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HANNA KERMINEN

Geriatric Assessment in Clinical Practice

Current Situation and Challenges in Implementation

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ABSTRACT

Background. Comprehensive geriatric assessment (CGA) is a central part of geriatric medicine. However, the concept of CGA is not well established, and the use of the term CGA is incoherent and unclear in both research and clinical practice. There is also a paucity of research considering CGA use in daily clinical practice.

Objectives. *Study I* aimed to collect data on the current situation of the use of CGA in clinical practice in Finland. In *Studies II and III,* the objective was to clarify how data acquired from a widely used geriatric assessment instrument (interRAI) may be utilised to detect hospitalised patients with an increased risk of adverse hospital outcomes. *Study II* aimed to construct a frailty index (FI) and analyse its association with hospital outcomes. In *Study III*, the objective was to identify readmission predictors among patients discharged from geriatric hospitals. *Study IV* aimed to gain insights on the challenges of the geriatric assessment implementation process by describing the preliminary results of a depression screening protocol implemented among respiratory insufficiency patients at a pulmonary outpatient clinic in a tertiary hospital.

Materials and methods. *Study I* involved a web-based questionnaire survey about CGA use among 95 geriatrician members of the Finnish Geriatrics Society. The evaluated domains were the assessment of cognition, assessment of nutrition and functional ability, evaluation of depression, and measurement of orthostatic blood pressure. *Studies II and III* were retrospective cohort studies of patients aged ≥70 years hospitalised in two geriatric hospitals over 3 years. These studies used data from interRAI-Post Acute Care (interRAI-PAC) assessments combined with hospital discharge records. Study II included 2,188 hospitalised patients, and Study III included 1,167 patients discharged to home from the index hospitalisation period. The FI was derived from interRAI-PAC data. The associations of interRAI-PAC scales and FI with hospital outcomes were analysed. Hospital outcomes included in-hospital mortality, prolonged hospital stay, and emergency department admission. Study III investigated the associations of interRAI-PAC variables and scales with 90-day readmission of the patients. *Study IV* was a retrospective evaluation of the outcomes of a depression screening protocol using the records of 238 patients. In the protocol, the patients completed the Depression

Scale (DEPS) questionnaire. Patients whose scores were indicative of depression were offered the opportunity to further undergo an assessment of mood at a psychiatric outpatient clinic.

Results. *Study I:* The majority of geriatricians involved in the study (94%) used CGA, but a minority (38%) administered it to all new patients (response rate 49%). Ten respondents (11%) incorporated all five domains into the assessment, whereas others selected domains according to their clinical judgement. *Study II:* The discriminative ability of the FI for in-hospital mortality (area under the curve [AUC] 0.73) and prolonged hospital stay (AUC 0.75) was good. However, the short hierarchical scale for the activities of daily living (ADLH) was as good as the FI in predicting these outcomes. All tested instruments were poor at predicting emergency department admission. *Study III*: The risk factors associated with readmission in univariate analysis were age, admission from home (vs. acute hospital admission), Alzheimer's disease, unsteady gait, fatigue, unstable condition, ADL impairment, body mass index (BMI), FI, bowel incontinence, hearing difficulties, and poor self-rated health. In multivariate analysis, age, ADL impairment, and BMI persisted as risk factors. *Study IV*: The DEPS was administered to 66% of the patients in the first year of screening, but the coverage increased to 88% in the second year. Of the patients, 34% (n=21) scored ≥9 points, thus exceeding the cut-off for referral. Only 13 patients were referred, as the remainder declined the referral. Finally, seven patients were evaluated at a psychiatric outpatient clinic, and all were deemed to have depression.

Conclusions. Most Finnish geriatricians used CGA, but CGA use was not systematic, and the content of CGA was variable. This type of incomplete evaluation may lead to inadequate detection of geriatric syndromes. It was possible to derive the FI from interRAI-PAC data, and this FI predicted adverse hospital outcomes as expected. However, its predictive ability was not better than that of the short ADLH scale. In clinical practice, assessment of ADL is a simple and valid way to evaluate a patient's prognosis. interRAI-PAC evaluation performed upon admission to geriatric hospitals revealed patient-related risk factors for readmission. Based on the identified risk factors, we recommend that the patient's functional ability, ADL needs, and individual factors underlying ADL impairment as well as nutritional and mobility problems should be carefully addressed and managed during hospitalisation to diminish the risk for readmission. Depression screening improved the detection of depressive symptoms, but its effect on the patients' treatment and clinical courses was small. Rather than referring patients to a psychiatric unit, the evaluation and management of depression should be undertaken at a same unit where a screening is performed.

TIIVISTELMÄ

Tausta. Kokonaisvaltainen geriatrinen arviointi (CGA) on yksi geriatrian kulmakivistä. Tästä huolimatta geriatrisen arvioinnin käsite on heikosti määritelty ja CGA-termiä käytetään sekä kirjallisuudessa että käytännön työssä epäjohdonmukaisesti. On vain vähän tietoa siitä, miten geriatrista arviointia hyödynnetään kliinisessä työssä.

Tavoitteet. *Tutkimuksen I* tavoitteena oli selvittää, miten Suomen geriatrit toteuttavat geriatrista arviointia työssään. *Tutkimusten II* ja *III* tavoitteena oli saada tietoa siitä, miten yleisesti käytössä olevaa CGA-työkalua (RAI) voidaan hyödyntää haittatapahtumien riskissä olevien iäkkäiden sairaalapotilaiden tunnistamisessa. Tutkimuksessa II RAI-mittarin muuttujista muodostettiin gerastenia-indeksi (*frailty index*, FI). Tarkoituksena oli tutkia, miten FI on yhteydessä sairaalahoidon ennustemuuttujiin. Tutkimuksen III tarkoituksena oli selvittää, mitkä tekijät ovat yhteydessä uudelleen sairaalaan joutumiseen pian geriatrisesta sairaalasta kotiutumisen jälkeen. *Tutkimuksen IV* tavoitteena oli saada tietoa geriatrisen arvioinnin implementoinnin haasteista kuvaamalla masennuksen seulonnan implementoinnin tulokset yliopistosairaalan keuhkosairauksien poliklinikalla.

Aineisto ja menetelmät. *Tutkimuksen I* aineisto muodostui Suomen Geriatrit ry:n geriatrijäsenten (n=95) vastauksista nettipohjaiseen kyselylomakkeeseen. Arvioitavat CGA:n osa-alueet olivat kognition, ravitsemustilan, mielialan ja toimintakyvyn arviointi sekä ortostaattisen verenpaineen mittaus. *Tutkimukset II* ja *III* olivat retrospektiivisiä kohorttitutkimuksia kahdessa geriatrisessa sairaalassa kolmen vuoden aikana hoidossa olleista ≥70 vuotiaista potilaista. Materiaalina käytettiin sairaaloiden hoitoilmoitusrekisterin ja laitoskuntoutuksen RAI-arviointien tietoja. Tutkimus II sisälsi sairaalahoidossa olleiden potilaiden tiedot (n=2 188), ja tutkimus III sisälsi indeksisairaalahoitojaksolta kotiutuneiden potilaiden tiedot (n=1 167). Tutkimuksessa II analysoitiin FI:n ja RAI-mittareiden yhteyttä sairaalahoidon ennustemuuttujiin (pitkittynyt sairaalahoito, päivystyshoidon tarve ja sairaalakuolleisuus). Tutkimuksessa III analysoitiin RAI-muuttujien yhteyttä uudelleen sairaalaan joutumiseen 90 vuorokauden aikana kotiutumisen jälkeen. *Tutkimuksessa IV* masennuksen seulonnan tuloksia arvioitiin retrospektiivisesti potilaskertomusmerkinnöistä (n=238). Masennusta seulottiin DEPS-mittarilla.

Masennusoireisille potilaille tarjottiin mahdollisuutta mielialan tarkempaan arviointiin psykiatrian poliklinikalla.

Tulokset. *Tutkimuksen I* perusteella suurin osa geriatreista kertoi käyttävänsä geriatrista arviointia työssään. Kymmenesosa vastaajista sisällytti kaikki viisi osa-aluetta arviointiinsa, kun taas muut valitsivat osa-alueet kliinisin perustein. *Tutkimuksen II* perusteella FI ennusti kuolleisuutta (AUC 0,73) ja pitkittynyttä sairaalahoitoa (AUC 0,75), mutta yhtä hyvä ennustevaikutus oli ADLH-mittarilla, joka arvioi päivittäisistä toiminnoista suoriutumista. Kaikki testatut mittarit olivat huonoja ennustamaan päivystyshoidon tarvetta. *Tutkimuksessa III* sairaalaan uudelleen joutumisen riskitekijöitä yksisuuntaisessa varianssianalyysissa olivat ikä, geriatriseen sairaalaan tuleminen kotoa (vs. sairaalasta), Alzheimerin tauti, epävakaa kävely, uupumus, epävakaat sairaudet, ADL-vaje, painoindeksi, FI, kuulovaikeudet, heikko itsearvioitu terveydentila ja ulosteinkontinenssi. Monimuuttujamallissa ikä, ADL-vaje, epävakaa kävely ja painoindeksi säilyivät riskitekijöinä. *Tutkimuksen IV* perusteella kolmasosa potilaista (n=21) sai DEPS-seulassa ≥9 pistettä, ja heille tarjottiin mahdollisuutta mielialan tarkempaan arviointiin psykiatrian poliklinikalla. Kuitenkin vain 13 lähetettä tehtiin, koska loput potilaista kieltäytyivät lähetteestä. Psykiatrian poliklinikalla arviossa kävi seitsemän potilasta, ja heidän kaikkien todettiin sairastavan masennusta.

Johtopäätökset. Suurin osa Suomen geriatreista käyttää geriatrista arviointia kliinisessä työssään. Arviointi ei kuitenkaan ole systemaattista ja sen sisältö vaihtelee. Geriatrisia oireyhtymiä on vaikea tunnistaa ilman systemaattista arviointia. FI:n luominen RAI-tiedoista onnistui, ja FI:n todettiin ennustavan sairaalahoidon haittatapahtumia (kuolleisuus ja pitkittynyt sairaalahoito). Sen kyky ennustaa haittatapahtumia ei kuitenkaan ollut parempi kuin lyhyen, päivittäisistä perustoiminnoista suoriutumista arvioivan mittarin kyky. Käytännön kliinisessä työssä FI:n määritys ei tarjoa lisäapua haittatapahtumien riskissä olevien potilaiden tunnistamiseen. Sen sijaan päivittäistoiminnoista suoriutumisen arviointi on yksinkertainen ja halpa menetelmä potilaan ennusteen arviointiin. Sairaalahoitoon uudelleen joutumisen riskin vähentämiseksi on suositeltavaa, että toimintakyvyn, ravitsemustilan ja liikkumiskyvyn heikentymisen taustalla olevat yksilölliset tekijät arvioidaan ja niihin puututaan sairaalahoidon aikana. Masennuksen seulonta paransi masennusoireiden havaitsemista, mutta vaikutukset potilaiden kokonaishoitoon olivat vähäisiä. Suurin osa masennusoireista kärsivistä potilaista kieltäytyi lähetteestä psykiatrian poliklinikalle. Sen sijaan, että potilaat ohjataan psykiatrian poliklinikalle, heille tulisi tarjota mielialan tarkempaa arviointia ja tarvittaessa masennuksen hoidon aloittamista samassa yksikössä, jossa seulonta tehdään.

CONTENTS

List of Figures

List of Tables

ABBREVIATIONS

AADLs	Advanced Activities of Daily Living
ABS	Aggressive Behaviour Scale
ACE	Acute Care for Elders Unit
ADLH	Activities of Daily Living Hierarchy Scale
ADLs	Activities of Daily Living
AUC	Area Under the Curve
AUDIT-C	Alcohol Use Disorders Identification Test
BADLs	Basic Activities of Daily Living
BAT	Brief Assessment Tool
BMI	Body Mass Index
CAPs	Clinical Assessment Protocols
CAT	COPD Assessment Test
CGA	Comprehensive Geriatric Assessment
CHESS	Changes in Health, End-stage disease, and Signs and Symptoms Scale
CI	Confidence Interval
COPD	Chronic Obstructive Pulmonary Disease
CPAP	Continuous Positive Airway Pressure
CPS	Cognitive Performance Scale
DEPS	Depression Scale
DRS	Depression Rating Scale
FI	Frailty Index
GEMU	Geriatric Evaluation and Management Unit
GS	Geriatric Syndrome
HAS	Home Assessment Service
HIHAS	Hospital Home Assessment Service
IADLs	Instrumental Activities of Daily Living
interRAI	interRAI Instrument
interRAI AC	interRAI Acute Care Instrument

interRAI-PAC	interRAI Post-Acute Care Instrument
LTOT	Long Term Oxygen Therapy
MDS	Minimum Data Set
MPI	Multidimensional Prognostic Index
6MWT	6-Minute Walk test
mMRC	modified Medical Research Council Dyspnoea Scale
NIV	Non-Invasive Ventilation
NPV	Negative Predictive Values
OAS	Outpatient Assessment Service
OR	Odds Ratio
PAIN	Pain Scale
PPV	Positive Predictive Value
RAI	Resident Assessment Instrument
RCT	Randomised Controlled Trial
ROC	Receiver Operating Characteristic curve
SG	Finnish Geriatrics Society
TICD checklist	The Integrated Checklist of Determinants of Practice
TFI	Tilburg Frailty Indicator
WHO	World Health Organization

ORIGINAL PUBLICATIONS

Publication I Kerminen H, Jämsen E, Jäntti P, Huhtala H, Strandberg T, Valvanne J. How Finnish geriatricians perform comprehensive geriatric assessment in clinical practice? European Geriatric Medicine 2016;7:454-8.

Publication II Kerminen H, Huhtala H, Jäntti P, Valvanne J, and Jämsen E. Frailty Index and functional level upon admission predict hospital outcomes: an interRAI-based cohort study of older patients in post-acute care hospitals. BMC Geriatrics 2020;20:1-12.

Publication III Kerminen H, Jäntti P, Valvanne J, Huhtala H, and Jämsen E. Risk Factors of Readmission after Geriatric Hospital Care: An InterRAI-Based Cohort Study in Finland. Archives of Gerontology and Geriatrics 2021;94:104350.

Publication IV Kerminen H, Jämsen E, Jäntti P, Mattila AK, Leivo-Korpela S, Valvanne J. Implementation of a depression screening protocol among respiratory insufficiency patients. The Clinical Respiratory Journal 2019; doi:10.1111/crj.12977.

1 INTRODUCTION

Comprehensive geriatric assessment (CGA) is a central part of modern geriatric medicine. It is based on the understanding that successful care for older persons occurs when the patient's condition is evaluated and treated from a holistic point of view. In addition to medical and physical elements, psychological, social, and environmental aspects have a significant role in both the sickness and recovery of older persons. CGA includes conventional medical history-taking and examination as well as the systematic evaluation of patients' functional, psychosocial, and cognitive capacities. Furthermore, the consideration of environmental factors that either enable or inhibit a person's capability to take care of himself/herself is an essential component of the assessment. CGA has been developed to help health care professionals deal with older patients' complicated situations and determine strategies to optimise the patients' functional ability and quality of life.

Even though CGA's vital role is widely accepted in geriatrics, its concept is not well established, and the use of the term CGA is incoherent and unclear in both research and clinical practice. In CGA studies, the design, contents, realisation, and intensity of CGA interventions vary greatly. The term CGA is often being used even though only screening for geriatric syndromes (GSs) or frailty is carried out without further evaluation, treatment, and rehabilitation.

Before this study, the author suspected a big gap between an ideal situation and reality in terms of using CGA in clinical practice. There is also a paucity of research considering this issue. Although the expanding use of interRAI assessments offers new opportunities for performing CGA systemically and in a standardised way, only completing interRAI assessments is not enough. The acquired knowledge needs to be interpreted and utilised for an effect to be observed on the treatment of individual patients.

The purpose of this study was to obtain knowledge on the current situation of the use of CGA in clinical practice in Finland, to clarify how the knowledge acquired from a widely used geriatric assessment instrument may be utilised to detect hospitalised patients at increased risk for adverse outcomes, and to gain insights into the challenges of a geriatric assessment implementation process.

2 LITERATURE REVIEW

2.1 Older patients

2.1.1 Ageing and heterogeneity

The general cause of ageing is the time-dependent accumulation of cellular damage (López-Otín et al. 2013). Ageing may be defined as 'the progressive loss of function accompanied by decreasing fertility and increasing mortality with advancing age" (Thomas & Austad 2000). The definition comprises two different aspects of ageing: chronological and biological. Chronological ageing is a measure of age in years and occurs at a constant rate in all individuals. Biological ageing is a progressive decrease in physiological ability to fulfil requirements that occur in all organ systems with increasing chronological age (Adams & White 2004).

Ageing is associated with a decline in the homeostatic reserve capacity of organs (Olde Rikkert et al. 2003). Homeostatic mechanisms aim to maintain the equilibrium of internal systems of the body despite variations in external conditions. Ageing causes homeostenosis, that is, alterations and disruptions in homeostatic mechanisms, which leads to reduction in the capacity of organs to respond to varied challenges. (Khan et al. 2017.) Homeostenosis affects organs at diverse rates in an individual, leading to differences in physiological reserve capacities between organ systems (Olde Rikkert et al. 2003).

Biological ageing also has a unique course in different persons (Khan et al. 2017). This leads to a heterogeneity in biological age among persons of the same chronological age (Belsky et al. 2015; Khan et al. 2017). Even though ageing is generally associated with an increase in chronic diseases and disability, chronological age is only loosely associated with a decline in health and functional status (Barnett et al. 2012; Lowsky et al. 2014). Some older persons remain healthy and functionally independent until an advanced age (Sarkeala et al. 2011), while others experience multimorbidity and functional impairment at the early retirement

age (Barnett et al. 2012; Nusselder et al. 2006). However, only a minority of older people manage to show no disability till the end of their lives (Gill et al. 2010).

2.1.2 Health and diseases in old age

Biological ageing is associated with an increased risk of acquiring chronic diseases and multimorbidity (Barnett et al. 2012) as well as functional impairment and disability (Gill et al. 2010). In addition to biological changes, ageing involves other significant changes that may affect health, morbidity, and functional ability. Changes in social roles and positions contribute to older people's well-being (Vos et al. 2019). Psychological changes are necessary for the adaptation of physiological and social changes that inevitably occur during the life course (Wernher & Lipsky 2015). The past experiences of an individual and self-efficacy and resilience as psychological resources impact psychological well-being (Bowling & Iliffe 2011; Wernher & Lipsky 2015). Similar to biological changes, these changes are highly individual, increasing the diversity among older people. The presence of chronic diseases and functional impairment does not necessarily significantly impact on individuals' lives. If an individual has compensatory psychological and social resources and is able to utilise them, successful ageing may coexist with diseases and functional impairment (Nosraty et al. 2012; Young et al. 2009).

The quality of life of older persons is closely related to the determinants of health and functional ability, psychological well-being, social roles and activities, and financial circumstances (Gabriel & Bowling 2004; Nosraty et al. 2015). Qualitative studies have shown that an essential element in the quality of life is the perception of health, that is, whether an individual feels fit and active or experiences physical, mental, or cognitive disorders. Functional impairment and the presence of different symptoms (such as poor balance, poor memory, pain, vision loss, and fatigue) significantly decrease quality of life. (Jylhä 2009; Van Leeuwen et al. 2019.)

In older persons, diagnosis of diseases is usually more challenging than in younger persons. The classic presenting symptoms of common diseases may be absent, and nonspecific symptoms may be present. For example, many infections may present with nonspecific symptoms such as motility problems, generalised weakness, or altered mental status instead of fever or symptoms related to the infection source. This atypical disease presentation signals a disruption of homeostatic reserve capacity in one or more organ systems. As the reserve capacity

is exceeded, presenting symptoms are related to the organ system with the lowest homeostatic reserve capacity instead of being related to the affected organ system. The most affected organ system in terms of the homeostenosis is the weakest link in stressful situations, for example, at the onset of an acute illness. (Olde Rikkert et al. 2003.) These alterations are related to GSs (see Chapter 2.2).

Older persons are more vulnerable to adverse health outcomes than younger persons. Vulnerability is defined as 'to exposure to contingencies and stress, and difficulty in coping with them' (Chambers 2006). The magnitude of a stressor and the coping capacity of an individual affect the risk of adverse outcomes and the severity of that outcome (Schröder-Butterfill & Marianti 2006).

In general, older persons have a limited life expectancy, that is, the average number of years of remaining life, compared to younger persons. However, there is considerable variability in life expectancy between individuals with similar chronological ages (Keeler et al. 2010). To some extent, this variability is explained by the number of chronic diseases (DuGoff et al. 2014) and their severity. Another essential factor is functional ability (Keeler et al. 2010). Factors associated with diminished survival include difficulties in performing basic activities of daily living (BADLs) and mobility disability (Keeler et al. 2010; Tiainen et al. 2013). In community-dwelling older persons, functional impairment influences mortality independently of age and the number of chronic diseases (Landi et al. 2010).

2.2 Geriatric syndromes (GSs)

2.2.1 Definition and criteria

GSs differ from diseases and traditional medical syndromes in that they have a multifactorial aetiology and present with a single symptom (Flacker 2003). The terms 'geriatric giants', 'geriatric syndromes', and 'geriatric conditions' are used interchangeably to characterise common health conditions in older adults that do not fit into discrete disease or syndrome categories. However, there are some differences in their use, and the term 'geriatric conditions' is somewhat broader than the terms 'geriatric giants' and 'geriatric syndromes'. Among geriatric conditions are usually included conditions that are prevalent in older population, although they do not fulfil the definition of GSs.

The word 'disease' is defined as 'a disorder with a specific cause (which may or may not be known) and recognisable signs and symptoms'. The word 'syndrome' is defined as 'a combination of signs and/or symptoms that form a distinct clinical picture indicative of a particular disorder'. (Martin, 2015.) In optimal situations, a disease or a syndrome may be treated by identifying and correcting a single disruption in the normal chain of physiological processes (Flacker 2003). In contrast, there are usually multiple, cumulative, interacting abnormalities that cause a GS (Inouye et al. 2007). For example, the cumulative effects of old age, impaired cognition, chronic and acute diseases, and use of multiple medications result in a delirium phenomenology under stressful situations. Consequently, a multifactorial approach is necessary when identifying and managing GSs.

The most widely used definition describes GSs as 'multifactorial health conditions that occur when the accumulated effect of impairments in multiple systems renders an older person vulnerable to situational challenges' (Inouye et al. 2007). Three criteria must be met when defining a condition as a GS: 1) it is highly prevalent in older adults; 2) it represents a unified manifestation of multiple aetiological factors that interact with each other and occurs in different combinations in each person or in the same person on repeated occasions; and 3) it is associated with multiple chronic conditions, adverse outcomes, and other GSs (Inouye et al. 2007; Olde Rikkert et al. 2003; Stevenson et al. 2019).

Despite the definition mentioned above and the criteria of GSs, the use of the term 'geriatric syndrome' is heterogeneous in the literature, and an extensive list of GSs is not available. When Bernard Isaacs created the term 'geriatric giants' in 1965, he included immobility, instability, incontinence, and impaired intellect/memory under this term (Morley 2004). Afterward, many other conditions have been added to the list. According to Morley (2017), modern GSs consist of frailty, sarcopenia, anorexia, weight loss, depression, delirium, falls, cognitive dysfunction, and caregiver stress. However, many other conditions may be added to the list, such as functional impairment (Inouye et al. 2007; Tinetti et al. 1995), orthostatic hypotension (Chen, L. et al. 2019), chronic multisite pain (Thapa et al. 2019), anaemia (Rohrig et al. 2018), dysphagia (Payne & Morley 2017), cognitive frailty (Morley 2015), medication-related harm (Stevenson et al. 2019), poor oral health (Putten et al. 2014), and self-neglect (Pavlou & Lachs 2006).

2.2.2 Prevalence of GSs

GSs are highly prevalent among older people. The prevalence of GSs varies among different healthcare settings. Generally, GSs are most prevalent in hospitalised patients. Overall, their prevalence increases with advancing age (Cigolle et al. 2007; Liang et al. 2018; Merchant et al. 2020; Sanford et al. 2020). As the use of the term 'geriatric syndrome' is heterogeneous in the literature, it is challenging to approximate and compare the prevalence of GSs in older populations. In different studies, diverse conditions and problems have been included as GSs/geriatric conditions and diverse study methods have been used. Table 1 illustrates the main studies that have reported the prevalence of GSs and geriatric conditions as a group in community-dwelling older adults, in primary care patients, and in hospital settings. Among the most prevalent GSs in the community are urinary incontinence, falls, and functional impairment. It is impossible to evaluate which GSs are the most prevalent in hospital and primary care settings due to methodological diversities.

2.2.3 Association with functional impairment

Although functional impairment is a GS, it is also a known risk factor for other GSs and frailty (Figure 1). Functional impairment refers to the inability of a person to perform ADLs independently. Hierarchical ADLs are divided into three groups: 1) basic self-care activities (BADLs) (such as bathing, dressing, transferring, toileting, continence, and eating); 2) instrumental activities (IADLs) (such as housework or other domestic chores, managing finances, using the telephone, shopping, preparing food, doing laundry, handling medications, and using transportation); and 3) advanced activities (AADLs) (such as hobbies and working). Usually, AADLs are the first to deteriorate when functional ability begins to decline, followed by IADLs and BADLs.

Both chronic diseases and GSs may lead to functional impairment and eventually, disability. There is an independent association between GSs and functional impairment, independent of chronic diseases. The risk for functional impairment due to GSs is similar or even greater than that for chronic diseases. (Cigolle et al. 2007; Rosso et al. 2013.) However, there is a different causal relationship between chronic diseases and GSs causing functional impairment. Chronic diseases usually cause pathological changes in an organ leading to impairment of the affected organ system. This may or may not lead to functional

impairment. Meanwhile, the relationship between GSs and functional impairment is bidirectional. Functional impairment is a risk factor for GSs (for instance, dependency in transferring makes a person vulnerable to injurious falls and urinary incontinence); and, in contrast, GSs may contribute to the development of functional impairment and disability (e.g. cognitive impairment or depression may lead to an inability to take a bath or dress independently) (Figure 1). (Cigolle et al. 2007.)

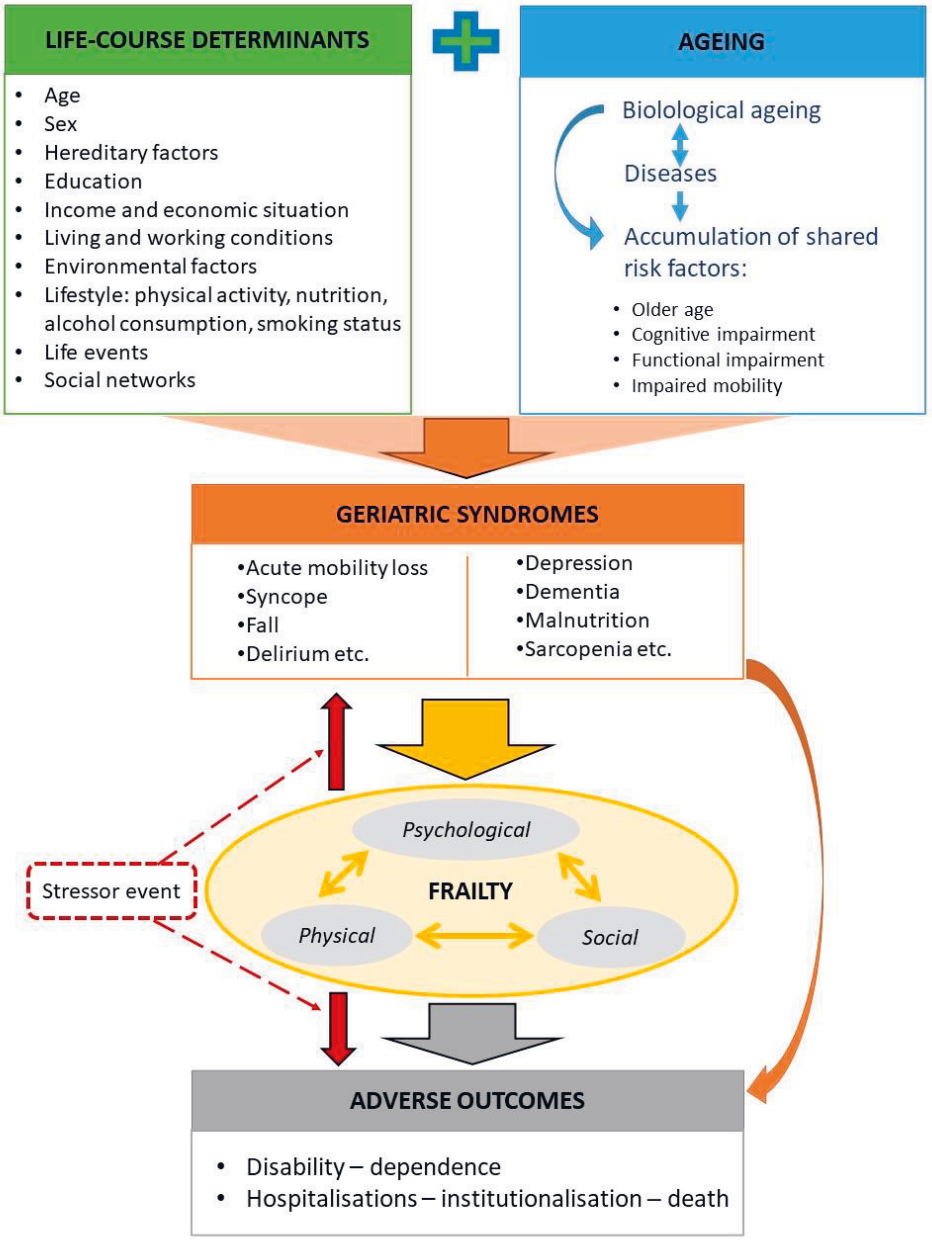
Functional impairment may lead to disability. Disability is a broader term than functional impairment. It is defined as 'a loss or restriction of functional ability or activity as a result of impairment of the body or mind' (Martin, 2015). Disability results from an interaction between persons (with an impairment or impairments) and their contextual factors (such as personal and environmental factors). According to the World Health Organization (International Classification of Functioning, Disability and Health 2001), disability has three dimensions: 1) impairments in body structure or function, 2) limitations in activity (individual level), and 3) restriction in participation in normal daily activities (societal level).

Table 1. Prevalence of geriatric syndromes (GSs) and geriatric conditions in the community, primary care, and in-hospital settings

Study	Age (years)	Setting	Patients n	Design	Method	Evaluated GSs n	Most prevalent GSs (up to five)	Prevalence of GSs (%)
Cigolle et al. (2007)	≥65	Community USA	11,093	Cross-sectional analysis	Interviews; Self-reported	7	Hearing impairment	26
							Dizziness	13
							Incontinence	13
							Injurious falls	10
							Cognitive impairment	9
Van Rijn et al. (2016)	≥70	Community Netherlands	934	Intervention group of a randomised controlled trial; patients at increased risk of functional impairment	Interviews; Self-reported	32	Functional dependency	85
							Alcohol/ drug abuse	69
							Walking aid	53
							Polypharmacy	48
							Falls	44
Liang et al. (2018)	≥65	Community Sweden	4,532	Cross-sectional analysis	Questionnaire; Self-reported	7	Insomnia	45
							Urinary incontinence	35
							Functional impairment	20
							Severe hearing loss	17
							Falls	15
Tabue-Teguo et al. (2018)	≥75	Community France	630	Cross-sectional analysis	Interviews; Self-reported	10	Polypharmacy	51
							Falls	43
							Frailty	42
							Dementia	16
							Sensorial deficit	13
Sanford et al. (2020)	≥65	Community USA	2,688	Screening of community-dwelling persons	Rapid Geriatric Assessment by members of the interdisciplinary team	4	Sarcopenia	48
							Anorexia of ageing	37
							Frailty	31
							Dementia	23
Mueller et al. (2018)	≥70	Primary care Switzerland	85	Prospective diagnostic study	CGA by a geriatrician	8	Visual impairment	71
							Hearing loss	48
							Osteoporosis	48

							Urinary incontinence	44
							Mood impairment	38
Merchant et al. (2020)	≥65	Primary care Singapore	2,710	Screening of primary care patients	Rapid Geriatric Assessment using a mobile app	3	Sarcopenia	15
							Anorexia of ageing	11
							Frailty	6
Sanford et al. (2020)	≥65	Primary care USA	6,445	Screening of primary care patients	Rapid Geriatric Assessment by members of the interdisciplinary team	4	Sarcopenia	33
							Anorexia of ageing	25
							Frailty	22
							Dementia	22
Nair et al. (2000)	≥70	Tertiary hospital Australia	100	Prospective diagnostic study	Evaluation using screening instruments by nurses	5	Falls	54
							Incontinence	40
							Polypharmacy	35
							Memory impairment	29
							Inability to walk on admission	25
Buurman et al. (2011)	≥65	Tertiary and secondary hospitals Netherlands	639	Prospective cohort study	CGA by a research nurse and a geriatrician	18	IADL impairment	83
							Polypharmacy	61
							Mobility difficulties	59
							Caregiver burden	53
							Malnutrition	52
Lakhan et al. (2011)	≥70	Secondary hospitals Australia	577	Prospective cohort study	Evaluation using the interRAI Acute Care assessment by nurses	7	ADL impairment	71
							Urinary incontinence	37
							Cognitive impairment	34
							Delirium	18
							Faecal incontinence	15
Kangas et al. (2018) *(In Finnish)*	≥70	Tertiary hospital Finland	150	Cross-sectional analysis	Screening by medical students	2	Memory disorders	28
							Attention deficits	20
Sanford et al. (2020)	≥65	Hospital USA	1,268	Screening of hospitalised patients	Rapid Geriatric Assessment by members of the interdisciplinary team	4	Sarcopenia	51
							Frailty	46
							Dementia	34
							Anorexia of ageing	33

Figure 1. Impact of life course determinants and ageing on the development of geriatric syndromes and frailty. Frail persons and those with geriatric syndromes are vulnerable to adverse outcomes. Modified from those reported by Inouye et al. (2007), Clegg et al. (2013),and Freitag et al. (2016).



2.2.4 Frailty

Frailty is a GS in which a person's ability to resist stressful events is reduced due to cumulative age-related decline in many physiological systems (Clegg et al. 2013; Dent, Elsa et al. 2016). The connection between frailty and GSs is bidirectional: frailty can be seen as an underlying process that leads to clinical manifestations of GSs in stressful situations (such as delirium, falls, acute mobility loss, and generalised weakness) (Fulop et al. 2010); in contrast, frailty is observed to be the final phenomenon of the accumulation of GSs (e.g. malnutrition, sarcopenia, cognitive impairment, and depression) (Tinetti et al. 1995) (Figure 1).

As normal ageing is characterised by a gradual decrease in the physiological reserve capacities of all organ systems, the rate of decline in organ functions is accelerated in frailty, and homeostatic mechanisms fail in this condition (Clegg et al. 2013). Clinically, frailty manifests only when the reserve capacity of interconnected physiological systems reaches a threshold level and homeostenosis occurs (Fulop et al. 2010). Persons with frailty are vulnerable to a disproportionate change in their health and functional status due to minor stressors (Clegg et al. 2013). Thus, under stress, a previously mobile person may become immobile, and a functionally independent person may begin to need assistance in daily activities. Besides, the recovery of homoeostasis after a stressful event is protracted and may be only partial. Therefore, the previous functional ability may not be fully recovered after the stressor's disappearance, making an affected individual susceptible to adverse outcomes such as hospitalisation, institutionalisation, and death.

A single definition of frailty is still unavailable despite many attempts to formulate it (Gobbens et al. 2010; Morley et al. 2013; Rodríguez-Mañas et al. 2013). Instead, there are many definitions of frailty based on different perspectives on its conceptualisation. Earlier definitions considered frailty as a biological or physiological, unidimensional state, whereas more recent definitions consider it to be multidimensional; for frailty, recent definitions also consider psychological and social components. Among the earliest definitions is the one by Fried et al (2001), who defined frailty as 'a biologic syndrome of decreased reserve and resistance to stressors, resulting from cumulative declines across multiple physiologic systems, and causing vulnerability to adverse outcomes'. According to the multidimensional definition of frailty by Gobbens et al. (2010), frailty is 'a dynamic state affecting an individual who experiences losses in one or more domains of human functions (physical, psychological, social), which is caused by the influence of a range of

variables and which increases the risk of adverse outcomes'. However, this definition did not achieve great success. More recently, a consensus statement by Morley et al. (2013) defined physical frailty as 'a medical syndrome with multiple causes and contributors that is characterised by diminished strength, endurance, and reduced physiologic function that increases an individual's vulnerability for developing increased dependency and/or death'.

The aetiology of frailty is not fully understood. Nevertheless, there is a consensus that the causes are multifactorial and complex, and the interplay between biological, genetic, physical, social, psychological, and environmental factors affect the process of frailty (Fulop et al. 2010) (Figure 1). From biological and physiological perspectives, it is suspected that pathological alterations in inflammatory processes (e.g. imbalance in the cytokine network), metabolic functions (e.g. alterations in the fat/lean body mass composition), and the secretion and effect of hormones (e.g., a decrease in circulating levels of growth hormones, sex hormones, and vitamin D and an increase in cortisol levels) are the key processes involved in the onset and progression of frailty (Clegg et al. 2013; Fulop et al. 2010).

There are currently three conceptual frailty models: the phenotype model (Fried et al. 2001), the cumulative deficit model (Rockwood et al. 2005), and the multidimensional model (Gobbens et al. 2010). The most widely used models are the phenotype model and cumulative deficit model. The multidimensional model offers a more holistic view of frailty, including psychological and social aspects (Gobbens et al. 2010). The World Health Organization recommends using a holistic view of functional ability and frailty (World report on ageing and health 2015; Beard & Bloom 2015).

In the phenotype model, frailty is a stage in the disabling process, and it usually precedes disability or other clinical outcomes. Frailty is clinically characterised by the measurable physical factors in an individual: weakness, slowness, low levels of activity, self-reported exhaustion, and unintentional weight loss. Of these five factors, having one or two is indicative of pre-frailty and having three or more is indicative of frailty. (Fried et al. 2001)

In the cumulative deficit model, frailty is defined as the cumulative effect of accumulation of health deficits (Rockwood et al. 2005). Frailty is seen as a continuum measure from the robustness to the most severe disability. The more health deficits an individual accumulates, the more frail he/she is. Deficit accumulation may be used to describe biological age of the person. (Rockwood &

Mitnitski 2011.) Deficit accumulation is associated with risk of worsening health status, institutionalisation, and death (Searle et al. 2008).

The cumulative deficit model operates with the frailty index (FI). The FI is the proportion of deficits present in an individual out of the total number of variables (deficits) considered. Health deficits can include symptoms, signs, diseases, medications, disabilities, and laboratory, radiographic, or electrocardiographic abnormalities. The deficits may have values between zero (no deficit) and one (maximal deficit), and the FI values range between zero and one. For example, if 50 variables were considered and 20 were present in a given person, the FI would be 20/50=0.40. The FI can be calculated using various databases according to the standard procedure for selecting an individual deficit. Briefly, variables can be included in the FI if they fulfil the following five criteria: 1) the variables must be deficits of health status, 2) prevalence of a deficit must generally increase with age, 3) the deficit must not saturate too early (i.e., deficit should not be present in most older persons), 4) the deficits that compose the FI must cover a range of systems (such as medical, cognitive, psychological, physical, and social systems), and 5) if the FI is used serially in the same person, the items used to calculate the FI need to be the same in the following assessments. (Searle et al. 2008.)

In the multidimensional model, frailty is seen as a dynamic state following impairments in the physical, psychological, or social domains of functions (Gobbens et al. 2010). An example of the multidimensional model is the Tilburg Frailty Indicator (TFI) (Freitag et al. 2016; Gobbens et al. 2017). TFI is a frailty screening instrument using a self-reported questionnaire. It consists of two parts: a) determinants of frailty and diseases and b) physical, psychological, and social components of frailty (Gobbens et al. 2010).

2.2.5 Clinical relevance of GSs and frailty

The clinical relevance of GSs and frailty is based on the fact that these conditions are associated with poor health outcomes. Besides, there are many good treatment options and rehabilitation strategies to manage GSs and frailty, or diminish their burden on patients, their families, and health care. The detection of GSs may improve older adults' comprehensive care, thus enabling the management and prevention of GSs and their adverse consequences (Fougère et al. 2018; Melis et al. 2008).

The association of a single GS with adverse outcomes is well established in the literature. GSs are associated with functional impairment and mortality among hospitalised older patients (Buurman et al. 2011) and community-living older persons (Cigolle et al. 2007; Huang et al. 2016; Kim et al. 2018; Lu et al. 2016). GSs are also associated with the risk of hospitalisation and institutionalisation among community-dwelling older persons (Wang et al. 2013) and with the length of hospital stay and institutionalisation among older hospitalised patients (Anpalahan & Gibson 2008).

Frailty is associated with falls and fractures, hospitalisation, institutionalisation, iatrogenic complications, and mortality (Clegg et al. 2013; Dent et al. 2019b; Hoogendijk et al. 2019; Shamliyan et al. 2013; Strandberg et al. 2011). Frailty is a dynamic entity, and the state of frailty may vary in an individual at different time points (Dent, E. et al. 2019b). Frailty is a potentially reversible state at least in its early stages (Gill et al. 2006; O'Caoimh et al. 2018). The identification of frailty should lead to the detection and treatment of known or unknown root causes for frailty and at its best, should prevent disability and other adverse outcomes (Dent et al. 2019a; Hoogendijk et al. 2019; Morley et al. 2013; Strandberg et al. 2011).

2.3 Challenges in organising health care for older patients

2.3.1 Complexity

Taking care of older patients is usually more complex than caring for younger patients. Complexity results from numerous interactions among medical, psychological, and social factors that impact the process and outcomes of care (Safford et al. 2007; Schaink et al. 2012). First, most older patients have multiple chronic diseases (Calderón-Larrañaga et al. 2017). Comorbidity, that is, having one or more diseases in addition to the index one, influences the prognosis of the index disease and may alter the patient's treatment response and tolerance (Valderas et al. 2009). The standard care for certain diseases stated by the guidelines may not be appropriate for older patients with frailty and may harm them. Multimorbidity is associated with functional impairment and disability, poor quality of life, and high health care costs (Marengoni et al. 2009; Marengoni et al. 2011).

Second, older patients often use multiple medications (Onder et al. 2014). Polypharmacy predisposes patients to adverse drug reactions (such as drug-drug

and drug-disease interactions) (Gnjidic et al. 2012; Laatikainen et al. 2017). Third, prevalent multifactorial conditions (GSs, functional impairment, and frailty) increase the risk of adverse health outcomes and complicate care and recovery (Buurman et al. 2011). Communication with older patients with cognitive impairment or hearing or vision problems is challenging for health care professionals. Finally, socioeconomic issues, such as the lack of social relationships and assistance and low economic status, have an impact on health outcomes (Andrew et al. 2008).

2.3.2 Hazards of the disease-oriented model

A disease-oriented model of health care was developed in Western societies during the 19th and early 20th centuries. At that time, the average life expectancy was much lower than the current life expectancy, and medical care was mostly channelled into treating acute diseases. In contrast, nowadays, most clinical encounters involve the treatment of chronic diseases and not disease-specific health complaints. The disease-oriented model does not consider the complex interplay of biological and nonbiological (physical, psychological, social, and environmental) factors that contribute to an individual patient's health issues. (Tinetti & Fried 2004.) The disease-oriented model is more suitable for treating acute diseases in otherwise healthy patients than for treating chronic diseases in multimorbid patients (Agusti 2018).

According to Tinetti and Fried (2004), if healthcare's primary focus is on a single disease, this usually leads to under-, over-, or mistreatment of the health complaints of older patients with multimorbidity. Undertreatment is related to the reluctance to treat and acknowledge the symptoms that cannot be ascribed to a single disease with a biological basis, although these symptoms are associated with discomfort and adverse consequences. Overtreatment is related to the emphasis on treating individual diseases according to the disease management guidelines. In multimorbid patients, this increases polypharmacy and thus, may lead to harmful adverse drug outcomes. Mistreatment is related to clinical decision-making based on disease-specific outcomes instead of a more holistic picture of the individual's other diseases, functions, social support, and health preferences. This may lead to investigations and treatments that do not bring health benefits for patients.

GSs are highly under-recognised in clinical practice although they have a strong impact on patient outcomes. Ugboma et al. (2008) examined the coding of GSs in

hospital settings. The presence or absence of eight medical diseases and four GSs (falls, mobility impairment, cognitive impairment, and incontinence) were noted in case note reviews. The results were compared to the findings of the discharge summaries and hospital coding records. The discharge summaries and hospital coding records captured medical diseases better than GSs. Buurman et al. (2011) noticed that the reporting rate of GSs in hospital discharge summaries was low: 54% of cognitive impairment, 50% for delirium, 22% for malnutrition, 2% for depression, 1% for incontinence and 0% for pressure ulcers. Atri et al. (2005) found that 38% of patient-reported falls were not recorded on the emergency department's computerised records. Berlowitz et al. (1999) found that hospital discharge diagnoses only captured 31% of pressure ulcers and 3% of incontinence cases.

The world report on ageing and health by WHO (2015) lists a few problems in the disease-oriented model of care for older people. First, the lack of coordination of care between health professionals and across treatment settings and levels increases both the burden of older patients and the risk for adverse outcomes. Second, health professionals are not used to dealing with the complex health needs of older patients. Consequently, health needs of older patients are not met. Finally, ageism within health care (such as negative attitudes, failure to involve older patients in clinical decision-making about their own care, and restricted access to otherwise-indicated medical interventions based on chronological age) impairs the quality of care.

2.4 Theory of Comprehensive Geriatric Assessment

2.4.1 Definition and main goals

CGA is a cornerstone of modern geriatric medicine (Ellis et al. 2011). Despite its central role in geriatric medicine for a couple of decades, the concept of CGA has not been well established. The use of the term CGA is incoherent and unclear in both research and clinical practice. The concept of CGA has evolved through CGA programmes (see Chapter 2.5). The lack of consensus on well-defined contents of CGA has created a wide variety of methods and interventions and led to different interpretations regarding which programmes may be called CGA programmes.

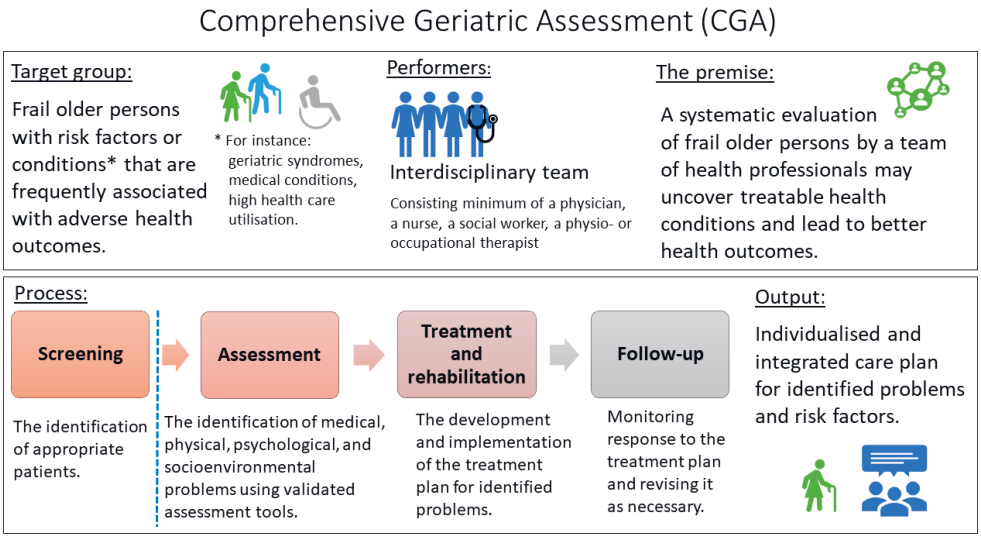
The most widely used definition determines CGA as 'a multidimensional, multidisciplinary process which identifies medical, social and functional needs of the patient, and the development of an integrated and coordinated care plan to meet those needs' (Parker et al. 2018; Stuck et al. 1993). This definition of CGA can be seen as a 'gold standard' for the assessment of older patients. CGA is based on the premise that a systematic evaluation of older persons may identify various treatable health conditions and, through assessment, treatment, and rehabilitation, may lead to better health outcomes (Welsh et al. 2014). The main goals are to improve diagnostic accuracy and optimise medical treatment, monitor clinical change over time, to improve and predict patient-related outcomes, minimise the use of unnecessary services, and optimise living locations (Rubenstein 2004; Solomon et al. 2003).

Geriatric assessment is performed in addition to the standard medical history-taking and physical examination. It differs from general medical care in its attempt to detect, assess, and treat complex problems of older patients not only in the medical but also in psychological, social, functional, and environmental dimensions, in its emphasis on functional status and quality of life, and in the frequent use of quantitative assessment scales and interdisciplinary teams (Gladman et al. 2016; Welsh et al. 2014).

2.4.2 The process of CGA

The process of CGA is not well described in the literature. For clarification, the author of the thesis divides CGA's process into five phases: screening for identifying the appropriate patient population, assessment, treatment, rehabilitation, and follow-up (Figure 2). Screening intends to differentiate older patients who are likely to benefit from geriatric assessment from those who are either too fit or have too many impairments to obtain benefits (Solomon et al. 2003). If only the disease has worsened without affecting function, the patient should be treated using general medical assessment and treatment options. Although there are no universal criteria available for patient selection, specific criteria that have been used include age, multimorbidity, GSs, psychosocial problems, high healthcare utilisation, and change in a living situation (Pilotto et al. 2017).

Figure 2. Overview of the target group, personnel, premise, process, and output of comprehensive geriatric assessment.



Several screening instruments to identify patients who are likely to benefit from CGA have been developed for different care settings. The Rapid Geriatric Assessment -instrument is a screening instrument for frailty, sarcopenia, anorexia of ageing, and cognitive impairment used in primary care settings (Morley et al. 2017). The Vulnerable Elders Survey-13 was developed for identifying vulnerable older people in the community (Saliba et al. 2001). The EASY-Care tool was designed to assessment the physical, social, and mental functions and unmet health and social needs of older people in the community and in the primary care setting (Craig et al. 2015). The ISAR is a tool for identifying older patients in the emergency department who are at an increased risk of adverse health outcomes (McCusker et al. 1999). The G8 is a screening tool for detecting older cancer patients who could benefit from CGA (Bellera et al. 2012).

The assessment of an individual begins with a case-finding approach to screen for health-related problems and issues that may compromise the functional ability of the patient (Solomon et al. 2003). Based on the screening results, a more detailed assessment focusing on the identified issues is undertaken (Solomon et al. 2003). Systematic assessment is usually performed by employing standardised assessment instruments (Devons 2002). Numerous assessment instruments for different domains have been developed and validated. Suitable instruments should be selected based on the clinical setting and patients' characteristics.

CGA may vary in intensity depending on the clinical setting and available resources (Pilotto et al. 2017). However, according to the definition of CGA, assessment is interdisciplinary. In this context, the interdisciplinary approach refers to effective interaction among members from multiple disciplines so that assessments and decisions are made as a team instead of the more traditional way of having professionals from multiple disciplines working parallel with the patient (Gladman et al. 2016). The interdisciplinary team consists of a minimum of a geriatrician or a senior physician with experience in geriatric medicine, a nurse, and a social worker (Devons 2002; Pilotto et al. 2017; Solomon et al. 2003). Usually, physiotherapists and occupational therapists belong to the core team or are consulted as needed (Ellis & Langhorne 2005; Pilotto et al. 2017; Welsh et al. 2014). Besides, specialists from several other disciplines, for example, a nutritionist, a psychologist, and a podiatrist, take part in the assessment as appropriate (Pilotto et al. 2017). In every team, it is necessary to identify which member acts as a care coordinator to coordinate the various interventions and maintain contact with the patient (Welsh et al. 2014). Family members or other persons close to the family are involved in the process, in addition to the patient and healthcare professionals (Solomon et al. 2003).

The interdisciplinary team members share responsibility for the coordinated assessment, discussion, and recommendation or implementation of the treatment plan. The treatment plan includes treatment and rehabilitation recommendations for assessing the patient's identified diseases, symptoms, and problems. Follow-up includes a review of the treatments and rehabilitation progress. If necessary, further assessments are carried out to achieve the goals of CGA. (Welsh et al. 2014.)

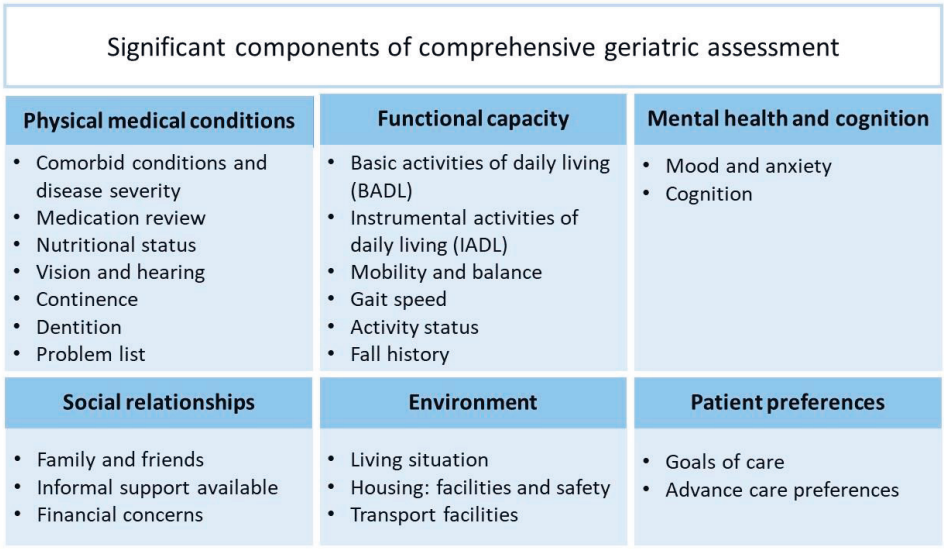
2.4.3 Contents of the assessment

The assessment contents may vary greatly depending on the purpose of assessment, setting, and resources available (Pilotto et al. 2017). However, CGA should be multidimensional, and include its fundamental domains: medical, psychological, socioenvironmental, and functional assessment. In systematic reviews and meta-analyses of inpatient CGA, the core domains consistently included in CGA were medical/physical, psychological/cognitive, socioeconomic, functional and nutritional evaluation (Parker et al. 2018). In studies of CGA in different healthcare settings, the core domains included in CGA were comorbidities and polypharmacy, geriatric syndromes (e.g., delirium, fall risk,

urinary incontinence, dentition, and visual and hearing impairment), functional status, mobility and gait speed, cognition, mood and cognition, nutritional status, socioenvironmental assessment, goals of care, and advanced care planning (Pilotto et al. 2017).

The significant CGA components are classified into six domains: physical medical conditions, mental health and cognition, functional assessment, social relationships, environment, and patient preferences (Figure 3). However, additional components may be added to this list based on the individual patient's identified needs, and the final contents of CGA are determined individually based on the patient's characteristics.

Figure 3. An example of the significant components of comprehensive geriatric assessment.



Assessment of physical medical conditions includes the evaluation of somatic diseases and their severity, medication review, and evaluation of nutritional status. Based on the evaluation, a problem list is often created. (Welsh et al. 2014.) Furthermore, assessments of gait and falls, sensory impairments, urinary incontinence, elder abuse, pressure sores, and pain, among other components, are included in this part (Devons 2002). Assessment of mental health and cognition includes the evaluation of mood and differential diagnosis of mood disorders as well as evaluation of cognition to rule out or raise suspicion of any cognitive impairment.

One of the key components of CGA is functional assessment (Devons 2002). Functional ability refers to a person's ability to be independent, both in caring for him/herself and the environment in which he/she lives. Most commonly, functional ability is evaluated at the level BADLs and IADLs. The nature and degree of help the patient needs compared with the assistance received is an essential piece of information collected. The strength of the patients' social support network or home care in terms of fulfilling patient needs is evaluated. Besides, because mobility plays a central role in the execution of most functional activities and the prevention of falls, assessments of gait and balance as well as activity and exercise levels of the patient are essential parts of functional assessment in most settings (Tinetti 2003).

Assessment of social relationships include the evaluation of family members or friends who can either offer or are already providing support to the person. The informal social support networks plays an essential role in determining whether older persons with frailty can remain at home or need placement in an institutional care setting. Assessment of financial concerns is an integral part of the evaluation. Environmental assessment includes the evaluation of the living situation, housing facilities, safety issues, and transportation facilities. Patient preferences include discussion and knowledge of the patient's own goals of care and advanced care preferences.

2.5 CGA-based programmes

2.5.1 History of geriatric assessment-based programmes

The pioneering country in the development of modern geriatric medicine and geriatric assessment-based programmes was the United Kingdom followed by the United States of America (Morley 2004; Wieland & Hirth 2003). The development of CGA programmes can be divided into three main periods. *The early conceptualisation and model development period* lasted from the mid-1930s to the mid-1970s (Rubenstein 2004). Understanding the special characteristics and complexity of older persons and the importance of a holistic approach and rehabilitation in older patients' care were the main messages in the writings of British physician Marjory Warren in the 1940s (St John & Hogan 2014; Warren 1943). She proposed that every older patient undergo comprehensive assessment and rehabilitation before being admitted for long-term care (Matthews 1984; St John & Hogan 2014).

However, it took decades before a widespread interest in geriatric assessment was observed.

The period of refinement and testing of clinical geriatric models based on CGA began in the mid-1970s and lasted until the mid-1990s (Rubenstein 2004). CGA programmes were first developed in acute care hospitals. There were two inpatient CGA models: 1) discrete geriatric wards managed by specialised interdisciplinary teams, and 2) multidisciplinary geriatric consultation teams that assessed older patients and delivered recommendations in the general and internal wards. The establishment of dedicated geriatric wards called acute care for elders (ACE) units and geriatric evaluation and management units (GEMU) represents a major cultural change in the hospital care of older patients (Palmer 2018). The ACE Unit model consists of several core components: 1) patient-centred care ensuring that patient preferences, needs, and values are considered in all clinical decisions, 2) nurse-driven care plans for the prevention and management of GSs, 3) early discharge planning, and 4) medical care review of treatments and medications to ensure the quality of clinical management and medication prescription (Flood et al. 2018; Palmer 2018; Pedersen et al. 2016). GEMUs were based on similar components, emphasising the importance of rehabilitation and follow-up after discharge (Van Craen et al. 2010). At that time, numerous randomised controlled trials (RCTs) that compared CGA-based care to the usual care were performed in inpatient settings (Applegate et al. 1990; Landefeld et al. 1995; Nikolaus et al. 1999).

The model of CGA-based care was also remodelled and adjusted to outpatient settings: 1) home assessment service (HAS) for community-dwelling older patients, 2) hospital home assessment service (HIHAS) for patients recently discharged from hospital, and 3) outpatient assessment service (OAS) with CGA provided in an outpatient setting for community-dwelling older persons. Several RCTs were published on HAS (Carpenter & Demopoulos 1990; Hendriksen et al. 1984; Vetter et al. 1984), HIHAS (Hansen et al. 1992; Melin & Bygren 1992) and OAS (Epstein et al. 1990; Tulloch & Moore 1979). The first seminal meta-analysis of 28 RCTs on the previously mentioned models was published in 1993, showing CGA's effectiveness for improving older persons' survival and function, especially when CGA was performed in inpatient settings using dedicated geriatric wards (Stuck et al. 1993). Consensus reports disseminated knowledge regarding CGA as a central part of geriatric care, in addition to white papers and major policy statements, for example, the National Institute of Health consensus statement of 1987 (Solomon et al. 2003) and the American Geriatrics Society policy statement of 1988 (AGS Public 1989).

The period of mainstream integration and consolidation began in the mid-1990s and is still continuing (Rubenstein 2004). Multisite trials of CGA programmes were performed to test the results of the single-site trials. The Resident Assessment

Instrument (RAI) from Minimum Data Set (MDS), a new CGA-based database, was launched in the USA as a quality indicator of care in long-term care settings (Hawes et al. 1997). The general standard of care for older patients has substantially improved (Rubenstein 2004). Numerous meta-analyses on the effectiveness of CGA in inpatient settings (Bachmann et al. 2010; Baztan et al. 2009; Deschodt et al. 2013; Ellis et al. 2017; Van Grootven et al. 2017), a few meta-analyses based on in-home CGA (Huss et al. 2008; Stuck et al. 2002), and on outpatient CGA (Beswick et al. 2008; Kuo et al. 2004) have been published (See Chapter 2.5.2).

During the last decade, trials of CGA have been performed in new settings, such as in emergency departments (Conroy et al. 2014), in orthogeriatric units among hip fracture patients (Grigoryan et al. 2014; Prestmo et al. 2015), and in oncological and surgical in- and out-patient settings among older cancer patients (Paillaud et al. 2014). Furthermore, the role of CGA in the perioperative assessment of older patients (Oresanya et al. 2014; Partridge et al. 2014) and in the assessment of patients with cancer has been studied (Corre et al. 2016; Hempenius et al. 2013; Kalsi et al. 2015; Wedding et al. 2007; Xue et al. 2018).

2.5.2 Effectiveness of CGA-based care

2.5.2.1 Evidence from systematic reviews and meta-analyses

Knowledge of the effectiveness of CGA-based programmes comes from numerous randomised controlled trials (RCTs) and controlled studies. Table 2 summarises the main systematic reviews and meta-analyses of CGA-based programmes in inpatient settings and in community and outpatient consultations. The most substantial evidence of the effectiveness of CGA-based care compared to that of usual care comes from hospitals. CGA performed by a multidisciplinary team in a dedicated ward is superior to CGA performed by a geriatric consultation team in different wards. CGA trials in the community have obtained mixed results. However, there is evidence that certain kinds of preventive home visits effectively reduce the occurrence of functional impairment, and complex interventions may reduce hospitalisations and institutionalisations of community-dwelling older persons.

Table 2. Systematic reviews and meta-analyses of effectiveness of CGA-based programs in inpatient settings and in community and outpatient consultations

Authors, year	Number and type of studies	Number and characteristics of older participants	Intervention group and control group	Outcome measures	Conclusions
In inpatient settings					
Baztan et al. (2009)	9 CSs[1] and 2 case-control studies	6,611 acutely ill hospitalised patients	Care in acute geriatric units vs. in conventional care units	Functional decline, living at home, cost of index admission, readmissions, and case fatality	Admission to acute geriatric units reduced the occurrence of functional impairment at discharge and increased the probability of living at home 3 months after discharge. The rate of case fatality or hospital care costs did not increase.
Van Craen et al. (2010)	7 RCTs[2]	4,759 hospitalised patients	Care in GEMUs[3] vs. in conventional care units	Functional decline, length of hospital stay, institutionalisation, readmissions, and mortality	Admission to a GEMU reduced the occurrence of functional impairment at discharge and the rate of institutionalisation after 1 year of discharge. For the other outcomes, the results did not differ.
Bachmann et al. (2010)	17 RCTs	4,780 patients in rehabilitation wards	Inpatient rehabilitation specifically designed for geriatric patients vs. usual inpatient rehabilitation	Functional status, nursing home admission, and mortality	Patients in the intervention groups had better functional status, fewer nursing home admissions, and lower mortality at discharge and at the end of 1-year follow-up.
Conroy et al. (2011)	5 RCTs	2,474 patients with frailty rapidly discharged after hospitalisation	CGA[4]-based care vs. usual care	Functional outcomes, quality of life, cognition, institutionalisation, readmissions, and mortality	No clear evidence of a benefit from CGA interventions.
Fox et al. (2012)	RCTs and quasi-experimental studies (n=13)	6,839 acutely ill or injured patients	Care in acute geriatric units vs. in non-geriatric hospital units	Functional decline, length of hospital stay, discharge destination, falls, pressure ulcers, delirium, costs, readmissions, and mortality	Care in acute geriatric units was associated with fewer falls, lower occurrence of delirium, shorter hospital stay, fewer nursing home admissions, more discharges to home, and lower costs. No differences were found in mortality or readmission rates.
Deschodt et al. (2013)	9 RCTs and 2 CSs	4,546 acutely ill hospitalised patients	Inpatient geriatric consultation teams vs. usual care without consultations	Functional status, length of hospital stay, readmissions, and mortality	No significant effect on outcomes.

Ekdahl et al. (2015)	17 RCTs	6,005 hospitalised patients with complex conditions	CGA performed in a ward or by consultation teams vs. usual care	Change in housing and in ADLs[5] and IADLs[6], readmissions, cognition, depression, quality of life, caregiver burden, and mortality	For patients with frailty, ward-based CGA was superior to usual care in living at home, better functional status, and a lower prevalence of depression. CGA performed by consultation teams preserved functional status among moderately frail patients.
Ellis et al. (2017)	20 RCTs	13,766 acutely ill hospitalised patients	CGA performed in a ward or by consultation teams vs. usual care	Living at home, nursing home admission, dependence, cognitive function, length of hospital stay, cost and cost-effectiveness, and mortality	CGA increased patients' likelihood of being alive and living in their own home and decreased the likelihood of admission to nursing homes at the end of a 3—12 month follow-up. There was little or no difference in mortality, patients' dependency status, or cognitive functions.
Eamer et al. (2018)	8 RCTs	1,583 patients with hip fracture	CGA-based care vs. usual care	Discharge destination, length of hospital stay, readmissions, cost, postoperative complications, and mortality	CGA reduced the rates of discharge to a higher level of care and mortality in patients with hip fracture. The intervention did not affect readmission rates or significant postoperative complications.
In community and outpatient consultations					
Stuck et al. (2002)	18 RCTs	13,447 community-dwelling persons	Preventive home visits vs. no visits. Further comparison between trials with CGA to those without CGA.	Functional status, nursing home admission, and mortality	Home visits were associated with reduced occurrence of functional impairment in such trials, which involved multidimensional assessment and follow-up visits. No effect on nursing home admission. Mortality was reduced in patients aged <80 years, but not in patients aged >80 years.
Kuo et al. (2004)	9 RCTs	3,750 persons from outpatient settings	CGA in an outpatient setting vs. usual care without CGA	Mortality	No effect of outpatient CGA on survival.
Huss et al. (2008)	21 RCTs	14,603 community-dwelling persons	Preventive home visits vs. no visits	Functional decline, nursing home admission, and mortality	Functional decline was reduced in such programs including a clinical examination. Mortality was reduced in younger study patients (72—78 years) but not in older patients. No effect on nursing home admission.
Beswick et al. (2008)	9 RCTs	3,750 persons from outpatient settings	CGA in an outpatient setting vs. usual care without CGA	Mortality	No effect of outpatient CGA on survival.

[1] CSs Controlled studies
[2] RCTs Randomised controlled studies
[3] GEMUs Geriatric evaluation and management units
[4] CGA Comprehensive geriatric assessment
[5] ADLs Activities of daily living
[6] IADLs Instrumental activities of daily living

2.5.2.2 Challenges in interpreting the evidence

There are many features of geriatric issues that make clinical ageing research challenging. The traditional way of research and collecting evidence by examining the causes and treatment of isolated diseases is not suitable for geriatric patients. (Studenski 2008.) Besides, there are barriers to recruiting older adults in research: multiple health problems, social and cultural barriers, and difficulties in obtaining informed consent (Mody et al. 2008).

Studies on the effectiveness of CGA programmes are heterogeneous in design and reported outcomes, making the interpretation of results difficult. While CGA interventions usually share common aims (such as restoring or improving functional ability), there are marked differences in methodologies, assessment and measurement tools used, and intervention processes. Furthermore, as interventions are carried out in diverse healthcare settings, contextual factors such as cultural issues, existing service capacity, organisational factors, and health care professionals' expertise and training may have diverse impacts on the results. Accordingly, the interventions' benefits and the studies' results are challenging to compare and distinguish. (Savy et al. 2019.)

Although CGA is a patient-centred process, patient-related outcomes, such as health-related quality of life or participation, are not usually reported in studies and reviews exploring the effectiveness of CGA in improving hospital outcomes. The most studied outcomes can be divided into three groups: 1) clinical outcomes (such as mortality, change in ADLs or cognitive function, and dependency status), 2) operational outcomes (such as the length of the hospital stay and readmission after discharge), and 3) outcomes related to the living situation (for example living at home and institutionalisation). (Parker et al. 2018.)

Lin et al. (2012) clarified the challenges in synthesising and interpreting the evidence from a systematic review of multifactorial interventions to prevent functional impairment in older people. First, there were challenges in understanding population risk and complex interventions. Study populations were heterogeneous and had been recruited using variable inclusion criteria and different definitions for persons at risk of functional impairment. Multifactorial assessment and management interventions varied greatly, which caused difficulties in synthesising the findings based on such heterogeneous populations and interventions. Second, there were challenges in conducting the outcome analyses. These challenges were related to variability in the use of instruments and outcome

measures and inconsistent reporting of outcomes between trials. Third, there were challenges in the interpretation of results. They were related to the inconsistent and inadequate reporting of data that hindered the comparison of populations, interventions, and outcomes among studies.

2.6 CGA in clinical practice

2.6.1 Shortness of research

Despite the extensive literature on CGA-based programmes, there is a lack of research on how CGA is being used in real-world clinical settings. Knowledge regarding the effectiveness of CGA comes mainly from clinical trials, and the implementation of CGA in real-world clinical settings has hardly been studied. There is a big gap between ideal conditions and reality in terms of using CGA in clinical practice (Polidori & Roller-Wirnsberger 2018).

Pitkälä et al. (2018) carried out an international electronic survey on the current status of geriatrics and geriatricians' position in different countries. The survey was administered to 22 geriatricians who had leading positions in Geriatric Medicine in their countries. The questionnaire included a question about the implementation of CGA in the care of older people in their respective countries. The response alternatives were very well, well, moderately, rather poorly, and poorly. Of the respondents, 59% answered that CGA was at least moderately implemented in their country.

Ivanoff et al. (2018) organised a focus group including 46 professionals who worked in different healthcare settings (primary care, hospital, or municipal health) and in social care in Sweden to explore other professionals' views and experiences related to CGA use. One of the study's main findings was the persisting contrast between the professionals' ideal image of CGA and reality. The ideal condition was to be able to perform a unique, well-performed need assessment for each older patient based on his/her own perspective of what is important. In reality, only needs that could be resolved within their own organisation were assessed, leaving their real needs usually undetected. Participants reported that they lacked the skills to determine the needs that the patient was reluctant to bring up or those that he/she was unaware of, for example, cognitive problems. There were communicational and structural barriers within and outside each organisation.

Patients did not receive equal assessment opportunities due to the lack of guidelines and assessment routines. In addition, professionals prioritised experience-based knowledge and competence during assessment, asking questions other than those in standardised tests.

2.6.2 CGA-based standardised assessment instruments

2.6.2.1 Development of assessment instruments

First-generation assessment instruments are widely used. They have various structures to cover different assessment domains, some examples include the Mini-Mental State Examination for cognitive impairment screening (Folstein et al. 1975) and the Barthel Index for functional assessment (Mahoney & Barthel 1965). The instruments used in a particular care setting are selected based on patients' characteristics, clinical settings, and available resources. Among the strengths of first- generation assessment instruments are their focus on a specific issue or problem, availability of measurement rules, and the known reliability, validity, and utility based on clinical trials. However, their weaknesses include lack of proven utility in different care settings, the focused nature of the assessment, the difficulty in combining all gathered information, and the problems of sharing essential information across different care settings. (Gray et al. 2009.)

The goals of the development of the second-generation assessment instrument system, the RAI-minimum data set (RAI-MDS) instruments, were to include several domains of assessment into the same instrument, thus making the instrument applicable in different clinical settings and providing an opportunity to interpret assessment information systemically (Gray et al. 2009; Hirdes et al. 1999). The information gathered in the assessment can be combined to form an integrated health information system linking acute care, long-term care, home care facilities, and mental health care. Other advantages include the coverage of all relevant care domains, the opportunity to base an individual patient's care planning on the information gathered, the ability to obtain a set of outcome measurements from the database, and the opportunity to create case-mix-based groups for funding purposes. (Hirdes et al. 1999.)

Third-generation assessment instruments belong to the family of interRAI assessment instruments. They were based on the RAI-MDS instruments and further developed to be more suitable in multiple care settings.

2.6.2.2 The interRAI assessment system

At present, these interRAI instruments are the most widely used CGA-based tools worldwide. They are also used in Finland. The interRAI instruments are standardised and fully structured assessment tools that collect information on the patient functions at the physical, cognitive, and psychosocial levels as well as collect sociodemographic data, medical diagnoses, and current symptoms. Several interRAI instruments with similar core items and divergent instrument-specific items are remoulded to suit different healthcare settings, such as the interRAI instruments for acute care, home care, long-term care, palliative care, and post-acute care and rehabilitation. (Gray et al. 2009.)

Nowadays, interRAI instruments are widely used in Europe, North America, and Oceania. interRAI instruments offer promising opportunities to perform a standardised geriatric assessment in clinical practice. Each interRAI instrument includes clinical assessment protocols (CAPs) to enhance the utilisation of assessment results in patient-level care. CAPs include triggers to identify persons with identified problems or GSs and make suggestions for care planning. However, there are several other purposes for the use of interRAI instruments, such as quality improvement, benchmarking, and the promotion of policy decision-making. In 2018, the most widely used interRAI instruments in Finland were interRAI Home Care (the assessment was performed for 35% of home care clients) and interRAI Long-Term Care (the assessment was performed for 40% of long-term care clients) (Finnish Institute for Health and Welfare). Despite the wide use of interRAI instruments and the large number of interRAI-based studies, little is known about the way assessment results are utilised in patient-level care.

2.6.2.3 The Multidimensional Prognostic Index

The Multidimensional Prognostic Index (MPI) developed by Pilotto et al. (2008) was constructed from a standardised CGA to acquire information about the patient's prognosis for clinical decision-making. The MPI is based on screening instruments that evaluate 63 items in eight domains: ADLs, IADLs, cognition, nutrition, mobility, multimorbidity, polypharmacy, and social support network. The programme for calculating the MPI is freely downloadable from the Internet and can be accessed via an IOS app. The programme calculates the MPI score, which ranges from zero to one. The score predicts an individual patient's mortality risk based on three levels: low, moderate, and high. The MPI has been validated in

different healthcare settings and has been shown to predict several adverse outcomes such as prolonged in-hospital length of stay (Pilotto et al. 2016) and short- and long-term mortality in hospitalised patients (De Luca et al. 2015). The MPI has not been translated into Finnish, and it is not used in Finland.

However, although MPI is based on the significant domains of CGA and the developers of the MPI call it a CGA tool, it is more of a prognostic instrument than a CGA tool. Categorically, it belongs to frailty tools than to CGA tools due to its nature to define an exact score that is further used for classification into mortality risk groups (Dent et al. 2019b).

2.7 Challenges in the implementation of CGA

According to Gladman et al. (2016), failure has been seen in terms of implementing research-knowledge for CGA; there is a 'know-do gap' and an uncertainty about how to implement CGA, (a 'know gap') in clinical practice. The implementation of new protocols in clinical practice is challenging. Successful implementation requires multiple changes, from individual clinical practice to organisational structures and systems of care (Brommels 2010). Implementation of complex interventions such as CGA may be especially challenging. Positive results from RCTs are not sufficient to support the implementation of complex, widespread interventions in clinical practice. It is necessary to certify that CGA-based interventions also work in real-world practice. Besides, in every individual setting of care, there is a need to explicitly define the assessment domains, the assessment depth, and the duties of individual professionals in the assessment and the creation of care plans. (Gladman et al. 2016.)

Flottorp et al. (2013) created a comprehensive, integrated checklist of determinants of practice (TICD Checklist) that might prevent or enable improvements in professional healthcare practice. They grouped potential determinants into seven domains: guideline factors; individual health professional factors; patient factors; professional interactions; incentives and resources; capacity for organisational change; and social, political, and legal factors.

Gladman et al. (2016) classified the barriers against the implementation of CGA in clinical practice according to the TICD Checklist. The barriers related to *guideline factors* include the scarcity of guideline instructions about how CGA interventions can be translated into real-world clinical settings. *Professional factors* include the lack of knowledge and understanding of CGA among health care professionals who

take care of older patients. *Patient factors* include the reluctance to use geriatric services because of negative perceptions and the fact that all services do not meet the users' needs. *Professional interactions* play a central role in the implementation of multi-professional processes. There are challenges in delivering effective team-based care when specialist wards are not designated for older patients. The barriers related to *incentives and resources* include establishing incentives and mobilising resources for CGA implementation. The obstacles related to the *capacity of organisational change* include the challenges in reorganising traditional, single-problem-oriented care delivery systems to a new model of care that considers the complexity of older patients and encourages the multifaceted assessment approach. *Social, political, and legal factors* include the challenges encountered by policymakers to understand the need for new models of care that integrates health and social care, primary and secondary care, and physical and mental health care.

Devriendt et al. (2013) evaluated the strengths, weaknesses, opportunities, and threats related the incorporation of the interRAI Acute Care (interRAI AC) instrument as a CGA tool in acute hospital settings in Belgium. Strengths included a timely understanding of the patients' condition early after admission to the ward, and promotion of multidisciplinary teamwork and multidimensional evaluation. Opportunities included the chance to create an individualised care plan based on assessment outcomes, benchmarking at the ward and organisational level, and the introduction of CGA in non-geriatric wards. Weaknesses included time-consuming processes and difficulties in making timely assessments in a busy clinical practice setting. It was noted that data quality and the use of clinical output varied strongly. Health care professionals (nurses, geriatricians, occupational therapists, and social workers) perceived that interRAI instruments are used purely for registration purposed without any clinical value. Threats included low funding, the need for coordination to avoid interference with clinical work and workload, and the need for extensive and repeated training for professionals'.

Traditionally, multidomain CGA has been performed in acute geriatric wards by a geriatrician-led multidisciplinary team. More recently, it has been recognised that the CGA principles need to be expanded beyond geriatrics due to workforce challenges in that field and the increasing number of older patients with frailty needing health care services (Dhesi et al. 2019; Kocman et al. 2019). Kocman et al. (2019) designed and formatively evaluated the implementation of the CGA toolkit in peri-operative cancer care pathways in two large teaching hospitals in the United Kingdom. The implementation process took a long time, and at the end of the 12-month pilot period, both hospitals remained at starting phase of the

implementation. Although clinicians subscribed the incorporation of CGA principles, the latter were not incorporated into routine practice. The authors concluded that the implementation of CGA principles in non-geriatric services requires adequate support as well as geriatric education and training for personnel. Furthermore, there is a need for policy changes to highlight the important individual and societal benefits of CGA.

2.8 Summary of the literature

Biological ageing, combined with an increased risk of acquiring chronic diseases and GSs as well as psychological and social changes that inevitably occur during old age, make older persons vulnerable to adverse health outcomes. Vulnerability becomes more evident in stressful situations. The traditional model of organising health care services is not suitable for older patients with multimorbidity, GSs and frailty, and may lead to an increase in adverse health outcomes. Most GSs and other health-related problems that have an impact on an individual patient's life remain undetected if they are not searched for systematically

CGA has been developed to help health care professionals deal with an older patient's complex situation and determine strategies in managing conditions that might worsen the patient's quality of life and prognosis. In addition to the conventional medical history-taking and examinations, CGA includes a systematic evaluation of patients' functional, psychosocial, and cognitive capacities as well as the consideration of environmental factors. CGA-based care is superior to usual care among older patients with frailty in terms of reducing functional deterioration and decreasing the rates of institutionalisation and mortality.

Although a large number of RCTs and other studies have examined the effectiveness of CGA-based care, there are hardly any studies evaluating CGA use in daily clinical practice. It has been acknowledged that there are challenges in implementing CGA in clinical practice (Gladman et al. 2016). The incorporation of standardised assessment instruments such as interRAI instruments in clinical practice offers opportunities to systematically and comprehensively perform CGA, and the information gathered may be utilised while providing care at the patient-level. However, challenges in implementation need to be overcome to successfully incorporate these new methods in clinical practice.

3 AIMS OF THE STUDY AND RESEARCH QUESTIONS

The aims of this study were to examine how Finnish geriatricians perform CGA in clinical practice, how a widely used geriatric assessment tool, interRAI Instrument (the interRAI), can be used to identify patients at increased risk of adverse hospital outcomes and readmission, and to describe the implementation and preliminary results of a depression screening protocol among respiratory insufficiency patients.

The specific questions were as follows:

1. How do Finnish geriatricians perform CGA in their clinical practices?

2. Which GSs and other conditions detected by a widely used geriatric assessment tool, interRAI, associate with adverse hospital outcomes (in-hospital mortality, prolonged hospital stay, and emergency department admission)?

3. How CGA, based on the interRAI Post-Acute Care instrument, interRAI-PAC, can be used to identify patients with an increased risk of readmission after discharge from a geriatric hospital?

4. How did the implementation of a depression screening protocol succeed and what were the challenges in implementation?

4 MATERIALS AND METHODS

4.1 Overview

This thesis consists of four original studies with three different subject populations (Table 3).

Table 3. An overview of the participants, setting, design, and methods of the thesis

Paper	Participants and setting	Design	Methods
I	95 geriatrician members of the Finnish Geriatrics Society	A cross-sectional study; a web-based questionnaire survey	Questions examined the use of comprehensive geriatric assessment in clinical practice. Evaluated domains were the assessment of cognition and functional ability, nutritional assessment, evaluation of depression, and measurement of orthostatic blood pressure.
II	2,188 hospitalised patients aged ≥70 years in a geriatric hospital	Retrospective cohort studies: analyses of interRAI Post-Acute Care (interRAI-PAC) assessments combined with hospital discharge records	The derivation of a frailty index based on the interRAI-PAC. The associations of interRAI scales and frailty index with hospital outcomes were analysed.
III	1,167 patients aged ≥70 years discharged to home from a geriatric hospital		The associations of interRAI-PAC variables and scales with readmissions were analysed.
IV	238 patients at a pulmonary outpatient clinic	A retrospective cohort study; an analysis of patient records concerning the results of the implementation of a depression screening protocol	The evaluation of the outcomes of a depression screening protocol. As per protocol, the patients filled the Depression Scale questionnaire. Patients whose scores were suggestive of depression were offered the opportunity of a further evaluation of mood at a psychiatric outpatient clinic.

4.2 Study I

4.2.1 Participants

The study population consisted of 95 geriatricians who responded to a web-based questionnaire survey directed to all members of the Finnish Geriatrics Society (SG) (n=248) in 2013. Most Finnish geriatricians belong to the SG. Most members of the SG are geriatricians, but some members are geriatric residents and physicians from other specialties. A total of 121/248 members responded to the survey (response rate: 49%). As the goal was to collect data on geriatricians' clinical practices, geriatric residents (n=14), other physicians (n=4), and geriatricians who did not work as clinical geriatricians (n=8) were excluded from the study.

4.2.2 Methods

The study hypothesised that geriatricians in Finland do not use CGA systematically in clinical practice. In 2013, the Finnish Geriatrics Society performed a questionnaire survey among its members about the content of work, coping at work, and the general atmosphere in geriatric care with respect to geriatricians (Löppönen et al. 2015). A few questions concerning the geriatricians' performance of CGA in their clinical practice were added to the questionnaire.

It was asked if the respondent included an assessment of cognition, nutrition, functional ability, mood, and stability of blood pressure in the standing position into CGA. Selected domains represented conditions that are a relevant part of the assessment in various medical settings, and there are suitable treatment protocols available for identified concerns. Furthermore, evaluation of functional ability is a fundamental component of CGA and the selected GSs (cognitive problems, nutrition problems, and depression) are prevalent (Buurman et al. 2011), severe, and often unrecognised in older patients (Carlson et al. 2015). Measurement of orthostatic blood pressure is an essential part of the medication review and the assessment protocol after falls (Phelan et al. 2015).

The first question sorted out whether the respondent administers CGA 1) to all new patients, 2) to selected patients, or 3) to no patients. Another problem was whether the respondent incorporated the following domains into CGA: 1) assessment of cognition (e.g. Mini-Mental State Examination), 2) screening and

assessment of malnutrition, 3) structured assessment of functional ability, 4) structured assessment of depression (using screening instruments or diagnostic criteria for depression), and 5) measurement of orthostatic blood pressure. The answer alternatives were 1) always, 2) after consideration, and 3) never.

4.2.3 Statistical analysis

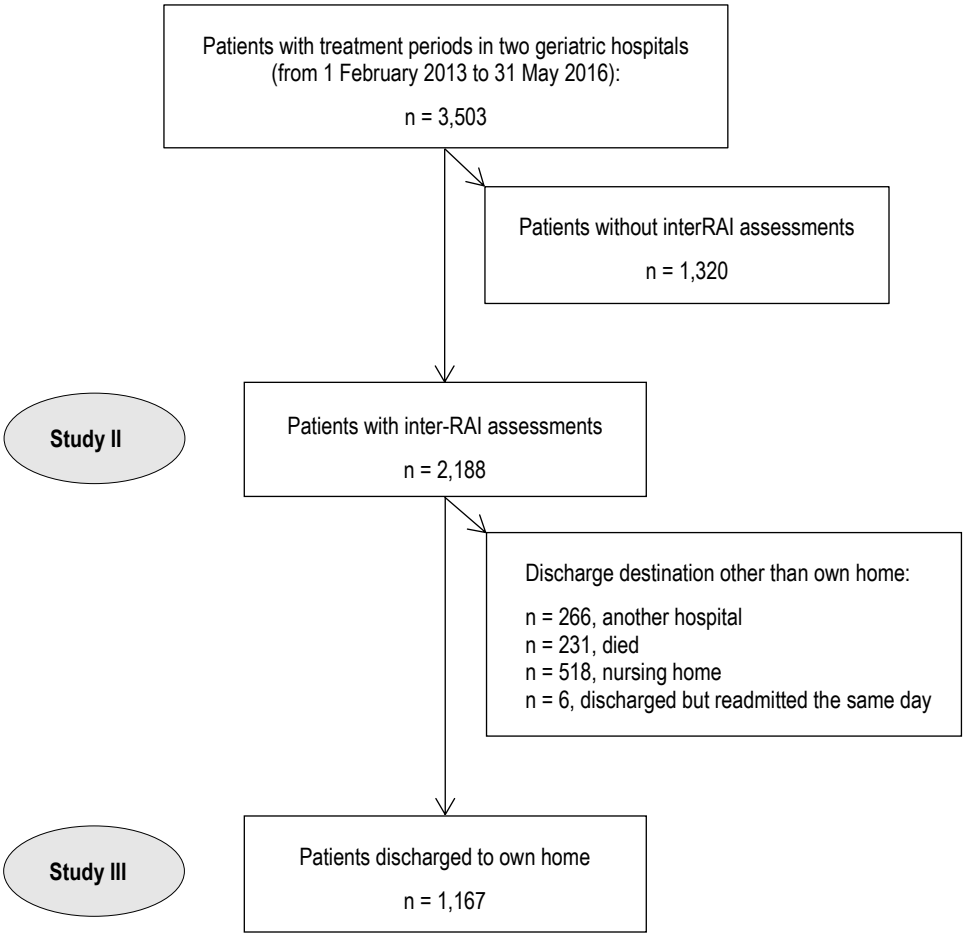
Respondents' use of CGA in relation to age, sex, workplace, and clinical experience as a geriatrician was reported descriptively. The chi-squared test or Fisher's exact test (as appropriate) was used to analyse statistical significance. P-values <0.05 were considered statistically significant. Data management and analyses were performed using IBM SPSS Statistics 20.

4.3 Studies II and III

4.3.1 Participants

The study populations consisted of patients aged ≥70 years who were hospitalised in two geriatric hospitals in Tampere from 1 February, 2013 to 31 May, 2016. The results of interRAI Post-Acute Care (interRAI-PAC) assessment were retrospectively linked to mandatory hospital discharge records. The records of the first hospitalisation period of the patient to which the interRAI assessment data could be linked were included in the study (i.e., the index hospital stay) (Figure 4). All 2,188 hospitalised patients during the study period were included in Study II. The 1,167 community-dwelling patients discharged to their own homes after the index hospital stay were included in Study III.

Figure 4. Study populations in Studies II and III

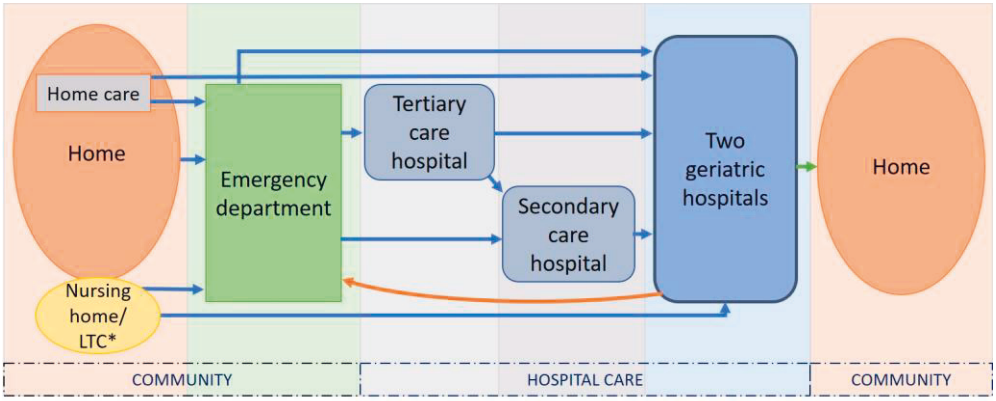


4.3.2 Methods

4.3.2.1 Setting, databases, and variables

Two geriatric hospitals, where patients were hospitalised, are situated in Tampere (population: 232,000, of which 11% are aged ≥70 years). These hospitals (230 and 190 beds) offered post-acute care and rehabilitation to patients who were first hospitalised in a tertiary or secondary care hospital. Furthermore, home care nurses or physicians in the emergency department could refer home care clients with acute sicknesses directly to the hospitals in the absence of previous hospitalisation in an acute care hospital (Figure 5).

Figure 5. Illustration of the organisational structure of geriatric care in Tampere and patient flow through care settings (blue arrows: from home to hospital, orange arrow: emergency department admission during stay in a geriatric hospital, green arrow: from the geriatric hospital to home). From Kerminen et al. (2020).



* LTC Long-term care

The use of interRAI-PAC assessment was started on 1 February, 2013 in one of the hospitals, and it gradually was introduced in the other hospital. All wards in both hospitals began to use interRAI-PAC assessment at the beginning of 2016. According to the instructions, trained nurses should perform the assessment within a few days of the patient's admission to the ward. During the assessment process, they observed the patient, reviewed the medical records, and interviewed the patient and family members.

The interRAI-PAC assessment has been designed to be used as a CGA tool in post-acute and rehabilitation settings (Gray et al. 2009). It consists of about 150

variables and contains information on the patient's living arrangements, home care, chronic diseases, functional ability, GSs, previous falls, several symptoms, and body mass index (BMI). Single variables are combined to compose validated scales that measure different aspects of functional ability (Gray et al. 2009). The hospital discharge records contained information about the patient's usual residence and the place he/she was admitted from, dates of admission and discharge, and discharge diagnosis and destination. Dates of death were based on comprehensive national records of death certificates, obtained from hospital discharge records.

The associations of both single variables and scales, as well as the FI derived from the interRAI-PAC assessment (see below), with hospital outcomes and readmission were analysed. Table 4 illustrates the interRAI scales used in the studies. Generally, increasing scores of interRAI scales describe worsening health conditions.

Table 4. Scales of the interRAI Post-Acute Care instrument used in studies II and III

Scale		Score*	Measurement
ADLH	The Activities of Daily Living Hierarchy Scale	0—6	Functional ability
CPS	The Cognitive Performance Scale	0—6	Cognition
DRS	The Depression Rating Scale	0—14	Symptoms of depression
ABS	The Aggressive Behaviour Scale	0—12	Behavioural symptoms
Pain	The Pain Scale	0—4	The frequency and severity of pain
BMI	Body Mass Index		Weight (kg)/height (m)^2
CHESS	The Changes in Health, End-stage disease, and Signs and Symptoms Scale	0—5	Stability of health status

* Increasing scores of the scales describe worsening health conditions.

In Study II, associations of the interRAI scales measuring cognitive functions, ADLs, mood, and stability of health state were used based on previous findings of prognostic factors related to the outcomes of older inpatients (Buurman et al. 2011; Covinsky et al. 2011; Hirdes et al. 2014; Lucke et al. 2018; Prina et al. 2013). The Cognitive Performance Scale (CPS) describes the cognitive status of the patient based on an algorithm (Morris et al. 2016). The Activities of Daily Living Hierarchy Scale (ADLH) is an algorithm that considers a measure of ADL performance in locomotion, eating, toilet use, and personal hygiene (Morris et al. 1999). The Depression Rating Scale (DRS) is based on existing symptoms of

depression (Burrows et al. 2000). The Changes in Health, End-stage disease, and Signs and Symptoms Scale (CHESS) is a summary measure based on decline in cognition and ADL performance, certain symptoms (for example, weight loss, shortness of breath, and oedema), and ratings of a prognosis of less than six months, and it is designed to identify individuals at high risk for clinically significant decline (Hirdes et al. 2003).

In Study III, the interRAI-PAC variables evaluated as possible risk factors for readmission included the baseline characteristics of the patients (e.g. age, sex, living place, home-care services, and chronic diseases), primary mode of locomotion, walking speed, and information about falls, hearing, vision, self-rated health, specific symptoms, continence, and rehabilitation potential. In addition, the interRAI scales (CPS, ADLH, DRS, CHESS, ABS, and the Pain Scale), BMI and the FI, were evaluated as possible risk factors. The Aggressive Behaviour Scale (ABS) measures the severity of behavioural symptoms (Perlman & Hirdes 2008) and the Pain Scale measures the frequency and severity of pain (Fries et al. 2001).

4.3.2.2 Derivation of a frailty index from interRAI-PAC assessment (II)

The FI-PAC was derived from the interRAI-PAC assessment according to the standard procedure of creating a FI (Searle et al. 2008) and based on the coding of related variables derived from the interRAI Acute Care instrument (Hubbard et al. 2015). All items of the interRAI-PAC were evaluated against the FI criteria independently by two geriatricians (H.K. and E.J.). Eventual differences were negotiated to achieve a consensus of appropriate variables in the post-acute care patient population. Of the variables considered, 57 were chosen for the FI-PAC. The FI was calculated for each patient by adding the deficit points and dividing the sum by the total number of deficits. The only missing item was BMI in 23 patients, and the denominator was adjusted to 56 items for these patients.

4.3.2.3 Hospital outcome measures (II)

Three hospital outcome measures were used:

1) *In-hospital mortality*, when the patient died during the index hospital stay or on the day of referral to the acute care hospital (n=4).
2) *Emergency department admission* in the tertiary care hospital during the index hospital stay.

3) *Prolonged hospital stay*. Length of hospital stay was determined as the difference between the date of admission and the date of discharge. Length of stay in geriatric hospital was recorded only for the patients who were discharged to their usual residency (own home or nursing home). In study materials, there were also patients that could not be discharged to their own home and they were waiting for the placement to the 24/7 care setting. These patients were not included, because their length of hospital stay was most probably more dependent on organisational factors than their health status. Length of hospital stay was dichotomously classified as less than 90 days and 90 days or more according to the usual cut-off for long-term care (Martikainen et al. 2009). Hospitalisation for 90 days or more was defined as a prolonged hospital stay.

4.3.2.4 Readmission as an outcome measure (III)

The primary outcome was all-cause readmission of the patient within 90 days following discharge after the index hospital stay. Patients' readmission to hospitals and deaths were registered for 1 year after discharge. Readmission data were obtained from the Tampere hospital discharge records and included information from the secondary care hospital and geriatric hospitals. As the Tampere hospital discharge records did not include data from a tertiary care hospital (Tampere University Hospital), readmissions to this hospital were not registered. However, older patients admitted to Tampere University Hospital are usually transferred to a secondary care hospital or geriatric hospitals before discharge to home.

4.3.3 Statistical analysis

Patient characteristics were described using frequencies and percentages. The results were presented as odds ratios (ORs) with 95% confidence intervals (CIs). Data management and analyses were performed using IBM SPSS Statistics 25.0.

In study II, the distribution of the FI-PAC was tested in all patients and in sex- and age-based groups; the results are presented as means and standard deviations. The FI-PAC's predictive ability for outcomes was investigated using binary logistic regression analysis adjusted for sex and age. The receiver operating characteristic curve (ROC) and the area under the curve (AUC) with 95% Cis were calculated to determine the discriminative ability of the FI-PAC for outcomes. For each

outcome, the optimal cut-off points of the FI-PAC for sensitivity and specificity were calculated using the Youden method, and the positive and negative predictive values (PPV and NPV, respectively) were determined. To compare the predictive ability of the FI-PAC to those of existing interRAI scales, AUCs for hospital outcomes were calculated for the Activities of Daily Living Hierarchy Scale (ADLH); the Changes in Health, End-stage disease, and Signs and Symptoms Scale (CHESS); the Cognitive Performance Scale (CPS); and the Depression Rating Scale (DRS).

In study III, the survival curve for readmission was created using the Kaplan–Meier estimator. Associations of the risk factors with readmission were analysed using binary logistic regression. Variables selected for regression analysis included functional, clinical, and social variables from the interRAI-PAC instrument and demographic variables from hospital discharge records. First, all variables included in the univariate analysis, except for the FI, were included in the multivariable analysis using the enter method. The FI was not included because it involved the other included variables. Second, the following supplementary analyses were performed: 1) only the FI, age, and sex were entered into the multivariable model, and 2) the patients were divided into three FI-based groups (<0.2, 0.2─0.4, and >0.4) and the original multivariable analysis was performed.

4.4 Study IV

4.4.1 Participants

The study population consisted of 238 patients who visited the respiratory insufficiency section of the pulmonary outpatient clinic during three different periods of the implementation of the depression screening protocol: pilot phase I (17 August–23 October, 2015), pilot phase II (9 November, 2015–15 January, 2016), and follow-up phase (15 September–31 December, 2016). For patients who visited several times during the observation period, the first visit was considered in the study.

4.4.2 Methods

4.4.2.1 Setting

Tampere University Hospital is a tertiary hospital that provides specialised care to about 530,000 people living in 23 municipalities. Patients with respiratory diseases are treated at the pulmonary outpatient clinic (annual volume: about 14,000 visits and 4,500 patients). There is a specialised section for patients with respiratory insufficiency (annual volume: approximately 500 patients).

The patients are referred to the respiratory insufficiency section by physicians working in primary, specialised, or private healthcare. Typically, the referred patients have severe lung, neurological, or heart diseases with suspected chronic respiratory insufficiency. A nurse coordinates the patient's multidisciplinary care at the clinic. In addition to nurses, the multidisciplinary team comprises a pulmonologist, physiotherapist, rehabilitation counsellor, dietician, and social worker. The pulmonologist considers the differential diagnosis and makes decisions about medications and possible device-based treatments (long-term oxygen therapy [LTOT] and non-invasive ventilation [NIV]). Follow-up is performed according to a discrete follow-up protocol.

4.4.2.2 Implementation of a depression screening protocol

As a part of development work in the respiratory insufficiency section, a geriatrician from Tampere University (H.K.) was invited to evaluate functionality of the care protocol from the perspective of older patients. It turned out that the care was well organised with multidisciplinary care members participating in care, ensuring that medical, physical, and social aspects were considered. However, a systematic evaluation of depressive symptoms was missing. Nurses had the impression that the patients often had depressive symptoms but received no treatment for depression. The nurses disclosed their lack of knowledge regarding managing depressive symptoms, particularly as patients with chronic respiratory insufficiency have difficulty in seeking help because of limited functional ability.

Based on this, incorporation of depression screening into the care protocol was decided in collaboration with the general psychiatric unit of the hospital. The Depression Scale (DEPS), the primary screening instrument for depression used at Tampere University Hospital, was selected as the screening instrument. The DEPS

is a validated, self-rated screening tool for depression (Salokangas et al. 1995). A contract was drawn up for this project, allowing the referral of patients with positive results to an outpatient psychiatric clinic, even if the usual referral criteria were not met. The DEPS consists of 10 questions, and scores vary from 1 to 30 points. The cut-off point for depressive symptoms is a score of ≥9 points, while the cut-off point for clinical depression is a score of ≥12 (Poutanen et al. 2010). The pulmonary unit personnel were educated about depression detection via lectures and group discussions. The aim was to bring up mood symptoms in the conversation, improve the identification of depressive symptoms, and enhance their further evaluation and treatment.

Screening commenced in the August, 2015. Nurses were instructed to administer the DEPS to every patient visiting the respiratory insufficiency section. Patients whose scores were suggestive of depression were offered the opportunity to further undergo mood evaluation at a psychiatric outpatient clinic. In 2015, the cut-off for referral was a score of ≥12/30 points, and in 2016, the cut-off was lowered to a score of ≥9/30 to include patients with milder depressive symptoms. A referral was scheduled, and the patient was informed of the appointment time.

4.4.2.3 Evaluation of the depression screening

Patient records were retrospectively reviewed to evaluate 1) the coverage of the screening protocol; 2) the patients' willingness to fill in the DEPS questionnaire; 3) the proportion of patients with positive DEPS scores; 4) patient characteristics associated with high DEPS scores; and 5) the consequences of positive screening results. Patients' background information such as that of age, sex, use of walking aids and home care, living arrangements, smoking history, pulmonary disease diagnosis, causes for chronic respiratory insufficiency, other diagnoses, use of psychoactive medications, available measurements of lung function (FEV1 on post-bronchodilator spirometry), and functional exercise capacity (6-Minute walk test [6MWT]) were registered. Furthermore, data collected during the visit was used: the patient's height, weight, microspirometry findings, and scores from the COPD Assessment Test (CAT) (Jones et al. 2009), the modified Medical Research Council Dyspnoea Scale (mMRC) (Mahler & Wells 1988), and the Alcohol Use Disorders Identification Test (AUDIT-C) (Bush et al. 1998).

4.4.3 Statistical analysis

To identify patient groups with a high prevalence of depressive symptoms, the associations of patient characteristics with DEPS scores (<12 vs. ≥12 in the year 2015 and <9 vs. ≥9 in the year 2016) were analysed. The results of spirometry, microspirometry, AUDIT-C, CAT, mMRC, and 6MWT were compared according to DEPS scores. Statistical significance of differences between the groups was analysed using the Mann–Whitney U test, the chi-squared test, or Fisher's test, as appropriate. Data management and analyses were performed using IBM SPSS Statistics 23.

4.5 Ethical considerations

Study I. The members of the Finnish Geriatrics Society responded the web-based survey on a voluntary basis. Responses were handled anonymously.

Studies II and III. Retrospective registry-based studies are not considered medical research under Finnish legislation (Medical research act 9.4.1999/488), and as such, approval from the ethics committee was not required. Retrospectively collected health registry data could be used for these studies with permission from the registry owner without the need for informed consent from participants, based on the current national legislation (Act on the publicity of official documents 21.5.1999/621; Data protection act 5.12.2018/1050), and European Union General Data Protection Regulation (Recital 157.). Both research plans were reviewed institutionally. Permission to use the interRAI-PAC assessments and hospital discharge records were obtained from Tampere's city administration (decision made on 30 August, 2016 by the director of hospital services).

Study IV. The implementation of depression screening in routine care was a part of development work at the pulmonary outpatient clinic. The patients could refuse to complete the DEPS questionnaire. This retrospective study was organised to evaluate screening outcomes, and the researchers did not contact the patients. Prior to commencing the study, permission was acquired from the Science Centre of Tampere University Hospital.

5 RESULTS

5.1 Overview

The detailed outcomes of the studies are presented in the original communications, and therefore, only the main results in response to the thesis questions are summarised here.

5.2 Study I

5.2.1 Characteristics of the respondents

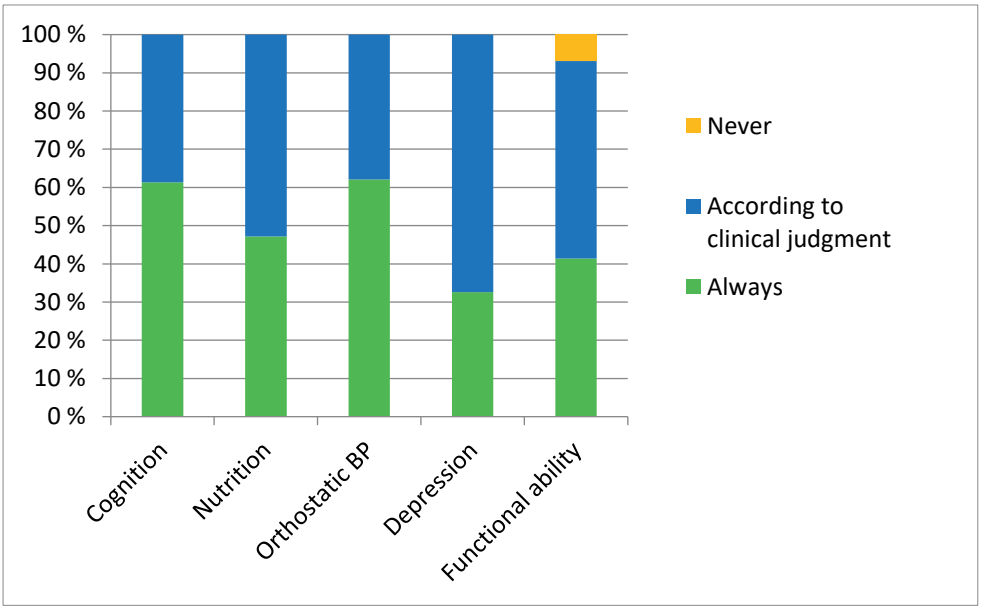
A total of 95 geriatricians responded to the survey. Of them, 71% were women, and 11% <40 years, 43% were aged 40─50 years, and 46% were aged >50 years. Nearly two-thirds of the respondents worked in the southern parts of Finland. The respondents' geographical distribution, age, and sex were similar to those of geriatricians in Finland in general (Löppönen et al. 2015). Half of the respondents had been working as clinical geriatricians for 5─15 years. The length of clinical experience as a geriatrician was <5 years in one-third and >15 years in one-fifth of the respondents.

5.2.2 CGA in clinical practice

The majority of the respondents (94%) answered that they use CGA when evaluating older patients. Of them, 38% performed CGA for all new patients, and the rest performed it for selected patients only. No differences were observed in the application of CGA according to sex, workplace, age groups, or the length of experience as a geriatrician.

The content of CGA considering the five evaluated domains varied between geriatricians. Assessment of cognition and measurement of orthostatic blood pressure were more systematically incorporated into CGA (60% of the respondents) than nutritional assessment (46%), the assessment of functional ability (40%), or the evaluation of mood (32%) (Figure 6).

Figure 6. Respondents' choice of comprehensive geriatric assessment (CGA) domains as reported by those who performed CGA (n=89). Modified from Kerminen et al. (2016)



The proportion of female physicians who included a structured assessment of functional ability (48% vs. 24%, p=0.01) and the evaluation of depression (39% vs. 16%, p=0.045) in CGA was significantly greater than that of male physicians. Respondents who applied CGA for all new patients, incorporated orthostatic blood pressure measurement and nutritional assessment more systematically into CGA than those who performed CGA to selected patients.

5.3 Studies II and III

5.3.1 Characteristics of the patients

Of all hospitalised patients, 69% were female, and the mean age (SD) was 84.7 (6.3) years. Almost half of the patients (46%, n=1,004) had a memory disorder diagnosis. Only 12% of the patients (n=255) independently performed all BADLs (eating, dressing, walking, bathing, personal hygiene, transfer to the toilet, and toilet use). In comparison, 18% (n=395) of the patients were entirely dependent on caregivers for all BADLs. Half of the patients came to the hospital from an acute care hospital, and the other half came straight from home. Table 5 illustrates the characteristics of all hospitalised patients (Study II) as well as the characteristics of patients who were discharged to their own homes (Study III).

Of the interRAI assessments, 64% and 85% had been performed within 7 and 14 days, respectively, of admission to the ward.

Table 5. Characteristics of the patients

	Study II		Study III	
	All patients		Patients discharged to home	
	n	%	n	%
Patients	2,188	100	1,167	53.3
Female sex	1,499	68.5	827	70.9
Age (years)				
70–79.9	498	22.8	275	23.6
80–89.9	1,234	56.4	666	57.1
≥90	456	20.8	226	19.4
Age (years) mean (SD)	84.7	(6.3)	84.5	(6.2)
Chronic diseases				
Alzheimer's disease	737	33.7	341	29.2
Other memory disorders	217	9.9	95	8.1
Alzheimer's disease and other memory disorder	50	2.3	25	2.1
Congestive heart failure	685	31.3	354	30.3
Coronary heart disease	572	26.1	298	25.5
Diabetes	528	24.1	296	25.4
Cancer	325	14.9	150	12.9

Depression	209	9.6	107	9.2
Stroke/ cerebrovascular accident	228	10.4	106	9.1
Chronic obstructive pulmonary disease	156	7.1	74	6.3
Parkinson's disease	59	2.7	33	2.8
Independence in activities of daily living				
Bathing	316	14.4	251	21.5
Personal hygiene	572	26.1	438	37.5
Dressing	649	29.7	498	42.3
Toilet use	859	39.3	631	54.1
Transfer to the toilet	1,003	47.5	722	61.9
Walking	1,014	46.3	719	61.6
Bed mobility	1,039	47.5	863	74.0
Eating	1,726	78.9	1,043	89.4
Primary mode of mobility				
Walking	1,573	71.8	983	84.2
Wheelchair or bedridden	615	28.1	184	15.8
Falls				
No falls in the last 3 months	1,077	49.2	601	51.5
Fall(s) 1—3 months ago	265	12.1	130	11.1
Fall(s) in the last month	846	38.7	436	37.4
Smokes tobacco daily	84	3.8	46	3.9
Body Mass Index (BMI) kg/m^2				
<18.5	192	8.9	80	6.9
18.5–24.9	997	46.1	500	42.8
25–29.9	606	28.0	336	28.8
≥30	370	17.1	240	20.6
BMI kg/m^2 mean (SD)	25.0	(5.4)	25.8	(5.6)
Admitted from				
Home	1,028	47.0	694	59.5
Hospital ward	1,111	50.8	473	40.5
Nursing home/ long-term care facility	49	2.2		
Operation during hospital stay	353	16.1	151	12.9
Duration of hospital stay				
1—30 days	1,459	66.9	971	83.2
>30 days	729	33.1	196	16.8

5.3.2 Distribution of the FI-PAC

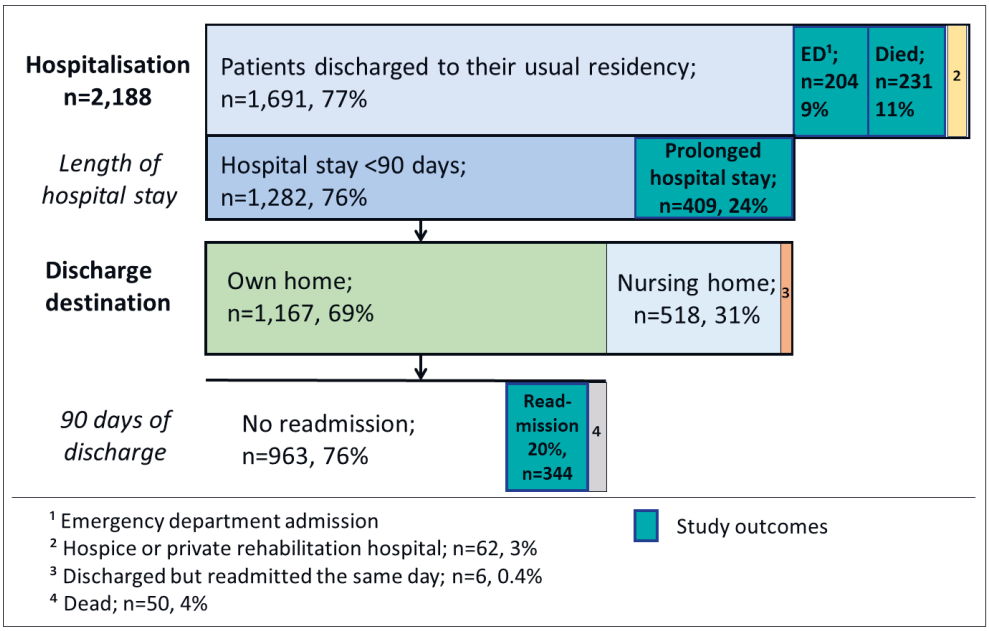
In all hospitalised patients (n=2,188), the FI-PAC was normally distributed, with a mean (SD) score of 0.34 (0.15), a minimum of 0.01, and a maximum of 0.76. There were no significant differences between the sex and age groups.

In the patients discharged to their own home (n=1,167), the FI-PAC was normally distributed, with a mean (SD) score of 0.28 (0.15), a minimum of 0.03 and a maximum of 0.62.

5.3.3 Outcomes

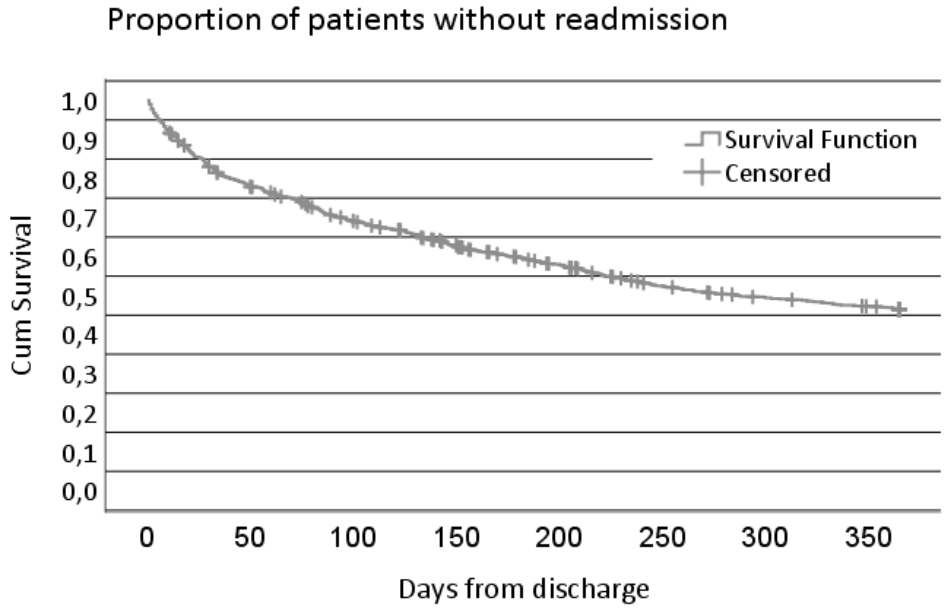
Of the hospitalised patients (n=2,188), 204 were transferred to the emergency department of acute care hospital during the index hospital stay *(emergency department admission)* and 231 patients died *(in-hospital mortality*) (Figure 7). Of the patients discharged to their usual residency (nursing home or own home) (n=1,691), 409 had hospital stay of ≥90 days *(prolonged hospital stay)*. In total, 1,167 patients were discharged to their own homes, and the remainder were discharged to a nursing home/long-term care facility. Of the patients discharged to their own homes, 344 patients were readmitted to a hospital within 90 days of discharge *(readmission)* and 50 died within 90 days of discharge.

Figure 7. Hospitalised patients and the length of hospital stay, discharge destination, and readmission status at 90 days of discharge. The outcomes of the studies have been shown in bold text.



The 90-day readmission rate was 29.5% (n=344), accounting for 57% of the (first) readmissions that occurred during the year after discharge (Figure 8). One-third (n=197) of yearly readmissions occurred in the first 30 days (30-day readmission rate: 16.9%). The 90-day mortality rate was 4.3% (n=50).

Figure 8. Kaplan–Meier curve showing readmissions 1 year after discharge from the rehabilitation hospital among 1,167 community-dwelling older patients. From Kerminen et al. (2021).



5.3.4 Association of the FI-PAC and interRAI scales with hospital outcomes (II)

The FI-PAC was associated with prolonged hospital stay, emergency department admission, and in-hospital mortality in logistic regression analyses adjusted for age and sex (Table 6). Each 0.1-point increase in the FI-PAC raised the likelihood of prolonged hospital stay by 91%, in-hospital death by 82%, and emergency department admission by 24%. There were no differences according to age and sex in the ability of the FI-PAC to predict hospital outcomes. The FI-PAC's ability to discriminate between patients who did or did not experience an adverse outcome was the best for prolonged hospital stay (AUC 0.75) and worst for emergency department admission (AUC 0.59).

Table 6. Discriminative capacity of the Frailty Index for Post-Acute Care (FI-PAC) for hospital outcomes. Adapted from Kerminen et al. (2020).

Outcome	Odds ratio*	(95% CI)	AUC	(95% CI)
Prolonged hospital stay	1.91	(1.73–2.09)	0.75	(0.72–0.77)
Emergency department admission	1.24	(1.11–1.37)	0.59	(0.55–0.63)
In-hospital mortality	1.82	(1.63–2.03)	0.73	(0.70–0.76)

* Odds ratio/ 0.1 increment in the FI. Adjusted for age and sex.

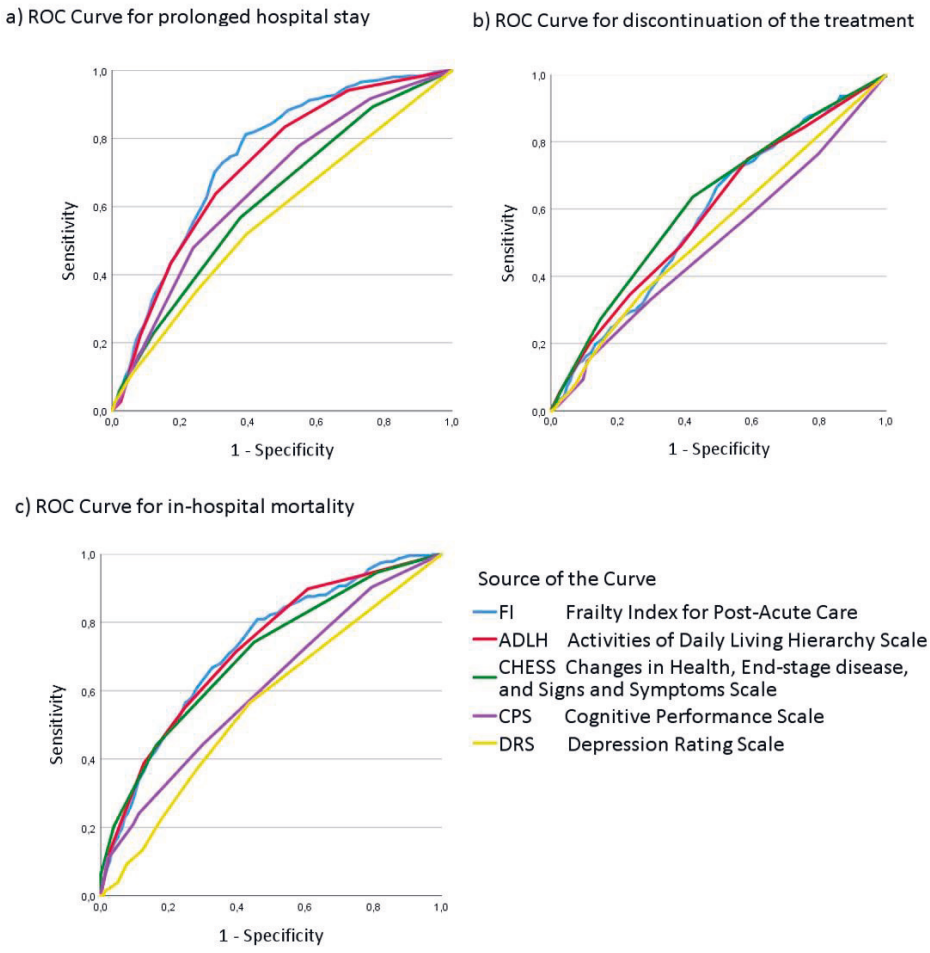
Table 7 shows the sensitivity, specificity, PPV and NPV of the FI-PAC for each outcome. The FI cut-off point for optimal sensitivity and specificity was 0.30 for emergency department admission, 0.32 for prolonged hospital stay, and 0.35 for in-hospital mortality. The FI's sensitivity was 81% for prolonged hospital stay and in-hospital mortality, whereas the sensitivity for emergency department admission was 73%. The specificity of the FI was the highest for prolonged hospital stay (61%). The NPVs were consistently high (91%–96%), whereas the PPVs varied from 14% to 40%.

Table 7. Discriminative and predictive capacity of the Frailty Index for Post-Acute Care (FI-PAC) for hospital outcomes. Adapted from Kerminen et al. (2020).

Outcome	FI cut-off point	Sensitivity		Specificity		Positive predictive value		Negative predictive value	
		n	(%)	n	(%)	n	(%)	n	(%)
Prolonged hospital stay	≥0.32	332/409	(81)	778/1,282	(61)	332/836	(40)	778/855	(91)
Emergency department admission	≥0.30	148/204	(73)	745/1,691	(44)	148/1,094	(14)	745/801	(93)
In-hospital mortality	≥0.35	188/231	(81)	1,057/1,957	(54)	188/1,088	(17)	1,057/1,100	(96)

On comparing the FI and the interRAI scales, the best scales for predicting prolonged hospital stay were the FI and ADLH, with equal discriminative capacity (Table 7 and Figure 9). They were significantly better than the DRS, CHESS, and CPS. The best scales for predicting in-hospital mortality were the FI-PAC, CHESS, and ADLH. The predictive abilities of the FI and interRAI scales were poor for emergency department admission.

Figure 9. Discriminative abilities of the Frailty Index for Post-Acute Care (FI-PAC) and interRAI scales for predicting hospital outcomes among 2,188 patients aged ≥70 years admitted to geriatric hospitals. From Kerminen et al. (2020).



5.3.5 Association of patient-related risk factors with readmission (III)

In the univariate analysis, the risk factors associated with 90-day readmission were age, admission from home (vs. hospital), unsteady gait, unstable condition, fatigue, Alzheimer's disease, ADLH score, CPS score, BMI, FI, faecal incontinence, hearing difficulties, and self-rated health (Table 8). Surgery during the treatment period was associated with a lower risk of readmission. In the multivariable analysis, age, ADLH, and BMI remained independent risk factors for 90-day readmission (Table 9).

When the multivariable model was used separately for patients with FIs <0.2, 0.2─0.4, and >0.4, the ORs for age and BMI were similar than those from the original model, though they were not statistically significant because of the wider CIs.

Table 8. Predictive abilities of different interRAI scales compared to that of the FI-PAC for different hospital outcomes. From Kerminen et al. (2020).

Scale	Outcome					
	Prolonged hospital stay		Emergency department admission		In-hospital mortality	
	AUC	(95% CI)	AUC	(95% CI)	AUC	(95% CI)
FI-PAC[1]	0.75	(0.72─0.77)	0.59	(0.55─0.63)	0.73	(0.70─0.76)
ADLH[2]	0.72	(0.69─0.75)	0.59	(0.55─0.63)	0.73	(0.69─0.76)
CPS[3]	0.66	(0.63─0.69)	0.50	(0.46─0.58)	0.62	(0.58─0.66)
DRS[4]	0.57	(0.54─0.60)	0.54	(0.50─0.58)	0.56	(0.52─0.60)
CHESS[5]	0.62	(0.59─0.65)	0.62	(0.58─0.66)	0.71	(0.67─0.75)

[1] Frailty Index for Post-Acute Care
[2] Activities of Daily Living Hierarchy Scale
[3] Cognitive Performance Scale
[4] Depression Rating Scale
[5] Changes in Health, End-stage disease, and Signs and Symptoms Scale

Table 9. Association of patient factors with 90-day readmission

	Patients	Readmission	Univariate		Multivariable	
	n	n (%)	OR	95% CI	OR	95% CI
Age (years)						
70—79.9	275	70 (25.5)	1		1	
80—89.9	666	192 (28.8)	1.19	0.86—1.63	1.24	0.86—1.77
≥90	226	82 (36.3)	1.67	1.14—2.45	1.94	1.22—3.08
Admitted from						
Hospital	473	119 (25.2)	1		1	
Home	694	225 (32.4)	1.43	1.10—1.85	1.34	0.99—1.84
Operation during the same treatment period	151	27 (17.9)	0.48	0.31—0.74	0.54	0.32—0.91
Unsteady gait	298	223 (31.9)	1.35	1.04—1.75	1.40	1.01—1.94
Unstable conditions	735	233 (31.7)	1.34	1.03—1.75	1.12	0.68—1.82
Fatigue	169	65 (38.5)	1.61	1.15—2.26	1.23	0.82—1.93
Alzheimer's disease	366	123 (33.6)	1.33	1.02—1.73	1.20	0.86—1.67
ADLH						
0	379	85 (22.4)	1		1	
1—2	455	148 (32.5)	1.67	1.22—2.28	1.62	1.12—2.34
3—4	263	84 (31.9)	1.62	1.14—2.31	1.67	1.04—2.71
5—6	70	27 (38.6)	2.17	1.27—3.72	2.52	1.17—5.43
CPS						
0	309	71 (23.0)	1		1	
1—2	643	199 (30.9)	1.50	1.10—2.06	1.22	0.84—1.78
3—4	153	49 (32.0)	1.58	1.03—2.43	1.05	0.51—1.89
5—6	62	25 (40.3)	2.27	1.28—4.02	1.51	0.67—3.39
Body Mass Index (kg/m^2)						
25—29.9	367	93 (25.3)	1		1	
<25 or ≥30	800	251 (31.4)	1.35	1.02—1.78	1.44	1.06—1.98
Frailty index/ 0.1 increment	1,167	344 (29.5)	1.20	1.09—1.32	Not entered as the index consists of the variables included in the multivariable analysis.	
Frailty index						
<0.20	362	84 (23.2)	1			
0.20—0.40	571	175 (30.6)	1.46	1.08—1.98		
>0.40	234	85 (36.3)	1.89	1.32—2.71		
Bowel continence						
Continent	890	249 (28.0)	1		1	
Incontinent	277	95 (34.6)	1.34	1.01—1.79	0.99	0.67—1.44
Hearing						
Adequate	837	234 (27.3)	1		1	
Minimal difficulty	206	72 (35.0)	1.43	1.04—1.98	1.15	0.80—1.66
Moderate or severe difficulty	104	38 (36.5)	1.53	1.00—2.35	1.31	0.81—2.13
Self-rated health						
Good	295	77 (26.1)	1		1	
Fair	614	174 (28.3)	1.12	0.82—1.53	1.08	0.76—1.53
Poor	158	56 (35.4)	1.55	1.03—2.36	1.36	0.81—2.27
Patient was unable to answer	100	37 (37.0)	1.66	1.03—2.69	1.14	0.64—2.02

5.4 Study IV

5.4.1 Characteristics of the patients

The records of a total of 238 patients' concerning the depression screening protocol were reviewed. Of the patients, 58% were male; 36% were aged <70 years, 40% were aged 70─80 years, and 24% were aged >80 years. The majority of the patients (91%) lived in their own home, while the remainder lived in sheltered housing or nursing homes. Of the patients living in their own homes, 30% needed assistance in daily living (home care, a close relative as a caregiver or a personal assistant). Of the patients, 45% needed walking aids.

Most patients had a diagnosis of chronic respiratory insufficiency (n=200, 84%), and in 75% (n=150) of patients the diagnosis had been made <5 five years previously. Of these, 106 required bilevel positive airway pressure (NIV) support, 88 used LTOT, 75 used portable oxygen therapy, and 17 required continuous positive airway pressure (CPAP) support regularly. Nearly half of these patients (n=82) were considered to have more than one disease as the cause of respiratory insufficiency. The most common diagnoses were chronic obstructive pulmonary disease (COPD) (n=105, 53%), obstructive sleep apnoea (n=66, 33%), and obesity hypoventilation (n=54, 27%). Other diagnoses related to respiratory insufficiency were pulmonary hypertension, pulmonary fibrosis, deformities of the chest wall, elevated hemidiaphragm, neurological disorders, and miscellaneous causes.

The most common comorbidities were hypertension (n=134, 56%), type 2 diabetes (n=80, 34%), and coronary artery disease (n=46, 23%). Previous diagnosis of depression had in forty-five patients (19%). Another psychiatric diagnosis had in 16 (7%) patients, while a memory disorder diagnosis had in 17 (7%) patients. Thirty-eight patients (16%) were using antidepressants, 88 (37%) used anxiolytic drugs, and 23 (10%) were using antipsychotics.

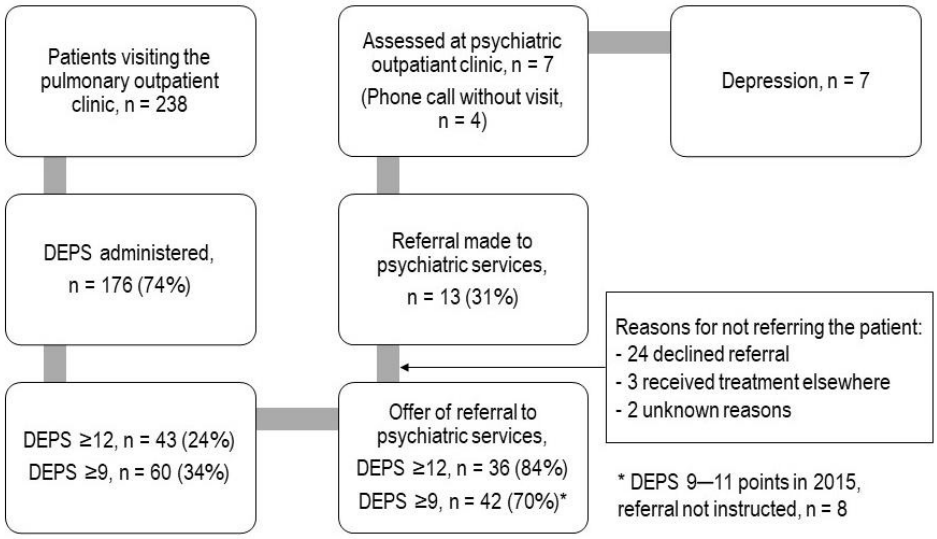
5.4.2 Outcomes of the screening protocol

The DEPS questionnaire was completed by 74% of the patients (n=176). The proportion of patients who completed the DEPS questionnaire increased from 66% in the first year of screening to 88% in the second year. Only six patients refused to complete the DEPS questionnaire.

Depression screening showed positive results in a quarter to a third of the patients, depending on the cut-off point (Figure 10). Referral to psychiatric services was offered to most patients with a positive screening result. However, most screening positive patients declined the referral. The reasons for declining the referral were not systematically recorded, but there were a few notes relating to travelling difficulties. Indeed, 19 of 24 patients who declined the referral lived outside Tampere, where the psychiatric clinic was situated.

Altogether, 13 referrals for a psychiatric clinic were written. Finally, seven patients met a nurse or psychologist at the psychiatric outpatient clinic. Of the remaining patients, four received a phone call to assess the severity of symptoms, because they could not travel to the clinic. Two patients died before the appointment. All patients visiting the clinic were deemed to have depression. After one or two visits, all patients were directed to receive further care from regional psychiatric services.

Figure 10. Depression screening in the respiratory insufficiency section of the pulmonary outpatient clinic and referral for further evaluation to a psychiatric outpatient clinic. Modified from Kerminen et al. (2019).



5.4.3 Identifying patients with a positive depression screening result

High DEPS scores were associated with the use of walking aids and a history of depression or heavy smoking (Table 10). Patients with high DEPS scores also had high CAT and mMRC scores. The mean CAT score (SD) among patients with a DEPS score of <12 points was 19 (29─36), while it was 25 (16─33) among patients with DEPS score of ≥12 points (p=0.001). The mean mMRC score among patients with a DEPS score of <12 points was 3 (1─4), while it was 3.5 (3─4) among patients with a DEPS score of ≥12 points (p=0.001). FEV1 on spirometry and microspirometry, AUDIT-C scores, and distance measured in the 6MWT were not associated with the DEPS scores.

Depression screening showed positive results in 44% of patients using antidepressants and 58% of patients with a history of depression. According to disease diagnoses, screening showed positive results in 29% of patients with obesity hypoventilation, 38% of patients with sleep apnoea, and 44% of patients with COPD. Among patients using device-based treatment for chronic respiratory insufficiency, depression screening showed positive results in 33% of patients using NIV and 43% of patients using LTOT.

5.5 Summary of the studies

Table 11 illustrates the thesis at a glance.

Table 10. Association of DEPS scores with the patients' baseline characteristics in two groups with different cut-off points (DEPS <9 vs. ≥9 and DEPS <12 vs. ≥12). From Kerminen et al. (2019).

		DEPS ≥9		DEPS ≥12	
	n	%	*p*	%	*p*
Subjects	176	34		24	
Sex			0.22		0.50
Male	102	30		23	
Female	74	39		27	
Age (years)			0.22		0.72
<70	56	43		27	
70–80	79	30		22	
>80	41	29		27	
Place of domicile			0.87		0.76
Tampere	69	33		23	
Another municipality	107	35		25	
Use of walking aids			0.06		0.049
Yes	100	40		30	
No	76	26		17	
Smoking history in pack-years			0.008		0.02
No smoking history	50	28		24	
<20	22	19		9	
20–40	55	29		18	
>40	49	53		39	
Device-based treatment			0.16		0.13
Oxygen therapy	65	27		31	
Non-invasive ventilation	70	30		19	
Both	19	42		37	
None	22	18		14	
Body mass index (kg/m^2)			0.65		0.57
<18.5	11	18		18	
18.5–24.9	50	38		30	
25–29.9	39	36		26	
≥30	72	32		19	
COPD			0.12		0.51
Yes	103	39		26	
No	73	27		22	
Obstructive sleep apnoea			0.52		0.62
Yes	56	38		27	
No	120	33		23	
Obesity hypoventilation			0.44		0.50
Yes	35	29		20	
No	141	36		26	
History of depression			0.002		0.01
Yes	31	58		42	
No or not known	145	29		21	

Table 11. Thesis at a glance

Paper	Objectives	Methods	Results	Conclusions
I	To obtain data on how geriatricians in Finland perform comprehensive geriatric assessment (CGA) in daily practice.	A web-based questionnaire survey among 95 Finnish geriatricians. The evaluated domains included the assessment of cognition, assessment of nutrition and functional ability, evaluation of depression, and measurement of orthostatic blood pressure.	The majority (94%) used CGA, but a minority (38%) assessed all new patients. Ten respondents (11%) incorporated all five domains into the assessment, whereas others selected domains according to their clinical judgement.	The use of CGA among geriatricians was not systematic. The components of the assessment were mostly selected according to clinical judgement. An incomplete evaluation may lead to inadequate detection of geriatric syndromes and other problems.
II	To derive a frailty index based on the interRAI Post-Acute Care (interRAI-PAC) instrument. To determine how the frailty index and other interRAI scales are associated with hospital outcomes (in-hospital mortality, prolonged hospital stay, and emergency department admission).	A retrospective cohort study of 2,188 patients aged ≥70 years who were hospitalised in two geriatric hospitals. Materials used consisted of data from the interRAI-PAC assessments and hospital discharge records. The frailty index was derived based on the interRAI-PAC instrument. The associations of interRAI-PAC scales with hospital outcomes were analysed.	The frailty index was normally distributed, and it was associated with all tested outcomes. The best instruments for predicting prolonged hospital stay and in-hospital mortality were the frailty index and the hierarchical activities of daily living (ADLH)-scale. There were no differences in the predictive abilities of interRAI scales and the frailty index for emergency department admission.	The frailty index derived from the interRAI-PAC instrument predicted adverse hospital outcomes. Its predictive ability was similar to that of the ADLH scale, whereas other interRAI-PAC scales had lower predictive values. In clinical practice, assessment of activities of daily living is a simple and valid way to evaluate a patient's prognosis.
III	To clarify how CGA, based on the interRAI-PAC instrument, can be used to identify patients with an increased risk for hospital readmission after discharge.	A retrospective cohort study of 1,167 community-dwelling patients aged ≥70 years who were hospitalised in and discharged to their own homes from two geriatric hospitals. Materials used consisted of patient data from interRAI-PAC instrument assessments and hospital discharge records. The associations of interRAI-PAC variables with readmissions were analysed.	The 90-day readmission rate was 29.5%. The risk factors associated with readmission in the univariate analysis were age, admission from home vs. acute hospital, Alzheimer's disease, unsteady gait, fatigue, unstable conditions, needing help in daily living tasks (ADLs), BMI, frailty index, bowel incontinence, hearing difficulties, and poor self-rated health. In the multivariable analysis, age, needing help in ADLs, and BMI remained as risk factors.	InterRAI-PAC performed upon admission to geriatric hospitals revealed patient-related risk factors for readmission. Based on the identified risk factors, we recommend that the patient's functional ability, ADL needs, and individual factors underlying ADL disability, as well as nutritional and mobility problems should be carefully addressed and managed during hospitalisation to diminish the risk for readmission.
IV	To describe the implementation and preliminary results of a depression screening protocol for respiratory insufficiency patients at the respiratory insufficiency section of a pulmonary outpatient clinic.	A retrospective evaluation of the outcomes of a depression screening protocol based on the patient records of 238 patients. As per protocol, the patients filled the Depression Scale questionnaire. Patients whose scores were suggestive of depression were offered the opportunity of a further evaluation of mood at a psychiatric outpatient clinic.	The Depression Scale was administered to 74% (n=60) of the patients, of whom 34% (n=21) scored ≥9 points (exceeding the cut-off for a referral). Only 13 patients were referred as the remainder declined the referral. Finally, seven patients were evaluated at the psychiatric clinic, and they all were deemed to have depression.	Depression screening improved the detection of depressive symptoms, but the effects on the patients' clinical courses were small. Rather than referring patients to a psychiatric unit, the evaluation and management of depression should be undertaken at the pulmonary unit.

6 DISCUSSION

6.1 Use of CGA in clinical practice

A questionnaire survey among Finnish geriatricians in 2013 showed that most of them used CGA when assessing older patients. However, the application of CGA was not systematic, and a minority of geriatricians administered the CGA to all new patients. Instead, CGA was performed to selected patients only. Considering the five evaluated domains (assessment of cognition and functional ability, assessment of nutritional status, evaluation of depression, and measurement of orthostatic blood pressure), the contents of assessment varied considerably. Only one-tenth of the geriatricians included all five domains systematically into CGA, whereas others selected domains according to their clinical judgement. For example, assessment of depression, functional ability, and nutritional assessment was mostly incorporated into CGA after consideration. Consequently, the CGA contents varied among individual patients.

This type of incomplete evaluation does not meet the purpose of CGA and may lead to inadequate detection of GSs and other health-related problems. Nearly all older patients that are treated by geriatricians suffer from GSs and frailty, and they would most probably benefit from CGA. GSs are associated with adverse health outcomes. To prevent or delay such outcomes, GSs should be detected and managed in their early stages. As GSs are difficult to detect without systematic assessment, there are good reasons for promoting a systematic approach instead of relying on clinical judgement. For example, one possible explanation for the under-diagnosis of depression in older patients is that physicians most likely suspect depression when patients mention experiencing sadness, worthlessness, and depression (Gregg et al. 2013). However, many older patients do not express emotional feelings related to depression but report poor appetite, fatigue, and other somatic complaints (Hybels et al. 2012). Thus, physicians should routinely evaluate patients' moods to detect depression.

Regarding functional ability, the structured assessment allows the transfer of data from one health care setting to another (Quinn et al. 2011). Furthermore, as

an older person's functional ability is a sensitive indicator of health changes (Covinsky et al. 2003), registering new functional impairments may lead to the identification of a new treatable disease or GS. Finally, together with cognition, functional ability is a strong indicator of future disability, prognosis, and the need for care (Lee et al. 2005). Hence, the measurement of these two indicators helps in developing proper treatment and rehabilitation plans.

The reasons underlying the unsystematic use of CGA among Finnish geriatricians are unclear. There are no peer-reviewed surveys on the use of CGA by geriatricians. We found only one Chinese study, published as a letter to the editor, with such an aim (Lin et al. 2013). One-tenth of Chinese geriatricians used CGA as a routine tool in their clinical practice. A possible explanation for non-systematic use may be the lack of adequate structural support for using CGA as a routine tool. Although the role of CGA is well-established among geriatricians, it is less well known among other professionals. As CGA is a multidisciplinary and time-consuming process, geriatricians cannot perform it without strong organisational support and assistance from educated interdisciplinary team members. Many Finnish geriatricians work in primary health care and therefore, lack the support of geriatric teams. There are no national incentives supporting the use of CGA, or national guidelines about the use of CGA. Another possible reason for incomplete assessment could be the heavy workload that does not encourage a systematic approach.

It is worth noting that the awareness regarding the benefits of CGA and opportunities to perform comprehensive assessment have significantly increased during the last 10 years. At present, there are good screening instruments available for GSs and for evaluating if the patient would benefit from CGA. Besides, standardised geriatric assessment instruments incorporated in routine practice offer new opportunities to perform CGA systematically. interRAI instruments are currently used in certain regions of Finland. The use of interRAI assessments will become mandatory in the evaluation process for service needs by the year 2023 (Act on supporting the functional capacity of the older population and on social and health services for older persons 980/2012). However, even the systematic use of the interRAI instrument does not automatically mean that the performance of CGA in patient-level care will increase. New protocols of care need to be implemented to reach CGA goals when the use of the interRAI or other CGA protocols is started.

Furthermore, there is a need for CGA guidelines in clinical practice to be tailored for national clinical circumstances and written in Finnish. As there is a

paucity of guidelines written in Finnish, the writer of this thesis participated in writing a guideline on the assessment of functions of older patients hospitalised for acute conditions (Kerminen et al. 2019). The guideline is published in the Toimia Functions Measures Database by the Finnish Institute for Health and Welfare.

6.2 Utilisation of the interRAI-PAC in the detection of risk factors for adverse hospital outcomes

The second and third studies aimed to clarify which GSs and problems detected by interRAI assessment upon hospital admission are associated with adverse hospital outcomes (prolonged hospital stay, emergency department admission, in-hospital mortality, and readmission). To evaluate frailty and its association with hospital outcomes, we derived a frailty index (FI-PAC) from the data obtained from interRAI-PAC assessments. We succeeded in deriving an FI-PAC with the expected normal distribution among hospitalised older patients. The FI-PAC was associated with prolonged hospital stay, emergency department admission, and in-hospital mortality. On comparing the FI-PAC and the interRAI scales, the best scales for predicting prolonged hospital stay were the FI-PAC and ADLH, with equal discriminative capacity. They were significantly better than the DRS, CHESS, and CPS. The best scales for predicting in-hospital mortality were the FI-PAC, CHESS, and ADLH, but their predictive abilities were poor for emergency department admission. The risk factors associated with 90-day readmission after discharge from a geriatric hospital in univariate analyses were age, admission from home (vs. hospital), unsteady gait, unstable condition, fatigue, Alzheimer's disease, ADLH score, CPS score, BMI, FI-PAC, faecal incontinence, hearing difficulties, and self-rated health. Surgery during the treatment period was associated with a lower risk of readmission. In the multivariable analysis, age, ADLH, and BMI remained independent risk factors for 90-day readmission.

In our study, the FI-PAC was associated with both in-hospital mortality and prolonged hospital stay. It had excellent discriminative ability (both AUCs over 0.70) to differentiate persons who are likely to face adverse outcomes during their hospitalisation from those who are likely to survive without them. Consistent with our study, the association between the FI AC (derived from the interRAI Acute Care instrument) and in-hospital mortality was showed (Hubbard et al. 2017). Besides, different frailty measurements are associated with in-hospital mortality in acute care settings (Basic et al. 2017; Cesari et al. 2018; Wallis et al. 2015).

Extended hospital stay was associated with the FI in an acute care setting (Evans et al. 2014; Singh et al. 2012), but studies in post-acute care settings had not been conducted. In our research, the FI-PAC was associated with emergency department admission, but the predictive ability was only modest. One explanation for this could be that most emergency admissions are due to medical issues, such as acute and chronic diseases (Conroy et al. 2012; Lee et al. 2014) and the impact of such issues on admission is greater than that of frailty status.

Interestingly, the short ADLH scale (which measures activities of daily living) was a good prognostic instrument for predicting hospital outcomes (with a performance similar to that of the multicomponent FI). The finding that functional impairment is associated with prolonged hospital stay and mortality is in line with those of previous studies among older patients in acute care settings (Alarcón et al. 1999; Matzen et al. 2012; Torisson et al. 2017). Frailty and functional impairment are comparable in predicting short-term outcomes after gastrointestinal surgery (Chen et al. 2018). A possible explanation for the similar prognostic abilities of the ADLH and FI for hospital outcomes might be that frailty is a complex phenomenon and different frailty instruments can measure only some aspects of it (Cesari et al. 2016). Although the FI consists of various health-related items, it more or less represents a sum of comorbidities and disabilities rather than a measure of the biological aspects of frailty (Wilson et al. 2017). If measuring biological frailty were possible in our study, the results considering the predictive ability of frailty and functional impairment could be different, possibly favouring frailty.

Regarding the readmission risk of community-dwelling older patients after a treatment period in a geriatric hospital, our study showed that both the FI-PAC and functional impairment (measured by the ADLH) were associated with readmission. The likelihood of experiencing readmission was 1.5-fold higher in patients with pre-frailty and nearly 2-fold higher in patients with frailty, than those in the robust group. Similarly, readmission risk was 2.5-fold higher in patients who needed help with ADLs than in those who could perform these activities independently. Frailty is associated with readmissions in older surgical (Stern et al. 2018; Wahl et al. 2016) and general medicine patients (Kahlon et al. 2015). The finding of functional impairment as a risk factor for readmission was consisted with those of previous studies in post-acute care and rehabilitation settings (Middleton et al. 2018; Ottenbacher et al. 2014; Middleton et al. 2016; Hoyer et al. 2013).

In addition to frailty and functional impairment, other independent risk factors for readmission were low or high BMI, unsteady gait, and age of ≥90 years. The finding that low or high BMI (<25 or ≥30 kg/m²) could predict readmission corroborates the findings of Woolley et al (2019). They suggested that the healthiest BMI related with fewer adverse outcomes in older hospitalised patients is ≥25 kg/m². Low BMI may be related to malnutrition, associated with readmission risk (Hudson et al. 2018). Furthermore, obesity was a risk factor for readmission among older persons receiving post-acute care in nursing home facilities (Cai et al. 2019).

Several patient-related factors were associated with readmission in the univariate analyses (such as poor self-rated health, cognitive impairment, faecal incontinence, and hearing difficulties). Still, their effects were attenuated after accounting for individual covariates. Furthermore, surgery during the treatment period was associated with a lower risk of readmission. The mechanism for this is unclear, but it may be related to patient selection for elective surgery.

There are no previous studies on the association between self-rated health and readmissions. However, poor self-rated health is a risk factor for hospitalisation among home care clients (Rönneikkö et al. 2017). Poor self-rated health was related to increased use of hospital services among community-dwelling people (Isaac et al. 2015; Tamayo-Fonseca et al. 2015). Studies regarding the association of cognitive impairment with readmission have generated contradictory results (Burke et al. 2015; Callahan et al. 2015). The association between faecal incontinence and readmission has not previously been reported, although incontinence is a known risk factor for unplanned hospitalisation among home care clients (Rönneikkö et al. 2017). Likewise, hearing difficulties with perceived communication problems are associated with readmission (Chang et al. 2018).

6.3 The implementation of a depression screening

To gain insight into the implementation of the CGA approach, we retrospectively assessed the preliminary outcomes of the application of a depression screening protocol among chronic respiratory insufficiency patients at a pulmonary outpatient clinic in a tertiary care hospital. Depression screening showed positive results in a third of the patients. High DEPS scores were associated with the use of walking aids and a history of depression or heavy smoking. Referral to psychiatric services was offered to most patients with a positive screening result. However,

most screening positive patients declined the referral. Depression screening improved the detection of depressive symptoms, but the effects on the patients' clinical courses were small.

Supporting earlier observations (Janssen et al. 2010; Kayhan et al. 2016; Lacasse et al. 2001), unnoticed symptoms of depression were prevalent among patients with chronic respiratory insufficiency: depression screening showed positive results in one-third of the patients. In line with earlier studies (Kim et al. 2014; Kunik et al. 2005), only a minority of the positive patients were using antidepressants or had a prior depression, underlining the need for depression screening. A long smoking history, the use of walking aids, and history of depression were associated with symptoms of depression. Daily smoking is a risk factor for depression (Pasco et al. 2008), and prior depression predisposes older persons to a new depression diagnosis (Cole & Dendukuri 2003). In our study, high scores in the CAT test (which evaluates the number of respiratory symptoms of COPD) and in mMRC test (which evaluates the degree of functional impairment due to breathlessness) were associated with depression symptoms. The relationship between high CAT scores and depression has been reported previously (Lee et al. 2013; Silva Júnior et al. 2014). It has also been shown that symptoms of depression increase dyspnoea (von Leupoldt & Dahme 2007). Therefore, high scores in CAT or mMRC tests should be an indicator warranting evaluation with aims others than those specific for lung disease (Masaki et al. 2014).

In the retrospective evaluation of the implementation of a depression screening protocol, it was found that the detection of depression symptoms improved substantially after commencing the screening, but the final effects on the patients' treatment and clinical courses were small. A third of the patients did not undergo screening, and among the patients with a positive screening result, compliance with the further evaluation of mood in a psychiatric outpatient clinic was poor. To the best of our knowledge, there are no other studies describing the implementation of a depression screening protocol among patients with respiratory insufficiency. However, there are studies describing the results of a depression screening protocol among patients with multimorbidity and acute myocardial infarction. Jani et al. (2013) reported the results of a cross-sectional study aiming to describe the challenges of routine depression screening in a primary care setting among patients with multimorbidity. Only a minority of patients underwent depression screening. Depression screening identified a large number of patients with depressive symptoms and increased prescription of antidepressants. Smolderen et al. (2011) reported the implementation and performance of a depression screening protocol

among patients with acute myocardial infarction. One-fourth of the patients did not undergo screening, and only a modest impact on depression recognition rates was realised.

The challenges related to the implementation of the screening protocol may be divided into three groups based on the TICD checklist: individual health professional factors, patient factors, and professional interactions (Flottorp et al. 2013). Individual health professional factors included obstacles in the acceptance of the screening protocol among nurses, especially at the beginning of the protocol's implementation (measured based on the proportion of patients who received the DEPS questionnaire). However, screening coverage improved towards the end of the implementation process. The nurses felt comfortable asking the patients to fill the DEPS questionnaire, but they experienced difficulties regarding discussing positive screening results with the patients.

Patient factors included completion of the DEPS questionnaire, but the acceptance of referral for further evaluation: most of the patients with positive results declined the referral. This may partly be explained by geographical obstacles, but there are also other possible explanations, for example, the fear of stigmatisation concerning a psychiatric diagnosis. Generally, COPD patients tend to deny experiencing depressive symptoms or they are unaware of them (Ouellette & Lavoie 2017), and patients usually refuse to accept referrals to psychiatric services (Maurer et al. 2008; Yohannes et al. 2006). Professional interactions included communication, team processes, and referral processes. Based on the protocol, there was insufficiency in personnel with adequate skills and resources. In particular, the nurses at the pulmonary clinic lacked time and knowledge, and there were insufficient resources to have a psychiatric nurse attending the pulmonary outpatient clinic for interviewing the patients. In addition, local care pathways for depression in the surrounding communities were not involved in the protocol. To conclude, the capacity for organisational change was not sufficient for managing patients with positive screening results.

6.4 Strengths and limitations

6.4.1 Strengths

This study have several strengths. Although there are a lot of studies about the effectiveness of CGA-based care, the use of CGA in clinical practice, beyond clinical trials, has scarcely been studied. As such, this study has a novelty value. Besides, as this study examined real-life situations and patients, it provides information for the implementation of CGA in real-life clinical practice. Although the results of this study may not be fully generalisable to other health care systems owing to the special characteristics of health care organisation in Finland, the generalisability in national context is good.

6.4.2 Limitations

Study I. The main weakness is the limited number of questions about CGA use in the questionnaire. Therefore, many important issues such as the social, economic, and environmental aspects related to CGA use as well as multidisciplinary teamwork have not been addressed. Another weakness is the small number of respondents in the study. Although the population was a representative sample of Finnish geriatricians and the response rate was comparable to the usual response rate of surveys among physicians, the small number of respondents might lead to misinterpretation of the results. The role of individual responders may be emphasised, and certain responder-related issues, including scientific competence, literacy, and leadership position, could affect (probably improve) CGA use, but these data could not be used for such analyses.

Studies II and III. In the international context, the number of patients in the studies was modest, although the sample was representative of the national population as the design covered the entire post-acute care setting in Tampere and the patients represented an unselected population (in terms of social or insurance status). The results may not be fully generalisable to other healthcare systems. Another weakness was that the studies did not include all patients receiving treatment in the study hospitals during the study period, as interRAI assessment was not performed for all patients. One of the possible reasons why assessments were not performed in some patients is the gradual introduction of interRAI-PAC

assessment in different wards; hospital discharge records were collected for the same period from all wards. Another reason may be the laboriousness of assessment in a busy clinical practice (Carpenter & Hirdes, 2013), which may lead to a substantial number of missing assessments in the clinical context (Wellens et al. 2011).

A limitation of these studies is that we did not examine the incidents occurring during the whole period of hospital treatment of the patient, for example, the length of stay in an acute care hospital and diagnoses of acute diseases. Furthermore, it could not be specified what kinds of assessment, treatment, and support were offered to the patients during their hospital stay. Therefore, it is not known how these treatments or interventions could have affected the adverse hospital outcomes or the rate of readmission.

As the Study III focused on patient characteristics that may increase the readmission risk, the study did not consider all known risk factors associated with readmissions, such as organisational factors and healthcare utilisation. Furthermore, functional impairment caused by an acute illness could not be differentiated from long-lasting functional decline because the time frame in which the ADL dependency had developed could not be determined. Finally, the hospital discharge database did not include data on readmissions to a tertiary care hospital. However, older patients are usually hospitalised in a secondary care hospital rather than a tertiary care hospital or transferred from a tertiary care hospital to a secondary care or geriatric hospital before discharge to their home.

Study IV. The implementation of a depression screening protocol was a part of development work at the pulmonary outpatient clinic. A note of caution is due here since the study was a retrospective evaluation of depression screening outcomes. One weakness was that neither the nurses nor the patients were systematically interviewed for the study; thus, all possible contributing factors were not clarified. Identifying patient groups with an elevated risk for depression was not the initial purpose of the study; however, some risk groups were nevertheless identified in the evaluation. Therefore, these results must be interpreted with caution.

6.5 Implications for clinical practice

According to our study, the application of CGA is not optimally organised in Finland, and many older patients do not undergo comprehensive assessment. The ageing population and the WHO's strategy for the modification of geriatric healthcare require the development of health care systems providing comprehensive and coordinated care to older people (World report on ageing and health 2015; Akner & Gustafson 2014). Greater efforts are needed to ensure that older patients undergo timely CGA with subsequent treatment and rehabilitation (Gladman et al. 2016). In every clinical practice, it is necessary to make a plan for the process of CGA: how older patients are screened to identify those who would benefit from CGA and how CGA is organised to them. Besides, the coordination of care needs special attention. Older patients gain advantage from continuity of care across care settings, and it is essential that the care protocol is planned regionally together with other care providers. Thus, considering its significance, the principles of CGA should be incorporated into the basic education of medial students and other health care professionals. Especially, CGA should be emphasised and incorporated from the beginning of geriatric training to ensure that geriatricians acquire the skills necessary to perform CGA (Eleazer et al. 2000; Polidori & Roller-Wirnsberger 2018).

Our results suggest that applying the FI to identify patients expected to have poor hospital outcomes does not bring additional value to the assessment of functional ability. The problem with frailty in this population is that about half of the patients are classified as being at risk for adverse outcomes. It is probable that some patients in our study suffered from persistent functional decline and they were in need of 24/7 care. Actually, the length of hospital stay was more than 30 days in one-third of the patients. However, based on scores below the cut-off points, patients who did not experience adverse outcomes could be ruled out.

From a clinical point of view, assessment of the patient's functional ability is inexpensive, quick, and simple. The factors underlying each person's functional impairment are probably different due to its multifactorial nature (Inouye et al. 2007; Tinetti et al. 1995). Thus, the detection of functional impairment should, in turn, lead to comprehensive clinical and interprofessional evaluation to clarify the underlying factors and create management and rehabilitation plans. As interRAI assessment is performed shortly after the patient's admission to the ward, there is a good timeframe for administering rehabilitative interventions during hospitalisation. However, our results showed that the goal of performing the

assessment in a few days after the patient's admission to the ward was not achieved: one-fifth of the patients still remained without the assessment after two weeks of hospitalisation. Further attention should be paid to permit timely assessments. The role of careful discharge planning is important, as functional impairment is a strong risk factor for readmission, mostly affecting patients who develop a new ADL deficit during hospital stay and are discharged with an unmet need for that ADL disability (Arbaje et al. 2008; Depalma et al. 2013). Discharge planning, including a plan for post-discharge services and rehabilitation, is effective in reducing readmissions and increasing the satisfaction of patients and healthcare professionals (Gonçalves-Bradley et al. 2016).

Undetected symptoms of depression are prevalent among patients with chronic respiratory insufficiency. Depression diminishes patients' functional performance and exercise tolerance while increasing fatigue, hospital admissions, morbidity and mortality (Norwood 2006; Pooler & Beech 2014). Optimally, the detection and treatment of depression would improve the quality of life of patients with chronic respiratory insufficiency. Treatment of depression could also reduce pulmonary disease symptoms (Momtaz et al. 2015); hence, screening for depression is recommended. However, the challenge lies in the organisation of services that are both accessible and acceptable from the patients' point of view. Successful implementation of a new protocol in clinical practice requires changes on different levels of care and sufficient time for adjustments. Therefore, before implementation, it is necessary to verify that individual health professional factors, patient factors, and professional interactions are properly evaluated, and that adequate resources and time-frames are available.

6.6 Future research

The use of CGA in clinical practice warrants further studies evaluating the utilisation of interRAI assessment data at the patient-level of care and evaluating factors that enhance or prevent the use of systematic assessment by healthcare professionals in clinical practice.

Considering the heterogeneity of patients in geriatric acute care and rehabilitation settings, future studies should focus on the effects of interventions targeting patients at the highest risk of adverse outcomes. The use of interRAI-PAC assessment at both admission and discharge offers opportunities for performing this type of study. Moreover, further research should be undertaken to

compare the abilities of the phenotypic (biological) frailty model and the FI in predicting hospital outcomes.

More information on the views and opinions of respiratory insufficiency patients regarding screening for depression and further evaluation of mood would help us organise services that are both acceptable and accessible from the patients' perspective.

7 SUMMARY AND CONCLUSIONS

In conclusion, most Finnish geriatricians report using CGA in the evaluation of older patients; however, CGA use is not systematic, and its content varies between patients. This type of incomplete evaluation may lead to inadequate detection of GSs and other health problems.

It was possible to derive the FI using the interRAI-PAC instrument; the FI predicted adverse hospital outcomes as expected. However, its predictive ability was not better than that of the short ADLH scale. As most patients had FI values that were predictive of adverse outcomes, the FI-PAC did not seem to aid in decision-making at an individual level. In clinical practice, assessment of ADLs is a simple and valid way to evaluate a patient's prognosis. Patients with functional impairment should be evaluated systematically, and multidisciplinary aspects should be considered to clarify the factors underlying functional impairment and create treatment and rehabilitation plans. This may lead to a decrease in the incidence of adverse hospital outcomes.

interRAI-PAC assessment performed upon admission to geriatric hospitals revealed patient-related risk factors for readmission. Based on the identified risk factors, we recommend that the patient's functional ability, ADL needs, and individual factors underlying ADL disability as well as nutritional and mobility problems should be carefully addressed and managed during hospitalisation to diminish the risk for readmission.

Depression screening improved the detection of depressive symptoms, but the effects on the patients' treatment and clinical courses were small. Further assessment of patients with positive screening results should be organised in a way that is acceptable and achievable from the patient's perspective. Rather than referring patients to a psychiatric unit, the evaluation and management of depression should be undertaken at a same unit where a screening is performed.

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PUBLICATIONS

PUBLICATION I

How Finnish geriatricians perform comprehensive geriatric assessment in clinical practice?

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Research paper

How Finnish geriatricians perform comprehensive geriatric assessment in clinical practice?

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ABSTRACT

Introduction: Comprehensive geriatric assessment (CGA) is one of the most important evaluation tools in geriatrics, but there is variability in its use in different clinical settings. In this study we aimed to clarify how Finnish geriatricians apply CGA in their clinical practice.
Methods: We organized a web-based survey among the members of Finnish Geriatricians (n = 248). The questionnaire included items about use and content of CGA. The evaluated domains were assessment of cognition, nutrition and functional ability, evaluation of depression, and measurement of orthostatic blood pressure.
Results: Altogether 121 physicians (49%) responded, and the present analysis included 95 geriatricians performing clinical work. Majority of the respondents (94%) used CGA. Of them, 38% performed CGA to all new patients and 62% to selected patients only. Ten respondents (11%) incorporated all five domains into CGA whereas others selected domains according to their clinical judgment. Greater proportion of female than male physicians included evaluation of depression (39% vs. 16%, P = 0.045) and assessment of functional ability (48% vs. 24%, P = 0.01) always in CGA. Respondents, who applied CGA to all new patients, incorporated nutritional assessment (68% vs. 34%, P = 0.002) and measurement of orthostatic blood pressure (76% vs. 54%, P = 0.04) always into CGA more often than those who performed CGA to selected patients only. Respondents' working conditions were not associated with the application of CGA.
Conclusions: Majority of the respondents performed CGA to their patients. The content of CGA varied between geriatricians. Incomplete evaluation may lead to inadequate detection of geriatric syndromes and other problems.

Comprehensive geriatric assessment (CGA) is a central part of modern geriatric medicine. It has been developed to help health care professionals deal with the complex situation of an older patient, and to determine strategies to maintain and optimize patient's functional ability. CGA includes conventional medical history and examination but also systematic evaluation of patient's functional, psychosocial and cognitive capacity as well as consideration of environmental factors [1].

An important component of CGA is the screening and assessment for geriatric syndromes [2,3]. These syndromes are common – though often undiagnosed – and present a considerable threat on patient's quality of life and functioning [2]. Although geriatric syndromes are as prevalent as chronic diseases among older persons, they are not traditionally considered in medical history and examination [4].

There is a large volume of studies describing the beneficial role of CGA-based health care compared to the conventional care of older patients. CGA has been established to reduce functional deterioration and mortality, to decrease nursing home admissions and to increase patients' chances to be living in their own homes at

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6–12 months after the assessment [5–7]. Especially effective CGA is in the subgroup of frail older patients [8,9].

However, implementation of evidence based practices into clinical practice is a complex task. Successful implementation requires multiple changes from the level of individual clinical practice to organizational structures and systems of care [10]. Owing to its complex nature, implementation of CGA may be challenging [11]. Furthermore, working conditions and factors related to the health care system may affect geriatricians' ability to perform CGA. Nevertheless, the use of CGA should be systematic, i.e. a standard practice [8], in order to reach its beneficial effects.

To the best of our knowledge, there is only one previous study about geriatricians' use of CGA. That Chinese study [12] showed that application of CGA was not adequate: only 12% of Chinese geriatricians used CGA as a routine tool, 14% used it often and 20% had never evaluated their patients using CGA. Also our experiences from Finland suggest that many frail older patients remain without multidimensional geriatric assessment even in geriatric units.

The aim of our study was to get knowledge about how geriatricians in Finland perform CGA in daily practice. Moreover, we wanted to clarify which factors are associated with the application of CGA.

1. Methods

We organized a web-based survey among Finnish geriatricians. An invitation to participate in the survey was electronically distributed to all members of the Finnish Geriatricians society ($n = 248$) in April 2013. The invitation was sent again in the beginning of May, and it was renewed at end of May to the members who had not yet participated in the survey.

The questionnaire's first set of questions aimed to clarify respondents' working conditions and views while the second set of questions explored their performance of CGA. There were also questions about respondents' background information. The results of the first set of questions have been published before [13]. In the second set of questions the respondents were asked whether they perform CGA to all new patients, to selected patients or to none. If the respondent performed CGA, he/she was asked if he/she incorporates following domains into CGA: (1) assessment of cognition (e.g. Mini Mental State Examination), (2) screening and assessment of malnutrition, (3) structured assessment of functional ability, (4) structured assessment of depression (using screening instrument or diagnostic criteria for depression) and (5) measurement of orthostatic blood pressure. The answer alternatives were (1) always, (2) after consideration, and (3) never.

Criteria for selecting these domains into questionnaire were as follows: assessment of functional ability is a fundamental component of CGA and the other selected domains (cognition, nutrition and depression) evaluate conditions that are prevalent [14], severe and often unrecognized in older patients [2]. These domains have been used in the studies that have demonstrated the effectiveness of CGA [15,16]. Measurement of orthostatic blood pressure is an important part of medication review and assessment of falls [17]. Furthermore, selected domains represent conditions that are relevant part of assessment in various medical settings and there are good treatment protocols available to address the identified concerns.

Respondents' application of CGA in relation to sex, age, clinical experience as a geriatrician and working place was reported descriptively. Statistical significance was analyzed using Chi-square test or Fisher exact test as appropriate. P-value <0.05 was considered statistically significant. Data management and analysis were performed using IBM SPSS Statistics 20.

2. Results

2.1. General data

A total of 121 physicians responded to the survey, of whom 103 were geriatricians, 14 were residents in geriatrics and 4 were other physicians. Response rate was 49%. Due to our will to get knowledge on geriatricians' clinical practice, we excluded non-geriatricians ($n = 18$) and respondents who did not work as clinical geriatricians ($n = 8$). Thus, 95 respondents were accepted to the analyses.

Of respondents, 71% were women, and 11% were under 40 years, 43% 40 to 50 years and 46% over 50 years of age. The length of clinical experience as a geriatrician was less than 5 years in 31%, 5 to 15 years in 50%, and more than 15 years in 19% of the respondents. One-fifth were working at least 50% of working time in primary care, two-fifths in hospital wards or rehabilitation, nearly one-fifth in specialized health care and the rest in nursing homes (5%), in private clinics (11%) or in administration, teaching or research (12%). Nearly two-thirds of the respondents were working in the southern parts of Finland. In 2013, there were 229 working-aged geriatricians in Finland, of whom 72% were women. The median age of geriatricians was 49 years [13]. The geographical distribution, age range and sex of the respondents were similar to that of geriatricians in Finland in general.

Most respondents rated the atmosphere in older people's health care and quality of health care for the older adults as very good or fairly good. Similarly, possibility to determine the content of one's own work and to enforce a good geriatric care at work were rated as good or fairly good by majority of the respondents [13].

2.2. CGA in clinical practice

Majority of the respondents ($n = 89$; 94%) used CGA when evaluating their older patients. Of them, 34 (38%) performed CGA to all new patients and 55 (62%) to selected patients only. No differences were observed in application of CGA between age groups, working places, length of experience as a geriatrician, or between female and male physicians (Table 1). Neither did the university where the respondents had studied geriatrics affect the results.

Respondents, who coped at work very well, seemed to perform CGA more often than those who coped at work well or moderately. Similarly, respondents who experienced good possibilities to determine the content of their own work seemed to perform CGA more often than those who experienced moderate or slight possibilities. However, no significant statistical differences were observed (Table 2). Other issues related to working environment were not related to the use of CGA either.

The content of CGA varied between geriatricians. Assessment of cognition and measurement of orthostatic blood pressure were incorporated always into CGA more often than nutritional assessment, evaluation of depression and structured assessment of functional ability (Fig. 1). 7% of the respondents did not incorporate structured assessment of functional ability into CGA. Most respondents (89%) selected the content of CGA after consideration. However, 10 respondents included all five domains always in CGA.

Greater proportion of female than male physicians included evaluation of depression (39% vs. 16%, $P = 0.045$) and structured assessment of functional ability (48% vs. 24%, $P = 0.01$) always in CGA. No differences were observed in the content of CGA between age groups, clinical experience as a geriatrician or working places. Respondents, who applied CGA to all new patients, incorporated nutritional assessment and measurement of orthostatic blood pressure always into CGA more often than those who performed CGA to selected patients only (Table 3).

Table 1
The use of CGA according to respondent's gender, age, clinical experience as a geriatrician and working place.

Respondent's characteristics		Use of CGA			
		No	Yes		
	n	%	To selected patients %	To all new patients %	*P*-value
Respondents	95	6	58	36	
Gender					0.22
Male	28	11	64	25	
Female	67	5	55	40	
Age					0.64
Under 50 years	51	4	61	35	
Over 50 years	44	9	55	36	
Clinical experience as a geriatrician					0.51
Less than 10 years	54	4	61	35	
More than 10 years	41	10	54	37	
Working place for at least 50% of working time					0.30
Primary care	20	5	50	45	
Hospital ward or rehabilitation	36	8	67	25	
Specialized health care	13	8	54	36	
Nursing home	5	0	80	20	
Private clinic	10	0	40	60	
Administration, teaching or research	11	9	55	36	

Table 2
The use of CGA according to respondent's opinions on health care for older people and on one's own work.

Working conditions		Use of CGA			
		No	Yes		
	n	%	To selected patients %	To all new patients %	*P*-value
General atmosphere in older people's care					0.53
Good	59	7	59	34	
Moderate	28	4	54	43	
Unsatisfactory	4	25	50	25	
The state of older people's care in Finland					1.00
Good	57	7	56	37	
Moderate	34	6	59	35	
Unsatisfactory	4	0	75	25	
The feeling of outside appreciation of geriatricians work					0.21
Good	72	4	57	39	
Moderate	20	5	65	30	
Unsatisfactory	2	50	50	0	
Coping at work					0.15
Very well	33	0	58	42	
Well	46	9	54	37	
Moderately	14	7	79	14	
Possibility to determine the content of one's own work					0.63
Good	38	3	61	37	
Fairly good	29	7	52	41	
Moderate or slight	28	11	61	29	
Possibility to enforce a good geriatric care at work					0.30
Good	29	3	48	49	
Fairly good	46	7	59	35	
Moderate or slight	18	3	78	22	

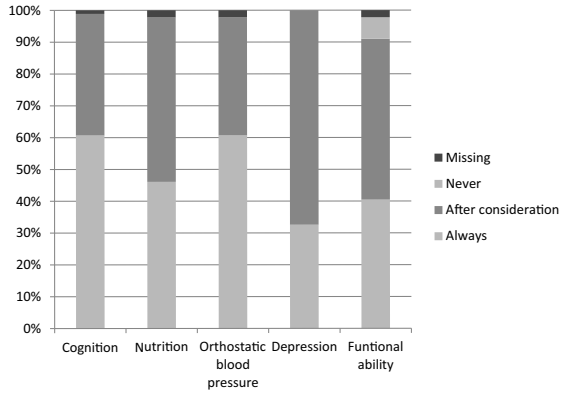

Fig. 1. The content of CGA in relation to the selected domains of assessment with the respondents who performed CGA (n = 89).

Table 3
The content of CGA according to weather CGA was conducted to all new patients or to selected patients only.

Component of CGA	Geriatricians who perform CGA				*P*-value
	To selected patients		To all new patients		
	n	%	*n*	%	
Cognition					0.21
Always	36	65	18	55	
After consideration	19	35	15	45	
Nutrition					0.002
Always	18	35	23	68	
After consideration	33	65	11	32	
Orthostatic blood pressure					0.04
Always	29	54	25	76	
After consideration	25	46	8	24	
Depression					0.25
Always	16	29	13	38	
After consideration	39	71	21	62	
Functional ability					0.27
Always	19	35	17	52	
After consideration	30	56	15	45	
Never	5	9	1	3	

3. Discussion

Majority of the Finnish geriatricians, who responded to our survey, reported that they evaluate older patients using CGA. However, CGA was not performed systematically to all new patients but usually to selected patients. The content of CGA varied between geriatricians. Because respondents included individual domains into assessment mostly according to clinical judgment, the content of CGA was variable also between individual patients. Only a few geriatricians systematically incorporated all five analyzed domains (assessment of cognition, screening and assessment of malnutrition, structured assessment of functional ability and depression, and measurement of orthostatic blood pressure) into CGA.

Despite of the knowledge on the benefits of systematically performed CGA, clinical experiences of the use of CGA have been reported scarcely. We found one Chinese study with this aim [12]. Compared to that, Finnish geriatricians used CGA more frequently than Chinese colleagues, but the use of CGA was not systematic or routine even in Finland.

A key to the success of CGA is identification and management of geriatric syndromes [18]. Despite of their substantial prevalence [4,14], they are largely undetected and untreated [3]. Especially true this is with the problems that are not clearly evident like depression, malnutrition and postural hypotension [19–21]. Geriatric syndromes are associated with poor health outcomes [14]. For example, depression and malnutrition worsen patient's quality of life and increase risks for functional decline and hospitalizations [19,20], and orthostatic hypotension is associated with falls and functional decline [17,21]. In order to prevent or delay such adverse consequences, geriatric conditions should be detected and managed in their early stages [18]. Therefore, the findings of our study are alarming. Systematic assessment of depression, malnutrition and measurement of orthostatic blood pressure were performed only by 30%, 45% and 60% of the respondents, respectively. We also noted that – for unclear reasons – greater proportion of female than male geriatricians included evaluation of depression and assessment of functional ability always in CGA. On the other hand, it turned out that the rare geriatricians, who perform CGA to all new patients, also incorporate domains into CGA more systematically, leading to fewer possibilities to miss problems.

Indeed, there are good reasons for promoting systematic approach instead of relying on clinical experience. In the case of depression, one possible reason for under-diagnostics is that physicians most likely detect depression when the patient expresses emotions like feeling depressed, sad and worthless [22]. However, many older patients more frequently report poor appetite and other somatic complaints rather than emotional feelings related to depression [23]. Consequently, physicians should routinely assess for other symptoms related to depression besides depressed mood and dysphoria. In the case of orthostatic hypotension, the only way to detect postural hypotension is to measure blood pressure in both supine and standing positions, as in patients with orthostatic hypotension supine systolic and diastolic blood pressure are, misleadingly, usually higher than in patients, who do not have postural hypotension [24].

As it comes to functional ability, structured assessment, firstly, is a useful tool for patient's treatment and rehabilitation planning and evaluation of their outcomes [25]. Secondly, it allows transfer of similar knowledge from one health care setting to another [25]. Thirdly, because an older person's functional ability is a sensitive indicator of health changes [26], registering new functional losses may lead to detection of new, treatable disease or geriatric syndrome. Finally, together with cognition, functional ability is a strong indicator of prognosis, future disability and need of care [27], and hence, measurement of these two indicators helps in developing proper treatment and rehabilitation plans.

The reasons underlying Finnish geriatricians' way of using CGA are unclear. A possible explanation for our results may be the lack of adequate structural support for geriatricians to use CGA as a routine tool. Although the role of CGA is well-established among geriatricians, the value of CGA is less well known among other professionals. Recently, a national consensus statement "Towards better old age" [28] stated that CGA should be a part of routine care of the aged. However, there are currently no national incentives requiring or supporting the use of CGA despite of the fact that CGA could be considered a quality measure of health care of the aged. As CGA is a multidisciplinary and time consuming process, geriatricians are not able to use it without educated assisting interdisciplinary team members and strong organizational support. Many Finnish geriatricians work alone in primary health care and, therefore, lack the support of geriatric colleagues and team. Another possible reason for incomplete assessment could be current heavy workload that does not encourage workers to use systematic approach on patients. In fact, there was a tendency that respondents who coped well at work, seemed to perform CGA more often than those who coped at work moderately. The association, however, did not reach statistical significance, and none of the other factors related to working environment were associated with the use of CGA. These issues indicate that the use of CGA is certainly linked with the leadership and underline the importance of having geriatricians also in leading roles in health-related decision-making.

The literature has emphasized the importance of frail older person to get comprehensive geriatric assessment timely. According to our study results, CGA is not optimally organized in Finland. Our health care system is basically designed for young people with one disease or disorder and this kind of approach is not optimal for older patients with multimorbidity and functional deterioration [29]. To take population aging and WHO's strategy into account, it is necessary to develop health care systems to provide comprehensive and coordinated care to older people with functional disability [30,31]. In the future, greater efforts are needed to ensure that older patients undergo CGA and rehabilitation when they need it the most [11]. Significance of CGA should be emphasized already from the beginning of geriatric training to ensure that geriatricians acquire good skills in performing CGA [32]. Furthermore, as there are large regions in Finland without geriatricians, it is necessary to broaden the use of CGA beyond geriatricians as well. Standardized geriatric assessment instruments embedded in routine practice could be one solution. Resident Assessment Instrument is currently used in certain regions of Finland but its value in everyday practice is not yet known. Based on our results, a proposition will be taken to the Board of Finnish Geriatrics society to promote CGA at the national level, perhaps embedded in the digital patient records being developed (Timo Strandberg, personal communication). Furthermore, training in CGA is an essential part in the courses for residents in geriatrics.

The main weakness of this study was the limited quantity of questions about the use of CGA. Important issues that were not addressed were social and environmental aspects of CGA and multidisciplinary teamwork, and availability of time for performing CGA. Again, we did not ask about precise working department (memory clinic, hospital ward, home care etc.) and about patients' case mix. In Finland, many geriatricians work in primary health care (either in health care center wards or geriatric outpatient clinics) treating a heterogeneous patient population. This may explain the somewhat surprising result that no differences in application of CGA were observed between different working places. Another possible explanation for this may be the small amount of geriatricians who did not use CGA at all. We acknowledge that certain responder-related issues, including scientific competence and literacy as well as having a leadership role, could affect (probably improve) the use of CGA but these items could not be analyzed with our data.

The small number of respondents in our study is obviously a weakness. This being the case, it was not possible to determine the independent roles of the different factors associated with the use of CGA. On the other hand, our material was a representative sample of Finnish geriatricians and the response rate (49%) is comparable to the usual response rate of surveys among physicians. Yet, the available number of respondents may lead to misinterpretation of the results and especially emphasize the role of individual responses. The challenges on implementation of CGA into daily practice warrant further study.

4. Conclusions

In conclusion, this study indicated that most Finnish geriatricians use CGA when they assess older patients. However, the use of CGA is not systematic and the content of CGA is variable. This

kind of incomplete evaluation may lead to inadequate detection of geriatric syndromes and other health problems.

Authors' contribution

H. Kerminen, T. Strandberg and J. Valvanne planned design and materials of the study. H. Kerminen and H. Huhtala analyzed the data. All authors contributed to analysis, interpretation and manuscript. All authors have approved the final article.

Disclosure of interest

Strandberg, T: EUGMS, past president; Finnish Geriatricians, member of the executive board.

Other authors have none to declare.

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This survey has been made with the permission of the executive board of Finnish Geriatricians society for the members of the society. Responding to the survey was voluntary.

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PUBLICATION II

Frailty Index and functional level upon admission predict hospital outcomes: an interRAI-based cohort study of older patients in post-acute care hospitals

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RESEARCH ARTICLE Open Access

Frailty Index and functional level upon admission predict hospital outcomes: an interRAI-based cohort study of older patients in post-acute care hospitals

Hanna Kerminen[1,2*], Heini Huhtala[3], Pirkko Jäntti[1], Jaakko Valvanne[1] and Esa Jämsen[1,2]

Abstract

Background: Geriatric assessment upon admission may reveal factors that contribute to adverse outcomes in hospitalized older patients. The purposes of this study were to derive a Frailty Index (FI-PAC) from the interRAI Post-Acute Care instrument (interRAI-PAC) and to analyse the predictive ability of the FI-PAC and interRAI scales for hospital outcomes.

Methods: This retrospective cohort study was conducted by combining patient data from interRAI-PAC with discharge records from two post-acute care hospitals. The FI-PAC was derived from 57 variables that fulfilled the Frailty Index criteria. Associations of the FI-PAC and interRAI-PAC scales (ADLH for activities of daily living, CPS for cognition, DRS for mood, and CHESS for stability of health status) with hospital outcomes (prolonged hospital stay ≥90 days, emergency department admission during the stay, and in-hospital mortality) were analysed using logistic regression and ROC curves.

Results: The cohort included 2188 patients (mean age (SD) 84.7 (6.3) years) who were hospitalized in two post-acute care hospitals. Most patients (n = 1691, 77%) were discharged and sent home. Their median length of stay was 35 days (interquartile range 18–87 days), and 409 patients (24%) had a prolonged hospital stay. During their stay, 204 patients (9%) were admitted to the emergency department and 231 patients (11%) died. The FI-PAC was normally distributed (mean (SD) 0.34 (0.15)). Each increase of 0.1 point in the FI-PAC increased the likelihood of prolonged hospital stay (odds ratio [95% CI] 1.91 [1.73—2.09]), emergency admission (1.24 [1.11—1.37]), and in-hospital death (1.82 [1.63—2.03]). The best instruments for predicting prolonged hospital stay and in-hospital mortality were the FI-PAC and the ADLH scale (AUC 0.75 vs 0.72 and 0.73 vs 0.73, respectively). There were no differences in the predictive abilities of interRAI scales and the FI-PAC for emergency department admission.

(Continued on next page)

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(Continued from previous page)
Conclusions: The Frailty Index derived from interRAI-PAC predicts adverse hospital outcomes. Its predictive ability was similar to that of the ADLH scale, whereas other interRAI-PAC scales had less predictive value. In clinical practice, assessment of functional ability is a simple way to assess a patient's prognosis.

Keywords: Older people, Aged, Geriatric assessment, Functional ability, Frailty, Frailty index, Inpatients, Post-acute care, Hospital outcomes

Background

Geriatric syndromes are common clinical conditions in older adults [1]. They are often connected to each other with multiple shared underlying aetiological factors that involve different organ systems [1]. Frailty is a geriatric syndrome in which the patient's ability to resist stressful events is reduced as a result of age-related cumulative decline in many physiological systems [2]. At least in its early stages, frailty is a potentially reversible condition [3].

Frail older patients [4, 5] and those suffering from other geriatric syndromes [6, 7] are vulnerable to adverse outcomes. Frailty predicts prolonged hospital stay [8–10] and in-hospital mortality [10–12]. Impaired functional ability in activities of daily living (ADLs) and impaired cognition predict all-cause mortality among hospitalized patients [13, 14]. Symptoms of depression associate with in-hospital mortality, all-cause mortality, and length of hospital stay [15, 16]. In addition, stability in health state, measured by combining different instability symptoms with functional ability, declined cognition, and poor prognosis, predicts all-cause mortality among institutionalized patients and patients with neurological conditions [17, 18], but studies among hospitalized patients are lacking.

Even though geriatric syndromes are highly prevalent among acutely ill hospitalized patients [6, 19], the recognition rate of these conditions is low [6]. However, hospitalization offers opportunities to identify and act on geriatric syndromes and undiagnosed diseases [20]. The Comprehensive Geriatric Assessment (CGA) was developed to improve the identification of older patients with geriatric syndromes [19]. The CGA includes an assessment of the patient's medical, psychological, cognitive and functional problems, as well as environmental and social factors. The assessment leads to a treatment plan, rehabilitation, and follow-up [19]. Performing the CGA during a stay in acute care increases the patient's likelihood of being alive and living at home one year later [19].

There is currently no clear consensus about the contents of the CGA, and several different CGA approaches have been developed. One example is the interRAI assessment system, which can be used as a CGA tool [21]. Similarly, frailty does not yet have an internationally recognized standard definition, nor is there a gold standard for detecting it [22]. Instead, there are multiple frailty instruments that are based on one of two widely used frailty models: the phenotypic model [23] and the cumulative deficit model [24]. The phenotypic model defines frailty as the presence of three or more of five factors in an individual [23]. In the cumulative deficit model, frailty is defined as the cumulative effect of individual deficits [24]. The Frailty Index is based on this latter model [24]. Although the interRAI instrument is lacking a frailty scale, it can be derived from the database [25].

To the best of our knowledge, no previous studies have dealt with the prognostic effects of the Frailty Index and different interRAI scales in post-acute care. The aims of this study were 1) to derive a Frailty Index (FI-PAC) from the interRAI Post-Acute Care instrument (interRAI-PAC), 2) to determine how the FI-PAC associates with hospital outcomes (in-hospital mortality, prolonged hospital stay, and emergency department admission), and 3) to clarify how the other scales of the interRAI-PAC compare in the prediction of hospital outcomes.

Methods

Design and setting of the study

This study was a retrospective cohort study among patients aged 70 and older who were hospitalized in two geriatric post-acute care hospitals in Tampere (population base 232,000, of which 11% is aged 70 years or older), Finland, during the period of 1 February 2013 to 31 May 2016. These hospitals (230 and 190 beds) offered subacute care and rehabilitation for older patients who were first hospitalized in a tertiary or secondary care hospital (Fig. 1). In addition, one of the hospitals served as a supporting hospital for home care clients. Consequently, home care nurses or physicians in the emergency room could refer these patients directly to this hospital without hospitalization in an acute care setting. At the end of 2015, this hospital was closed due to organizational changes.

The results of the interRAI-PAC assessments (see below) were linked to hospital discharge records, which contained information about the patient's usual residence, the place he/she was admitted from, dates of

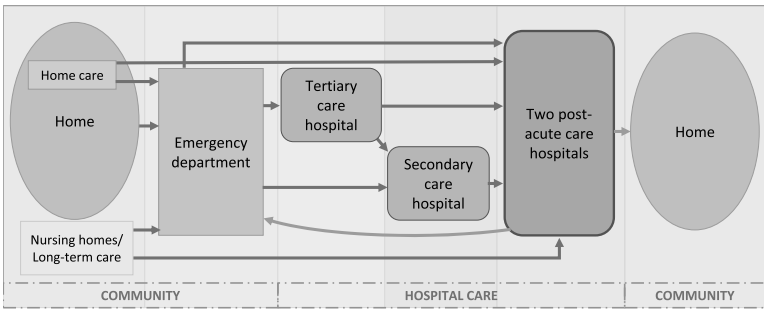

Fig. 1 Illustration of the organizational structure of geriatric care in the city of Tampere, Finland, and the movement of patient-flow through care settings (*blue arrows* from home to hospital, *orange arrow* emergency department admission during the stay in post-acute care hospital, *green arrow* from the post-acute care hospital to home)

admission and discharge, discharge diagnosis and destination, and, when applicable, death during hospitalization. In patients with several hospitalizations during the observation period, the first to which interRAI data could be linked was included in this study. Information on the patient's chronic diseases, functional ability, previous falls, smoking habits, and Body Mass Index (BMI) were collected from the interRAI-PAC. Some 2188 patients were included in the final analysis (Fig. 2).

InterRAI Post-Acute care instrument (interRAI-PAC)

There are several interRAI instruments with similar core items and divergent instrument-specific domains. The interRAI-PAC is designed for post-acute care and rehabilitation settings [26]. It contains information across domains, including functioning on the physical, cognitive and psycho-social levels as well as sociodemographic data, medical diagnoses, and current symptoms. Single items are combined to compose validated scales that measure different aspects of functional ability. InterRAI instruments have substantial interrater reliability [27, 28].

The use of interRAI-PAC instrument was started on 1 February 2013 in one post-acute care hospital and gradually in the other hospital. All the wards in this particular hospital had started to use interRAI-PAC by the beginning of the year 2016. Trained nurses performed the assessment within a few days of the patient's

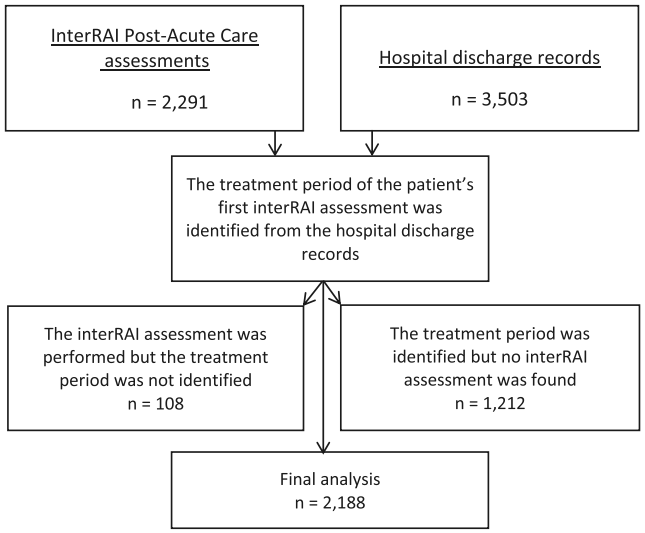

Fig. 2 Formation of materials

admission to the ward. To obtain relevant information, they interviewed the patient and family members, observed the patient, and reviewed the medical records. The assessment consisted of 150 variables. The only missing variables were for weight or height (in 23 patients).

Based on previous findings of prognostic factors related to the outcomes of older inpatients [4–7, 10, 13, 16, 18], associations of the interRAI scales measuring cognitive functions, ADLs, mood, and stability of health state were used in this study. The Cognitive Performance Scale (CPS) describes the cognitive status of the patient based on an algorithm [29]. The Activities of Daily Living Hierarchy Scale (ADLH) is an algorithm that considers a measure of ADL performance in locomotion, eating, toilet use, and personal hygiene [30]. The Depression Rating Scale (DRS) is based on existing symptoms of depression [31]. The Changes in Health, End-stage disease, and Signs and Symptoms Scale (CHESS) is a summary measure based on decline in cognition and ADL performance, certain symptoms (for example, weight loss, shortness of breath, and oedema), and ratings of a prognosis of less than six months, and it is designed to identify individuals at high risk for clinically significant decline [17].

Derivation of the Frailty Index from the interRAI-PAC instrument

The Frailty Index is a method to measure frailty in relation to the accumulation of health deficits [32], and it can be calculated from a variety of databases according to the standard procedure for selecting individual deficits [32]. The Frailty Index is the proportion of deficits present in an individual out of the total number of variables considered [32], and so higher scores are associated with adverse hospital outcomes – for example longer length of hospital stay, new discharge to a nursing home, and death [9, 10]. The Frailty Index from the interRAI Acute Care instrument (FI-AC) was previously derived and published by Hubbard et al. in 2015 [25]. The interRAI-AC instrument includes the same core items as the interRAI-PAC but has fewer items in total.

In this study, the Frailty Index (FI-PAC) was derived from the interRAI-PAC according to the standard procedure and the well-defined criteria created by Searle et al. [32], and leaning on the coding of variables in FI-AC. In short, all the items of the interRAI-PAC were evaluated against the Frailty Index criteria independently by two geriatricians. Secondly, eventual differences were negotiated to achieve a consensus of appropriate variables in post-acute care patient population. Finally, variables were compared with the coding of FI-AC [25]. There are several explanations for the differences between FI-PAC and FI-AC. First, some variables that were used in FI-PAC are not recorded in interRAI AC. Second, some differences are based on the differences in interpretation of the criteria for selecting appropriate variables to FI, mainly based on different characteristics of patient populations in post-acute and acute care settings. Finally, the Depression Rating Scale, Pain Scale, and Aggressive Behaviour Scale were included in the FI-PAC instead of using single variables, because the scales reflect both the patient's situation and criteria for selecting variables to FI better than separate variables related to the issue. Of the variables considered, 57 variables were chosen for the FI-PAC [Additional file 1]. The FI-PAC was calculated for each patient by summing deficit points and dividing the sum by the total number of deficits considered. The only missing item was BMI (in 23 patients), and the denominator was adjusted to 56 items for these patients.

Outcome measures

Prolonged hospital stay. Length of hospital stay was determined as the difference between the date of admission and the date of discharge. Length of stay in post-acute care hospital was recorded only for the patients who were discharged to their usual residency (own home or nursing home). It was not recorded for the patients who had emergency department admissions or who died during the hospital stay. In addition, length of hospital stay was not recorded for the patients who were admitted from home but were discharged to nursing home for long-term care ($n = 69$). This is because the delay of a new nursing home placement was most probably more dependent on the organizational factors than on patient's condition. Length of hospital stay was dichotomously classified as less than 90 days and 90 days or more according to the usual cut-off for long-term care [33]. Hospitalization for 90 days or more was defined as a prolonged hospital stay.

Emergency department admission was recorded for the patients who were transferred to the emergency department during their post-acute care treatment period.

In-hospital mortality was recorded from the discharge records and defined as death during the stay in the post-acute care hospital. In addition, deaths in patients who were referred to an acute care hospital because of an acute illness and who died there on the same day were also counted as in-hospital deaths ($n = 4$).

Statistical analysis

Patient characteristics were described using frequencies and percentages. The distribution of the FI-PAC was tested in all patients as well as in sex and age groups; the results are presented as means and standard deviations. The predictive ability of the FI-PAC on outcome

measures was investigated using binary logistic regression analysis, adjusted for age and sex. Logistic regression analyses were also performed for sex and age subgroups. The receiver operating characteristic curve (ROC) and the area under the curve (AUC) with 95% confidence intervals (CIs) were calculated to clarify the discriminative ability of the FI-PAC for hospital outcomes. For each outcome measure, the optimal cut-off point of the FI-PAC for sensitivity and specificity was calculated using the Youden method, and positive and negative predictive values (PPV and NPV) were determined. To compare the predictive ability of the FI-PAC to that of existing interRAI scales, the ROC curve and the AUC with corresponding 95% CIs for hospital outcomes were also calculated for the ADLH, CHESS, CPS, and DRS scales. Data management and analysis were performed using IBM SPSS Statistics version 25.

Ethics

Retrospective register-based studies in which the subjects are not contacted are not considered medical research by Finnish legislation (Medical Research Act 1999/488 § 2) [34] and, therefore, ethics committee approval was not required. Retrospectively collected health register data could be used for this study with permission of register owner without participants' informed consent, based on current legislation (Data Protection Act 2018/2010, Act on the Publicity of Official Documents 1999/621, European Union General Data Protection Regulation) [35–37]. Research plan was institutionally reviewed and permission to use the interRAI-PAC assessments and hospital discharge records was hence obtained from the administration of the City of Tampere (decision the Director of Hospital Services, in August 30, 2016).

Results

Characteristics of the patients

The cohort included 2188 patients with a mean age (SD) of 84.7 (6.3) years. Most of the patients were female (n = 1499, 69%) (Table 1). Almost half of the patients (46%, n = 1004) had a memory disorder diagnosis. Only 12% of the patients (n = 255) were independent in all basic activities of daily living (BADLs) (bathing, personal hygiene, dressing, walking, locomotion, transfer to toilet, toilet use, bed mobility, and eating), while 18% (n = 395) were totally dependent on caregivers for all BADLs. Half of the patients came to hospital straight from home and the other half came from an acute care hospital.

Most of the patients (n = 1691, 77%) were discharged to their usual place of residence (own home or nursing home) (Table 1). The median length of stay in post-acute care was 35 days (interquartile range 18–87 days), and 409/1691 patients (24%) had a prolonged hospital stay. Some 204/2188 patients (9%) were admitted to the emergency department. The in-hospital mortality rate was 11% (n = 231/2188).

Distribution of the FI-PAC

The FI-PAC was normally distributed, with a mean (SD) score of 0.34 (0.15), a minimum of 0.01 and a maximum of 0.76 (Fig. 3). There were no significant differences between age and sex groups.

Association of the FI-PAC and the interRAI scales with hospital outcomes

The FI-PAC

In logistic regression analyses adjusted for age and sex, the FI-PAC was associated with prolonged hospital stay, emergency department admission, and in-hospital mortality (Table 2). Each 0.1-point increase in the FI-PAC raised the likelihood of prolonged hospital stay by 91%, emergency admission by 24%, and in-hospital death by 82%. The predictive ability of the FI-PAC to discriminate between patients who did or did not experience an adverse outcome was the best for prolonged hospital stay (AUC 0.75). The predictive ability was lowest for emergency department admission (AUC 0.59). There were no differences between sex and age groups for the ability of the FI-PAC to predict hospital outcomes.

Table 2 shows the sensitivity, specificity, PPV, and NPV of the FI-PAC for each outcome measure. The cut-off point for optimal sensitivity and specificity differed slightly between the outcomes (0.32 for prolonged hospital stay, 0.30 for emergency department admission, and 0.35 for in-hospital mortality). At these optimal cut-off points, sensitivity was higher than specificity. The FI-PAC was equally sensitive in predicting prolonged hospital stay and in-hospital mortality (sensitivity 81%), whereas the sensitivity for emergency department admission was poorer (73%). The specificity was the highest for prolonged hospital stay (61%) and the lowest for emergency department admission (44%). PPV varied from 14% for emergency department admission to 40% for prolonged hospital stay with consistently high NPVs (91–96%). When the cut-off point was elevated to 0.40, which is the usual cut off for frailty [10, 24, 38], specificity rose at the cost of sensitivity (Table 3).

The interRAI scales (ADLH, CHESS, CPS, and DRS) compared to the FI-PAC

In a comparison of the interRAI scales and the FI-PAC, the best scales for predicting prolonged hospital stay were the FI-PAC and ADLH with equal discriminative capacity (Table 4 and Fig. 4), and they were also significantly better than CHESS, CPS, and DRS. There were no differences in the predictive abilities of interRAI scales and the FI-PAC for emergency department admission.

Table 1 Baseline characteristics and outcomes of the patients ($n = 2188$)

	n	%
Female	1499	68.5
Age (years)		
70–79.9	498	22.8
80–89.9	1234	56.4
≥ 90	456	20.8
Age (years) mean (SD)	84.7	(6.3)
Usual residence		
Own home	1959	89.5
Nursing home/long-term care	229	10.5
Chronic diseases		
Alzheimer's disease	737	33.7
Other memory disorder	217	9.9
Alzheimer's disease and other memory disorder	50	2.3
Congestive heart failure	685	31.3
Coronary heart disease	572	26.1
Diabetes	528	24.1
Cancer	325	14.9
Stroke/cerebrovascular accident	228	10.4
Depression	209	9.6
COPD	156	7.1
Parkinson's disease	59	2.7
Independent in Activities of Daily Living		
Bathing	316	14.4
Personal hygiene	572	26.1
Dressing	649	29.7
Toilet use	859	39.3
Transfer to toilet	1003	47.5
Walking	1014	46.3
Bed mobility	1039	47.5
Eating	1726	78.9
Primary mode of locomotion at the hospital		
Walking, no assistive device	245	11.2
Walking, with assistive device	1328	60.7
Wheelchair	329	15.0
Bedridden	286	13.1
Falls		
No falls in last 3 months	1077	49.2
Fall(s) 1 to 3 months ago	265	12.1
Fall(s) in last month	846	38.7
Smokes tobacco daily	84	3.8
< 18.5	192	8.9
18.5–24.9	997	46.1
25–29.9	606	28.0
≥ 30	370	17.1

Table 1 Baseline characteristics and outcomes of the patients ($n = 2188$) *(Continued)*

	n	%
Body Mass Index (BMI) kg/m^2 [a] mean (SD)	25.04	(5.4)
Admitted from		
Home	1028	47.0
Nursing home/long-term care	49	2.2
Acute care hospital	1111	50.8
Ten most common main hospital discharge diagnosis code groups (ICD-10)		
Diseases of the circulatory system (I)	496	22.7
Diseases of the nervous system (G)	408	18.6
Injury, poisoning and certain other consequences of external causes (S or T)	315	14.4
Mental and behavioural disorders (F)	237	10.8
Neoplasms or diseases of the blood (C or D)	129	5.9
Diseases of the musculoskeletal system and connective tissue (M)	128	5.9
Diseases of the respiratory system (J)	110	5.0
Diseases of the genitourinary system (N)	100	4.6
Symptoms and signs, not elsewhere classified (R)	79	3.6
Endocrine, nutritional and metabolic diseases (E)	69	3.2
Outcomes		
Prolonged hospital stay[b] ($n = 1691$)	409	24.2
Emergency department admission	204	9.3
In-hospital death	231	10.6

[a] BMI missing, $n = 23$
[b] In patients who were discharged to their usual place of residence (home or nursing home)

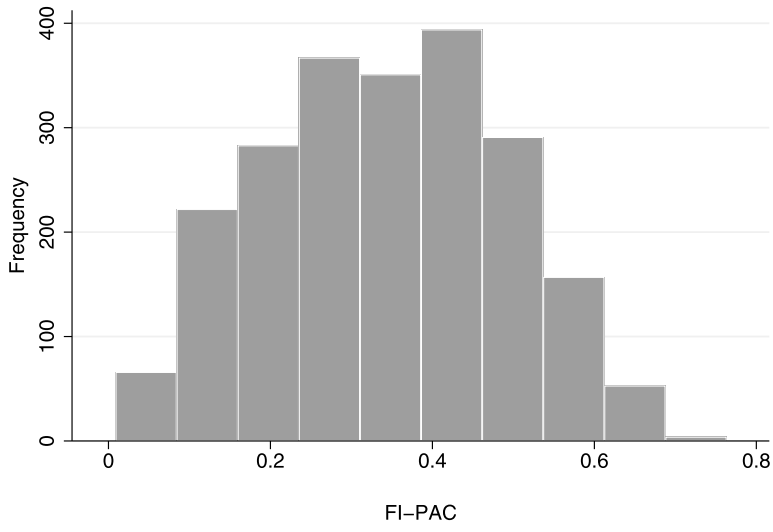

Fig. 3 Distribution of the Frailty Index for Post-Acute Care (FI-PAC) among 2188 patients aged ≥70 years in two post-acute care hospitals

Table 2 Discriminative and predictive capacity of the FI-PAC for hospital outcomes

Outcome	OR[a]/0.1 FI increment		AUC	(95% CI)	Optimal cut-off point	Sensitivity		Specificity		PPV[b]		NPV[c]	
		(95% CI)				n	(%)	n	(%)	n	(%)	n	(%)
Prolonged hospital stay	1.91	(1.73—2.09)	0.75	(0.72—0.77)	≥0.32	332/409	(81.2)	778/1282	(60.7)	332/836	(39.7)	778/855	(91.0)
Emergency department admission	1.24	(1.11—1.37)	0.59	(0.55—0.63)	≥0.30	148/204	(72.5)	745/1691	(44.1)	148/1094	(13.5)	745/801	(93.0)
In-hospital mortality	1.82	(1.63—2.03)	0.73	(0.70—0.76)	≥0.35	188/231	(81.4)	1057/1957	(54.0)	188/1088	(17.3)	1057/1100	(96.0)

[a] Adjusted for age and gender
[b] Positive predictive value
[c] Negative predictive value

The best scales for predicting in-hospital mortality were the FI-PAC, ADLH, and CHESS.

Finally, we repeated the analyses concerning the FI-PAC with the cut-off point < 0.40 vs ≥0.40 firstly among patients with ADLH < 2 vs ≥2 and secondly among patients with CPS < 2 vs ≥2. Among patients with both FI-PAC ≥0.40 and ALDH ≥2, the odds ratio for prolonged hospital stay was greater than that of sole ADL deficit (ADLH+FI-PAC OR [95% CI] 7.49 [5.47—10.26], sole ADL deficit 3.35 [2.40–4.68]). The situation was the same for CPS (CPS + FI-PAC 5.45 [4.05—7.33], sole CPS deficit 1.71 [1.24—2.36]). For other outcomes, no such differences were observed.

Discussion

In this large retrospective cohort study of older patients in a post-acute care setting, we derived a Frailty Index (FI-PAC) from the interRAI Post-Acute Care instrument (interRAI-PAC) to summarize the results of the comprehensive assessment. A Frailty Index has previously been derived from the interRAI Acute Care instrument [25], and it has been shown to predict multiple adverse outcomes in hospitalized older patients [10], but the interRAI-PAC has not been previously used for that purpose. Most variables are the same in the FI-PAC as in the Frailty Index derived from the interRAI assessment system for Acute Care (FI-AC), but one difference is that instead of using single variables, we included the Depression Rating Scale (DRS), Pain Scale (PAIN), and Aggressive Behaviour Scale (ABS) in the FI-PAC. Another difference is that we did not include the number of medications in the FI-PAC. In addition, we included walking speed.

We succeeded in deriving a Frailty Index from the interRAI-PAC with the expected normal distribution in this study population [25, 39]. The distribution of the Frailty Index is usually skewed in population-based samples, but it tends to change to a normal distribution in more morbid and unwell groups of older people [41]. However, a skewed distribution was also found in hospitalized older patients in a study by Cesari et al. [11]. This discrepancy could be attributed to the better functional ability of the patients in their study. The mean score for the FI-PAC was 0.34, which was close to the mean score of 0.32 for the FI-AC [25]. There were no significant differences between age and sex groups, and this finding is consistent with the finding of Hubbard et al. [25].

It transpired that the FI-PAC was associated with both prolonged hospital stay and in-hospital mortality, and it had a good discriminative ability (both AUCs over 0.70).

Table 3 Predictive capacity of the FI-PAC for hospital outcomes in different Frailty Index (FI) cut-off points

Outcome	FI cut-off point	Sensitivity		Specificity		PPV[a]		NPV[b]	
		n	(%)	n	(%)	n	(%)	n	(%)
Prolonged hospital stay (≥90 days)	≥0.40	227/409	(56)	975/1282	(76)	227/534	[43]	975/1157	(84)
	≥0.32	332/409	(81)	778/1282	(61)	332/836	[40]	778/855	(91)
Emergency department admission	≥0.40	79/204	[41]	1157/1691	(68)	79/613	[13]	1157/1282	(90)
	≥0.30	148/204	(73)	745/1691	[44]	148/1094	[14]	745/801	(93)
In-hospital mortality	≥0.40	156/231	(68)	1316/1957	(67)	156/797	[20]	1316/1391	(95)
	≥0.35	188/231	(81)	1057/1957	(54)	188/1088	[17]	1057/1100	(96)

[a] Positive predictive value
[b] Negative predictive value

Table 4 Predictive ability of different interRAI scales compared to the FI-PAC for different hospital outcomes

Scale		Outcome					
		Prolonged hospital stay		Emergency department admission		In-hospital mortality	
Name		**AUC**	**(95% CI)**	**AUC**	**(95% CI)**	**AUC**	**(95% CI)**
Frailty Index for Post-Acute Care	FI-PAC	0.75	(0.72—0.77)	0.59	(0.55—0.63)	0.73	(0.70—0.76)
Activities of Daily Living Hierarchy Scale	ADLH	0.72	(0.69—0.75)	0.59	(0.55—0.63)	0.73	(0.69—0.76)
Cognitive Performance Scale	CPS	0.66	(0.63—0.69)	0.50	(0.46—0.58)	0.62	(0.58—0.66)
Depression Rating Scale	DRS	0.57	(0.54—0.60)	0.54	(0.50—0.58)	0.56	(0.52—0.60)
Changes in Health, End-stage disease, and Signs and Symptoms Scale	CHESS	0.62	(0.59—0.65)	0.62	(0.58—0.66)	0.71	(0.67—0.75)

Previous studies have not dealt with length of hospital stay in the post-acute care setting, but the results from acute care showed an association between the Frailty Index and prolonged length of stay [8, 9]. In accordance with our results, Hubbard et al. found an association between the FI-AC and in-hospital mortality [10]. This finding is also consistent with previous studies that have examined the predictive ability of the Frailty Index [11] and the Clinical Frailty Scale [40, 41] for in-hospital mortality in the acute care setting.

It was noted also that the FI-PAC associated with emergency department admission, but the predictive

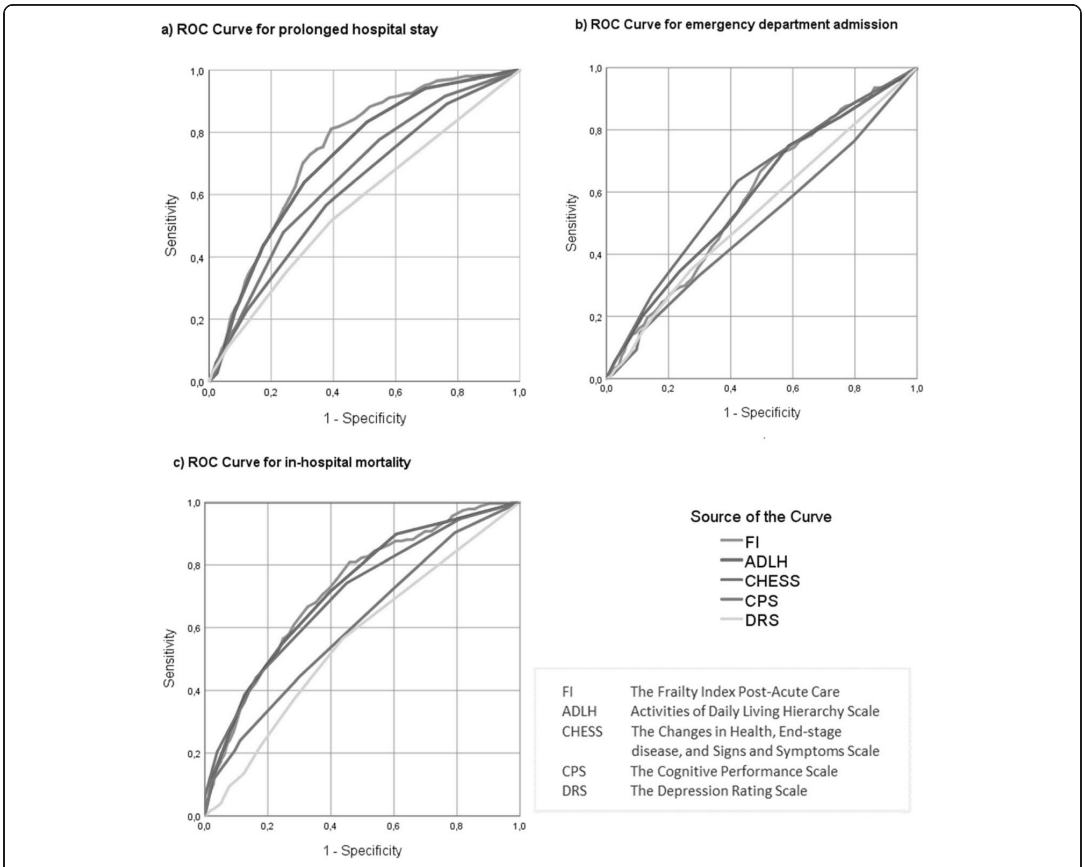

Fig. 4 Discriminative ability of the Frailty Index for Post-Acute Care (FI-PAC) and interRAI scales for predicting hospital outcomes among 2188 patients aged ≥70 years in post-acute care hospitals

ability was only modest. This result may be explained by the fact that most short-term readmissions to acute care hospitals are due to medical issues [42, 43] – for example, acute and chronic diseases – and the impact of these diseases on admission to acute care is greater than that of frailty status.

Interestingly, the FI-PAC was equal but not superior to ADLH in predicting prolonged hospital stay and in-hospital mortality. However, having a high Frailty Index significantly increased the odds for adverse hospital outcomes in patients with ADL impairments or cognitive decline compared to the effects of these conditions alone. In their analysis based on the FI-AC, Hubbard et al. did not compare the predictive ability of the FI-AC to the standard interRAI scales [10]. Although several studies have shown that ADL impairment upon admission to acute hospital is a strong predictor of prolonged hospital stay and mortality in older patients [14, 43, 45], it was surprising that functional impairment, measured by the short ADLH scale, was as good a prognostic instrument as the multicomponent Frailty Index. These results are, however, in agreement with Chen's findings, which showed that frailty and functional dependence were comparable in predicting short-term outcomes after gastrointestinal surgery [46]. A possible explanation might be that frailty is a complex phenomenon and different instruments – for example, the Frailty Index – can measure only some aspects of it [3]. Although the Frailty Index consists of a variety of different health-related items, it more or less represents a sum of comorbidities and disabilities rather than a measure of the biological aspects of frailty [47]. If measuring biological (phenotypic) frailty had been possible in our study, the results might be different.

It can thus be suggested that, in clinical practice, calculating the Frailty Index for the purpose of identifying patients with poor outcomes does not bring additional value over assessment of functional ability. Instead, the detection of functional impairment can be used to define frailty [48]. From a clinical point of view, assessment of the patient's functional ability is simple, quick, and inexpensive, and it is usually already part of the nurses' assessment protocol. Owing to the multifactorial basis of functional impairment [49], factors underlying each person's functional decline are probably different regardless of similar scores on the Frailty Index. Thus, the detection of functional impairment should in turn lead to the comprehensive clinical and interprofessional evaluation of the patient in order to clarify underlying factors and make a plan for proper treatment and rehabilitation.

For clinical decision making, cut-off points with approximate discrimination between robust, prefrail and frail individuals have been developed. In older adults with functional decline, the cut-off point is about 0.25 between robust and prefrail and about 0.40 between prefrail and frail [10, 38]. We considered it important to clarify the clinically relevant cut-off points for the FI-PAC that can be used to differentiate persons who are likely to experience adverse outcomes during their hospitalization from those who are likely to survive without complications. Optimal cut-off points, based on the ROC curves, varied from 0.30 to 0.35 in our study population. The problem with the Frailty Index in this patient population is that by using the cut-off point of 0.35, half of the patients are classified as being at risk for adverse outcomes. However, scores that were lower than the cut-off points ruled out most patients who did not face adverse outcomes during hospitalization.

The strengths of our study are the representative sample size and quite homogenous patient population, the complete records, and the representation of real-life patients due to the retrospective nature of the study. However, a note of caution is due here since our materials did not include all patients that had a treatment period in a post-acute care hospital during the study period, because the interRAI assessment was not made for everybody. There are many possible reasons for missing assessments. One reason is that the introduction of interRAI-PAC was gradual in different wards, but hospital discharge records were collected the same period of time from both hospitals. In addition, the assessment was not done for the patients who were in a terminal care phase and to the patients with suspected hospital stay for less than seven days. Another reason may be related to the fact that the completion of an interRAI assessment is time and resource demanding [50], which may lead to a substantial number of the missing assessments in real-life clinical context [51]. However, this is unlikely to cause systematic bias in our analysis.

Another source of uncertainty is our lack of knowledge of incidents occurring during the whole hospital treatment period of the patient – for example, the length of stay in an acute care hospital, diagnoses of acute diseases, or treatments given. The predictive ability of the FI-PAC probably varies between different patient groups, for instance between patients whose reason for hospitalization is acute disease versus patients whose reason for the hospital stay is postoperative rehabilitation. Therefore, caution must be applied when applying our results to diverse patient groups. In addition, although our materials cover all post-acute care in our city and although the patients represent unselected population (in terms of social or insurance status), it is acknowledged that in international context, the current patient numbers are modest and the results may not be fully generalizable to other health care systems.

Conclusions

It is possible to derive Frailty Index from the interRAI-PAC and such FI predicts adverse hospital outcomes as expected. However, its predictive ability was not better than that of the ADLH scale and because most patients had FI values predictive of adverse outcomes, FI-PAC does not seem to aid in decision-making at the level of an individual patient. In clinical practice, the assessment of functional ability is an important and simple way to assess the patient's prognosis. Patients with functional impairment should be evaluated carefully in order to clarify underlying factors and make a plan for treatment and rehabilitation. Future research should focus on the comparison of the phenotypic (biological) frailty model and the Frailty Index in predicting hospital outcomes.

Supplementary information

Supplementary information accompanies this paper at https://doi.org/10.1186/s12877-020-01550-7.

Additional file 1. The Frailty Index derived from interRAI Post-Acute Care instrument. Table that describes the formation of Frailty Index from interRAI Post-Acute Care instrument.

Abbreviations

ABS: Aggressive Behaviour Scale; ADLH : Activities of Daily Living Hierarchy Scale; ADLs: Activities of daily living; AUC: Area under the ROC curve; BALD: Basic activities of daily living; BMI: Body mass index; CGA: Comprehensive Geriatric Assessment; CHESS : Changes in Health, End-stage disease, and Signs and Symptoms Scale; CIs: Confidence intervals; CPS : Cognitive Performance Scale; DRS : Depression Rating Scale; FI-AC : Frailty Index derived from the interRAI assessment system for Acute Care; FI-PAC : Frailty Index derived from the interRAI assessment system for Post-Acute Care; interRAI-PAC: interRAI assessment system for Post-Acute Care; NPV : Negative predictive value; PAIN: Pain Scale; PPV : Positive predictive value; ROC: Receiver operating characteristic curve

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Authors' contributions

Study concept and design: HK, HH, PJ, JV, EJ; acquisition of data: HK; analysis of data: HK, HH; interpretation of data: HK, HH, PJ, JV, EJ; manuscript drafting: HK; manuscript revision and approval: HK, HH, PJ, JV, EJ.

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Availability of data and materials

The datasets generated and analysed during the current study are not publicly available, because they represent confidential health information of the included patients, and distribution of such data is forbidden according to data protection legislation. Furthermore, the authorities responsible for the health data have granted access to these data only for the present study. Summarized data is available on reasonable request from the corresponding author.

Ethics approval and consent to participate

Retrospective register-based studies in which the subjects are not contacted are not considered medical research by Finnish legislation (Medical Research Act 1999/488 § 2) [34] and, therefore, ethics committee approval was not required. Finnish legislation (Data Protection Act 2018/1050, 4§ and 31§) [36] and European Union General Data Protection Regulation (Directive 95/46/EC, art. 6.1e, 9.2j and 89.2) [37] allow retrospective use of health-related data for scientific research without informed consent, and according to Finnish legislation (Act on the Publicity of Official Documents 1999/621 § 28) [35], the owner of the register in question (a local/municipal authority in the context of our study) gives permission for use of such data. Research plan was institutionally reviewed and permission to use the interRAI-PAC assessments and hospital discharge records was hence obtained from the administration of the City of Tampere (decision the Director of Hospital Services, in August 30, 2016).

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Risk factors of readmission after geriatric hospital care: An interRAI-based cohort study in Finland

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Risk factors of readmission after geriatric hospital care: An interRAI-based cohort study in Finland

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ABSTRACT

Purpose: To identify risk factors for readmission after geriatric hospital care.
Methods: A retrospective cohort study of 1,167 community-dwelling patients aged ≥70 years who were hospitalised in two geriatric hospitals and discharged to their homes over a three-year period. We combined the results of the interRAI-post acute care instrument (interRAI-PAC) with hospital discharge records. Factors associated with readmissions within 90 days following discharge were analysed using logistic regression analysis.
Results: The patients' mean age was 84.5 (SD 6.2) years, and 71% (n = 827) were women. The 90-day readmission rate was 29.5%. The risk factors associated with readmission in the univariate analysis were as follows: age, admission from home vs. acute care hospital, Alzheimer's disease, unsteady gait, fatigue, unstable conditions, Activities of Daily Living Hierarchy Scale (ADLH) score, Cognitive Performance Scale (CPS) score, body mass index (BMI), frailty index, bowel incontinence, hearing difficulties, and poor self-rated health. In the multivariable analysis, age of ≥90 years, ADLH ≥1, unsteady gait, BMI <25 or ≥30 kg/m 2 , and frailty remained as risk factors for readmission. Surgical operation during the treatment period was associated with a lower readmission risk.
Conclusions and implications: InterRAI-PAC performed upon admission to geriatric hospitals revealed patient-related risk factors for readmission. Based on the identified risk factors, we recommend that the patient's functional ability, activities of daily living (ADL) needs, and individual factors underlying ADL disability, as well as nutritional and mobility problems should be carefully addressed and managed during hospitalization to diminish the risk for readmission.

1. Introduction

Hospital readmission shortly after discharge is a common adverse outcome of hospitalization among older patients (Pedersen et al., 2017). Approximately 15% of patients discharged from acute care (Pedersen et al., 2017) and 11—23% of patients discharged from post-acute care or rehabilitation settings are admitted to hospital within 30 days of discharge (Hoyer et al., 2013; Hughes & Witham, 2018; Ottenbacher et al., 2014).

The reasons for readmissions are multifactorial (Pedersen et al., 2017). According to a systematic review, the main risk factors associated with a higher risk for hospital readmission after a stay in an acute care hospital are related to socio-demographic determinants (e.g. higher age and male sex), and impaired health state (e.g. poor overall condition, functional disability, geriatric syndromes, and frailty) (Pedersen et al., 2017). The factors associated with hospital admission shortly after a stay in post-acute care or rehabilitation settings include delirium (Miu et al., 2016), congestive heart failure (Flanagan et al., 2018), dependencies in mobility, self-care and cognition at discharge (Hoyer et al., 2013; Middleton et al., 2016; Middleton et al., 2018), possible depression, chronic obstructive pulmonary disease (COPD), and unstable or acute conditions (Sinn et al., 2016). Meanwhile, higher gait speed (Peel et al., 2014) and optimism about rehabilitation are protective against readmission (Sinn et al., 2016). About a quarter of readmitted patients are readmitted with the same condition that they had for their initial admission (Hughes & Witham, 2018).

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Geriatric syndromes are common multifactorial clinical conditions in older hospitalised patients (Buurman et al., 2011; Inouye et al., 2007), and they increase the risk for readmission and other adverse hospital outcomes (Espallargues et al., 2008). In patients with geriatric syndromes, recovery after acute illness or trauma is usually prolonged. As the length of stay in acute hospitals is short, patients are often transferred to post-acute care settings (Bowles et al., 2009). In Finland, post-acute care is organised in hospital settings.

There are a few studies concerning risk factors of readmissions following discharge from post-acute care or rehabilitation settings and from acute geriatric units, but there are no studies about risk factors after other kind of geriatric care. In previous studies, follow-up has been limited to 30 days of discharge. This study explored risk factors of readmissions to any hospitals after geriatric hospital care among mixed patient populations; including patients with subacute, post-acute and rehabilitation care needs. Especially, this study aimed to clarify how comprehensive geriatric assessment (CGA), based on the interRAI Post-Acute Care instrument (interRAI-PAC), can be used to identify patients in a mixed patient population of community-dwelling older adults with increased risk for such readmissions.

2. Methods

2.1. Setting and materials

This retrospective cohort study was conducted among community-dwelling older patients who were hospitalised in two geriatric hospitals and discharged to their own homes. The hospitals (230 and 190 beds) are situated in the city of Tampere (population 232,000, of which 11% are ≥70 years old) in western Finland. These hospitals offered post-acute care and rehabilitation to older patients who were first hospitalised in acute care hospitals. Furthermore, home care clients could be referred directly from home to these hospitals when they needed temporary hospital care or rehabilitation without the need for a higher level of acute care.

The materials of this study consisted of two routinely collected health databases: 1) interRAI-PAC assessments and 2) hospital discharge records of these two geriatric hospitals. The use of interRAI-PAC was started in February 2013 in one hospital and gradually in the other hospital. All the wards in both hospitals had started to use interRAI-PAC by the beginning of 2016. The hospital discharge records contained information on the place the patient was admitted from, dates of

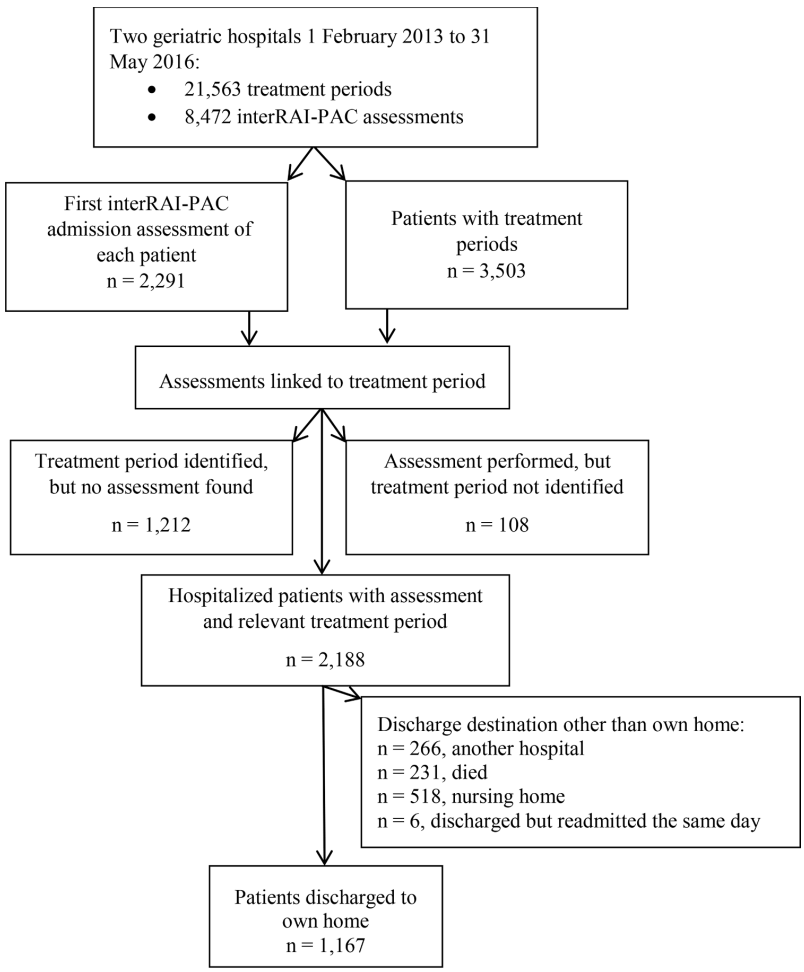

Fig. 1. Formation of materials.

admission and discharge, and discharge diagnoses and destination.

The results of the interRAI-PAC assessments were linked to the mandatory hospital discharge records of these two geriatric hospitals. The formation of materials is shown in Fig. 1. First, interRAI-PAC assessments of patients aged ≥70 years that had been performed during the study period from 1 February 2013 to 31 May 2016 in geriatric hospitals were considered. From all the assessments performed in these hospitals (n = 8472), we included all patients' first admission assessment. There were 2291 such assessments. Second, the discharge records of these hospitals from the same time period were collected, including 21,826 treatment periods of 3503 patients. Third, the interRAI assessments were linked to the hospital discharge records using social security numbers, resulting in 2188 matches, or patients with both the assessment and corresponding hospital discharge records. Only patients who were discharged back to their own homes were included, because our purpose was to obtain evidence on the risk factors for hospital admission following the stay in geriatric hospitals in community-dwelling older adults. The excluded patients were those 1) who were transferred to an acute care hospital during their stay in the geriatric hospital, 2) who died during hospitalization, 3) who were discharged to a nursing home or long-term care facility, or 4) who were discharged but returned to the hospital on the same day. Thus, 1167 patients were included in the analysis (Fig. 1).

Finally, dates of new hospital admissions in the Tampere region and possible dates of death for one year after discharge were noted. Dates of death were based on comprehensive national records of death certificates.

2.2. InterRAI-PAC variables and scales

The interRAI-PAC was designed to be used as a CGA tool in post-acute and rehabilitation settings (Gray et al., 2009). It consists of about 150 variables and contains information, for example, on the patient's home care, chronic diseases, functional ability, number of symptoms, and body mass index (BMI). According to the guidance, the interRAI admission assessment should be performed by trained nurses within a few days of the patient's admission to the ward. During the assessment, these nurses interview the patient and family members, observe the patient, and review the medical records. Single variables are combined to compose validated scales (Gray et al., 2009) that generate knowledge on the patients' functioning in different domains. For example, the Cognitive Performance Scale (CPS) describes the cognitive status of the patient (Morris et al., 2016); the Activities of Daily Living Hierarchy Scale (ADLH) measures functional ability (Morris et al., 1999); the Depression Rating Scale (DRS) is based on existing symptoms of depression (Burrows et al., 2000); the Changes in Health, End-stage disease, and Signs and Symptoms Scale (CHESS) is a summary measure designed to identify individuals at high risk for a clinically significant decline in health status (Hirdes et al., 2003; Hirdes et al., 2014) the Aggressive Behaviour Scale (ABS) measures the severity of behavioural symptoms (Perlman & Hirdes 2008); and the Pain Scale measures the frequency and severity of pain. (Fries et al., 2001). Generally, increasing scores describe a worsening state of health.

The interRAI-PAC variables evaluated as possible risk factors for readmission included the baseline characteristics of the patients (e.g. age, sex, living place, home-care services, and chronic diseases), BMI, the frailty index, the scales that assess functioning in different domains (CPS, ADLH, DRS, CHESS, ABS, and the Pain Scale), primary mode of locomotion, walking speed, and information about falls, hearing, vision, self-rated health, specific symptoms, continence, and rehabilitation potential.

BMI was classified as 1) the healthiest range for older adults (25—29.9 kg/m^2) and 2) outside the healthiest range (<25 or ≥30 kg/m2) according to previous findings of the relation between BMI and health outcomes among older persons (Heiat et al., 2001; Porter Starr & Bales 2015; Winter et al., 2014; Woolley et al., 2019). The Frailty Index is not included in the interRAI-PAC, but it can be calculated from the database according to the standard procedure for selecting individual deficits (Searle et al., 2008). In our study, the Frailty Index was calculated from the interRAI-PAC, as described previously (Kerminen et al., 2020).

2.3. Outcome measure

The primary outcome was the all-cause readmissions of patients within 90 days following discharge from the geriatric hospitals. Time for hospital admission was determined as the difference between the date of discharge and that of the first hospital admission of the patient. Hospital admission data were obtained from the hospital discharge records of Tampere, and they included data from the secondary care hospital and geriatric hospitals.

2.4. Statistical analyses

Patient characteristics were described using frequencies and percentages. We created the survival curve for readmissions using the Kaplan—Meier estimator. Associations of the risk factors with readmission were analysed using binary logistic regression. Variables selected for regression analysis included demographic variables from hospital discharge records and clinical, functional, and social variables from the interRAI-PAC.

In the first step, all variables included in the univariate analysis, except for the Frailty Index, were included in the multivariable analysis using the enter method. The Frailty Index was not included because it consists of the other included variables. In the second step, the following supplementary analyses were performed. First, only age, sex, and the Frailty Index were entered into the multivariable model. Second, patients were divided into three Frailty Index groups for performing the original multivariable analysis: <0.2 (robust), 0.2—0.4 (pre-frail), and >0.4 (frail).

The results were presented as odds ratios (ORs) with 95% confidence intervals (CIs). Data management and analysis were performed using IBM SPSS Statistics 25.0.

2.5. Ethics

Retrospective register-based studies are not considered medical research by Finnish legislation (Medical research act 9.4.1999/4881999), and as such, ethics committee approval was not required. Our research plan was institutionally reviewed. We obtained permission to use hospital discharge records and the interRAI-PAC assessments from the city administration of Tampere (decision by the Director of Hospital Services, given on 30 August 2016). Retrospectively collected health register data could be used for this study with permission from the register owner without the participants' informed consent, based on current national legislation (Act on the publicity of official documents 21.5.1999/6211999; Data protection act 5.12.2018/10502018 and European Union General Data Protection Regulation: General data protection regulation (GDPR), recital 1572018).

3. Results

3.1. Basic characteristics of the patients

The cohort included 1167 patients with a mean age (SD) of 84.5 (6.2) years; 71% (n = 827) were women (Table 1). Of the patients, 37% (n = 436) were diagnosed with a memory disorder, 70% used assistive devices while walking, 6% needed help in all basic activities of daily living (BADLs), and 33% were independent in BADLs. Of the patients, 60% were admitted from home and 40% from hospital wards. Within the past 90 days before admission to geriatric hospitals, 60% had experienced a

Table 1
Baseline characteristics of the patients ($n = 1167$).

	n	%
Female	827	70.9
Age (years)		
70–79.9	275	23.6
80–89.9	666	57.1
≥90	226	19.4
Age (years), mean (SD)	84.5	(6.2)
Living arrangement prior to admission		
Alone	765	65.6
With somebody	402	34.4
Home-care services		
No	443	38.0
Yes	723	62.0
Chronic diseases		
Alzheimer's disease	341	29.2
Other memory disorder	95	8.1
Alzheimer's disease and other memory disorder	25	2.1
Congestive heart failure	354	30.3
Coronary heart disease	298	25.5
Diabetes	296	25.4
Cancer	150	12.9
Depression	107	9.2
Stroke	106	9.1
Chronic obstructive pulmonary disease	74	6.3
Parkinson's disease	33	2.8
Independent in Activities of Daily Living		
Bathing	251	21.5
Personal hygiene	438	37.5
Dressing	498	42.3
Toilet use	631	54.1
Transfer toilet	722	61.9
Walking	719	61.6
Bed mobility	863	74.0
Eating	1043	89.4
Primary mode of locomotion		
Walking	983	84.2
Wheelchair or bedridden	184	15.8
Falls		
No falls in the last 3 months	601	51.5
Fall(s) 1 to 3 months ago	130	11.1
Fall(s) in last month	436	37.4
Smokes tobacco daily	46	3.9
BMI, kg/m^2*		
<18.5	80	6.9
18.5–24.9	500	42.8
25–29.9	336	28.8
≥30	240	20.6
BMI, kg/m^2*, mean (SD)	25.8	(5.6)
Admitted from		
Home	694	59.5
Hospital ward	473	40.5
Operated on during hospital stay	151	12.9
Ten most common main discharge diagnoses codes (ICD-10)		
Diseases of the circulatory system (I)	284	24.4
Diseases of the nervous system (G)	187	16.0
Injury, poisoning and certain other consequences of external causes (S or T)	146	12.5
Mental and behavioural disorders (F)	138	11.8
Diseases of the musculoskeletal system and connective tissue (M)	86	7.4
Diseases of the genitourinary system (N)†	71	6.1
Neoplasms or diseases of the blood (C or D)	59	5.0
Symptoms and signs, not elsewhere classified (R)	56	4.8
Endocrine, nutritional and metabolic diseases (E)	43	3.7
Diseases of the respiratory system (J)	35	3.0
Duration of hospital stay		
1—30 days	971	83.2
>30 days	196	16.8

* $n = 1156$, BMI missing $n = 11$.
† Urinary tract infections 77%.

decline in ADL performance. The median length of the stay in the geriatric hospital was 26 days (interquartile range, 15—48 days), and 196 patients (17%) were hospitalized for ≥30 days. The most common reasons for the hospital stay were diseases of the circulatory system, diseases of the nervous system, injuries, mental and behavioural disorders, and diseases of the musculoskeletal system and connective tissue (Table 1). Of interRAI assessments, 64% and 85% had been performed within seven and 14 days upon the patient's admission to the ward, respectively.

3.2. Readmissions after discharge from geriatric hospitals

The 90-day readmission rate was 29.5% ($n = 344$), accounting for 57% of the (first) readmissions that occurred during the year after discharge (Fig. 2). One-third ($n = 197$) of yearly readmissions occurred in the first 30 days after discharge (the 30-day hospital admission rate was 6.9%). There were no clinically significant differences in patient characteristics among patients readmitted within 30 days of discharge ($n = 197$) between those readmitted in 31 to 90 days of discharge ($n = 147$). Meanwhile, the 90-day mortality rate was 4.3% ($n = 50$).

Among the ten most common main discharge diagnosis codes (Table 2), the hospital readmission rate was the highest among patients with diseases of the genitourinary system (42.3%), followed by symptoms and signs not elsewhere classified (35.7%), diseases of the musculoskeletal system and connective tissue (32.6%), and neoplasms or diseases of the blood (32.2%).

3.3. Univariate and multivariable analyses

The risk factors associated with the 90-day readmission in the univariate analysis were as follows: age of ≥90 years, admission from home vs. acute care hospital, Alzheimer's disease, unsteady gait, fatigue, unstable conditions, ADLH score of ≥1, requiring assistance in eating, CPS score of ≥1, BMI of <25 or ≥30 kg/m^2, Frailty Index of ≥0.20, bowel incontinence, hearing difficulties, and poor self-rated health (Table 2). Undergoing a surgical operation during the treatment period was associated with a lower risk for readmission.

In the multivariable analysis, age of ≥90 years, ADLH score of ≥1, BMI of <25 or ≥30 kg/m^2, and unsteady gait remained as independent risk factors for 90-day readmission (Table 2). When only age, gender, and the Frailty Index were entered into the multivariable model, both age and Frailty Index associated with readmission. When the multivariable model was repeated separately for patients with Frailty Indexes <0.2, 0.2—0.4, and >0.4, the ORs for age and BMI were similar to those of the original model, albeit not to a statistically significant degree because of the wider CIs. In addition, we observed a tendency towards a greater risk for readmission in patients with ADL disability and patients with a Frailty Index of >0.4 (Appendix).

4. Discussion

In this retrospective cohort study, nearly one third of the older patients discharged from geriatric hospitals were admitted to hospital within 90 days of discharge. The independent risk factors associated with readmissions were ADL disability, age of ≥90 years, unsteady gait, and low or high BMI.

The 30 and 90-day readmission rates were 16.9% and 29.5%, respectively. The 30-day readmission rate was comparable to that in previous studies among older patients discharged from post-acute care and rehabilitation settings (Hoyer et al., 2013; Hughes & Witham 2018; Ottenbacher et al., 2014). Meanwhile, no studies have examined 90-day hospital admission rates. Consistent with the literature (Burke et al., 2015), our study found that the readmission risk was the highest soon after discharge: although one-third of yearly readmissions occurred within 30 days, readmissions continued to cumulate rapidly and over half of them occurred within 90 days.

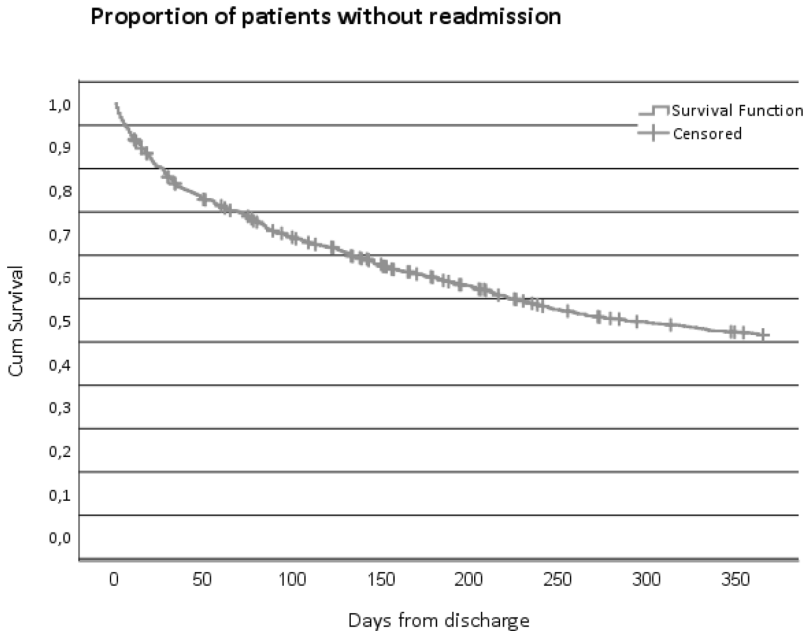

Fig. 2. Kaplan—Meier curve showing one-year readmissions after discharge from a geriatric hospital among 1167 community-dwelling older patients.

Our results showed that the strongest independent risk factor for readmission was ADL disability upon admission to hospital. This finding coincided with previous reports on the risk factors for 30-day readmission after a treatment period in post-acute care or inpatient rehabilitation settings (Hoyer et al., 2013; Middleton et al., 2018, Middleton et al., 2016; Ottenbacher et al., 2014). ADL disability and increasing age could remain as risk factors beyond the previously studied period of 30 days following discharge. Furthermore, age was an independent risk factor regardless of frailty status.

The finding that low or high BMI ($<$25 or $\geq$30 kg/m^2) could predict readmission corroborates the position of Woolley et al., who suggested that the healthiest BMI with fewer adverse outcomes in older hospitalized patients is $\geq$25 kg/m^2 (Woolley et al., 2019). Low BMI may be related to malnutrition, which has been associated with the 30-day readmission risk (Hudson et al., 2018). In addition, obesity has been found to be a risk factor for readmission among persons aged $\geq$85 years receiving post-acute care in nursing home facilities (Cai et al., 2019).

Several patient-related factors were associated with readmission in the univariate analyses, but their effects were attenuated or lessened after accounting for individual covariates. Studies regarding the association of cognitive impairment with readmission have generated contradictory results (Burke et al., 2015; Callahan et al., 2015). Poor self-rated health has been shown to be a risk factor for hospitalization among home-care clients (Rönneikkö et al., 2017), and it increases hospital services use among community-dwelling adults (Isaac et al., 2015; Tamayo-Fonseca et al., 2015). However, previous studies about readmissions are absent.

The association between bowel incontinence and readmission has not previously been reported, although it is a known risk factor for unplanned hospitalization among home-care clients (Rönneikkö et al., 2017), and is related to mortality in older people (Jamieson et al., 2017). Likewise, hearing difficulties with perceived problems in communication increase the risk for readmission in older patients (Chang et al., 2018). Surgical operation during the treatment period was associated with a lower risk for readmission. The mechanism for this is unclear, but it may be related to patient selection for elective surgery.

In our study, the Frailty Index was associated with readmission in the univariate analysis and also after adjustments for age and sex. The likelihood of experiencing readmission was 1.5-fold in pre-frail and nearly 2-fold in frail patients, compared with those with a Frailty Index of $<$0.20. Frailty has been shown to be associated with early readmissions in older medical (Kahlon et al., 2015) and surgical patients (Stern et al., 2018; Wahl et al., 2016). In our previous study among the same patient cohort as used in this study, the Frailty Index is shown to be associated with prolonged hospital stay and in-hospital mortality, but its predictive ability is similar to that of ADL disability measured by the ADLH scale (Kerminen et al., 2020).

Knowledge of the risk factors for readmission following discharge from geriatric hospitals have several implications in clinical practice. First, the early detection during hospitalization of individual factors that predispose patients to readmission may aid in avoiding such admissions after discharge. Discharge planning, including a plan for post-discharge services and rehabilitation, has already been shown to reduce readmissions and increase the satisfaction of patients and healthcare professionals (Goncalves-Bradley et al., 2016). Functional impairment is a strong risk factor for readmission, and the greatest risk is among patients who develop a new ADL deficit during the hospital stay (Depalma et al., 2013) and are discharged with an unmet need for an ADL disability (Arbaje et al., 2008; Depalma et al., 2013). Therefore, functional ability and ADL needs, as well as the factors underlying the ADL disability of the patient, should be carefully addressed and managed during hospitalization. It is especially important to identify modifiable conditions, such as unsteady gait and nutritional problems. Second, our study demonstrated that interRAI-PAC can be used as a tool for CGA, or the evaluation of the patient's medical, psychological, cognitive, and functional state to identify factors that may contribute to ADL disability, gait instability, and nutritional problems. Information gathered in CGA forms the basis of individually designed treatment, rehabilitation, and follow-up (Ellis et al., 2017). The present results highlighted the importance of systematic assessment, as many of the identified risk

Table 2
Association of patient factors with the 90-day hospital admission following discharge from geriatric hospitals providing primary care.

	Patients	Readmissions	Univariate		Multivariable	
	n	n (%)	OR	95% CI	OR	95% CI
Age (years)						
70—79.9	275	70 (25.5)	1		1	
80—89.9	666	192 (28.8)	1.19	0.86—1.63	1.24	0.86—1.77
≥90	226	82 (36.3)	1.67	1.14—2.45	1.94	1.22—3.08
Sex						
Men	340	99 (29.1)	1		1	
Women	827	245 (29.6)	1.03	0.78—1.35	1.03	0.77—1.37
Living arrangement prior to admission						
Alone	765	220 (28.8)	1		1	
With somebody	402	124 (30.8)	1.11	0.85—1.44	1.03	0.77—1.37
Admitted from						
Hospital	473	119 (25.2)	1		1	
Home	694	225 (32.4)	1.43	1.10—1.85	1.34	0.99—1.84
Operated on the same treatment period	151	27 (17.9)	0.48	0.31—0.74	0.54	0.32—0.91
Primary mode of locomotion						
Walking	983	290 (29.5)	1		1	
Wheelchair or bedridden	184	54 (29.3)	0.99	0.70—1.40	1.11	0.70—2.30
Walking speed						
>0.80 m/s	77	23 (29.9)	1		1	
0.80—0.14 m/s	787	236 (30.0)	1.01	0.60—1.68	0.85	0.47—1.54
<0.14 m/s or patient was not able to perform the test	303	85 (28.1)	0.92	0.53—1.58	0.67	0.33—1.35
Rehabilitation potential						
Patient is optimistic	1057	310 (29.3)	1.03	0.58—1.84	1.27	0.70—2.30
Care professionals are optimistic	1108	327 (29.5)	0.93	0.61—1.42	0.96	0.43—2.14
Worsening of ADL performance	817	249 (30.5)	1.18	0.89—1.56	1.14	0.77—1.67
Symptoms						
Dizziness	497	148 (29.8)	1.03	0.80—1.32	0.91	0.69—1.20
Unsteady gait	298	223 (31.9)	1.35	1.04—1.75	1.40	1.01—1.94
Constipation	198	67 (33.8)	1.28	0.92—1.77	1.27	0.89—1.82
Sleeping problems	265	87 (32.8)	1.23	0.91—1.65	1.33	0.96—1.85
Dyspnoea	206	65 (31.6)	1.13	0.81—1.56	1.13	0.72—1.78
Fatigue	169	65 (38.5)	1.61	1.15—2.26	1.23	0.82—1.93
Dysphagia	63	18 (28.6)	0.96	0.54—1.67	0.65	0.33—1.28
Weight loss	71	24 (33.8)	1.24	0.75—2.06	1.41	0.74—2.69
Disease diagnoses						
Alzheimer's disease	366	123 (33.6)	1.33	1.02—1.73	1.20	0.86—1.67
Another memory disorder	120	41 (34.2)	1.27	0.85—1.90	1.33	0.86—2.06
Stroke	106	32 (30.2)	1.04	0.67—1.60	0.96	0.59—1.56
Coronary artery disease	298	80 (26.8)	0.84	0.63—1.13	0.85	0.62—1.18
Congestive heart failure	354	106 (29.9)	1.03	0.79—1.36	0.89	0.65—1.22
Chronic obstructive pulmonary disease	74	27 (36.5)	1.41	0.86—2.30	1.57	0.90—2.72
Depression	107	30 (28.0)	0.93	0.60—1.44	0.89	0.55—1.44
Cancer	150	45 (30.0)	1.03	0.71—1.50	1.28	0.84—1.95
Diabetes	296	88 (29.7)	1.02	0.76—1.35	1.12	0.82—1.54
Activities of daily living hierarchy scale						
0	379	85 (22.4)	1		1	1
1—2	455	148 (32.5)	1.67	1.22—2.28	1.62	1.12—2.34
3—4	263	84 (31.9)	1.62	1.14—2.31	1.67	1.04—2.71
5—6	70	27 (38.6)	2.17	1.27—3.72	2.52	1.17—5.43
Cognitive Performance Scale						
0	309	71 (23.0)	1		1	
1—2	643	199 (30.9)	1.50	1.10—2.06	1.22	0.84—1.78
3—4	153	49 (32.0)	1.58	1.03—2.43	1.05	0.51—1.89
5—6	62	25 (40.3)	2.27	1.28—4.02	1.51	0.67—3.39
Depression Rating Scale						
0—2	1010	294 (29.1)	1			
3—14	157	50 (31.8)	1.14	0.79—1.64	0.98	0.45—1.49
The Changes in Health, End-Stage Disease, Signs and Symptoms Scale						
0	276	75 (27.2)	1		1	
1	476	132 (27.7)	1.03	0.74—1.43	0.89	0.59—1.32
2	277	92 (33.2)	1.33	0.93—1.92	0.91	0.55—1.50
3	109	33 (30.3)	1.16	0.72—1.89	0.59	0.29—1.19
4	29	12 (41.4)	1.89	0.86—4.15	0.80	0.26—2.42
Pain Scale						
0	613	183 (29.9)	1		1	
1	330	105 (31.8)	1.10	0.82—1.46	1.10	0.80—1.52
2–4	224	56 (25.0)	0.78	0.55—1.11	0.67	0.45—1.01
Communicative Ability Scale						
0–1	853	234 (27.4)	1		1	
2–5	290	97 (3313)	1.33	1.00—1.77	1.02	0.71—1.47
6–8	24	13 (54.2)	3.13	1.38—7.08	2.36	0.83—6.71

(*continued on next page*)

Table 2 (*continued*)

	Patients	Readmissions	Univariate		Multivariable	
	n	n (%)	OR	95% CI	OR	95% CI
Requiring assistance in eating	124	48 (38.7)	1.59	1.08—2.34	*	
Aggressive Behaviour Scale	1167					
0	997	296 (29.7)	1		1	
1—14	170	48 (28.2)	0.93	0.65—1.34	0.62	0.40—0.95
Body Mass Index						
25—29.9	367	93 (25.3)	1		1	
<25 or ≥30	800	251 (31.4)	1.35	1.02—1.78	1.44	1.06—1.98
Frailty index/ 0.1 increment	1167	344 (29.5)	1.20	1.09—1.32	**	
Frailty index						
<0.20	362	84 (23.2)	1			
0.20—0.40	571	175 (30.6)	1.46	1.08—1.98		
>0.40	234	85 (36.3)	1.89	1.32—2.71		
Bladder continence						
Continent	540	146 (27.0)	1		1	
Occasionally or frequently incontinent	627	198 (31.6)	1.25	0.97—1.61	0.80	0.57—1.12
Bowel continence						
Continent	890	249 (28.0)	1		1	
Occasionally or frequently incontinent	277	95 (34.6)	1.34	1.01—1.79	0.99	0.67—1.44
Hearing						
Adequate	837	234 (27.3)	1		1	
Minimal difficulty	206	72 (35.0)	1.43	1.04—1.98	1.15	0.80—1.66
Moderate or severe difficulty	104	38 (36.5)	1.53	1.00—2.35	1.31	0.81—2.13
Vision						
Adequate	843	236 (28.0)	1		1	
Minimal difficulty	239	80 (33.5)	1.29	0.95—1.76	0.99	0.70—1.41
Moderate or severe difficulty	85	28 (32.9)	1.26	0.78—2.06	1.04	0.62—1.76
Foot problems	233	75 (32.2)	1.17	0.86—1.60	1.24	0.88—1.75
Falls						
No (in last month)	731	218 (29.8)	1		1	
Yes	436	126 (28.9)	0.96	0.74—1.24	0.86	0.64—1.16
Self-rated health						
Good	295	77 (26.1)	1		1	
Fair	614	174 (28.3)	1.12	0.82—1.53	1.08	0.76—1.53
Poor	158	56 (35.4)	1.55	1.03—2.36	1.36	0.81—2.27
Patient was unable to answer	100	37 (37.0)	1.66	1.03—2.69	1.14	0.64—2.02
Unstable conditions	735	233 (31.7)	1.34	1.03—1.75	1.12	0.68—1.82
Acute episode or flare-up	305	98 (32.1)	1.19	0.89—1.57	1.15	0.84—1.57
Duration of hospital stay						
1—30 days	971	286 (29.5)	1		1	
>30 days	196	58 (29.6)	1.01	0.72—1.41	1.12	0.75—1.67
Ten most common main discharge diagnosis codes (ICD-10)						
Diseases of the circulatory system (I)	284	82 (28.9)				
Diseases of the nervous system (G)	187	54 (28.9)				
Injury, poisoning and certain other consequences of external causes (S or T)	146	27 (18.5)				
Mental and behavioural disorders (F)	138	42 (30.4)				
Diseases of the musculoskeletal system and connective tissue (M)	86	28 (32.6)				
Diseases of the genitourinary system (N)	71	30 (42.3)				
Neoplasms or diseases of the blood (C or D)	59	19 (32.2)				
Symptoms and signs, not elsewhere classified (R)	56	20 (35.7)				
Endocrine, nutritional and metabolic diseases (E)	43	10 (23.3)				
Diseases of the respiratory system (J)	35	11 (31.4)				

* Not entered, because the variable is included in ADLH.
** Not entered, because the indec consists of the variables included in the multivariable analysis.

factors could be easily missed in routine clinical practice. However, CGA performed during the stay in a post-acute care hospital may or may not have an impact on readmissions. In the case of acute care, CGA has not been shown to reduce readmissions (Ellis et al., 2017). Finally, the present results suggested that information on ADL performance, cognition, frailty, and nutritional state is needed for appropriate case-mix adjustments when comparing readmission rates between different hospitals; ignoring these factors might lead to the inadvertent poor performance of units taking care of the most vulnerable patient groups. InterRAI could be potentially used for benchmarking purposes in geriatric hospitals, as is the practice in nursing homes (Hirdes et al., 2013).

One strength of our study was the use of a regionally representative sample size of real-life patients. Analysis of 90-day readmissions extends earlier literature and ensured sufficient statistical power for multivariable analysis. Although our materials covered all interRAI-PAC assessments performed in Tampere, and although the patients represented an unselected population (in terms of insurance or social status), the current patient numbers are modest, from an international context. The results may not be fully generalisable to other health care systems. Besides, as Finnish health care system differs from other countries, these results should be interpreted with caution. Another source of uncertainty is related to the reasons for readmissions. We could not exclude planned readmissions from our study as our materials did not include reasons for readmissions. However, it is unlikely that there were many planned readmissions within 90 days of discharge in this patient population.

In addition, our materials did not include all patients who had a treatment period in the study hospitals during the study period, as the interRAI assessment was not performed for all patients. Among the possible reasons for missing assessments is that the introduction of interRAI-PAC was gradual in different wards. Meanwhile, hospital discharge records were collected for the same period from both

hospitals. Another reason may be related to the laboriousness of assessment in a busy clinical practice (Carpenter & Hirdes 2013), which may lead to a substantial number of missing assessments in clinical context (Wellens et al., 2011). As we concentrated on patient characteristics that may increase the readmission risk, this study did not consider all known risk factors associated with readmissions, such as organisational factors and healthcare utilization. Furthermore, we could not differentiate ADL disability caused by an acute illness from longer-lasting functional decline because the time frame in which ADL disability had developed could not be determined.

In addition, the hospital discharge database did not include readmissions to the hospital providing tertiary care. However, older patients living an area are usually hospitalised in a secondary rather than a tertiary care hospital or, at least, transferred from a tertiary to a secondary care hospital before discharge to their home. Finally, the kind of assessment, treatment, and support offered to the patients during their hospital stay could not be specified, as well as the way they could affect the rate of readmissions.

5. Conclusions

The interRAI-PAC assessment performed upon admission to geriatric hospitals revealed patient-related risk factors for readmissions: ADL disability, age, low or high BMI, unsteady gait, and frailty were independent risk factors. Based on the identified complex risk factors, we recommend that patients' assessments should be systematic and multidisciplinary. Functional ability, ADL needs, and individual factors underlying the ADL disability, as well as nutritional and mobility problems, should be carefully addressed and managed during hospitalization to avoid repeat hospital admissions.

Considering the heterogeneity of patients in geriatric care settings, future studies could pay attention to the effects of interventions that target patients at the highest risk of adverse outcomes. The use of both interRAI-PAC admission and discharge assessments would offer opportunities for this kind of study.

Declaration of Competing Interest

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Appendix 1. Multivariable model in all patients and in Frailty Index groups

			Frailty Index					
	All patients		<0.2		0.2—0.4		>0.4	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age (years)								
70—79.9	1		1		1		1	
80—89.9	1.24	0.86—1.77	1.41	0.61–3.23	1.07	0.63–1.82	1.36	0.56–3.35
≥90	1.94	1.22—3.08	3.65	1.27–10.50	2.16	1.09–4.27	0.86	0.24–3.04
Sex								
Men	1		1		1			
Women	1.03	0.77—1.37	1.18	0.56–2.46	0.91	0.56–1.51	2.08	0.87–4.95
Living arrangement prior to admission								
Alone	1		1		1		1	
With somebody	1.03	0.77—1.37	1.72	0.89–3.31	0.68	0.44–1.05	1.62	0.71–3.67
Admitted from								
Hospital	1		1		1		1	
Home	1.34	0.99—1.84	0.89	0.43–1.84	1.17	0.75–1.82	2.76	1.19–6.41
Operated on the same treatment period	0.54		0.50	0.14–1.79	0.66	0.13–1.39	0.26	0.07–1.04
Primary mode of locomotion								
Walking	1		1		1		1	
Wheelchair or bedridden	1.11	0.70—2.30	3.85	0.81–18.39	0.96	0.46–2.01	1.10	0.40–3.04
Walking speed								
>0.80 m/s	1		1		1			
0.80—0.14 m/s	0.85	0.47—1.54	0.72	0.29–1.84	0.99	0.38–2.61		
<0.14 m/s or patient was not able to perform the test	0.67	0.33—1.35	0.42	0.11–1.57	0.74	0.24–2.31		
Rehabilitation potential								
Patient is optimistic	1.27	0.70—2.30	5.61	0.55–57.67	1.02	0.41–2.53	1.51	0.45–5.09
Care professionals are optimistic	0.96	0.43—2.14			1.23	0.34–4.48	0.57	0.12–2.69
Worsening of ADL performance	1.14		1.63	0.71–3.74	0.83	0.48–1.44	1.19	0.31–4.51
Symptoms								
Dizziness	0.91	0.69—1.20	0.99	0.50–1.98	0.99	0.66–1.48	0.89	0.41–1.84
Unsteady gait	1.40	1.01—1.94	2.26	1.11–4.58	1.34	0.85–2.13	2.13	0.56–8.17
Constipation	1.27	0.89—1.82	2.43	0.95–6.22	1.23	0.70–2.15	1.31	0.58–2.93
Sleeping problems	1.33	0.96—1.85	0.79	0.30–2.04	1.89	1.19–3.01	0.82	0.36–1.88
Dyspnoea	1.13	0.72—1.78	0.30	0.07–1.22	0.98	0..51–1.86	3.40	1.16–9.99
Fatigue	1.23	0.82—1.93	0.60	0.05–7.73	1.71	0.86–3.39	1.50	0.67–3.35
Dysphagia	0.65	0.33—1.28	3.60	0.40–32.14	0.89	0.32–2.44	0.44	0.13–1.46
Weight loss	1.41	0.74—2.69	0.54	0.09–3.49	2.10	0.82–5.41	1.06	0.25–4.45
Disease diagnoses								
Alzheimer's disease	1.20	0.86—1.67	0.85	0.35–2.04	1.22	0.74–1.99	2.05	0.94–4.46
Another memory disorder	1.33	0.86—2.06	1.63	0.51–5.19	1.23	0.62–2.44	2.68	1.02–7.00
Stroke	0.96	0.59—1.56	1.45	0.41–5.09	0.62	0.28–1.35	1.33	0.44–3.95
Coronary artery disease	0.85	0.62—1.18	1.41	0.67–2.98	0.77	0.47–1.25	0.61	0.27–1.41

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(*continued*)

			Frailty Index					
	All patients		<0.2		0.2—0.4		>0.4	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Congestive heart failure	0.89	0.65—1.22	0.35	0.15–0.82	1.15	0.73–1.81	1.57	0.64–3.84
Chronic obstructive pulmonary disease	1.57	0.90—2.72	8.81	1.89–41.14	2.21	1.00–4.88	0.77	0.20–2.99
Depression	0.89	0.55—1.44	0.63	0.13–2.96	0.71	0.36–1.40	1.50	0.49–4.62
Cancer	1.28	0.84—1.95	1.96	0.76–5.03	0.93	0.49–1.78	2.30	0.76–6.99
Diabetes	1.12	0.82—1.54	1.76	0.86–3.61	0.94	0.59–1.49	1.23	0.53–2.88
Activities of daily living hierarchy scale								
0	1		1		1			
1—2	1.62	1.12—2.34	2.81	1.28–6.16	1.11	0.61–2.00		
3—4	1.67	1.04—2.71	0.66	0.03–13.33	1.21	0.56–2.53		
5—6	2.52	1.17—5.43			2.65	0.85–8.23		
Cognitive Performance Scale								
0	1		1		1		1	
1—2	1.22	0.84—1.78	1.79	0.87–3.70	1.25	0.70–2.24	1.51	0.13–18.31
3—4	1.05	0.51—1.89	4.12	0.39–43.89	0.76	0.30–1.87	1.69	0.13–22.77
5—6	1.51	0.67—3.39			1.02	0.25–4.20	3.72	0.23–59.45
Depression Rating Scale								
0—2	1		1		1		1	
3—14	0.98	0.45—1.49	0.33	0.07–1.66	1.26	0.68–2.34	0.86	0.35–2.10
The Changes in Health, End-Stage Disease, Signs and Symptoms Scale								
0	1		1		1		1	
1	0.89	0.59—1.32	0.75	0.33–1.70	0.90	0.49–1.64	0.99	0.26–3.79
2	0.91	0.55—1.50	2.37	0.59–9.42	0.93	0.46–1.90	0.72	0.17–3.10
3	0.59	0.29—1.19	1.84	0.12–29.36	0.68	0.24–1.94	0.32	0.05–1.83
4	0.80	0.26—2.42					0.53	0.05–6.12
Pain Scale								
0	1		1		1		1	
1	1.10	0.80—1.52	2.64	1.25–5.56	0.85	0.53–1.35	0.82	0.34–1.96
2–4	0.67	0.45—1.01	1.63	0.64–4.20	0.50	0.27–0.92	0.48	0.18–1.26
Communicative Ability Scale								
0–1	1		1		1		1	
2–5	1.02	0.71—1.47	1.35	0.41–4.40	0.95	0.56–1.62	1.61	0.70–3.70
6–8	2.36	0.83—6.71						
Aggressive Behaviour Scale								
0	1		1		1		1	
1—14	0.62	0.40—0.95	2.14	0.50–9.27	0.32	0.16–0.64	1.03	0.45–2.35
Body Mass Index								
25—29.9	1		1		1		1	
<25 or ≥30	1.44	1.06—1.98	1.50	0.75–3.00	1.36	0.84–2.19	1.34	0.58–3.14
Bladder continence								
Continent	1		1		1		1	
Occasionally or frequently incontinent	0.80	0.57—1.12	1.00	0.48–2.08	0.69	0.44–1.09	0.90	0.19–4.31
Bowel continence								
Continent	1		1		1		1	
Occasionally or frequently incontinent	0.99	0.67—1.44	0.39	0.09–1.76	1.16	0.66–2.04	0.90	0.39–2.07
Hearing								
Adequate	1		1		1		1	
Minimal difficulty	1.15	0.80—1.66	1.58	0.66–3.77	1.37	0.80–2.36	0.95	0.40–2.23
Moderate or severe difficulty	1.31	0.81—2.13	0.50	0.09–2.81	1.27	0.66–2.46	2.36	0.64–8.65
Vision								
Adequate	1		1		1		1	
Minimal difficulty	0.99	0.70—1.41	0.94	0.36–2.49	0.83	0.50–1.37	1.03	0.42–2.50
Moderate or severe difficulty	1.04	0.62—1.76	0.53	0.09–3.14	1.16	0.57–2.36	0.49	0.13–1.87
Foot problems	1.24	0.88—1.75	1.37	0.55–3.43	1.08	0.64–1.81	1.51	0.64–3.52
Falls								
No (in last month)	1		1		1		1	
Yes	0.86	0.64—1.16	0.61	0.29–1.25	0.88	0.57–1.34	0.89	0.43–1.85
Self-rated health								
Good	1		1		1		1	
Fair	1.08	0.76—1.53	0.77	0.39–1.55	0.99	0.59–1.66	5.34	1.47–19.38
Poor	1.36	0.81—2.27	2.03	0.53–7.77	1.10	0.51–2.36	3.10	0.69–14.02
Patient was unable to answer	1.14	0.64—2.02	0.50	0.09–2.90	1.23	0.52–2.90	2.75	0.58–13.09
Unstable conditions	1.12	0.68—1.82	1.50	0.95–2.38	1.50	0.95–2.38	1.50	0.51–4.39
Acute episode or flare-up	1.15	0.84—1.57	1.39	0.66–2.91	1.07	0.66–1.73	0,86	0.39–1.95
Duration of hospital stay								
1—30 days	1		1		1		1	
>30 days	1.12	0.75—1.67	0.19	0.04–1.04	1.65	0.92–2.96	1.29	0.53–3.11

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PUBLICATION IV

Implementation of a depression screening protocol among respiratory insufficiency patients

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ORIGINAL ARTICLE

WILEY

Implementation of a depression screening protocol among respiratory insufficiency patients

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Abstract

Introduction: Unnoticed and untreated depression is prevalent among patients with chronic respiratory insufficiency. Comorbid depression causes suffering and worsens patients' outcomes.

Objectives: The objective of this evaluation was to assess preliminary outcomes of a depression screening protocol among chronic respiratory insufficiency patients at a tertiary care pulmonary outpatient clinic.

Methods: In the depression screening protocol, the patients filled the Depression Scale (DEPS) questionnaire. Patients whose scores suggested depression were offered the opportunity of a further evaluation of mood at a psychiatric outpatient clinic. The outcomes of the protocol were evaluated retrospectively from the patient records.

Results: During the period of evaluation, 238 patients visited the outpatient clinic. DEPS was administered to 176 patients (74%), of whom 60 (34%) scored ≥9 (out of 30), thus exceeding the cut-off for referral. However, only 13 patients were referred, as the remainder declined the referral. Finally, seven patients were evaluated at the psychiatric clinic, and they all were deemed depressive. Symptoms of depression were most prevalent among patients with a long smoking history, refractory dyspnoea and a history of depression.

Conclusion: Depression screening was positive in a third of the patients. The depression screening protocol improved the detection of depression symptoms, but the effects on the patients' treatment and clinical course were small. Rather than referring patients to a psychiatric unit, the evaluation and management of depression should be undertaken at the pulmonary unit.

KEYWORDS

depression, health services research, respiratory insufficiency

1 | INTRODUCTION

Depression is a common comorbidity in severe chronic pulmonary diseases. Depression diminishes functional performance and exercise tolerance while increasing fatigue, hospital admissions, morbidity and mortality.[1,2] The risk for developing depression increases with the severity of chronic obstructive pulmonary disease (COPD),[3] and up to 30%-50% of patients with severe COPD have depression.[4,5] In patients with oxygen-dependent chronic respiratory insufficiency, the prevalence of depression may be as high as 60%-75%.[6,7]

Depression is often undetected and untreated among respiratory insufficiency patients.[8] According to previous reports, less than a third of COPD patients suffering from depression are being treated for it.[9-11] There are several possible reasons for the low detection rate. First, the diagnosis of depression is challenging, because the symptoms of pulmonary disease may resemble those of depression. In addition, both patients and health-care personnel may consider psychiatric symptoms a normal reaction to having progressive illness rather than suspecting comorbid psychiatric disease.[12] Finally, depression is rarely screened for in routine health care.

As comorbid depression is widely undetected, routine screening for depression has been recommended.[13,14] Nevertheless, screening should only be performed if a local depression treatment pathway with the possibility of consulting a psychiatrist has been established.[13] Thus, it is essential to implement not only the screening instrument but also a care pathway allowing appropriate diagnostics and treatment for patients with positive screening results. However, the implementation of new protocols in clinical practice is usually challenging, and a variety of problems may arise at different organisational levels.[15,16]

In this paper, we describe the implementation and preliminary results of a depression screening protocol among respiratory insufficiency patients at a pulmonary outpatient clinic. To the best of our knowledge, such care pathways have not been described previously.

2 | MATERIALS AND METHODS

2.1 | Setting

Tampere University Hospital is a tertiary hospital situated in the southern part of Finland. It provides specialised care to about 530,000 people living in 23 municipalities situated within a 110 km radius from the city of Tampere. Patients with respiratory diseases are treated at the outpatient clinic; the annual volume is about 14 000 visits by 4500 patients. At the outpatient clinic, there is a specialised section for respiratory insufficiency patients; its annual volume is approximately 500 patients.

The patients are referred to the respiratory insufficiency section by physicians working in primary, private or specialised health care. Typically, the patients have a severe lung, heart or neurological disease with suspected chronic respiratory insufficiency. At the clinic, a pulmonologist meets the patient, considers the differential diagnosis, and makes decisions about medications and possible device treatments (long-term oxygen therapy (LTOT) and/or non-invasive ventilation (NIV)). A multidisciplinary team consisting of a nurse, a physiotherapist, a social worker, a dietician and a rehabilitation counsellor participates in the care. Follow-up is organised according to a discrete protocol.

2.2 | Implementation of the depression screening protocol

When interviewing the patients at the outpatient clinic, nurses have noticed that the patients often have depressive symptoms but no treatment for depression. The nurses also noted their lack of knowledge of how to approach such symptoms, especially as patients with chronic respiratory insufficiency often have difficulties in seeking help because of restricted functional ability.

From this background, we decided to start the development and implementation of a depression screening protocol. The protocol was developed in collaboration with the general hospital psychiatric unit. For this project, a contract was drawn up to allow the referral of screening-positive patients to the psychiatric outpatient clinic even though the usual referral criteria were not met. The personnel of the pulmonary unit were educated about depression detection by lectures and group discussions. The aim was to improve the identification of depressive symptoms, bring up mood symptoms in discussion, and enhance their further evaluation and treatment.

The Depression Scale (DEPS) was selected as the screening instrument. The DEPS is a validated, self-rated screening tool for depression.[17] It is the primary screening instrument for depression at Tampere University Hospital. The DEPS questionnaire consists of 10 items, and scores vary from 1 to 30 points. The cut-off point for depressive symptoms is $\geq$9, while the cut-off point for clinical depression is $\geq$12.[18]

Screening commenced in the autumn of 2015. Nurses were instructed to administer the DEPS questionnaire to every patient visiting the respiratory insufficiency section. A referral to an appointment at the psychiatric outpatient clinic was offered to patients with a positive screening. A pulmonologist made the referral, and the patient was later informed of the appointment time. In 2015, the cut-off for referral was $\geq$12/30 points. In 2016, the cut-off was lowered to $\geq$9/30 to include patients with milder symptoms. According to Sheehan and McGee,[19] a lower cut-off score increases the possibility of identifying depression (greater sensitivity), whereas a higher cut-off score diminishes false-positive results (greater specificity) at the cost of sensitivity.[19]

2.3 | Evaluation of screening

Evaluation of the screening protocol was made retrospectively from the patient records. The patients included in the study were those who visited the respiratory insufficiency section during three different time periods: August 17, 2015-October 23, 2015 (pilot phase I), November 9, 2015-January 15, 2016 (pilot phase II) and September 15, 2016-December 31, 2016 (follow-up phase).

Patient records were reviewed to evaluate: (1) the coverage of the screening; (2) the patients' willingness to fill the DEPS

questionnaire; (3) the proportion of patients with positive DEPS scores; (4) the patient characteristics associated with high DEPS scores; and (5) the consequences of positive screenings.

To identify patients at an elevated risk for depression, we registered each patient's age, gender, use of walking aids and home care, living arrangements, smoking history, pulmonary disease diagnosis, causes for chronic respiratory insufficiency, other diagnoses, use of psychoactive medications, available measurements of lung function (FEV_1 in post-bronchodilator spirometry), and functional exercise capacity (6-Minute Walk test, 6MWT). In addition, the measurements made during the visit were gathered, including the patient's height, weight, microspirometry, and the scores of the Alcohol Use Disorders Identification Test (AUDIT-C),[20] the modified Medical Research Council Dyspnoea Scale (mMRC),[21] and the COPD Assessment Test (CAT).[22] Spirometry was performed using the Vmax 20 spirometer (Sensor-Medics, Yorda Linda, California, USA) and microspirometry was performed using a microspirometer (Vitalograph copd-6, Vitalograph, Ennis, Ireland).

2.4 | Statistics

The process of the depression screening protocol is reported descriptively. To identify patient groups with a high prevalence of depression symptoms, the associations of the above-mentioned patient characteristics with DEPS scores <9 vs ≥9 and <12 vs ≥12 were analysed. In addition, the results of microspirometry, spirometry, 6MWT, CAT, mMRC and AUDIT-C were compared with the DEPS scores.

Statistical significance between groups was analysed using the Mann-Whitney *U* test, the chi-squared test or Fisher's test as appropriate. A *P*-value <0.05 was considered statistically significant. Data management and analysis were performed using IBM SPSS Statistics 23.

2.5 | Ethics

The implementation of depression screening in routine care was part of development work at the pulmonary outpatient clinic. The patients could refuse to fill the DEPS questionnaire. The retrospective study was organised to evaluate the outcomes of the screening, and the patients were not approached by the researchers. Prior to commencing the study, permission was acquired from the Science Centre of Tampere University Hospital.

3 | RESULTS

3.1 | Baseline characteristics of the patients

In total, 242 patients visited the respiratory insufficiency section during the defined time periods. Four patients using ventilators were excluded, leaving 238 for evaluation. Table 1 illustrates the characteristics of the included patients. Of the patients, 38 (16%) were attending their first visit, while the remainder had made earlier visits. A third of the patients attended a nurse's visit only; the rest met both a nurse and a physician.

Most patients had a diagnosis of chronic respiratory insufficiency ($n = 200$, 84%), and in 75% ($n = 150$) the diagnosis had been made less than 5 years ago. Nearly half of these patients ($n = 82$) were considered to have more than one disease diagnosis as the cause for their respiratory insufficiency. The most common diagnoses were COPD ($n = 105$, 53%), obstructive sleep apnoea ($n = 66$, 33%) and obesity hypoventilation ($n = 54$, 27%). Other diagnoses related to respiratory insufficiency were pulmonary fibrosis ($n = 17$, 9%), pulmonary hypertension ($n = 17$, 9%), neurological disorders ($n = 14$, 7%), deformities of the chest wall ($n = 9$, 5%), elevated hemidiaphragm ($n = 7$, 4%) and miscellaneous causes ($n = 11$, 6%). Hypertension ($n = 134$, 56%), type 2 diabetes ($n = 80$, 34%) and coronary artery disease ($n = 46$, 23%) were the most common comorbidities. Forty-five patients (19%) had a previous diagnosis of depression, 16 (7%) had another psychiatric diagnosis and 17 (7%) had a memory disorder. Thirty-eight patients (16%) were using antidepressants, 88 (37%) were using anxiolytic drugs and 23 (10%) were using antipsychotics.

3.2 | Outcomes of the screening

The DEPS questionnaire was filled by 74% of the patients ($n = 176$). The proportion of the patients that completed the DEPS questionnaire increased from 66% in the first year to 88% in the second year. Only six patients refused to fill the DEPS questionnaire. The unscreened patients were younger and had a lung disease diagnosis other than COPD more often compared to the screened patients.

Depression screening was positive in a quarter to a third of the patients, depending on the cut-off point (Figure 1). Referral to psychiatric services was offered to most patients with a positive screening. However, more than three quarters of them declined the referral. The reasons for declining the referral were not systematically recorded, but there were a few notes relating to difficulties with travelling, and indeed, 19 of the 24 patients who declined the referral lived outside the city of Tampere where the psychiatric clinic is situated.

Altogether, 13 referrals were made. Seven patients met a nurse or a psychologist at the psychiatric outpatient clinic. Of the remaining patients, four could not travel to the clinic; instead, they received a phone call to assess the severity of symptoms. Two patients died before the time of the appointment. All patients visiting the clinic were deemed depressive. After one or two visits, all patients were directed to further care at regional psychiatric services.

TABLE 1 Baseline characteristics of the patients

	n	%
Gender		
Male	138	58
Female	100	42
Age (years)		
<70	86	36
70-80	95	40
>80	57	24
Place of domicile		
Tampere	95	40
Another municipality in the Pirkanmaa region	143	60
Residence		
Own home	216	91
Sheltered housing	12	5
Nursing home	10	4
Home care or assistance		
none	164	69
Communal home care	38	16
Close relative as a carer	17	7
Nursing home staff	10	4
Personal assistant	9	4
Use of walking aids	131	45
Current smoking	19	8
Smoking history in pack-years		
No smoking history	75	32
<20	31	13
20-40	70	29
>40	62	26
Use of long-term oxygen therapy or non-invasive ventilation		
Long-term oxygen therapy	88	37
Portable oxygen therapy	75	32
Bilevel positive airway pressure (NIV)	106	45
Continuous positive airway pressure (CPAP)	17	7
Body mass index (BMI) kg/m^2 ($n = 227$)		
Underweight <18.5	12	5
Normal 18.5-24.9	69	30
Overweight 25-29.9	41	18
Obese ≥30	101	45

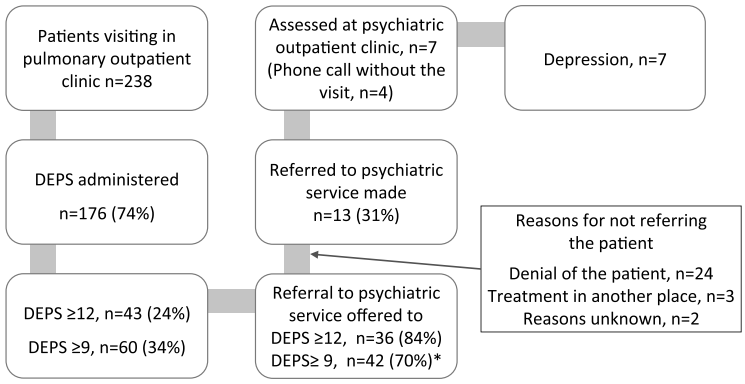

FIGURE 1 Realisation of the depression screening in the pulmonary outpatient clinic's respiratory insufficiency section and referral to further evaluation at the psychiatric outpatient clinic

3.3 | Identifying the patients with a positive depression screening

Table 2 illustrates the associations of the DEPS scores with the patients' characteristics. High DEPS scores were common in patients who used walking aids or had a history of depression or heavy smoking. Depression screening was positive in 44% of the COPD patients, 38% of the sleep apnoea patients and 29% of the obesity hypoventilation syndrome patients. Depression screening was positive in 43% of the patients using LTOT and 33% of the patients using NIV. Screening was positive in 58% of the patients with a history of depression and in 44% of the patients using antidepressants.

Table 3 illustrates the associations of the DEPS scores with the measurements of lung function and assessment tests. The patients with high DEPS scores also had high scores in the CAT and mMRC tests. The FEV_1 in spirometry and in microspirometry, AUDIT-C scores and distance in 6MWT were not associated with the DEPS scores.

4 | DISCUSSION

4.1 | Symptoms of depression

Supporting earlier observations,[4,6,7] symptoms of depression were prevalent in patients: depression screening was positive in a third of patients. In line with earlier observations,[3,9] only a minority had a prior diagnosis of depression or were using antidepressants, underlining the need for depression screening. Prior depression, a long smoking history and the use of walking aids were associated with having symptoms of depression. In addition, symptomatic COPD patients with functional limitations owing to dyspnoea often experienced depression symptoms. Daily smoking has been shown to be a risk factor for depression,[22] and prior depression predisposes to new depression.[23] A relationship between CAT scores >20 and depression has been reported previously.[24,25] Furthermore, the perception of dyspnoea is related to psychological factors, meaning that symptoms of depression increase dyspnoea.[26] Therefore, high CAT or mMRC scores should be taken as sign warranting broader evaluation of the patient beyond lung disease-specific aims.[27]

4.2 | Implementation of depression screening

The challenges that we met when implementing the screening protocol can be divided into three groups based on the integrated checklist of determinants of practice (the TICD checklist)[28]: individual health professional factors, patient factors and professional interactions.

Individual health professional factors include knowledge and skills, attitudes, and professional behaviour.[28] The acceptability of the screening among nurses, measured as the proportion of patients who received the DEPS questionnaire, was not good in the first year of screening, but it improved in the second year. Nevertheless, one in ten patients went unscreened in the second year, although in itself, the inclusion of the DEPS questionnaire in the clinic visit appeared feasible. The nurses felt comfortable asking the patients to fill the DEPS questionnaire, but they experienced difficulties regarding how to discuss positive screening results with the patients. Future education of the health-care professionals at the pulmonary clinic should therefore focus on communication and supportive discussion with a depressed patient. Emphasising the importance of separating the symptoms of depression from those of pulmonary disease—and seeing improvement in both symptoms and quality of life when mood disorder is treated—would help in motivating for systematic, continuous use of the screening tool.

Patient factors include beliefs and knowledge, motivation, and behaviour.[28] The acceptability of completing

TABLE 2 Association of the DEPS scores with the patients' baseline characteristics in two groups with different cut-off points (DEPS <9 vs ≥9 and DEPS <12 vs ≥12)

		DEPS ≥9		DEPS ≥12	
	n	%	*P*	%	*P*
Subjects	176	34		24	
Gender			0.22		0.50
Male	102	30		23	
Female	74	39		27	
Age years			0.22		0.72
<70	56	43		27	
70-80	79	30		22	
>80	41	29		27	
Place of domicile			0.87		0.76
Tampere	69	33		23	
Another municipality	107	35		25	
Use of walking aids			0.06		0.049
Yes	100	40		30	
No	76	26		17	
Smoking history in pack-years			0.008		0.02
No smoking history	50	28		24	
<20	22	19		9	
20-40	55	29		18	
>40	49	53		39	
Device treatment			0.16		0.13
Oxygen therapy	65	27		31	
Non-invasive ventilation	70	30		19	
Both	19	42		37	
None	22	18		14	
BMI[a] kg/m^2			0.65		0.57
Underweight <18.5	11	18		18	
Normal 18.5-24.9	50	38		30	
Overweight 25-29.9	39	36		26	
Obese ≥30	72	32		19	
Chronic obstructive pulmonary disease			0.12		0.51
Yes	103	39		26	
No	73	27		22	
Obstructive sleep apnoea			0.52		0.62
Yes	56	38		27	
No	120	33		23	
Obesity hypoventilation			0.44		0.50
Yes	35	29		20	
No	141	36		26	
History of depression			0.002		0.01
Yes	31	58		42	
No or not known	145	29		21	

[a]BMI = Body mass index.

TABLE 3 The associations of DEPS scores with lung function parameters, walking test distance and assessment tests in two groups with different cut-off points (DEPS <9 vs ≥9 and DEPS <12 vs ≥12)

	All patients		DEPS			DEPS		
	n		<9	≥9	*P*	<12	≥12	*P*
Microspirometry FEV_1	101							
% predicted[a]		40 (12–91)	42 (12–91)	39 (17–79)	0.49	43 (12–91)	36 (17–79)	0.10
Litres[a]		1.1 (0.4–3.0)	1.1 (0.4–3.0)	1.0 (0.4–2.5)	0.36	1.1 (0.4–3.0)	0.9 (0.4–2.1)	0.08
Spirometry[b] FEV_1	88							
% predicted[a]		55 (19–114)	55 (19–95)	52 (25-114)	0.93	55 (19–104)	51 (25–114)	0.93
Litres[a]		1.4 (0.4–3.6)	1.5 (0.4–3.3)	1.4 (0.7–3.6)	1.0	1.5 (0.4–3.3)	1.5 (0.7–3.6)	0.92
6MWT[b,c]	96							
Distance metres[a]		160 (25–500)	170 (25–450)	150 (35–500)	0.20	165 (25–480)	135 (50-500)	0.10
CAT[d,e] score[a]	92	22 (2–36)	19 (2–33)	25 (11–36)	0.001	19 (2–36)	25 (16-33)	0.001
mMRC[d,f] score[a]	95	3 (1–4)	3 (1–4)	3.5 (2–4)	0.001	3 (1–4)	3.5 (3–4)	0.001
AUDIT-C[g] score[a]	132	1 (0–12)	0 (0–10)	1 (0–12)	0.04	1 (0–10)	1 (0–12)	0.62

[a]Median (range).
[b]Performed within two years before the visit.
[c]6-Minute Walk Test.
[d]The COPD Assessment Test (CAT) and the modified MRC Dyspnoea Test were made only by COPD -patients.
[e]CAT-scores can range from 0 to 40. Scores more than 20 mean that patient´s symptoms of lung disease have high impact on the patient´s perceived health status.
[f]Scores on the modified MRC Dyspnoea Test can range from 0 to 4, with a score of 4 indicating that the patient is too breathless to leave the house or becomes breathless when dressing or undressing.
[g]AUDIT-C, the three first questions of the Alcohol Use Disorders Identification Test scores range from 0 to 12, with a score 0 indicating no alcohol use and score more than 5 (among women) and 6 (among men) indicating risky drinking that may cause health problems.

the DEPS questionnaire was good, but the acceptability of referral for further evaluation was not: most of the screening-positive patients declined referral. This may partly be explained by geographical obstacles, but there are other possible explanations. Generally, COPD patients tend to deny depressive symptoms and usually refuse to accept referral to psychiatric services.[12,29] The fear of stigmatisation concerning a psychiatric diagnosis may be one reason. Moreover, being unaware of the symptoms of depression, many patients may think that feeling depressed is a normal reaction to having a progressive somatic illness.[8] Therefore, after a positive depression screening, it is important to educate patients about depression and to explain the potential advantages of seeking help.[12] More than one discussion may be needed to achieve this.

Professional interactions include communication, team processes and referral processes.[28] We failed to equip the professional teams with adequate skills and resources. Implementing a new protocol in clinical practice successfully requires changes in diverse levels of care and time for adjustments. In particular, the nurses at the pulmonary clinic lacked time and knowledge, and there were insufficient resources to have a psychiatric nurse attend the pulmonary outpatient clinic to interview the patients there. In addition, local care pathways for depression in surrounding communities were not involved in the protocol. In conclusion, the capacity for organisational change was not sufficient to manage patients with a positive screening.

After the implementation of the screening, the detection of depressive symptoms certainly improved, but it is unclear how the screening affected the patients' clinical course. Optimally, the detection and treatment of depression would improve quality of life and also reduce the pulmonary disease symptoms.[30] Therefore, screening for depression is recommendable, but the issue to be resolved is how to organise services so that they are both accessible and acceptable from the patients' point of view.

In the future, greater efforts are needed to ensure that appropriate discussion is available after a positive screening and further evaluation of mood is more accessible for the patients. Taken together, one solution would be to conduct a further evaluation of mood at the pulmonary clinic alongside screening instead of referring patients to a psychiatric unit. For the patients, the pulmonary unit is a natural environment to deal with the comorbidities of the pulmonary disease. The fear of stigmatisation related to the diagnosis of depression would likely be lower in pulmonary than psychiatric unit. Furthermore, such approach would reduce the need for separate hospital visits that would be burdensome to the patients. The problems to be solved include clarifying who is competent to perform the evaluation and how the resources should be guided so that the patients receive

a timely evaluation. However, the best solution for the patients would probably be a care pathway that is connected to local health care, enabling the patients to receive evaluation and treatment (when necessary) close to their homes. This is challenging, however, because practices and the availability of services concerning the suspicion of depression vary greatly between municipalities.

4.3 | Limitations

This evaluation was part of developmental work at the pulmonary outpatient clinic. These data must be interpreted with caution because our study was a retrospective evaluation of depression screening outcomes. One weakness was that neither the patients nor the nurses were systematically interviewed for the study; thus, not all possible contributing factors were fully clarified. Our initial purpose was not to search for patient groups with an elevated risk for depression, but some risk groups were nevertheless identified in the evaluation.

5 | CONCLUSION

Unnoticed symptoms of depression are prevalent among patients with chronic respiratory insufficiency. After commencing a protocol for depression screening in the pulmonary outpatient clinic, the detection of depression symptoms improved, but the effects on the patients' clinical course were small. The patients' compliance with the further evaluation of mood was poor. Screening for depression is recommendable, but the further assessment of patients with a positive screening should be organised in a way that is more acceptable and achievable from the patient's point of view. Instead of referring patients to a psychiatric unit, the evaluation and management of depression should rather be performed in the pulmonary unit.

CONFLICT OF INTEREST

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

AUTHOR CONTRIBUTIONS

Designed evaluation: All authors
Collected data: Kerminen
Analyzed data: Kerminen, Jämsen
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ETHICS

No ethical approval is required.

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