aannames die gemaakt zijn bij de ontwikkeling van het DEFENCE-zorgmodel worden omschreven en de drie studiecohorten waarop de artikelen in dit proefschrift gebaseerd zijn, worden kort omschreven.

Omdat functieverlies tijdens en na een acute ziekenhuisopname de belangrijkste uitkomstmaat is van de studies in dit proefschrift wordt in **hoofdstuk 2** een systematische review gepresenteerd naar meetinstrumenten om het dagelijks functioneren van ouderen in kaart te brengen en de definities van functieverlies die in de verschillende studies gehanteerd worden. In totaal werden in de systematic review 28 klinische studies geïncludeerd, waarbij er een grote variatie was in de toepassing van de verschillende vragenlijsten, zowel in de items die gebruikt werden, als ook de scoring van de instrumenten. De minimale achteruitgang, die gehanteerd werd om functieverlies te definiëren, varieerde van 2-20 % van het daadwerkelijk niveau van functioneren van ouderen. Dit betekent dat verschillende cohort studies en klinische trials nauwelijks met elkaar te vergelijken zijn en dat er geen uitspraken gedaan kunnen worden over de effectiviteit van bepaalde interventies.

De hoofdstukken 3, 4 en 5 focussen op screening van patiënten naar verhoogd risico op slechte uitkomsten na ziekenhuisopname.
In **hoofdstuk 3** wordt de voorspellende waarde van 4 screeningsinstrumenten op terugkerend bezoek aan spoedeisende hulp, opname in ziekenhuis en sterfte vergeleken bij ouderen na een bezoek aan de spoedeisende hulp. In totaal zijn 381 oudere patiënten geïncludeerd in deze studie. Drie maanden na het bezoek aan de spoedeisende hulp, was 15 % weer op de spoedeisende hulp geweest, 17% was opgenomen in het ziekenhuis en 13 % was overleden. Geen van de onderzochte screeningsinstrumenten had voldoende discriminatieve waarde om ouderen met een verhoogd risico op slechte uitkomsten te selecteren. Verschillen in gezondheidszorgsystemen beïnvloeden mogelijk de voorspellende waarde van de onderzochte meetinstrumenten.

Hoofstuk 4 bevat een studie naar het voorspellen van sterfte bij acuut opgenomen oudere patiënten door artsen en verpleegkundigen. De hypothese die in deze studie werd onderzocht is, of de klinisch blik van artsen en verpleegkundigen een toegevoegde waarde heeft in het voorspellen van sterfte, in vergelijking met objectief meetbare factoren.

Artsen en verpleegkundigen werden gevraagd om op een schaal van 0-10 aan te geven hoe groot de kans was op overlijden (hogere score is grote kans op overlijden). In totaal werden 463 patiënten geïncludeerd, waarvan 24 % binnen 3 maanden was overleden. Vier factoren waren geassocieerd met sterfte: functionele beperkingen, de aanwezigheid van een maligniteit, aantal comorbiditeiten en een hoog ureum. Het toevoegen van de klinische blik aan het model verbeterde de voorspelling van het overlijden niet, de voorspelling moet daarom vooral gebaseerd worden op objectief meetbare factoren.

In **hoofdstuk 5** wordt de ontwikkeling en validatie van de Identification of Seniors at Risk-Hospitalized Patients (ISAR-HP) omschreven, een kort screeningsinstrument om ouderen met een verhoogd risico op functieverlies op te sporen. Vijfendertig procent van de acuut opgenomen ouderen uit het ontwikkelcohort en 32 % van de ouderen in het validatiecohort hadden functieverlies 3 maanden na ziekenhuisopname. Het predictiemodel bestaat uit 4 items: reeds bestaande beperkingen in instrumentele ADL voor de ziekenhuisopname, gebruik van een loophulpmiddel, hulp bij reizen en geen opleiding na het 14^{e} levensjaar. Met deze 4 items kunnen ouderen met een verhoogd risico op functieverlies worden opgespoord. Dit predictiemodel is stap 1 uit het DEFENCE-zorgmodel, een snelle selectie van patiënten met een verhoogd risico op functieverlies.

De hoofdstukken 6 en 7 bevatten twee studies naar het diagnostisch geriatrisch assessment.en de associatie tussen de geriatrische condities en overlijden, functieverlies en cognitieve beperkingen. Samen geven zij invulling aan stap 2 van het DEFENCE-zorgmodel.

Hoofdstuk 6 evalueert de prevalentie van 18 geriatrische condities en de associatie met overlijden, functieverlies en cognitieve beperkingen. In deze studie namen 639 acuut opgenomen ouderen deel uit 3 ziekenhuizen in Nederland. De oudere patiënten hadden gemiddeld 6 geriatrische problemen. Beperkingen in de IADL (83 %), polyfarmacie (61 %), problemen met lopen (59 %), overbelasting van de mantelzorg (53%) en ondervoeding (52

%) waren het meest frequent aanwezig. Één jaar na ziekenhuisopname was 35 % van de ouderen overleden, had 33 % functieverlies en 26 % had te maken met cognitieve beperkingen. Hoge leeftijd, de aanwezigheid van meerdere comorbiditeiten, ondervoeding, obesitas, valrisico en IADL beperkingen waren geassocieerd met overlijden. Hoge leeftijd, meerdere comorbiditeiten en de aanwezigheid van een urinecatheter waren geassocieerd met functieverlies. De resultaten laten zien dat met het uitvoeren van een diagnostisch assessment veel problemen worden opgespoord, die voorkomen of behandeld kunnen worden tijdens en na ziekenhuisopname. Dit kan tot betere gezondheidsuitkomsten leiden na ziekenhuisopname en de last van ziekenhuisopname voor oudere patiënten verkleinen.

Steeds meer onderzoeken laten zien dat niet iedere oudere patiënt op een gelijke manier baat heeft bij geriatrische interventie, maar dat uitkomsten mogelijk verschillen afhankelijk van het klinische risicoprofiel bij opname. In **hoofdstuk 7** wordt een studie beschreven waarin het studiecohort van 639 patiënten verdeeld wordt over 3 subgroepen op basis van de score op de ISAR-HP; een laag, midden en hoog risicogroep voor functieverlies. Acuut opgenomen ouderen in de laag-risicogroep hadden minder geriatrische problemen (gemiddeld 3), in vergelijking met de midden (gemiddeld 6 condities) en hoog-risiscogroep (gemiddeld 7 geriatrische condities). Twaalf maanden na ziekenhuisopname, had 39 % van de ouderen in de laag-risicogroep een slecht uitkomst (overlijden of functieverlies), tegenover 50 % in de middengroep en 69 % in de hoog-risicogroep ($p<0.001$). Deze onderverdeling in risicogroepen wordt meer en meer gepropageerd door zowel de Gezondheidsraad als ook experts in het veld. Deze onderverdeling kan helpen om de juiste behandeling, geriatrische interventies en nazorg in te zetten.

Hoofdstuk 8 beschrijft het design van een gerandomiseerde interventiestudie ter preventie van functieverlies bij in het ziekenhuis opgenomen ouderen en is een uitwerking van stap 3 van het DEFENCE-zorgmodel, de transmurale zorgbrug. Drie ziekenhuizen in

Nederland doen momenteel mee aan deze multicenter, dubbelblinde, gerandomiseerde klinische trial, waarbij proactieve zorg tijdens ziekenhuisopname en gestructureerde nazorg door een transitiecoach wordt vergeleken met gewone nazorg bij ouderen. Alle ouderen die acuut worden opgenomen op de divisie inwendige geneeskunde die tenminste 48 uur worden opgenomen en een verhoogd risico op functieverlies hebben worden uitgenodigd voor deelname. Alle ouderen krijgen proactieve zorg via DEFENCE-zorgmodel. Randomisatie vindt plaats voor ziekenhuisontslag en is gestratificeerd op cognitie en ziekenhuis. De interventiegroep krijgt het transmurale zorgbrug nazorgprogramma, bestaande uit een bezoek van de transitiecoach tijdens opname voor een overdracht en vijf bezoeken na ziekenhuisontslag. De controlegroep krijgt de gebruikelijke zorg na ontslag. Belangrijkste uitkomstmaat is niveau van ADL functioneren 6 maanden na ziekenhuisontslag.

De discussie in **hoofdstuk 9** gaat in op de resultaten en zowel methodologische issues als implicaties voor de dagelijkse praktijk en verder onderzoek worden omschreven. Samengevat laten de studies in dit proefschrift zien dat er substantiële verschillen bestaan in het meten van het ADL functioneren en de definities van functieverlies. Acuut opgenomen ouderen hebben een grote kans op overlijden, functieverlies en cognitieve beperkingen 1 jaar na ziekenhuisopname. We hebben een systematisch zorgmodel ontwikkeld, het DEFENCE-zorgmodel, dat gebruikt kan worden in de dagelijkse praktijk en bestaat uit screening op risico voor functieverlies, een diagnostisch assessment naar geriatrische condities en geriatrische interventie. Een aantal praktijkprotocollen zijn ontwikkeld om implementatie in medische en verpleegkundige praktijk te bevorderen. Momenteel wordt het DEFENCE-zorgmodel in 8 ziekenhuizen in Nederland uitgetest.

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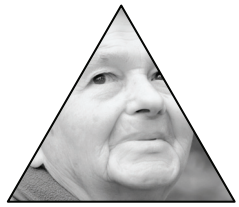

Curriculum Vitae

Curriculum Vitae

Bianca Buurman is geboren op 13 augustus 1977 in Rotterdam. Na het halen van haar VWO diploma aan het Comenius College in Capelle a/d IJssel is zij gestart met de studie Bewegingswetenschappen aan de VU in Amsterdam, waar zij haar propedeuse behaalde. In 1996 startte zij met de HBO-V aan de Hogeschool van Amsterdam. Al tijdens de opleiding had zij speciale affiniteit met ouderen, oncologische patiënten en onderzoek. In 2003 haalde zij haar diploma Master of Science in Nursing gevolgd aan de Hogeschool van Utrecht en University of Cardiff.

Haar werkervaring startte in 2000 op de afdeling algemene inwendige geneeskunde van het AMC als klinisch verpleegkundige en in 2003 maakte ze de overstap naar de afdeling oncologie/hematologie, waar zij ook haar oncologie-specialisatie behaalde. In 2006 ging ze gedeeltelijk op de afdeling ouderengeneeskunde van het AMC werken en kreeg ze de mogelijkheid om promotie-onderzoek op te starten onder begeleiding van prof. dr. M.M. Levi, prof.dr R.J. de Haan en dr S.E.J.A. de Rooij. Tijdens haar promotie-onderzoek heeft ze 2 jaar als docent verpleegkunde op de Hogeschool van Amsterdam gewerkt, totdat in 2008 het Nationaal Programma Ouderenzorg (NPO) startte en in de AMC-regio de Kring Ouderenzorg AMC & partners werd opgericht. Toen is ze volledig overgestapt om voor het NPO te werken als coördinator van verschillende projecten gericht op veilige transities van ziekenhuis naar thuissituatie en interventies om functieverlies te voorkomen. In alle projecten staat de verbinding tussen onderzoek en het verbeteren van de klinische praktijk centraal.

Na haar promotie blijft Bianca Buurman verbonden aan de afdeling Ouderengeneeskunde als postdoc. Binnen de onderzoekslijn ‘Causes, effects and outcomes of acute illness on normal and pathological ageing’ zal zij het deelprogramma Functional decline and Recovery gaan leiden. Per september 2011 wordt zij daarnaast trainee in het bestuur van Verpleegkundigen & Verzorgenden Nederland (V&VN).

Acknowledgements (Dankwoord)

Dankwoord

Ergens in mijn derde jaar van de HBO-V liep ik stage op één van de afdelingen inwendige geneeskunde van het AMC. Op de afdeling werd een oudere man verpleegd, die ruim een week in een diep delier verkeerde. In foetushouding en erg angstig werd hij omringd door 2 dochters die hem dag en nacht bij stonden, hem te eten gaven, hem voorlazen. Als team probeerden we deze man zo goed mogelijk te verzorgen. Zelf had ik als leerling de hoop opgegeven, maar wonder boven wonder knapte hij weer op. Hier is mijn liefde voor de geriatrie aangewakkerd: de wetenschap dat door goede multidisciplinaire zorg, gericht op zowel somatische als psychische problematiek en de inzet van de mantelzorg je zoveel voor mensen kunt betekenen, fascinerend!

Mijn loopbaan is gestart als verpleegkundige en twee hoofdverpleegkundigen, Peter Sluijter en Aline Coenraedts ben ik heel dankbaar dat ze me gestimuleerd hebben om verplegingswetenschap te gaan studeren en de stap naar onderzoek te zetten. Een stimulans die uiteindelijk de eerste aanzet is geweest tot dit proefschrift.

Op die verpleegafdeling kwam ik aan het begin van mijn studie Dr. Sophia de Rooij tegen, die zowaar als dokter de studie verplegingswetenschap kende en geïnteresseerd informeerde of ik niet verder wilde in onderzoek. Nooit heb ik 1 dag spijt gehad van die keus! Lieve Sophia, de afgelopen jaren hebben we heel intensief samengewerkt aan de DEFENCE-studie, de projecten van het NPO en alle andere kwaliteitsverbeteringprojecten voor ouderen. Ik ben je zeer dankbaar dat je me als co-promotor zoveel ruimte hebt gegeven, zowel op onderzoeksgebied, als ook op allerlei andere terreinen. Van onze gesprekken, discussies en je adviezen heb ik enorm veel geleerd en bovendien ben je gewoon erg leuk om mee samen te werken. Ik waardeer het vertrouwen dat je me geeft, ook al is het niet altijd gemakkelijk om de dingen meer los te laten. Ik zie uit naar onze verdere samenwerking, het verder uitbouwen van het multidisciplinaire onderzoek binnen de afdeling ouderengeneeskunde en zo de zorg voor de oudere patiënten tijdens en na ziekenhuisopname verder te verbeteren.

Prof dr. M.M Levi en prof. dr. R.J. de Haan, mijn beide promotoren. Beste Marcel, dank voor de ruimte, de mogelijkheden en het steunen van verpleegkundig onderzoek in het AMC. Het is goed te zien dat verpleegkundig onderzoek de komende jaren verder opgetuigd wordt, gekoppeld aan een aantal sterke onderzoeksspeerpunten. Beste Rob, jij kwam na mijn eerste artikel het team versterken. In het begin kon ik je wel eens vervloeken om je strakke schrijfstijl en daarmee uitgebreide feedback. Goed gestructureerd schrijven heb ik vooral van jou geleerd, en daarmee ben je een goede leermeester geweest; ik pas het nu ook toe op alle mensen die ik begeleid. Daarnaast bewaar ik ook goede herinneringen aan alle inhoudelijke discussies die we gevoerd hebben, waar ik altijd vol nieuwe energie uitkwam. Ik hoop dat deze goede samenwerking de komende jaren blijft bestaan!

Alle collega's van de afdeling ouderengeneeskunde! In het begin was dat nog een overzichtelijke groep van een vrouw of 8, maar ondertussen zijn het ongeveer 25 mensen. Barbara van Munster, ik kwam ongeveer 1,5 jaar na jou op de afdeling als onderzoeker werken en in het begin heb je me ingewijd in queries, statistiek, maar vooral kijk ik met veel plezier terug op de humor, samenwerking en telefoongesprekken toen je niet meer dagelijks in het AMC verkeerde. In ieder geval kan ik zeggen dat ik je op gebied van kinderaantal niet voorbij ga streven……
Liesbeth, wij kwamen tegelijkertijd op de afdeling werken en kregen ook ongeveer tegelijk onze eerste baby. Ik kijk me veel plezier terug op die tijd, de herkenning en nog steeds op de verpleegkundige benadering van ouderen in het AMC.

De promovendi van de afdeling ouderengeneeskunde; Alice, Annemarieke, Annerike, Barbara, Erja, Esther, Janet, Jeroen, Juliette, Margriet, Marije, Ozgul. Het is leuk met jullie te werken en te onderzoeken, frustraties en hoogtepunten te delen. Barbara, Nathalie en Erja, ik zie ernaar uit om als postdocs samen te bouwen aan de verschillende onderzoekslijnen. Het is leuk en inspirerend om met jullie te praten over het heden en toekomst van het doen van onderzoek en alles wat eraan vast zit.

Jose, Marjolein, Rita, Josephine, Caroline, Arja, Wendy; dank voor alle data die verzameld zijn (en dat zijn er nogal wat!!) en gewoon voor alle nauwkeurigheid, inzet en gezelligheid de afgelopen jaren. Wat zijn er een projecten gestart, afgerond en weer nieuw gestart. Zonder jullie hulp was dit proefschrift er niet geweest. Marlien, heel veel dank voor al je hulp bij het proefschrift, en ook bij alle andere projecten!

De eerste jaren was ik vooral bezig met de DEFENCE-studie. Prof. dr. Marieke Schuurmans, dr. (!) Jita Hoogerduijn en dr. Joke Korevaar, ik denk met veel plezier terug aan onze bijeenkomsten en alle discussies die gevoerd zijn over alle data. Marieke, voor mij als verpleegkundige ben je altijd een rolmodel geweest, voor hoe je als verpleegkundige ook een carrière in de wetenschap kan hebben. Ik hoop dat we in de nabije toekomst kunnen blijven samenwerken aan goede verpleegkundige zorg voor ouderen. Jita, wat een werk was het hé, die promotie! Ik denk op een goede manier terug aan onze samenwerking, telefoontjes, frustraties, maar ook hoogtepunten. Joke, heel veel dank voor alle geduld en uitleg in het begin van mijn promotie! Carolien Verstraten, Ruth Pel, Dominique van Vugt, dank dat jullie als verpleegkundigen in het UMCU en het Spaarne Ziekenhuis destijds alle gegevens hebben verzameld en bij het project betrokken waren! Dr. Harald Verhaar en Dr. Gooke Lagaaij, dank voor de mogelijkheden onderzoek te doen op jullie afdelingen.

In 2007 ging ik als docent op de Hogeschool van Amsterdam werken. Ongeveer tegelijk met mij startte ook Dr. Wilma Scholte op Reimer, als lector evidence based nursing. Beste Wilma, we delen een voorliefde voor verpleegkundig onderzoek dat sterk aansluit bij medisch onderzoek. In de afgelopen jaren heb je bakens verzet op de HVA. Ik verheug me op een verdere samenwerking op onderzoeksgebied en ik vind het erg leuk dat je komt opponeren! Cees Salentijn, onder jouw vleugels mocht ik me als docent verder ontwikkelen. Je liet me goed mijn kunnen en mogelijkheden zien, en praten met jou over ouderen was inspirerend en zette aan tot verder nadenken. Marjolein, Corine, Jos, Margriet, Vivi, Joop, Marieke en alle andere collega's; ik heb heel prettig met jullie samengewerkt.

Ergens in 2009 ben ik aangehaakt bij het FIT-project, niet wetend wat daar allemaal uit voort zou komen. Dr. Eric Moll van Charante en Drs. Jacqueline Suijker, het is me een waar genoegen om met jullie samen te werken. Als ik aan FIT denk, is dat vooral aan de lol die we tijdens de vergaderingen hebben; of het nu om couchsurfen, samenwerkingspartners of de toolkit gaat; goede wetenschap gaat altijd hand in hand met humor. Ik ken geen enkel project waar zo tot in detail is nagedacht is over de verantwoording van keuzes (je weet wel Jose!). Het is ook gewoon heel leuk dat FIT nu zo goed land in de praktijk. Marjon sprong na een tijd uit de transmongolie-express op de FIT-express en nu ga je zelf ook schrijven, leuk!

Dat je met computers veel meer kan doen, dan internetten en tekstverwerken, is me wel duidelijk geworden in de samenwerking met Prof. dr. Ameen Abu-Hanna. Ingewikkelde analyses, clusteringen, decision support, er ging een wereld voor me open. Beste Ameen, vooral is samenwerken met jou en je team (Saied, Ace, Marjan en Lilian) erg inspirerend en leuk. Als hoofd en professor van de klinische informatiekunde gaan jullie ongetwijfeld nog veel betekenen in het AMC en daarbuiten en ik hoop dat de samenwerking met de ouderengeneeskunde daarin ook intensief blijft.

Dr. Suzanne Geerlings, wij kwamen elkaar tegen bij projecten rondom vertrek en nazorg uit het ziekenhuis, wat uitgemond is in een moederproject ‘Beter voorbereid met ontslag’. Het is erg leuk dat je ook zo’n passie hebt voor verbeteren van kwaliteit en dat we dit project nu samen kunnen uitvoeren. Ik bewonder je kordaatheid, ik ken geen enkel persoon die zo goed en efficiënt kan vergaderen en hoop dat we dit project verder kunnen uitbouwen, samen met alle betrokken hoofdverpleegkundigen en artsen. Kim, jij kwam als Rabobank-meisje weer terug de zorg in. Het is leuk om je begeleiden, zowel in het project als ook met je eerste artikel.

Verder alle mensen waar ik de afgelopen jaren binnen en buiten het AMC mee heb samengewerkt; Marian Mens, Susanne Smorenburg, Jan Coolen, Tamara Slagter, Ingeborg

Goes, Jolanda Maaskant, Marian Smeulers, Hester Vermeulen, Jeanet Steenbruggen, Jikke Bootsma, Joanna Klopotowska, Peter Wierenga, Nanne Frenkel, Margriet Pol, Rien de Vos, Soemitro Poerbodipoero, Elise Bos, Petra Wempe, Ben Krose, Lieke Rijnen, de partners van de Kring Ouderenzorg AMC, Rose Tuizenga, Rene Swarts, Bob van Deelen, Karin de Kanter, Rianne van Dasler, Willem de Blok, Simone Jong, Helma Meijer, congrescommissie geriatriedagen, Jan Willem Broek (alias Bob Ross).

De leescommissie wil ik bedanken voor het lezen en beoordelen van mijn proefschrift!

Ik wil ook alle ouderen en mantelzorgers die meegedaan hebben aan onze projecten bedanken. We hebben u veel gevraagd, maar het heeft ons ook veel inzichten gegeven. Speciale dank gaat uit naar de ouderenmonitors op de transmurale zorgbrug; Dhr. Verdonk, Mw. Herpers, Mw. Cornelis en Dhr. van Lint. U houdt ons scherp, agendeert belangrijke onderwerpen en de inhoudelijke discussies vind ik altijd heel waardevol!

Lieve vriendinnen! Marike, Janna, Geke, Anne-margreet, Franca en Chantal. We leerden elkaar lang geleden kennen aan het begin van de studie en sindsdien zijn we elkaar nooit meer uit het oog verloren. Interrailen, reizen, mannen, kinderen, humor, loopbaan, lief en leed. We delen veel met elkaar en ik ben blij met jullie als vriendinnen.

Mijn paranymfen Marike van der Leeden en Jacqueline Suijker! Lieve Marike, we kennen elkaar als sinds ons 15e toen we vooral veel winkelden en uitgingen en bijna 20 jaar later wonen we bij elkaar om de hoek, hebben beiden 2 prachtige kinderen en zitten op werkgebied ook helemaal op 1 lijn. Dat koester ik! Lieve Jacqueline, ik hoop jou samen met Eric en Sophia over een aantal jaar naar het ‘altaar’ te begeleiden. Samenwerken met jou geeft veel energie en we praten heel wat af over de studies en privé, overdag, in de avonden en weekenden…..

Mijn promotietijd was ook een hele vruchtbare tijd. Lieve Mila en Carlijn, jullie zijn in deze periode geboren. Wat een voorrecht om zulke mooie dochters te hebben! Ik geniet van jullie vrolijkheid, onbevangenheid en tegenwoordig ook wijsheid en gevatheid. Wat je ook kan zeggen van een werkende moeder, het doet me deugd te zien dat jullie tegenwoordig mij ook graag nadoen in jullie fantasiespel; achter de computer of met mijn werktas op stap met de mededeling dat jullie ook gaan werken.

Lieve Frank, ik ben heel blij met jou als mijn man, dat je me stimuleert mijn dromen na te jagen, me de ruimte geeft, naar me luistert als ik weer van alles hebt meegemaakt, maar ook dat je me soms kan afremmen en kan laten zien dat er meer is dan werk alleen. Dat is me heel veel waard. We hebben al heel veel mooie herinneringen samen: samen reizen, studeren, verhuizen, leuke avonturen met vrienden en onze 2 mooie dochters. Ik zie ernaar uit om samen met jou en met Mila en Carlijn de toekomst vorm te geven. Mooie weekenden en vakanties met onze camper liggen in ieder geval in het verschiet!