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FUNCTIONAL DECLINE IN THE HOSPITALIZED ELDER

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List of Abbreviations and Acronyms

ACE – Acute Care for Elders

ADL – Activities of Daily Life

CGA – Comprehensive Geriatric Assessment

AUC - Area Under the Curve

BRIGHT - Brief Risk Identification for Geriatric Health Tool

CAN – Care Needs Assessment

COMPRI - Care Complexity Prediction Instrument

DBI – Drug Burden Index

FIM – Functional Independence Measure

GEMU – Geriatric Evaluation and Management Units

HARP - Hospital Admission Risk Profile

HELP – Hospital Elder Life Program

IADL – Instrumental Activities of Daily Life

ICF - International Classification of Functioning

ISAR - Identification of Seniors at Risk

ISAR-HP - Identification of Seniors At Risk-Hospitalized Patients

MMSE – Mini-Mental state examination

NICHE - Nurses Improving Care for Healthsystem Elders

OARS - Older Americans Resources and Services

PReCaP – Prevention and Reactivation Care Program

SHERPA - Score Hospitalier d'Evaluation du Risque de Perte d'Autonomie

SPPB - Short Physical Performance Battery

TRST - Triage Risk Screening Tool

USA – United States of America

UK – United Kingdom

WIQ – Walking Impairment Questionnaire

Abstract

Introduction: 20 to 62% of elders hospitalized for an acute medical problem experience functional decline following admission. This functional decline is partially due to the hospital environment and to potentially modifiable factors. This review presents screening tools intended to identify elders at higher risk of functional decline, whom could most benefit from preventive measures, together with preventive measures and programs aimed at reducing functional decline in the hospitalized elder.

Methods: Systematic literature review from 2005 to January 2014.

Results: Eleven screening tools, with AUC range from 0.56 to 0.83, aimed at identify hospitalized elders at risk of functional decline were found. Data regarding scientific qualities of the screening tools, such clinical utility was poor. Main prevention measures found in the literature regard several domains: awareness of health care providers, patients and family/caregivers; adequate hydratation and nutrition; reduce bed rest and physical restrain; availability of technical aids, physical and occupational therapist; encourage ADL independency; enable safe mobility; give special attention to medication, hospital devices and procedures appropriateness; and focus on effective discharge planning. Additionally, three multidisciplinary programs were found: Comprehensive Geriatric Assessment, Hospital Elder Life Program and Prevention and Reactivation Care Program. Comprehensive Geriatric Assessment was shown to increase the odds of a patient remaining alive and living at home after discharge, while maintaining functional status and potentially decreasing health care cost. Hospital Elder Life Program and Prevention and Reactivation Care Program results will be published in the future.

Conclusion: Use of screening tools alone to target hospitalized elders at risk of functional decline is not recommended. Preventive measures presented can potentially be applied in the hospital-setting and are not compulsory associated with time or resource-consumption. The multidisciplinary programs have shown promising results and might be of use in the future to improve the quality of health service provided, and, possibly, decrease the total costs of health care provided to the elderly. Further research

is needed regarding targeting elders whom would most benefit from specific preventive measures and cost-effectiveness of preventive measures and multidisciplinary programs.

Key-words: *elderly, geriatric care, hospitalization, functional decline, hospitalization-disability, identify, screening tools, prevention.*

Resumo

Introdução: Aproximadamente 20 a 60% dos idosos internados por um problema de saúde agudo experiencia declínio funcional após a admissão hospitalar. Este declínio funcional é parcialmente causado por fatores do ambiente hospitalar potencialmente modificáveis. Neste artigo de revisão são apresentados instrumentos para identificar idosos hospitalizados mais vulneráveis a declínio funcional, assim como medidas preventivas e programas com o objetivo de reduzir o declínio funcional no idoso internado.

Métodos: revisão de bibliografia publicada entre 2005 e Janeiro de 2014.

Resultados: Foram encontrados onze instrumentos, com AUC entre 0.56 e 0.83, desenvolvidos para identificar idosos internados em risco de declínio funcional. Os dados relativos às qualidades científicas, como utilidade clínica, dos instrumentos de triagem encontrados são insuficientes. As principais medidas de prevenção encontradas na literatura são relativas aos seguintes domínios: sensibilização dos prestadores de cuidados de saúde, pacientes e familiares/cuidadores; nutrição e hidratação adequada; redução de repouso no leito e contenção física; disponibilidade de ajudas técnicas e fisioterapeuta/terapeuta ocupacional; encorajar o paciente a ser independente nas atividades diárias; assegurar, sempre que possível, mobilidade com segurança; dar atenção especial à adequação dos dispositivos médicos e da medicação; e planeamento da alta hospitalar eficaz. Além disso, foram identificadas três programas multidisciplinares: um primeiro, Comprehensive Geriatric Assessment, que já demonstrou aumentar as probabilidades de o idoso se encontrar vivo e a viver em casa depois de ter alta hospitalar, sem alteração significativa da funcionalidade e que parece diminuir os custos do internamento; e dois mais recentes, Hospital Elder Life Program e Prevention and Reactivation Care Program, cujos resultados irão ser publicados no futuro.

Conclusão: O uso isolado dos instrumentos para identificar idosos internados com risco de declínio funcional não é recomendado. As medidas preventivas identificadas nesta revisão podem ser aplicadas no ambiente hospital e não estão obrigatoriamente associadas a maior consumo de tempo ou de recursos. Os programas

multidisciplinares mostram resultados iniciais promissores e podem vir a melhorar a qualidade do serviço de saúde prestado no futuro, possivelmente acompanhados por uma diminuição dos custos totais associados aos cuidados prestados ao idoso. Há necessidade de realização de mais estudos com a finalidade de identificar os idosos internados com maior risco de declínio funcional e que beneficiariam mais com medidas preventivas específicas, assim como perceber os benefícios e a relação custo-benefício das diferentes medidas e programas multidisciplinares.

1) Introduction

Aging is a natural process that is associated with loss of resilience and functional reserve. When an acute health problem determines hospitalization in this group, 20 to 62%[1–6] of the elderly experience functional decline. This functional decline experienced by elders during hospitalization is not entirely explained by the acute episode which led to the hospitalization or admission in the emergency department and it may persist even after resolution of the medical problem.[7] It is in this context that terms such hospital-related functional decline, hospitalization-associated disability[4,8] or hospital-acquired disability[9] appear.

Like in any other geriatric syndrome, functional decline cannot be linked to any unique cause, but rather due to several factors[4]. These factors can either be inherent to the patient or environment related, and some can be potentially modifiable in the hospital-setting[1]. Identification of the factors which play an important role in hospital-related disability, or hospital related functional decline, and are susceptible to modification is the first step in making possible active prevention[4].

In order for the prevention actions to achieve optimal cost-effect relation it is crucial to target the patients that would most benefit from specific preventive measures.

Results of this systematic review are divided in three main parts. The first domain regards the thematic of functional decline and hospital-related functional. The second domain is focused on screening tools aimed at detecting hospitalized elderly at risk of functional decline. The third and last domain is related to measures and interdisciplinary programs, found in the literature, which are aimed at preventing hospital-associated disability.

2) Methods

Two strategies were used to search relevant articles included in this review.

First, a systematic search of literature in English and Portuguese from 2005 to January 2014 in PubMed sites using the search terms: *functional decline, functionality, function, functional status, ADL, activities of daily living, disability, hospitalization, geriatric, elderly, at risk, identification, screening, care, prevention, geriatric care*. Full-text, date and language were used as search filters.

Additionally, reference lists of selected articles from search were reviewed to identify other relevant articles.

Articles were included if they were of value to the following thematics:

Measurement tools: instruments used in functionality characterization of the elderly.

Screening instruments: instruments with the aim of identifying older hospitalized patients at risk of functional decline with described validity and discriminative value.

Prevention of functional decline: strategies to prevent functional decline in elders hospitalized in standart care and geriatric units. Measures aimed at preventing functional decline in elders with potential adaptations in the hospital setting.

Other articles were included if valuable for defining functional decline or opportune in characterizing the context of hospital-related functional decline.

3) Search results

a) Functionality and functional decline in the hospitalized elderly

Functionality is defined as the ability to perform activities of daily life independently and safely. Basic activities of daily living (ADL) are walking, dressing, bathing, transferring, eating and toileting. Instrumental activities of daily life (IADL) are shopping, housekeeping, preparing meals, taking medications, handling finances and using public transports [3].

A decline in the ability to perform activities of daily life independently and safely, a loss of dependency in self-care activities or deterioration in self-care skills[3,5] are defined as functional decline. Other terms referring to functional decline are: loss of function, ADL decline, declining function, status decline, ADL status decline, functional impairment [10].

Functional decline following hospital admission is a common problem in older patients[4,5], who are more susceptible to such problem[2,4,11,12], and is responsible for approximately half of new-onset disability[4,13].

Functional decline often starts around the time of admission and can progress quickly [14]. This event is partially a result of hospitalization and not related to diagnostic or therapeutical interventions[6], meaning that it is not entirely explained by the acute medical problem that led to hospitalization or emergency department admission, and may persist even after the medical problem is resolved[3,4]**.** Since in-hospital adverse advent is defined as "an injury to a patient as the result of a medical intervention rather than the underlying medical condition" [15], part of functional decline experienced by the hospitalized elder can be consider an in-hospital adverse event, and for this reason, this identity can be designated as hospitalization-associated disability[4,8] or hospital-acquired disability[9], including both new-onset disability and further disability development[4].

The percentages advanced for hospital-related functional decline from studies and age groups range from 19% to 63%. In patients aged over 65 years, Wu et al.[1] described 40% of patients experiencing hospital-related functional decline, while

Siqueira et al.[2] advances with a value of 19% and Hoogerduijnet al.[3] refers values from 30 to 60%. In patients over 70 years, Covinsky et al.[4] refers that more than 30% experiencing functional decline while hospitalized and Vos et al.[5] found a concordant value of 35%. Vos et al.[5] observe that the percentage increases up to 50% in elders aged over 85 years and Kosse et al.[6] and de Vos et al.[5] refer values up to 63% in elders aged over 90 years.

Table 1: Main factors contributing to hospitalization-related disability.

Risk for disability	Preillness determinants of functional reserve ✓ Age ✓ Poor mobility ✓ Cognitive function ✓ ADL ✓ Geriatric syndrome ✓ Social functioning ✓ Depression ✓ IADL	
	Severity of acute illness	
	Hospitalization factors ✓ Environment ✓ Restricted mobility ✓ Undernutrition ✓ Enforced dependence ✓ Polypharmacy ✓ Little encouragement of independence	
		Post-hospitalization factors ✓ Environment ✓ Resources ✓ Community supports ✓ Quality of discharge planning
	Acute illness onset and hospitalization	Discharge

Table adapted from *Hospitalization-Associated Disability "She was probably able to ambulate, but I'm not sure"*[4].

Acute medical illness, iatrogenic effects [1] and bed rest deconditioning[1,9,16] are the main reasons for functional decline in hospital setting. Other factors such as co-morbilities, immobilization, isolation, inaccessibility to fluids [5], loss of confidence and self-steeam, cognitive loss, muscle loss, falls, polymedication and loss of muscle and strength also play a role in hospital-associated disability[17].

Hospital-associated disability is associated with prolonged hospital stay, decrease in quality of life and autonomy, greater health care needs after discharge, Increased risk of readmission and mortality, dehydration, malnutrition, falls, depression and delirium, worst cognitive status[2–5,7,10,16,18–20].

Table 2: Main problems associated with hospital-related functional decline

Decreased quality of life
Loss of independence
Nursing home placement
Falls
Depression
Delirium
Higher length of stay
Greater health care needs after discharge
Higher risk of readmission
Higher need for support given by the family or caregiver
Higher cost in long-term
Death

This functional decline may be transitory or permanent and requires more support given by the family or a caregiver [10,16,21] and may be followed by loss of independence, nursing home placement [4,10,12]or death.

In a simplistic way, IADL and ADL can be used together or separated in order to measure functionality[5]. Several instruments were developed to rate functionality.

In 2001, the World Health Organization approved the International Classification of Functioning, Disability and Health ICF[22], a classification system that provides 1434 alphanumeric codes arranged in a hierarchical manner in order to describe functioning in health and health-related contexts.

In a review article by Buurman et al.[18] regarding a systematic literature search from 1990 to 2010, five instruments to measure functionality were identified: Barthel Index, Katz ADL index, Lawton IADL scale, Functional Independence Measure (FIM) and Care Needs Assessment (CAN). Only 14% of the studies used the complete original content of the measurement tool. Although all the studies included the items dressing, bathing, eating and toileting, transferring was addressed only in 82% of the studies and continence was addressed in 14%. It is possible that continence was not included because of the low reliability of self-reported assessment. Katz ADL index was the instrument most frequently used (in 22 out of the 28 studies included in the review) and was presented as the best tool to measure functionality and disability. Incontinence is included in the complete and validated version of Katz ADL index.

Bisset et al.[23] performed a systematic review including articles from 1996 to 2011. Fifteen psychometric testing of functionality used in ED in elders aged 65 or older, addressing function as defined by the ICF, were identify: Barthel index or components of the Barthel index; Brief Risk Identification for Geriatric Health Tool (BRIGHT); Functional Autonomy Measurement System; Functional Independence Measure; Functional Status Assessment of Seniors in Emergency Departments; Identification of Seniors at Risk (ISAR); Katz; Lawton IADL scale; Modified Barthel index; Modified Lawton IADL scale; Older American Resources and Services; Runciman Questionanaire; SF-12 and Triage Risk Screening Tool (TRST). BRIGHT, ISAR and TRST are discussed in this review as tools to predict functional decline in the hospitalized elder patient.

In Kosse et al. review[6], the instruments to measure ADL, IADL and physical performance included some of the already mentioned tools and SIVIS dependency scales, Walking impairment questionnaire (WIQ), Timed Up and Go test, Functional Ambulation Classification, Physical activity scale, Mobility, Physical performance and

Mobility examination, Short Physical Performance Battery (SPPB) and Modified Berg Balance Scale. SPPB is discussed in this review as a screening tool to predict functional decline in the hospitalized elder patient.

Additionally, Covinsky et al. [4] presents a set of questions that can be use to perform a minimal functional assessment.

Table 3: Minimal functional assessment

Functional Domain	Assessment on Admission	Daily Assessment
ADL	For each ADL the following elements should be assessed at admission and before onset of illness: Difilculty with ADL: "On the day of admission did you have any difficulty bathing or taking a shower? Did you have any difficulty bathing before the onset of the problem that led to hospitalization?" Ascertainment of equipment use for walking or bathing. If patient reports difficulty, assess need for help: "On the day of admission, did you need the help of another person to bathe? How about before the illness?" If the patient needs help, assess adequacy of help: "What help do you need? Who helps you? Do you get enough help?"	Ask nurse or nursing assistant at bedside the extent of help they are providing for bathing, dressing, transferring, use of toilet, eating and walking Review nursing and physical/occupational therapy notes
Mobility	Observe by asking the following: To sit up in the bed without assistance To get out of the bed and stand To walk a few steps, using a walker or cane as necessary	Repeat on daily rounds
Cognitive function	Administer MiniCog Give the patient 3 items to remember (ie. Bird, paper, watch) Ask the patient to draw a clock, setting hands to show 11:10 Ask the patient to recall the 3 words Score 2 points for correct clock and 1 point for each correct word ≥3 points indicate passing score	Assess delirium on daily interview with patient: Orientation: "What day of the week is it?" Inattentiveness (does the patient have difficulty focusing, is easily distractible) Unclear thinking (does the patient seem to ramble; is the flow of speech unclear, tangencial, or difficult to follow) Assess these parameters for fluctuation over time Review nursing notes looking for evidence of these features

Table adapted from *Hospitalization-Associated Disability "She was probably able to ambulate, but I'm not sure"*[4]

Since the review done by Buurman, new scales for staging basic mobility and walking based on the ICF were developed by Okochi et al[22] in 2013. The high number of codes in ICF makes implementation of the tool unlikely in the daily routine, but there have been several studies with the aim of countering this difficulty by selecting ICF codes sets for specific population like patients with ostheoporitis and patients that experience stroke, and in 2013 for elder patients (≥65 years old). The study conducted in Japan by Okochi et al. in 2013 resulted in the development of a Guttman-type scale, method also use before in tools to measure functionality (eg in OARS)[2,23], for "basic mobility" and "walking" to rate functional performance in the elderly. The scales divide functional performance into five levels, with a hierarchical organization. The authors are presently carrying out validity and reliability studies to qualify the scales to be used in international geriatric settings.

The main advantage of these types of scales is the prospect that each functional level will require similar resources resulting on a standardization of care needed. In this case, characterization of the type of care needed by each group was not discussed, authors only referred that the tasks represented by the adjacent ICF items can be used as targets for rehabilitation.

b) Identification of hospitalized elders at risk of functional decline

i) Screening instruments

There was found a great variability in the studies about measurement tools to predict functional decline in the hospitalized elders. These differences consist of different methodological approaches, different goals, different designs, different variables, different measurements and measurement times, different methods to obtain information and different follow up time.

A systematic review carried out by Hoogerdujn et al.[10] including studies done between 1990 and 2005 found three instruments to predict functional decline in elder presented at emergency departments: Hospital Admission Risk Profile (HARP) by Sager et al. 1996, Identification of Seniors at Risk (ISAR) by McCusker et al. 1999 and Care Complexity Prediction Instrument (COMPRI) by Huyse et al. 2001. A study to

compare the predictive values of this three screening instruments was also done by Hoogerduijn et al. in 2009.

A review article by Sutton et al.[7] includes studies done between 1990 and 2007. In this review article five screening tools were reported, two already identified by Hoogerduijn et al.: HARP and ISAR, and another three: Inouye et al. 1993., Score Hospitalier d'Evaluation du Risque de Perte d'Autonomie (SHERPA) by Cornette et al. 2005 and Triage Risk Screening Tool (TRST) by Hustey et al. 2007.

Inouye et al. was not included in the review done by Sutton et al. as a screening tool, but as a study regarding predictors of functional decline. Although Inouye et al. showed an overall sensitivity of 88% and a specificity of 54%, no additional studies regarding Inouye et al. were identified and there is no data on AUC value, positive or negative predictive values reported in the literature. For these reasons Inouye et al. is not discussed in more detail in this review.

Beaton et al.[19] in 2013 published an updated review including studies between November 2007 and 2012. Two additional tools were identified: Brief Risk Identification for Geriatric Health Tool (BRIGHT) by Boyd et al. 2008 and Simplified PROFUNCTION index by Bernabeu-Wittel et al. 2012.

In the present review eleven instruments are presented to predict functional decline in elderly, meaning an additional three to the seven identified by Beaton et al.: Mehta et al. 2011 Clinical index, Short Physical Performance Battery (SPPB) by Corsonello et al. 2012, Identification of Seniors At Risk-Hospitalized Patients (ISAR-HP) by Hoogerduijn et al. 2012 and Barnes et al. 2012 tool.

In addition to the eleven screening tools, frailty scores predictive properties are presented. Although worst pre-admission status is a predictor in many of the tools, frailty scales failed when tested for predictive value [24]. In fact, Wu et al.[1] observed that elderly patients who were independent before of the acute health problem that lead to hospitalization were at higher risk of develop functional decline, in comparison to partially dependent patients. This fact contradicts the idea that a worse preadmission function is a predictor of functional decline. Authors presented a possible explanation for findings, the characteristics of the patients included in the study: 38.7% of the participants in the study were above 84 years of age, being possible that even pre-

morbid independent subjects were more likely to suffer functional decline at first instance.

The prognostic instruments differ in sensitivity, specificity, positive and negative predictive values and discriminative value. The ability to identify correctly those patients who are not at risk is measure by specificity and negative predictive value while sensitivity and positive predictive value measured the ability to correctly identify the patients at risk of functional decline[3].

The discriminative value can be expressed by the Area Under the Curve (AUC) value. AUC is a common measure of diagnostic accuracy and can be seen as the best fit between sensitivity and specificity[7]. The value can range from 0.5, no discrimination, to 1, perfect discrimination[3]. AUC between $\geq 0.7 < 0.8$ represent an acceptable discrimination, AUC $\geq 0.8 < 0.9$ represent an excellent discrimination and AUC ≥ 0.9, discrimination is outstanding[7].

Achieving the optimal balance between incorrectly identify elders that will not experience functional decline (false-positives), resulting in over-treatment, and failure to identify elders that will experience functional decline (false-negatives), causing under-treatment, is a challenge.

(1) Hospital Admission Risk Profile (HARP) by Sager et al. 1996

HARP predicts the risk of patients aged 70 years and over, hospitalized for acute medical illness, to experience functional decline in 6 ADL, in the first 3 months following discharge.

Exclusion criteria include terminal illness, severe cognitive impairment, inability to give informed consent, admission to the intensive care unit, admitted for surgery, living in a nursing home before admission, complete dependency upon presentation and death.

Functional decline was characterize as the ADL performance decline experienced by the participants, between two weeks prior to the hospitalization to 3 months after discharged.[17]. Functionality measurement tool was not specified.

HARP was developed in one acute care hospital in the USA with 448 patients in the development cohort and 379 in the validation cohort[10] followed by studies in 98 patients in a tertiary care hospital in Belgium and in 177 patients from an university teaching hospital in Netherlands[19].

HARP consists of 3 items with a total of 29 questions related to age, cognition (abbreviated Mini-Mental Status Exam, omitting the language items from the 30-item MMSE) and seven different IADL (managing finances, taking medications, use of the telephone, shopping, using transportation, doing housework and preparing meals) two weeks prior to admission[10] (table 5).

According to the score, the risk is low (<2 points), intermediate (2-3 points), or high (>3 points).

Overall, HARP was found to have a discriminative value of 0.56-0.68[3,7,10,17,19]. Predictive properties from the different risk levels can be found on table 6.

(2) Identification of Seniors at Risk (ISAR) by McCusker et al. 1999

ISAR was developed for emergency department practice and is suited for fast screening [23] to predict the risk of mortality, functional decline, re-admission and institutionalization of patients aged 65 years and over, in the 6 months following emergency department admission.

Exclusion criteria includes patient not being able to be interviewed (for medical problem or cognitive impairment) and no informant available. Research ethics committee permitted that participants were recruited with consent of responsible physician, even if without informant available, in the most recent study regarding ISAR[25].

ISAR was developed in four acute care, university affiliated hospitals in Montreal, Canada, in a sample of 1854 patients, 60% for development cohort and 40% validation [7], followed by a study on the test-retest reliability by the same authors and a study with a sample of 200 elders admitted to two Italian Emergency department[26]. Posterior studies were identify by Beaton et al.[19] and are represented by a 98 patient sample from a tertiary care hospital in Belgium, 345 patients sample from Geneva

University hospital in Switzerland, in a 177 patient sample from a university teaching hospital in the Netherlands. A more recent study[25], not included in the Beaton et al. review was identified. The study was done in a 667 patient sample from UK acute medical units.

The tool consists of six yes-or-no questions about pre-morbid functionality, acute decline in functionality, history of hospitalization, impaired vision, cognitive status and polymedication (table 5). The questions can be answered by either the patient or informants.

In the studies included in the review done by Beaton et al.[19], ISAR with a cut off of 2 was found to have a sensitivity of 72.0 – 92.9, a specificity of 39.3-58.0, positive predictive value of 36.4, a negative predictive value of 93.6 and discriminative value of 0.67-0.75. [3,7,10,17,19] Values for cut off of 3 and 4 are showed on table 6. In the more recent study, ISAR was poor at predicting increased dependency, defined by a decrease of 2 or more points in the Barthel ADL scale, obtaining an AUC of 0.62[25].

Reliability was examined and ISAR was found to have test-retest reliability, with a concordance correlation coefficient of 0.78[17].

(3) Care Complexity Prediction Instrument (COMPRI) by Huyse et al. 2001

COMPRI predicts the risk complex care need, poor discharge health status and extended length of stay in hospitalized patients. These outcomes overlap with functional decline [3].

COMPRI was initially developed to be used in all-aged patients. The tool was created from a list of 117 potential risk factors found in another study with a sample of more than 2.000 patients from 10 hospitals in Europe. Posteriorly, COMPRI was studied in 275 patients admitted to a general internal ward in two Dutch hospitals[10] and in 177 patients aged 65 years and older admitted to an internal ward in a Dutch hospital [3]. The validation study was not done with a sample exclusively compose of elders, but further studies found similar discriminative values in this group.

The tool consists of 13 yes-or-no questions that evaluate patient health perception, expectations from both doctor and nurse, patient walking difficulties in the previous 3 months, number of doctor visit in the last 3months, hospitalization history, polymedication and if the patient is retired or not (table 5). Four items should be completed by the physician, three items by the nurse and six items by interviewing the patient.

COMPRI with a cut off of 6 was found to have a sensitivity of 70.2-71, a specificity of 62.0-63.0, positive predictive value of 41.8-70.0, a negative predictive value of 64.0-84.3 and discriminative value of 0.69-0.73 [3,10] (table 6).

It is part of a two-step instrument to be used together with Intermed, an assessment regarding biological, psychological, social and health care domains.

(4) Score Hospitalier d'Evaluation du Risqué de la Perte d'Autonomie (SHERPA) by Cornette et al. 2005

SHERPA was developed with the aim of providing clinicians useful information to plan care and therapy for older patients. This tool identifies elderly at risk of functional decline, considered as loss of at least one point on the ADL scale, one and three months after discharge from hospital.

It is validated to use in a population aged 70 years or over, admitted to the emergency departments. Exclusion criteria include terminal illness, admission to the intensive care unit, admission for stroke, length of stay less than 48h and total dependence for ADL[27].

SHERPA was studied on a sample of 625 patients, aged 70 years old or more, hospitalized after admission to the emergency department at two academic hospitals in Belgium(Pascale Cornette et al. 2006). Posteriori was also studied on a sample of 98 patients, aged 75 years-old or more, at a tertiary care hospital in Belgium[19].

SHERPA consist of five items: age, impairment in premorbid IADLs, falls in the year before hospitalization, cognitive impairment (Abbreviated Mini Mental State below 15/21) and poor self-rated health (table 5).

According to the score obtained, patients are classified as low risk (<3 points), mild risk (3-4 points), moderate risk (5-6 points), high risk (>6 points).

SHERPA was found to have a sensitivity of 67.9, a specificity of 70.8, and discriminative value of 0.73.[7,27] Posterior studies found a sensitivity value of 0.93[3] and 0.98[19] (table 6).

(5) Triage Risk Screening Tool (TRST) by Hustey et al. 2007

TRST initially was developed for emergency department practice and is suited for fast screening[23]. It predicts the risk of re-admission or nursing home placement in elders aged 65 years and older.

Functional decline was described as loss of independence on at least one ADL or IADL from baseline to 30 and 120 days after admission.

Exclusion criteria included inability to speak English, residence outside the geographic service area, no telephone access, difficulty hearing, severe cognitive impairment and no primary caregiver as proxy respondent.

TRST was studied in 650 patients admitted to emergency departments from two academic hospitals in the USA[7]. Posteriors studies were done in a sample of 345 patients at the Geneva University Hospital in Switzerland and in a sample of 213 patients hospitalized following admission to a emergency department in a academic hospital in Belgium[19].

TRST consists of six items that evaluate cognitive status, difficulty walking / transferring or recent falls, polymedication, hospitalization and emergency department history in the last 90 days, living alone and/or no available caregiver and registered nurse concern, such as excessive alcohol consumption (table 5).

Clinical utility, content validity, criterion validity and predictive validity were studied. Reliability data is not reported.[17,23]

TRST with a cut off of 2 was found to have a sensitivity of 40-63, a specificity of 57-63, and a discriminative value of 0.64-0.66 [7,19] (table 6).

(6) Brief Risk Identification for Geriatric Health Tool (BRIGHT) by Boyd et al. 2008

BRIGHT identifies elders, aged 75years and over, at risk of functional decline after admission to an emergency department.

The tool was based on a study with a sample of 139 patients admitted to emergency departments in New Zealand and no further studies were identified.

BRIGHT includes 11 items regarding ADL (bathing, dressing lower body, transferring, personal grooming) and IADL (need help with housework), cognitive status, times tripped or fallen, self-rated health, depression, shortness of breath with light activity and difficulty in decision making (table 5).

In predicting ADL deficit, BRIGHT was found to have a sensitivity of 69.0, a specificity of 70.0 and discriminative value of 0.66. In predicting IADL deficit BRIGHT was found to have a sensitivity of 76.0, a specificity of 79.0, and discriminative value of 0.83[19] (table 6). The disparity of BRIGHT in predicting IADLS and ADL decline was not discussed.

Criterion validity and internal reliability were studied.[23] Reability was reported as good but no supporting statistics were presented[17].

BRIGHT was designed to be used with interRAI in order to determine the necessary measures for discharge. InterRAI Acute Care Instrument is an electronic medical record system instrument that enables standardization of elderly people assessment in acute care. Standardized clinical data systems can contribute to effectiveness, efficiency, administration of health systems as well as enabling easiest data analysis [29].

(7) Simplified PROFUNCTION index by Bernabeu-Wittel et al. 2012

Simplified PROFUNCTION index[19] identifies polypathologic patients aged 60 years and over, at risk of functional decline. Functional decline was defined as loss of twenty or more points on Barthel index, over 12 months.

The screening tool was based on a study with a sample of 958 polypathological patients admitted to 36 Spanish hospitals and no further studies were identify.

Simplified PROFUNCTION index includes seven domains regarding age, functional class of dyspneia, Barthel index, osteoarticular disease, neurological condition, polypathology and risk of or pre-established social problem (table 5).

Simplified PROFUNCTION was found to have a discriminative value of 0.51-0.64 (table 6).

Regarding reliability, screening tool has shown a good calibration in derivation cohort in the Hosmer-Lameshow goodness-of-fit test.[17]

(8) Mehta et al. 2011 clinical index

The Mehta et al. clinical index[21] is an instrument that allows risk stratification for new-onset disability in hospitalized elders aged 70 years or over. New-onset disability was defined as need for personal assistance on at least one ADL.

Exclusion criteria includes admission to an intensive care unit or oncology ward, elective admission and expected length of stay inferior to 48h, and also dependence in at least one ADL two weeks prior to hospitalization.

The screening tool was developed in the USA, in a cohort with a sample of 885 patients hospitalized in a community teaching hospital followed by a validation cohort in a university teaching hospital in a sample of 753 patients.

The instrument consist of seven items regarding age, ADL and IADL dependence at admission, impaired mobility at admission, acute stroke or metastatic cancer, severe cognitive impairment and albumin levels. The scores range from 0 to14 and risk of new-onset disability goes from 8% with scores of 0, up to 83% with scores of 7 and over (table 5).

Mehta Clinical Index was found to have an AUC of 0.784 (table 6). Sensibility and specificity were not described. Authors referred a good calibration and suggested good clinical utility, but no support data was shown.

(9) Short Physical Performance Battery (SPPB) by Corsonello et al. 2012

SPPB[30] is a screening instrument to identify elders aged 70 years or more, at risk of functional decline or death, one year after discharge from acute care hospital. Functional decline was defined as loss of independence in at least one ADL. Need for assistive devices or aids without need of personal assistance, was considered independent.

Exclusion criteria included inability to obtain informed consent.

SPPB was studied on a sample of 506 patients from an Italian community and university hospitals. No further studies were found.

The tool consist of 3 items regarding gait speed (time needed to walk 6m), muscle strength (5 chair-stands test) and balance. Each item is scored on a scale of 0-4 points, with final score range of 0-12 points, with being 12 a reflex of a better lower body function (table 5).

SPPB was found to have a sensitivity of 60.0, a specificity of 69.0, positive predictive value of 16.0, a negative predictive value of 94.0 and a discriminative value of 0.69[30] (table 6).

(10) Identification of Seniors At Risk-Hospitalized Patients (ISAR-HP) by Hoogerduijn et al. 2012

ISAR-HP[16] was developed to identify elders aged 65 or over, at risk of functional decline following hospital admission.

Exclusion criteria includes patients too ill to participate, transferred to another ward, transfer to ICU within 48h after admission, unable to communicate in English, death in the 3 months after admission, no functional decline during the study and maximum Katz index score on admission.

The predictive tool was created based on a development cohort with a sample of 492 patients and a validation cohort with a sample of 484 patients acutely admitted to the internal medicine department of two university and one regional teaching hospital in the Netherlands[16].

The screening instrument consist of four questions which can be answered either by the patient or by an informant, regarding pre-admission IADL, use of walking devices, need for assistance in travelling and education after age of fourteen (table 5). The patient is consider at risk if scores exceeds 2 out of 5 points.

ISAR-HP with a cut off of 2 was found to have a sensitivity of 89.0, a specificity of 41.0, positive predictive value of 41.0, a negative predictive value of 89.0 and a discriminative value of 0.68 (table 6).

ISAR-HP is being used to select patient for the Prevention and Reactivation Care Program[31], discussed in this review in the multidisciplinary programs section.

(11) Barnes et al. 2013 screening tool

Barnes et al. instrument[21] estimates the probably of recovery, dependence or death in elders aged 70 or more, one year after discharge from the hospital for acute illness.

Exclusion criteria includes elective admission, intensive care or subspecialty units, length of stay less than 48h.

The tool was studied on sample of 449 patients hospitalized for acute illness and discharged with new-onset ADL dependence from both specialized Acute Care for Elders as well as usual hospital care.

Prognostic index consists of 8 items regarding age and gender, ADL at baseline and at discharge, reason of admission, polypathology and creatinine values (table 5).

The instrument presented a discriminative value of 0.81, 072 and 0.78, in predicting recovery, dependency and death, respectively[21] (table 6).

(12) Frailty scales

Relationship between functional decline and frailty have been proposed[17,24] and taking into consideration the fact that in community populations, frailty is related to a

higher risk of functional decline, it is logical to consider frailty scales as potential screening instruments for functional decline.

A study done by Wou et al. [24] in the UK regarding the predictive value of frailty-rating scales in the acute medical unit in patients aged 65 or older showed that from the five different frailty-rating scales (CHS model by Fried; SOF model proposed by Ensrud; Rothman model; Ávila-Funes model; Frailty index) included in the study, only four predicted functional decline at 3 months, and very poorly, with AUC 0.55 to 0.59. Authors concluded that even if frail old people are at an increased risk of adverse outcome, frailty-rating scales present poor predictive properties when it comes to identifying those at risk of functional decline, being of limited use in risk stratifying older people discharged from acute medical units.

Frailty scales were also found to be inferior to gait speed alterations at predicting short-term mortality[32]. One possible explanation is that gait speed continuous assessments increases statistic robustness and that gait speed already "resembles a composite summary of physiological impairments", more sensitive to change.

ii) Methodological considerations

There are some important methodological considerations that are worth mentioning regarding the studies sample, data collection method and follow-up time of the studies regarding screening tools development and further validation.

Sample

The number of participant excluded due to death was significant, reaching more than 20% and sometimes representing more than double of the patients excluded by difficulties in contacting for follow-up [3]. Exclusion of such patients together with the exclusion of patients who lacked mental capacity to give informed consent, had no family consultee available or enrolled in long-term care/rehabilitation units, may have resulted in the exclusion of patients with worse out-comes and with higher risk of functional decline. Exclusion of patients that had hospitalization length of stay too short for being included in the studies is expected to have the opposite effect.

Overall, it is not know if exclusion criteria created a biased view of the effect of the measured variables.

Data collection

Tools were found to be scored based on verbal answers from the patient in all the studies identified by Bissett et al. [23] despite the possibility of scores based on direct patient observation, which would provide real-time information. Even if self-reported and performance-based measurements were shown to have high concordance [33], it is not clear if informants are as reliable. In fact, ISAR was designed to be a self-report questionnaire, but was only completed independently by 145 patients out of 1673[7]. Time saving for health care providers and effortless gathering of data certainly exceeds the negative effects of the possible impediment of the data obtained, but this possibility should be recognized.

Another aspect worth mentioning is the moment when data collection is done.

Patient ability to answer or to perform functionality tests may be affected in the emergency department and for that reason, assessment in a busy emergency department with a sick, distressed patient can affect the precision of the measurements.

Screening in less stress environments such a doctor's room would be a better approach but it depends on the regular community health contacts and awareness of health care providers. A balance should be found between assessing in a less ideal environment, such as an emergency department, and coming to a wrong conclusion or not assessing at all the risk of functional decline [19].

Follow-up time

Follow-up time varied from one year to no follow-up after discharge.

It is not clear if patients experienced further changes after the follow-up time, meaning it is not clear if results can be extended to predict disability in the long term [34]. Mobility disability has been shown to be a dynamic process[33], with a great variability of dependence-independence pardons, if this is also true for other aspects of functional

decline is possible that follow-up time was not enough to reflect long term functional fluctuations.

iii) Scientific qualities and comparison of screening tools

Choice of the best screening tool should be based on internal validity, predictive validity, reliability and clinical utility, the scientific qualities of the instrument described by Streiner & Norman 2003[10]. Bisset et al.[23] goes further and gives reference to a more detailed description of the domains that should be used in the evaluation of functional assessments: predictive validity, construct validity, content validity, criterion validity, internal reliability, inter-rater reliability, intra-rater or test-retest reliability, clinical utility, interpretability and responsiveness.

Predictive validity

Predictive validity is "the extent to which the test is able to predict important future clinical results"[23]. Predictive validity is the most well characterize item of the screening tools, with most of the tools presenting predictive validity data regarding specificity, sensitivity, negative and positive predictive values and discriminative value expressed in AUC (table 6).

Construct validity

Construct validity is "the extent to which scores on a particular questionnaire relate to other measures in a manner that is consistent with theoretically derived hypotheses concerning the concepts that are being measured"[23]. There is no information regarding this item on any of the tools.

Content validity

Content validity is "the extent to which the domain of interest is comprehensively sampled by the items in the questionnaire" [23]. In general, content

validity is well described since the predictors used (table 5) are known from the research literature as predictors of functional decline, but new evidence suggests that the use of functionality trajectory or functionality measurements in two moments, has higher statistic robustness at predicting functional decline, when compared to a functionality measurement at one unique specific time, such as pre-illness or at-discharge functionality. From all the screening tools, only ISAR incorporated "acute decline in function" and Barnes et al. incorporated the measurement of functional status in two different specific moments: at admission and at discharge.

Evidence supporting the use of functional trajectory over one unique functional value includes several observations. First, Sleiman et al. [35] observes that acutely ill elderly who suffers a severe loss of function but later regains function to the baseline level, has a mortality rate at 3 months less than half compared with an elderly who does not achieve functional regain during hospitalization, even if both groups initially suffer from an equivalent functional decline. Second, Sherrintong et al.[34] found that association between functional decline and mortality is stronger when functional trajectories are used as prognostic tools instead of a single measure of functionality at a specific time. In addition, Sherrington et al. [34] developed a tool to predict inability to walk 800m and climb a flight of stairs in elders, 3 months after aged care rehabilitation. The final tool included both pre-admission and at discharge values and was found to have an AUC of 0.77, but the AUC value decreased to 0.64 when only pre-admission values were considered. Finally, Grimmer et al.[17] observed that elders who experience functional decline one month after an emergency department discharge generally continued to decline over the next two months.

Criterion validity

Criterion validity is "the extent to which scores on a particular questionnaire relate to a gold standard"[23]. Although there is some conceptual uniformity in measuring functionality in ADL and/or IADL, there is no gold-standard for functional decline. Functional decline needed to be consider significant was found to vary from 2.4% up to 20% depending on the study[18].

Internal reliability

Internal reliability is "the extent to which items in a (sub)scale are intercorrelated, thus measuring the same construct" [23]. There is no information regarding this item on any of the tools.

Inter-rater reliability

Inter-rater reliability is "extent to which similar results can be obtained in stable people examined by two different observers" [23]. This item is described only for TRST.

Intra-rater / test-retest reliability

Intra-rater or test-retest reliability is "extent to which similar results can be obtained through repeat measures in stable people"[23]. Lack of information regarding internal reliability was found for all the tools except for ISAR.

Clinical utility

Clinical utility is "extent to which a description is provided of the time, effort, requirements and demands of test administration for the interviewee and interviewer" [23]. Clinical utility was not specifically assessed quantitatively for any of the tools. Clinical utility was characterized subjectively with affirmations such as "quickly and efficiently administered by nurse"[19], regarding BRIGHT or "good, all data generally routinely collected on or near admission"[7], regarding SHERPA. It would be of interests to know how much time and effort is required by each instrument, as to know the level of formation, knowledge and training needed to administer the tools.

Interpretability

Interpretability is "the degree to which one can assign qualitative meaning to quantitative scores"[23]. There is no information regarding this item on any of the tools.

Responsiveness

Responsiveness is "the ability of a questionnaire to detect clinically meaningful changes over time" [23]. There is no information regarding this item on any of the tools.

iv) Comparison of screening tools

From all the tools, HARP, TRST, simplified PROFUNCTION index, SPPB and ISAR-HP shown AUC values <0.70, not reaching acceptable discrimination. SPPB AUC value is 0.69, being near the limit of acceptable discrimination.

Four tools were found to have AUC values between 0.70 and 0.80, reflecting an acceptable discrimination: ISAR, COMPRI, SHERPA and Mehta et al. tool.

BRIGHT predicting IADL decline and Barnes et al. tool were found to have excellent discrimination, reaching AUC values over 0.80.

Table 4: Discriminative values and discrimination power of screening tools

Maximum AUC described		Screening Tools
<0.70	No acceptable discrimination	HARP, TRST, simplified PROFUNCTION index, SPPB, ISAR-HP, BRIGHT predicting ADL decline
0.70 - 0.79	Acceptable discrimination	ISAR, COMPRI, SHERPA, Mehta et al. clinical índex
0.80 – 0.89	Excellent discrimination	BRIGHT predicting IADL decline, Barnes et al. tool
≥0.9	Outstanding discrimination	-

Table adapted from *Screening tools to identify hospitalized elderly patients at risk of functional decline: A systematic review*[7].

Table 5: Items included in the screening tools.

Items \ Tools	HARP	ISAR	COMPRI	SHERPA	TRST	BRIGHT	PROFUNCTION	Mehta et al.	SPPB	ISAR-HP	Barnes et al.
Age	X			X			X	X			X
Basic ADL		X			X	X		X			X
Barthel index							X				
IADLs	X			X		X		X		X	
Polypharmacy		X	X		X						
Reason of admission											X
Polypathology							X				X
Creatinine levels											X
Albumin levels								X			
Muscle strength									X		
Mobility			X					X	X		
Need of walking devices										X	
Need for assistance travelling										X	
Balance									X		
Cognitive status	X	X		X	X	X		X			
Self-rated health			X	X		X					
Difficulty decision making						X					
Social activity level							X				
Feeling of depression						X					
History of hospitalization or doctor visit		X	X		X						
Impaired vision		X									
Recent fall				X	X	X					
Lives alone					X						
Health-care givers expectations			X		X						
Acute decline in function		X									
Shortness of breath						X	X				
Osteoarticular disease							X				
Neurological condition							X				
Acute stroke								X			
Metastatic cancer								X			
Education after 14years										X	

Table 6: Screening tools predictive characteristics

Screening Tool	AUC*	Sensitivity	Specificity	PPV*	NPV*
HARP	0.56-0.68				
Low risk	0.65	60.5	68.4	39.0	83.9
Intermediate risk	0.60	39.5	80.7	40.5	80.0
High risk	0.56	21.1	88.6	38.1	77.1
ISAR	0.62-0.75				
Cut-off 2	0.67- 0.75	72.0 – 92.9	39.3-58.0	36.4	93.6
Cut-off 3		44.0	80.0		
Cut-off 4		23.0	92.0		
COMPRI					
Cut-off 6	0.69-0.73	70.2	62.0	41.8	84.3
SHERPA	0.73	67.9	70.8		
Cut-off 3.5	0.73	98			
TRST	0.64-0.66				
Cut-off 2		40-63	57-63		
BRIGHT					
Cut-off 3 or 4					
Predicting:					
IADL deficit	0.83	76.0	79.0		
ADL deficit	0.66	69.0	70.0		
Simplified PROFUNCTION	0.51-0.64				
Clinical Index	0.784				
SPPB	0.69	60.0	69.0	16.0	94.0
ISAR-HP					
Cut-off 2	0.68	89.0	41.0	41.0	89.0
Barnes et al.					
Predicting:					
Recovery	0.81				
Dependence	0.72				
Death	0.78				

*AUC: Area Under the Curve; *PPV: Positive Predictive Value; *NPV: Negative Predictive Value.

Concerning the screening tools which were presented with excellent discrimination, BRIGHT at predicting IADLs decline and Barnes et al. tool, both lack validation studies, therefore meaning that no single tool proved to have sufficiently statistic robustness to be recommended over the others.

Despite this fact, there are some specific observations worth noting.

Firstly, ISAR seems to be the most user-friendly instrument, and is suited for fast screening [23], it is easy to administrate, can be completed either by the patient or informants[7] and the administrators do not need any specialized training. It seems to be the most useful tool in elderly patients admitted in an emergency department. In fact, in a study by Hoogerduijn et al. [3], comparing ISAR, COMPRI and HARP, the authors concluded that ISAR showed the best predictive value in identifying elders at risk of functional decline and it is the easiest instrument to be used in the hospital-setting. Also, in a systematic review, Bisset et al.[23] concluded that functional assessment in ED is recommended with moderate reservations, being the best tools for functional assessment according to the authors ISAR and TRST. The choice was based on the extensive psychometric testing they have been submitting and their promising clinical utility.

Secondly, SHERPA was found to be the most useful tool for identifying patients at low risk of functional decline with the highest sensitivity value (up to 0.98). For the patients who test negative for SHERPA only 6% presented functional decline three months after discharge[20].

c) Prevention of functional decline in hospitalized elderly

i) Improve pre-admission functional status

Although this review article focus specifically on measures aimed at preventing functional decline in the hospital-setting, it should be noted that worst pre-admission functional status is associated with functional decline during and following hospitalization. Therefore prevention of hospital-related functional decline can be begun prior to the hospitalization by avoiding proximity of the disability threshold [4,11,13,36–38].

Approaches aimed at increasing functionality in the dwelling-community elders are supposed to result in decreased risk of hospital-related disability.

Signs reflecting disability threshold proximity may be used to identify elders who would benefit from intervention. Impaired mobility and dependence in IADL 2 weeks prior to hospitalization was suggested to be a sign of proximity to the disability threshold before hospitalization [13]. Also, incident preclinical mobility disability was related to decreased walking abilities, being almost five times more likely to incur new walking difficulties in the following three years.

Programs should focus on the prevention of disability as well as the functional restoration and maintenance in older persons who become disabled. [33]

Functionality based activity program and goal-setting functional activity programs, based in incorporating more everyday life activities in the daily routine and aimed at improve self-efficacy have shown high adherence[39]. Interventions promoting mobility may also be useful in preventing loss of functional reserve and resilience [4,11,13,36–38].

ii) **Medication**

Increasing evidence suggest that sedative and anticholinergic drugs have a negative impact on physical function and ADL performance, being associated with functional decline in medically stable elders living at home[40]. Sedative drugs have been found to be related with higher risk of falls, fractures and car accidents in the general population, but particularly with elders. Anticolinergic drugs were reported to be associated with reduced handgrip strength, gait speed and ADL performance by Landi et al. Benzodiazepines were associated with reduced functional status in a community-based population[40].

The impact of such drugs in the hospital setting was studied by Lowry et al.[40] in a sample of 362 patients aged 60 or over admitted to 2 acute geriatric medicine units in the UK. In the study Drug Burden Index (DBI) was used as a scoring system for exposure to anthicolinergic and/or sedative drugs. Higher DBI scores were associated with lower scores in bathing, grooming, dressing, urinary continence, transfers, mobility

and stairs climbing. These findings are consistent with the results of a study done by Gnjidic et al. which showed an association between higher DBI and reduced gait speed, balance, grip strength and ADL performance in community-based older males.

A pilot controlled trial[41] in self-care retirement villages in Australia found a reduction of DBI scored by 32% when general practitioners where informed of patients DBI scores contrasting with a reduction of 19% on the control group. The intervention was shown to be less effective than expected. Further research is needed in strategies targeting to reduce DBI scores and to prove the beneficial effects that it can have on hospitalized elders.

Taking this into consideration, nonpharmacologic sleep protocols, daily review of medication, with special attention to sedative and anthicolinergic drugs are active measures aimed at reducing hospital-related functional decline[4]. It is also adviced judicious use of antibiotics[11].

Clinical pharmacist may round with primary teams to increase prescribing appropriateness and reduce polymedication [4].

iii) Hospital devices and procedures

Hospital devices, such intravenous lines and urinary catheters, are associated with an iatrogenic effect and were believed to be a barrier to mobility in hospital setting by 89% of health care providers and by 30% of patients[42].

Measures aimed at reducing hospital-related functional decline include avoid urinary catheters in the first instance[4], proper catheter care [11], daily review of the need for intravenous connections, oxygen, urinary catheters and earlier implementation of voiding trials[4].

iv) **Physical restrain**

Physical restrain is often used to ensure the safety of patients and staff, prevent falls, facilitate treatment, secure medical devices and compensate for understaffing [43].

In 2008, a restrained reduction program was implemented in a Hong Kong hospital. A study[43] was done to compare 958 patients hospitalized before the implementation of the program with 988 patients enrolled in the program. Patients in both groups had a mean age of 79 years. The program resulted in a significant reduction in mean length of stay in the cognitively impaired patients, without significant change in fall incident. Although this study did not refer to an improvement in functionality, it is possible that patients regained their pre-morbid function more quickly, explaining the shorter length of stay. Core elements in the physical restrain reduction program were resources such as electrical high-low beds, pressure sensors, shortened bed rails which facilitate transfers, and the additional associated element of training and continuous support provided to nurses by senior-nurses.

Considering that, measures aimed at reducing hospital-related functional decline include limiting restrain orders, frequent review of restrain orders and implementation of a restrain reduction program [4,43] are necessary. More measures found in the literature comprise use of intermittent catheterization in order to reduce hand restrain and, when truly needed, use of hand mittens, since they are regarded as less restrictive to patients[43].

v) Activity and mobility

Brown at al.[36] executed a study on mobility on 45 men aged 65 and over, hospitalized in a Veterans Affair Hospital in the USA. All the patients were able to ambulate prior to hospitalization. Wireless accelerometers were used to collect information on the proportion of time spent in three levels of mobility: lying, sitting and standing or walking during the first 7 days of hospitalization. Results are actual measures and not based on care health observations or self-report, therefore providing more-accurate information [36,37]. 33% of patients were found to spend more than 90% of their hospital stay in bed. Overall, patients spent 83% of their time lying, with an average of 3.1hours a day sitting and 43 to 55 minutes standing or walking. Ambulation in the hallways was done by only 27% of older patients.

Low mobility and activity in hospital-setting are partly explained by restrictions imposed by the hospital environment which limit patient's range of activities. In matter

of fact, bed rest is seen as easier than ambulation, and as a measure to prevent falls and the risk of "pulling out" the medical devices [9,42].

It has been shown that 10 days of bed rest for healthy old adults results in the lost of 12 to 14% of maximal aerobic capacity and extremity muscle strength[6]. Deconditioning during hospitalization makes patients more vulnerable to weakness, immobility, pressure sores, infection[1,2] and need of physical rehabilitation as an attempt to regain functionality[9,11]. Additionally, low mobility is associated with functional decline and other adverse outcomes[36], such constipation or impactation, orthostatics hypotension, exercise intolerance, impaired ambulation[44], pulmonary atelectasis, bone demineralization, vasomotor instability and skin tissue ischemia[9].

Interventions promoting enhanced mobility may be useful in preventing functional decline [4,9,11,13,36,37]. The interventions advised in the literature are towards enabling and encouraging safe mobility and ADL independence.

Fear of falling is a barrier to mobility in the hospital setting, with 75% of patients expressing concern about falling and this concern being shared by the health care providers[42]. Rather than encourage bed rest as a protective measure against falls, safe mobility methods should be researched. Enabling safe mobility includes patient evaluation regarding subjacent problem, need of physical rehabilitation, psychological support, need of assistance with ambulation, transferring or toileting aids[4] and information in how to properly use the mobility aids.

Even if it still remains unknown which elders patients are more likely to benefit from targeted interventions aimed at ambulation [14], gait speed above 1.0m/s was found to reflect the capacity to perform ADL, while gait speed inferior 0.4m/s is a important marker of decline in functional independence and slower recovery of physical health[14]. Evaluating gait speed daily in the hospital setting can be important in functional decline prevention, although is still not clear whether there is a clinically meaningful cut-off point for gait speed needed to protect elderly from functional decline while hospitalized. More work is needed in order to find the optimal cut-off points and to define clinically meaningfully change in gait speed, such as the examination of the trajectories of gait speed during and after hospitalization and their relation with functionality.

Mobility encouragement can be done with programs such as Walking for Wellness[44] which is a walking program for hospitalized elders aimed at increased mobility in the hospital setting.

The program consists of trained escorts assisting older patients with walking in the hallways 2 to 3 times a day, walking trails marked inside the hospital and outdoor trails near the hospital and a community walking program at a local shopping mall. Escorts use a gait belt with all the patients to increase safety and obtained permission of the nurse to ambulate the patient. Any signs of distress while walking were reported to the nurse and could be discussed with the unit physical therapist, resulting also in the detection of patients needing skilled physical therapy, who otherwise might not be identified. Patients not deemed appropriated to be enrolled in the program at admission but whose status improved were reconsidered by the nurse staff or physicians.

Key aspects of the program are increasing awareness of the patient and family about the importance of mobility during the hospitalization, the assessment of walking aids needed and establish walking goals with the patient. All of the patients integrated into the program were satisfied. Further studies regarding effectiveness of the problem in mobility maintenance and improvement were not found. The authors refer budget constraints and inadequate support for continued growth and visibility[44].

Further measures aimed at encouraging mobility and reducing functional decline in the hospitalized elder, are standing orders for the patients able to be out of bed[4], earlier ambulation[11], and earlier identification of changes in mobility function[38]. A simple question such as “Have you changed the way you walk ½ mile, or how often do you do this, due to a health or physical condition?” can identify preclinical mobility disability which should be earlier determine and addressed[38].

Encouragement of ADL independence is supported by emphasizing the importance of mobility and independence in ADL to the patient, and through providing supervision and support when needed, rather than assisting the patient in ADL regardless of patient's ability to perform tasks independently [4,9].

vi) Earlier physical rehabilitation programs

According to Kosse et al.[6], 14% to 48% of the hospitalized patients met the inclusions criteria to be enrolled in early physical rehabilitation programs, with only 3 to 19% of patients declining the participation. Adherence rates were from 60 to 90% and the main reasons for dropping out of the program were early discharge, transferring to another service such intensive or palliative care, being medically instable and death.

Early physical rehabilitation programs were not associated with higher number of incidents such as falls or other injuries and showed a better ADL and physical performance at discharge than patients in the usual care groups, even if the results were not significant in all the 11 studies[6]. Although associated to benefits in functional status, multidimensional exercise programs fail to reduce fear of falling[45].

Even if there is little evidence to guide admission of hospitalized elders in physical rehabilitation or if physical rehabilitation is cost-effective, in-hospital physical rehabilitation programs have shown positive effects at discharge. The beneficial effects are not significant over time, suggesting that patients would also benefit from an intervention following discharge, such as physical or occupational therapy[6].

Interventions focusing only in strength gain did not reported consistent results, beneficial effect of physical activity is likely to involve other pathways[37].

vii) Hydratation and nutrition

Adequate hydratation and nutrition are indispensible aspects in functional decline prevention.

Oral hydratation should be encouraged and patient must have easy access to water[4,11].

Hand feeding must be maintained as much as possible [43] and no food by mouth orders should be daily reviewed[4]. Interventions aimed to improve nutrition may be useful in preventing loss of functional reserve and resilience[13]. When possible it is advice to provide a diet accordingly to the patient's preferences and to allow easy access to snacks [4].

viii) Discharge planning

Longer hospital stay (>11days) was associated with a functional decline 2 to 3 times superior as compared to shorter hospital stay[1]. Higher functional decline can be explained by the probable more complex acute medical situation, which might also be responsible for the extended length of stay. However 95% of long-stay patients will experience a medical problem not related to acute health problem that led to admission[11]. This fact suggests that delay in discharge of elder hospitalized patients might result in further functional decline, not related with the primary health problems and higher odds of negative outcomes.

Focusing on reduced length of stay might have unforeseen consequences such as shifting the costs from hospitalization to post discharge care [46] when attention should be given to the reasons behind delayed discharge in order to provide solutions and achieve a earlier, but effective discharge.

Two common factors found to be responsible for delay in discharge of elderly patients in an Acute Care Hospital were decontitioning, which has already been discussed, and social issues[11]. Social issues can be lack of identified caregiver or waiting for a domestic helper, caregiver training or nursing home placement[11].

It is important to focus on discharge planning, with earlier discussions with patient, family, caregivers and social worker. And in taking particular attention to the changes in care needs[4], in order to organize care services and provide continuation of care in the community. Effective discharge has been shown to decrease the likelihood of admission in long-term care facilities[11] and can be more efficient if done by a multidisciplinary team[4].

Discharge should not be motivated by bed utilization but rather patient-centered[4].

ix) Attitudinal factors and awareness

Attitudinal factors include the expectations, motivation and concerns of both patients and health care providers.

Even if literature shows that more attention is being given to the hospital-related disability problematic, both patients and health care providers still undermine the importance of hospital-related functional decline. Some patients have the misconception that all patients lose their independence when they come to the hospital[3] and some health care providers show a tacit acceptance of functional decline[9]. In fact, while patients lack of motivation to ambulate was mentioned by more than 50% of the health care providers, none of the interviewed patients referred to lack of motivation, but rather to believe that ambulation was not consider important by the staff[42].

In order to reduce hospital-related disability, health care staff should be aware of the risk the elderly patients have for hospital-related disability and should cultivate patient and patient family/caregivers awareness in order to encourage the patient to do as much activity as possible[4,6,44].

Fear, lack of motivation, depression and poor understanding of long-term benefits of physical activity may be some of the barriers in the older patient's enrollment in activity programs. Involvement of health care providers, trained volunteers[44,47], family and friends were found to be important in increased hospital mobility[44]. Strategies to bring awareness to the problem of functional decline by means such as such brochures or short videos[44] appear to be relatively easy to implement and without incurring significative costs.

x) Institutional factors

Institutional factors include both the hospital environment and the health care services.

Risk factors for disability have been studied extensively but the relation between acquired disability and hospital environment has not been studied with such detail[13].

Measures reported in the literature to reduce hospital-related functional decline, including elder-friendly hospital environment, with such amenities as geographically defined units which encourages mobility and social function, carpeted floors instead of shiny floors that increase likelihood of falling[4], available chairs in the rooms[42], and large calendars and clocks in order to minimize disorientation[4]. Walking trails in the hospital floor have also been suggested to encourage mobility[44].

With regard to health care providers, it has been shown that lack of specialized knowledge of geriatric care negatively affects quality of care[48]. Programs such as Nurses Improving Care for HealthSystem Elders (NICHE)[49], which is currently being developed in the USA, aims to providing clinical, organizational and educational resources that have shown beneficial effects and obtained increased funding for the improvement of services, web-based tools and benchmarking. Crucial elements of NICHE are creation of specialized care, autonomy of direct care nurse, geriatric-specific resources (material and human), organizational tools for the modification of the nurse practice environment and making it more geriatric-responsive, institutional protocols and practices supporting interdisciplinary teamwork.

Multidisciplinary programs that include specialized care as key elements will be discussed next.

xi) Multidisciplinary Programs

Three multidisciplinary programs aimed to reduce functional decline in the hospitalized elders, were found in the literature: Comprehensive geriatric assessment (CGA)[12,46,50] Hospital Elder Life Program (HELP)[47] and Prevention and Reactivation Care Program (PReCaP)[5,31].

(1) Comprehensive geriatric assessment

Comprehensive geriatric assessment (CGA) is defined as a "multidimensional interdisciplinary diagnostic process focused on determining a frail older person's medical, psychological and functional capability in order to develop a coordinated and

integrated plan for treatment and long term follow up"[12] and is aimed at maintenance and/or improvement of hospitalized elders functional status.

The multidisciplinary team is composed of several key elements specified in table 7.

Table 7: Main differences between CGA Wards and General Medical Wards

	CGA wards	General Medical Wards
Daily Medical Rounds	Yes	Yes
Staff on ward:		
Internist	Yes	Yes
Geriatrician	Yes	No
Nurses and nurses aids	Yes	Yes
Physiotherapist	Yes	Not routinely available
Occupational therapist	Yes	Not routinely available
Social worker	No	Part-time
Dietician	Yes	Not routinely available
Assessment by physiotherapist /occupational therapist	Majority of patients	Occasionally
Early start of rehabilitation	Yes	Occasionally
Interdisciplinary team work	Yes	No

Table adapted from *Geriatric-based Versus General Wards for Older Acute Medical Patients: A randomized comparison of outcomes and use of resources*[51].

Table 8: Discharge planning differences between CGA Wards and General Medical

CGA wards	General Medical Wards
Very earlier after admission	Shortly before discharge
Nurses directly responsible after special training or by multidisciplinary team	Mostly nurses, occasionally social workers
Intense planning with repeated interactions with family, contact with social services	Moderate planning

CGA trials regarding hospitalized older adults have been identified in six countries: USA, Sweden, Canada, Germany, Netherlands and Australia[12].

There are two different models of CGA. The first model consists of a ward with a coordinated specialist multidisciplinary team. This type of ward can be designated as Acute Care for Elders (ACE)[12,46], Acute Geriatric-Based Wards[51], Geriatric Evaluation and Management Units (GEMU)[12] or rehabilitation wards[12,34]. The second model consists of a mobile team that visits selected patients[12].

Ellis et al. conducted a meta-analysis[12] regarding randomized controlled trials comparing CGA with usual care. Although no significant difference was found between CGA and usual care in terms of physical functioning on time of discharge[6], death, dependence, or readmission to hospital; wards applying CGA, though both admitting patients based on age and needs related basis, were found to significantly enhance the odds of a patient being alive and living at home after discharge. This included a number needed to treat of 20 to avoid one death or unnecessary admission to residential care. Mobile teams fail to show significant benefit when compared to usual care.

Authors suggest that the disparity of results between wards and mobile teams can be explained by several factors. Firstly, wards applying CGA may have a modified environment which is more elder-friendly. Secondly, wards may allow staff to experience greater skills development coupled with an efficient and effective team work while mobile teams often find it challenging to correct or adjust the behavior of the health care professionals responsible for patient care[12].

Costs were reported in various ways and did not permit cost meta-analysis. Regardless of this fact, it seems that when nursing home costs are taken into consideration, comprehensive CGA was associated with a cost reduction when compared to usual care [12].

A more recent study[46] was done on Acute Care for Elders Units, a CGA program developed in the 1990s, in the USA. The study found a significantly shorter length of stay (6.7days versus 7.3days) and cost reduction in comparison to usual care, while maintaining functional status. No significative difference on independence at discharge or 3 months readmission rates was observed.

Comprehensive geriatric assessment is also being studied in community-dwelling older persons in the Netherlands. A trial[50] aimed at investigating if this kind of approach can delay functional decline in this population group is being done. A control

group will receive usual care provided by a general practitioner, while an intervention group will receive comprehensive geriatric assessment entailing: personalized care and treatment plan, multifactorial interventions and nurse-led care coordination. 12 months after from the beginning of the trial analysis an analysis will be performed on elder's physical functioning status, process evaluation and the cost-effectiveness of the program.

Information about which elders would most benefit from CGA is still limited. It is reported that some patients who are physically independent or terminally ill are less likely to benefit[52]. Additionally, a tool was developed aimed at predicting inability to walk 800m and climb a flight of stairs in the elderly, 3 months after aged care rehabilitation [34]. This tool was developed based on a study with a sample of 442 patients admitted to inpatient rehabilitation units in Australia. Fifteen predictor variables were initially included, but the final version consists of five predictor variables that were shown to have a minimal AUC difference which was not statistically significant, when compared to the full fifteen-predictor model. Evaluated items include maximal balance range, visual acuity, knee extension strength pre-admission and pre-discharge and co-morbidity on admission. Sherrington et al. instrument demonstrates an AUC of 0.77, but clinical utility is not described.

(2) Hospital Elder Life Program (HELP)

Hospital Elder Life Program (HELP) is a multicomponent intervention developed to maintain physical and cognitive functioning, improve independence at discharge, help with discharge planning and prevent unplanned readmission of hospitalized elders. Although the main purposes of the program included functional maintenance in the hospitalized elder, it is implemented as a delirium prevention program. In fact, this program has been shown to be efficient and cost-effective in reducing delirium incidence in the USA and its implementation in the Netherlands is now being studied[47].

The program targets hospitalized elders aged 70 years and over, with at least one risk factor for delirium (cognitive impairment, visual impairment, hearing impairment, immobility or dehydration). This intervention includes a daily visitor program, a feeding

assistance program, an early mobilization program and a therapeutic activities program [47].Other important elements of the program are elderly care nurse practitioner and trained volunteers. Elderly care nurse practitioners will provide geriatric assessment, educational programs and bedside teaching for nurses and will coordinate with interdisciplinary teams. Trained volunteers will stimulate the hospitalized elder to eat, hydrate, walk and participate in social activities, acting as a additional psychosocial support[47].

Outcome and process evaluations results should be published in a series of future papers.

Table 9: Key interventions of Hospital Elder Life Program

Daily visit program
Feeding assistance program
Earlier mobilization program
Therapeutical activities program

Table 10: Human resources of Hospital Elder Life Program

HELP staff:
Program Director
Elder Life Specialist
Elder Life Nurse Specialist
Geriatrician
Staff nurses
Trained volunteers

(3) Prevention and Reactivation Care Program (PReCaP)

The Prevention and Reactivation Care Program (PReCaP) is a multidisciplinary integrated and goal-oriented program, aimed at reducing hospital related functional

decline among elders. This intervention program was implemented in the Netherlands in early 2010 and is still being developed and undergoing modifications[5,31].

The program has five main elements: early identification of elders at risk of functional decline with ISAR-HP (cut-off »1) and starting the program in the first 48h after hospital admission, intensive follow-up for selected patients at the Prevention and Reactivation Center, multidisciplinary geriatric expertise, relevant professionals available to give support to informal caregivers, and casemanagers with geriatric expertise following the entire process. PReCaP core staff consists of a research nurse, casemanager with geriatric expertise, geriatrician, nurse practitioner and social worker.

Further results regarding cost-effectiveness and other domains of PReCaP in comparison to current geriatric care in the Netherlands, should be available in the future.

Table 11: Key interventions of Prevention and Reactivation Care Program

Biweekly multidisciplinary team meetings
Goal Attainment Scaling
Interdisciplinary consultation (psychiatrist, psychologist, physiotherapist, occupational therapist, dietician, behavioral consultant)
Case management
Support and treatment for informal caregivers
Review of prognosis and discharge destination.

Table 12: Human resources of Prevention and Reactivation Care Program

Research nurse
Casemanager with geriatric expertise
Geriatrician
Nurse practitioner
Social worker
Psychiatrist, psychologist, physiotherapist, occupational therapist, dietician, behavioral consultant available for consultation

4) Discussion and Conclusion

Functional decline in the hospitalized elderly is a complex process resulting from the interactions of multiple factors and is experienced by approximately by 20 to 60% of hospitalized elders. It is difficult to translate this complex and dynamic multi-variable process into an objective measurement and for this reason it seems unlikely that any single tool will show excellent predictive properties.

Eleven screening tools, with very different predictive items, were developed to identify hospitalized elders at risk of functional decline: Hospital Admission Risk Profile (HARP); Identification of Seniors at Risk (ISAR); Care Complexity Prediction Instrument (COMPRI); Score Hospitalier d'Evaluation du Risque de Perte d'Autonomie (SHERPA); Triage Risk Screening Tool (TRST); Brief Risk Identification for Geriatric Health Tool (BRIGHT); Simplified PROFUNCTION index; Mehta et al. clinical index, Short Physical Performance Battery (SPPB); Identification of Seniors At Risk-Hospitalized Patients (ISAR-HP) and Barnes et al. 2012 tool. Frailty scales failed when tested as screening tools.

Data regarding the screening tools scientific qualities is scarse and decision-making based solely on the outcomes of any of the screening tools is not advisable. Using ISAR with a cut-off of 2 as an example, which is the most extensively studied and user-friendly tool, if it was applied in a random sample of elderly patients, it would be expected to miss one out of four patients who will suffer functional decline and incorrectly screen positive for more than one in every three patients[7]. Furthermore, it is still unclear if the presented screening tools are identifying the elders with more potential of functional recovery or maintenance who would most benefit from comprehensive discharge planning, specialized geriatric care or other type of preventive measures. Only a screening tool capable of selective identification of those who are most at risk of functional decline due to potentially modifiable factors would enable the optimal rentabilization of resources.

Since predictive ability of the tools alone might be insufficient to assess with accuracy the individual's likelihood for functional decline, it can be stated that rather than an intervention based only on the result of any one of these screening tools, a clinical judgment together with a battery of indicators might have a higher predictive value when combined[24].

Further research is needed on predictive validity, construct validity, content validity, criterion validity, internal reliability, inter-rater reliability, intra-rater or test-retest reliability, clinical utility, interpretability, responsiveness and generalisability of screening tools to identify hospitalized elders at risk of functional decline.

Measures in the literature to reduce hospital-related functional decline are aimed at several domains: health care staff, patient and family/caregivers awareness on hospital-related functional decline, elder-friendly hospital environment, reduction of bed rest and physical restrain, availability of appropriate aids (transferring aids, mobility aids, hearing and visual aids), supported ADL independence and safe mobility, special attention to medical devices, medication appropriateness and iatrogenic effects, physical and occupational therapist availability; and effective discharge planning. The data supporting the beneficial effects of such measures is not always reduction of hospital-related disability, but rather, a reduction of worse outcomes such death and institutionalization.

Three types of multidisciplinary programs, with goal-oriented interventions in the physical, social, and psychological domains of functional decline, were found in the literature: Comprehensive geriatric assessment, Hospital Elder Life Program and Prevention and Reactivation Care Program. Comprehensive geriatric assessment has already shown to increase the odds of a patient remaining alive and living at home after discharge, while maintaining functional status and potentially decreasing health care cost. Hospital Elder Life Program and Prevention and Reactivation Care Program results will be published in the future. It is expected that multidisciplinary programs will succeed in demonstrating high beneficial results, transforming investment in staff and hospital restructuration, now considered a leap of faith, in a secure investment to reach a better, more elderly-friendly and cost-effective health care.

The studies methodological heterogeneity manifest a strong need to standardize functionality measures and significative functional decline concept which is essential for conducting meta-analysis. For this reason it is possible that concepts such as functionality and functional decline change over the next years. In fact, even the concept of preventing functional decline may undergo alterations. In 2014 Mercante el al. published *Loss of autonomy of hospitalized elderly patients: does hospitalization increase disability?*[53] where a new idea is introduce: instead of simply aiming for the

reduction of hospital-related disability in the hospitalized elder, the authors go further and point out that hospitalization is an opportunity for earlier recognize of disability and loss of functional reserve and intervene. Meaning that the aim should also be to achieve a better functional status compared to pre-illness baseline.

Additionally, in the future the creation of guide-lines with proven beneficial effects which will be use in the hospital-setting is expected. In December 2014, Schoenenberger et al. published a review article, regarding current opinion; *Can geriatric approaches support the care of old patients in emergency departments? A review from a Swiss ED*[54], in which a set of steps regarding emergency geriatric screening is presented. Even if not supported by data proving the benefits of such an approach, it is another step closer to the creation of reliable guide-lines concerning disability in the hospitalized elders.

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