The road to successful geriatric rehabilitation

Holstege, M.S.

THE ROAD TO SUCCESSFUL GERIATRIC REHABILITATION

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CHAPTER 1

General introduction

Background

Due to the rising life expectancy and improved treatment possibilities of chronic illness and acute care, the group of older persons will continue to increase worldwide. Concurrently, the number of older people with multi-morbidities in acute care will also increase.[1] Patients in acute care with multi-morbidity have a higher risk for hospitalization and adverse outcomes such as hospitalization-associated disability.[2] About 30% of patients in acute care develop new disabilities in performing activities of daily living (ADL).[2] However, geriatric rehabilitation has a positive effect on the improvement of functioning after hospitalization, leads to less re-admissions to hospital and nursing homes, and to lower mortality rates. Therefore, geriatric rehabilitation is of great importance to this specific population.[3]

Geriatric rehabilitation is a relatively new and important emerging field in medicine and research. Historically, the majority of people failed to survive an acute illness so that rehabilitation was relatively rare.[4] Fortunately, due to related developments in medicine, geriatric rehabilitation started to develop. In 1947, the Lancet addressed this topic by reporting: *"…an active approach to the problem (deterioration because of hospitalization) more and more can receive treatment in bed preparatory to the restoration of assisted or unassisted ambulation….This can be achieved by geriatric rehabilitation". The aim of geriatric rehabilitation is to restore the maximum degree of painless movement by means of active physiotherapy and remedial exercises, resulting in the maximum of personal independence.*[5]

Geriatric rehabilitation consists of two main characteristics. First, geriatric rehabilitation is a multidisciplinary set of evaluative, diagnostic and therapeutic interventions with the purpose to restore functioning or enhance residual functional capacity in older people with disabling impairments.[6] Second, geriatric rehabilitation treatment has a multidisciplinary patient-centered approach. The population receiving geriatric rehabilitation is characterized by having a high burden of pre-existing multiple comorbidities.[4, 7, 8] Geriatric rehabilitation is indicated after acute care or an acute illness. In case of elective joint replacement, geriatric rehabilitation already starts in the preoperative phase.

The population receiving geriatric rehabilitation can be categorized into five main groups of medical diagnoses for geriatric rehabilitation: stroke, elective joint replacement (hip or knee), traumatic injuries, amputation, and a miscellaneous group with other diagnoses for rehabilitation (i.e. chronic obstructive pulmonary disease, heart failure, prolonged hospital stay after major surgery).

Geriatric rehabilitation: an international perspective

Internationally, post-acute care rehabilitation is provided in different settings. For example, in the USA post-acute care is provided in inpatient rehabilitation facilities (rehabilitation ward within a hospital), skilled nursing facilities (care-coordination

provided by a physician), long-term care hospitals, or by home health agencies. There is an overlap in types of patients treated in these different settings. In England, post-acute care is provided in community hospitals and care homes, and in New Zealand and Australia post-acute care is mostly provided by geriatricians in hospitals and in ambulatory settings. The heterogeneity in settings and organization of care makes it difficult to compare the outcomes of treatment in an international perspective.[9-11] Nevertheless, internationally, there is growing interest in how to organize and measure outcomes (e.g. functional measures, patient satisfaction, cost-effectiveness) of post-acute geriatric rehabilitation in order to improve patient outcomes.

Geriatric rehabilitation in the Netherlands

In the Netherlands, geriatric rehabilitation in the post-acute care setting developed within nursing homes. A descriptive study showed that, in 1988, half of the nursing home population in the Netherlands had a temporary residence.[12] This led to the development of the first Dutch nursing home to offer a geriatric rehabilitation ward (with 15 beds)[13] and with the aim to discharge home to the patient's former living environment. The Dutch nursing homes have now evolved into skilled nursing facilities with specialized knowledge on specific diagnostic groups. For example, skilled nursing facilities became part of integrated stroke services, and (elective) joint care and traumatic injuries services, in collaboration with university and general hospitals. In these skilled nursing facilities treatment is provided by a multidisciplinary team.

The multidisciplinary teams are led by an elderly-care physician, which is a unique concept in an international perspective. Elderly-care medicine is acknowledged as a medical specialty (with a training program of three years) and consists of training in geriatric, palliative and rehabilitation medicine.[14, 15] The multidisciplinary team consist of nursing staff, physiotherapist, occupational therapist, social worker, psychologist, speech therapist and dietician. When appropriate, other specialists such as a psychiatrist, psychomotor therapist, rehabilitation physician or orthotist/prosthetist, can be consulted.[16] The composition of the team is dependent on the patient's rehabilitation goals, which are described in rehabilitation treatment plans. The rehabilitation treatment plan is evaluated and adjusted during regular team meetings to coordinate the rehabilitation activities.

Aspects of successful geriatric rehabilitation

In this thesis we used the evidence-based Structure, Process and Outcomes (SPO) Donabedian framework to describe the various aspects of successful rehabilitation.[17] The SPO framework is used extensively in international research to describe and evaluate the quality of health care .[18] 'Structure' refers to the characteristics in which the care occurs. This includes facilities and equipment, organizational management, methods

of reimbursements, amount of team members, and expertise.[17] 'Process' specifies the actions that take place during patient care that affect patient outcomes, such as direct patient care processes, or the interaction of inter-professional processes such as team functioning and improvement processes.[9, 17] 'Outcome' refers to the effect of care on patients' health status. Because geriatric rehabilitation is focused on patient-centered care the most important aim of quality improvement in structure and process is to improve patient outcomes. The Donabedian framework addresses the aspects which are most important in improving quality of care. However, little is known about which specific elements or combination of elements contribute to successful geriatric rehabilitation in the post-acute care setting.

Geriatric rehabilitation has now developed to a stage where there is a need for quality improvement in order to further improve successful rehabilitation outcomes. However, there is still a lack of well-conducted studies focusing on i) quality improvement of geriatric rehabilitation, and ii) evaluating successful geriatric rehabilitation outcomes, such as discharge to home with a higher level of physical functioning, and optimizing the length of stay in skilled nursing facilities by improvement of the rehabilitation processes.

Aims of this thesis

The overall aim of this thesis is to investigate various aspects of the structure and processes in geriatric rehabilitation in relation to the outcome of successful rehabilitation.

The first part of this thesis examines the structure and process aspects of geriatric rehabilitation. Internationally, there is a strong focus on how to organize the structure of care in order to improve patient outcomes.[9] For example, in hospital care, patient volume is considered to be an important facilitator for quality and a proxy for specialization. However, only for complex high-risk treatment there is evidence that high volume is associated with better patient outcomes.[19] In addition, the concentration of services has shown positive results in stroke rehabilitation,[20] although large randomized controlled trials targeting geriatric rehabilitation are lacking.[3] Moreover, little is known about the actual numbers of patients using geriatric rehabilitation resources, and whether organizational characteristics (e.g. patient volume, service concentration) will benefit successful geriatric rehabilitation outcomes.[9, 21, 22] **Chapter 2** describes the association of patient volume and service concentration with successful geriatric rehabilitation, defined as short length of stay and discharge to home.

In the case of elective joint replacement, the geriatric rehabilitation process already starts before admission to the hospital by providing information about surgical procedures and postoperative therapy. Studies have focused on the preoperative predictors of postoperative functioning in patients with joint replacement.[23] Knowledge on preoperative predictors of successful rehabilitation is very important: e.g. more knowledge on the effects of preoperative functioning on rehabilitation outcomes can be used to

optimize care processes, such as timing discharge to home. The question arises as to whether we can measure preoperative functioning to predict functional outcomes of geriatric rehabilitation affecting patients' outcome. In patients with total knee replacement, preoperative quadriceps strength is associated with postoperative functioning,[24] whereas this has not yet been investigated in patients with total hip replacement. **Chapter 3** investigates which specific muscle groups of the lower extremities measured preoperatively are associated with short-term functional recovery after total hip replacement.

The second part of this thesis investigates initiatives to improve process and structure aspects with the aim to improve the outcome of successful geriatric rehabilitation. The overall organization of geriatric rehabilitation is a complex care process that suffers from fragmentation of care because of the many different specialists, professionals and settings involved. The geriatric rehabilitation pathway consists of acute care, post-acute care, outpatient or home rehabilitation, and home health care if needed. Good collaboration between the healthcare providers and professionals involved is essential for smooth transitions in care. Internationally there are attempts to improve the quality of the care processes, but these attempts did not specifically address geriatric rehabilitation patients and did not reflect the post-acute care setting.[9] In addition, little is known about the perspectives of professionals, patients and informal caregivers on the quality of care during these initiatives. The Dutch Ministry of Health, Welfare and Sport initiated a national program ('Proeftuinen geriatrische revalidatie') to improve integrated geriatric rehabilitation, with the aim to improve quality of care and health service delivery. **Chapters 4 and 5** describe the 'Synergy and Innovation in Geriatric Rehabilitation (SINGER) Study'. The SINGER study is a prospective longitudinal study performed during the implementation of this national program to improve quality geriatric rehabilitation care. **Chapter 4** addresses changes in the health services delivery process as experienced by professionals, patients and informal caregivers during the national program. **Chapter 5** describes the patient outcomes of the SINGER study in terms of successful geriatric rehabilitation, defined as independency in ADL and discharge to home after a short length of stay in the skilled nursing facility.

Early discharge planning is an important patient care process in geriatric rehabilitation that can affect patient outcome. If the patient is discharged to home in a timely fashion, this is considered to improve functional outcomes and reduce hospitalization rates, especially in patients with stroke and traumatic injuries.[25, 26] A pilot study in the Netherlands concluded that for 25% of the participating geriatric rehabilitation patients, earlier discharge was deemed possible.[27] In case a few nursing support tasks are required during the evening and night, these could be dealt with by a homecare provider or informal caregiver. Geriatric rehabilitation can then be continued with outpatient or home rehabilitation. However, no instruments are currently in place/available for this purpose.

In **Chapter 6**, in a quasi-experimental study (including a pre- and postimplementation cohort) we evaluated whether weekly scoring of a nursing support scorecard, and discussion within the multidisciplinary team, has the potential to lead to earlier discharge home.

Chapter 7 presents a general discussion on the main results of the studies. In addition, various aspects of successful geriatric rehabilitation are considered in a broader perspective, the methodological challenges and practical implications of the findings are addressed, and some recommendations are made for future research.

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PART ONE

Aspects of successful geriatric rehabilitation

CHAPTER 2

Relationship of patient volume and service concentration with outcome in geriatric rehabilitation

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ABSTRACT

Objective

Although geriatric rehabilitation (GR) is beneficial for restoration of activities and participation after hospitalization of vulnerable older persons, little is known about the optimal organization of care of these postacute facilities. This study examines the relationship of patient volume and service concentration with successful GR (short length of stay and discharge home) in skilled nursing facilities (SNFs).

Design

A national multicenter retrospective cohort study.

Setting and participants

All patients indicated for GR in a Dutch SNF.

Measurements

Nurses filled out digital registration forms from patient records. Patients were studied in 3 predefined diagnostic groups: total joint replacement, traumatic injuries, and stroke. Facility characteristics were obtained by structured telephone interviews with facility managers. Volume was based on the number of discharges in a 3-month period and categorized in low-, medium-, and high-volume facilities. Concentration was defined at the organizational level in which the population consists of 80% or more of 1 or 2 diagnostic groups, with the prerequisite of having a minimum of 10 rehabilitation beds.

Results

From 88 facilities, 2269 GR patients (mean age 78.2 years [SD 9.7]; 68.2% female) were included. The median length of stay in the SNF was 45 days (interquartile range 23-81), 57% of the patients were discharged home, and 9.8% died during GR. Of patients with total joint replacement (n = 501), concentration was related to successful rehabilitation (odds ratio 5.7; 95% confidence interval 1.3-24.3; P= .020, adjusted for age and gender); this relationship was not found for patients with traumatic injuries or stroke. Volume showed no relation with successful rehabilitation in any of the 3 diagnostic groups.

Conclusion

This study may indicate that concentration in an SNF, as a proxy for specialization, favors successful GR in total joint replacement. This relationship was not found for the traumatic injuries or stroke groups, or for volume. The relation on functional outcome in GR needs further investigation.

Keywords

Geriatric rehabilitation, postacute care, length of stay, discharge destination

INTRODUCTION

With the increasing population of vulnerable older persons, the number of hospital admissions will increase worldwide.[1] Patients in acute medical care with multiple geriatric conditions are at high risk for functional decline and institutionalization. Geriatric rehabilitation (GR) in a postacute care (PAC) setting is beneficial for restoration of activities and participation.[2-4] GR is defined as a multidisciplinary set of evaluative, diagnostic, and therapeutic interventions with the purpose to restore functioning or enhance residual functional capability in older people with disabling impairments.[5]

In hospital care, a higher volume of complex high-risk treatments is recognized as an indicator for better outcomes.[6,7] However, in a PAC setting, such as a skilled nursing facility (SNF), the relation between the organization of GR and outcomes have rarely been studied.[8-11] Among inpatient rehabilitation facilities, stroke units have proven efficient, although high-quality randomized clinical trials (RCTs) are still lacking for units specifically designed for the care of geriatric patients.[11-13] In addition, Li et al[8] found that a higher patient volume had a positive effect on reducing the risk of rehospitalization of patients admitted for PAC to an SNF. Tian et al[14] reported that patients receiving joint replacements had the most efficient treatment in a medium-volume SNF (ie, 100-183 admissions per annum) and inpatient rehabilitation facilities.

In the Netherlands, GR includes personal care, nursing, accommodation, counseling, and treatment in an SNF. The rehabilitation treatment has an interdisciplinary patient-centered approach that requires a temporary residence situation (on average 2 months) with a therapeutic living environment. Each client is reimbursed for an average of 18 to 22 hours per week of nursing care and 4 hours per week of treatment. The rehabilitation activities are performed by a multidisciplinary team led by an elderly care physician (ie, a medical practitioner who has specialized as a primary care expert in geriatric medicine and qualified as a basic specialist with expertise in geriatric medicine).[15] The multidisciplinary team involves nursing staff, physiotherapists, psychomotor therapists, occupational therapists, psychologists, social workers, speech therapists, dieticians, and pharmacists. They coordinate their work with regular team meetings in which rehabilitation care plans are evaluated.

Anticipating future changes with more people growing old and needing rehabilitation resources, there is considerable focus on structural changes of reimbursement and organization to improve the outcomes of Dutch GR within the limited financial resources. However, few data are available on the actual use of GR resources and outcomes. Therefore, this study aimed to identify basic patient and organizational characteristics of patients indicated for GR in SNFs related to outcomes of GR, such as length of stay (LOS) and discharge destination. In line with an acute care setting[6,7] we hypothesized that a

higher volume and/or concentration would be related to more successful GR in terms of shorter LOS and discharge home.

METHODS

Design

This was a national multicenter retrospective cohort study in facilities providing GR. The original goal of this study, ordered by Dutch Ministry of Health, was to estimate the total number of patients receiving GR in the Netherlands; therefore, all facilities providing GR were included. We used the data to answer our research questions (post hoc analysis).

Recruitment of facilities and patients

The Dutch government provided a list of all Dutch facilities providing GR (n= 295). For each location, the institutional board of directors was informed of the study and invited to participate. During a 3-month period, in the participating facilities, all discharged patients who were indicated for GR after hospitalization were included. Exclusion criteria were primary diagnosis of dementia, not having an indication for GR, LOS in GR of 6 months or longer, and rehabilitation in a PAC setting but not in a GR ward on an SNF.

Data collection and outcome measures

Data collection took place between October 2006 and October 2007. The participating facilities were randomly assigned to different 3-month periods.

Outcomes

The primary outcome was successful GR, defined as having a short LOS (total number of rehabilitation days in the facility) combined with being discharged to home (with or without day care). Short LOS was defined as the lowest 25% LOS per diagnostic group. The outcome for patients who died in the SNF within the 3-month time frame was categorized as "not successful." Dutch SNFs are well equipped for palliative care and therefore it is unusual that a patient is sent home with the intention to die.

Predictors

The predictors in relation to the outcome "successful GR" were the organizational characteristics of "concentration" and "volume." "Concentration" was defined at the organizational level in which 80% or more of the included final population (n= 2269) undergoing GR in an SNF GR ward consists of 1 or 2 diagnostic groups. An additional prerequisite was that the facility should have a minimum of 10 rehabilitation beds. The

few patients who were admitted to a concentrated ward with a diagnosis other than the concentration diagnoses of the ward were coded as not being on a concentrated ward.

For the definition of volume, we used the same procedure as described by Li et al.[8] Volume was based on the total population receiving GR in the GR ward. The facilities were categorized into tertile groups for volume: low volume (≤18 discharges in a 3-month period), medium volume (19-28 discharges in 3-month period), and high volume (29–127 discharges in a 3-month period).

Patient information

Nurses filled out digital registration forms from patient records, including age, gender, medical diagnosis for GR, type of setting before GR and type of facility, LOS in GR, readmission rate to the hospital, and discharge destination. The medical diagnosis for GR was used to compose 3 diagnostic groups: total joint replacement, traumatic injuries, and stroke. In addition, a fourth group of patients was compiled with a mix of other medical diagnoses for GR (ie, "Other diagnosis for GR").

Organization information

The number of rehabilitation beds was obtained by structured telephone interview with the facility managers, or from a national database. These data were also obtained for the nonparticipating GR facilities. The Medical Ethics Committee of the Leiden University Medical Center approved the study with a waiver of informed consent.

Statistical Analysis

Descriptive statistics were calculated for the characteristics of the population receiving GR in a GR ward of an SNF. Differences in characteristics between the patients in an SNF by type of medical diagnosis for GR were analyzed using a chi-square test. For age and LOS, differences were calculated with a Kruskal-Wallis test.

The generalized estimating equations (GEE) model was used to correct for cluster effects (n= 88 SNFs).[16] Three GEE models (adjusted for age and gender) were applied for the 3 diagnostic groups (total joint replacement, trauma, and stroke) in relation to short LOS, discharge to home, and a final model with the combination of short LOS and discharge to home. Possible related organizational characteristics included volume and concentration. The diagnostic group "Other diagnosis for GR" was excluded because this group was very heterogeneous. Assumptions were checked for dependency within subjects and independency between subjects.

Sensitivity analyses were performed for seasonal effects and alternative definitions of volume groups (2 groups, quartile groups, and quintile groups). In the GEE model, an evaluation of effect modification was also performed with an interaction term (volume x concentration).

RESULTS

Study Population

Facilities

Of the 295 GR facilities, 128 agreed to participate. Participating facilities did not differ from the nonparticipating facilities with regard to the number of beds and the geographical location (rural or urban) (data not shown).

There were 2 steps in the exclusion procedure of facilities. First, patients were excluded because of patient-related exclusion criteria, which led to the exclusion of 14 facilities and, second, patients who stayed in a PAC setting other than on an SNF GR ward were excluded, resulting in the exclusion of 26 facilities. Finally, 88 facilities remained for final analysis (Figure 1).

Of all facilities, 75% were not concentrated and had a heterogeneous population with several diagnostic groups receiving GR. During a 3-month period, the 88 SNFs had a median volume of 24 admissions (interquartile range [IQR] 12.25-32, range 1 to 127).

Patients

Of the total 3371 patients, 256 were excluded: 67 with no rehabilitation indication, 53 with psychogeriatric diagnosis, 98 with LOS of 180 days or longer, 36 were duplicate cases, and 2 patients had incomplete data; also excluded were 846 patients who received rehabilitation in a PAC setting but not in a GR ward on an SNF (Figure 1). This resulted in a final study population of 2269 participants; mean age was 78.2 (SD 9.7) years and 68.2% were women.

In total, 22.1% had the primary diagnosis of total joint replacement (n= 502), 26.9% traumatic injury (n= 611), 24.8% stroke (n= 562), and 26.1% (n= 594) had other GR indications. Most participants were admitted via a hospital (84.7%).

Overall, the median LOS was 45 (IQR 23-81) days and 57% of the participants were discharged home. During the stay on the GR ward, 9.8% died, with a considerable difference between the diagnostic groups (Table 1). The distribution of LOS also varied per diagnostic group: for trauma participants, the short LOS (and not deceased) was 35 days or less (25th percentile), for total joint replacement, short LOS was 11.25 days or less, and for stroke, it was 31.5 days or less. Of the total study population, 7.2% (n=163) were readmitted to a hospital.

Effects on successful geriatric rehabilitation

Table 2 shows the relationship (adjusted for gender and age) between organizational characteristics (volume and concentration) and the outcome of successful rehabilitation (short LOS and discharge home) for patients with total joint replacement (n= 501), trauma (n= 611), and stroke (n= 562).

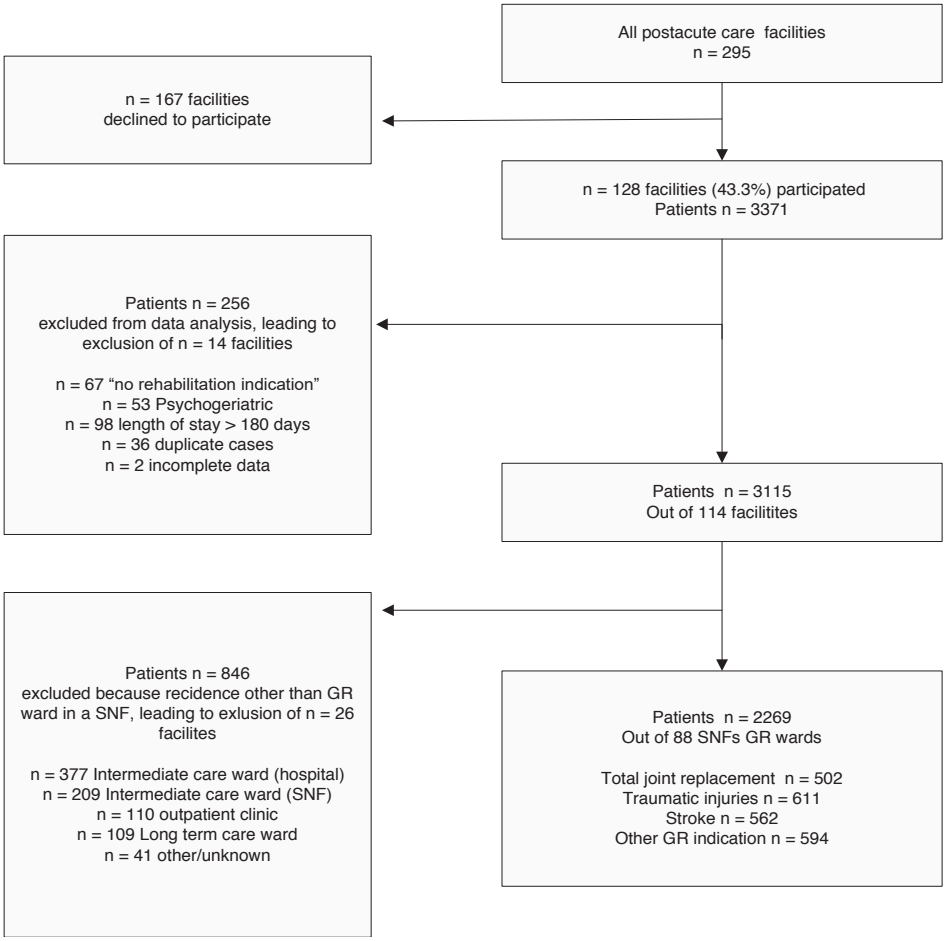

Figure 1. Flowchart of the study, showing facilities and number of patients.

In patients receiving total joint replacement, concentration was significantly related to the combined outcome of successful GR (odds ratio [OR] 5.67; 95% confidence interval [CI] 1.32-24.26; P= .020). In the model with only short LOS and the model with only discharge home as the outcome, concentration was not significantly related to the combined outcome. Among patients receiving total joint replacement, volume was not related to successful rehabilitation (high volume OR 2.27; 95% CI 0.50-10.18; P=.286; with low/medium volume as reference group). Because of low numbers, we combined low and medium volume as a reference group.

In patients with traumatic injuries, concentration was significantly related to discharge home (OR 1.89; CI 1.14-3.11; P= .013); however, the combined outcome for successful rehabilitation showed no significant differences. In patients with stroke, neither volume nor concentration had a significant relation to the outcome of successful rehabilitation.

Table 1. Characteristics of patients in a skilled nursing facility (SNF) by type of medical diagnosis for GR.

Patient characteristics	GR ward (in SNF)	Total joint replacement	Traumatic injuries	Stroke	Other GR indication	p-value
	n=2269	n=502	n=611	n=562	n=594	
Sex						
Female	1548 (68.2)	401 (79.9)	481 (78.7)	315 (56.0)	351 (59.1)	<0.001
Age, y	78.2±9.7	76.4±8.9	79.5±10.4	78.8± 8.7	77.8±10.3	<0.001
Setting (before admission to PAC facility)						
Hospital	1922 (84.7)	447 (89.0)	527 (86.3)	497 (88.4)	451 (75.9)	<0.001
Living situation, home	144 (6.3)	9 (1.8)	32 (5.2)	22 (3.9)	81 (13.6)	
Intermediate care	94 (4.2)	33 (6.6)	21 (3.4)	25 (4.4)	15 (2.5)	0.008
Institutional residential care facility	71 (3.1)	6 (1.2)	23 (3.7)	14 (2.6)	28 (4.8)	0.012
Rehabilitation center	3 (0.1)	0 (0.0)	0 (0.0)	1 (0.2)	2 (0.3)	0.384*
Other or unknown	35 (1.6)	7 (1.4)	8 (1.3)	3 (0.5)	17 (2.8)	0.031*
LOS median days (IQR)	45 (23-81)	28 (11.8-49)	55 (34-87)	55 (27.8-94)	47 (23-83.3)	<0.001
Discharge location						
Living situation, home	1293 (57.0)	423 (84.2)	394 (64.5)	215 (38.3)	261 (43.9)	<0.001
Home with outpatient day care and treatment	67 (3.0)	4 (0.8)	13 (2.1)	35 (6.2)	15 (2.5)	<0.001*
Hospital	163 (7.2)	23 (4.6)	40 (6.5)	30 (5.3)	70 (11.8)	<0.001
Rehabilitation center	9 (0.4)	0 (0.0)	1 (0.2)	7 (1.2)	1 (0.2)	0.0016*
Institutional residential care facility	457 (20.1)	32 (6.4)	111 (18.1)	185 (33.0)	129 (21.7)	<0.001
Other or unknown	57 (2.5)	14 (2.8)	21 (3.5)	8 (1.4)	14 (2.4)	0.329
Deceased	223 (9.8)	6 (1.2)	31 (5.1)	82 (14.6)	104 (17.5)	<0.001

GR, geriatric rehabilitation; PAC, post-acute care facility; IQR, interquartile range; LOS, length of stay; SD, standard deviation

NOTE. Values are numbers (%) or mean ± SD unless indicated otherwise. P-value calculated with χ^2 test, except for age and LOS calculated with Kruskal-Wallis test.

* Fisher's exact test

Table 2. Relation between organizational characteristics and successful rehabilitation (including short LOS and discharge to home), including patients in a skilled nursing facility receiving geriatric rehabilitation with the diagnosis total joint replacement, traumatic injuries and stroke (n=1674).

	Volume				*Concentration*		
	Low [a]	**Medium [b]**	**High [c]**	**p-trend / p-value [†]**	**No**	**Yes**	**p-value**
	Ref	**OR (95%CI)**	**OR (95%CI)**		**Ref**	**OR (95%CI)**	
Traumatic injuries (n=611)							
Short LOS[III]	1	0.67 (0.35-1.31)	1.07 (0.58-1.99)	0.271	1	0.93 (0.60-1.43)	0.730
Discharge home	1	0.78 (0.41-1.49)	0.77 (0.41-1.45)	0.488	1	1.89 (1.14-3.11)	0.013
Short LOS + Discharge home	1	0.81 (0.37-1.78)	0.95 (0.45-2.01)	0.885	1	1.02 (0.58-1.78)	0.945
Stroke (n=562)							
Short LOS[II]	1	0.71 (0.35-1.42)	1.00 (0.51-1.98)	0.718	1	1.26 (0.72-2.24)	0.421
Discharge home	1	1.03 (0.56-1.92)	0.81 (0.43-1.51)	0.382	1	0.67 (0.39-1.14)	0.141
Short LOS + Discharge home	1	0.68 (0.31-1.49)	0.83 (0.39-1.81)	0.862	1	0.82 (0.41-1.64)	0.568
Total joint replacement (n=501)							
Short LOS[I]	1[*]		2.80 (0.70-11.23)	0.147	1	3.48 (0.92-13.19)	0.067
Discharge home	1[*]		0.51 (0.25-1.07)	0.075	1	2.10 (0.89-4.96)	0.089
Short LOS + Discharge home	1[*]		2.27 (0.50-10.18)	0.286	1	5.67 (1.32-24.26)	0.020

CI; confidence interval, LOS; length of stay, Ref; reference group, OR; odds Ratio,
OR were estimated by Generalized Estimating Equations adjusted for gender and age. [†] P-trend was calculated in case of >2 volume groups and in case of 2 volume groups p-value was calculated. [*]Due to low numbers, low and medium volume were combined as a reference group for the diagnosis group total joint replacement.
Short LOS: I ≤ 11.25 days, II ≤31.5 days, III≤ 35 days
[a]< 18 discharges during a 3-month period
[b] 19-28 discharges during a 3-month period
[c] 29-127 discharges during a 3-month period

Results of the sensitivity analysis on seasonal influences and on alternative definitions of volume did not alter the effect estimators of the final model (data not shown). In the final model, there was no interaction of volume and concentration within the 3 diagnostic groups.

DISCUSSION

This is the first study to describe GR within a large sample of GR facilities in the Netherlands. In this national multicenter retrospective cohort study of patients indicated for GR in an SNF, 75% of the facilities had a heterogeneous population with different diagnostic groups receiving GR. During a 3-month period, the 88 SNFs had a median volume of 24 (IQR 12.25-32) discharges.

High concentration, but not volume, was related to successful rehabilitation only in the total joint replacement group. Further examination of the reasons for this benefit is important when redesigning or improving the organization of GR for these patients.

The concentrated GR facilities performed better in the total joint replacement group for the outcome of successful rehabilitation. For patients with traumatic injuries, a significant relation was found in the model with only the outcome of discharge home. No relationship with concentration was found in the group of patients with stroke. Earlier studies showed some efficacy with concentrated stroke units in an inpatient facility, although high-quality RCTs are still lacking for units especially designed for geriatric patients.[11,12] However, patients in an inpatient rehabilitation facility may differ from the population in an SNF (ie, they are usually younger and have a better functional prognosis compared with patients indicated for GR in an SNF).[12]

Volume had no significant effect on the outcome of successful rehabilitation. For the group with joint replacement, the ORs suggest that a high volume results in more successful GR; however, this result was not significant and was mainly due to a short LOS. Also, total joint replacement is generally planned care and the continuous care chain might be better organized in these patients compared with patients with traumatic injuries and/or stroke. However, this can also lead to selection bias in which high-volume PAC settings select patients with a good prognostic outcome resulting in a short LOS. Also, in acute care, the results are difficult to compare because of different levels of analysis (eg, hospital, surgeon, ward, or patient level) and different outcome measures.[17]

In most studies, rehospitalization rate is another important outcome indicator for SNF care quality.[8,18] In the present study, the rehospitalization rate was relatively low (7.2%) compared with PAC facilities in the United States, with an estimated rate of 23.5% within 30 days.[19] We are not sure whether this is the effect of an intensive interdisciplinary approach and/or the presence of a trained elderly care physician leading to a higher qual-

ity of medical care within Dutch SNFs, or whether this reflects case-mix differences.[18] However, the rate is in line with other studies showing low hospital referral rates in long term care facilities in the Netherlands.[20]

Researchers and policymakers worldwide are focusing on the effect of volume and concentration of treatment/care to improve cost-effectiveness.[6,8,10,14,21] Concentration suggests a level of specialization within the organization. Therefore, in our definition of concentration, we combined the predominance of 1 or 2 diagnostic groups with a minimum of 10 rehabilitation beds, to meet the conditions of specialization. Facilities with a concentration on specific diagnostic groups are able to form a specialized multidisciplinary team, operate more efficiently, and develop more skills, possibly resulting in better outcomes ("practice makes perfect effect"). In turn, facilities with a good reputation will attract more patients, resulting in a higher volume ("selective referral effect"), and these 2 effects interact with each other.[6,8] Thus, concentration as a proxy for specialization could be a predictor for better outcomes. However, in GR it is unknown which characteristics the most optimal organization should have in daily practice, and which type of patient is best suited for which rehabilitation path.[22] In the present study, our definition of concentration may not be fully equivalent to an efficiently operating multidisciplinary specialized team. For instance, we lacked data on the level of expertise/years of experience of the individual team members, which may have influenced the results.[17] Future research should explore the active ingredients of concentration, what best reflects the quality of care, and how organizational characteristics might improve functional outcomes.

Because this was a national retrospective study, only limited data were available; we lacked potentially interesting data on (for example) individual functional outcomes, functional level before admission, length of hospital stay, living location before hospitalization, and the active ingredients of concentration. Also, power was restricted for further subgroup analysis. Future studies exploring the effect of geriatric revalidation need to include these data, which are also related to outcomes of GR. Despite these limitations, this is the first study to describe the total population in the Netherlands receiving GR, with a large sample of all Dutch PAC facilities providing GR. Another strength is that we used the GEE model to adjust for correlated observations within the SNF clusters, which other studies often lacked. Cluster correlation can lead to an overestimation of the effect.[16]

CONCLUSION

This study may indicate that concentration in an SNF, as a proxy for specialization, within the diagnostic group total joint replacement favors successful GR, because concentra-

tion of the GR facility was related to a shorter LOS and more discharge to home. For the other diagnostic groups, and for the characteristic volume, no such relationship was found. Future research needs to explore the relation on functional outcome in GR.

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CHAPTER 3

Pre-operative quadriceps strength as a predictor for short term functional outcome after total hip replacement

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ABSTRACT

Objective

To determine the preoperative strength of the muscle group of the lower extremity that is most important in predicting functional recovery after primary unilateral total hip replacement (THR).

Design

Prospective observational study with inception cohort.

Settings

Joint care program (hospital care/clinical division of a nursing home/outpatient physical therapy).

Participants

Patients (N=55) undergoing primary unilateral THR.

Interventions

Not applicable.

Main Outcome Measures

Baseline measures within 2 weeks preoperative and follow-up at 6 and 12 weeks postoperative included isometric strength measurement of the hip (flexors, extensors, abductors, adductors) and knee (flexors, extensors) musculature using a handheld dynamometer. Functional outcome was tested using performance-based (Timed Up and Go Test, 6-Minute Walk Test) and self-report measures (Western Ontario and McMaster Universities Osteoarthritis Index, subscale Physical Function [WOMAC PF], 36-ItemShort form Health Survey subscale Mental Health, visual analog scale for pain).

Results

Of the patients (N=55; mean age, 72.7±6.8y; 41 women) included; 18 dropped out, leaving 37 patients for analyses. After correction for WOMAC PF score at baseline, body mass index, sex, and age, the preoperative knee extensors strength measure of the operated site was the only muscle group showing a significant effect on functional outcome measured by using the WOMAC PF at 12 weeks postoperatively (R^2=.355; β=.105; *P* for β=.004).

Conclusion

Preoperative greater knee extensor strength of the operated site is associated with better physical function, measured by using the WOMAC PF at 12 weeks postoperative.

Keywords Arthroplasty, Hip, Muscle strength, Quadriceps muscle, Rehabilitation, Replacement

LIST OF ABBREVIATIONS

6MWT	six-minute walk test
ADL	activity of daily living
BMI	body mass index
HHD	handheld dynamometer
SF-36 MH	Medical Outcomes Study 36-Item Short-Form Health Survey, subscale Mental Health
THR	total hip replacement
TKR	total knee replacement
TUG	Timed Up & Go
VAS	visual analog scale
WOMAC PF	Western Ontario and McMaster Universities Osteoarthritis Index, subscale Physical Function

INTRODUCTION

Osteoarthritis is the most common chronic musculoskeletal disorder worldwide. The most important consequences of osteoarthritis in the hip are pain; morning rigor; crepitus; decreased mobility, muscle strength, and stability; deformation of the joint; and decreased aerobic capacity. The prevalence of people with osteoarthritis is increasing yearly because of the increased life span and bulging cohort of baby boomers.[1] The prognosis for demographic trends in The Netherlands shows an increase of 52% between 2007 and 2040 for the absolute number of patients with osteoarthritis.[2] Total joint replacement is an effective intervention used in patients with severe osteoarthritis, with 202,500 THRs performed in the United States in 2003 and an expected 174% growth to 572,500 in 2030.[3] In The Netherlands, 19,546 THRs were undertaken (68% women) in 2007 because of osteoarthritis.

Preoperative prognostic determinants of functional recovery are important for patients, physicians, and therapists. Several studies focused on preoperative predictors of postoperative functioning after hip replacement. Factors associated with functional recovery included age, sex, level of pain, number of comorbid conditions, site of arthroplasty, BMI, SF-36 score, WOMAC score, short-term self-efficacy, and patient perceptions concerning the outcome.[4-10]

Muscle atrophy in patients with osteoarthritis due to chronic inactivity was another factor affecting postoperative functional recovery after THR, and strength deficits can persist after hip replacement.[11-13] Another study[14] found a significant relation between quadriceps strength and functional recovery with TKR, but at present, it is still unclear which muscle group is most important in predicting functional recovery after THR.

The aim of the study was to investigate the muscle group of the lower extremity measured preoperatively that is associated most with short-term functional recovery in patients undergoing primary unilateral THR. We hypothesized that specific muscle groups measured preoperatively can predict short-term functional recovery in patients undergoing primary unilateral THR.

METHODS

Design

We performed a prospective observational study with a preoperative inception cohort. The primary endpoint was physical functioning at 12 weeks postoperatively. Outcome measurements were performed within 2 weeks preoperatively and at 6 and 12 weeks after surgery, when study participants visited an outpatient clinic. All measurements were performed by the same physical therapist (M.S.H.). Four subjects were measured

by a different physical therapist because they were treated at another location. Both assessors were trained physical therapists.

Participants

The study sample consisted of elderly patients scheduled to undergo primary unilateral THR for advanced osteoarthritis in the Zaans Medical Centre, The Netherlands. Hip arthroplasty consisted of a cementless acetabular component and hip stem component. Patients participated in the joint care program, where they were provided with oral and written information about the enrollment procedure, surgical procedures, and postoperative therapy during a preoperative information meeting. The first day after surgery, all patients were allowed to use walking aids while 100% weight-bearing capacity of the prosthesis was assumed. On average, patients remained on the surgical ward for 4 days and received clinical rehabilitation treatment for 8 to 12 days thereafter. After discharge, patients were referred to 1 of the 4 outpatient physical therapy settings that cooperated with the joint care program and had additional rehabilitation treatment for approximately 60 minutes twice a week. No preoperative physical therapy was prescribed. The clinical rehabilitation and outpatient physical therapy programs were in line with the orthopedic guidelines from the Dutch institute for health care improvement.

Patients were eligible for inclusion if they provided informed consent to participate in the study and the joint care program (clinical and postclinical pathway) and had the ability to answer questions in Dutch or English. Exclusion criteria were patients scheduled for revision arthroplasty, Birmingham Hip Replacement, or bilateral arthroplasty (contralateral THR <1 y before). Patients with significant neuromuscular disease, extreme deformation of extremities, and mental disorders also were excluded. Eligible patients were asked for informed consent by 1 of the 3 orthopedic surgeons involved in the surgical procedure or by their surgeon assistant.

Measures

Because functional recovery after THR is multifactorial, we used performance-based and self-report measures for this study.

Strength measurement

The MICROFET2[a] was used as an HHD to assess isometric strength of the flexors, extensors, adductors, and abductors of the hip and flexors and extensors of the knee (fig 1). An HHD is a widely used, reliable, and valid instrument to measure isometric peak force, also in elderly patients,[15-17] and interobserver reliability appeared to be high (intraclass correlation coefficient=.94) in a study with subjects after THR and TKR.[18]

Tests were performed in a gravity-neutralized position with the patient lying supine, except for knee flexion and extension, which were tested with the subject in an upright

Figure 1. Hand Held Dynamometer

sitting position. Tests were carried out according to a standardized protocol,[15] except for measurements of the hip extensors and adductors, which were not recorded. We also performed these measurements in a gravity-neutralized position. Measurements were performed 3 times successively, and the highest score was used for analysis.

Performance-based measures

Basic functional mobility was measured by using the TUG test and 6MWT. Both are validated to measure functional ability in elderly patients.[19,20] Patients were permitted to use the regular walking aids used at the given stage of recovery. For the 6MWT, standard phrases of encouragement were allowed. Performance-based measures deal with functional performance in a clinical setting, whereas functional outcome measures deal with the result of true ADL performance. Instead of a real ADL measurement, the latter also might be established by means of a self-report questionnaire.

Self-report measures

Functional recovery, the outcome of interest, was measured by using the WOMAC PF (Dutch version).[21] The WOMAC PF (17 items) is a self-assessed disease-specific measure for patients with osteoarthritis of the knee and hip. Responses were given by means of an ordinal 5-point rating scale, with 0 indicating no problem and 4 indicating an extreme problem with the activity. Scores for the PF subscale range from 0 to 68 points. To assess MH, we used the SF-36 MH subscale (Dutch version).[22] The subscale includes 5 items: depression, anxiety, behavioral control, emotional control, and general positive affect. Scores range from 0 to 70, with higher scores indicating lower levels of mental health. To assess subjective pain, we used a VAS with the following question[23]: "Which level of pain do you subscribe to your affected hip?" with 0 indicating no pain and 10 indicating worst pain.

Statistical Analysis

Post hoc sample-size calculations indicated that with our expected inclusion of 40 patients (excluding attrition), the multiple linear regression test of R^2 of 0 for 5 covariates would have 80% power to detect an R^2 of .30. We aimed to include 50 patients because we expected a 20% attrition rate. Eventually, we included 55 patients, of whom 37 could be analyzed (discussed next). To assess the effect of preoperative muscle strength on functional recovery at 12 weeks postoperatively measured by using the WOMAC PF, we used multivariable linear regression analysis. WOMAC PF score at 12 weeks after surgery was used as the dependent variable, and the selected muscle strength measures (newtons), as predictors while correcting for baseline WOMAC PF score, age, BMI, and sex. A predictor variable was considered statistically significant at *P* less than .05 in the multivariable model. Multicollinearity was deemed concerning if the variance inflation factor for any independent variable was greater than 5. Graphical examination of standardized residuals against total muscle strength measurements and scatter plots of dependent and independent variables were used to examine violation of the linearity assumption in all regression models.

RESULTS

Descriptive Data

Patients were included between 2008 and 2009. Of 55 eligible patients, 18 dropped out of the study for various reasons, leaving 37 patients for analysis, which is in accordance with our sample size (fig 2). Patient demographic characteristics at baseline are listed in table 1. Baseline characteristics of patients who dropped out were not relevantly different from those with complete follow-up. At 12 weeks, there was 1 missing value for the 6MWT, VAS, and TUG test. We used values from the 6-week assessments in case of missing values at 12 weeks (last observation carried forward). The WOMAC PF had 21 missing responses for item 13 (level of difficulty going in and out of bath) at the 3 measurement points because subjects used a shower. We replaced the missing values for the WOMAC PF bath item with the subject's mean item score. There were 12 patients with 5 or fewer missing items on the WOMAC PF. For these patients, we replaced the missing value with the highest score of 4 (extreme difficulty) because we assumed that patients skipped the activity because they were unable to perform it.

Descriptive statistics (mean ±SD or median with interquartile range) for measures preoperatively and at 6 and 12 weeks postoperative are listed in table 2. At 6 weeks postoperatively, all outcomes had improved significantly compared with the preoperative state, except for knee extensors, TUG test, and 6MWT. All outcomes had improved significantly at 12 weeks postoperatively compared with the (preoperative) baseline score.

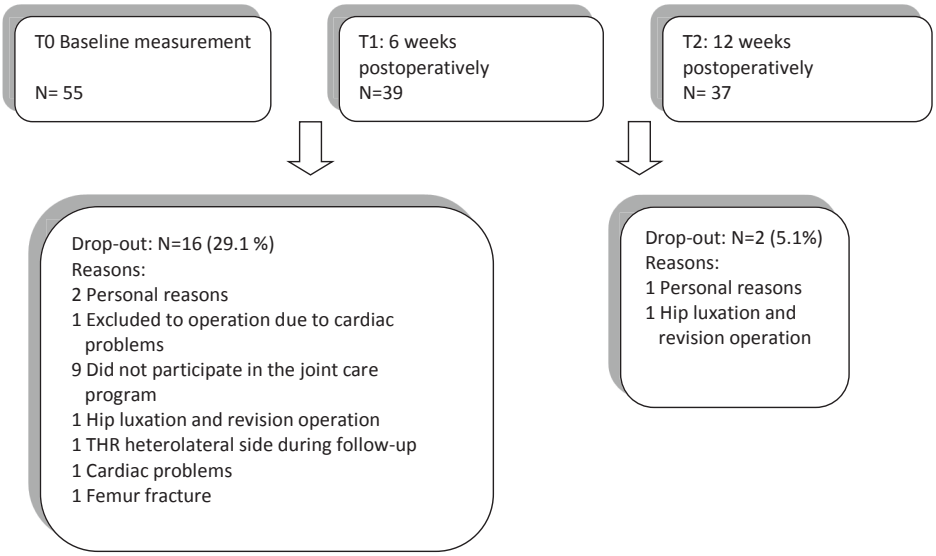

Figure 2. Inclusion Flowchart

Table 1. Baseline characteristics of included patients

Characteristic	Total sample (N=55)	Complete follow-up (N=37)	Drop-out 12 weeks (N=18)
Mean age (y)	72.7 (±6.8)	72.1 (±6.4)	73.9 (±7.5)
Women n	41 (74.5)	28 (75.7)	13 (72)
THR left side	28 (50.9)	18 (48.6)	10 (55.6)
Operated hip, dominant side	30 (54.5)	22 (59.5)	8 (44.4)
Approach posterior	38 (69.1)	27 (73)	11 (61.1)
Mean BMI (kg/ m^2)	28.0 (±4.1)	27.8 (±3.9)	28.5 (±4.2)
Comorbid condition	34 (62)	22 (60)	12 (68)

NOTE. Values expressed as mean ± SD or n(%)

At baseline, all muscle strength measures from the operated side were significantly lower in comparison to the nonoperated side. At 6 weeks' follow-up, hip extensors, hip abductors, knee flexors, and knee extensors still showed significantly lower strength compared with the nonoperated side. At 12 weeks' follow-up, only hip abductor and knee flexor strength of the operated side were still significantly lower. WOMAC PF score had improved significantly at 6 and 12 weeks postoperatively compared with baseline.

Table 3 lists results of linear regression analysis to assess the effect of preoperative muscle strength on functional outcome (WOMAC PF score at 12 weeks postoperatively) after THR. After correction for WOMAC PF score at baseline, BMI, sex, and age, knee extensor strength (quadriceps muscle) of the operated site was the only variable show-

Table 2. Descriptive statistics for muscle strength, Womac-PF, SF36-MH, VAS, TUG and 6MWT measured pre-operatively and at 6 and 12 weeks post-operatively.

Outcome		pre-operative (N=55)	6 weeks (N=39)	12 weeks (N=37)
Hip				
Flexors	Operated side	114.3 ± 39.1†	136.5 ± 43.9	162.5 ± 44.5
	Non-operated side	130.7 ± 42.6	147.7 ± 43.3	171.6 ± 5.0
Extensors	Operated side	162.1 ± 51.9†	190.9 ± 49.7†	228.1 ± 55.7
	Non-operated side	187.1 ± 52.4	217.2 ± 54.8	235.2 ± 51.2
Abductors	Operated side	129.9 ± 54.1†	150.5 ± 57.1†	192.8 ± 59.5†
	Non-operated side	170.2 ± 59.0	187.0 ± 65.4	207.8 ± 69.3
Adductors	Operated side	106.4 ± 38.1†	129.5 ± 37.1	152.9 ± 51.3
	Non-operated side	126.8 ± 40.8	138.8 ± 52.8	160.6 ± 57.6
Knee				
Flexors	Operated side	139.4 ± 46.8†	155.3 ± 38.1†	174.0 ± 48.8†
	Non-operated side	152.0 ± 51.7	170.2 ± 44.2	185.0 ± 53.0
Extensors	Operated side	192.7 ± 74.2†	190.8 ± 60.4†*	233.2 ± 74.6
	Non-operated side	222.2 ± 69.9	222.6 ± 67.2*	246.7 ± 66.7
Womac-PF (0-68)		34.7 ± 13.8	21.6 ± 13.3	14.7 ± 9.6
SF36-MH (0-70)		50.5 ± 6.7	55.6 ± 8.5	57.8 ± 10.6
Median VAS-pain (IQR)		4.7 (3.1-6.0)	0.3 (0-1.5)	0 (0-0.3)
TUG (seconds)		13.5 ± 6.0	12.9 ± 4.9*	10.6 ± 4.3
6MWT (meters)		317.9 ± 112.3	313.8 ± 89.6*	380.4 ± 99.0

NOTE. Values expressed as mean ± SD unless indicated otherwise. Muscle strength in Newtons.
Abbreviation: IQR, interquartile range. All comparisons between preoperative strength measure and 6 weeks and 12 weeks were significant at the $p < 0.05$ unless indicated otherwise. * not significant (paired -T-test). † indicates that the strength measures from the operated side were significant ($p < 0.05$) lower in comparisons with the operated side (two-sample T-test).

ing a significant effect on functional outcome (WOMAC PF score) at 12 weeks postoperatively. β coefficient was -.105 (*P*=.004), indicating that a difference in knee extensor strength at baseline of 20N is associated with a 2-point (20 x .105) lower WOMAC PF score at 12 weeks, to be interpreted as a better functional outcome. Excluding the 3 patients who used a walking aid (elbow cane) at follow-up did not alter results: β equals -.119 (*P*=.006). Also, we reanalyzed data for posterior (n=27) and lateral (n=10) surgical approaches separately. Results were similar to those for the groups combined. For the posterior surgical approach, β equals -.099, and for the lateral approach, β equals -.147. Result of the test for interaction of knee extensor strength at baseline and surgical approach were not significant (*P*=.51), indicating that surgical approach did not influence results. We repeated the analysis using TUG test, 6MWT, SF-36 MH, and VAS scores as

Table 3. Effect of preoperative muscle strength on the functional outcome after total hip replacement: results of linear regression analysis.

	R2	ß± SE*	P for ß
Hip flexors	22.0%	-0.086 (0.053)	0.116
Hip extensors	16.7%	-0.022 (0.032)	0.496
Hip abductors	24.1%	-0.078 (0.041)	0.069
Hip adductors	17.5%	-0.055 (0.062)	0.380
Knee flexors	23.8%	-0.091 (0.049)	0.074
Knee extensors	35.5%	-0.105 (0.034)	0.004

NOTE. No violation of assumptions of the regression models were observed. Variance inflation factors were lower than 2, and residuals had a symmetrical distribution.

* Corrected for age, sex, baseline WOMAC-PF score and BMI. ß-coefficients represent the difference in WOMAC-PF score per unit increase in the independent variable. For example, a ß= - 0.105 for Knee extensors indicates that per 1-Newton higher knee extensor measure pre-operatively, the 12-week WOMAC-PF score is 0.105 points lower. Thus, a patient with 20 Newton higher pre-operative strength has, on average, a 20 x 0.105 = 2 points lower (better) WOMAC-PF score 12 weeks post-operatively.

dependent variables indicating functional outcome, but none was significantly related to preoperative muscle strength.

DISCUSSION

The primary aim of this study was to investigate which muscle group of the lower extremity in the preoperative phase is most important in predicting short-term functional recovery after THR, measured by using the WOMAC PF. Our analysis showed the knee extensors (quadriceps muscle) of the operated site as the only significant predictor for 12-week postoperative physical function measured by using the WOMAC PF. The relation between preoperative quadriceps function and postoperative recovery also was reported in studies with patients undergoing TKR.[14,24] To our knowledge, this is the first study that focused on this relationship with THR patients. One study[25] described the relationship of strength as a preoperative predictor in THR, suggesting that preoperative Modified Barthel Index score and isokinetic peak strength of hip flexors and extensors were strong predictors of timing for hospital discharge. As described in the introduction, several studies focused on the relationship of preoperative variables to postoperative function after hip and knee arthroplasty. Our study also confirms the "better in, better out" principle: better preoperative function leads to better postoperative function.

A systematic review[26] suggested that physical therapy in people with hip osteoarthritis may be beneficial, but results have not been established. Suetta et al[27] described an early postoperative protocol of unilateral resistance training of the quadriceps that improved both impairment and function and shortened hospital length of stay after THR. The

investigators suggested that further research is necessary to study the effect of a preoperative quadriceps strengthening program on postoperative functional rehabilitation.

At the 6-week postoperative measurement, knee extensors, TUG score, and 6MWT score showed no significant improvement. Mizner et al[24] reported that preoperative quadriceps strength was associated significantly with physical performance of the TUG test and 6MWT in a sample of TKR patients. In contrast to the findings of outcome performance in TKR reported by Mizner,[24] we could not detect a significant outcome performance based on quadriceps strength in THR. However, in our study, preoperative quadriceps strength correlated significantly with self reported outcome on the WOMAC PF. A possible explanation could be that this selfreport measurement scale may be influenced by patients' overestimation and socially desirable answers. Second, the study of Mizner[24] showed that quadriceps strength appeared to be a significant predictor in performance-based outcome in TKR, whereas this could not be confirmed in our study of THR. This could be explained because the quadriceps muscle group is a primary mover in knee extension, whereas hip flexion using the quadriceps muscle group is of minor importance. In conclusion, extension of the knee joint in TKR is of major importance with respect to performance outcome, whereas flexion of the hip joint in THR by the same muscle group (mm. quadriceps) contributes only a very limited extent to performance outcome.

Hip abductors and knee flexors at 12 weeks were the only muscle groups that had significantly lower muscle strength compared with nonoperated hip strength at the 12-week followup, but both significantly improved in comparison to baseline data. Whether this should have implications in the rehabilitation regimen in terms of selective muscle strength training is disputable. In our study, we did not detect any muscle group to be a significant predictor of functional outcome.

In addition, persisting muscle fiber atrophy after THR is described as an important factor of decreased progress in functional rehabilitation in several studies,[11,13] with the possibility to persist for 2 years after THR. There are different explanations for persisting muscle atrophy and differences in recovery of the independent muscle groups. One is fat infiltration in the hip muscles due to preoperative inactivity as a negative predictor in muscle recovery.[13] Also neuromuscular activation deficits,[12] the trauma of the surgical procedure, and persisting inactivity may influence rehabilitation of hip muscles. Patients with osteoarthritis who had an inactive life style before THR due to pain and loss of mobility frequently persist in such inactivity after THR.[28]

Study limitations

Our study had several limitations. We had a small sample size, which can affect the external validity of the study. However, results of descriptive statistics showed data similar to other studies, confirming that our sample was generalizable to a group of patients

with hip osteoarthritis and THR.[7,13,29] There was a dropout rate of 32.7% of the total sample: 29% left the study before the postoperative measurement at 6 weeks, of which 16.4% decided not to participate in the joint care program, mostly because they had no transportation to 1 of the 4 outpatient facilities of the joint care program. However, we had a low dropout rate (5.1%) at the 12-week follow-up measurement. The last measurement in our study was at 12 weeks postoperatively; thus, no long-term follow-up was measured. In our center, postoperative physical therapy usually ends after 3 months because most patients reach their functional endpoints within that time frame and the additive benefit of rehabilitation therapy flattens out. In addition, in longer follow-up, other external factors irrelevant to the rehabilitation course could distort the association we aimed to examine in these elderly patients. Because of the small sample, we can adjust for only a limited number of confounders. We corrected for the most important ones, which were BMI, baseline score of the dependent variable, age, and sex.

In our study, we had 2 surgical procedures, the lateral and posterior approach (73% of analyzed subjects). In our study, surgical approach also was not associated with WOMAC PF score at follow-up.

Muscle strength measurement using a dynamometer was used widely in other studies. It is an objective measurement of muscle peak force. The limitation of dynamometry occurs when the outcome assessor is unable to stabilize the patient in to the position according to protocol. This can happen occasionally when measuring the quadriceps. If stabilization of the patient appears to be impossible, the muscle cannot be tested isometrically and a concentric test procedure remains. This might underestimate the absolute level of peak force of the mm. quadriceps. Despite these limitations, the HHD is a proven, reliable, and valid instrument measuring strength in the elderly population after THR.[15-18]

CONCLUSIONS

Preoperative greater knee extensor strength of the operated site is associated with better physical function, measured by using the WOMAC-PF at 12 weeks postoperatively. We suggest that studies with larger samples are required to confirm our findings.

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Supplier

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Bouchier

PART TWO

Initiatives to improve successful geriatric rehabilitation outcomes

CHAPTER 4

Changes in geriatric rehabilitation: a national programme to improve quality of care. The synergy and innovation in geriatric rehabilitation study

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ABSTRACT

Objective

To describe changes in the health service delivery process experienced by professionals, patients and informal caregivers during implementation of a national programme to improve quality of care of geriatric rehabilitation by improving integration of health service delivery processes.

Study Setting

Sixteen skilled nursing facilities

Study Design

Prospective study, comparing three consecutive cohorts.

Data Collection

Professionals (elderly care physicians, physiotherapists and nursing staff) rated four domains of health service delivery at admission and at discharge of 1075 patients. In addition, these patients [median age 79 Interquartile range 71-85 years, 63% females] and their informal caregivers rated their experiences on these domains 4 weeks after discharge.

Principal Findings

During the three consecutive cohorts, professionals reported improvement on the domain team cooperation, including assessment for intensive treatment and information transfer among professionals. Fewer improvements were reported within the domains alignment with patients' needs, care coordination and care quality. Between the cohorts, according to patients (n=521) and informal caregivers (n=319) there were no changes in the four domains of health service delivery.

Conclusion

This national programme resulted in small improvements in team cooperation as reported by the professionals. No effects were found on patients' and informal caregivers' perceptions of health service delivery.

Keywords

Geriatric rehabilitation, health service delivery, national programme, quality of care, care process

INTRODUCTION

In the Netherlands, postacute geriatric rehabilitation takes place in skilled nursing facilities, with a comprehensive rehabilitation team which often includes an elderly care physician, nursing staff, physiotherapist and occupational therapist, together with a psychomotor therapist, psychologist, social worker, speech therapist, dietician and pharmacist[1]. Geriatric rehabilitation is defined as a multidisciplinary set of evaluative, diagnostic and therapeutic interventions with the purpose to restore functioning or enhance residual functional capability in older people with disabling impairments[2]. The medical diagnosis for geriatric rehabilitation can be categorized into four main groups, i.e. stroke, trauma, joint replacement and a miscellaneous group for other diagnoses, i.e. COPD, amputee, heart failure.

The organisation of geriatric rehabilitation is a complex care process which suffers from a fragmented approach allowing room for improvement in the coordination, communication and continuity of care between the various health care providers and professionals involved[3]. Because most geriatric rehabilitation is provided after acute hospitalization of older persons, effective collaboration between hospitals and postacute care settings for the development and performance of integrated care is essential[4-6]. Poor organisation of care has a negative impact on health care costs, patient outcomes and patient satisfaction with care[7, 8].

An important challenge when developing integrated care is to get the patient and informal caregiver more involved in the rehabilitation process. Involvement of the patient and informal caregiver can improve continuity of care, quality of care and positive experiences with care[9-11]. Therefore, it is important to use different perspectives (patient/professional/informal caregiver) in the evaluation of processes and outcomes on the level of health service delivery (i.e. alignment with patients care needs; care coordination; team cooperation; and quality of care[12]. However, few studies have evaluated multiple perspectives involved with changes in health service delivery[9, 10, 13].

To improve the quality of service delivery for geriatric rehabilitation in the Netherlands, a national programme was initiated by the Dutch Ministry of Health, Welfare and Sport in 2011. The aim of this programme was to stimulate self-organising capacity to develop integrated geriatric rehabilitation in order to improve the health service delivery. This programme was introduced at a time when the health care system was transforming from a typical long-term care government-guided reimbursement system without financial incentive for efficient geriatric rehabilitation, towards a more market-guided bundled payment system Internationally, bundled payment systems appear to be a strong incentive for collaborating geriatric rehabilitation service organisations with the goal to improve quality of care[6, 13].

The aim of this study is to describe changes in the health service delivery process during implementation of the national programme, as experienced and rated by professionals, patients and their informal caregivers.

METHODS

Study design

During implementation of the national programme in the Netherlands, a prospective longitudinal mixed method study was performed among the participating skilled nursing facilities, i.e. the Synergy and INnovation in GEriatric Rehabilitation (SINGER) Study. For data collection, three consecutive cohorts (each cohort recruited over a 4-month period in March 2011, September 2011 and March 2012), were used to evaluate changes in perceptions of health service delivery during implementation of the national programme. The first cohort was enrolled at the start of the implementation phase, and the second and third cohorts at 6 and 12 months, respectively, after the start of the national programme. The process evaluation with quantitative measures was postulated by the Dutch Ministry of Health

Participants

Eighty groups of collaborating geriatric rehabilitation service organisations that wanted to participate in the national programme provided an action plan outlining the goals they aimed to achieve to improve their quality of care. A geriatric rehabilitation service organisation consisted of at least one skilled nursing facility, a hospital and a health insurance company, but could also include home care providers, primary care providers (e.g. physiotherapists, occupational therapists) or rehabilitation centers. From the 80 available geriatric rehabilitation service organisations, the Dutch Ministry of Health, Welfare and Sport selected 16 for the national programme based on their initial plans and national coverage. Data collection took place in the skilled nursing facilities of the selected organisations.

Patients admitted to a participating skilled nursing facility for geriatric rehabilitation were recruited for participation. For each participating patient, their professional caregivers (elderly care physician, physiotherapist and one delegate of the nursing staff) and informal caregivers involved were also invited to participate. The study population was recruited in three consecutive cohorts starting in March 2011, September 2011 and March 2012 (spanning a 4-month period for each cohort).

Each skilled nursing facility was asked to include a minimum of (the first) 10-15 admitted patients, stratified for diagnostic group, in each cohort. Excluded from the study were patients with a diagnosis of dementia.

A waiver of consent was given by the Medical Ethics Committee of the Leiden University Medical Center (LUMC).

National intervention programme

The Ministry of Health, Welfare and Sport initiated the national programme with the aim to stimulate self-organising capacity to develop integrated geriatric rehabilitation in order to improve the health service delivery. The Ministry provided financial support to the participating geriatric rehabilitation service organisations for internal project management. The health insurance companies provided financial incentives for the more intensive treatment programmes. In addition, the geriatric rehabilitation service organisations themselves contributed to the implementation of their goals to improve geriatric rehabilitation service delivery. Each participating geriatric rehabilitation service organisation was responsible for the internal project organisation, implementation of their action plan, and for achievement of their formulated goals. During implementation of the programme, nine national meetings were held with the project board and members of the participating geriatric rehabilitation service organisations. The project board consisted of an expert team of stakeholders with the aim to initiate, identify and disseminate best practices between the involved geriatric rehabilitation service organisations. During these meetings, representatives of the 16 geriatric rehabilitation service organisations shared their experiences and knowledge. In addition, preliminary process outcomes on this national evaluation study were presented as feedback for the ongoing implementation process. To monitor and supervise the action plans and goals, using the plan-do-study-act cycles[14], two national process managers visited the internal project managers of each geriatric rehabilitation service organisations at the start of the implementation (between July and December 2011) and twice during follow-up. These process managers had a more qualitative approach and interviewed the internal project managers of each geriatric rehabilitation service organisations on the facilitators and barriers of this national incentive and reported in a process evaluation[15]. The lessons learned from these interviews were reported in a guidebook [16] and summarized in Box 1.

Content of the programme

To improve the geriatric rehabilitation service, each geriatric rehabilitation service organisation set its goals to optimize integrated care. Integrated care is defined as "*a concept bringing together inputs, delivery, management and organisation of services related to diagnosis, treatment, care, rehabilitation, and health promotion. Integration means to improve the service in relation to access to care, quality of care, user satisfaction, and efficiency of care*".[17] For that purpose each geriatric rehabilitation service organisation developed or improved care pathways for a specific group, i.e. stroke, joint replacement and hip fracture, as well as for other smaller groups of specific diseases (i.e. COPD, am-

Box 1. Facilitators and Barriers during the national incentive according to the national process managers

Facilitators:

- A top-down mandate is necessary to bring about changes and to collaborate the different stakeholders to set goals together.
- Commitment of all participating organisations to participate, wanting to invest (time, capacity and education) and focusing on the benefit for the patient instead of organisational interest is essential to optimize integrated care.
- Project management was necessary to maintain the process and keep focus on the outcomes. Also a project group with participants from the different organisations and a mix of management, health professionals, innovators, and incorporating the patients' opinion is warranted.
- The development of goals had to fit daily practice, and had to connect with the process and content of care to get a good adaptation in the health service delivery.

Barriers:

- Development of integrated care within a changing healthcare economy, with little room for investment hampers the process.
- The benefit of the innovation is not always to the benefit of the organisation that invests.
- A lack of communication between patient registration systems across organisations hampers the process.

putation, heart failure), or for all patient groups. A care pathway is defined as a complex intervention for the mutual decision-making and organisation of care processes for a well-defined group of patients during a well-defined period[18, 19].

Within the national programme the main goals of development of integrated care in geriatric rehabilitation can be divided into four domains of (geriatric rehabilitation) service delivery, according to the evaluation model of Hartgerink et al.[12], i.e. 1) with patients (care) needs; 2) care coordination 3) team cooperation, and 4) quality of care. Box 2 presents the main goals of development in this national programme based on these domains and aiming to improve quality of care.

Data collection and outcome measures

Professional caregivers collected patient characteristics, i.e. age, gender, Barthel Index[20] and indication for geriatric rehabilitation by diagnostic group, as well as process outcomes of geriatric rehabilitation service delivery, were collected for each cohort at admission and again at discharge by means of an online questionnaire. A helpdesk was available for any questions concerning the online questionnaire.

In addition, patients and informal caregivers filled in a (paper version) questionnaire to measure their experiences with the process of geriatric rehabilitation service delivery 4 weeks after patient discharge.

The experience with the geriatric rehabilitation health service delivery processes was measured with self-developed questionnaires based on face validity for the professionals, as well as for patients and informal caregivers; all questions (answered on a 4-point

Box 2. Main goals of development of integrated care within the skilled nursing facilities in the four domains of geriatric rehabilitation service delivery

Domains of geriatric rehabilitation service delivery	Main goals of development
1. Alignment with patients' (care) needs	The professionals invested in (more) involvement of the patient and informal caregiver in the rehabilitation process (goal attainment). For example: in setting rehabilitation goals, process of referral for post-acute and home care, involvement in the multidisciplinary team meetings, and discharge planning.
2. Care coordination	The healthcare providers and professionals aimed to work closely together to achieve common patient-centered goals of care to improve the quality and continuity of care by: • Developing structured care pathway(s) and (information, communication and clinical) guidelines. • Developing assessment and referral instruments to determine priority of need and proper place of treatment (triage). • Introducing case managers who coordinated care, aimed to reach 'seamless' care and alignment with the patient needs during the continuum from acute to postacute care.
3. Team cooperation	Aiming at improving inter-professional information handover and alignment of professional performance during the care pathway. For example by: • Introducing digital patient registration • Using multidisciplinary treatment plans • Evaluating rehabilitation goals in multidisciplinary team meetings. • Involvement of the elderly care physician (of the skilled nursing facility) in the multidisciplinary team meeting in the hospital
4. Quality of care	Aiming at improving quality of care by: • Improving the communication of professionals towards patients and informal caregivers. • Enhancing the rehabilitation culture by stimulating and facilitating individual exercises at the rehabilitation ward and empowering the patient in the rehabilitation process. • Stimulating knowledge exchange between the professionals of the different healthcare providers by exchange programs and 'on-the-job training' in a different setting. • Education of the professionals Introducing more treatment intensity (i.e. 6 h/per week) for a selected population. For example, by: • Implementation of more treatment moments during the day or more treatment days a week • Beside individual treatment, also (mono and multi-disciplinary) group therapy • Enhancing and stimulating patients to do more individual exercise, e.g. by using an exercise agenda.

Likert scale) concerned the four domains of health service delivery. Questions on(1) alignment with patients care needs were filled out by the elderly care physicians and physiotherapists; on (2) care coordination were filled out by the elderly care physicians

and a member of the nursing staff; on (3) team cooperation were filled out by all three professionals; and questions on (4) care quality were filled out by the nursing staff.

The questionnaire for the patients and informal caregivers covered also all these four domains.

Statistical analysis

Descriptive statistics were used to analyze outcomes on the four domains of health service delivery as reported by the professionals, patients and informal caregivers. For each question, the percentage of the category 'good and excellent' was reported versus the answer option 'poor and fair'. To compare the outcomes of the three consecutive cohorts, *P* for trend values were calculated with the Kruskal-Wallis test and, in case of numeric data, values were calculated with one-way analysis of variance (ANOVA). A *P* for trend ≤ 0.05 was considered statistically significant. All patients with data from all three professional caregivers at admission to the skilled nursing facility (baseline) and who had not died and who were not readmitted to hospital during the rehabilitation stay were included for analysis of the process outcomes at admission, discharge and four weeks follow up.

Data were analyzed using IBM SPSS Statistics for Windows, version 20.0.

RESULTS

Respons and background characteristics

The flowchart of patient recruitment and follow-up is presented in Figure 1.

Of the 1150 eligible patients, at baseline 1075 patients (93.5%) had completed questionnaires from all three professionals and were included in the present study. At discharge 1018 patients (95%) were included for data analysis. Of this latter group, at 4 weeks after discharge 774 patients were eligible for follow-up measurement. Finally, 512 patients and 319 of their informal caregivers had provided a response to the follow-up questionnaire.

Each of the 16 skilled nursing facilities included a median of 46.5 (IQR 28-126) patients. Overall, the baseline population of patients (n=1075) had a median age of 79 (IQR 71-85) years, consisted of 63% females, and were categorised into stroke (36%), elective joint replacement (15%), traumatic injuries (25%), and other smaller groups of specific diseases (i.e. COPD, amputation, heart failure (24%). There were no differences in age, gender and baseline Barthel Index between the cohorts. The informal caregivers (n=319) had a median age of 65 (IQR 56-75) years and consisted of 66% females. The relationship between informal caregivers and patients was: spouse (49%), sibling (4%), daughter or

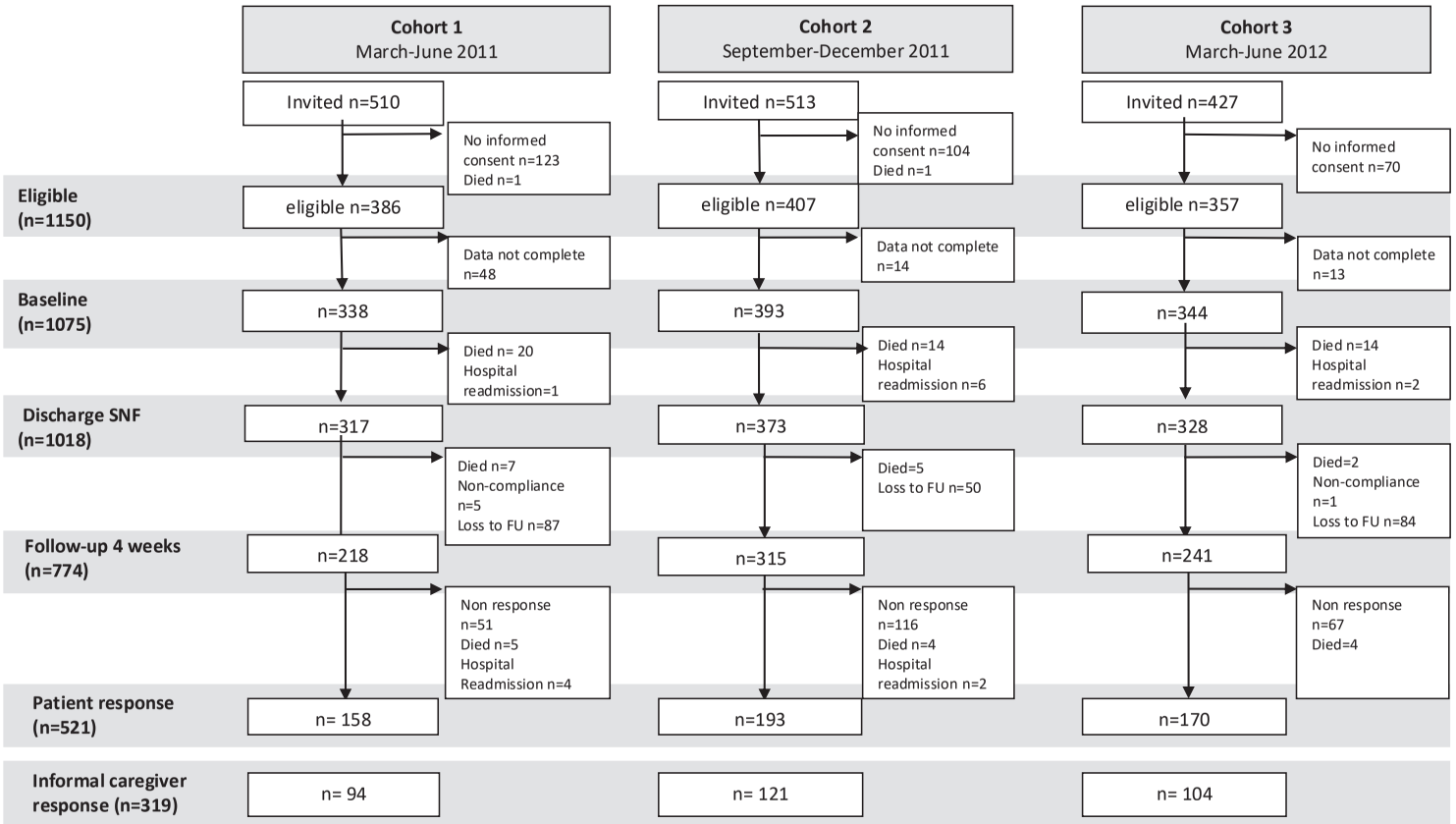

Figure 1. Flowchart of patient recruitment and follow-up in the 16 skilled nursing facility. Analysed data includes data rated by professional caregivers at admission and discharge, and response at 4 weeks' follow-up, of patients and their informal caregivers.

son (36%), and other relation (11%). There were no differences in age, gender and type of relationship between the cohorts.

Process outcomes

Tables 1-4 present the outcomes (in percentage 'good and excellent') on geriatric rehabilitation service delivery process as reported by the professionals (elderly care physicians, nursing staff and physiotherapists), patients, and their informal caregivers.

Alignment with patients (care) needs: do professionals give what patients need? (Table 1)
Professionals

Involvement of the patient by the physiotherapist in setting rehabilitation goals decreased across three cohorts (p trend=0.05). Elderly care physicians reported high patient involvement in setting rehabilitation goals in all cohorts, with no significant change between the cohorts (p trend=0.69). In contrast, the percentage involvement of the informal caregiver in setting rehabilitation goals had increased (p trend <0.01), as reported by elderly care physicians. Physiotherapists reported that in total (all three cohorts together) 155 (21%) of the informal caregivers were involved in setting rehabilitation goals, but with no change over time (p=0.85).

Across three cohorts, there was an increase in the percentage of patients and/or informal caregivers attending the multidisciplinary team (meeting or the discussion of individual care plans, as reported by elderly care physicians (p trend=0.05)

Patients and informal caregivers

Across three cohorts there was a non significant increase in the percentage involvement of setting rehabilitation goals, as reported by the informal caregivers (p-trend: 0.06). In total, 312 (61%) patients and 150 (48%) informal caregivers reported a 'good' or 'excellent' way of dealing with individual needs, with no difference between the three cohorts (p trend=0.85 and 0.74, respectively).

In total, 48% of the patients and 52% of the informal caregivers were involved in the decision-making process for referral to a rehabilitation location after a hospital stay, with no difference in trend between the cohorts (p trend= 0.38 and 0.85, respectively).

Care coordination (Table 2)
Professionals

Across three cohorts, professionals gave a higher rating (percentage 'good or excellent') for guidance and support of patients' transfer from hospital to a skilled nursing facility (p trend <0.01). The rating of patients and informal caregivers for guidance and support with the transfer from a skilled nursing facility to home remained the same in all three

Table 1. *Alignment with patients (care) needs, do professionals give what patients need?* According to professionals (elderly care physicians and physiotherapists), patients and informal caregivers in percentage good and excellent. Selection of patients with completed professional data at baseline who had not died and were not readmitted to hospital during their rehabilitation stay (n=1018).

	Responders	Cohort 1 March-June 2011		Cohort 2 Sept-Dec 2011		Cohort 3 March-June 2012		P for trend
		N	n (%)	N	n (%)	N	n (%)	
Professional rating*								
Patient involvement in setting rehabilitation goals	ECP	264	216 (81.8)	348	275 (97)	309	247 (79.9)	0.69
	PT	260	186 (71.5)	354	259 (73.2)	313	203 (64.9)	0.05
Informal caregiver involvement in setting rehabilitation goals	ECP	242	131 (54.1)	325	220 (67.7)	277	163 (58.8)	<0.01
	PT	202	44 (21.8)	289	57 (19.7)	258	54 (20.9)	0.85
Patient/informal caregiver attending the multidisciplinary team meeting (SNF)	ECP	265	49(18.5)	349	94(26.9)	310	73(23.5)	0.05
Patients/Informal caregivers rating#								
Way of dealing with individual needs	P	155	95 (61.3)	191	119 (62.3)	165	98 (59.4)	0.85
	IC	90	44 (48.9)	118	54 (45.8)	102	52 (51)	0.74
Involvement in setting rehabilitation goals	P	125	86 (68.8)	174	110 (63.2)	148	92 (62.2)	0.48
	IC	72	30 (41.7)	99	59 (59.6)	86	41 (47.7)	0.07
Involvement in referral to a rehabilitation location	P	154	78 (50.6)	190	83 (43.7)	170	84 (49.4)	0.38
	IC	92	46 (50)	120	61 (50.8)	104	56 (53.8)	0.85

ECP: Elderly Care Physician; PT: Physiotherapist; P: Patient; IC: Informal Caregiver. Values are numbers (% good and excellent) unless indicated otherwise. P for trend values were calculated with the Kruskal-Wallis test

Professional rating N total: C1: n=317; C2: n=373; C3: n=328

Patient rating N total: C1:158; C2:193; C3:170

Informal Caregiver rating N total: C1:94; C2:121; C3:104

*rated at discharge from skilled nursing facility (SNF)

#rated 4 weeks after discharge SNF

Table 2. *Care coordination* according to professionals (elderly care physicians and nursing staff), patients and informal caregivers in percentage good and excellent. Selection of patients with completed professional data at baseline and not-died or having a readmission to hospital during their rehabilitation stay (n=1018).

	Responders	Cohort 1 March-June 2011		Cohort 2 Sept-Dec 2011		Cohort 3 March-June 2012		P for trend
		N	n (%)	N	n (%)	N	n (%)	
Professional rating								
Guidance and support of the patient from hospital → SNF[$]	NS	281	217(77.2)	346	305 (88.2)	310	276 (89)	<0.01
Guidance and support of the patient from SNF → home[*]	NS	267	261 (97.8)	347	339 (97.7)	304	298 (98)	0.96
Guidance and support of the informal caregiver SNF → home[*]	NS	267	240 (89.9)	347	309 (89)	304	275 (90.5)	0.84
Preparation of the patient for discharge[*]	ECP	252	230 (91.3)	338	307 (90.8)	298	271 (90.9)	0.98
Patients/Informal caregivers rating[#]								
Coordination of the transfer hospital →SNF	P	153	88 (57.5)	187	118 (63.1)	165	104 (63)	0.50
	IC	88	43 (48.9)	118	50 (42.4)	103	53 (51.5)	0.38
Coordination of the transfer SNF → home	P	154	88 (57.1)	186	116 (62.4)	167	107 (64.1)	0.42
	IC	89	43 (48.3)	115	60 (52.2)	103	58 (56.3)	0.54

SNF. NS: Nursing Staff; ECP: Elderly Care Physician; P: Patient; IC: Informal Caregiver. Values are numbers (% good and excellent) unless indicated otherwise. P for trend values were calculated with the Kruskal-Wallis test

Professional rating N total: C1: n=317; C2: n=373; C3: n=328

Patient rating N total: C1:158; C2:193; C3:170

Informal Caregiver rating N total: C1:94; C2:121; C3:104

[$] rated at admission skilled nursing facility (SNF)

[*] rated at discharge SNF

[#] rated 4 weeks after discharge

cohorts (p=0.96 and p=0.84, respectively), as did the rating for the preparation of the patient for discharge home (overall 91%, p trend=0.84).

Patients and informal caregivers

The rating for guidance and support with the transfer from hospital to skilled nursing facility (percentage 'good' or 'excellent') did not change over time, as rated by patients (p trend=0.50) and informal caregivers (p trend=0.38); neither did satisfaction with the transfer from skilled nursing facility to home as reported by patients (p trend=0.42) and informal caregivers (p trend=0.54).

Team cooperation (Table 3)

Professionals

There was an improvement in the rating (percentage 'good or excellent') of the information handover between professionals from hospital to skilled nursing facility, as reported by the nursing staff (p trend=<0.01) and elderly care physicians (p trend=0.04). Rating of the information handover between physiotherapists improved significantly from skilled nursing facility to follow-up care (p trend=0.01) and did not change between nurses and between medical specialists from skilled nursing facility to follow-up care.

There was an increase of the (small) percentage of elderly care physicians who participated in the MDT hospital meetings (p trend=0.04), to determine the priority of need and proper place of treatment (triage). There was no change in the percentage of consultations by rehabilitation physicians during the rehabilitation stay (p trend=0.14).

In the skilled nursing facility, in 98% of the MDT meetings the team consisted of an elderly care physician, a physiotherapist and a member of the nursing staff. In addition, the MDT meetings consisted of an occupational therapist (79%), speech therapist (39%), a dietician (26%) and other professional(s) (51%) (i.e. psychologist, social worker, creative therapist, nurse practitioner, case manager). Only participation of the occupational therapist showed an increase across cohorts (p trend <0.01). Rehabilitation goals were evaluated weekly or every two weeks for 64% of the included patients.

According to the elderly care physician, the amount of patients assessed for the indication of more intensive treatment at the rehabilitation ward increased by 10% between cohort 1 and cohort 3 (p trend=0.01).

Patients and informal caregivers

In all cohorts, patients and informal caregivers reported similar percentages for good and excellent alignment of the professionals.

Table 3. *Team cooperation* according to professionals (elderly care physicians, nursing staff and physical therapists), patients and informal caregivers in percentage good and excellent. Selection of patients with completed professional data at baseline and not-died or having a readmission to hospital during their rehabilitation stay (n=1018).

	Responders	Cohort 1 March-June 2011		Cohort 2 Sept-Dec 2011		Cohort 3 March-June 2012		P for trend
		N	n (%)	N	n (%)	N	n (%)	
Professional rating								
Consulted ECP in the multidisciplinary team meeting in the hospital	ECP	311	13 (4)	367	9 (3)	323	21 (6.2)	0.05
Consulted rehabilitation physician during rehabilitation stay	ECP	265	26 (9.8)	349	48 (13.8)	310	29 (11.1)	0.14
Assessment of patients for indication intensive treatment at the SNF (yes)[*]	ECP	313	211 (67.4)	368	252 (68.5)	328	254 (77.4)	0.01
Information handover between professionals hospital à SNF[$]								
between nurses	NS	314	227 (72.3)	365	297 (81.4)	327	270 (82.6)	<0.01
between physical therapists	PT	316	162 (51.3)	369	215 (58.3)	327	177 (54.1)	0.18
medical information transfer	ECP	313	163 (52.1)	368	214 (58.2)	328	203 (61.9)	0.04
Information handover between professionals SNF à follow up care[*]								
between nurses	NS	267	217 (81.3)	347	293 (84.4)	304	241 (79.3)	0.23
between physical therapists	PT	265	157 (59.2)	355	238 (67)	315	226 (71.7)	0.01
medical information transfer	ECF	261	233 (89.3)	343	307 (89.5)	304	278 (91.4)	0.62
Patients/Informal caregivers rating[#]								
alignment of the professionals	P	135	84 (62.2)	180	110 (61.1)	164	86 (52.4)	0.15
	IC	85	41 (48.2)	112	54 (48.2)	98	39 (39.8)	0.39

NS: Nursing Staff; ECP: Elderly Care Physician; PT: Physical therapist; P: Patient; IC: Informal Caregiver. Values are numbers (% good and excellent) unless indicated otherwise. P for trend values were calculated with the Kruskal-Wallis test

Professional rating N total: C1: n=317; C2: n=373; C3: n=328

Patient rating N total: C1:158; C2:193; C3:170

Informal Caregiver rating N total: C1:94; C2:121; C3:104

[$] rated at admission skilled nursing facility (SNF)

[*] rated at discharge SNF

[#] rated 4 weeks after discharge SNF.

Table 4. *Care quality* at discharge skilled nursing facility (SNF) according to nursing staff and at 4 weeks follow-up according to patients and informal caregivers in percentage good and excellent. Selection of patients with completed professional data at baseline and not-died or having a readmission to hospital during their rehabilitation stay (n=1018).

	Responders	Cohort 1 March-June 2011		Cohort 2 Sept-Dec 2011		Cohort 3 March-June 2012		P for trend
		N	n (%)	N	n (%)	N	n (%)	
Professional rating								
Patient received sufficient information about care/treatment during rehabilitation (yes)	NS	267	259 (97)	347	344 (99.1)	304	302 (99.3)	0.03
Informal caregiver received sufficient information about care/ treatment during rehabilitation (yes)	NS	267	251(94)	347	331 (95.4)	304	292 (96.1)	0.51
Patients / Informal Caregivers rating								
Rating total care pathway (0-10 scale)[a] mean (sd)	P	155	7.3 (1.2)	190	7.31 (1.3)	166	7.3 (1.2)	0.88[#]
	IC	91	7.1 (1.3)	121	7.1 (1.3)	104	7 (1.3)	0.96[#]
Care/treatment during the hospital stay	P	157	125 (79.6)	190	155 (81.6)	167	131 (78.4)	0.76
	IC	92	66 (71.7)	120	83 (69.2)	104	76 (73.1)	0.81
Care/treatment during the rehabilitation stay	P	155	118 (76.1)	186	142 (76.3)	168	130 (77.4)	0.96
	IC	88	59 (67)	115	73 (63.5)	98	74 (70.5)	0.56
Care/treatment received in the current home situation	P	131	99 (75.6)	156	118 (75.6)	136	106 (77.9)	0.87
	IC	82	56 (68.3)	106	70 (66)	90	68 (75.6)	0.33
Information received from the professionals during rehabilitation	P	139	84 (60.4)	179	108 (60.3)	158	94 (59.5)	0.98
	IC	82	38 (46.3)	106	56 (52.8)	93	48 (51.6)	0.66
Appropriate referring from hospital to SNF (yes)	P	145	126 (86.9)	172	151 (87.8)	156	138 (88.5)	0.92
	IC	85	77 (90.6)	111	104 (93.7)	95	87 (91.6)	0.71
Sufficient possibilities to exercise individually (yes)	P	154	108 (70.1)	188	136 (72.3)	169	120 (71)	0.90
	IC	89	74 (83.1)	120	92 (76.7)	102	77 (75.5)	0.39

SNF: Skilled Nursing Facility; NS: Nursing Staff; P: Patient; IC: Informal Caregiver. Values are numbers (% good and excellent) unless indicated otherwise. P for trend values calculated with the Kruskal-Wallis test;

Professional rating N total: C1: n=317; C2: n=373; C3: n=328

Patient rating N total: C1:158; C2:193; C3:170

Informal Caregiver rating N total: C1:94; C2:121; C3:104

[#] One-Way ANOVA

[a] 10 indicating excellent

Quality of care (Table 4)

Professionals

According to the nursing staff, patients (p trend= 0.03) and informal caregivers (p trend=0.51) received sufficient information about care and treatment during rehabilitation.

The percentage of patients receiving more (or more intensive) treatment (≥ 4 hours/week) increased, as reported by the elderly care physicians (p trend <0.01).

Only longer treatment periods (i.e. more treatment time during each session) decreased from 11% in cohort 1 to 2% in cohort 3 (p trend <0.01). The amount of group therapy increased between the cohorts from 13% in cohort 1 to 30% in cohort 3 (p trend <0.01). According to the physical therapists, a low percentage of patients (overall 13.9%: p trend=0.71) performed individual exercise without the supervision of a physical therapist; in contrast, the nursing staff reported that 68% of the patients performed daily individual exercise. Also, there was more physical activity at the rehabilitation ward under the supervision of the nursing staff (p trend=0.01).

Patients and informal caregivers

Overall, patients and informal caregivers rated the total care pathway as 7.3 (SD 1.3) on a 0-10 scale (with 10 indicating excellent). The level of satisfaction did not differ between the cohorts. In total, 390 (77%) patients and 201 (67%) informal caregivers rated the care and treatment during rehabilitation stay as good or excellent.

In total, 286 (60%) patients and 142 (51%) informal caregivers reported the received information from professionals to be 'good' or 'excellent'. Also, 415 (88%) patients and 268 (92%) informal caregivers reported that the patient was referred in a proper manner from hospital to skilled nursing facility for rehabilitation, with no change over the cohorts.

Overall 71% (n=364) of the patients and 78% (n=243) of the informal caregivers reported that there was enough (or more than enough) possibility to perform individual exercise at the rehabilitation ward without supervision of a physical therapist; this did not differ between the cohorts.

DISCUSSION

This study evaluated the perceptions of professionals, patients and informal caregivers related to the quality of health service delivery in geriatric rehabilitation during implementation of a national programme aimed at improving quality of geriatric rehabilitation in the Netherlands. The study underlines that geriatric rehabilitation is a multidisciplinary process aiming to achieve integrated patient-centered care.[3]

Professionals reported small but positive effects on several items of health service delivery, mainly on the domain team cooperation. Within the domains alignment with patients needs, care coordination and care quality, less changes were reported. In cohort 1, the perception of the quality of the service delivery was already high, indicating that professionals were largely satisfied with the service they provided. Our results also show positive patient and informal caregiver perceptions on the quality of geriatric rehabilitation service delivery. The level of satisfaction of patients and informal caregivers did not change during implementation of the programme. An explanation for this may be that patient satisfaction is related to service delivery and is based on expectations and personal interactions, rather than on the quality of technical competence.[21]

Our results are in line with the national integrated care pilot in the UK[13] in which improvements appeared on a process level, but had limited effects on patient satisfaction. However, after implementation of quality improvements, a longer period of evaluation may be needed to reveal changes in service delivery as experienced by patients and informal caregivers[9]. It is a worldwide challenge to initiate, develop and evaluate integrated care on a large scale with multiple health care providers involved in a changing health care economy, also called 'complex adaptive systems' or 'complex interventions'[22-24]. These systems are complex because of the dynamics within the different health care providers and the large number of components that interact when developing integrated care delivery[13, 22, 23, 25, 26]. Another explanation may be that the national project had too optimistic expectations about the capacity of the organisations to execute a successful change themselves. Although there was central monitoring of the goals and progress next to exchange of experiences between organisations, little was done on education and coaching of effective ways of change management in these complicated integrated care processes.

Strengths and limitations

One strength of this study is the use of multiple data sources, including the patient, informal caregiver and three core professionals (elderly care physicians, physiotherapists and nursing staff) to gain a broad perspective on the perceptions of health care delivery in skilled nursing facilities. Also, the study has a high response rate from the professionals.

The present study can been seen as having a type of active participatory research design. To achieve good adaptation in a real-world setting, an active research design has several advantages[13, 22]. Development, implementation and evaluation were combined to develop tailor-made integrated care. The developments covered the different aspects of health care delivery and all stakeholders were committed to improve the quality of care. The collaboration between hospitals, skilled nursing facilities, homecare, health insurance companies and the government resulted in a process to innovate and ex-

change knowledge. This national programme stimulated the self-organising capacity of the participants, and resulted in a national movement of development in skilled nursing facilities.

The study also has some limitations. First, the process outcomes of the professionals were based on self-rating, which may have led to more social desirable answers. However, quality outcomes were also based on rating by patients and informal caregivers, who were not aware of the changes. Second is that the ratings of the process and outcomes of professionals, patients and informal caregivers were already high at baseline, leaving little room for improvement (ceiling effect). Third is that the Dutch Ministry of Health may have selected relatively good quality geriatric rehabilitation service organisations, whereas a selection based on relatively poor performance by means of quality indicators might leave more room for improvement. Finally, within this study we were particularly interested to explore the changes in the health service delivery process experienced by professionals, patients and informal caregivers. Other factors depending on organisational characteristics of the skilled nursing facilities would be of interest for further research, since these characteristics could influence the expected level of change as well[12]. However, this was outside the scope of our study.

This study reports on a national programme to improve integrated care in geriatric rehabilitation. Professionals, informal caregivers and patients reported some and small improvements in the care process. Effective change in complex integrated care processes and the measurement of the effects on process outcomes remains a challenge.

CONCLUSION

This national programme to improve quality of care in geriatric rehabilitation resulted in small improvements in team cooperation, as reported by the professionals. However, no effects were found for patients' and informal caregivers' perceptions on health service delivery. These results may suggest that changes in organisational structure need time to penetrate to the outcome level of patients and informal caregivers

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CHAPTER 5

Successful geriatric rehabilitation: effects on patients' outcome of a national program to improve quality of care, the SINGER study

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ABSTRACT

Objective

To determine whether the implementation of a national program to improve quality of care in geriatric rehabilitation (GR) in the Netherlands improves successful GR in terms of independence in activities of daily living (ADL), discharge destination and length of stay.

Design

Prospective longitudinal study, comparing two consecutive cohorts: at the start of implementation (n=386) and at 1-year after implementation (n=357) of this program.

Setting/Participants

Included were 16 skilled nursing facilities, 743 patients [median age 80 years, interquartile range 72-85; 64.5% females] indicated for GR and their health care professionals (elderly care physicians, physiotherapists and nursing staff).

Intervention

National program to stimulate self-organizing capacity to develop integrated care to improve GR service delivery in 4domains: alignment with patients' (care) needs, care coordination, team cooperation and quality of care.

Measurements

Data on patients' characteristics, functional outcomes at admission and discharge, length of stay and discharge destination, were collected via an online questionnaire sent to health care professionals. The primary outcome measure was successful rehabilitation defined as independence in ADL(Barthel Index ≥15), discharged home and a short length of stay (lowest 25% per diagnostic group). Generalized estimation equation analysis was used to adjust for age, gender and clustering effects in the total population and for the 2 largest diagnostic subgroups; traumatic injuries and stroke.

Results

In the total population, at 1-year postimplementation there was 12% more ADL independence [odds ratio (OR) 1.59, 95% confidence interval (CI) 1.00-2.54] Although successful rehabilitation (independence in ADL, discharge home, short length of stay) was similar in the 2cohorts, the subgroup of patients with traumatic injuries were more successful 1year post-implementation (OR 1.61; 95% CI 1.01-2.54). In stroke patients, successful rehabilitation was similar between the cohorts, but with more independence in ADL in the follow-up cohort (OR 1.99; 95%CI 1.09-3.63).

Conclusions

This study shows that 1-year after the implementation of the Dutch national program to improve quality of care there was more independence in ADL at discharge, but the combined outcome of successful GR (independence in ADL, discharge home, short length of stay) was only significantly improved in patients with traumatic injuries.

Keywords

Geriatric rehabilitation, successful rehabilitation, independence in ADL, length of stay, discharge destination, quality of care

INTRODUCTION

There is an ongoing challenge to improve the quality of care for people with complex care needs, especially because health care services for patients with complex care needs are still often fragmented and not always patient centered, causing inefficiency and poor quality of care.[1, 2]

Although this challenge is also present in postacute geriatric rehabilitation (GR), very few attempts to improve the quality of GR have been reported, or their efficacy tested.[3, 4] To develop and improve GR, structural improvements are needed in the organization and process of care, for example, stimulating collaboration between health care services.[3, 5] However, quality improvement programs have mainly addressed acute or long term care settings and seldom focus on postacute GR.[3]

In the Netherlands, GR is provided in skilled nursing facilities (SNF) using a multidisciplinary team approach. The rehabilitation team includes an elderly care physician (ie, a qualified basic specialist specialized in geriatric medicine and rehabilitation medicine), physiotherapist, nurse, and an occupational therapist. Additional team members can include a psychomotor therapist (body and movement oriented therapist), psychologist, social worker, and speech therapist.[6] The purpose of GR is to restore physical function, or enhance residual functional capability and participation in older patients after, for instance, a hip fracture or stroke, using a multidisciplinary team approach.[7]

In 2011 a Dutch national program was initiated aimed at improving the quality of GR care, by stimulating the self-organizing capacity of the GR service organizations to set goals to facilitate integrated care in GR in order to improve health service delivery in 4 domains (ie, alignment with patients (care) needs, care coordination, team coordination, and quality of care). Details of this national program have been described elsewhere.[8] A GR service organization consisted of at least 1 hospital and 1 SNF providing GR.

Integrated care is defined by the World Health Organization (WHO) as "a concept bringing together inputs, delivery, management and organization of services related to diagnosis, treatment, care, rehabilitation and health promotion. Integration is a means to improve the service in relation to access, quality, user satisfaction and efficiency".[1] Integrated care has shown potential beneficial effects on functional outcomes (increased independence on activities of daily living[ADL]) and reducing length of stay (LOS) in the hospital in stroke and trauma patients.[9-12] However, outcome measures of integrated care were mostly reported on single outcomes (such as LOS or functioning) and did not investigate a combined outcome as a proxy for successful GR in a postacute care setting. Successful GR represented by a combined outcome of independence in ADL, discharged to home with a reduced LOS, may better reflect the goals of GR which is to restore or enhance functioning and discharge to home in a short clinical rehabilitation timeframe. Therefore, the present study aimed to determine whether the implementation of a na-

tional program to improve quality of care in GR in the Netherlands improves successful GR in terms of independence in ADL, discharge destination and LOS.

METHODS

Study design

This study, referred to as the Synergy and INnovation in GEriatric Rehabilitation (SINGER) Study, was part of a national program in the Netherlands to improve the quality of health service delivery for GR. It is a prospective longitudinal study performed during the implementation of this national program comparing 2 consecutive cohorts, that is, at the start of implementation and at 1 year post-implementation of this program. Included were patients admitted for GR in an SNF and their care professionals (elderly care physician, physiotherapist and nursing staff).

The National program

The national program aimed to stimulate the self-organizing capacity of the care organizations to develop integrated GR care in order to improve health service delivery. Sixteen GR service organizations participated in the program. Such a GR service organization consisted of at least 1 hospital and 1 SNF providing GR. Each GR service organization self-developed or improved care pathways for a specific GR diagnostic group (ie, stroke, joint replacement and hip fracture), as well as for the group of other GR-diagnoses (ie, COPD, amputation, heart failure). Within the national program, the main goals of the development of integrated care focused on the 4 domains of health service delivery: (1) alignment with patient (care) needs, (2) care coordination, (3) team cooperation, and (4) quality of care.[8]

Examples of these developments were involvement of the patient and informal caregiver in setting rehabilitation goals, improving active rehabilitation culture and communication towards patients and informal caregivers, collaboration between health care providers and professionals from different care settings to improve continuity of care and patient targeting (triage) for GR, and providing education to the multidisciplinary team and stimulating knowledge exchange. Details on the national program and the design of this study are published elsewhere.[8]

Setting and participants

In all 16 participating geriatric service organizations 2 cohorts of patients were selected: a baseline cohort, that is, at the start of the national program (March-June 2011) and a cohort at 1-year post-implementation (follow-up cohort) (March-June 2012). Each SNF was asked to include a minimum of (the first) 10 to 15 consecutively admitted patients,

stratified by diagnostic group, in each cohort. For each included patient, 3 professional caregivers (elderly care physician, physiotherapist and a delegate of the nursing staff) were invited to participate.

The study was approved by the Medical Ethics Committee of the Leiden University Medical Center (LUMC).

Data collection and outcome measurements

At admission to the SNF and at discharge, information on patient characteristics, functional outcomes, LOS and discharge destination were collected via an online questionnaire among elderly care physicians, physiotherapist and nursing staff.

Successful rehabilitation

The primary outcome measure was successful rehabilitation operationalized as the combination of 3 components: (1) independence in ADL at discharge, (2) discharge home, and (3) short LOS in the GR unit. Independence in ADL was defined as having a Barthel Index (BI) of ≥ 15 at discharge.[13] The BI has 10 items and nurses assessed the degree of support a person needs in performing ADL; scores range from 0 to 20 with higher scores indicating more independence in ADL. Discharge home was defined as discharge to the former living environment versus discharge to another setting.

A short LOS in the SNF was defined as the lowest 25% for each GR group, based on the LOS from a previous study on GR patients in Dutch SNFs (traumatic injuries ≤ 35 days, stroke ≤ 31.5 days, elective joint replacement ≤ 11.3 days, and other ≤ 25 days).[6] The combined dichotomous outcome of successful rehabilitation was defined as independence in ADL at discharge and being discharged home with a short LOS as "successful", when either of these criteria were not met it was defined "not successful". The outcome for patients that died or were readmitted to the hospital was categorized as "not successful'".

Functioning

Various instruments were used to measure functioning by a physiotherapist as a secondary outcome, at admission and discharge. (In-)dependency of gait was measured with the Functional Ambulation Categories (FAC).[14] The FAC is an observational instrument to distinguish 6 levels of walking ability based on the amount of physical support needed; a higher FAC score indicates more independence of gait. Additional postural control was tested for stroke patients with the performance-based Berg Balance Scale (BBS). The 14-item BBS ranges from 0 to 56, where 0 indicates the lowest level of function and 56 the highest level of function.[15]

Patient characteristics

The patient characteristics collected were age, sex, marital status, medical diagnosis for GR, hospital readmission rate, and number of comorbidities. The Functional Comorbidity Index (FCI) measures the sum of 18 comorbid conditions, with scores ranging from 0 (no comorbid condition) to 18 (comorbid conditions).[16] The FCI was assessed by an elderly care physician.

Cognitive functioning was measured by nurses with the 7-category Minimum Data Set Cognitive Performance Scale (CPS). The CPS is a valid measure for cognitive performance and ranges from intact (level 0), borderline intact (1), mild (2), moderate (3), moderately severe (4) and severe impairment (5) to very severe impairment (level 6).[17] A CPS level of ≥ 1 was defined as having an impaired cognitive performance. Depression was measured by nurses with the Depression Rating Scale, range 0-14; a score of ≥ 3 is indicative of depression. [18]

Statistical analysis

Baseline patient characteristics, functioning, medical indication for GR by diagnostic group, and number of comorbid conditions (FCI) were compared between the cohort at start of the implementation and the follow-up cohort using an independent t test or Mann-Whitney *U* test, depending on the distribution of the data. A p value <.05 was considered statistically significant.

The effect of the national program on successful rehabilitation was calculated with a 5-step generalized estimation equation (GEE) model adjusted for cluster effects (n=16 SNFs), age, and gender and consisted of(1) independence in ADL, (2) discharge home, (3) short LOS, (4) discharge home + short LOS, and (5) successful GR (combination of independence in ADL + discharge home + short LOS) as a dichotomous outcome. The effect on successful rehabilitation was calculated for the total population and for the 2 largest diagnostic subgroups (ie, traumatic injuries and stroke).

Differences in functional improvement measured with the BI, FAC and BBS were analysed using delta scores (ie, discharge-admission) between the 2 cohorts using the independent samples *t* test. Differences in median LOS were analysed with the Mann-Whitney *U* test.

Analyses were performed with SPSS for Windows, version 20.0 (IBM Corp, Armonk, NY).

RESULTS

Response

Of the 937 invited patients, 193 (20.6%) did not give informed consent to participate and 1 (0.1%) patient died before baseline measurement, resulting in 743 (79.3%) patients

(and their care professionals) eligible to participate in this study (386 in the baseline cohort, 357 in the follow-up cohort).

In the baseline cohort 26 (6.7%) participants died during rehabilitation and 29 (7.5%) were readmitted to hospital. In the follow-up cohort, 16 (4.5%) participants died and 35 (9.1%) were readmitted to hospital. This left a subgroup of 637 participants for analysis of functional improvement at discharge (331 in the baseline cohort, 306 in the follow-up cohort).

Population characteristics

Overall, 743 GR patients participated [median age 80 years, interquartile range (IQR) 72-85; 64.5% females], categorized into stroke (n=269), elective joint replacement (n=112), traumatic injuries (n=185), other diagnoses for GR (n=172) and diagnose unknown (n=5).

Table 1 presents the baseline characteristics of the participants. There were no significant differences at baseline between the 2 cohorts for sex, age, marital status and functioning.

Table 1. Baseline characteristics of the study population (n=743)

	Baseline cohort (n=386) T^0		Cohort at 1-year follow-up (n=357) T^{12}		p-value*
	n	%	n	%	
Socio-demographic					
Female	249	64.5	212	59.4	.15†
Age in years, median (IQR)	383	80 (71-85)	354	79 (71-84)	.32
Married/living together	68	37.8	65	35.5	.66†
Functioning					
Barthel index, admission (0-20), median (IQR)	359	11 (6-15)	348	12 (8-16)	.13
Functional Ambulation Categories (0-5), median (IQR)	367	3 (1-4)	352	3 (1-4)	.63
Berg Balance Scale (0-56),median (IQR) ‡	127	19 (2-38)	128	24 (4-24)	.07
CPS score (>1), % Impaired (vs intact)	107	31.3	97	28.0	.34†
DRS (% DRS ≥ 3)	53	15.1	38	11.0	.11†
GR groups					.84†
Traumatic Injuries	93	23.3	92	25.9	
Stroke	137	35.8	132	37.2	
Joint Replacement	59	15.4	53	14.9	
Other	94	24.5	78	22.0	
FCI, median (IQR)	368	2 (1-3)	352	1(0-2)	<.001

* p-value calculated with the Mann-Whitney *u* test unless indicated otherwise.

† χ^2 test

‡ Additional for stroke patients.

At admission, in the baseline cohort the median number of comorbidities measured with the FCI was 2 (IQR 1-3) and in the follow-up cohort it was 1 (IQR 0-2); p<.001.

Successful geriatric rehabilitation

Table 2 presents data on the effects of the national program on successful GR (including: independence in ADL, discharge to home, and short LOS) in a 5-step model adjusted for age, gender and clustering effects. In the baseline cohort, at discharge 51% of the total

Table 2. Effect of the national program on successful GR (including independency in ADL, discharge to home and short LOS) in a 5-step model adjusted for age, gender and clustering effects.

	Baseline Cohort (ref) T^0		Cohort at 1-y Follow-up T^{12}			P value
	n	%	n	%	OR (95%CI)	
Total population [trauma/stroke/joint replacement/other (16 SNFs)]	386		357			
Independency in ADL	258	51	348	63	1.59 (1.00-2.54)	.05
Discharge home	278	73	309	73	0.99 (0.62-1.60)	.98
Short LOS[#]	358	29	348	27	0.94 (0.61-1.45)	.78
Discharge home + Short LOS	278	27	309	26	0.96 (0.62-1.47)	.85
Successful GR: Independency in ADL + Discharge home + Short LOS	278	23	309	24	1.06 (0.63-1.77)	.81
Subgroups of interest						
Traumatic injuries (11 SNFs)	93		92			
Independency in ADL	88	53	91	65	1.63 (0.78-3.38)	.19
Discharge home	73	67	82	81	2.1 (1.32-3.23)	<.001
Short LOS (≤ 35 days)	88	38	91	32	0.76 (0.41-1.42)	.39
Discharge home + Short LOS	73	26	82	32	1.43 (1.02-2.00)	.05
Successful GR: Independency in ADL + Discharge home + Short LOS	73	22	82	31	1.61 (1.01-2.54)	.04
Stroke (12 SNFs)	137		132			
Independency in ADL	127	40	128	57	1.99 (1.09-3.63)	.02
Discharge home	91	66	113	63	0.87 (0.43-1.77)	.71
Short LOS (≤ 31.5 days)	127	26	128	25	0.92 (0.55-1.54)	.76
Discharge home + Short LOS	91	25	113	21	0.79 (0.41-1.55)	.49
Successful GR: Independency in ADL + Discharge home + Short LOS	91	20	113	19	0.97 (0.45-2.07)	.94

Ref; reference group.

[#]Short LOS defined per medical diagnosis for GR: Traumatic injuries =≤ 35 days, Stroke=≤ 31.5 days, Elective joint replacement=≤ 11.3 days; and other=25 days.

population was independent in ADL compared to 63% in the follow-up cohort (OR 1.59; 95% CI: 1.00-2.54, p=0.05). In the total population, successful rehabilitation was similar in both the baseline and the follow-up cohort [OR 1.06 (0.63-1.77) p=0.81].

Patients with traumatic injuries had more successful rehabilitation (OR 1.61; 95% CI 1.01-2.54, p=.04) at 1-year follow-up. The 5-step model shows that the percentage trauma patients discharged to home was higher in the follow-up cohort (67% vs 81%, p=<.001). The percentage of trauma patients with short LOS (≤ 35 days) was similar in both cohorts (p=.39), as was independence in ADL (p=.19). In stroke patients, successful rehabilitation was similar in both cohorts, but with more independence in ADL (OR 1.99, 95% CI: 1.09-3.63; p=.02) in the follow-up cohort.

Additional posthoc stratified analysis showed that independence in ADL at discharge was similar in patients with high comorbidity (FCI >2;baseline 37% vs follow-up 50%; OR 1.72, 95% CI1.00-2.98; p=.05) compared with patients with low comorbidity (FCI ≤2;baseline 58% vs follow-up 66%; OR 1.39, 95% CI 0.79-2.49; p=.25]. Other outcomes in the 5-step model stratified for comorbidity were also similar in both cohorts.

Functional improvement

Table 3 presents data on functional improvement (delta discharge-admission SNF) and LOS in the total population not having died or being readmitted to hospital (n=637), and on the 2 subgroups investigated (stroke and trauma). Functional improvement was

Table 3. LOS and Functional Improvement (Delta Scores)*

	Baseline cohort (n=331) T^0		**Cohort at 1-year follow-up (n=306) T^{12}**		**p-value †**
	n		**n**		
LOS, median days (IQR)	328	37 (19-80)	298	35 (20-62)	.39
Traumatic injuries	79	37 (19-68)	79	41 (22-56)	.11
Stroke	111	58 (27-111)	109	49 (26.5-88.5)	.88
Functional improvement, mean (SD)					
Δ Barthel Index (0-20)	258	3.7 (4.2)	276	3.9 (4.2)	.63
Traumatic Injuries	65	4.0 (3.3)	74	5.2 (3.9)	.06
Stroke	85	4.1 (4.9)	100	3.4 (4.7)	.27
Δ Functional Ambulation Categories (0-5)	264	1.1 (1.2)	289	1.3 (1.3)	.24
Traumatic Injuries	63	1.3 (1.2)	77	1.8 (1.6)	.06
Stroke	91	1.1 (1.2)	107	1.1 (1.3)	.78
Δ Berg Balance Scale (0-65)					
Stroke	80	9.5 (11.9)	103	9.8 (13.0)	.87

*Selection of patients not having died or having been readmitted to hospital during their rehabilitation stay (n= 637).

† p-value= *t* test except for LOS calculated with Mann-Whitney *U* test

similar between the baseline and follow-up cohorts for all functional outcomes. LOS was similar between the baseline and follow-up cohorts in the total population and on the 2 subgroups investigated (stroke and trauma).

DISCUSSION

This prospective cohort study explored if the implementation of a national program to improve quality of care in GR improves successful GR in terms of a combination of independence in ADL, discharge home and short LOS. Our study showed no difference in successful GR (independence in ADL, discharge home and short LOS) before and 1-year after the implementation of the national program, but also showed that there was more independence in ADL after the implementation. Moreover, in the diagnostic subgroup of patients with traumatic injuries we did find more successful GR after implementation of the national program and stroke patients had more independence in ADL at discharge after implementation.

We recently showed that this national program resulted in small improvements in team cooperation as reported by the professionals but little changes were found on patients' and informal caregivers' perceptions of the care delivery.[8]

Successful GR

The combined outcome measure for successful GR that we used was based on the overall aim of GR: to restore independence in ADL in the own home of older patients.[7] We added the component short LOS because health care resources should be used as efficiently as possible. By combining these 3 outcomes into 1, we believe that we have better targeted 'success' than by using only 1 of these measures separately, or costs of LOS and readmission rates. [10, 11,] An even more desirable outcome of successful rehabilitation would include the patients' own rehabilitation goals and care-needs. It could also be argued that is not as important as a save and successful discharge home.

The National Program consisted of improving care coordination by developing instruments to select patients for GR (triage). Another development was to improve team cooperation in the triage process by involvement of the elderly care physician during the multidisciplinary team meeting in the hospital.[6] This may have resulted in a selected population for GR, because the presence of the elderly care physician might increase or reduce the number of patients admitted to GR. Comparison of the baseline characteristics of the 2 cohorts shows that, in the follow-up cohort, the median number of comorbid conditions was lower compared with the baseline cohort (p=<.001). The lower amount of comorbid conditions in the follow-up cohort might indicate a development in patient selection where more complex patients with more comorbid conditions were

not admitted to GR. Posthoc stratified analysis for comorbidity showed similar outcomes on successful geriatric rehabilitation in both cohorts. More research is required to identify which patients benefit most from GR.[19]

Strengths and limitations

The strength of this study lies in the rather large sample size, both in facilities as in patient numbers, next to the more holistic view we developed on successful geriatric rehabilitation.

The present study has also some limitations. The national program aimed to improve a variety of complex interfacility and interdisciplinary care structures and processes. Also, different external factors (such as societal and organizational context) could have affected rehabilitation outcomes in the study period.[20] This complexity could explain the small effects we found on successful GR, but also a longer follow-up period might be needed to detect change in the combined measure of discharge destination, LOS and ADL-independence.[21] As in most complex implementation studies, it is very difficult to pinpoint specific improvement to specific components of the interventions. Future studies should examine which components of integrated care are most effective in improving successful GR outcomes.[8]

CONCLUSION

This study shows that 1-year after the implementation of the Dutch national program to improve quality of care there was more independence in ADL at discharge, but the combined outcome of successful GR (independence in ADL, discharge home, short LOS) was only significantly improved in patients with traumatic injuries.

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CHAPTER 6

Structured scoring of supporting nursing tasks to enhance early discharge in geriatric rehabilitation: the BACK-HOME quasi-experimental study

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ABSTRACT

Introduction

In geriatric rehabilitation it is important to have timely discharge of patients, especially if they have low nursing support needs. However, no instruments are available to identify early discharge potential.

Objective

To evaluate if weekly scoring of a nursing support scorecard in the evenings/nights and discussing the results in the multidisciplinary team meeting, leads to potential differences in discharge of geriatric rehabilitation patients.

Design

Quasi-experimental study with a reference cohort (n = 200) and a Back-Home implementation cohort (n = 283).

Setting/Participants

Patients in geriatric rehabilitation in the four participating skilled nursing facilities in the Netherlands.

Methods

Implementation of the nursing support scorecard during one year consisted of (1) weekly scoring of the scorecard to identify the supporting nursing tasks during the evenings/nights by trained nurses, and (2) discussion of the results in a multidisciplinary team meeting to establish if discharge home planning was feasible. Data on patients' characteristics and setting before admission were collected at admission; at discharge, the length of stay, discharge destination and barriers for discharge were collected by the nursing staff.

Results

Both cohorts were comparable with regard to median age, gender [reference cohort: 81 (IQR 75– 88) years; 66% females vs. Back-Home cohort 82 (IQR 76–87) years; 71% females] and reasons for admission: stroke (23% vs. 23%), joint replacement (12% vs. 13%), traumatic injuries (31% vs. 34%), and other (35% vs. 30%). Overall, the median length of stay for the participants discharged home in the reference cohort was 56 (IQR 29–81) days compared to 46 (IQR 30–96) days in the Back-Home cohort (p = 0.08). When no home adjustments were needed, participants were discharged home after 50 (IQR 29.5–97) days in the reference cohort, and after 42.5 (IQR 26–64.8) days in the Back-

Home cohort (p = 0.03). Reasons for discharge delay were environmental factors (36.7%) and patient-related factors, such as mental (21.5%) and physical capacity (33.9%).

Conclusion

Structured scoring of supporting nursing tasks for geriatric rehabilitation patients may lead to earlier discharge from a skilled nursing facility to home, if no home adjustments are needed.

Keywords

Geriatric rehabilitation, Early discharge, Nursing support scorecard, Nursing tasks

What is already known about this topic?

- The purpose of geriatric rehabilitation is to restore functioning or enhance residual functional capability and discharge to home.
- A pilot study using this (evening/night) scorecard showed that 13 of 31 patients (49%) might be dismissed home earlier.
- No instruments are available to adequately evaluate earlier discharge to home based on the need for supporting nursing tasks.

What this paper adds

- Structured scoring of supporting nursing tasks may lead to earlier discharge to home, if no home adjustments are required.
- Besides patient-related factors, environmental factors play an important role in delay of discharge.
- Nursing staff play an important role in targeting patients for early discharge.

INTRODUCTION

Approximately 25% of hospitalized older patients experience new disabilities in activities of daily living[1] and may benefit from geriatric rehabilitation before they can return to their own home. In the Netherlands, post-acute geriatric rehabilitation takes place within skilled nursing facilities, sometimes followed by rehabilitation in an ambulatory setting. Rehabilitation is performed by a multidisciplinary specialized team, led by an elderly care physician.[2] As part of the multidisciplinary team approach, 24-h specialized nursing care and support during self-care activities is available during the stay in the skilled nursing facility.

The purpose of geriatric rehabilitation is to restore functioning or enhance residual functional capability in geriatric rehabilitation patients to discharge them to their own living environment, with continuation of geriatric rehabilitation in an ambulatory care setting when required.[3] Primary reasons for geriatric rehabilitation are stroke, traumatic injuries, total joint replacement and a miscellaneous group (heart failure, chronic obstructive pulmonary disease, and amputation). These patients are characterized by having complex care needs because of a high burden of comorbidities and pre-morbid limitations in functioning.[4, 5]

Timely home discharge after inpatient rehabilitation is thought to improve functional status after discharge, in both stroke and hip fracture patients.[6-10] However, discharge potential and timing are dependent on patient-related factors (e.g. functioning, capacity, activities of daily living, participation in social life) and environmental factors (e.g. housing situation), thereby leaving the important discussion on timely discharge relatively open.[11, 12] An earlier study in the Netherlands found that 25% of the included geriatric rehabilitation patients thought that earlier discharge had probably been possible.[13] In addition, Arling et al. reported that 20% of the total population of nursing home residents were still in the nursing home at 90 days, despite that only minimal supporting nursing tasks (supervision with eating, transferring, bed mobility, hygiene and activities of daily living) were needed.[14] If minimal nursing support is needed, discharge to home with home care and additional ambulatory rehabilitation is feasible and desirable.

We hypothesized that in geriatric rehabilitation patients with a maximum of two supporting nursing tasks during the evening, and no support needed at night, discharge to home would be possible at an earlier stage, because such assistance can be provided by a homecare provider and/or an informal caregiver. Rehabilitation during daytime, including nursing support, could then be continued in an ambulatory setting or at their own home. However, to our knowledge, no instruments are available to adequately evaluate geriatric rehabilitation patients based on the need for supporting nursing tasks, for earlier discharge to home. In a previous study a nursing support scorecard was developed to record the supporting nursing tasks required during evenings/ nights

to target geriatric rehabilitation patients possibly eligible for earlier discharge.[15] A pilot study using this (evening/night) scorecard showed that 13 out of 31 patients (49%) could be discharged home earlier. [15] Besides the potential beneficial effects on patient outcomes, this could also lead to a more cost-effective rehabilitation program.
The aim of this study was to evaluate whether structured scoring of supporting nursing tasks leads to potential differences in discharge of geriatric rehabilitation patients.

METHODS

Setting and population

The BACK-HOME study is a quasi-experimental study with a reference cohort (n = 200) and a Back-Home cohort (n = 283). For the reference cohort, data were collected prospectively during one year from 50 patients in each of the 4 participating skilled nursing facilities, to establish the length of stay before implementation of the scorecard. Thereafter, the scorecard was implemented in the Back-Home cohort and data were collected between October 2011 and November 2012. All consecutive patients admitted for geriatric rehabilitation in the participating skilled nursing facilities were invited to participate in the study by a research nurse; no exclusion criteria were applied.

The present study was conducted within the University Network for the Care sector South-Holland (UNC-ZH). In this network care professionals work together with researchers of the Leiden University Medical Center (LUMC) to put initiatives from professionals into research with the aim to improve quality of care.[16, 17]
The medical ethics committee of the Leiden University Medical Center approved the study. All participants gave oral informed consent for the entire study, including the use of data from their medical records for additional analyses, following explanation of the study requirements and assurance of confidentiality and anonymity.

Data collection

Data in both cohorts were collected by the nursing staff at admission and at discharge. All participants were followed for a maximum of 4 months, because after 4 months no major recovery is expected.[14] At admission, data were collected on patient characteristics: sociodemographic variables (i.e. age, gender, marital status), setting before hospital admission, medical indication (diagnosis) for geriatric rehabilitation, and functioning in activities in daily living measured with the Barthel Index.[18] At discharge, data were collected on length of stay in the skilled nursing facility, discharge locations, readmissions to hospital, death during rehabilitation stay, or not yet discharged (4 months after admission). Discharge locations were categorized into discharge to home (independent

living environment) with or without the need for (new) home adjustments, or a long-term care facility, or an inpatient medical (non-geriatric) rehabilitation facility.

Environmental and patient-related reasons for discharge delay were registered, based on two categories of the International Classification of Functioning, Disability and Health (ICF model).[11] First, patient-related factors subdivided into the domains mental functioning (cognitive impaired, anxiousness and depression) and low physical capacity. Second, environmental factors (e.g. no realized home adjustments, waiting for institutional care or another home, and low physical capacity of the informal caregiver).

The Back-Home implementation consisted of (1) completing a weekly scorecard to identify the supporting nursing tasks during the evenings/nights provided by a trained nurse[15], and (2) discussion of the results of the scorecard in a weekly multidisciplinary team meeting.

Nursing support scorecard

To target the potential of geriatric rehabilitation patients for earlier discharge home, a scorecard was implemented to assess the nursing support required during the evenings/nights.[15] The scorecard was scored weekly every Wednesday at the end of both the evening and night shift by trained nurses. The reliability of the scorecard has been established (Cronbach's a 0.895) and the inter-rater agreement of the items was sufficient to good (Cohen's Kappa k = 0.40–0.82).[15]

The 12 items on the scorecard are presented in Box 1. If the patient is in need of physical or cognitive nursing assistance during the evening the item is scored with 1 point. Items 7, 9, 11 and 12 refer to nursing tasks at night. This leads to a maximum score on the scorecard of 16 points (maximum of 12 points during the evening and 4 points at night). If the patient needs assistance in maximally two nursing tasks during the evening and no assistance at night, this is defined as targeted for discharge home with an ambulatory rehabilitation program. Theoretically, the remaining nursing support can be provided by a homecare provider or an informal caregiver. The outcome on the scorecard is discussed

Box 1. Items on the nursing support scorecard scored during evening and night.

Scored during the evening:	**Scored during the night:**
1. Medication intake	
2. Fluid and food intake	
3. Transfer to toilet room	
4. Going on or off the toilet	
5. Getting (un)dressed when toileting	
6. Hygiene	
7. Incontinence pads	7. Incontinence pads
8. Transfer to bedroom	
9. Going in and out of bed	9. Going in and out of bed
10. Getting (un)dressed for the night	
11. Position in bed	11. Position in bed
12. Change of position in bed	12. Change of position in bed

in the weekly multidisciplinary team meetings; if the patient was targeted for discharge to home, the aim was to plan discharge to home within 2 weeks, or register the reasons why discharge was not possible or desirable.

Statistical analysis

For the reference cohort and the Back-Home cohort, differences in the length of stay in the skilled nursing facility were compared for each discharge location using an independent *t*-test or a Mann- Whitney *U* test, depending on the distribution of the data. In addition, data on patient characteristics were compared between the reference cohort and the Back-Home cohort using a chi-square test for gender, marital status, diagnosis and setting before admission; for median age and the Barthel Index, differences were calculated with a Mann-Whitney *U* test.

Analyses were performed with SPSS for Windows, version 20.0 (SPSS, Inc., Chicago, IL, USA). A p-value < 0.05 was considered statistically significant.

In the Back-Home cohort descriptive statistics were used to report the percentage of the population targeted for discharge, reasons for discharge delay, and discharge duration (i.e. number of days between targeted date for discharge and the actual discharge).

RESULTS

Study population

A total of 200 participants were included in the reference cohort. Of the 306 patients invited to participate in the Back-Home cohort, 22 did not want to participate and 1 was discharged shortly after admission; this resulted in 283 participants in the Back-Home cohort. In the reference cohort none of the included patients dropped out. Characteristics of the study population are presented in Table 1. At admission, the reference cohort and the Back-Home cohort were comparable with regard to gender, age, marital status, setting before admission, diagnosis and Barthel Index. In the reference cohort the median age was 81 (interquartile range 75– 88) years, compared with 82 (interquartile range 76–87) years in the Back-Home cohort. In both cohorts the majority of the participants was female.

Length of stay and discharge location

There was no difference in the percentage of participants discharged to the various discharge locations between the reference cohort (n = 121) and the Back-Home cohort (n = 163); p = 0.43. Of the participants not discharged in the reference cohort (n = 79) and in the Back-Home cohort (n = 119), the percentage of hospital readmissions was comparable in both cohorts (6% vs. 3.9%; p = 0.28). However, in the Back-Home cohort fewer participants

died during their rehabilitation stay (13.6% vs. 7.1%; p < 0.001) and more participants were still in the rehabilitation ward 4 months after admission (20% vs. 31.1%; p < 0.001).

Table 2 presents data on comparison of the population discharged in the reference cohort (n = 121) and in the Back-Home cohort (n = 163) for length of stay (median days) and the mean difference for each discharge location. The overall length of stay in the reference and Back-Home cohorts was similar. In the population discharged to home, only those discharged to home without new home adjustments had a shorter length of stay in the Back-Home cohort compared with the reference cohort [median 50 [interquartile range (IQR) 29.5–97 days vs. 42.5 (IQR 26–64.8) days; p = 0.03]. There was no difference in the median length of stay for the population discharged to the living environment with new home adjustments (p = 0.72) or to a long-term care facility (p = 0.33).

Table 1. Characteristics of the study population at admission to the reference and Back-Home cohort pre- and post-implementation cohort

	Reference cohort		Back-Home cohort		p-value[#]
	n	n (%)	n	n (%)	
Sociodemographic					
Female	200	131 (65.5)	283	200 (70.7)	0.23
Age in years; median (IQR)	200	81.1 (74.6-88.2)	283	82.4 (75.8-87.4)	0.72*
Married/living together	199	76 (37.7)	281	85 (30.2)	0.09
Setting (before admission to hospital)	200		281		0.38
Home (independent living environment)		197 (98.5)		280 (99.6)	
Without home adjustments		177 (88.5)		254 (90.4)	
With home adjustments		20 (10.0)		26 (9.2)	
Long-term care facility		3 (1.5)		1 (0.4)	
Diagnosis	200		282		0.69
Stroke		45 (22.5)		65 (23)	
Joint Replacement		24 (12)		36 (12.8)	
Trauma		62 (31)		96 (34)	
Other		69 (34.5)		85 (30.2)	
Functioning					
Barthel Index at admission (0-20); median (IQR)	199	9.6 (6-14)	274	10 (6-14)	0.41*

IQR: interquartile range. Values are numbers (%) unless indicated otherwise. [#] p-value calculated with Chi-square test unless indicated otherwise; * Mann-Whitney U test

Discharge planning

In the Back-Home cohort, 156 (55.1%) participants who were targeted for discharge, were discussed in the multidisciplinary team meetings with the aim to plan discharge within 2 weeks. Of this targeted population, 115 were discharged and 41 were not discharged (2 died; 3 re-hospitalizations and 36 were not yet discharged at 4 months).

Table 2. Comparison of length of stay for patients who were discharged in the reference and Back-Home cohort

	Reference cohort n=121		Back-Home cohort n=163		p-value[#]	Mean difference (95% CI)
	n (%)	Median (IQR)	n (%)	Median (IQR)		
Length of stay (days) for patients discharged	121	56 (30-80)	163	47 (30-70)	0.21	-4.2 (-11.2 – 2.7)
Length of stay (days) for each discharge location*:						
Home (Independent living environment)	99 (49.7)	56 (29-81)	142 (50.4)	46 (30-69)	0.08	-6.6 (-13.8, 0.69)
No (new) home adjustments needed	84 (42.2)	50 (29.5-97)	118 (41.8)	42.5 (26-64.8)	0.03	-9.3 (-17, -1.6)
With (new) home adjustments	15 (7.5)	62 (27-88)	24 (8.5)	62 (46.5-90.5)	0.72	6.5 (-12.6, 25.7)
Long-term care facility	22 (13.8)	60.5 (31.5-80)	20 (10.3)	70.5 (28-106.8)	0.33	12 (-10.1, 34.2)

IQR: interquartile range. [#] p-value calculated with Mann-Whitney *U* test. *One person in the Back-Home cohort was discharged to an inpatient medical (non-geriatric) rehabilitation facility, length of stay for this person was not reported due to the low number.

Of the population targeted, 112 (71.8%) were discharged to home in a median of 26 (IQR 12–42) days between the moment of targeting and actual discharge. For the participants discharged to home without home adjustments (n = 95) the median discharge duration was 22 (IQR 12–36) days compared to 42 (IQR 22–70) days for participants discharged to home with new home adjustments (n = 17); p = < 0.001. One participant was discharged to an inpatient medical (non-geriatric) rehabilitation facility and 2 participants to a long-term care facility.

In the population that was targeted by the scorecard and that were discharged to home (n = 115), 36 (31.3%) were discharged within the 2 weeks that were set as a goal. The reasons for delay in discharge for the remaining 79 (68.7%) participants that were discharged after 2 weeks can be divided into two categories. First, patient-related factors (n = 46; 58.2%) subdivided into the domains mental functioning (21.5%) and low physical capacity (33.9%). Second, environmental factors (n = 29; 36.7%) were also reasons for discharge delay.

DISCUSSION

The present study shows that implementation of structured weekly scoring of supporting (evening and night) nursing tasks has the potential to lead to earlier discharge from a skilled nursing facility to home in patients for whom no new home adjustments are needed. Nursing staff play an important role in targeting patients for possible discharge. The nursing support scorecard has the potential to assist staff to identify patients that are eligible for early discharge. After discussion in the multidisciplinary team, discharge to home with additional ambulatory rehabilitation is feasible. This is important because of the potential beneficial effects of earlier discharge with ambulatory rehabilitation on increased independency, e.g. better functional outcomes and reduced institutionalization.[10, 19-21]

In this study several barriers to earlier discharge were observed: i.e. patient factors (e.g. mental or physical capacity) and environmental factors (e.g. delay of adjustments to the living environment, low physical capacity of the informal caregivers and impaired cognition). These latter barriers are also related to hospital discharge delay, whereas discharge arrangements and nonmedical factors played a more prominent role in predicting discharge delay than the patient factors.[22, 23]

After being targeted for possible discharge, the reported barriers for discharge were also explained (in part) by unplanned medical or nursing care needs, other than those incorporated in the scorecard. This emphasizes the importance of discussing the scorecard results in a multidisciplinary team setting.[4] The multidisciplinary team plays an important role in discharge planning because the various professionals together can

provide a broader view on the contributing factors (e.g. patient and environmental factors) that help make a well-considered decision for discharge.

To overcome these barriers, early identification of these factors by assessing them at admission (or at pre-admission in patients with elective joint replacement) may be warranted. Earlier identification of environmental factors (such as the need for home adjustments) could help to avoid discharge delay. Between the moment of targeting and actual discharge in the Back-Home cohort there was a significant difference in the median discharge duration of 20 days between the population discharged to home without home adjustments (compared to participants discharged to home with new home adjustments). This indicates that a median reduction of approximately 20 days in the length of stay for the population discharged to home with home adjustments could be aspired.

In addition, more knowledge on (predictive) validity of the scorecard and patient-related factors for discharge possibilities and reasons for delay is needed to improve tailored and efficient discharge planning. These insights may also help to improve the content of the scorecard and determine the effect size in further interventional studies. Further, more pro-active involvement is required of the patient and informal caregiver in setting rehabilitation goals focused on discharge planning. Positive outcomes have been found on wellbeing, accepting a caring role, satisfaction with the process and continuity of care, when patients and informal caregivers are actively involved in discharge planning (from acute care to home).[8, 24] However, these outcomes have not been studied in the setting of post-acute care to home.

This study was conducted within the University Network for the Care sector South Holland (UNC-ZH). It provides a good example of bottom-up research, initiated by a care professional (physiotherapist) and supported by researchers.[16, 17] Within this context, the scorecard was easy to implement in the total population receiving geriatric rehabilitation in the skilled nursing facility. However, in a quasi-experimental design there is a risk of low internal validity due to potential differences between the cohorts due to non-randomization. Although baseline characteristics were similar in both cohorts, the Back-Home cohort included more participants who were still in the rehabilitation ward 4 months after admission, and fewer participants who died during rehabilitation stay; this could have altered the effect on the length of stay when comparing the cohorts due to other reasons. This study gives recommendations on further development of the nursing support scorecard and gives insight in important barriers for discharge and how to overcome those barriers.

CONCLUSION

Structured weekly scoring of supporting nursing tasks may result in earlier discharge of geriatric rehabilitation patients from a skilled nursing facility to home, if no home adjustments are needed. The nursing staff plays an important role in targeting patients for possible discharge and the use of a scoring card may help staff to assess earlier discharge planning for geriatric rehabilitation patients in the post-acute care setting.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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Ethical approval

None

Authors' contributions

WA, MC, RvB and EB designed the study. EB participated in data collection. MC had full access to all data in the study and takes responsibility for integrity of the data and accuracy of the data analysis. MH did the initial analysis. MH, WA, MC RvB and JG interpreted the data. MH prepared the manuscript. All authors critically revised the manuscript and approved the final version.

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CHAPTER 7

General discussion

The overall aim of this thesis is to investigate aspects of both structure and processes in geriatric rehabilitation related to the outcome of successful rehabilitation.

PART 1. ASPECTS OF SUCCESSFUL GERIATRIC REHABILITATION

The first part of this thesis presents two observational studies investigating structure and process aspects on the outcome of successful rehabilitation. First, we investigated the effects of organization structure (patient volume and service concentration) as a proxy for specialization on geriatric rehabilitation outcomes. We performed a post-hoc analysis in a national multicenter retrospective cohort study in skilled nursing facilities that provide geriatric rehabilitation in the Netherlands. This study showed that high service concentration, but not volume, may favor a shorter length of stay and discharge home for patients with total joint replacement. In addition, trauma patients in a concentrated ward had a greater chance to be discharged to home compared with trauma patients in a non-concentrated ward (**Chapter 2**). Second, in patients undergoing unilateral total hip replacement, we investigated whether preoperative strength of the muscle groups of the lower extremity is associated with postoperative functional recovery. The conclusions drawn from this prospective observational cohort are that preoperative greater musculus quadriceps femoris strength of the operated side is associated with better physical functioning, measured with the self-reported Western Ontario and McMaster Universities Osteoarthritis (WOMAC) physical functioning scale, 12 weeks postoperatively (**Chapter 3**).

In summary, the first part of this thesis shows that some aspects of structure and process are associated with successful geriatric rehabilitation. Development and improvement of the organizational structure and processes of care are needed to improve positive outcomes in geriatric rehabilitation. However, there is a lack of studies focusing on quality improvement in geriatric rehabilitation. Also, it remains unclear whether development of organizational structure and processes has an effect on the perspectives of professionals, patients and informal caregivers on the quality of care and on patient outcomes.

PART 2. INITIATIVES TO IMPROVE GERIATRIC REHABILITATION OUTCOMES

The second part of this thesis focuses on initiatives of skilled nursing facilities aiming to improve successful geriatric rehabilitation outcomes. The Synergy and Innovation in Geriatric Rehabilitation (SINGER) study was designed together with a government initiated program ('Proeftuinen geriatrische revalidatie') to improve the quality of care

through development of geriatric rehabilitation services. The SINGER study is a prospective longitudinal study with the participation of 16 skilled nursing facilities. The first SINGER study (**Chapter 4**) is a prospective cohort study describing changes in the geriatric rehabilitation service delivery process as experienced by professionals (elderly-care physicians, physiotherapists and nursing staff), patients, and their informal caregivers. The main goals of the development of integrated care fall into four domains of geriatric rehabilitation service delivery i.e. alignment with patients' care needs, care coordination, team cooperation and quality of care. During the national program small improvements were made in team cooperation (including assessment for intensive treatment and information transfer among professionals), but fewer improvements were found in alignment with patients' needs, care coordination, and care quality. No effects were found for patients' and informal caregivers' perceptions of geriatric rehabilitation service delivery. The perceptions of the geriatric rehabilitation service delivery were high at the start of the national program, which left little room for improvement due to this ceiling effect. The second SINGER study (**Chapter 5**) describes patient outcomes of successful rehabilitation after comparing two consecutive cohorts; i.e. at the start of implementation and at 1-year post-implementation of this national program. The program resulted in 12% more independency in activities of daily living (ADL) at discharge in the total geriatric rehabilitation population. Successful geriatric rehabilitation (independency in ADL, discharge home, and short length of stay) was not higher 1-year post-implementation of the national program. However, in patients with traumatic injuries, at 1-year post-implementation there was more successful rehabilitation compared with the start of implementation [OR 1.61; 95% CI 1.01-2.54]. In the subgroup of patients with stroke, independency in ADL increased at 1-year post-implementation of the program compared with the start of the program [OR 1.99; 95% CI 1.09-3.63].

In other words, the SINGER study showed small positive effects on geriatric rehabilitation service delivery process in the perception of professionals. Patients' and informal caregivers' perceptions of the process of care were similar after 1-year of implementation (**Chapter 4**). One year after implementation of the Dutch national program there was more independency in ADL at discharge, whereas the combined outcome of successful geriatric rehabilitation (independency in ADL, discharge home, short length of stay) showed significant improvement only in patients with traumatic injuries (**Chapter 5**).

The BACK-HOME study (**Chapter 6**), describes a local initiative (within the University Network of the Care sector South-Holland, UNC-ZH) for structured discharge planning with weekly scoring of a nursing support scorecard, and discussion of the results in the multidisciplinary geriatric rehabilitation team. The BACK-HOME study shows that structured scoring of supporting nursing tasks in geriatric rehabilitation may lead to earlier discharge from a skilled nursing facility to home, if no home adjustments of the home environment are required. The use of a nursing support scorecard may help as a

tool to target which patients have the potential to be discharged home, and to discuss the results in a multidisciplinary team meeting to establish if discharge home planning is really feasible.

This general discussion places successful geriatric rehabilitation in a broader perspective and addresses the methodological challenges involved when studying outcomes in geriatric rehabilitation. The discussion ends by considering which aspects of structure and processes need attention to improve successful outcomes, the implications for clinical practice, and some recommendations are made for future research.

PERSPECTIVES ON SUCCESSFUL GERIATRIC REHABILITATION

This thesis describes the evolvement in the outcome of successful geriatric rehabilitation aimed at a combined outcome measure consisting of the following factors i) being independent in ADL at discharge, ii) being discharged to home, and iii) having a short length of stay (≤25% of length of stay in the skilled nursing facility for each diagnostic group). This combined outcome measure was based on the overall aim of geriatric rehabilitation to restore physical functioning, or enhance residual functional capability and participation in older patients aiming at discharge to home. We added the component 'short length of stay' as we believe that healthcare resources should be used as efficiently as possible. In addition, a short length of stay with discharge to home (possibly with outpatient or home rehabilitation) has potential positive effects on regaining independency in ADL after discharge.[1-5] Many studies have focused on single outcomes of successful rehabilitation, such as length of stay, or discharge destination.[6, 7] In our opinion, the combination of components targets success better than the use of separate components. An even more desirable outcome would also include the 'patient's perspective' on the outcome of successful rehabilitation on the functional and participation level.

This combined outcome measure is an overall measure for the total population receiving geriatric rehabilitation. This also enables to compare performances within geriatric rehabilitation diagnostic groups and between facilities, when adjusted for case-mix characteristics. The combined measure consists of three perspectives, i.e. the patient's, the professional's, and the management perspective. However, because the term 'successful geriatric rehabilitation' is potentially ambiguous, these three perspectives are described in detail below to provide a broader view.

Patient perspective

In a prospective multicenter cohort study among geriatric rehabilitation patients receiving post-acute care in a hospital ward, the patients reported regaining ADL, return to

home, reduction of pain, regaining autonomy and improving general health condition as the most important goals.[8] The conclusions of a report from the Dutch Federation of Patients and Consumers Organizations (NPCF) on patients' perspectives in geriatric rehabilitation were that patients found it most important to be discharged to home and to be actively involved in the rehabilitation process.[9] The patient perspective on geriatric rehabilitation is not focused on one part of the care pathway, but based on the total care pathway from (pre-) acute care in hospital to post-acute care in the skilled nursing facility, followed by outpatient or home rehabilitation with home health care if needed.[9] In this thesis we did not study the patient perspective on the outcome of successful geriatric rehabilitation; however, this is an interesting topic for future research. In **Chapter 4** we described the patient's and informal caregiver's perspectives on geriatric rehabilitation service delivery processes during the implementation of a national program to improve the quality of geriatric rehabilitation. The results show overall positive patient and informal caregiver perceptions of health service delivery. Patients and informal caregivers rated the care pathway with a 7.3 (SD 1.3) (on a 0-10 scale). In **Chapter 4**, 61% of the patients and 48% of the informal caregivers rated the professionals dealing with their individual needs during geriatric rehabilitation as good or excellent. This implies that there is room for improvement.

When does the patient consider the outcome of geriatric rehabilitation to be successful? This should be an important question when setting rehabilitation goals. Active involvement of the patient and informal caregiver in goal setting, reporting on outcomes and decision-making, can improve positive experience with quality of care, regaining autonomy, and may increase intervention adherence.[10-14] There are initiatives for the development and implementation of goal attainment scaling in geriatric rehabilitation, e.g. the Canadian Occupational Performance Measure (COPM)[15] and the Goal Attainment Scale (GAS).[16, 17]

Both scales are individualized measures to identify and prioritize rehabilitation goals and rate the performance of the goals set by the patient in cooperation with a professional.

Development of patient-reported outcome measures (PROMs) is important when aiming to improve patient-centered care. PROMs can give insight into the patient's own opinion about the impact of their functioning on their daily life.[18, 19] **In Chapter 3**, the primary outcome 'functional recovery' was measured with the WOMAC physical function scale.[20] The WOMAC is a disease-specific PROM for patients with osteoarthritis of the hip and knee. No such PROM is available for measuring functioning in the total population of geriatric rehabilitation. Besides functional assessment, regaining participation in daily living is an important goal of geriatric rehabilitation; also, on a participation level, PROMs are needed to evaluate geriatric rehabilitation. More studies are required to develop and validate PROMs for geriatric rehabilitation.

Professional perspective

One of the main characteristics of geriatric rehabilitation is a multidisciplinary patient-centered approach. Structured and coordinated multidisciplinary team work with balanced and tailored interventions has a positive effect on functional improvement.[21] Goal setting can be challenging because the desired outcome of geriatric rehabilitation is dependent upon different context variables, such as patient-related factors (e.g. functioning, capacity, activities of daily living, participation in social life) and environmental factors (e.g. housing situation).[22] The patient's goals should be aligned with what professionals think is feasible within the rehabilitation period, and frequently evaluated when considering these context variables.[23] For this purpose, professionals need specific expertise and experience in geriatric rehabilitation.[21] Early assessment of rehabilitation goals, and discharge possibilities and barriers, may enhance discharge planning (**Chapter 6**). The BACK-HOME study showed that nursing staff can play an important role in targeting patients for possible discharge. The nursing support scorecard has the potential to assist staff to identify patients that are eligible for early discharge. After a patient is identified for discharge, the outcome on the scorecard is discussed in the multidisciplinary team to evaluate whether discharge home is in fact feasible (**Chapter 6**).

Management perspective

An increasing number of older patients with comorbidities have a need for rehabilitation resources. Reducing the length of stay is considered an indicator for efficient use of healthcare resources.[24] By reducing the length of stay, healthcare services can treat more patients and have shorter waiting lists. However, reducing the length of stay should not be achieved at the expense of quality of care and patient outcomes.[24] The costs and benefits of the geriatric rehabilitation pathway should be carefully weighed, taking into account patient, professional and management perspectives.[25]

No set of outcome measurements is currently available for geriatric rehabilitation across all settings to facilitate quality improvement and provide insight into the efficiency of the healthcare resources.[26] When aiming to further develop the quality of post-acute geriatric rehabilitation, improvements on different aspects of structure and process level are needed.[26]

METHODOLOGICAL CHALLENGES WHEN STUDYING OUTCOMES IN GERIATRIC REHABILITATION

Various challenges exist when investigating successful outcomes in geriatric rehabilitation. Because geriatric rehabilitation is a relatively young field of research, few evidence-based intervention strategies are available. Also, little is known about the dose-response

relations of therapy in geriatric rehabilitation, or which types of patients need which type of intervention frequency, intensity and setting, and which patients benefit most from geriatric rehabilitation.[27, 28]

Geriatric rehabilitation is multidisciplinary integrated care involving different health-care providers for patients with complex care problems. It is a worldwide challenge how to initiate, develop and evaluate integrated care for patients with complex care needs.

In this thesis, observational study designs were used to address the research questions. This type of study design has the advantage of providing information on the outcomes of geriatric rehabilitation in a 'real-world' setting and allows the inclusion of patients with co-morbidities and complications; this is not possible in clinical trials because of the strict eligibility criteria.[29] This thesis provides insight into the outcomes of successful geriatric rehabilitation on a national level **(Chapter 2),** regional level **(Chapters 4 and 5),** and local level **(Chapters 3 and 6).** A disadvantage is that the outcome of observational studies can be affected by selection bias and confounding variables, which can reduce the internal/external validity of the outcomes. Another methodological challenge is that, in geriatric rehabilitation practice, no validated set of outcome measurements is available, which makes it difficult to compare research outcomes. A good infrastructure for research and development in skilled nursing facilities (such as an academic nursing home network) is needed to enable coordinated research in geriatric rehabilitation and to implement research outcomes into daily practice.[30]

THE ROAD TO SUCCESSFUL GERIATRIC REHABILITATION

Improving the quality of geriatric rehabilitation consists of multiple factors on the structure and process level. However, because geriatric rehabilitation is a relatively young field of research we are still in the early stages of exploring which aspects of structure and process may help to improve geriatric rehabilitation.[26] Nevertheless, the following brief summary of clinical implications and recommendations can be drawn from the work in this thesis:

Structure:

1. Organizational structure: service concentration and patient volume
2. Research and innovation in skilled nursing facilities

Process:

3. Coordinated multidisciplinary care
4. Early discharge planning
5. Early assessment of barriers for discharge

6. Systematic evaluation with standardized measures

1. Organizational structure: service concentration and patient volume

In this thesis, we studied the effects of the organizational structure characteristics 'service concentration' and 'patient volume' on successful outcomes in geriatric rehabilitation **(Chapter 2).** Service concentration was defined as ≥ 80% of the population in a geriatric rehabilitation ward of a skilled nursing facility consisting of 1 or 2 diagnostic groups. Additionally, the facility should have a minimum of 10 rehabilitation beds. In a Dutch guideline for geriatric rehabilitation, a minimum of 10 beds is recommended in order to compose a multidisciplinary specialized team.[31] Patient volume was based on the total population receiving geriatric rehabilitation and categorized into tertile groups, categorized into low, medium and high volume.[32]

Internationally, discussion on the concentration of services and patient volume is an important topic among researchers and policymakers. High volume and concentration of services is thought to be a facilitator for good quality by health insurance companies and policymakers. In high-risk surgical procedures, there is evidence that high patient volume is related to lower complication and mortality rates.[33, 34] One study developed an extended methodology to examine the volume-effectiveness relationship in hip fracture patients. That study found a positive association with higher volume in rehabilitation units on the 4-month mortality rate, but not with hospital volume. These earlier studies focused on the effect of volume on mortality and readmission rates, whereas the effect of volume on patient functional recovery and cost-effectiveness remains unknown.[35]

In **Chapter 2** we reported that a high concentration of services in patients with joint arthroplasty has a positive effect on shorter length of stay in combination with discharge to home. Patient volume was not associated with the outcome of faster discharge to home. In order to improve the organization of geriatric rehabilitation, reasons for the benefit of concentration with discharge to home with a short length of stay for patients recovering from joint replacement also need further research. In our study, we used a narrow definition of successful rehabilitation because we lacked data on patients' functional and participation outcome. There is considerable evidence that stroke units (concentration of services) are efficient; however, evidence is lacking for geriatric rehabilitation post-acute services.[6]

In conclusion, more research is required to explore whether concentration of services and patient volume are a good proxy for specialization, and to establish which components of organizational structure are beneficial to successful geriatric rehabilitation in terms of cost-effectiveness and successful patient outcomes.

2. Research and innovation in skilled nursing facilities

Because geriatric rehabilitation is a relatively young field of research, more evidence-based practice, expertise and knowledge exchange is required. Introducing a research and innovation culture within skilled nursing facilities could facilitate this development. When developing geriatric rehabilitation, it is a challenge to examine possibilities of new innovative methods, such as e-health solutions, in order to optimize the outcome of successful geriatric rehabilitation.[36, 37] An innovative culture provides patients with access to innovative treatments, and professionals with the opportunity to improve clinical practice and develop expertise. An innovative culture also attracts outstanding clinicians which, in turn, facilitates the research culture.[30 38, 39] Professionals working in geriatric rehabilitation should have the opportunity to develop research expertise in the field and have the time, capacity and education to develop these skills and share best practices. Until know, funds for research in geriatric rehabilitation are limited, whereas specific funding might enhance research possibilities in the skilled nursing facilities. A research agenda is required to define and align research topics and questions between academia and practice.

The Netherlands has five university nursing home networks. These networks combine the expertise of elderly-care medicine departments with practical and organizational expertise of skilled nursing facilities. Care professionals collaborate with university researchers to improve the quality of care by developing, implementing and testing new initiatives.[30] Evidence-based practice combines the best available evidence with clinical expertise and patient's preferences and values. The BACK-HOME study **(Chapter 6)** is a good example of professionally-initiated research, supported by a university nursing home network which resulted in the implementation and evaluation of structured scoring of supporting nursing tasks to identify early discharge potential. Combining a research and innovation culture within skilled nursing facilities with the expertise of universities is needed to develop research in geriatric rehabilitation and to implement the results into practice.[30, 40]

3. Coordinated multidisciplinary care

The structure and processes of care for patients with complex care needs are often fragmented, causing inefficiency and poor quality outcomes.[41, 42] One of the main goals of geriatric rehabilitation is to provide coordinated multidisciplinary care to improve patient outcomes.[43] However, because of the different healthcare providers and professionals involved, optimal coordination, communication and continuity of care between settings is also required.[44]

The SINGER study **(Chapters 4 and 5)** monitored the process and effect outcomes of a national program aimed at stimulating integrated care ('Proeftuinen geriatrische revalidatie'). This thesis provides insight into the main goals of development in optimizing

integrated care formulated by the participating organizations (Chapter 4). The national program resulted in small improvements in team cooperation. The goals of development in team cooperation consisted of improving the inter-professional communication and alignment of professional performance. Team cooperation is a crucial aspect of integrated care because of the complementary role of the professionals and the interdependency between professionals.[21, 26, 45] Fewer process improvements were reported in the other three domains (alignment with patients' needs, care coordination, and care quality). This suggests that either very little change took place, or that we were unable to detect the improvement on a process level. However, other measurement tools might have been needed to capture the specific improvements being made, instead of the more general assessments of these different domains.

Despite the small improvements on the process level, the effect evaluation in the total population resulted in more ADL independency after 1-year of implementation of the national program, compared with the start of the program. However, the combined outcome (independency in ADL, discharge home and short length of stay) was higher only in patients with traumatic injuries. The efforts of the participating skilled nursing facility to improve the quality of geriatric rehabilitation seem to have yielded a positive movement towards improving the quality of geriatric rehabilitation. Participation in the program seems to have energized the skilled nursing facilities to organize projects aimed to improve or develop integrated care. Evidence on the effectiveness and cost-effectiveness of interventions in geriatric rehabilitation is scarce. Developments of more specific interventions are needed to further develop the four main domains (team cooperation, alignment with patient needs, care coordination, and care quality) and to explore which active ingredients lead to successful outcomes.

4. Early discharge planning

Timely home discharge is thought to improve functioning in ADL after discharge, in both stroke and trauma patients.[3] Patients may be more encouraged to resume ADL in their own home. The BACK-HOME study **(Chapter 6)** shows that structured scoring of supporting nursing tasks during the evenings and nights has the potential to lead to earlier discharge from a skilled nursing facility in patients for whom no new adjustments of the home environment are required. This implies that nursing staff can play a prominent role in detecting patients for possible discharge with structured scoring of the supporting nursing tasks during evening and night and discussing this in the multidisciplinary team meetings. However, more research is needed to explore the potential benefits of early discharge in geriatric rehabilitation on long-term outcomes on patient functioning, participation and the amount of healthcare resources used.

Besides patient-related factors (e.g. mental or physical capacity), environmental factors (e.g. delay of home adjustments) play an important role in discharge delay. These

factors should be discussed with the patient and informal caregiver early in rehabilitation, and evaluated in the multidisciplinary team to set rehabilitation goals and consider discharge possibilities. Development of instruments for early identification of possible barriers for discharge, such as environmental factors (e.g. home adjustments), could avoid discharge delay. Also, regulations to purchase home adjustments could delay timely discharge. More research is needed on the (predictive) validity of the nursing support scorecard and to explore patient-related and environmental barriers for discharge to improve tailored and efficient discharge planning **(Chapters 3 and 6).** In addition, further development and exploration of the feasibility and effectiveness of outpatient or home rehabilitation programs following post-acute care are needed.

5. Early assessment of barriers for discharge

Insight in (pre-operative) predictors for functional outcome in geriatric rehabilitation provides information on rehabilitation potential and can help improve discharge planning.[46] In this thesis, greater preoperative quadriceps strength was a predictor for better short-term functional outcome measured with the self-reported WOMAC physical functioning scale[20] in patients undergoing a total hip replacement **(Chapter 3).** In that study, no association was found with performance-based measures (e.g. Timed Up and-Go[47], 6-Minute Walking Test[48]). Additional research is needed to confirm this finding in larger samples and to examine the optimal timing for surgery and effects of preoperative strength training on successful rehabilitation outcomes in patients with joint replacement. A recent systematic review showed that preoperative pain and physical functioning, higher body mass index, presence and amount of comorbidity, worse general health and lower radiographic osteoarthritis severity were also associated with poor outcomes.[46] However, the strength of these associations could not be assessed due to heterogeneity between the studies.[46] Because joint replacements are 'planned care', in contrast to acute events such as stroke or trauma patients, this group of patients are particularly suitable for preoperative screening and assessment of overall functioning. Although better preoperative functioning may be associated with improved outcomes, until now there is no clinical consensus or strong empirical evidence about the necessity, optimal timing and effect of preoperative strength training in patients with a unilateral total hip replacement.[46]

6. Systematic evaluation with standardized measures

To further develop geriatric rehabilitation, it is important to analyze the outcomes of geriatric rehabilitation when changing or developing the structure and processes of care **(Chapter 4).** Internationally, there has been a shift from focusing on patient safety as an outcome, towards patient-related outcomes.[26] However, no common outcome measurement has been established between skilled nursing facilitates providing

post-acute geriatric rehabilitation and rehabilitation service organizations (hospital, skilled nursing facility, home care agencies).[27] Systematic evaluation with standardized measures at fixed moments is needed to evaluate individual rehabilitation goals and the quality of care within and between geriatric service organizations. Such a standardized outcome measurement set could facilitate research and knowledge exchange in geriatric rehabilitation.[27] Recently, the University Network for the Care sector South-Holland (UNC-ZH) developed the first measurement set for the evaluation of outcomes in geriatric rehabilitation on both patient and facility level. Future research should focus on development and validation of a measurement set for the geriatric rehabilitation population. The domains of the WHO model of International Classification of functioning, disability and Health (ICF) can be used to select and develop these measurement scales.[22, 28] In addition to the ICF framework, Jesus et al. developed a conceptual framework for the development of quality of care in post- acute geriatric rehabilitation. In this framework, also macro-outcomes measured after discharge are included, such as patients' and caregivers' health-related quality of life, consumers' experience, place of discharge, healthcare utilization, and functional performance. These various outcomes can provide us with a broader view on geriatric rehabilitation in general.

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CHAPTER 8

Summary

INTRODUCTION

Due to the rising life expectancy and improved treatment possibilities of chronic illness and acute care, the group of older persons will continue to increase worldwide. Concurrently, the number of older people with multi-morbidities in acute care will also increase. Geriatric rehabilitation is important for this specific population, because it has a positive effect on the improvement of functioning after hospitalization, and leads to less re-admissions to nursing homes/hospitals and to lower mortality rates.

Geriatric rehabilitation consists of two main characteristics. First, geriatric rehabilitation is a multidisciplinary set of evaluative, diagnostic and therapeutic interventions with the purpose to restore functioning or enhance residual functional capacity in older people with disabling impairments. Second, geriatric rehabilitation treatment has a multidisciplinary patient-centered approach.

Internationally, post-acute care rehabilitation is provided in different settings. In the Netherlands, geriatric rehabilitation is provided in the post-acute care setting of skilled nursing facilities (SNFs). However, because geriatric rehabilitation is a relatively young field of research we are still in the early stages of exploring which aspects of structure and processes may help to improve successful geriatric rehabilitation outcomes.

There is a lack of well-conducted studies focusing on i) quality improvement of geriatric rehabilitation, and ii) evaluating successful geriatric rehabilitation outcomes, such as discharge to home with a higher level of physical functioning, and optimizing the length of stay by improvement of the rehabilitation processes.

The general aim of this thesis is to investigate various aspects of the structure and processes in geriatric rehabilitation in relation to the outcome of successful rehabilitation.

PART ONE. ASPECTS OF SUCCESSFUL GERIATRIC REHABILITATION

Chapter 2 focuses on the association between organizational structure (patient volume and service concentration) as a proxy for specialization, and geriatric rehabilitation outcomes, because little is known about the optimal organization of care. In a post-hoc analysis of a national multicenter retrospective cohort study in 88 SNFs, the relationship between patient volume and service concentration on the outcome (short length of stay in the SNF and discharge home) was examined. SNF characteristics were obtained by structured telephone interviews with facility managers. Volume was based on the number of discharges in a 3-month period and categorized in low, medium, and high-volume facilities. Concentration was defined as 80% or more of the patients in a geriatric rehabilitation ward that consists of 1 or 2 diagnostic groups. An additional prerequisite was that the facility should have a minimum of 10 rehabilitation beds. From 88 facili-

ties, 2269 geriatric rehabilitation patients with a mean age of 78.2 years were included. This study showed that high service concentration, but not volume, may favor a shorter length of stay and discharge home for patients with total joint replacement. However, this relationship was not found for patients with traumatic injuries or stroke. In addition, trauma patients in a concentrated ward had a greater chance to be discharged to home compared with trauma patients in a non-concentrated ward. More research is required to explore whether the concentration of services and patient volume are a good proxy for specialization, and to establish which components of organizational structure are beneficial to successful geriatric rehabilitation in terms of cost-effectiveness and successful patient outcomes.

Because joint replacements are 'planned care', in contrast to acute events such as stroke or trauma, this group of patients are particularly suitable for preoperative screening and assessment of overall functioning. In **Chapter 3**, in a prospective observational cohort study, we investigated whether preoperative strength of the muscle groups of the lower extremity is associated with postoperative functional recovery after total hip replacement. A total of 55 patients with a mean age of 73 years participated. Baseline measures within 2 weeks pre-operatively, and follow-up at 6 and 12 weeks postoperatively, included isometric strength measurement of the hip and knee musculature. Functional outcome was tested using performance-based (functional mobility) and self-report measures (physical functioning, mental health and pain). The conclusions drawn from this study are that a preoperative greater knee extensor strength of the operated side is associated with better physical functioning (WOMAC-PF) at 12 weeks postoperatively, in patients undergoing a total hip replacement. In that study, no association was found with the performance-based outcome measures. Insight into (pre-operative) predictors for functional outcome in geriatric rehabilitation provides information on rehabilitation potential and can help improve discharge planning.

PART 2. INITIATIVES TO IMPROVE GERIATRIC REHABILITATION OUTCOMES

The overall organization of geriatric rehabilitation is a complex care process that suffers from fragmentation of care because of the many different medical specialists, professionals and settings involved. Although, internationally, attempts have been made to improve the quality of the care processes, they did not specifically address geriatric rehabilitation patients and did not reflect the post-acute care setting. In addition, little is known about the perspectives of professionals, patients and informal caregivers on the quality of care during these initiatives.

The Dutch Ministry of Health, Welfare and Sport initiated a national program ('*Proeftuinen geriatrische revalidatie*') to improve quality of care through the development of

geriatric rehabilitation services. The 'Synergy and Innovation in Geriatric Rehabilitation (SINGER) study' is a prospective longitudinal study performed during the implementation of this national program to improve quality geriatric rehabilitation care, in which 16 SNFs participated.

The first part of the SINGER study (**Chapter 4**) describes changes in the geriatric rehabilitation service delivery process as experienced by professionals (elderly-care physicians, physiotherapists and nursing staff), as well as by patients and their informal caregivers. For three consecutive cohorts, the professionals rated four domains of health service delivery (i.e. alignment with patients' care needs, care coordination, team cooperation, and quality of care) at admission and at discharge for a total of 1075 patients. In addition, these patients (median age 79 years) and their informal caregivers rated their own experiences on these domains 4 weeks after discharge. During the national program, small positive effects were found in team cooperation (including assessment for intensive treatment and information handover between professionals). Fewer improvements were found in alignment with patients' needs, care coordination, and care quality. At 1 year after implementation of the national program, patients' and informal caregivers' perceptions of the geriatric rehabilitation service delivery process were similar. This study provides insight into the main goals of development in optimizing integrated care formulated by the participating organizations.

The second part of the SINGER study (**Chapter 5**) describes patient outcomes of successful rehabilitation by comparing two consecutive cohorts; i.e. at the start of implementation (n=386) and at 1-year post-implementation of this national program (n=357). Included were 743 patients (median age 80 years) indicated for geriatric rehabilitation and their healthcare professionals (elderly care physicians, physiotherapists and nursing staff) from 16 SNFs. Successful geriatric rehabilitation was defined as independency in activities of daily living (ADL) and discharge to home after a short length of stay in the SNF. One year after implementation of the Dutch national program, there was 12% more independency in ADL at discharge, whereas the combined outcome of successful geriatric rehabilitation (independency in ADL, discharge home, short length of stay in the SNF) showed significant improvement only in patients with traumatic injuries (**Chapter 5**). This combined outcome measure (independency in ADL, discharge home, short length of stay in the SNF) is an overall measure for the total population receiving geriatric rehabilitation. This also enables to compare performances within geriatric rehabilitation diagnostic groups and between facilities, when adjusted for case-mix characteristics. For the future, an even more desirable outcome would also include the 'patient's perspective' on the outcome of successful rehabilitation (i.e. goal attainment scaling) on the functional and participation level.

In geriatric rehabilitation, early discharge planning is an important patient care process that can affect patient outcome, especially if they have low nursing support needs.

Timely home discharge is thought to improve functioning in ADL after discharge and reduce hospitalization rates, especially in patients with stroke and traumatic injuries. In case a few nursing support tasks are required during the evening and night, these could be dealt with by a homecare provider or informal caregiver. Geriatric rehabilitation can then be continued with outpatient or home rehabilitation. However, no instruments were available to adequately evaluate earlier discharge to home based on the patient's need for supporting nursing tasks.

The BACK-HOME study **(Chapter 6)** evaluates if weekly scoring of a nursing support scorecard in the evenings/nights and discussing the results in the multidisciplinary team meeting, leads to potential differences in discharge of geriatric rehabilitation patients. The BACK-HOME study is a quasi-experimental study with a reference cohort (n=200) and a BACK-HOME implementation cohort (n=283), in which four SNFs participated. This study concludes that structured scoring of supporting nursing tasks in geriatric rehabilitation may lead to earlier discharge from an SNF to home, if no home adjustments of the home environment are required. The use of a nursing support scorecard may help target which patients have the potential to be discharged home, and to discuss the results in a multidisciplinary team meeting to establish if discharge home planning is really feasible. This implies that nursing staff can play a prominent role in early discharge planning. However, more research is needed to explore the potential benefits of early discharge in geriatric rehabilitation on long-term outcomes on patient functioning, participation and the amount of healthcare resources used.

FINALLY

Because geriatric rehabilitation is a relatively young field of research, more evidence-based practice, expertise and knowledge exchange is required. When aiming to further develop the quality of post-acute geriatric rehabilitation, more research/development on different aspects of structure and processes is needed such as: coordinated multidisciplinary care, early discharge planning and assessment of barriers for discharge, and the development of systematic evaluation with standardized measures. In addition, development of patient-centered care with active involvement of the patient and informal caregiver in goal setting, reporting on outcomes and decision-making, may be beneficial to optimize the quality of care. A good infrastructure for research and development in SNF (such as a university nursing home network) is needed to enable coordinated research in geriatric rehabilitation and to implement research outcomes into daily practice.

CHAPTER 9

Samenvatting

INTRODUCTIE

Als gevolg van de stijgende levensverwachting en betere behandelmogelijkheden voor chronische ziekten en acute zorg, neemt de omvang van de populatie ouderen toe. Tegelijkertijd is de verwachting dat hiermee de groep kwetsbare ouderen met multimorbiditeit groeit. Voor deze specifieke populatie is geriatrische revalidatie belangrijk, omdat het een positief effect heeft op het functioneren van de patiënt na ziekenhuisopname, het leidt tot minder heropnamen in het verpleeghuis en het ziekenhuis en verlaagt de kans op overlijden.

Geriatrische revalidatie bestaat uit geïntegreerde multidisciplinaire zorg die gericht is op verwacht herstel van functioneren, en participatie bij laag belastbare ouderen na een acute aandoening of functionele achteruitgang. Internationaal zijn er veel verschillen in de organisatie van geriatrische revalidatie. In Nederland vindt geriatrische revalidatie plaats op revalidatieafdelingen in gespecialiseerde verpleeghuizen. We staan echter, door het relatief jonge vakgebied, nog maar aan het begin van "de weg" waarop we verkennen wat er nodig is in de organisatiestructuur en revalidatieprocessen om succesvolle revalidatiezorg te kunnen realiseren.

Momenteel zijn er nauwelijks kwalitatief goede studies beschikbaar die gericht zijn op verbetering van de kwaliteit van geriatrische revalidatie. In het bijzonder wordt hier bedoeld onderzoeken van geriatrische revalidatie met als uitkomst succesvolle revalidatie, zoals ontslag naar huis met een goed niveau van fysiek functioneren en optimalisatie van de opnameduur door verbetering van revalidatieprocessen.

Het doel van dit proefschrift is om verschillende aspecten van de organisatiestructuur en revalidatie processen in geriatrische revalidatie te onderzoeken in relatie tot succesvolle revalidatie.

DEEL 1. ASPECTEN VAN SUCCESVOLLE GERIATRISCHE REVALIDATIE

Hoofdstuk 2 richt zich op de relatie tussen organisatiestructuur (hoeveelheid patiënten en concentratie van doelgroepen), als synoniem voor specialisatie, en geriatrische revalidatie uitkomsten. Tot nu toe is er weinig bekend over de optimale organisatie die nodig is binnen de geriatrische revalidatie.

In de studie in hoofdstuk 2 werd in 88 verpleeghuizen de relatie tussen patiëntvolume (hoeveelheid patiënten) en concentratie van doelgroepen op de uitkomst van geriatrische revalidatie onderzocht, met als uitkomstmaat "korte opnameduur in het verpleeghuis en ontslag naar huis". Per geriatrische revalidatieafdeling was het volume gebaseerd op het aantal ontslagen patiënten per kwartaal, en werd ingedeeld laag-, midden- en hoog-volume instelling. Als minimaal 80% van de opgenomen patiënten

op een geriatrische revalidatieafdeling bestond uit 1 of 2 diagnostische groepen werd deze afdeling gedefinieerd als "geconcentreerd". Kenmerken van verpleeghuizen werden verzameld door gestructureerde (telefonische) interviews met locatiemanagers. 88 verpleeghuizen en 2269 geriatrische revalidatiepatiënten met een gemiddelde leeftijd van 78 jaar, hebben deelgenomen aan deze studie.

Deze studie laat zien dat een hoge concentratie, en niet het patiënt-volume, gerelateerd blijkt aan een kortere opnameduur met ontslag naar huis bij patiënten na een electieve operatie (bijna altijd een totale heup of totale knie vervanging). Deze relatie werd niet gevonden bij patiënten met een heupfractuur of een beroerte. Patiënten met een heupfractuur, die revalideerden op een geconcentreerde afdeling, hadden wel een grotere kans op ontslag naar huis, in vergelijking met heupfractuur patiënten verblijvend op een niet-geconcentreerde afdeling.
Meer onderzoek is nodig om te onderzoeken of de concentratie van doelgroepen en patiënt-volume goede indicatoren zijn voor specialisatie, en om te bepalen welke aspecten van organisatiestructuur een gunstige invloed hebben op succesvolle geriatrische revalidatie in termen van kosteneffectiviteit en succesvolle patiënt uitkomsten.

Electieve orthopedie betreft "geplande zorg" in tegenstelling tot acute opname na bijvoorbeeld een beroerte of heupfractuur. De groep electieve orthopedie patiënten is bijzonder geschikt voor preoperatieve screening en beoordeling van het preoperatief functioneren. In **hoofdstuk 3** van dit proefschrift hebben we onderzocht of bij ouderen preoperatieve kracht van de spiergroepen van de onderste extremiteit samenhangt met postoperatief functioneel herstel na een totale heupvervanging. In totaal namen 55 patiënten met een gemiddelde leeftijd van 73 jaar deel aan deze studie. Baseline metingen vonden plaats binnen 2 weken voor de operatie, en de follow-up 6- en 12 weken na de operatie. Deze metingen bestonden uit isometrische krachtmeting van de heup- en knie spiergroepen. Fysiek functioneren werd getest met behulp van uitvoeringsgerichte meetinstrumenten (functionele mobiliteit) en zelf-gerapporteerd functioneren (fysiek en cognitief functioneren) en pijn.

De conclusie van deze studie is dat een preoperatieve grotere kracht van de kniestrekkers (mm. Quadriceps) van de geopereerde zijde is geassocieerd met een beter zelf gerapporteerd fysiek functioneren (WOMAC-PF) 12 weken na de operatie, bij patiënten met een totale heup vervanging. In deze studie werd geen verband gevonden met de uitvoeringsgerichte uitkomstmaten voor functionele mobiliteit, en voor zelf gerapporteerd cognitief functioneren en pijn. Inzicht in (preoperatieve) voorspellers van postoperatief fysiek functioneren in de geriatrische revalidatie geeft informatie over herstel mogelijkheden en kan daardoor mogelijk helpen bij het verbeteren van de kwaliteit van de ontslagplanning.

DEEL 2. INITIATIEVEN OM GERIATRISCHE REVALIDATIE TE VERBETEREN

De algemene organisatie van de geriatrische revalidatie is complex door de versnippering van de zorg waarin veel verschillende partijen (medisch specialisten, professionals en instellingen) betrokken zijn bij het zorgproces. Hoewel er internationaal pogingen zijn gedaan om de kwaliteit van de zorg bij kwetsbare ouderen te verbeteren, is deze niet specifiek gericht op geriatrische revalidatiepatiënten en revalidatieafdelingen in gespecialiseerde verpleeghuizen. Bovendien is er weinig bekend over de perspectieven van professionals (zorgverleners, behandelaren, specialisten ouderengeneeskunde), patiënten en mantelzorgers over de kwaliteit van de zorg tijdens deze verbeterinitiatieven.

Het Ministerie van Volksgezondheid, Welzijn en Sport heeft in 2011 een nationaal programma ('Proeftuinen geriatrische revalidatie') geïnitieerd om de kwaliteit van geriatrische revalidatie te verbeteren. De 'Synergie en Innovatie in Geriatrische revalidatie' (SINGER) studie is uitgevoerd tijdens de implementatie van dit nationale programma. 16 verpleeghuizen namen deel aan deze studie.

Een eerste deel van de SINGER studie (**hoofdstuk 4**) beschrijft de veranderingen in de geriatrische revalidatie zorg- en behandelprocessenervaren door professionals (specialisten ouderengeneeskunde, fysiotherapeuten en verpleegkundigen) en patiënten en hun mantelzorgers. Gedurende drie opeenvolgende cohorten, hebben professionals bij 1075 patiënten bij opname en ontslag vier domeinen van zorg- en behandelprocessen geëvalueerd (afstemming op behoeften van patiënten, zorgcoördinatie, team samenwerking en kwaliteit van zorg). Daarnaast hebben deze patiënten (gemiddelde leeftijd 79 jaar) en hun mantelzorgers vier weken na ontslag van de revalidatie afdeling hun eigen ervaringen met deze domeinen beoordeeld.

Tijdens dit nationale programma ter verbetering van de kwaliteit van geriatrische revalidatie, werden door professionals kleine positieve effecten gevonden in team samenwerking ('triage voor intensieve behandeling' en 'informatie overdracht tussen professionals'). Er werden minder verbeteringen gevonden op de domeinen: afstemming op behoeften van patiënten, zorgcoördinatie en de kwaliteit van de zorg. Eén jaar na de uitvoering van het nationale programma was de mate van tevredenheid van patiënten en mantelzorgers met de geriatrische revalidatieprocessen vergelijkbaar met de start van het programma. Deze studie geeft inzicht in de doorontwikkelingsrichting voor het optimaliseren van geïntegreerde zorg, gebaseerd op de vier domeinen van zorg en behandelprocessen.

Een tweede deel van de SINGER studie (**hoofdstuk 5**), beschrijft de veranderingen in resultaten van de revalidatie op patiëntniveau. We kozen als uitkomstmaat succesvol revalideren. Succesvolle geriatrische revalidatie werd gedefinieerd als onafhankelijkheid in algemene dagelijkse levensverrichtingen (ADL) bij ontslag in combinatie met ontslag naar huis na een korte opnameduur in het verpleeghuis.

Hiervoor zijn twee groepen oudere patiënten met elkaar vergeleken, te weten; Eén groep patiënten een jaar na de start van dit nationale programma, in vergelijking met een groep patiënten bij start van het programma. In totaal namen 743 patiënten (gemiddelde leeftijd 80 jaar) uit 16 verpleeghuizen, die voor geriatrische revalidatie in aanmerking kwamen en hun professionals (specialisten ouderengeneeskunde, fysiotherapeuten en verpleegkundigen) deel aan deze studie.

Eén jaar na de uitvoering van de proeftuinen geriatrische revalidatie bleek het percentage ouderen dat zelfstandig functioneerde in ADL na geriatrische revalidatie met 12% te zijn toegenomen. De gecombineerde uitkomstmaat van succesvolle revalidatie (onafhankelijkheid in ADL en ontslag naar huis met een korte opnameduur in het verpleeghuis) was alleen verbeterd bij patiënten met geriatrische revalidatie na een heupfractuur.

Deze gecombineerde uitkomstmaat (onafhankelijkheid in ADL, ontslag naar huis met een korte opnameduur in het verpleeghuis) blijkt een generieke uitkomstmaat voor de totale populatie die voor geriatrische revalidatie in aanmerking komt. Deze generieke maat maakt het mogelijk om de prestaties te vergelijken binnen de diagnostische groepen (heupfractuur, totale heup- en totale knie vervanging, beroerte en overige groep) en tussen faciliteiten voor geriatrische revalidatie, gecorrigeerd voor verschillende patiënt en organisatie kenmerken.

Voor de toekomst lijkt het wenselijker als het 'patiënt perspectief' van succesvolle revalidatie op functioneel en participatieniveau (bijvoorbeeld d.m.v. "goal attainment scaling") een belangrijk onderdeel uitmaakt van de uitkomst succesvol revalideren.
In geriatrische revalidatie is tijdige ontslagplanning belangrijk voor het revalidatieproces en kan mogelijk van invloed zijn op de revalidatie uitkomsten voor de patiënt. Tijdig ontslag naar huis heeft een positief effect op het verbeteren van ADL functioneren na ontslag uit het verpleeghuis vooral bij patiënten die revalideren na een beroerte of heupfractuur. Een mogelijke verklaring is dat ADL activiteiten sneller worden hervat in de thuissituatie. In het geval dat er minimale ondersteuning van zorg noodzakelijk is tijdens de avond en nacht, kan dit ook worden geboden door een thuiszorgorganisatie en/of mantelzorger. Geriatrische revalidatie kan vervolgens worden voortgezet met ambulante revalidatie in het verpleeghuis of thuis. Er zijn echter geen instrumenten beschikbaar om na te gaan of ontslag naar huis mogelijk is op basis van het benodigde aantal verpleegkundige steuntaken.

De BACK-HOME studie (**hoofdstuk 6**) evalueert of het wekelijks scoren van de verpleegkundige steuntakenscorelijst in de avond en nacht, en het bespreken van de resultaten in het multidisciplinaire team overleg, leidt tot afname van de opnameduur in het verpleeghuis bij geriatrische revalidatiepatiënten. De BACK-HOME studie is een interventie studie met een referentie-cohort (n = 200) en een BACK-HOME implementatie- cohort (n = 283), waaraan 4 verpleeghuizen deelnamen. Voorafgaand aan de

interventie (referentie cohort) is de gemiddelde verblijfsduur van de revalidanten in de verschillende instellingen vastgesteld. In het BACK-HOME implementatie cohort is gedurende 1 jaar de steuntakenscorelijst wekelijks gescoord gedurende de avond en nacht door getrainde verpleegkundigen. De uitkomsten van de steuntakenscorelijst werd besproken in het multidisciplinaire team overleg. Wanneer er sprake was van maximaal 2 steuntaken in de avond werd de mogelijkheid tot ontslag besproken. Bij opname werden patiëntkarakteristieken en woonsituatie (voor ziekenhuisopname) geregistreerd. Bij ontslag werd de opnameduur en eventuele barrières voor ontslag door verpleegkundigen geregistreerd.

Deze studie concludeert dat het gebruik van de verpleegkundige steuntakenscorelijst in de geriatrische revalidatie leidt tot eerder ontslag uit een verpleeghuis naar huis, alleen als er geen woningaanpassingen noodzakelijk blijken te zijn.

Het gebruik van de verpleegkundige steuntakenscorelijst kan helpen patiënten te herkennen die mogelijk met ontslag naar huis zouden kunnen gaan. De uitkomsten van de steuntakenscorelijst worden besproken in een multidisciplinair teamoverleg om vast te stellen of ontslag naar huis haalbaar is. Dit houdt in dat het verplegend personeel een prominente rol speelt in de ontslagplanning. Er is echter meer onderzoek nodig om de potentiële voordelen van vroegtijdig ontslag in geriatrische revalidatie te onderzoeken alsook de effecten op de lange termijn op patiënt functioneren, participatie, zorgconsumptie en kosteneffectiviteit.

TOT SLOT

Geriatrische revalidatie is een relatief jong onderzoeksgebied, meer evidence based practice, expertise en kennis uitwisseling is noodzakelijk. Bij het streven naar verbetering in de kwaliteit van de geriatrische revalidatie, is meer onderzoek en ontwikkeling op de verschillende aspecten van organisatiestructuur en revalidatieprocessen nodig. Voorbeelden hiervan zijn gecoördineerde multidisciplinaire zorg, tijdige ontslagplanning, evaluatie van barrières voor ontslag, en de ontwikkeling van een systematische evaluatie met gestandaardiseerde uitkomstmaten. Daarnaast is de ontwikkeling van patiëntgerichte zorg met actieve betrokkenheid van de patiënt en mantelzorger, in het stellen van revalidatie doelen, het rapporteren over de resultaten en de besluitvorming, belangrijk om de kwaliteit van de zorg te optimaliseren. Een goede infrastructuur voor onderzoek en ontwikkeling in het verpleeghuis (zoals een academisch verpleeghuis netwerk) is nodig om gecoördineerd onderzoek in geriatrische revalidatie mogelijk te maken en om onderzoeksresultaten te implementeren in de dagelijkse praktijk.

APPENDIX

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Dankwoord

Curriculum Vitae

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CURRICULUM VITAE

Marije Sara Holstege was born on 7 July 1980 in Alkmaar, the Netherlands. In 1999, after graduating secondary school, she began her physiotherapy study at the 'Hogeschool van Amsterdam' (HvA). In 2002 she started a research elective at the department of Rehabilitation Medicine at the VU medical center in Amsterdam. In 2003 she graduated cum laude for her Bachelor of Health (Bhealth) degree and started to work as a physiotherapist in a skilled nursing facility at 'Evean'. Then, in 2005 she began the Master Evidence-Based Practice in Health Care (Clinical epidemiology) study at the University of Amsterdam where she graduated in 2009. During this period, she also started as chair of the scientific board of 'Evean' and member of the University Network Elderly care (UNO-VUmc) at the VU medical center. From 2010 to 2016, she was a researcher at 'Evean' at the department of Innovation and Development: during that period, she was involved in various projects and initiated pilot studies that were aimed at improving the quality of care and outcomes for vulnerable older persons in skilled nursing facilities. In 2011 she started her PhD project, that is described in this thesis, at the department of Public Health and Primary Care of the Leiden University Medical Center (supervisors: Prof. W.P. Achterberg, Prof. J. Gussekloo, Dr. M.A.A. Caljouw, Dr. R. van Balen). At present, she is working as a senior researcher at 'Evean'. Marije has a special interest in applied research in vulnerable older persons in skilled nursing facilities and currently focuses on geriatric rehabilitation and e-health innovations.