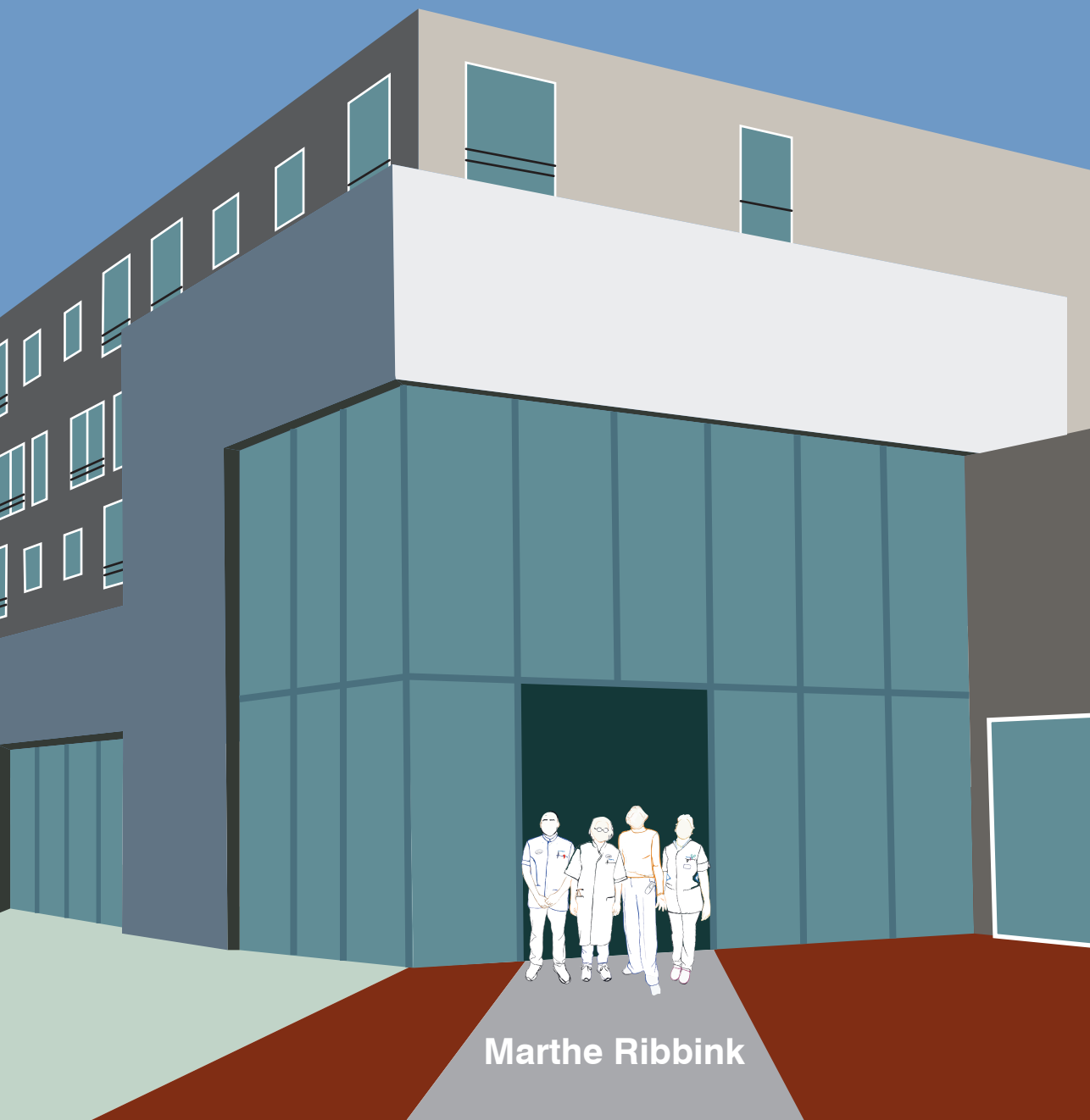
The implementation and evaluation of an acute geriatric community hospital in the Netherlands



Marthe Ribbink

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Marthe Elisabeth Ribbink

The research in this thesis on the Acute Geriatric Community Hospital (De Wijkkliniek) is funded by ZonMw, the Netherlands Organization for Health Research and Development (grant number 808393598041) and the PVE fund. Care is provided at the AGCH in a partnership between Cordaan (a community, intermediate, and home care organization) and the Amsterdam University Medical Centers. The AGCH is financially supported by Zilveren Kruis, a health insurance company.

Chapters 2 & 5: The Hospital-ADL study was supported by ZonMw, grant number 16156071

Chapter 3: this research was supported by the Amsterdam Public Health – Ageing and Later Life travel grant 2019.

Stelling 11 & 12 uit: Een geval van albumosurie, Ribbink, Herminius Carl George Ludolf. Gorinchem : F. Duym, 1892. Persistent Identifier: https://pid.uba.uva.nl/ark:/88238/b1990001123000205131
Identifiers: OCLC : 64665340

The printing of this thesis was financially supported by the Amsterdam UMC, location AMC & Cordaan.

ISBN: 9789083252230
Cover: Mijn Proefschrift en Annemieke Smorenberg
Lay-out: Mijn Proefschrift | www.mijn-proefschrift.nl
Printed by: Ipskamp Printing, Enschede

The implementation and evaluation of an acute geriatric community hospital in the Netherlands

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad van doctor
aan de Universiteit van Amsterdam
op gezag van de Rector Magnificus
prof. dr. ir. P.P.C.C. Verbeek
ten overstaan van een door het College voor Promoties ingestelde commissie,
in het openbaar te verdedigen in de Aula der Universiteit
op vrijdag 16 december 2022, te 14.00 uur

door

Marthe Elisabeth Ribbink
geboren te AMSTERDAM

Promotiecommissie

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1 General introduction

General introduction

Mrs. Goslinga
Mrs. Goslinga is an 82-year widow who lives at her daughter's home. Mrs. Goslinga suffers from diabetes, hypertension and was recently diagnosed with Alzheimer's disease. She still goes shopping for groceries on her own and as a pastime she likes to play Scrabble. With the informal care and help her four children provide she has been able to manage until she falls and breaks her hip. She is rushed to the Emergency Department (ED) where she receives surgery within 24 hours. She recovers slowly after surgery and becomes increasingly vulnerable throughout the year resulting in two hospitalizations; once for pneumonia and a second time for a urinary tract infection, complicated by delirium. Throughout the year she loses much of her vigor and can no longer perform her usual Activities of Daily Living (ADL) such as bathing, dressing herself and toileting.[1] As she can no longer live at home without the continuous help of others she moves to a nursing home.

An increased demand for acute care in older adults

Providing care to older adults is a challenge for countries with ageing populations.[2] Throughout Europe recent care reforms have focused on 'aging in place' by providing more care in the community.[3] At the same time, health care systems are confronted with an increase of older adults, like Mrs. Goslinga, who require acute care services.[4] Moreover, when looking at the division of healthcare services by age, inpatient services are mostly consumed by those over the age of 65.[5, 6]

The Netherlands recently (2015) implemented stay-at-home policies leading to an increase of frail older adults living longer in the community.[7] It is suggested that these reforms also put stress on acute care pathways and contribute to overcrowding in EDs.[8]

Furthermore, when looking at the care system, the demand for care older adults is increasing while at the same time there is a shortage of healthcare workers. It is expected that one in three workers in the Netherlands has to work in healthcare by 2060 to meet the increased care demand.[9] Currently, one in seven workers works in healthcare. This development is a great challenge to the provision, sustainability, and affordability of care. As the Dutch Scientific Council for Government Policy states in their 2021 report, we need to think of ways in which we can provide *less* care with *less* healthcare workers for *less* money if we want to protect the access of healthcare to all in the future.[9]

Problems older patients experience when admitted to hospital

The provision of acute care for older adults itself is complicated because when older adults go to the hospital they often present with complex and atypical health problems.[10, 11] After subsequent hospitalization, there is an increase in poor health outcomes such as disability, morbidity or mortality.[12] For example, previous research showed that 30% of hospitalized older adults gain new disabilities and 20% are readmitted within 30 days post-discharge.[13, 14]

Patients with geriatric syndromes have even higher risks of adverse outcomes compared to older adults who do not suffer from these conditions.[15-17] Geriatric syndromes such as cognitive impairment[15], delirium[18], frailty[17], malnutrition and depressive symptoms[16], are multi-factorial conditions that are highly prevalent

among older adults.[19] Cognitive impairment and delirium may increase risk of functional decline, nursing home placement and mortality.[15, 18] Frailty, malnutrition and depressive symptoms may increase mortality, risk on functional decline, and hospital readmission.[16, 17] According to Fried et al.[20] frailty is a clinical syndrome that can be defined as reduction in the physiological reserve presenting with self-reported exhaustion, muscle weakness, unintentional weight loss, low walking speed and low physical activity, but other definitions exist in literature.[21]

Moreover, older adults frequently suffer from multiple chronic conditions (MCC), for example a patient suffering from diabetes, hypertension and heart failure.[22] Older hospitalized adults with MCC are predisposed to poorer outcomes compared to older adults who suffer from a single disease[23] including early unplanned hospital readmissions, functional decline and potential overtreatment in the final months of life.[13, 14, 24] The high prevalence of MCC and geriatric syndromes in older adults contribute to poor outcomes after hospitalization. Hospitalization itself may also contribute to older adults' reduced mobility.[25, 26] Low physical activity may contribute to the development of new disabilities, particularly in frail patients.[27, 28]

Low physical activity, noise from the hospital environment and visits by many different staff members also contribute to sleeping problems in older hospitalized adults. Sleeping problems and sensory overstimulation can in turn contribute to the occurrence of delirium.[29] The etiology of delirium is multifactorial and the prevalence and incidence of delirium varies between settings and populations. Incident or new-onset delirium occurs in 10% to 56% of hospitalizations.[30]

Hospital admissions are also stressful for informal caregivers like Mrs. Goslinga's children. Following recent care reforms, informal caregivers in the Netherlands have spent more time in providing care, which has led to an absolute increase in caregiver burden.[31] At the same time, the role of informal care givers in discharge planning and providing care once a patient has returned home has become increasingly important. Evidence exist that involving informal caregivers in discharge planning can reduce hospital readmissions.[32] Lack of discharge planning in the hospital can result in patients' care needs being unmet, which can in turn potentially increase the burden on informal caregivers.[33] Readmissions themselves can also affect patients' recovery and increase healthcare costs.[34] It is therefore essential to involve both the patient and informal caregivers to improve discharge planning, relieve stress and prevent unwanted outcomes such as unplanned readmissions in the post-acute care phase.[32]

Alternative models of care for older adults

Hospital at home, outpatient management and nurse-led intermediate care units

Different models of care that aim to avoid admission to an acute hospital have already been developed. Such alternatives to conventional hospitalization for older adults include among others, Hospital at Home (HaH), outpatient management and (nurse-led) intermediate care units.[35-37] These models of care aim to provide better care for older populations and they show similar clinical and patient satisfaction outcomes compared to conventional hospitalization. HaH, for example has been evaluated in multiple studies and has been implemented in many countries.[35, 38-40] Moreover, nurse-led care in the United States, observation units and HaH care all show a potential cost reduction compared to care as

usual.[36, 37] However outpatient follow-up and HaH may only be possible when patients have an informal caregiver. Besides, depending on where patients live, or the clinical context, acute or unplanned care may not be as easily provided in an outpatient or home setting.

Intermediate care services
Bed-based intermediate care services for older adults could be a better alternative than HaH for those recovering from acute illness. *Intermediate care* was defined in an international Delphi study as: care that represents a broad range of time-limited services that aim to ensure continuity and quality of care; promote recovery; restore independence and confidence; or prevent a decline in the functional ability at the interface between hospital, home, long-term care (nursing homes), primary care and community services.[41] Bed-based intermediate care services can fill the gap between primary care and secondary care. Specifically an acute geriatric unit located in intermediate care can be seen as a link within the continuum of services for older adults situated either in a hospital, intermediate care or at home.

European examples of acute geriatric units in intermediate care
An acute geriatric unit was opened in 2012 at an intermediate care facility in Barcelona, Spain.[42] Here, a specific ward, the Subacute Care Unit (SCU), provides care for older adults with exacerbations of chronic conditions or 'minor' acute events. Previous studies of this unit have shown that this model of care is an alternative to conventional hospitalization for selected older patients.[42, 43] Furthermore there are community hospitals in Northern Europe and the United Kingdom which can also provide hospital care such as the administration of IV-medication.[44] However, these community hospitals typically also provide care in the post-acute care phase and therefore have a longer length of stay(range 11-58 days) compared to an acute geriatric unit (range 10-14 days).[45]

The development of an acute geriatric unit in the Netherlands
Until recently the Netherlands had limited alternatives to hospitalization for older adults who required acute care. In 2018 the Dutch government implemented a program called 'the right care at the right place' with the aim to enable aging in place. This program includes health insurers financing alternative models of hospital care.[46] In light of these developments our research group sought to create an acute care alternative and opened the Acute Geriatric Community Care Hospital (AGCH) in July 2018, partnering an academic hospital (Amsterdam UMC, location AMC), an insurance company (Zilveren Kruis) and a home care and nursing home agency (Cordaan). This acute geriatric care unit, which is based within an intermediate care i.e., skilled nursing facility, provides an alternative to conventional hospitalization and delivers acute care closer to home.

The Acute Geriatric Community Hospital
The care pathway of the Acute Geriatric Community Hospital
The Acute Geriatric Community Hospital serves the south-eastern part of Amsterdam and its surrounding areas (an area with approximately 150 000 inhabitants).[47] This 23-bed unit is located in a skilled nursing facility which

integrates specialized medical treatment with geriatric nursing care. Patients are selected for admission at the ED of a university or general hospital and then transferred to the AGCH. Figure 1 shows the admission route to the AGCH. Older adults with common medical problems (such as urinary tract infections, pneumonia, or heart failure) and geriatric syndromes requiring hospital admission can be admitted to the AGCH.

The AGCH identifies medical conditions, geriatric syndromes and care needs through Comprehensive Geriatric Assessment (CGA).[48] The care at the AGCH is supervised by a geriatrician and provided by nurses trained in geriatric care who have experience as either a hospital or community nurse. The patient care goals of the AGCH are to treat acute medical conditions, improve self-efficacy[49] and prevent functional decline through mobilization.[13] To achieve these goals the AGCH has an adapted environment with single rooms and open hallways that allow patients to mobilize. Also, patients are encouraged to set daily goals, to promote self-efficacy and mobilization. Patients are offered physical therapy, including simple daily exercises.[50, 51]

In addition the AGCH aims to improve sleep, orientation and prevent overstimulation because sleep deprivation, disorientation and overstimulation increase occurrence of delirium.[30] A continuous non-contact heart and respiration rate monitor (Early Sense™)[52] is used, which allows monitoring the patient's vital signs without waking the patient at night. The AGCH has extended visiting hours and informal caregivers may stay with their admitted partner or family member during the night (known as rooming-in), as these adaptations help to improve the patient's orientation.

The AGCH involves patients and their informal caregivers in treatment and discharge planning because this can reduce the risk of hospital readmission.[32] Furthermore, we know that discharge planning and follow-up compared to hospital care as usual can lower the rate of readmissions.[53] At the AGCH discharge planning is discussed with the patient and informal caregivers within 48-72 hours after admission.[54] Treatment goals required for discharge are set by the physician or nurse practitioners and nurses arrange post-discharge care during admission. Personal or "warm" handovers by telephone are used to inform primary care providers that the patient is being discharged and to assist in (re) starting primary care. If possible discharge letters are returned to primary care practitioners within 48 hours after discharge.[54]

These interventions— CGA, early mobilization, improving sleep and orientation, caregiver involvement and discharge planning, aim to result in better clinical outcomes of care, patient and informal caregiver satisfaction with care and reduce post-acute care costs.[55] Creating an attractive work environment is also a goal of the AGCH, because community care sector struggles to recruit enough healthcare workers.[56]

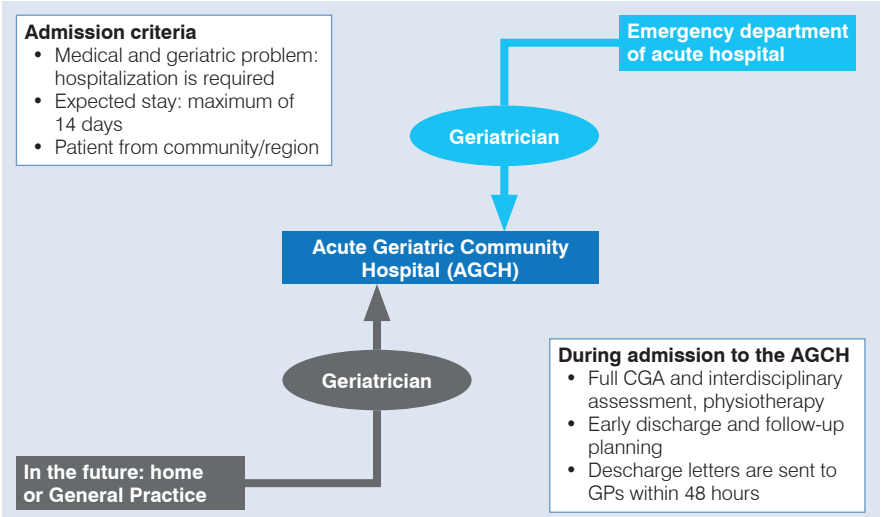

Figure 1 Patient admission process and criteria, components of the AGCH intervention and goals. CGA= Comprehensive Geriatric Assessment[48] GP= General Practitioner. Figure 1[55] provides an overview of the AGCH patient admission process and criteria. Furthermore, a potential future admission 'direct' admission route through primary care is presented (in grey).

Aim and content of this thesis

The aim of this thesis is to provide evidence concerning the implementation and effectiveness of the Acute Geriatric Community Hospital. *Chapter 2* provides insight into the distribution of post-acute care costs in older hospitalized adults and shows what patient characteristics are associated with high post-acute care costs. In *Chapter 3* and *4* we describe the care model of the AGCH and provide preliminary data of the prospective observational cohort study at the AGCH. *Chapter 3* is a comparison of the AGCH care model to a similar model of care that has been implemented in Barcelona, Spain. *Chapter 4* specifically contains the study protocol for the AGCH prospective cohort study. *Chapter 5* then presents the results of the AGCH prospective cohort study controlled with a historical control group. The primary composite outcome of this study was 90-days readmission or death. Secondary outcomes included admission to long-term residential care, functional dependence over time, occurrence of falls, and death. In *Chapter 6* we present the results from a mixed-method study that focuses on the patient experience of the AGCH-care pathway, this study aims to gain insight into the patient experience and to describe patient satisfaction with admission to the AGCH. In *Chapter 7* we aimed to identify facilitators and barriers associated with the implementation of the AGCH using the theoretical model of adaptive implementation. *Chapter 8* concerns evaluating one of the secondary outcomes of the AGCH-study: the incidence of delirium. This exploratory study compares the incidence of delirium at the AGCH to pooled delirium incidence rates in hospitals from six studies found in a high-quality review. *Chapter 9* is the general discussion of this thesis and *Chapter 10* provides a summary of the presented chapters.

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2

Determinants of post-acute care costs in acutely hospitalized older adults: the Hospital-ADL study

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J Am Med Dir Assoc 2019;20 (10):1300-1306

Abstract

Objectives: After hospitalization many older adults need post-acute care, including rehabilitation or homecare. However, post-acute care expenses can be as high as the costs for the initial hospitalization. Detailed information on monthly post-acute healthcare expenditures and the characteristics of patients that make up for a large share of these expenditures is scarce. We aimed to calculate costs in acutely hospitalized older patients and identify patient characteristics that are associated with high post-acute care costs.

Design: Prospective multicenter cohort study (between October 2015 and June 2017).

Setting and participants: 401 acutely hospitalized older persons from internal medicine, cardiology, and geriatric wards.

Measurements: Our primary outcome was mean post-acute care costs within 90 days post-discharge. Post-acute care costs included costs for unplanned readmissions, home care, nursing home care, general practice and rehabilitation care. Three costs categories were defined: low [0-50th percentile (p0-50)]; moderate (p50-75); and high (p75-100). Multinomial logistic regression analyses were conducted to assess the associations between costs and frailty, functional impairment, health-related quality of life, cognitive impairment and depressive symptoms.

Results: Costs were distributed unevenly in the population, with the top 10.0% (n=40) accounting for 52.1% of total post-acute care costs. Mean post-acute care costs were €4035 euro [standard deviation (SD) 4346)] or $4560 (SD 4911). Frailty [odds ratio (OR) 3.44, 95% Confidence Interval (CI) 1.78-6.63], functional impairment (OR 1.80, 95% CI 1.03-3.16) and poor health-related quality of life (OR 1.89, 95% CI 1.09-3.28) at admission were associated with classification in the high cost group, compared to the low cost group.

Conclusions/Implications: Post-acute care costs are substantial in a small portion of hospitalized older adults. Frailty, functional impairment and poor health-related quality of life are associated with higher post-acute care costs and may be used as an indicator of such costs in practice.

Introduction

In many Western countries, including the Netherlands, overall demand for healthcare is increasing due to aging populations. Acute hospitalizations in older persons are an important driver of increasing healthcare expenditures. Moreover post-acute care expenses can be high in these patients. For example, the cost of readmission along with post-discharge care like rehabilitation care and nursing care can be just as costly if not more than then initial index admission.[1] The high demand for post-acute care in older persons is often caused by the presence of multiple medical and functional problems.[2] Older patients develop impairments in performing activities of daily living and after hospitalization often do not regain their previous level of functioning.[3-5] Moreover, such functional loss is associated with the need for home care or rehabilitation, which might result in a long-term stay in a nursing care facility.[6-8] Furthermore, over 20% of older patients require rehospitalization within 30 days postdischarge.[2]

Insights into post-acute care spending and characteristics of high cost patients are of interest to policy-makers and care managers alike, as such information may reveal opportunities for care improvement or cost reduction.[1, 9-11] When studying overall healthcare costs it is often found that a small population of patients with multiple chronic conditions consume most care.[12-14] Furthermore, previous studies have identified frailty as a risk factor associated with increased healthcare utilization.[15] Although the association between frailty and costs might overlap with the association between costs and functional status or comorbidity, frailty has been described as a distinct entity.[16, 17] Most preventable costs, such as for preventable hospital admissions, can be attributed to frail patients.[18] Other determinants, such as depressive symptoms and cognitive impairment are associated with poorer outcomes, and can also be related to increased healthcare utilization.[19, 20] Although high health care costs are thus often caused by multiple underlying factors, the problems that are associated with high care costs in older patients are often studied individually, describing only 1 determinant of increased overall healthcare or hospital care utilization.[15, 21]

Previous research in healthcare costing has focused on large cohorts of patients, often derived from insurance or, in the United States, Medicare databases.[1, 11, 22] These studies have shed light on the distribution of healthcare costs in various populations. They indicate that healthcare utilization and associated costs are typically unevenly spread; high cost groups, top 10% or even 1 % often make up for 20% to 50% of the total healthcare budget.[10, 11, 22] Targeting particular high-cost patient groups, who have high inpatient and post-acute care costs may help to reduce costs more effectively.[9, 23, 24]

However, currently there are few studies that provide a detailed description of post-acute healthcare expenditures in older patients and the characteristics of patients that make up for a large share of these expenditures. Insight into the characteristics of these patients can help to identify targets for cost-reduction strategies and care improvement.[23] Therefore, the objectives of this study were to (1) calculate costs that are associated with post-acute care in acutely hospitalized older patients, and (2) identify and analyze patient characteristics and clinical measurements (ie determinants) that are associated with high post-acute care costs in the 90 days following hospitalization.

Methods

Study Design and Setting

The Hospital-Associated Disability and impact on daily life (Hospital-ADL-study) is a multicenter prospective cohort study. The study was conducted between October 2015 and June 2017, including a 3-month follow-up period. Further details of the study can be found in the study protocol, which was published elsewhere.[25] Participants were recruited from Internal Medicine, Cardiology, or Geriatric wards at 6 hospitals in the Netherlands.

Study population

Patients aged 70 and older requiring an acute admission to the hospital were eligible for inclusion. Following inclusion criteria were applied: (1) approval of the attending medical doctor, (2) sufficient Dutch language proficiency to complete questionnaires, and (3) Mini-Mental State Examination (MMSE)[26] score ≥. We were not able to include patients diagnosed with delirium, due to the short time frame of inclusion, i.e. 48h after admission. The researcher asked the attending medical doctor for approval, for example to confirm that the patient was not delirious or terminally ill and could be approached. Also, patients were excluded if they: had a life expectancy of less than 3 months or were disabled in all basic activities of daily living.[27] Besides community dwellers, individuals who did not live independently, but, for example, in a nursing home, were also eligible for inclusion. Two trained researchers (R.S. and L.R.) visited the participating wards on Mondays, Wednesdays and Fridays and contacted eligible patients within 48h after hospital admission. After informed consent was obtained, patients were enrolled in the study.

Definition of healthcare utilization and costs

Data on post-discharge healthcare utilization were collected through reviewing patient files, that is, medical records, and questionnaires that were conducted either interviewing patients over telephone (at 2 months postdischarge) or during home visits (at 1 month and 3 months postdischarge). Interviews were conducted by trained research personnel. Costs were determined according to the Dutch Manual for Costing studies, and standard costs were obtained and set for the year 2017.[28] We included costs that are funded through the Dutch healthcare system.[28] We assessed the following units of care during the 90 days after discharge: (1) number and duration of acute (unplanned) readmissions within the last month; (2) number of general practice visits, during office hours and outside of office hours; (3) number and duration of admissions and returns to a home for the elderly, nursing home (including palliative care) or rehabilitation facility (4) number of hours of home care per week: both medical as nonmedical home care; (5) rehabilitation care, namely the number of outpatient physiotherapist consultations and occupational therapy sessions. We did not collect data on emergency room visits and therefore could not calculate costs for these visits. Also omitted were elective readmissions, such as admissions for cataract surgery, pacemaker insertion, chemotherapy or other procedures, because describing these types of care costs lies beyond the scope of this study. Observation days were included because in the Netherlands, there is no difference in the standardized cost rate for

an observation day versus an inpatient day.[28] Costs of patients living in a nursing home, senior residence or in a rehabilitation facility were assessed using the per diem cost tariff in the Dutch Costing Manual, this tariff includes rent, nursing, home care and daily activities.[28]

Primary outcome measure

We first calculated the mean and median costs, which was the sum of post-acute care costs over 3 months. For the primary outcome in the multinomial regression model, we made a categorical variable based on the sum of 3-month post-acute care costs. Patients who had below median costs (p0-p50) were labeled as the low-cost group. The third quartile of costs (p50-p75) was labeled as moderate-cost group and above that (p75 >) was labeled as high-cost group.

Measurements and Determinants in Relation to Costs

All measurements, including baseline demographic characteristics, length of hospital stay (LOS), hospitalization in the past 6 months and score on the Charlson Comorbidity Index were assessed at admission.[29] The Charlson Comorbidity Index is a common parameter that can be used to correct for any overlap between comorbidity, disability and frailty.[16] Baseline characteristics included age, sex, living arrangements before admission, marital status, whether participants were born in the Netherlands, level of education (primary, elementary/ domestic, secondary, higher level education) and admission diagnosis (see Table 1 for a complete overview).

Functional impairment was defined as a score of 1 or higher on the Katz-6 ADL index.[27] Depressive symptoms were classified as a score of 6 or higher on the 15-item, Geriatric Depression Scale (GDS-15).[30] Cognitive impairment was defined as a MMSE of 23 points or lower.[26] Health-Related Quality of Life (HRQOL) was measured using the EQ-5D questionnaire. Based on the answers to the EQ-5D, utility scores were calculated using the Dutch EQ-5D tariff.[31] The EQ-5D is widely used to measure HRQOL and is validated in many countries. The questions concern mobility, self-care, usual activities, pain and discomfort, anxiety and depression.[32] HRQOL is expressed as a utility score between 0-1, where 0 equals death and 1 perfect health. Poor HRQOL was defined as utility score below the median value.[33]

Frailty was assessed according to the criteria described by Fried et al.,[34] including weight loss, fatigue, low physical activity, slowness and muscle weakness. A person was considered frail when 3 or more criteria were present. Weight loss was dichotomized as determined by the SNAQ-score: having lost 6 kg or more in the last 6 months, or 3 kg or more in the past month.[35] Fatigue was defined by a Numerical Rating Scale (NRS) score of 4 or more on the question: "On a scale of 0-10 how would you score your sense of fatigue at this time?"[36] Low physical activity was scored as present when patients reported that they did not do any physical exercise, walking, cycling or swimming for 30 minute at least monthly, in the past 6 months. Slowness was defined with a cut-off point of walking slower than 6.42 seconds on a 4-m walking test.[34] We measured muscle weakness using maximum handgrip strength (Jamar). Cut-off points were <18 kg for women and <30 kg for men.[34]

Statistical analysis

Missing values for cost and effect data were imputed using multiple imputation by chained equations with predictive mean matching.[37] We reported missingness and used chi-square or Kruskal-Wallis test to evaluate differences between the group with complete and missing cost data. Individual subcosts per category were imputed instead of total costs to maximize the accuracy of the imputation.[38] We created 25 datasets where the analysis results were pooled using Rubin's rules.[39] Cost groups (low, moderate, and high) were calculated per imputed dataset and pooled in further analyses.

We used multinomial logistic regression models to calculate Odds Ratios (OR) to estimate the association between variables and the 3 cost-groups.[40] The low cost group was the reference group in all analyses. Besides crude analysis, we adjusted for demographic characteristics: age (continuous), sex, educational level, marital status and/or living situation in all adjusted multivariable multinomial logistic regression analyses. We ran a further adjusted analysis including length of stay (LOS), hospitalization in the past 6 months and score on the Charlson Comorbidity Index.[29] For sensitivity analyses, we performed a complete case analysis, including only complete cases and patients who died within three months post-discharge. Moreover, we performed additional sensitivity analyses to see if postdischarge costs and associations would be different if participants who originated from a nursing home or senior residence would be excluded from the analysis. Data was analyzed using SPSS version 25.00.

Results

Participants and study sample

In total, 1024 consecutive patients were determined eligible for participation, of whom 505 did not meet inclusion criteria, could not be approached or were too ill to participate. Of the 519 remaining patients, 401 were enrolled in the study. Forty patients (10.0%) died within the first three months post- discharge, of whom 28 died during admission or within the first month post-discharge. For these 28 patients post-acute care costs were zero. Overall we had 296 complete (including those who died and whose costs were set to zero) and 105 incomplete cases, missing partial or all cost data. Overall cost data missingness was 25%. Baseline missingness was very low (range 94.51- 99.75 % complete), except for the frailty variable, which was low (84.5% complete). Participants who were single or widow(er), or had an lower education were more likely to have missing data.

Mean care costs and distribution of costs

In the imputed dataset we found that mean costs, that is, the average per-person value, for index admission were €4121 [standard deviation (SD) €7597 or $4657 (SD $5846)].41 Mean costs for post-acute care were €4035 [SD €4346; $4560 (SD $4911)]. Post-acute care costs were distributed unevenly in the population, with the top 10.0% (n=40) of participants accounting for 52.1% of total post-acute care costs. Mean healthcare costs were highest in the first month post-discharge: €1689 euro ($1909) and were €1161 ($1312) and €1186 euro ($1340) in the second and third month respectively. Of total costs, 40.9% were attributed

to unplanned readmissions. (Figure 1) Additional analysis showed that in patients who originated from the community the average costs for post-acute care were €3366 euro (SD €7018), equal to $3804 (SD $7930).

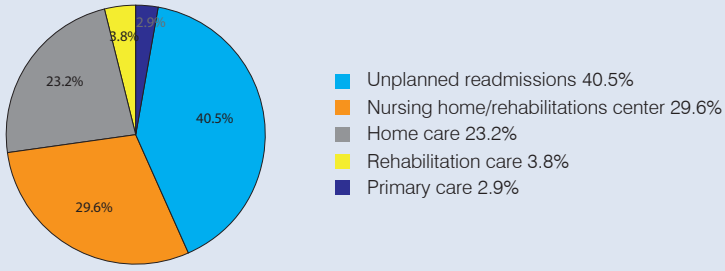

Figure 1. Distribution of post-acute care costs, by type of care

Costs groups and patient characteristics by cost group

Total post-acute care costs for the 401 cases were €1.6 million euro ($1.8 million). The low-, moderate- and high-cost groups accounted for 4.3%, 16.3% and 79.4% of total post-acute care costs, respectively. In Figure 2, we present the mean costs for index admission and the mean associated post-acute care costs per cost group based on index admission. Table 1 presents the baseline table per cost group based on post-acute care costs: participants in the high cost group tended to be older, had a higher length of stay (LOS), were often previously hospitalized and tented to be nursing home residents more often than patients in the low- and moderate- cost groups.

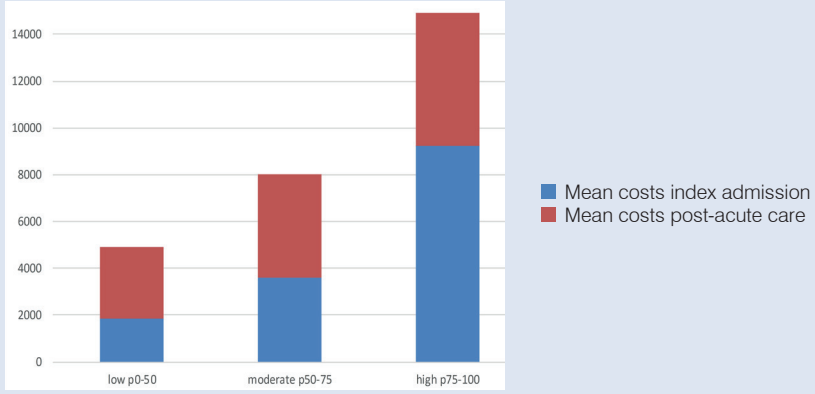

Figure 2. Displaying the mean costs of the index admission and associated post-acute care costs, in euro, per cost group defined as low (p=percentile, p0-50), moderate (p50-75) and high (p75-100). In the lowest cost group (p0-p50) mean index admission cost and associated mean post-acute care costs in euros were 1 852 (SD 2 746) and 3062 (SD 7 797). In the group p50-75, these costs were 3 581 (SD 2 181) and 4 416 (SD 6 948) and for the highest quartile (p75-p100) this was 9 146 (SD 6 289) and 5 556 (SD 10 114). In US dollar these costs would be 2093 (SD 3 103) and 3460 (SD 8 811) in the lowest cost group (p0-p50). In the group p50-75, these costs were 4047 (SD 2 465) and 4 990 (SD 7 851) and for the highest quartile (p75-p100) this was 10 335 (SD 7 107) and 6 278 (SD 11 429).

Table 1. Patient characteristics and cost groups n=401

Patient characteristics	Low-cost group N= 201	Moderate-cost group N=100	High-cost group N= 100
Age in years, mean (SD*)	78.9 (6.7)	80.6 (8.1)	80.2 (7.2)
Male, N(%)	114 (56.7)	48 (48.0)	45 (45.0)
Living arrangements before admission, N(%)			
Independent	181 (90.0)	83 (83.0)	73 (73.0)
Nursing home	1 (0.5)	-	7 (7.0)
Senior residence/Assisted living	19 (9.5)	17 (17.0)	20 (20.0)
Marital status, N(%)			
Married or living together	118 (58.7)	51 (51.0)	40 (40.0)
Single or divorced	26 (12.9)	12 (12.0)	26 (26.0)
Widow/widower	57 (28.4)	37 (37.0)	34 (34.0)
Born in the Netherlands, N(%)	179 (89.1)	90 (90.0)	90 (90.0)
Education, N(%)			
Primary school	46 (22.9)	24 (16.0)	31 (31.0)
Elementary technical/domestic science school	43 (21.4)	28 (28.0)	18 (18.0)
Secondary vocational education	62 (30.8)	31 (31.0)	27 (27.0)
Higher level high school/third-level education	50 (24.9)	17 (17.0)	24 (24.0)
Charlson Comorbidity Index† (mean, SD)	2.04 (2.00)	2.21 (2.08)	2.27 (2.11)
Polypharmacy‡, N(%)	120 (59.7)	71 (71.0)	71 (71.0)
Mean MMSE§ **score** (mean, SD)	26.20 (3.15)	25.48 (4.16)	25.19 (3.82)
Hospitalization in past 6 months, N(%)	61 (30.3)	46 (46.0)	27 (27.0)
Primary admission diagnosis, N(%)			
Infection	24 (11.9)	18 (18.0)	16 (16.0)
Gastrointestinal	23 (11.4)	11 (11.0)	11 (11.0)
Cardiac	74 (36.8)	18 (18.0)	30 (30.0)
Respiratory	37 (18.4)	21 (21.0)	18 (18.0)
Cancer (including hematology)	8 (4.0)	4 (4.0)	1 (1.0)
Electrolyte disturbance	5 (2.5)	4 (4.0)	1 (1.0)
Renal	7 (3.5)	4 (4.0)	4 (4.0)
Other	23 (11.4)	20 (20.0)	19 (19.0)
Length of hospital stay, Mean, SD	6.96 (6.15)	7.47 (7.94)	10.48 (10.75)
Discharge destination, N(%)			
Home	168 (83.6)	83 (83.0)	66 (66.0)
Nursing home	2 (1.0)	-	4 (4.0)
Rehabilitation center	3 (1.5)	4 (4.0)	13 (13.0)
Assisted living	1 (0.5)	-	5 (4.0)
Other (e.g. other hospital)	7 (3.5)	4 (4.0)	6 (6.0)
Unknown	20 (10)	9 (9.0)	6 (6.0)
Functional impairment	104 (51.7)	72 (72.0)	73 (73.0)
Depressive symptoms	38 (18.9)	25 (25.0)	28 (28.0)
Cognitive impairment	36 (17.9)	28 (28.0)	23 (23.0)
Poor health related quality of life	90 (44.8)	57 (57.0)	65 (65.0)
Frailty ≥ 3 factors	85 (42.3)	58 (58.0)	74 (74.0)

* Standard Deviation
† Range of 0 to 31, with a higher score indicating more or more severe comorbidity[40]
‡ Use of 5 or more different medications
§ Range 0-30, ≤23 is cognitive impairment[26]

Multinomial logistic regression analyses

In Table 2, we show that participants who had functional impairment, poor HRQOL or were frail at admission had higher odds of being categorized in the high-cost group compared to the lowest-cost group. These associations were still present in the adjusted analyses. Cognitive impairment and depressive symptoms at admission were not associated with higher odds of categorization in the moderate- or high-cost group compared to the low-cost group in any of our models (Table 2). In the complete case analysis (n=296) results were similar, except for frailty; the found associations were much stronger in the complete case analysis (Appendix 1). The observed results from the main analysis were also similar to the analysis that only included participants (n=377) who originated from home, though functional impairment was not as strongly associated with a risk of being categorized in the high cost group (Appendix 2).

Discussion

This is one of the first studies to describe post-acute care costs in older hospitalized persons, clinically relevant patient characteristics and determinants that are associated with higher costs. Our results demonstrated that for the total study population, the mean costs of post-acute care were as high as the costs of the index admission. As mean costs of index admission increased, post-acute care costs increased as well. The top 10.0% (n=40) of patients with highest post-acute care cost accounted for 52.1% of total post-acute care costs. Hence, whereas most patients had none to minimal costs, costs were substantial in a small part of the population. Costs were highest in the first month post-discharge and the costliest types of care were unplanned readmissions, nursing home/rehabilitation care and home care. Frailty, functional impairment and poor HRQOL at admission were strongly associated with higher post-acute care costs.

Our findings on the ratio between post-acute care costs and the costs of index admission are consistent with a report by Mechanic et al.[1] This study stated that the average post-acute care payments by Medicare were almost as high as the costs for the initial index admission.1 Our findings on the pattern of spending, with highest costs occurring in the first month post-discharge coincide with the post-discharge literature that describes that most readmissions occur within 30 days after discharge.[42, 43] General practice care was only a small proportion of overall costs, which is in a accordance with the small percentage (3.9%) of total healthcare budget that is allocated to general practice in the Netherlands.[44]

Although frailty can be measured using various scales,[34, 45, 46] the finding that frailty is associated with increased post-acute care costs, corresponds with previous literature that has described frailty as an independent determinant of high healthcare costs in both the in- as outpatient setting.[15, 17, 46] Building on these findings, our study indicates that frailty measured during the hospitalization period, is also associated with increased post-discharge costs. Moreover, our findings are consistent with Murray et al. who studied mean costs in the inpatient setting and found hospital expenses were higher in older patients with functional impairment.[21] Finally, our analyses suggests there is a relationship between poor HRQOL scores and costs.

Table 2. Multinomial logistic regression on cost groups with the low-cost group as reference group at admission n=401

Outcome variables at admission	OR (CI) P-value Moderate-cost group Unadjusted		OR (CI) P-value Moderate-cost group Adjusted*		OR (CI) P-value Moderate-cost group Adjusted**		OR (CI) P-value High-cost group Unadjusted		OR (CI) P-value High-cost group Adjusted*		OR (CI) P-value High-cost group Adjusted**	
Functional impairment	2.36 (1.34-4.16)	0.003	2.03 (1.11-3.73)	0.22	1.84 (0.98-3.46)	0.06	2.58 (1.45-4.61)	0.001	2.19 (1.17-4.10)	0.015	1.80 (1.03-3.16)	0.04
Depressive symptoms	1.44 (0.74-2.81)	0.28	1.38 (0.70-2.73)	0.35	1.43 (0.71-2.86)	0.32	1.68 (0.89-3.19)	0.11	1.52 (0.79-2.94)	0.21	1.49 (0.75-2.95)	0.25
Cognitive impairment	1.75 (0.86-3.52)	0.12	1.50 (0.71-3.15)	0.29	1.68 (0.78-3.61)	0.18	1.38 (0.71-2.69)	0.34	1.20 (0.59-2.45)	0.62	1.17 (0.57-2.44)	0.66
Poor health-related quality of life	1.62 (0.96-2.74)	0.07	1.49 (0.87-2.53)	0.15	1.50 (0.87-2.58)	0.14	2.29 (1.36-3.88)	0.002	2.10 (1.23-3.59)	0.007	1.89 (1.09-3.28)	0.02
Frailty	1.86 (1.03-3.35)	0.04	1.70 (0.91-3.15)	0.10	1.60 (0.83-3.06)	0.16	3.93 (2.15-7.18)	<0.001	3.69 (1.98-6.88)	<0.001	3.44 (1.78-6.63)	<0.001

* Multivariable regression with the low cost group as reference group, correction for demographic characteristics: age, marital status, education level, sex, and living arrangements at admission

** Multivariable regression with the low cost group as reference group, correction for demographic characteristics, length of stay, previous hospitalization in the past 6 months and Charlson Comorbidity index.

CI, confidence interval; OR, odds ratio.

The fact that post-acute care costs are substantial underlines the importance of adequate follow-up care to prevent unnecessary post-acute care expenditures. Our findings show that several measures that are often included in Comprehensive Geriatric Assessment (CGA), such as screening on frailty, are associated with increased healthcare expenditure. Although there is no definitive evidence that CGA has a cost-reducing effect on overall post-acute care costs,[47, 48] using recommendations provided in the CGA treatment for discharge planning and initiation of appropriate follow-up care may reduce costs from preventable readmissions and institustionalization.[47, 48] It should be noted however that frailty may also be a sign that an older patient is entering the final phase of life, which may not warrant a sole focus on early treatment of recurrent illness but also on advance care planning.[34,49]

There is no decisive evidence on the effects of advance care planning on post-acute care costs.[50] This study is limited to the extent in which hospice care costs and planning can be described precisely. Further research on this topic is warranted, especially on how advance care planning could aid in preventing unnecessary readmissions or hospital interventions and thereby reduce costs. This has been studied more extensively in patients suffering from malignant diseases, but not in in frail older patients who were recently hospitalized.[50]

Limitations

This study has some limitations. First, how post-acute care should be defined is contentious. For instance, because it is difficult to distinguish between post-acute care and "care as usual" in participants who were already nursing home residents, we decided to account all costs for home care and nursing home/rehabilitation care as post-acute care. However, we corrected for this in our analyses and performed a sensitivity analysis including only community dwelling participants, which showed similar costs and associations. Furthermore, we did not include costs for emergency department visits that did not result in a hospitalization, which in other research has been studied as a source of preventable costs.[11, 18] Secondly, patients with an MMSE score lower than 15 were excluded from this study, which fundamentally alters our study population from the populations that have been studied with respect to the relation between dementia and costs.[20] This could explain why we did not find an association between cognitive impairment and costs. Moreover, missing data may have decreased the accuracy of the absolute cost data per participant. After performing multiple imputation we found similar results in our multinomial regression analysis, so this missingness may not have changed our results and conclusions. However, it is possible that we were underpowered for drawing conclusions on some of the relations between determinants and costs, as the number of participants in the study was powered to draw conclusions on differences in ADL functioning.

Conclusions and Implications

Post-acute care costs are substantial, but only in a small portion of acutely hospitalized older adults.

The presence of frailty, functional impairment and poor health-related quality of life at time of admission are associated with an increased risk of high post-acute care costs. These measures may provide means to be studied as a predictor of post-acute costs in future research. Moreover, our findings suggest that adequate follow-up care planning in patients who score positive on these measures may help in making cost-reduction strategies more effective in practice.

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Appendix 1- Complete Case analysis (n=296)

Multinomial logistic regression on cost groups with the low cost group as reference group at admission n=296

	OR (CI) P-value Moderate-cost group Unadjusted		OR (CI) P-value Moderate-cost group Adjusted*		OR (CI) P-value Moderate-cost group Adjusted**		OR (CI) P-value High-cost group Unadjusted		OR (CI) P-value High-cost group Adjusted*		OR (CI) P-value High-cost group Adjusted**	
Outcome variables at admission												
Functional impairment	2.10 (1.16-3.78)	0.01	1.62 (0.85-3.07)	0.14	1.58 (0.81-3.08)	0.18	2.69 (1.46- 4.98)	0.002	2.19 (1.14-4.21)	0.02	2.16 (1.10-4.20)	0.02
Depressive symptoms	1.44 (0.72-2.88)	0.3	1.36 (0.66-2.80)	0.4	1.62 (0.76-3.43)	0.2	1.91 (0.99-3.73)	0.06	1.75 (0.89-3.45)	0.1	1.69 (0.85-3.41)	0.14
Cognitive impairment	2.83 (1.40-5.76)	0.004	1.90 (0.87-4.12)	0.11	2.28 (1.03-5.10)	0.043	1.69 (0.77-3.69)	0.19	1.57 (0.68-3.61)	0.29	1.64 (0.70-3.86)	0.25
Poor health-related quality of life	1.46 (0.83-2.56)	0.19	1.32 (0.74-2.35)	0.35	1.39 (0.77-2.53)	0.28	1.93 (1.09-3.41)	0.02	1.80 (1.01-3.21)	0.047	1.72 (0.96-3.10)	0.07
Frailty	1.41 (0.77-2.59)	0.27	1.07 (0.55-2.10)	0.84	1.04 (0.51-2.15)	0.91	6.93 (3.03-14.54)	<0.001	6.87 (3.16-14.92)	<0.001	6.93 (3.09-15.54)	<0.001

* Multivariable regression with the low-cost group as reference group, correction for demographic characteristics: age, marital status, education level, sex, and living arrangements at admission

** Multivariable regression with the low-cost group as reference group, correction for demographic characteristics, length of stay, previous hospitalization in the past 6 months and Charlson Comorbidity index.

CI, confidence interval; OR, odds ratio.

Appendix 2- Analysis in Community dwelling older adults n=377)

Multinomial logistic regression on cost groups with the low-cost group as reference group at admission

	OR (CI) P-value Moderate-cost group Unadjusted		OR (CI) P-value Moderate-cost group Adjusted*		OR (CI) P-value Moderate-cost group Adjusted**		OR (CI) P-value High-cost group Unadjusted		OR (CI) P-value High-cost group Adjusted*		OR (CI) P-value High-cost group Adjusted**	
Outcome variables at admission												
Functional impairment	2.30 (1.28-4.16)	0.006	1.85 (0.99-3.46)	0.052	1.65 (0.87-3.14)	0.13	2.28 (1.28-4.04)	0.005	1.93 (1.04-3.58)	0.04	1.80 (0.94-3.44)	0.08
Depressive symptoms	1.73 (0.89-3.37)	0.11	1.63 (0.83-3.21)	0.16	1.74 (0.87-3.47)	0.12	1.71 (0.86-3.35)	0.12	1.54 (0.77-3.06)	0.16	1.53 (0.74-3.15)	0.25
Cognitive impairment	1.94 (0.95-3.95)	0.07	1.55 (0.72-3.34)	0.26	1.81 (0.81-4.04)	0.15	1.74 (0.88-3.44)	0.11	1.49 (0.73-3.06)	0.28	1.56 (0.74-3.29)	0.24
Poor health-related quality of life	1.55 (0.88-2.74)	0.23	1.44 (0.80-2.57)	0.22	1.44 (0.80-2.58)	0.23	2.15 (1.24-3.73)	0.006	2.08 (1.19-3.64)	0.01	1.86 (1.04-3.32)	0.036
Frailty	1.64 (0.85-3.17)	0.15	1.45 (0.71-2.97)	0.31	1.32 (0.63-2.75)	0.46	3.32 (1.83-6.02)	<0.001	3.13 (1.70-5.79)	<0.001	2.84 (1.48-5.42)	0.002

* Multivariable regression with the low cost group as reference group, correction for demographic characteristics: age, marital status, education level, sex, and living arrangements at admission

** Multivariable regression with the low cost group as reference group, correction for demographic characteristics, length of stay, previous hospitalization in the past 6 months and Charlson Comorbidity index.

CI, confidence interval; OR, odds ratio.

3

Two European examples of acute geriatric units located outside of a general hospital for older adults with exacerbated chronic conditions

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J Am Med Dir Assoc 2021;22 (6):1228-1234

Abstract

Objective: Throughout Europe the number of older adults requiring acute hospitalization is increasing. Admission to an acute geriatric unit outside of a general hospital could be an alternative. In this model of acute medical care, comprehensive geriatric assessment and rehabilitation are provided to selected older patients. This study aims to compare patients' diagnoses, characteristics, and outcomes of two European sites where this care occurs.

Design: Exploratory cohort study.

Setting and participants: Subacute Care Unit (SCU)– introduced in 2012 in Barcelona Spain, and the Acute Geriatric Community Hospital (AGCH)– introduced in 2018 in Amsterdam, the Netherlands. The main admission criteria for older patients were acute events or exacerbations of chronic conditions, hemodynamic stability on admission, and no requirement for complex diagnostics.

Measures: We compared setting, characteristics and outcomes between patients admitted to the 2 units.

Results: Data from 909 patients admitted to SCU and 174 to AGCH were available. Patients were admitted from the emergency department or from home. The mean age was: 85.8 years (standard deviation, SD=6.7) at SCU and 81.9 years (SD=8.5) ($p<.001$) at AGCH. At SCU, patients were more often delirious (38.7% versus 22.4%, $p<0.001$) upon admission. At both units, infection was the main admission diagnosis. Other diagnoses included heart failure or chronic obstructive pulmonary disease. 5% or less of patients were readmitted to general hospitals. Average length of stay was 8.8 (SD=4.4) days (SCU) and 9.9 (SD=7.5) days (AGCH).

Conclusions/Implications: These acute geriatric units are quite similar and both provide an alternative to admission to a general hospital. We encourage the comparison of these units to other examples in Europe and suggest multicentric studies comparing their performance to usual hospital care.

Introduction

Throughout Europe, health care systems are confronted with an increase of older adults requiring acute care services.[1] Older adults frequently suffer from multiple chronic conditions and frailty compared to younger adults (aged <70).[2, 3] Consequently, we observe an increase of patients with multiple chronic conditions and frailty who require hospitalization.[2-4] Older hospitalized adults with multiple chronic conditions and/or frailty are predisposed to poorer outcomes compared to patients who do not have these conditions,[5, 6] including early unplanned hospital readmissions, functional decline and potential overtreatment in the final months of life.[7-9] With increased demand for care, increasing costs and poor outcomes after hospital admission, several models of care that aim to avoid admission to a general acute hospital have been developed.[10] Examples of such models are: intensive outpatient follow-up and hospital at home (HaH).[11, 12] However these models may assume that patients have an informal caregiver and cannot always provide acute or unplanned care.

Another model of care is admission to an acute geriatric unit in intermediate care as alternative to admission to a general hospital. Intermediate care was recently defined in an international Delphi study as: care that represents a broad range of time-limited services that aim to ensure continuity and quality of care; promote recovery; restore independence and confidence; or prevent a decline in the functional ability at the interface between hospital, home, long-term care (nursing homes), primary care and community services.[13]

In our model of acute geriatric units in intermediate care, acute medical care and early rehabilitation are provided for patients with exacerbations of chronic conditions or "minor" acute events, for example, an infection in patients with complex social or functional problems. The care is delivered at unit within an intermediate care facility and is led by a geriatrician.[14] We present this model of care in context with other models of care for geriatric patients in figure 1. Figure 1 shows how acute geriatric units may fill a gap in care for adults with multiple chronic conditions[15] and frailty[16, 17] who need acute care.

The specific example of acute geriatric units that we will discuss in this paper was pioneered in 2012 at an intermediate care facility, Parc Sanitari Pere Virgili in Barcelona, Spain.[18] Here, a specific ward, the Subacute Care Unit (SCU), provides acute and subacute care to older adults. Previous studies of this unit have shown its potential as an alternative to conventional hospitalization in selected older patients.[14, 18] Recently, this model of care was successfully scaled up to provide acute care to older adults affected by COVID-19 and thereby reduce the caseload of general hospitals.[19]

In the Netherlands, a similar unit, the Acute Geriatric Community Hospital (AGCH) opened in 2018.[20] These 2 units– the SCU and the AGCH, both offer an age-friendly environment, where a comprehensive geriatric assessment (CGA) is used to direct care and provide early rehabilitation.[20-22] Both units provide care to patients directly admitted from emergency departments (ED) or from home through specific primary care pathways(only SCU).

Acute care for older adults in bed-based units led by a geriatrician and implemented outside a general hospital, is not common and has not yet been compared between European countries. We think the model that was

implemented since 2012 (SCU) is like the model that was newly introduced (AGCH). By comparing and sharing these existing practices, this approach could be implemented in other European countries. Therefore, we will describe and compare these 2 existing models of care that have been implemented in Spain (SCU) and in the Netherlands (AGCH).

We will answer 2 questions: (1) What patients are amendable to transfer to these two units? (We will do this by evaluating the baseline characteristics of patients who have been transferred to these units.) and (2) What are the outcomes at discharge, regarding return to a general acute hospital, length of stay (LOS), mortality during admission and return to original living situation?

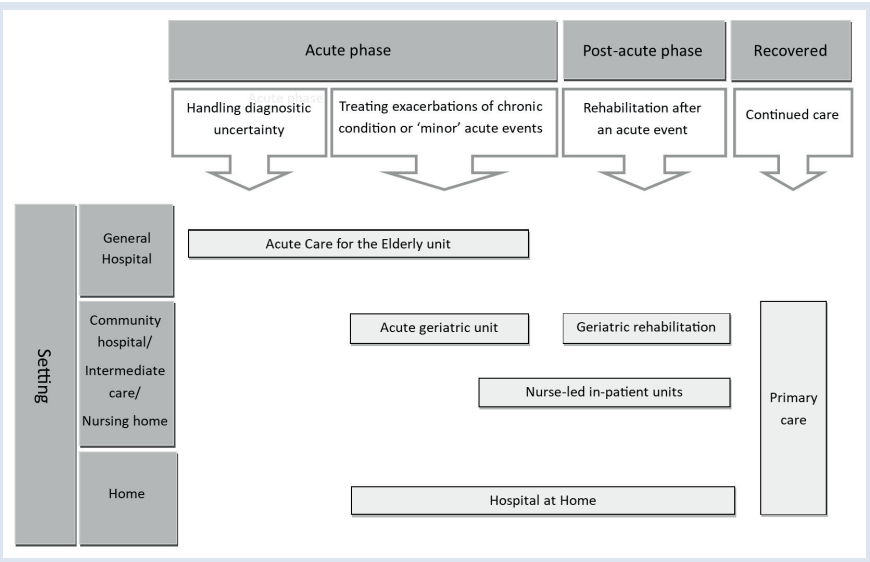

Figure 1. Patient trajectory and care settings during an acute medical crisis.
Figure 1 depicts the patient trajectory during an acute medical crisis, the settings in which care can be provided and the specialized units for (older) adults in acute and post-acute care. Acute care for the Elderly units (ACE) are situated in a general hospital and provide care during the acute phase, when there is diagnostic uncertainty or patients may require admission to an intensive care unit.[23] Nurse-led in-patient units (NLU) can be situated both inside as outside of a general hospital and provide care in the late acute, that is, subacute, and post-acute phases.[24] The acute geriatric units that we describe in intermediate care can provide acute care when there is no diagnostic uncertainty in patients who have exacerbations of chronic conditions or "minor" acute events. Hospital at Home care (HaH) can be provided during both acute and post-acute phases.[12] After hospitalization in either a general hospital or at an acute geriatric unit, patients can receive care in an geriatric rehabilitation unit, which is similar to post-acute care in an community hospital in the UK.[25, 26] After patients have recovered, they transition back to primary care.

Methods

Design, setting and staffing

In both settings, we gathered data from existing prospective cohort studies.[20, 27] Please see table 1 for an overview of staffing, setting and resources of both units.

The SCU is a 40 -bed unit, which serves a large city (reference population 900,000). It is located within a 350-bed intermediate care facility, Parc Sanitari Pere Virgili, including wards for geriatric rehabilitation, palliative care and long-term nursing beds as well as outpatient and home care resources. Patients are mainly admitted from the nearby university hospitals Vall d'Hebron and Hospital Clinic de Barcelona (1.5 and 4.5 km from the SCU, respectively) or directly from primary care. Staff at the referring hospitals and primary care centers are trained to select patients for admission to the SCU. Table 1 lists all daytime staff that work exclusively at the SCU located within the intermediate care facility. During evening, nighttime, and weekends, the intermediate care facility has a geriatrician on duty who attends to medical emergencies and provides clinical support to the SCU. The geriatrician may attend the SCU in person 1 up to 5 times per evening and night.

The AGCH is a 23-bed unit, which serves an urban area with approximately 150 000 inhabitants.[28] It is located in a 123-bed skilled nursing facility, Eben Haëzer from care organization Cordaan providing geriatric rehabilitation, palliative care, and long- term care. Patients are directly and primarily admitted from the EDs of 2 nearby locations of the Amsterdam University Medical Centers. At the first location, the Academic Medical Center, specialized nurse practitioners and/or the attending geriatrician select(s) patients at the ED for admission to the AGCH. At the second location, the Vrije Universiteit Medical Center, staff from the department of internal medicine was trained to select patients for transfer and request transfer through the attending geriatrician at the AGCH. Staff from the AGCH operate from the skilled nursing facility. The geriatricians work both at the AGCH as in the university hospital Academic Medical Center location. During the evening, nighttime, and weekends, a geriatrician is on duty and will be present at the university hospital or on call at home. On average, the attending geriatrician may receive 3 to 5 phone calls per evening and night and may need to come to the AGCH once per week to perform acute medical interventions.

Moreover, both units may adapt beds and/or staffing when the demand from ED of general acute hospitals increases during the winter vs in summer when bed occupation is usually lower.

Admission criteria

Admission criteria for transfer to both units were:

1) acute medical problems in older patients that require hospitalization (eg acute events such as a pneumonia, exacerbation of chronic conditions such as heart failure or minor acute events in very frail patients)
2) hemodynamic stability (upon assessment at the ED)
3) no need for complex diagnostic testing (such as CT or MRI scans during admission)
4) expecting to return to previous living situation in 10-14 days
5) only for AGCH: geriatric conditions (see table 1. e.g. delirium, cognitive impairment, falls, functional impairment)

Table 1. Overview of acute geriatric units, staffing, setting and resources

Subacute Care Unit (SCU)			**Acute Geriatric Community Hospital (AGCH)**		
Setting					
350-bed (total) intermediate care hospital			**123-bed (total) skilled nursing facility**		
230- beds for geriatric rehabilitation			24-bed geriatric rehabilitation unit		
40-bed Subacute Care Unit			23-bed Acute Geriatric Care Unit		
23-bed palliative Care Unit			No separate palliative care unit		
Double rooms			Single rooms		
Inclusion/admission criteria					
Exacerbations of chronic conditions or "minor" acute events requiring			Exacerbations of chronic conditions or "minor" acute events requiring hospitalization		
Hemodynamic stability			Hemodynamic stability		
No need for complex diagnostic testing			No need for complex diagnostic testing		
Expecting to return to previous living situation within 10 days			Expecting to return to previous living situation within 14 days		
-			Presence of geriatric conditions (e.g. falls, delirium, dementia, functional impairments)		
Daytime staff					
Geriatrician –	1 per 12-14 beds	3 in total	Geriatrician or internist	1 per 23 beds	1 in total
-			Nurse practitioner	1 per 8-10 beds	2 in total
Registered nurses	1 per 12-14 beds	3 in total	Registered nurses	1 per 4-6 beds	4 in total
Nurse assistants	1 per 10 beds	4 in total	Nurse assistant	1 per 23 beds	1 in total
Physiotherapist	1 per 40 beds	1 in total	Physiotherapist	1 per 10-12 beds	2 in total
Social worker	1 per 40 beds	1 in total	-	-	-
Evening/night time staff					
On-call geriatrician at intermediate care hospital (*same facility*) attending SCU			On-call geriatrician/internist at acute hospital (*separate facility*) attending AGCH		
Registered nurses	1 per 20 beds	2 in total	Registered nurses	1 per 10-12 beds	2 in total
2 nurse assistants	1 per 20 bed	2 in total	1 nurse assistant	1 per 23 beds	1 in total
Consultant services					
Clinical pharmacist			Clinical pharmacist		
Occupational therapist			Occupational therapist		
Clinical psychologist					
Medical Resources					
Oxygen			Oxygen		

Table 1. *Continued*

Intravenous medication	Intravenous medication
Electrocardiogram	Electrocardiogram
Urgent blood testing, blood gas analysis	Urgent blood testing, blood gas analysis
Daily simple X-ray	Weekly simple X-ray
Healthcare setting	
Opened February 2012	Opened July 2018
Admission through EDs of acute hospitals and primary care	Admission through EDs of acute hospitals
Serving area with 700 000 inhabitants	Serving area with 150 000 inhabitants
Structurally funded within Catalan public healthcare system	Funded as care innovation by healthcare organizations and insurance until May 2021
Reimbursed per admission	Reimbursed per day

*residents, nurse- practitioners in training or nursing students not included ED=emergency department

Care provided and preferable outcomes

At both units, a full CGA[22] is performed upon admission as a basis for an individualized interdisciplinary care plan. For the AGCH, the CGA is partially conducted at the ED by a nurse practitioner and is completed by a nurse practitioner at the AGCH. The care plan includes the prevention or management of complications of hospitalization in older adults such as immobilization, delirium or falls.[14] Moreover, Advance Care Planning,[29] is established, including both short-term goals during admission (maximum desirable intensity of care, transfer to acute care, resuscitation) as well as conversations related to long-term goals. Another focus of both units is discharge planning.[30] A transitional care program is available for selected patients at the SCU. In this program an advance practice nurse will prepare the discharge by connecting to local home care agencies and informing the patient and family with regard to medication and primary care services. In addition, the electronic healthcare record is shared in Catalonia between hospital and primary care, which facilitates the transmission of clinical information.[31] At the AGCH, discharge planning is discussed with the patient and family members within 48-72 hours after admission.[32] At both units personal handovers by telephone or email are used to inform primary care providers that the patient is being discharged and to assist in (re)starting primary care services.[32]

Like traditional hospitals, IV- medication and fluids can be administered at both units. Daily routine laboratory testing and simple X-ray are available (X-ray available once a week at the AGCH). The units both aim to admit patients for a limited number of days, a maximum of 10 at the SCU and 14 at the AGCH, to discharge >70 % of patients to their original living situation and to discharge less than 15 % of patients to another intermediate care unit. We collected these outcomes for both samples.

Preventative strategies and adaptations/environment at the SCU and the AGCH

Lack of social support, reduced physical activity and sensory overstimulation can contribute negative outcomes in older admitted patients.[33, 34] The SCU and AGCH have several adaptations to support the recovery of older patients and reduce the risk of negative outcomes such as delirium. Firstly, at the SCU patients may stay in a room alone or with 1 other patient. The AGCH has large single rooms, where there is space for an extra bed so that informal caregivers to stay overnight. Secondly, from Monday through Friday patients receive daily specialized rehabilitation therapy from a physiotherapist, the AGCH also has therapy sessions on Saturday. The SCU has physical therapy room on the same floor, which makes it easier for patients to attend physical therapy sessions. Thirdly, at both units family, friends and informal caregivers may visit patient throughout the day. Finally, to improve sleep quality the SCU has quiet hours (12 pm through 6 am). Also, staff is asked to take special care to reduce noise levels and these are monitored with an on-site and visible decibel meter. At the AGCH, each room is equipped with a continuous, non-contact heart rate and respiration monitor (Early Sense), which allows measurement of these vital signs without having to disturb the patient during sleep.[35]

Data collection and baseline evaluation

We used data from both institutions' routine CGAs. For the SCU, we obtained routine collected data for health care purposes from the electronic health records. In concordance with Spanish law, patients did not sign a specific informed consent other than a general consent, allowing anonymous data use for study purposes. For the AGCH individual patient or proxy (in case of cognitive impairment) consent was obtained. Each study protocol was approved by local medical Ethics Committees. The data is partly duplicative to earlier publications.[20, 21]

Sociodemographic data, clinical characteristics (main admission diagnosis, Charlson comorbidity index[36], history of dementia) and activities of daily living scores (Barthel index[37] or Katz–ADL index[38]) were collected. At the SCU, history of dementia included patients with suspected dementia. At the AGCH, this only included confirmed (by a medical doctor) cases of dementia. Main admission diagnosis was differently defined in the two samples. At the SCU these were defined as respiratory infections, urinary tract infections, cardiovascular diagnosis and other diagnosis. At the AGCH there were additional disease categories: other infection, neurological diagnosis and gastrointestinal/dehydration/electrolyte disturbance. Upon admission, the *Identification of seniors at risk* (ISAR) score at the SCU and the *Identification of seniors at risk* – hospitalized patients (ISAR-HP) score at the AGCH were filled out by clinicians. ISAR scores range from 0-6 and ISAR-HP score range from 0-5, both are used to predict adverse outcomes after home discharge with a higher score indicating a higher risk. We used a cut-off of 2 or more point to indicate an increased risk.[39] Confusion Assessment Method (CAM)[40] at the day of admission was used to assess the presence of delirium. For the SCU the presence of delirium upon admission was assed at the SCU itself. For the AGCH this was assessed at the ED, prior to transfer to the AGCH.

Analysis

Outcomes were presented in frequencies and percentages, means, standard deviations (SDs) and 95% confidence intervals (CIs). For comparing proportions, we used the Chi-square test, and when comparing means we used the independent samples t-test. To measure Activities of Daily Living, two different instruments were used; Barthel versus Katz-ADL index. Therefore, we did not perform comparative statistical analysis for ADL indices. We performed descriptive analysis using SPSS version 26.00. (IBM SPSS Statistics, IBM Corporation, Armonk, NY).

Results

The detailed clinical sample from SCU included 909 patients collected in January 2015 to March 2016, including readmitted patients. The bed occupancy rate in this period was 47.6%. The sample from AGCH included data collected between February 1st 2019- October 19th, 2019. In this period there were 278 admissions including 23 readmissions, 174 patients provided consent for the use of their data. Bed occupancy rate in this period was 52.5%.

Baseline characteristics

Table 2 provides baseline characteristics of patients admitted to the SCU and AGCH. At the SCU, more patients had been previously hospitalized (45.8% vs 32.8%, p <0.001). At the SCU, patients were admitted for respiratory infections (47.4 %), urinary tract infections (11.2%), cardiovascular diagnosis (22.9 %) and other diagnosis (18.5%) . At the AGCH, there were less respiratory infections (25.9 %), more urinary tract infections (16.7%) and less cardiovascular principal diagnosis (8.0 %). Respiratory infections also included exacerbations of chronic obstructive pulmonary disease (COPD). At both sites, cardiovascular diagnosis concerned mostly exacerbations of heart failure. Charlson comorbidity was similar between the groups, and co-morbid dementia was present at 43.8% of patients at the SCU and 19.5 % at the AGCH (p=<0.001). Also, at the SCU, relatively more patients (39.7%) were delirious upon admission compared to the AGCH (22.4%) (p=<0.001).

Outcomes at discharge

Rate of discharge to original living situation (n/ntot), SCU 76.1% (692/909) and AGCH 79.9% (139/174), was similar (p=0.28). At the SCU site 6.6 % (60/909) of patients died during admission, this was 5.2% (9/174) at the AGCH (p=0.48). A small percentage of patients was readmitted to an acute hospital during admission, 2.4% (22/909) at the SCU and 5.2% (9/173) at the AGCH (p=0.044) (Table 2).

Table 2. Baseline characteristics and outcomes in patients from both intermediate care geriatric units

	Subacute Care Unit (SCU) n= 909	Acute Geriatric Community Hospital (AGCH) n= 174	p-value
Age, mean (SD)	85.8 (6.7)	81.9 (8.5)	<0.001
Men, n (%)	363 (40.0)	84 (48.3)	0.04
Living independently alone, n (%)	180 (19.8)	85 (48.9)	<0.001
Nursing home resident, n (%)	220 (24.4)	15 (8.6)	<0.001
ISAR score, mean (SD)	3.4 (1.4)	3.1 (1.5)	0.02
ISAR ≥ 2 , n (%)	822 (90.5)	126 (80.3)	<0.001
Activities of Daily Living (ADL)* Barthel index at admission, n (%) Katz index at admission, n (%)	 45.4 (30.1) -	 - 3.0 (2.1)	
Number of usual drugs, mean (SD)	8.5 (3.8)	7.2 (4.0)	<0.001
Delirium upon admission, n (%) †	352 (38.7)	38 (22.4)	<0.001
Previous hospitalization, n (%)‡	370 (45.8)	51 (31.5)	<0.001
Primary admission diagnosis			
Respiratory infections§, n (%)	431 (47.4)	45 (25.9)	<0.001
Urinary tract infection, n (%)	102 (11.2)	29 (16.7)	0.04
Other infection or cellulitis, n (%)	-	18 (10.3)	-
Cardiovascular, n (%)	208 (22.9)	14 (8.0)	<0.001
Neurological, n (%)		14 (8.0)	-
Gastrointestinal/dehydration/electrolyte disturbance, n (%)		12 (6.9)	-
Other‖, n (%)	169 (18.5)	42 (24.1)	0.09
Comorbidities			
Dementia, n (%)**	398 (43.8)**	34 (19.5)**	<0.001
Diabetes mellitus, n (%)	306 (33.7)	45 (25.8)	0.043
Heart failure, n (%)	449 (49.4)	40 (23.0)	<0.001
Ischemic cardiomyopathy, n (%)	195 (21.5)	29 (16.7)	0.15
Chronic renal disease, n (%)	255 (28.1)	54 (31.0)	0.42
COPD, n (%)	338 (37.2)	41 (23.6)	<0.001
Cerebrovascular disease, n (%)	224 (24.6)	58 (33.3)	0.02
Charlson comorbidity index,†† mean (SD)	2.77 (1.7)	2.86 (2.1)	0.60
Outcomes at discharge			
Mean length of stay, mean (SD), target <10/14 days‡‡	8.8 (4.4)	9.9 (7.5)	0.08

Table 2. *Continued*

Return to usual living situation, n (%), target >70 %	692 (76.1)	139 (84.2)	0.28
Discharge to other intermediate care unit, n (%), target < 15 %	136 (14.9)	18 (10.3)	0.11
Admission to acute hospital, n (%), target < 5%	22 (2.4)	9 (5.2)	0.044
Death during admission, n (%)	60 (6.6)	9 (5.2)	0.48

*Barthel Index range 0-100, Katz Index range 0-6
† positive CAM (Confusion Assessment Method) at the SCU or at the ED prior to transfer to the AGCH.
‡ 6 months prior to index admission.
§ Including exacerbation of chronic obstructive pulmonary disease.
|| At AGCH recurrent falls, delirium, medication reconciliation. At the SCU this includes other diagnoses different to respiratory or urinary tract infections, or cardiovascular diseases.
** The SCU includes suspected and confirmed cases of dementia. The AGCH only includes confirmed (by a medical doctor) cases of dementia.
†† Range of 0-31, with a higher score indicating more or more severe comorbidity.
‡‡ 10 days at the SCU, 14 days at the AGCH.

Discussion

We found similar models of care between the SCU and the AGCH, with similar admission diagnosis (respiratory and/or urinary infections and heart failure). We also observe relative differences: patients at the SCU were older, with a higher prevalence delirium at admission compared to the AGCH. At the SCU, more patients were living in a nursing home, where geriatric syndromes are more prevalent[41] and less were living independently compared to the AGCH. At discharge, we find similar lengths of stay, return to previous living situation, discharge to another intermediate care unit and mortality. Importantly, return and admission to general hospital is lower than five percent. Meaning that hospital admission is avoided in most patients.

To place this model of acute geriatric units outside of a general hospital within an international context, we will discuss four other models of care for older adults: Acute Care for the Elderly units (ACE)[23], Hospital at Home (HaH)[12], nursing led in-patient units (NLU)[24] and post-acute geriatric rehabilitation units in community hospitals.[42] (Figure 1)

The acute geriatric unit model of care that we describe, differs from other geriatric care units like Acute Care for the Elderly units (ACE) developed in the United States.[23] An ACE is hospital-based and provides a full range of hospital diagnostics and services.[23] ACE units improve hospital outcomes such as LOS and readmissions in frail, older patients. However acute geriatric units that are situated outside of a general hospital, may have advantages over ACE units in specific settings. First, an acute geriatric unit can allow for a more comfortable environment, closer to the community that can help in the management of care transitions. This may allow for more adequate care in the “right time and place”[43]. Second, there may also be an advantage in that an intermediate care facility can combine acute, rehabilitation and palliative care if indicated. Third, compared to a general acute hospital, the SCU and AGCH do not provide the same range of

costly diagnostics and services reducing the cost per admission.

Other models of care for older adults are admission to nurse-led in-patient units (NLU)[24] and post-acute care wards in community hospitals.[42] Compared to nurse-led in-patient units (NLU), we find that NLU LOS ranges from 16 to 60 days which is longer than the length of stay at the AGCH an SCU.[24] This prolonged LOS indicates that care provided at NLU will be within the post-acute phase, and not in the acute phase as in our model.

Post-acute care units in community hospitals have been implemented in countries like the United Kindom.[25] There is evidence they improve functional outcomes and are cost-effective compared to continued hospital stay.[26, 44] Compared to our model these post-acute care units may not fully replace acute hospital admission because they may not always have resources for providing acute hospital treatment (eg no intravenous medication or 24/7 acute medical services).[25] However, there are community hospitals in Northern Europe and the United Kingdom which can also provide acute care and administer IV medication.[25] However there is a large variation in practice. Most community hospitals are focused on rehabilitation and may be nurse-led versus led by a physician. They may also have a longer LOS (range 11-58 days) compared to the model of care that we descibe.[26] Moreover, in community hospitals in the UK most patients are discharged from wards of general acute hospitals and are not referred from the ED, unlike our model of care.[26]

Another bed-based model of care is where a Hospital at Home (HaH) team comes in to a nursing home or community hospital to provide e.g. treatment with IV medication.[45]

More commonly in the HaH model, hospital-level care is provided at the home of an older patient. The outcomes (eg, mortality, readmission) of admission to HaH, are similar to an acute general hospital.[12] However, HaHs cannot fully replace acute geriatric units because HaH care is frequently provided when an informal caregiver is present.[12] Contrary in our sample many older persons were living in a nursing home (SCU) or independently by themselves (AGCH), without a spouse or family member who could act as an informal caregiver. Therefore, the social support of patients attended in SCU or AGCH could be lower and this can contribute to the clinical and functional complexity.[12] These patients may need more intensive monitoring or treatment than can be provided by a HaH team.

Limitations of this study include data collection in 2 settings and at 2 different time points, which may reduce comparability of data. Therefore the statistical testing should be interpreted with caution. However, our descriptive patient data demonstrate that these 2 units serve a similar population with similar outcomes.

Speculating on benefits of acute geriatric units, we suggest that they are adapted to the needs of older patients with frailty. At both units, patients receive specialized geriatric rehabilitation which may help to prevent functional decline and sustain functional capacity at an early stage. Furthermore, the environment is adapted to improve night rest, prevent delirium and boost recovery. These adaptations may not have been feasible in the setting of a general hospital, as the growth of hospital budgets has been restricted in recent years, length of hospital stay is decreasing and hospitals are primarily focused on providing acute specialist care, which may not be the primary focus of care for frail older adults.[43, 46] In rural areas or island communities, this model could be implemented

if there is no general acute hospital within the proximity of the patient's home. Another benefit is that this model of care can be scaled up within a facility; the SCU was scaled up and used to deliver acute care to older adults affected by COVID-19.[19] Telemedicine could also be implemented within this model of care for example by inviting consulting specialists and primary care providers to partake in multidisciplinary consultations.[17, 47] Moreover, the Early Sense could also be used to monitor vital signs (respiration, heart rate) from an outside location.[35]

Conclusions and implications

Our descriptive data show that, though in two different settings, these acute geriatric units are quite similar and can provide an alternative to general hospital. Our results encourage the comparison with other European care models that aim to provide acute care outside of a general hospital. Further research could focus on performing multi-center studies, evaluating cost-effectiveness and comparison to hospital-based units.

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4

Investigating the effectiveness of care delivery at an acute geriatric community hospital for older adults in the Netherlands: a protocol for a prospective controlled observational study

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BMJ open 2020; 10:e033802

Abstract

Introduction: Hospital admission in older adults with multiple chronic conditions is associated with unwanted outcomes like readmission, institutionalization, functional decline, and mortality. Providing acute care in the community and integrating effective components of care models might lead to a reduction in negative outcomes. Recently, the first geriatrician-led Acute Geriatric Community Hospital (AGCH) was introduced in the Netherlands. Care at the AGCH is focused on the treatment of acute diseases, comprehensive geriatric assessment, setting patient-led goals, early rehabilitation and streamlined transitions of care.

Methods and analysis: This prospective cohort study will investigate the effectiveness of care delivery at the AGCH on patient outcomes by comparing AGCH patients to two historic cohorts of hospitalized patients. Propensity score matching will correct for potential population differences. The primary outcome is the three-month unplanned readmission rate. Secondary outcomes include functional decline, institutionalization, healthcare utilization, occurrence of delirium or falls, health-related quality of life, mortality and patient satisfaction. Measurements will be conducted at admission, discharge and one, three and six months after discharge. Furthermore, an economic evaluation and qualitative process evaluation to assess facilitators and barriers to implementation are planned.

Ethics and dissemination: The study will be conducted according to the Declaration of Helsinki. The Medical Ethics Research Committee (METC) confirmed that the Medical Research Involving Human Subjects Act did not apply to this research project and official approval was not required. The findings of this study will be disseminated through public lectures, scientific conferences and journal publications. Furthermore, the findings of this study will aid in the implementation and financing of this concept (inter)nationally.

Trial Registration Number: NL7896; pre-results

Introduction

Background

Throughout the western world, there is an increase in older adults requiring acute care. Inpatient services are mostly consumed by those over the age of 65.[1, 2] The Netherlands, like many other countries, recently (2015) implemented stay-at-home policies leading to an increase in frail older persons living longer in the community.[3] These reforms juxtaposed with an increased ageing population contribute to increased acute care utilization.[4] There has been a 19% increase in emergency department (ED) visits by Dutch older adults based on data from 2015 versus 2017.[5, 6]

Many older adults come to the hospital with complex and atypical health problems.[5, 7] When older persons are subsequently hospitalised, health outcomes are known to be poor,[8] particularly in patients with geriatric syndromes such as cognitive impairment or mobility impairment.[9, 10] For example, previous research showed that 30% of older persons gained new disabilities and 20% were readmitted within 30 days postdischarge.[11, 12] Hospitalization itself may contribute to these poor outcomes, as hospitalizedolder adults often have reduced mobility because they are bedbound for approximately 20 hours a day.[13, 14] Low physical activity, in combination with poor nourishment and increased caloric demand due to acute illness, can lead to the loss of muscle mass and may contribute to the development of new disabilities, particularly in frail patients.[15, 16] Together with the noise in a hospital environment and the different personnel rotating between patient rooms, this contributes to sensory overstimulation and sleep deprivation, which may lead to confusion and the occurrence of delirium.[17, 18,19] Not only is the patient affected during hospitalization but the informal caregivers also find hospital admissions stressful.[20] Furthermore, previous research shows that a lack of discharge planning in the hospital can result in patients' care needs being unmet.[21] Hospital care as usual compared to discharge planning and follow-up show a higher rate of early readmissions.[22] Readmissions can further affect patients' recovery and increase healthcare costs.[23]

The complex medical needs of older persons, combined with their more dependent social situation, requires care delivery that offers guidance and support for realistic health and life goals.[24] Perhaps a 'gap' exists between what care can be provided in an acute care hospital versus what can be provided in the community (primary care). Acute hospital care is secondary care with a focus on medical treatment and diagnostics, whilst primary care focuses on rehabilitation, nursing care and well-being.

Several alternative strategies to hospital admission and (nurse-led) intermediate care have been developed in the past as a substitute to conventional hospitalization.[25] Examples include (nurse-led) intermediate care and subacute geriatric care units, which are low-tech but with geriatric expertise.[26, 27] In general, these types of care have comparable outcomes to hospital care as usual. Moreover, nurse-led care in the United States, observation units and hospital at home care all show a cost reduction compared to care as usual.[25, 26] Until recently, the Netherlands had limited alternatives to hospitalization for older persons who required acute care. Therefore, our research group sought to create an acute care alternative and opened the Acute Geriatric Community Care Hospital (AGCH)

in July 2018, partnering with an academic hospital (Amsterdam UMC, location AMC), an insurance company (Zilveren Kruis) and a home care and nursing home agency (Cordaan). This acute geriatric care unit, which is based within an intermediate care facility, provides an alternative to conventional hospitalization and delivers acute care closer to home.

The AGCH delivers acute care that is focused on early mobilization and rehabilitation. Older persons with common medical problems (such as urinary tract infections, pneumonia or heart failure) and geriatric syndromes requiring hospital admission can be admitted to the AGCH. The AGCH provides a form of *intermediate* care between primary and secondary care. In the Netherlands, primary care includes general practice, community nursing and (temporary) admission to a nursing home. Secondary care includes specialist medical care and hospital admission. The care at the AGCH is supervised by a geriatrician and provided by nurses trained in geriatric care who have experience as either a hospital or community nurse. The single rooms are designed to accommodate respite for the informal caregivers. This concept of care is new to the Netherlands, and to our knowledge, there is only one comparable example in Europe: a "subacute care unit" in intermediate care, which has been implemented in Spain.[27]

Our hypothesis is that with the provision of integrated medical and nursing care close to home, the AGCH is better suited to the needs of older adults with multiple chronic conditions and will lead to better patient health outcomes and reduced post-acute care costs. Therefore, this study is designed to compare care provided for older patients in the AGCH versus care provided in a hospital setting. Specifically, we aim to:

- Evaluate the 90-day readmission rate of patients acutely admitted to the AGCH compared to a traditional hospital (usual care). Secondary outcomes include functional decline, institutionalization, healthcare utilization, the occurrence of geriatric syndromes such as delirium, health-related quality of life (HRQOL), mortality, and patient satisfaction;
- Assess the cost-effectiveness of the AGCH versus usual care by performing an economic evaluation from a health care provider and societal perspective;
- Conduct a process evaluation using interviews with key stakeholders to identify facilitators and barriers to the implementation of the AGCH.

Methods

Setting

The AGCH opened in July 2018. It serves the south-eastern part of Amsterdam and its surrounding areas (an area with approximately 147 500 inhabitants).[28] The AGCH is a 23-bed facility within a skilled nursing facility. The hospital has 24-hour geriatric and nursing assistance. Physiotherapy and routine laboratory testing are available during the workweek and simple X-ray is available once a week. The population that is eligible for admission to the AGCH are patients with a combination of an acute medical problem requiring hospitalization (e.g., pneumonia, exacerbation of heart failure or a urinary tract infection), and a geriatric condition (e.g., delirium, cognitive impairment, falls, or functional impairment).

Additionally, patients have to be haemodynamically stable and should not require complex diagnostic testing. In general, patients will not be admitted if they have the following exclusion criteria: 1) require care that can only be provided at an intensive care unit, 2) require surgery, 3) require urgent treatments or diagnostic tests that can only be provided in-hospital (e.g., endoscopy, interventional radiology), 4) do not need hospital care but require transfer to a skilled nursing facility and 5) live in another region of the Netherlands.

Patients are directly admitted to the AGCH from the ED of the Amsterdam UMC-location Academic Medical Centre (AMC) in Amsterdam, which is a 1000-bed academic hospital with approximately 30 000 ED visits yearly. After the on-call geriatrician has assessed whether the patient is eligible for AGCH admission and the patient or representative has agreed to admission, the patient is transferred to the AGCH by ambulance. Since October 2019, patients can also be transferred from the EDs of other hospitals in Amsterdam. In the future, we plan to admit patients from home or general practice offices. Patients are admitted between 8.00 am and 23.00 pm, seven days a week. At admission, a Comprehensive Geriatric Assessment (CGA) is conducted.[29] The CGA gives an overview of all medical, functional, psychological and social problems. The CGA is discussed during multidisciplinary team meetings and used to formulate a care plan for each patient. For an overview of the admission process, the admission criteria and the components of this intervention, see figure 1.

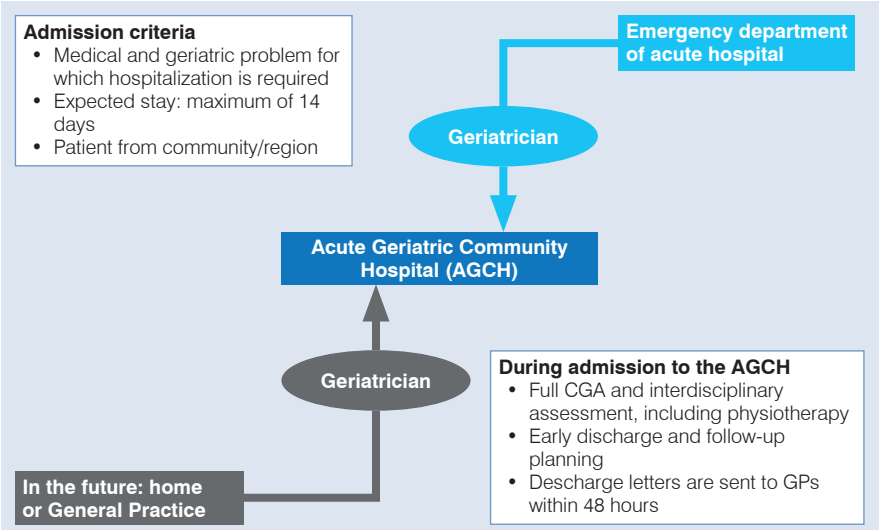

Figure 1 Patient admission process and criteria, components of the AGCH intervention and goals.
CGA= Comprehensive Geriatric Assessment[29]
GP= General Practitioner

Study design
This study is a prospective, observational, cohort study with two historical control groups to evaluate the clinical and economic effects of the AGCH. The STROBE statement was used in preparing the study protocol (appendix 1).[30] Participants will be compared to hospital controls. The participants are recruited into the study and are assessed at admission, discharge, and one, three and six months after discharge. Recruitment for this study started in February 2019. We plan to recruit for 18-24 months. The first three months of data collection consisted of a piloting phase to assess the feasibility of data collection and follow-up. In addition, a qualitative process evaluation on the facilitators and barriers to the implementation of the AGCH and patient experience will be conducted.

Participants
Patients admitted to the AGCH are eligible for inclusion in the study. However, patients are excluded from the study if: 1) the attending physician judges that the patient is too ill to participate, e.g., the patient is terminally ill, 2) the patient or legal representative does not consent to participate, or 3) the patient or legal representative does not speak or understand Dutch or English. In the case of cognitively impaired or delirious patients, patients can only be included if a legal representative consents to participation and acts as healthcare proxy. Cognitive functioning is assessed by the attending physician and confirmed by the researcher by conducting a Mini-Mental State Examination (MMSE).[31] An MMSE score of 15 or less indicates severe cognitive impairment, in which the approval of a legal representative will be sought.

Historical control groups
We selected two completed cohort studies that were conducted by our research group as historical control groups. We expect that the patients from these cohorts have similar admission diagnoses as those who can be admitted to the AGCH, namely, diagnoses that are ambulatory care sensitive conditions such as infections and exacerbations of COPD or heart failure.[32] Patients in these two cohorts were admitted to internal medicine, cardiology, pulmonology and geriatrics departments. These departments admit patients with diagnoses similar to those that can be admitted to the AGCH. In addition, we have selected these cohorts as control groups as the patients come from the same area as the studied population admitted to the AGCH, that is, the greater Amsterdam area. The first control group from the Transitional Care Bridge Study consists of 674 patients who were recruited between September 2010 and March 2014.[33] Participants were patients of 65 years and older hospitalized for at least 48 hours. Proxy consent was provided for participants suffering from severe cognitive impairment (MMSE $\leq$15). They participated in a negative randomized controlled trial that assessed the effectiveness of a nurse-led transitional care program in preventing functional decline.[33] The second control group from Hospital-ADL study consists of 401 patients who were recruited between October 2015 and June 2017.[10] These participants were enrolled in a prospective cohort studying the trajectory of functional decline in older hospitalized adults. Participants were aged 70 years and older and were hospitalized for at least 48 hours. Patients suffering from severe cognitive impairment (MMSE $\leq$15) and delirium were

excluded from participation. For the detailed methodology and inclusion criteria of the two control cohorts, please refer to the study protocols and papers of these studies.[10, 33-35]

Patient and public involvement
Older persons living in Amsterdam were involved in the design of the AGCH concept. No patients were involved in the design of this study.

Outcomes
The primary outcome measure is the 3-month unplanned readmission rate to the AGCH or hospital.
Secondary outcomes measured at one, three and six months will include:

1) Activities of daily living (ADL)-functioning, as defined by the Katz-ADL scale.[36]
2) Healthcare utilization, including institutionalization in a long-term care facility.
3) Occurrence of delirium and/or falls.
4) Health-related quality of life.[37]
5) All-cause mortality.
6) Satisfaction of the patients and primary caregivers with the provided care.

Data collection
Eligible patients and/or legal representatives will be contacted and informed about the study procedures after which written informed consent is obtained. Inclusion and interviewing of patients is conducted by an onsite researcher. Routine data on functioning and risk assessments are collected by a trained registered nurse and physiotherapist as part of the CGA for each patient.[38] Table 1 gives an overview of measurement of the primary and secondary outcomes over time. These measurements were chosen based on the assessments and data collected from the two historic control groups. The supplementary table provides an overview of the content and timing of measurements in the AGCH-group compared to the two historic control groups. Measurements during admission are at H1, which is within 48 hours after admission, and H2, which is within 48 hours before discharge. Follow-up is completed by telephone at one, three and six months after discharge (P1, P3 and P6).
Data collection includes the following.

1. Medical and demographical data

Sociodemographic data
These will include age, gender, highest level of education, ethnicity, marital status and living arrangement.

Data on admission
Time spent at the ED, admission diagnosis, and date and time of admission.

Chronic conditions
The number and severity of chronic conditions will be assessed using the Charlson Comorbidity Index.[39] This index is commonly used to indicate the risk of mortality;

Table 1 Overview of the content and description of the (outcome) measurements and timing of the measurements at the Acute Geriatric Community Hospital.

	Description and/or instrument	H1	H2	P1	P3	P6
1. Medical and demographical data						
Sociodemographic data	Date of birth, age at admission, sex, level of education, living conditions, marital status	R				
Data on admission	Time spent at the ED, admission diagnosis, date and time of admission	R				
Chronic conditions	Charlson Comorbidity Index[39]	R				
Polypharmacy	Number of drugs	R				
Mortality	Date of death		R	R	R	R
2. Cognitive functioning						
Cognitive impairment	Mini-Mental State Examination (MMSE)[31]	R				
Delirium	Safety management system patient screening (VMS)[42] Confusion Assessment Method (CAM)[40] Delirium Observation Scale (DOS)[43]	N/D	N/D			
3. Psychosocial functioning and quality of life						
Apathy	Geriatric Depression Scale (GDS-3)[44]	N	R	R	R	R
Social network and informal care	Presence and frequency of informal care	R		R	R	R
Quality of life and health status	EQ-5D[37]	R		R	R	R
4. Physical functioning						
Identifying at-risk-patients	ISAR-HP- Identifying Seniors at Risk score[45]	N				
Functional status	Activities of daily Living (ADL) modified Katz-ADL score[36]	N	R	R	R	R
(Im)mobility	Using a walking aid, information from the Katz-ADL questions on exercise	N				
Handgrip strength	Jamar[49]	P				
Gait speed	Short Physical Performance Battery (SPPB)[50]	P				
Falling	Fall history Falls in the AGCH Numeric Rating Scale (NRS) on the fear of falling[35]	N N	R R	R R	R R	R R
Pain	Numeric Rating Scale (NRS) on pain[51]	N	R	R	R	R
Fatigue	Numeric Rating Scale (NRS) on fatigue[52]	N	R	R	R	R
Nutrition	Short Nutritional Assessment Questionnaire (SNAQ)[53]	N				

Table 1 *Continued*

	Description and/or instrument	H1	H2	P1	P3	P6
5. Healthcare utilization and satisfaction with care						
Medical care during admission	Diagnostics performed in the AGCH Readmission to university hospital Length of stay at the AGCH		R			
Hospital readmission	Readmission rate to the hospital or AGCH		R	R	R	R
Health care utilization	Home care, medical specialist care, temporary institutional care, primary care	R		R	R	R
Satisfaction with Care	Eight question questionnaire[54]		R	(R)*		

H1= at admission, H2= at discharge, P1= one month after discharge, P3 = three months after discharge, P6 = six months after discharge. N=nurse Geriatric Community Care Hospital, P= physiotherapist, D= Doctor/attending physician, R= researcher/research nurse. *in case the assessment was missed at H2.

each condition is scored 1, 2, 3 or 6 points, with a higher total number of points indicating a greater risk of death.

Polypharmacy
Polypharmacy will be assessed by counting the number of individual drugs that are chronically prescribed to a participant, in which a number of 5 or more drugs is considered polypharmacy.

Mortality
This will be assessed during follow-up, either from the patients' electronic files or from general practice registries.

2. Cognitive functioning

Cognitive impairment
This is assessed by reviewing the score of the MMSE that is performed within 48 hours of admission. The MMSE includes 23 items (total score 0-30) that screen for cognitive impairment. A score of 23 or less is defined as possible cognitive impairment.[31] When a patient is delirious upon inclusion, the MMSE is not conducted.

Delirium
The Confusion Assessment Method (CAM), 4 item short version, is used to assess the presence and duration of delirium.[40] The CAM is widely used by physicians and nurse practitioners to diagnose delirium (sensitivity of 53-90% and specificity of 84-100%).[41] The CAM is filled out within 24 hours of admission. Moreover, the risk on developing delirium is assessed using the Dutch Safety Management Programme (Veiligheidsmanagementsysteem (VMS)) criteria for risk of delirium.[42] Nurse practitioners will score the CAM daily from day 1 till day 3 of admission; if there are signs of possible delirium at day 3, these measurements

are continued until the symptoms are resolved. In addition, during the first three days of admission, the Delirium Observation Screening Scale (DOSS) is scored during each nursing shift and is continued when there is a clinical suspicion of delirium.[43]

3. Psychosocial functioning and quality of life

Apathy
We use three items of the Geriatric Depression Scale (GDS-15) to assess apathy (sensitivity of 69% and specificity of 85 %). These items include the following questions: 1) 'Do you prefer to stay at home, rather than going out and doing new things', 2) 'Have you dropped many of your activities and interests?', and 3) 'Do you feel full of energy'. A score of >2 points is classified as 'apathy present'.[44]

Social network and informal care
Participants are asked if they receive informal care, how many hours a week, what type of care (housekeeping and/or personal care) and from which persons (partners, children, other family members or neighbours/volunteers).

Health-related quality of life
This will be measured by the EuroQoL-5D (EQ-5D). The EQ-5D is a broadly used and validated instrument for measuring generic HRQOL.[37]

4. Physical functioning

Risk of functional decline
Patients are assessed for risk of functional decline using the Identification of Seniors at Risk- Hospitalized Patients (ISAR-HP) tool; scores of two and up indicate an increased risk for functional decline.[45]

Functioning level
The 15-item modified Katz-ADL score is used to measure ADL functioning. This includes statements about independence in performing basic activities of daily living (ADL) and in instrumental activities of daily living (IADL).[46, 47] We measure the Katz-ADL both currently (at admission), as well as two weeks before admission, reflecting pre-morbid level of functioning. The Katz-ADL is also measured during follow-up.

(Im)mobility
Mobility is assessed by reviewing three questions that are in the admission assessment regarding: 1) the use of a walking aid, 2) being able to walk outside of the house for five minutes (two weeks before and currently) and 3) the performance and frequency of physical activity.[48]

Handgrip strength
Muscle weakness is measured by physiotherapists in all admitted patients using the maximum handgrip strength (Jamar).[49]

Gait speed
Gait speed is measured as part of the Short Physical Performance Battery (SPBB), which is part of the physiotherapists' admission assessment.[50]

Falls
Fall history is assessed by asking about the number of falls in the past six months.[42] During the discharge assessment, the occurrence of falls in the AGCH and the consequences of falls (indication for prolonged stay, diagnostics or injury) are recorded.

Fear of falling
The Numeric Rating Scale (NRS, score 0-10) is used to assess the fear of falling; 0 indicates no fear of falling, and 10 indicates the greatest fear of falling possible.[35]

Pain
The standard clinical measure for pain is the NRS, ranging from 0 to 10, in which a score of 0 represents no pain and 10 represents the worst possible pain.[51]

Fatigue
A NRS from 0-10 is used, with 0 indicating no fatigue and 10 indicating the greatest fatigue ever felt by the participant.[52]

Sleep
Participants are asked if they have had difficulties with sleeping in the past month and whether participants have used sleep medication.

Nutrition
We will use the Short Nutritional Assessment Questionnaire (SNAQ) to identify patients with malnourishment. The SNAQ consists of three questions concerning weight loss, appetite and drink/tube nutrition, resulting in a score ranging from 0 to 5. Scores of 0 and 1 are defined as 'no malnutrition', 2 as 'moderate malnutrition' and 3 or more as 'severe malnutrition'.[53]

5. Healthcare utilization and satisfaction with care

Medical care during admission and the process of discharge
The following items are collected from patients' electronic health records: the diagnostics performed in the AGCH, revisits to the hospital, admissions to the hospital, length of stay at the AGCH, discharge destination and time needed to send medical handovers to the general practitioner.

Hospital readmission
This outcome will be assessed during follow-up. Follow-up will consist of three telephone interviews at one, three and six months after discharge. Readmission will be both assessed during the follow-up interviews and by checking care data from an aggregated database of expense claims from various healthcare insurers. Data that will be collected are as follows: number of readmissions, total days of readmission, reasons for readmission and whether the readmission was

planned or unplanned.

Emergency department (ED) visits
ED visits will be assessed during follow-up and checked in the insurance data. We will record the number of separate ED visits.

Outpatient hospital visits
We will ask patients if there have been any outpatient visits in the past month(s), and if so, how many.

Consultations by general practitioners
We will ask patients if, and how many times, they have consulted with their general practitioner (both during the day and during out-of-office hours).

Consultations by physiotherapists or dieticians
We will ask patients if, and how many times, they have consulted with a physiotherapist or dietician in the past month(s).

Home care
This includes questions on the frequency of home care, including housekeeping, personal care and nursing care. We will also include hours of informal care provided by family members or friends.

Temporary admission to a nursing home
This includes days of (temporary) admission to a skilled nursing facility or rehabilitation facility.

Permanent institutionalization
This concerns long-term admission to a skilled nursing facility and the date of admission to this facility.

Patient satisfaction with care
Patients or informal caregivers are asked to fill out an 8-question questionnaire regarding their satisfaction with the care that they received. Questions are answered on a 5-point Likert scale.[54]

Sample size calculation
In the Hospital-ADL study, 34% of participants experienced a readmission at 90 days.[35] Assuming that 26% of patients admitted to the AGCH will experience a 90-day readmission, data from 515 patients at the AGCH will yield 80% power to detect an absolute difference of 8% in the readmission rate (which is a 25% reduction in the relative risk) using a two-sided test with an alpha of 0.05.[55] As we expect 10% loss to follow-up, we aim to include a total of 567 (= 515*1.10) patients from the AGCH.

Planned statistical analyses
The complete participant flow diagram will show a summary of admissions and study recruitment at the AGCH and will provide study discontinuation rates at

1, 3 and 6 -months follow-up.[30] We will describe the demographic, clinical and prognostic characteristics of the study participants at baseline. The number of participants with missing data will be collected and described alongside our variables to check for the pattern of missingness. Inversely weighted propensity scores will be used to control for any imbalances between the treatment groups.[56] Propensity scores will be calculated using generalized boosted methods. Balance and overlap of propensity score distribution will be assessed. Propensity score weights for the estimation of the average treatment effect will be created using all covariates where groups differed at baseline or that were associated with the 90-day readmission rate. As this is a repeated measures design, we will assume equal weighting for all measurements.[57]

All hypotheses will be tested using a two-tailed significance level of 0.05. All secondary outcomes will be adjusted for multiple testing using a Hochberg method.[58, 59] Descriptive analyses will be performed to examine the participants' characteristics. Differences in changes over time in outcomes will be compared between groups using multilevel models. All models will include a main effect of treatment group, a linear term for time and an interaction between time and treatment group. Models will be checked with residual and appropriate goodness-of-fit statistics.

Economic evaluation

A healthcare and societal perspective is planned for the economic evaluation. The evaluation from the healthcare perspective will only include direct medical costs accrued in the 6 months after the admission to the AGCH. Direct medical costs will only include costs that are funded through the Dutch healthcare system. The evaluation from a societal perspective will include an estimation of the costs of informal care. Costs will be based on the reference prices found in the Dutch Manual for Costing studies and will be set for the final year of data collection (2020 or 2021). Propensity scores will also be used in the economic evaluation. Missing data will be imputed using multiple imputation chained equations, if necessary, for the cost and effect data. We plan to use generalized linear regression models with a gamma distribution and an identity link to account for the right skew of the cost data. A generalized linear regression model will be used to estimate the incremental effect in QALY adjusted for baseline utility estimates with a Gaussian distribution and identify link.[60] Incremental cost-effectiveness ratios will be calculated using the pooled cost and effect estimates. Bootstrapped cost-effect pairs will be plotted on a cost-effectiveness plane and used to estimate cost-effectiveness acceptability curves.[61]

Process evaluation and patient experience

We plan to use a qualitative study design to describe the barriers and facilitators to implementation of the AGCH concept and describe the experiences of the patients and healthcare professionals with the AGCH. We will conduct semi-structured interviews with various stakeholders, such as geriatricians, nurses, physiotherapists and hospital administrators. These interviews will concern the implementation of the AGCH concept. In addition, semi-structured interviews with patients and informal caregivers will be conducted in order to describe the patient experience and satisfaction with this new form of care. A representative sample of

patients and/or caregivers who participate in the prospective cohort study will be approached and invited to be interviewed shortly after discharge from the AGCH. Stakeholders and healthcare professionals will be selected by a researcher and will be invited for an interview to discuss their experiences and opinions on the AGCH. Interviews will be typed verbatim and analyzed independently by two researchers using thematic analyses.[62] In our analysis of the barriers and facilitators to implementation, we will describe these factors at three different levels: micro (healthcare professionals), meso (care organizations) and macro (legal and financial framework).[63] The findings will be summarized in matrices with the facilitators and barriers at these three different levels and can be used to develop a guideline for implementation of the AGCH elsewhere.[64]

Preliminary results

Between February 1st and December 20th, 2019, there were 362 consecutive admissions to the AGCH. Of these admissions, 26 were readmissions of patients who were already study participants. Of the remaining 336 admissions, 90 were by patients who did not meet the inclusion criteria. The remaining 246 patients or legal representatives and healthcare-proxy were approached for participation; 212 consented to participation (figure 2). The healthcare-proxy provided informed consent in 62 (29.2 %) of cases. Sixteen patients did not consent to follow-up by

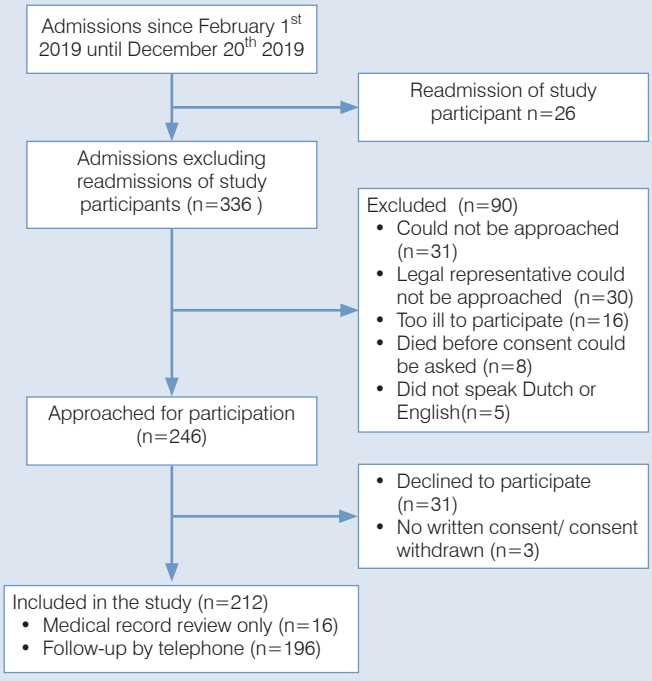

Figure 2 Diagram of patient participation between February 1st and December 20th, 2019.

telephone but did consent to medical record review. The total study sample as of December 20th, 2019, consisted of 212 participants at baseline. Table 2 displays the baseline characteristics of this group. Participants had a mean age (standard deviation) of 81.8 (8.4) years and 47.6 % were male. Most participants were living independently before admission (81.1%). The most frequent admission diagnoses were infectious diseases (28.3%, mostly urinary tract infections), respiratory-related diseases (25.5%, of which half were pneumonia), and other (geriatric) diagnoses such as falls, delirium or sudden unexplained functional decline (30.2%). The main cardiovascular (9.4%) admission diagnosis was exacerbation of heart failure. The median (interquartile range) length of stay was 8.0 days (5.0-12.0), and 83.7 % of patients were discharged to their original living situation.

Table 2 Baseline characteristics of the study participants

Variable	N=212
Age in years, mean (SD)	81.8 (8.4)
Male, N (%)	101 (47.6)
Living arrangements before admission, N (%)	
Independent	172 (81.1)
Assisted living/senior residence	31 (14.6)
Nursing home/other	9 (4.2)
Marital status, N (%)	
Widow/widower	94 (44.5)
Married or living together	71 (33.6)
Single or divorced	46 (21.8)
Education, N (%)	
Primary school	36 (18.7)
Elementary technical/domestic science school	41 (21.2)
Secondary vocational education	65 (33.7)
Higher level high school/third-level education	51 (26.4)
Born in the Netherlands, N (%)	158 (76.0)
Katz-ADL (6 item) score[a] **upon admission**, median (IQR)	3.0 (1.0-5.0)
MMSE score[b], mean (SD)	23.7 (4.7)
Polypharmacy[c], N (%)	159 (75.0)
Hospitalization in past 6 months, N (%)	61 (31.1)
Charlson Comorbidity Index[d], mean (SD)	2.8 (2.0)
Primary admission diagnosis, N (%)	
Infectious diseases	60 (28.3)
Respiratory (including pneumonia)	54 (25.5)
Gastrointestinal	9 (4.2)
Cardiovascular	20 (9.4)
Neurologic	16 (7.5)
Other (e.g., falls, delirium, sudden unexplained functional decline)	53 (30.2)

SD, standard deviation; IQR, interquartile range
[a] Score ranging from 0-6, with a higher score indicating more dependence in activities of daily living[36]
[b] Score ranging from 0-30, with a score of ≤23 indicating possible cognitive impairment[31]
[c] Use of 5 drugs or more
[d] Ranging from 0-31, with a higher score indicating more severe comorbidity[39]

Discussion

The complex acute medical needs of older patients require the delivery of specialized geriatric care. The traditional hospital environment may however not support recovery and maintaining independence. The AGCH aims to deliver care that focuses on medical treatment, early rehabilitation and proper transitions of care for older adults with multiple chronic conditions.[29, 65] The AGCH is unique in the Netherlands in its aim to combine multiple evidenced-based components of care for frail older persons at an alternative location for hospital care. The proposed research will provide insight into the clinical and economic effectiveness of care delivered at the AGCH, compared to hospital care.

Our preliminary results show that data collection at the AGCH is feasible and we expect to recruit enough patients to evaluate the primary outcome. There are also limitations to the design of this study. It is a non-randomized study and historic cohorts are used as control groups. Therefore, baseline differences between the intervention and control groups may hamper the matching between the groups. Additionally, the data from the historic cohorts were not collected in the same time period as the AGCH cohort. This is a limitation as work processes in hospitals may have changed over the years, which could influence our results. However, the two control populations do represent a geriatric population that was admitted for exacerbations of chronic conditions and acute illnesses that frequently occur in older persons. The strengths of the study are the involvement of patients and informal caregivers in the design of the concept of the AGCH. Moreover, a process evaluation will address the barriers and facilitators to implementation of the AGCH in the Dutch Healthcare system. In short, this research will provide valuable insights into the implementation of this concept of care in other regions of the Netherlands and abroad.

Ethics and Dissemination

Based on the study protocol, the Ethics Committee (METC) of the Amsterdam University Medical Centre waived the obligation for the study to undergo formal ethical approval as is described under Dutch law in the Medical Research in Humans Act, January 2019 (ref W17_474 # 19.001). As this is a prospective study and pseudonymized data is used, written informed consent was obtained from the participants prior to participation. This is in line with current European legislation under the General Data Protection Regulation (GDPR).

This study will be carried out in accordance with the Declaration of Helsinki and current ethical requirements. The outcomes of this study will be reported according to the STROBE guidelines for cohort studies.[30] This study will evaluate both the effectiveness of this type of care delivery and the costs that are involved, allowing for the system to be implementation elsewhere. The findings of this study will be published in peer-reviewed journals.

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Appendix 1 STROBE statement checklist

STROBE Statement—Checklist of items that should be included in reports of **cohort studies**

	Item No	Recommendation	Item found on page
Title and abstract	1	*(a)* Indicate the study's design with a commonly used term in the title or the abstract	Abstract
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Abstract
Introduction			
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction
Objectives	3	State specific objectives, including any prespecified hypotheses	Introduction
Methods			
Study design	4	Present key elements of study design early in the paper	Methods- Study design
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Methods-Setting
Participants	6	*(a)* Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Methods- Setting & Participants, Methods – data collection
		(b) For matched studies, give matching criteria and number of exposed and unexposed	Methods- Participants- historical control groups
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Methods – data collection

Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Methods – data collection (+ supplementary table)
Bias	9	Describe any efforts to address potential sources of bias	Methods- Planned statistical analysis, Discussion
Study size	10	Explain how the study size was arrived at	Methods- Sample size calculation
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Methods
Statistical methods	12	*(a)* Describe all statistical methods, including those used to control for confounding	Methods- Planned statistical analysis
		(b) Describe any methods used to examine subgroups and interactions	n/a
		(c) Explain how missing data were addressed	Methods- Planned statistical analysis
		(d) If applicable, explain how loss to follow-up was addressed	Methods- Sample size calculation
		(e) Describe any sensitivity analyses	n/a
Results			
Participants	13*	*(a)* Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Preliminary results & (figure 2)
		(b) Give reasons for non-participation at each stage	Preliminary results & (figure 2)
		(c) Consider use of a flow diagram	(figure 2)

Descriptive data	14*	*(a)* Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Preliminary results & (table 2)
		(b) Indicate number of participants with missing data for each variable of interest	n/a
		(c) Summarise follow-up time (eg, average and total amount)	n/a
Outcome data	15*	Report numbers of outcome events or summary measures over time	n/a
Main results	16	*(a)* Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	n/a
		(b) Report category boundaries when continuous variables were categorized	(table 2)
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	Discussion
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Discussion

Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Discussion
Generalisa-bility	21	Discuss the generalisability (external validity) of the study results	n/a
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Funding

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

5

Investigating the effectiveness of care delivery at an acute geriatric community hospital for older adults in the Netherlands: a prospective controlled observational study

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Abstract

Introduction: Hospital admission in older adults is associated with unwanted outcomes such as readmission, institutionalization, and functional decline. To reduce these outcomes the Netherlands introduced an alternative to hospital-based care: the Acute Geriatric Community Hospital (AGCH). The AGCH is an intermediate care unit focusing on early rehabilitation and comprehensive geriatric assessment. In this study we investigated if AGCH care is associated with decreasing unplanned readmissions or death compared to hospital-based care.

Methods and analysis: This was a prospective cohort study controlled with a historic cohort of hospitalized older adults. We used inverse propensity score weighting to account for baseline differences. The primary outcome was 90-day readmission or death. Secondary outcomes included 30-day readmission or death, time-to-death, admission to long-term residential care, occurrence of falls and functioning over time. Generalized logistic regression models and multilevel regression analyses were used to estimate effects.

Results: AGCH patients (n=206) had lower 90-day readmission or death rates (odds ratio [OR]: 0.39, 95% confidence interval [CI]: 0.23–0.67) compared to patients treated in hospital (n=401). AGCH patients had lower risk of 90-day readmission (OR 0.38, 95% CI, 0.21-0.67 but did not differ on all-cause mortality (OR 0.89, 95% CI: 0.44–1.79) compared to the hospital control group. AGCH-patients had lower 30-day readmission or death rates. Secondary outcomes did not differ.

Conclusion: AGCH patients had lower rates of readmission and/or death than patients treated in a hospital. Our results support expansion of the AGCH in the Netherlands and other European countries seeking alternatives to hospital-based care.

Trial Registration Number: Dutch Trial Registry NL7896

Introduction

Acute hospital admission in older adults is associated with unplanned hospital readmission, functional decline, admission to a nursing home, and death.[1, 2] Acute hospital admissions are stressful for patients and their families[3] and post-acute care services are costly.[4, 5] As populations age worldwide, acute admission and post-acute care costs are expected to increase even further.[4]

Alternatives to hospital-based care have been developed to reduce cost and improve negative outcomes of hospitalization in older adults.[6] Examples of such alternatives are nursing-led intermediate care units and hospital-at-home interventions.[7, 8] A Cochrane review found that these nursing-led units improved physical functioning and reduced the three-month admission rate to long-term care.[8] Sheppard et al. found that a hospital-at-home intervention combined with a comprehensive geriatric assessment (CGA)[9] reduced long-term care admissions.[7] Other geriatric care models, such as geriatrician-led acute geriatric intermediate care units, are also being investigated in countries like the United Kingdom and Spain.[10, 11]

In the Netherlands, an acute geriatric unit in intermediate care – the Acute Geriatric Community Hospital (AGCH) – was implemented in 2018.[12] The AGCH admits older adults with acute events or exacerbations of chronic conditions. Treatment includes CGA and early rehabilitation.[13] The AGCH also aims to improve transitions through warm handovers with primary care providers. Patients are discharged home when they can perform activities of daily living (ADLs). To achieve this goal, patients receive ADL training before leaving hospital, which is not standard practice in Dutch hospital-based care. Transitional patient care needs and care wishes in the post-discharge period are discussed and considered when planning rehabilitation.[14]

To determine whether AGCH care improves patient outcomes in older adults, a prospective cohort study was conducted to compare patients treated at the AGCH with patients from a historical control cohort who were admitted to hospital.[12, 15] The aim of this study was to investigate if AGCH care is associated with a decrease in unplanned readmissions or death compared to hospital-based care at 90 days. Unplanned readmission or death was chosen as the primary outcome for this study because readmissions contribute most to the costs of post-acute care.[5] This study provides evidence to determine whether the AGCH should be recommended as an alternative to hospital-based care for selected patient groups in the Netherlands and other European countries.

Methods

Study design

This was a prospective observational cohort study with a historical control group evaluating the clinical effects of AGCH care. Participants in the AGCH group were compared with participants from the Hospital-ADL study, a cohort of older adults treated in Dutch hospitals between 2015 and 2017.[15] The Medical Ethics Committee of the AUMC, location AMC waived the obligation for formal ethical approval as described under Dutch law. A study protocol was published before the study was completed.[12]

Setting and AGCH intervention

The AGCH opened in July 2018 within a skilled nursing facility. It started with 12 beds and now has 23. The facility serves the south-eastern part of Amsterdam and its surrounding areas (of approximately 147,500 inhabitants).[16] The AGCH has 24-hour nursing assistance and a hospital-based geriatrician or internist is present in the daytime and on-call during nights and weekends. Physiotherapy and routine laboratory testing are available every day and simple X-rays can be performed once a week. Patients eligible for admission to the AGCH are those with an acute medical problem requiring hospitalization (e.g., pneumonia, heart failure, or urinary tract infections) and a geriatric condition (e.g., delirium, cognitive impairment, falls, or functional impairment) who are hemodynamically stable. Patients are not admitted to the AGCH if they need: 1) care that can only be provided at an intensive care unit, 2) surgery, 3) urgent treatments or diagnostic tests that can only be provided in hospital (e.g., endoscopy, interventional radiology), or need 4) transfer to short-term residential care. Patients are directly admitted to the AGCH from the emergency department (ED) of nearby hospitals. After the on-call geriatrician has assessed that the patient is eligible for admission and the patient or representative has agreed to admission, the patient is transferred to the AGCH by ambulance. At admission, a CGA is conducted to obtain an overview of all medical, functional, psychological, and social problems. Results of the CGA are discussed during multidisciplinary team meetings and are used to formulate a care plan for each patient.

AGCH study cohort

Patients admitted to the AGCH were eligible for inclusion in the study. Patients were excluded if: 1) the attending physician judged that they were too ill to participate, e.g., the patient was terminally ill, 2) they or their legal representative did not consent to participate, or 3) they or their legal representative did not speak or understand Dutch or English. Cognitively impaired or delirious patients could only be included if a legal representative consented and acted as a healthcare proxy. The primary sample used for analysis consisted of participants without delirium upon admission, because no participants with delirium upon admission were recruited in the historical control group.[17]

Historical hospital control group

The historical hospital control group (401 participants) were recruited between October 2015 and June 2017 for the Hospital-ADL cohort study.[15] This was a prospective cohort study investigating the trajectory of functional decline in older ($\geq$ 70 years old) hospitalized adults. These participants were admitted to internal medicine, cardiology, and geriatrics departments and were hospitalized for at least 48 hours. Patients with severe cognitive impairment (determined by a Mini Mental State Exam [MMSE] score of $\leq$15) and delirium were excluded. The detailed methodology and inclusion criteria of this control cohort are described in the Hospital-ADL study protocol.[15]

AGCH study cohort and data collection

Eligible patients or legal representatives were informed about the study and provided written informed consent to participate. Measurements upon admission

were conducted within 48 hours after admission, and measurements upon discharge were conducted 48 hours prior to discharge. Follow-up was completed by telephone at one and three months after discharge. Most data were collected from medical records and during the routine CGA. Results from physical tests were extracted from the patients' physiotherapy chart.[12]

Primary and secondary outcomes

The primary outcome measure was a composite of all-cause unplanned readmission to hospital or death within 90 days post discharge. This composite outcome was chosen to account for the competing risk of death. Readmission was assessed during the follow-up interviews or by contacting the general practitioner. Death was confirmed by contacting the general practitioner.

Secondary outcomes included readmission or death (within 30 days), mortality (within 30-days, 90-days after admission and time to death), readmission (within 30 and 90 days post discharge), institutionalization or death (within 30 and 90 days post discharge), the occurrence of falls (30 and 90 days post discharge) and (instrumental) activities of daily living ([i]ADLs) measured by the modified 6-item (ADL) and 9-item (iADL) Katz-ADL[18] subscales (measured at discharge, 30 and 90 days post discharge).

Baseline and follow-up measurements

The number and severity of chronic conditions was assessed at baseline using the Charlson Comorbidity Index (CCI).[19] Polypharmacy was defined as using five or more drugs. Cognitive impairment and delirium were assed upon admission using the MMSE and Confusion Assessment Method).[20] The MMSE includes 23 items (total score 0–30) that screen for cognitive impairment. A score of ≤23 indicates possible cognitive impairment.[21] The assessment of the other variables is described in the study protocol.[12]

Power calculation

Our study assumed that AGCH admission would reduce the relative risk of 90-day readmission by 25%. Data from 515 AGCH patients would yield 80% power to detect this difference in readmission rate using a two-sided test with an alpha of 0.05.[22] We did not recruit this many patients because the study was terminated early because of the COVID-19 pandemic.

Statistical analyses

We computed baseline characteristics of included participants, describing the percentage of missing data. Baseline differences between cohorts were tested using the t-test and Mann–Whitney U test for continuous data and the Chi-square test for categorical data.

Because the study was non-randomized, we used inverse propensity score weighting (IPW) to control for baseline imbalances between treatment groups using *twang* R package (see Appendix 1 for more details).[23] A generalized boosted model was used to estimate propensity scores and their associated weights, including baseline covariates that should be balanced between treatment groups (such as age, sex, living situation, marital status, comorbidity index, born in the Netherlands, history of memory problems, history of delirium, requiring help with

basic ADLs in the past 24 hours). Any variables that had a standardized mean effect size >0.10 and <0.25 were also included as covariables in all outcome models to assure sufficient balance between groups.[24]

Subsequently, multiple imputation by chained equations, stratified by treatment group, was used to impute missing data.[25] In total, 35 imputed datasets were generated based on the maximum amount of missing data in outcome variables using the *MICE* R package.[25, 26] Variables associated with missingness as well as potential confounders (i.e., age, living situation, comorbidity, frailty) were included in the imputation model. All analyses pooled using Rubin's rules.[26, 28]

A generalized logistic regression model was used to evaluate the composite primary outcome. Cox proportional hazards regression was used to evaluate time to death between the groups at 30 and 90 days. Readmission, institutionalization and falls were evaluated using logistic regressions. To analyse (i)ADL functioning (i.e., ADL Katz-6 sub score and iADL Katz-9 sub score), we performed a linear multilevel regression analysis accounting for repeated measurements of (i)ADL-functioning.[27, 28] ADL functioning was measured at admission, discharge, 30-days post-discharge and 90-days post-discharge. The multilevel model included a random intercept at the participant level, a treatment dummy variable, a time variable, and an interaction between the treatment and time variable to test differences in ADL-functioning between the two cohorts. Age, sex, propensity weights and pre-admission ADL-scores were included as covariates. All tests were two-sided and a p-value of 0.05 was considered significant. Analyses were performed in SPPS version 28.0 and R version 4.0.

Results

Between January 31, 2019, and March 13, 2020, 466 consecutive patients were admitted to the AGCH (Figure 1). In total, 261 participants were recruited, 206 of whom were not delirious upon admission and were included in our analysis. Table 1 outlines the baseline characteristics of the AGCH cohort and the Hospital-ADL control cohort and missing data per variable. AGCH patients were older than Hospital-ADL participants; they were also more likely to live alone, be a widow, and were born outside of the Netherlands. AGCH patients also had a higher CCI than the hospital control group. Dementia was diagnosed in 12.6% of participants in the AGCH group and in 2.7% of participants in the hospital control group. Polypharmacy also occurred more frequently in the AGCH group and AGCH patients had higher VMS (Dutch Safety Management Programme) risk scores[29, 30] than the hospital control group. AGCH participants had a lower SPPB[31], physical performance score, and more dependency in iADLs. Baseline EQ-5D[32, 33] scores were higher in the hospital control group, indicating a higher health-related quality of life at baseline. The mean (SD) length of stay was 9.8 (7.5) days for AGCH patients and 8.0 (7.5) days for patients admitted to the hospital.

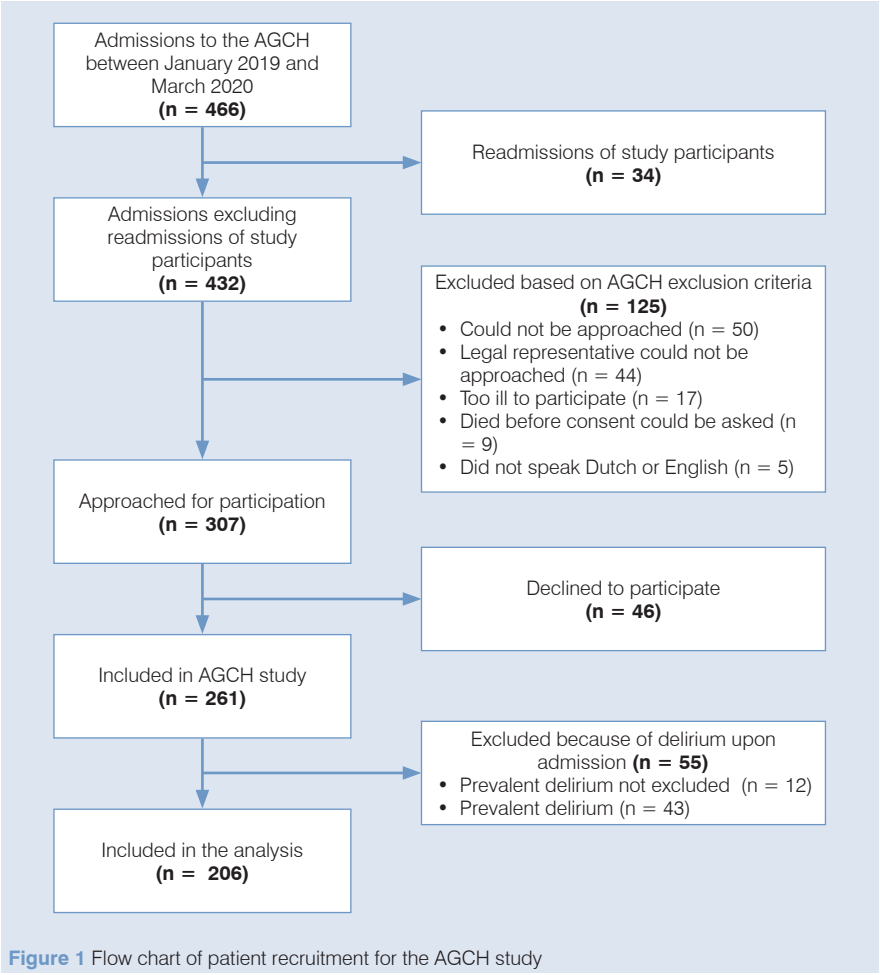

Figure 1 Flow chart of patient recruitment for the AGCH study

Table 1 Patient characteristics in the AGCH study sample and Hospital-ADL (H-ADL) study * % given as valid percentages of non-missing values

Patient characteristics	AGCH N = 206	H-ADL N = 401	p-value
Age in years, mean (SD*)	81.8 (8.1)	79.7 (6.7)	0.001
Missing, n	0	0	
Male, n (%)	97 (47.1)	206 (51.4)	0.32
Missing, n	0	0	
Living arrangements before admission, n (%)			
Independent alone	100 (48.5)	144 (35.9)	
Independent with others (partner, children)	67 (32.5)	193 (48.1)	0.002
Nursing home	3 (1.5)	4 (1.0)	
Senior residence/assisted living	34 (16.6)	55 (13.7)	
Other	2 (1.0)	5 (0.8)	
Missing, n	0	0	
Marital status, n (%)			
Married or living together	66 (32.0)	209 (52.1)	<0.001
Single or divorced	43 (20.9)	64 (16.0)	
Widow/widower	96 (46.6)	128 (31.9)	
Missing, n	1	0	
Born in the Netherlands, n (%)	157 (76.2)	359 (89.5)	<0.001
Missing, n	2 (0.8)	0	
Education, n (%)			0.501
Primary school	37 (19.5)	101 (25.2)	
Elementary technical/domestic science school	45 (23.7)	89 (22.2)	
Secondary vocational education	61 (32.1)	120 (29.9)	
Higher level high school/third-level education	47 (24.7)	91 (22.7)	
Missing, n	16	0	
Charlson Comorbidity Index,† mean (SD)	2.8 (2.0)	2.1 (2.0)	<0.001
Dementia, n (%)	26 (12.6)	11 (2.7)	<0.001
Missing, n	0	2 (1)	
Polypharmacy‡, n	155 (75.2)	260 (64.8)	0.004
Missing, n	0	4 (1.2)	
VMS score positive+, n (%)	133 (70.4)	117 (29.3)	<0.001
Missing, n	17	2 (0.5)	
Mean MMSE§ score, mean (SD)	24.3 (4.2)	25.9 (3.2)	<0.001
Missing, n	49	22	
Hospitalization in past 6 months, n (%)	57 (27.7)	133 (33.2)	0.47
Missing, n	17	0	
Primary admission diagnosis, n (%)			
Infection	53 (25.7)	58 (14.5)	NA
Gastrointestinal	9 (4.4)	45 (11.2)	
Cardiac	19 (9.2)	122 (30.4)	
Respiratory	61 (29.6)	75 (18.7)	
Cancer (including hematology)	0	13 (3.2)	
Electrolyte disturbance	6 (2.9)	11 (2.7)	
Renal	3 (1.5)	15 (3.7)	
Neurology	19 (9.2)	62 (15.5)	
Other	36 (17.5)	0	
Missing, n	0	0	

Table 1 *Continued*

Patient characteristics	AGCH N = 206	H-ADL N = 401	p-value
SNAQ score upon admission, median (IQR)** *Missing, n*	1 (0–3) 17	1 (0–3) 1 (0)	0.34
GDS-3[††] upon admission, mean (SD) *Missing, n*	1.7 (1.0) 30	1.7 (1.0) 3 (0.7)	0.59
SPPB[‡‡] upon admission, mean (SD) *Missing, n*	4.7 (2.6) 55	5.5 (3.8) 74 (18.5)	0.003
Katz-6 (ADL) score upon admission, median (IQR) *Missing, n*	2.5 (1–4) 4	1 (0–3) 1 (0.2)	<0.001
Katz-15 (ADL+iADL) score upon admission, median (IQR) *Missing, n*	8 (4.75–11) 12	4 (2–7) 1 (0.2)	<0.001
EQ-5D[++] score upon admission, mean (SD) *Missing, n*	0.62 (0.3) 27	0.75 (0.2) 0	<0.001
Maximum handgrip strength (kg) upon admission, mean (SD) *Missing, n*	22.3 (8.4) 75 (28.7)	27.3 (10.8) 31 (7.7)	<0.001
Frailty ≥ 3 factors[§§], n (%) *Missing, n*	105 (71.4) 59	206 (57.2) 41 (10,2)	0.003
Length of hospital stay, mean (SD) Median (IQR) *Missing, n*	9.8 (7.5) 7.5 (5.0–12.0) 0	8.0 (7.5) 5.8 (3.9–8.9) 14	<0.001
Discharge destination, n (%)*** Home/independent living Nursing home Geriatric rehabilitation Short-term residential care Assisted living Other (e.g., other hospital) Unknown/missing Not applicable (e.g. patient deceased)	 139 (67.5) 11 (5.4) 15 (7.3) 7 (3.4) 13 (6.3) 5 (2.4) 0 6 (2.9)	 317 (79.1) 6 (1.5) 20 (5.0) 0 6 (1.5) 17 (4.2) 29 (6.7) 8 (2.0)	NA

* Standard deviation
† Range of 0-31, with a higher score indicating more or more severe comorbidity[19]
‡ Use of 5 or more different medications
+ Dutch Safety Management Programme (VMS= Veiligheidsmangementsysteem) includes , history of memory problems, history of delirium, requiring help with basic ADLs in the past 24 hours[30]
§ Mini Mental State Exam, range 0-30, ≤23 is cognitive impairment[21]
** Short Nutritional Assessment Questionnaire, range 0-330, [42]
†† Apathy subscale, range 0-3, of the Geriatric Depression Scale[43]
‡‡ Short Physical Performance Battery, range 0-12, with a higher score indicating better physical performance[31]
++ Health related quality of life score, range 0-1, with a higher score indicating better health[33]
§§ Using Fried´s criteria for physical frailty, with 3 or more criteria indicting frailty[44]
*** not measured in same way in both studies

Primary outcome
AGCH patients were less likely to be readmitted or die within 90 days after discharge (odds ratio [OR]: 0.39, 95% CI: 0.23–0.67). The AGCH group had lower odds of 90-day readmission (OR 0.38, 95% CI, 0.21-0.67) compared to the control group. All-cause mortality upon 90-days post discharge was not different between groups (OR 0.89, 95% CI: 0.44–1.79).

Secondary outcomes
Secondary outcomes are listed in table 2. AGCH patients were also less likely to be readmitted or die within 30 days post discharge (OR: 0.42, 95% CI: 0.23–0.78) (Table2). The odds of being admitted to long-term residential care or having died versus being in their original living situation and alive was not different between groups 30 days after discharge (OR: 1.19, 95% CI: 0.57-2.49) or 90 days after discharge (OR: 1.31, 95% CI: 0.71–2.40). There was also no difference in falling at discharge, 30 days after discharge, or 90 days after discharge. There were 33 (16%) deaths in the AGCH cohort and 40 (10%) deaths in the hospital cohort within 90 days after discharge. However, IPW analyses showed no differences in mortality between the two groups hospital at discharge, 30 days after discharge, and 90 days after discharge (Table 2). Time to death (in days) within 90-days after hospitalization also not different between the two groups (hazard ratio: 0.93, 95% CI: 0.51-1.69, p-value = 0.81). Longitudinal models did not show a difference in individual changes of ADL or iADL functioning over time between the AGCH cohort and Hospital-ADL cohort (ADL Katz-6 sub score: b=<0.001, p=0.87, iADL Katz-9 sub score: b=0.004, p=0.36).

Outcomes specific to the AGCH
Of the 206 patients who were not delirious upon admission, 199 were alive at discharge and 81.4% returned to their original living situation. No data were available from the Hospital-ADL study on return to the original living situation. Of the 206 participants, 15 (7.3%) returned to hospital for diagnostic procedures and 11 (5.3%) returned to hospital for inpatient admission. In 61.1% (118/193) of cases, discharge letters were sent to the GP within 2 days after discharge. Outcomes in the AGCH cohort are described in Appendix 1, including those for participants with possible delirium upon admission.

Discussion

Patients admitted to the AGCH had a lower risk of readmission or death within 90 days after discharge than patients admitted to a hospital. However, there were no differences between groups on: 30-day or 90-day mortality after discharge, time to death, admission to long-term residential care, number of falls or ADL-functioning over time. These findings suggest that the AGCH model of care could be expanded elsewhere in the Netherlands and tested in other European countries as an alternative to hospitalization.

We believe that the reduction in readmissions may have been due to early initiation of advance care planning in frail AGCH patients.[14] Advance care planning can be defined as the patient's goals and preferences for future medical treatment

Table 2 Outcomes of patients admitted to the AGCH compared with controls in the H-ADL study. Multivariable model corrected for variables in the propensity score model with a standardized mean difference greater than 0.10 and sex.* Primary outcome

Outcome	OR (95% confidence interval)
Composite outcome	
30-day	0.42 (95% CI: 0.23–0.78)
90 days*	0.39 (95% CI: 0.23–0.67)*
Unplanned readmission	
30-day	0.45 (95% CI: 0.22–0.92)
90-day	0.38 (95% CI: 0.21–0.67)
All-cause mortality	
Discharge	0.41 (95% CI: 0.13–1.33)
30-day	0.93 (95% CI: 0.33–2.60)
90-day	0.89 (95% CI: 0.44–1.79)
Composite of institutionalization in a long-term care facility or death	
30-day	1.19 (95% CI: 0.57–2.49)
90-day	1.31 (95% CI: 0.71–2.40)
Institutionalization in a long-term care facility	
30-day	1.59 (95% CI: 0.58–4.37)
90-day	1.88 (95% CI: 0.77–4.56)
Falls	
During admission	0.78 (95% CI: 0.25–2.35)
30-day	1.29 (95% CI: 0.63–2.62)
90-day	0.82 (95% CI: 0.36–1.83)

and care and discussing these goals and preferences with family and health-care providers.[14] Initiating advance care planning during an acute hospital admission and continuing it in the primary care setting can prevent unplanned readmissions by allowing those patients who do not want to be readmitted to stay at home and by helping GPs to better support their patients at home.[34]

In agreement with previous studies on admission avoidance from nursing homes and hospital-at-home interventions, we found that AGCH care can reduce readmission rates. For example, Ouslander[35] et al. showed that the INTERACT program successfully reduced the number of hospital admissions from a nursing home by 17% and Federman et al.[36] showed that hospital-at-home interventions reduce hospital readmissions and nursing home admissions compared with in-hospital care. However, these positive findings have not been reproduced in some larger scale studies. For example, Kane et al.[37] found that the INTERACT program did not significantly reduce hospital admissions when implemented in more than 30 sites in the United States. In contrast, Shepperd et al.[7] found that a hospital-at-home intervention at multiple sites reduced the likelihood of patients living in a nursing home 6 months after the intervention. These results indicate that the

AGCH concept should also be evaluated at multiple sites in a larger study.

Strengths and limitations

This study was not randomized; we used a historical control group, which resulted in baseline differences between groups. A strength of the study is that we used IPW to balance these differences.[38] Furthermore by imputing missing data, we were able to analyze the complete study sample. We used the percentage of missing data to calculate the number of imputations required, but other methods also exist.[25, 26] With regards to limitations of our study; first we had to terminate the study early because of the COVID-19 pandemic. Second, the control cohort was not recruited at the same time. This could have influenced our results as work processes in hospitals have changed over the years, which may have reduced unplanned readmissions. In general, the number of hospital admissions has decreased in the past years, but we do not know if this decrease is specific to older adults.[39] Therefore, we do not know whether our results are related to a general decline in unplanned readmissions in frail older adults. Furthermore, the main diagnoses at admission were different between the AGCH (primarily infection) and Hospital-ADL (primarily cardiac) cohorts; therefore, disease-related factors may have influenced the readmission rate. Finally, we had to exclude patients from the analysis who were delirious upon admission. This means that our results are not fully generalizable to the frail population of older adults admitted from the ED.

Overall our results have provided valuable information on the effectiveness of the AGCH model of care. In addition other research on the AGCH showed that patient satisfaction with care was high[40], and incident rates for delirium were lower compared to control groups from literature.[41] Therefore the AGCH may be a useful alternative to hospital care. For further research an economic evaluation of this model is warranted as the related costs may be lower than those of hospital-based care because of fewer unplanned readmissions.

Conclusion

Adults with acute medical and geriatric conditions who were admitted to the AGCH had decreased chances of unplanned readmissions or death compared to hospital controls. These preliminary findings show that the AGCH is a promising new model of care for older adults and may offer an alternative to hospital-based care.

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Appendix 1 – Variables included in multiple imputation model

Variables included in the propensity score were prespecified and associated to treatment allocation.[45] These included age, marital status, living arrangement, country of birth, CCI (Charlson comorbidity index)[19], and VMS-1,2,3 scores[29](Dutch Safety Management Programme, in Dutch *Veiligheidsmangementsysteem*, scores reflecting functional dependence, history of memory problems, and history of delirium).

Appendix 2 – Outcomes specific to the AGCH, including patients admitted with delirium (n=261)

Out of the 261 patients admitted, including those with delirium, 251 were alive at discharge and 82.1% returned to their original living situation. 15 out of 261 participants (5.7%) returned to hospital for diagnostic procedures such as a CT scan, after which they returned to the AGCH for the remainder of their admission. 14 out of 261 (5.4%) participants had to be admitted to hospital. Discharge letters were sent to the patient's GP within 2 days after discharge in 61.4% of cases (151 out 246 cases with data).

Appendix 3 –STROBE statement checklist

STROBE Statement—Checklist of items that should be included in reports of cohort studies

	Item No	Recommendation	Item found on page
Title and abstract	1	*(a)* Indicate the study's design with a commonly used term in the title or the abstract	Abstact
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Abstract
Introduction			
Background / rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction
Objectives	3	State specific objectives, including any prespecified hypotheses	Introduction
Methods			
Study design	4	Present key elements of study design early in the paper	Introduction & Methods Study design
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Methods
Participants	6	*(a)* Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Methods
		(b) For matched studies, give matching criteria and number of exposed and unexposed	Methods
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Methods- Primary and secondary outcomes

Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Methods- Baseline and follow-up measurements
Bias	9	Describe any efforts to address potential sources of bias	Methods- Statistical analyses
Study size	10	Explain how the study size was arrived at	Methods- Power calculation
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Methods- Statistical analyses Appendix 1 and 2
Statistical methods	12	*(a)* Describe all statistical methods, including those used to control for confounding	Methods- Statistical analyses
		(b) Describe any methods used to examine subgroups and interactions	n/a
		(c) Explain how missing data were addressed	Methods- Statistical analyses & appendix 1
		(d) If applicable, explain how loss to follow-up was addressed	Methods- Statistical analyses & appendix 1
		(e) Describe any sensitivity analyses	Appendix 2
Results			
Participants	13*	*(a)* Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Results and Figure 1
		(b) Give reasons for non-participation at each stage	Results and Figure 1
		(c) Consider use of a flow diagram	Figure 1

Descriptive data	14*	*(a)* Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Results and Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Table 1
		(c) Summarise follow-up time (eg, average and total amount)	Not reported
Outcome data	15*	Report numbers of outcome events or summary measures over time	Results
Main results	16	*(a)* Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Results Table 2
		(b) Report category boundaries when continuous variables were categorized	Table 2
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Results – Outcomes specific to the AGCH
Discussion			
Key results	18	Summarise key results with reference to study objectives	Discussion
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Discussion

Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Discussion
Generalisa-bility	21	Discuss the generalisability (external validity) of the study results	Discussion
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Funding sources

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

6

Patient experience and satisfaction with admission to an acute geriatric community hospital in the Netherlands: a mixed method study

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Journal of Integrated care 2021;29 (4):390-402

Abstract

Purpose: The Acute Geriatric Community Hospital (AGCH) in an intermediate care facility is an alternative to conventional hospitalization. A comprehensive geriatric assessment and rehabilitation are integrated into acute medical care for older patients. This study aims to evaluate patient experience and satisfaction with the AGCH.

Design/methodology/approach: This is a mixed method observational study including a satisfaction questionnaire and qualitative interviews with AGCH patients or informal caregivers.

Findings: 152 participants filled in the questionnaire and thirteen semi-structured interviews were conducted. Eleven categories and four overarching themes emerged in the analysis. In general, study participants experience the admission to the AGCH as positive and are satisfied with the care they received, there were also suggestions for improvement.

Research limitations/implications: Limitations of this study include possible participation bias. Our results show that patients value this type of care indicating that it should be implemented elsewhere. Further research will focus on health outcomes, readmission rates and cost effectiveness of the AGCH.

Originality/value: This is the first study to evaluate care satisfaction with the AGCH. It shows that hospitalized older adults positively value the AGCH as an alternative to hospitalization.

Introduction

Hospital admission is a stressful event for older adults and their families. It is associated with deconditioning, functional decline, hospital readmissions and increased mortality.[1, 2] Furthermore, patients with geriatric syndromes such as delirium, malnutrition, depressive symptoms, and functional impairment have an increased risk of functional decline, nursing home admission[3] and readmission.[4]

With an aim to prevent these negative outcomes, alternatives to conventional hospitalization have been developed.[5] An example is hospital at home where a patient receives hospital treatment at home.[6] Another alternative that was recently developed and opened in 2018 in Amsterdam, the Netherlands, is admission to a specialized acute geriatric unit in an intermediate care facility: the Acute Geriatric Community Hospital (AGCH).[7] In this new model, patients are selected for admission at the emergency department (ED) of a general hospital and then transferred to the AGCH. Complete criteria for admission have been described elsewhere.[7, 8] At the AGCH, patients receive specialized treatment including a comprehensive geriatric assessment[9] and early rehabilitation.[10] The patient care goals of the AGCH are firstly to improve self-efficacy[11] and prevent functional decline.[1] It therefore has an adapted environment with single rooms and open hallways that allow for mobilization during the day. Also, patients receive physiotherapy and are encouraged to set daily goals, to promote self-efficacy and mobilization. Secondly, the AGCH aims to improve sleep by allowing informal caregivers to stay during the night and by preventing overstimulation. A continuous non-contact heart and respiration rate monitor (Early Sense™)[12] is used, which allows monitoring the patient's vital signs without waking the patient at night. Thirdly, the AGCH focuses on family and informal caregiver involvement[13] and transitional care[14]; patients and their informal caregivers are involved in treatment and discharge planning. These interventions aim to improve clinical outcomes of care, improve patient and informal caregiver satisfaction with care and reduce costs. A prospective cohort study is underway to evaluate if the AGCH improves clinical and economic outcomes.[7]

The current study evaluates the patient and informal caregiver experience and satisfaction with care. As the AGCH aims to involve patients and their caregivers in the care provided at the AGCH, the concept itself was also developed iteratively together with older adults living in the community. Nineteen patients and their informal caregivers were interviewed about the AGCH concept during the development phase of the project. In these interviews, the interviewees expressed that they would like the AGCH to be a small-scale unit, providing patient-centered care that provided support for informal caregivers. However now that the AGCH has opened, we do not know how older adults experience admission to the AGCH. This is relevant as patient experience has been linked to the quality-of-care pathways[15] and we would like to evaluate if patients and caregivers are indeed satisfied with the care that they received. Our study aim was therefore: to gain insight into the patient experience and to describe patient satisfaction with admission to the AGCH. We wanted to understand what experiences, processes or circumstances led to patients being (dis)satisfied with the received care. The outcomes of this study will be used to further improve the AGCH concept and to evaluate if the AGCH concept should be implemented elsewhere.

We used a mixed method design where we analyzed responses to a questionnaire and conducted qualitative semi-structured interviews with a selected group of patients. During the initiation phase of this research, we developed a conceptual framework of the patient experience within the AGCH. This framework was used to guide interviews (Figure 1).

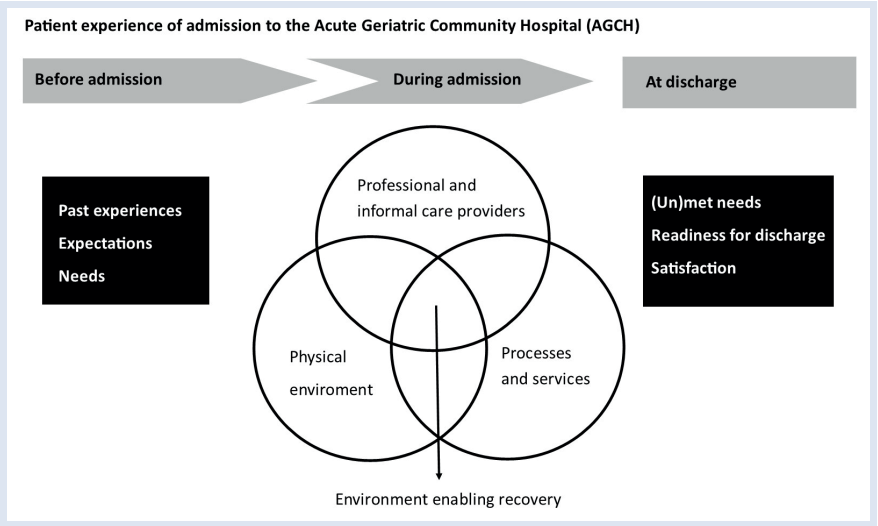

Figure 1. This conceptual framework was created to explain the experience of patients admitted to the AGCH. Before admission patients have already formed medical experiences, expectations and needs, these terms have been previously been described for the experience in long term care by Sion et al.[16] When they are admitted there are both professional care providers (nurses, therapists, doctors) and informal care providers (family members, friends), processes and services (admission via ambulance, food and daily schedule) and the environment (single room, quiet hallways, space to move around) that we associate with an environment that enables recovery.[17] If patients 'needs are met or not met during admission this will lead to (un)met needs[18], (un)readiness for discharge[19] and a feeling of (dis)satisfaction[16] terms from previous literature.

Methods

Study design

Participants 65 years and older were enrolled in a prospective controlled study evaluating the effectiveness of care delivery at the AGCH. The full protocol of this study has been described elsewhere.[7] Data collection for this study started in February 2019 and was temporarily ceased in March 2020 during the coronavirus disease 2019 (COVID-19) pandemic. Data collection, both quantative as qualitative on patient experience and satisfaction was not recommenced during the pandemic because 1) in-person interviews were no longer allowed and 2) patient experience was heavily impacted by Covid-19 restrictions because, for example, patients could no longer receive visitors.

We conducted a mixed-method study because using both quantitatve as qualitative methods can improve study validity.[20] This is sometimes referred to as method triangulation. Hence, this mixed method study evaluates 1) the

quantative secondary outcome patient and caregiver satisfaction using an satisfaction questionnaire and 2) the patient experience and satisfaction studied using qualitative methods. The questionnaire contained six Likert-scale questions (figure 2), an overall satisfaction score (0-10) and one open-ended question: 'Do you have any remarks or comments regarding your stay at the AGCH?' The results from the questionnaire were analyzed and used as input for a more thorough qualitative analysis of the patient experience and satisfaction with care at the AGCH. We decided to do this because the answers to the open-ended question provided insight into patient satisfaction with care but were not in-depth descriptions of patient experience. Therefore, we conducted, more in-depth, semi-structured interviews and used the answers to the open-ended question to triangulate our findings. We used the criteria for reporting qualitative research (COREQ) checklist[21] to ensure all relevant items for reporting qualitative research were included (checklist in supplementary appendix).

Qualitative interviews

Patients were eligible for participation in a semi-structured interview if they 1) were participants in this prospective controlled cohort study, *and* 2) did not have cognitive impairment, i.e., the patient should be able to provide informed consent for the interview and audio recording, or 3) had an informal caregiver who agreed to act as a proxy for the interview. A purposeful sampling method was used, where we aimed for variation in age, gender, previous occupation and/or level of education of the patient. For the final interviews we asked informal caregivers of patients with cognitive impairment to partake in an interview.

We wanted to understand the patient experience from a chronological time-path, the *patient journey*,[22] from admission to discharge home. Therefore, we created a conceptual framework (figure 1) and interview guide that followed this patient journey. In addition, we used answers from the questionnaire to add topics that seemed particularly relevant to the patient experience; for example, 'food and meals' was a topic which had not been initially included in the interview guide but one that was repeatedly mentioned by participants. The guide was discussed in the research team prior to the first pilot interview. After two pilot interviews the interview guide was reviewed and adjusted by MER and CCR. During data collection minor alterations and additions were made to the interview guide.

Interviews were scheduled between 48 hours prior to discharge and two weeks post-discharge. Based on the patient's preference, the interview was conducted at the ACGH or at the patient's home. The presence of an informal caregiver was discussed, and verbal informed consent was obtained when an informal caregiver was present during the interview. Their input was included in the data, although we focused on analyzing the data from the patient's viewpoint. The interviews were all audio recorded. There were no repeat interviews. The audio-recorded interviews were transcribed verbatim and anonymized. During and after the interview, field notes were made to capture impressions of and thoughts on the interview. Transcripts were not returned to participants and no participant checking was performed.

Qualitative analysis

We conducted a thematic analysis following the steps described by Braun and Clarke.[23] For the first six semi-structured interviews we used an open coding approach. MER and CCR separately coded these interviews. After discussing the codes thoroughly an initial coding structure was created. We used the conceptual framework (figure 1) to guide us in creating this coding structure. The remaining interviews were coded using the initial coding structure, if relevant, new codes were included in the second coding structure. After all the interviews were coded MER and CCR reviewed the second coding structure and identified all relevant categories and themes. If there was not enough data to support initial categories, they were removed. Finally, MER and CCR agreed on a final coding structure, categories, and overarching themes. MAXQDA 2020 (VERBI Software, 2019) software was used for coding. We did aim for saturation but could not assure saturation on all topics because the study was not recommenced after the start of the COVID-19 pandemic.

Research team and contributions

The interviews and analysis were conducted by MER and CCR. MER is a PhD candidate who received training in qualitative research. At the time of conducting this research CCR was a sixth-year medical student with no prior training in qualitative research. JMV, RF and BMB are senior researchers who oversaw the design and conducting of the study. RF is an internist working at the ED and AGCH.

Ethical considerations

The Medical Ethics Research Committee of the Amsterdam University Medical Centers confirmed that the Medical Research Involving Human Subjects Act did not apply to this research project and official approval was not required.

Results

Between February 2019 and March 2020, 239 participants were recruited for the questionnaire study (Figure 2). Out of these 239, 152 participants answered the questionnaire, a further 123 participants provided an answer to the open-ended question. Mean age in the group of patients who answered the questionnaire was 81.1 (standard deviation 8.4) years, 51.3 % (n=78) were female, and in 23.7% (n=36) of cases an informal caregiver partook in the study on behalf of the patient. Participants rated their satisfaction with the AGCH with a score of 8.1 out of 10 (Figure 2).

For the semi-structured interviews, 13 participants were included between September 1, 2019 and March 11, 2020 (Table 1). Seventeen were purposefully selected and approached for participation in an interview. Four declined participation. Three additional participants were selected but not approached for an interview during the start of the COVID-19 pandemic. Interviews lasted 30 -80 minutes. Mean age of the 13 participants was 79 years (range 65-94 years) (Table 1). We identified eleven categories with four overarching themes (Table 2).

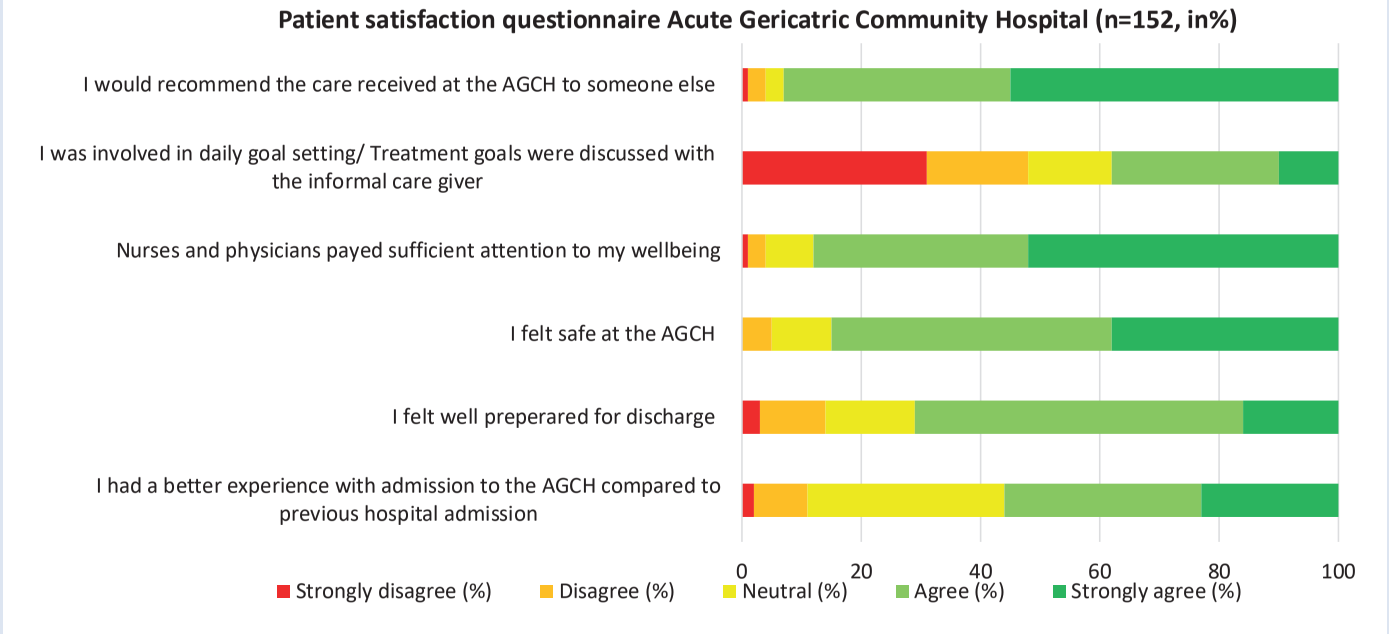

Figure 2. Results from patient satisfaction questionnaire using a Likert scale[24]

Table 1. Participant characteristics

	Age (years)	Gender	Marital status Living situation	Diagnosis	Length of stay (days)	Caregiver present during interview
P1	77	F	Widow- living alone	Hyponatraemia	10	No
P2	65	F	Widow- living alone	Pneumonia, heart failure	6	No
P3	78	F	Unmarried- living alone	Urinary tract infection	4	Not applicable
P4	80	M	Widower- living alone	Exacerbation COPD	12	Not applicable
P5	90	M	Widower – living alone	Heart failure	7	No
P6	79	M	Living with partner	Urinary tract infection, delirium	10	No
P7	68	M	Living with partner	Exacerbation COPD	7	No
P8	72	F	Living with partner	Post-pneumonial bronchial hyperreactivity	11	Yes, partner
P9	72	F	Living with partner	Exacerbation COPD	9	Yes, partner
P10	74	M	Unmarried- living alone	Fracture	10	Not applicable
P11	94	M	Living with partner	Heart failure	5	Yes, partner and son
P12	92	F	Unmarried – living alone	Fall, delirium	22	Yes, daughter
P13	86	F	Living with partner	Urinary tract infection, delirium	29	Yes, daughter

Table 2. Categories and overarching themes concerning the Acute Geriatric Community Hospital (AGCH) care pathway

Category	Theme
1. Acute medical needs 2. Care process at the emergency department 3. Satisfaction with care provided expectations of the AGCH	Visiting the emergency department
4. The Physical Environment of the AGCH 5. Care processes and important persons 6. Recovering from illness, remaining independent	The experience of the AGCH admission
7. Views on the AGCH 8. Comparison to care in a general acute hospital 9. Suggested improvements for the AGCH	Satisfaction with the AGCH concept
10. Home and primary care 11. Discharge home	Going home, being home

Theme 1- Visiting the emergency department

Most participants indicated that they did not remember all that had passed at the ED, but all could describe the reasons for visiting the ED. Three categories emerged: *acute medical needs, the care process at the ED and satisfaction with the care provided, expectations of the AGCH*.

Acute medical needs. Participants were sent to the ED by a general practitioner, after consulting a medical specialist or after family members had called for an ambulance. Patients experienced a range of symptoms, but many either had pain or were short of breath:

> *'The GP service came by and they did not think it was responsible…. that I was short of breath, that they brought me there [to the emergency department]' – Interview 2*

Most suffered from exacerbations of chronic conditions such as an exacerbation of chronic obstructive pulmonary disease (COPD) or heart failure (Table 1- participant characteristics). In many cases their symptoms had emerged in the past few days or had worsened in the past 24 hours. Once at the ED many participants felt that their symptoms improved, because they were attended to and were now in "good hands".

Care process at the emergency department. The ED was often described as a busy place. There was not always an informal caregiver present. Participants were generally quickly attended to, but then had to wait a long time before they could be admitted:

> *'I was there for over six hours, before I came here [the AGCH] it was already six pm, so I came there [the ED] at quarter to two in the afternoon I believe, so I was lying there [on a stretcher] for quite a long time.' – Interview 3*

Satisfaction with the care provided and expectations of the AGCH. Not all participants felt they were consulted about the decision to be admitted to the AGCH. This was however not experienced as burdensome. Participants usually did not know what to expect from the AGCH:

> *'Then the doctor came and said: we will transfer you to the AGCH. Well, for me that was a big question mark, I had never heard of it.'- Interview 11*

They received a leaflet and information about the AGCH from a physician or nurse at the ED, which was considered sufficient. Many expected to be admitted to a hospital department, but then did not recognize the AGCH as a hospital department:

> *'Well, I was expecting to go to some sort of hospital, how terrible. But that was not how I felt once I was here.' – Interview 1*

Participants did not mind the transition to the AGCH by ambulance. An unmet need was the need to drink or eat during the stay at the ED, many reported to be

very hungry, thirsty, and tired once they arrived at the AGCH.

Theme 2: The experience of the AGCH admission
Three categories within the theme experience of the AGCH admission emerged: *The Physical Environment of the AGCH, care processes and important persons at the AGCH and recovering from illness, remaining independent.*

The physical environment of the AGCH. The physical environment of the AGCH is the first thing many participants mention. They describe a hotel-like environment with a single room, a comfortable bed, and a personal bathroom. Many participants recognized that the department had been recently renovated. Furthermore, they described it as a quiet environment, where they could sleep well most nights. When asked most participants felt safe from a medical perspective and felt that they would be quickly attended to in case of medical emergency. The Early Sense™ monitor did not improve their sense of safety per se, they did however not mind being monitored continuously:

> *'Well, they [the nurses] cannot…they cannot be by your bedside all night. A sensor like this is perfect for people…confused people and so on. Because then they [the nurses] are warned and they come. No, I think it is an excellent idea'. – Interview 6*

With regards to access to the department and patients rooms, it was experienced to be unsafe at times because the department was freely accessible and there was no doorman or reception. Some patients did not leave the department during their stay at the AGCH. Others used the restaurant or made walks in the garden. Overall, participants felt that the AGCH, compared to a general hospital, had more of a "home-like" environment.

Processes and important persons at the AGCH. Nurses were the most important persons for participants during their stay at the AGCH. Patients describe the nurses to be involved, wanting to genuinely care for the patient and friendly:

> *'(…) I am really positive about the way in which nurses approach their patients. (…) How approachable and how willingly they are to help. That was exemplary.'- Interview 11*

Doctors were more in the background. Multiple participants found themselves 'medically unskilled' but trusted doctors to be competent and present when needed. Not all participants received physiotherapy. One participant had not recognized the therapy session as physiotherapy. Other participants were satisfied with the physiotherapy and the frequency of sessions.

Recovering from illness. All participants described a noticeable recovery during their stay. Physiotherapy was seen as useful, especially for improving their functioning in daily life. Some participants felt the medical treatment and their personal motivation was most important for their recovery, not the involvement of care professionals:

> *'Was there someone who helped you in the process of recovery? Well, honestly,*

I myself, I have to, I am not going to just give up, I cannot.'- Interview 2

The phrase 'the will to be independent' was used by multiple participants to describe they themselves oversaw their recovery.

All participants talked about the food in the AGCH. Opinions on the quality of the food differed. Participants mentioned that food was important for their recovery. Some felt that not enough information and guidance on healthy eating was provided.

Theme 3: Satisfaction with the AGCH concept

Views on the AGCH. In general patients were positive about the AGCH and the concept of the AGCH. Participants described the AGCH as a place to receive treatment and recover, after which they would go back home. Participants who lived nearby liked that visiting was easier for their relatives. Many thought the AGCH a good alternative for hospitalization or as a 'step' between hospital and home. Participants thought that the AGCH would lead to lower healthcare costs and a reduced burden on the hospital:

'A great concept. (…) I think it is a solution in its purest form. The size of the neighbourhood is not up to me, I believe there is a professor at the [University Hospital] who thought of this, but I think every neighbourhood should have such an AGCH.(…) Just for people like me, I do not have to go to hospital, costing thousands of euro's a day, but an AGCH, great! Yes, I think it is very well indeed'- Interview 6

Comparison to care in a general hospital. Compared to hospital the AGCH's rooms where bigger and patients got more rest, which allowed for a better recovery. However, the hospital was more open and allowed for contact with other patients. Most participants felt they received more personal attention from nurses and physicians in the AGCH:

'Well, I would prefer to go to the AGCH! Firstly, they will help you in a more personal manner, of course they cannot help that in the hospital. There, there are at least four patients per room and if you have room to yourself, you are lucky. They cannot give you the same attention, as they give you here.' – Interview 8

There were less doctors and no medical students during rounds which patients perceived as positive. A 'white tornado' of doctors and medical students (in a general hospital) was perceived as not personal and not allowing the patient to partake in decision making. Participants felt that they and their informal caregivers were more involved in decision making. Some participants felt that they were not involved in decision making, especially regarding their discharge date and discharge location. However, there was no clear difference in received medical care, some stated services in the hospital were more punctually, for example with handing out medication:

'Well, maybe you think less about being ill when you are here [at the ACGH]. But I feel fine in a hospital as well. It does not matter to me. (…) If someone looks

out for you, then for me it is fine. (laughs). If I get my medication [on time] then for me, it is totally fine.' – Interview 3

Some participants observed that the provided care at the AGCH was less complex compared to a general hospital. Multiple participants thought the personnel at the AGCH had a lower level of education. The lower level of care provided at the AGCH compared to hospital did however suffice. Finally, free parking at the AGCH was considered a benefit.

Suggested improvements for the AGCH. Most participants did not have specific suggestions for the AGCH and regarded adverse events as so minor that they should not receive any attention from the interviewers. Some could identify several unmet needs or suggestions for improvement of the AGCH.

These unmet needs were "lack of information", "lack of activities", "lack of contact with other patients" and goals of the AGCH being too ambitious. Lack of information concerned lack of information provided by the staff about medication, nutrition, and exercise. Especially with regards to medication patients would like to be informed better. Some participants experienced staff not to always be up to date on decisions that had been made. With regards to lack of activities and lack of contact with other patients, a participant stated:

'What did you think of activities? Well, that, television, you do not have anything else.' –Interview 5

Once they felt better some participants described the AGCH to be boring and not stimulating. However, some participants did not want any special activities, as they would go home soon. No participant had contact with other patients because of the single rooms. However, half of the participants would have liked some contact. Finally, some caregivers thought that the goals set by the AGCH were perhaps too ambitious. One participant had a goal of walking 500 meters whereas he could only walk less than 100 meters preadmission. Some of the practical improvements were adding handlebars in the shower and/or adding a curtain for more privacy to the room. Moreover, the location and naming of the AGCH was not always clear to visitors. A reception to the AGCH was a suggested improvement. Some were not satisfied with the cleaning of the room.

Theme 4: Going home, being home

Home and primary care. When talking about their living situation many participants stated the wish to remain in their own house and to be independent for as long as possible. Most participants relied on the care of professional or informal caregivers in some way. Participants usually did not want to impose on their family members, however direct family was the primary source of support. Some of the participants did not receive any home care before admission, but after discharge many started to receive home care.

Discharge home. Discharge was a topic that was most clearly associated with miscommunication and unmet needs. Some experienced difficulties with their changed medication or even reported medication errors. Miscommunication about discharge concerned the date and time of discharge and the possibility that discharge could be postponed. Many participants experienced they were

informed late about their upcoming discharge, feeling rushed and not ready to go home. This feeling was caused either by uncertainty about their physical state and the wish to train more with the physiotherapist before returning home, or because participants felt that home care and medication had not been organized well enough. Proxy-interviewees stated that the moment of discharge came unexpected because in the final days of admission there was less contact with the doctors.

Nevertheless, many of the participants stated that they were happy to be home once they were discharged. However, most of the participants did not feel fully recovered yet:

> *'Yes I was happy to go home. Could you manage once you were home? (…) Well, not exactly (…) I do want to remain independent however. So you did manage? Yes, but, slowly and with a lot of effort.' – Interview 2*

Discussion

This mixed-method study showed that patients generally experience the admission to the AGCH as positive. The care pathway of the AGCH, which starts at the ED, was considered well-organized up to discharge. At discharge there were some unmet needs and an unexpected change in the discharge date could overwhelm and dissatisfy participants. However satisfactory experiences strongly outweighed dissatisfactory experiences in our analysis. There were also suggested improvements for the AGCH which concerned practical problems and the request for more information from doctors and nurses. Nevertheless, most participants would support the opening of more AGCHs and tend to prefer admission to the AGCH to admission in a general acute hospital.

When we compare the quantitative to the qualitative data, these are generally consistent, however in the questionnaire that was conducted mostly prior to the interviews, we see that many of the participants had not been involved in daily goal-setting. Interestingly this was not one of the subjects that was mentioned in the interviews and it did not seem to influence how participants experienced their recovery. Personal motivation and 'the will to be independent' where important to participants and perceived as the main drivers of recovery. Even so, the physiotherapists— who are explicit in setting treatment goals, where seen as important persons who aided recovery. It is known that in a geriatric population goal setting can be difficult and therefore it is possible that professionals at the AGCH do use (daily) goal-setting, but that patients did not understand or recognized these goals, because they were e.g. not patient-centered enough.[25, 26]

The categories we found in our qualitative analysis are like themes Green et al. identified when comparing patient and caregiver experiences with a community hospital and a general hospital.[27] Green et al. identified amongst other themes the theme of community hospital environment ('home-like' place) and location (accessible and free parking), staff attitude and activities. In the community hospital patients did not experience a lack of activities, as was the case in the AGCH.

Similar to what was reported by Small et al.[28] interviewees at the AGCH did not

talk much about the medical treatment they received but how, when and by whom care was delivered. Small et al called this the 'soft process'.[28] This differs from the 'hard process' that doctors and nurses focus on: what training or treatment is given. Patients commented they were medically unskilled and therefore could not say anything useful about experiences with their medical treatment, however they had great trust in the attending physician. Some participants or informal caretakers were more critical of medical treatment, this mostly concerned lack of information about treatment goals and changes in medication.

Limitations

One of the study's limitations is that some patients were interviewed about their experience with the AGCH until after the admission. This may have led to recall bias, especially for the phase at the ED. Another limitation is we could not conduct further interviews and check for saturation. The COVID-19 pandemic also restricted us in interviewing even more very frail patients and/or their informal caregiver as a proxy. These patients may have other needs compared to those who are relatively more resilient and have less memory problems. Furthermore, patients who were not satisfied or had negative experiences with the AGCH might have declined to participate in the cohort or qualitative study.

Implications for clinical practice

This study shows that older adults who need to be hospitalized value the AGCH concept as an alternative to hospitalization. Nevertheless, participants had suggestions for improvements, which will be and have been taken into consideration by the staff of the AGCH. For example, within the theme of *the physical environment of the AGCH* the need for a reception was mentioned; this reception now has been installed at the AGCH. When looking just at satisfaction with care, our research results support the implementation of the AGCH concept and/or interventions elsewhere in the Netherlands and supports the opening of similar models of care abroad. Further research will focus on outcomes such as the 3-month unplanned readmission rate, incidence of functional decline, and cost-effectiveness of the AGCH. If the AGCH concept is implemented elsewhere in the Netherlands research evaluating patient experience and satisfaction can be repeated to see if the concept is also experienced as positive when implemented at another location in the Netherlands.

Conclusion

This mixed-method study provides an insight in patient experiences and satisfaction with the Acute Geriatric Community Hospital, a unique acute geriatric care facility in the Netherlands. These qualitative outcomes are favorable, with most older persons preferring admission to AGCH to admission in a general hospital. However, further research on health outcomes, readmission rates and cost effectiveness of the AGCH is needed to complete the evaluation of the AGCH and conclude if implementation elsewhere is indeed advisable.

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Appendix table- results of patient satisfaction questionnaire

	Strongly disagree N (%)	Disagree N (%)	Neutral N (%)	Agree N (%)	Strongly agree N (%)	Missing N (%)
I would recommend the care received at the AGCH to someone else	1 (0.7)	5 (3.3)	5 (3.3)	58 (38.2)	83 (54.6)	0 (0)
I was involved in (daily) goal setting/ Treatment goals were discussed with the informal care giver	44 (30.8)	24(16.8)	20 (14.0)	41 (28.7)	14 (9.8)	9 (5.9)
Nurses and physicians paid sufficient attention to my wellbeing	1 (0.7)	5 (3.3)	12 (7.9)	54 (35.8)	79 (52.3)	1 (0.7)
I felt safe at the AGCH	0 (0)	7 (4.7)	3.0 (9.5)	70 (47.3)	57 (38.5)	4 (2.6)
I felt well prepared for discharge	5 (3.4)	16 (11)	22 (15.2)	79 (54.5)	23 (15.9)	7 (4.6)
I had a better experience with admission to the AGCH compared to previous hospital admission	2 (2.0)	9 (8.9)	33 (32.7)	34 (33.7)	23 (22.8)	51 (33.5)*
Score for the AGCH admission 0-10 0= worst experience, 10= best experience, mean (SD)	8.1 (1.1)					8 (5.3)

*some participants were not previously admitted to hospital

COREQ (COnsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	Methods
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	Title page
Occupation	3	What was their occupation at the time of the study?	Methods
Gender	4	Was the researcher male or female?	N/A
Experience and training	5	What experience or training did the researcher have?	Methods
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	Methods
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	Methods
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Methods
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Methods
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Methods
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	Methods
Sample size	12	How many participants were in the study?	Results
Non-participation	13	How many people refused to participate or dropped out? Reasons?	N/A

Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	Methods
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	Table 1
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	Table 1
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Methods
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	Methods
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	Methods
Field notes	20	Were field notes made during and/or after the interview or focus group?	Methods
Duration	21	What was the duration of the inter views or focus group?	Results
Data saturation	22	Was data saturation discussed?	Methods + Discussion
Transcripts returned	23	Were transcripts returned to participants for comment and/or correction?	Methods
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	Methods
Description of the coding tree	25	Did authors provide a description of the coding tree?	Table 2
Derivation of themes	26	Were themes identified in advance or derived from the data?	Methods
Software	27	What software, if applicable, was used to manage the data?	Methods
Participant checking	28	What software, if applicable, was used to manage the data?	Methods
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Results
Data and findings consistent	30	Was there consistency between the data presented and the findings?	Results
Clarity of major themes	31	Were major themes clearly presented in the findings?	Results
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	Results

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

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7

Facilitators and barriers to implementing an acute geriatric community hospital in the Netherlands: a qualitative study

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Abstract

Background: There is a trend across Europe to enable more care at the community level. The Acute Geriatric Community Hospital (AGCH) in the Netherlands in an acute geriatric unit situated in a skilled nursing facility (SNF). It provides hospital-level care for older adults with acute medical conditions. The aim of this study is to identify barriers and facilitators associated with implementing the AGCH in a SNF.

Methods: Semi-structured interviews (n=42) were carried out with clinical and administrative personnel at the AGCH and university hospital and stakeholders from the partnering care organizations and health insurance company. Data were analysed using thematic analysis.

Results: Facilitators to implementing the AGCH concept were enthusiasm for the AGCH concept, organizing preparatory sessions, starting with low-complex patients, good team leadership, and ongoing education of the AGCH team. Other facilitators included strong collaboration between stakeholders, commitment to shared investment costs, and involvement of regulators.

Barriers to implementation were providing hospital care in an SNF, financing AGCH care, difficulties selecting patients at the emergency department, lack of protocols and guidelines, electronic health records unsuited for hospital care, department layout on two different floors, and complex shared business operations. Furthermore, transfer of acute care to the community care meant that some care was not reimbursed.

Conclusions: The AGCH concept was valued by all stakeholders. The main facilitators included the perceived value of the AGCH concept and enthusiasm of stakeholders. Structural financing is an obstacle to the expansion and continuation of this care model.

1. Introduction

Recent European long-term care reforms have focused on 'aging in place' by providing more care in the community.[1] Prior to these reforms, alternative models of care like Hospital at Home (Hah) or outpatient management were developed to care for aging populations living in the community and to prevent functional decline, delirium, and hospital readmissions.[2-7] Clinical outcomes and patient satisfaction with these models of care are similar to or better than those for conventional hospitalization are.[5, 7, 8] Hah has been evaluated in multiple studies and has had significant uptake internationally.[7-10] A process evaluation of Hah in the United States identified strategic planning, involving stakeholders, and strong partnerships with outside vendors as key facilitators for this care concept.[11]
In the Netherlands, a program has been implemented that enables aging in place, with health insurers financing alternative models of hospital care.[12] The Acute Geriatric Community Hospital (AGCH) was inspired by this program and is located in a skilled nursing facility (SNF).[6, 13] It provides hospital-level care for older adults with acute medical conditions. Hospital-level care is treatment that is usually provided in an in-patient hospital setting, except for surgery and intensive care. Admission criteria for the AGCH are presented in Table 1.[13, 14] Treatment at the AGCH includes a comprehensive geriatric assessment[15] and early rehabilitation.[16, 17] The AGCH model is similar to that of Hah, except care is provided in an SNF and not at home. The facilitators and barriers to implementing this model of care in this setting are still unknown.

Understanding the facilitators and barriers to implementing the AGCH is critical for the evaluation of the AGCH care concept, and will inform the implementation of similar care models. To fill this knowledge gap, our research question was: What facilitators and barriers exist to implementation of the AGCH care model? We used the theoretical model of adaptive implementation as a framework to identify these barriers and facilitators (Figure 1a).[18-20] This model describes influencing factors, facilitators, and barriers at different phases (preparation, execution, and continuation) and levels (micro, meso, and macro) of implementation. The micro level involves healthcare professionals, the meso level involves collaboration between care organizations, and the macro level involves the legal and financial framework.[18]

2. Methods

2.1. Study design

We conducted one-on-one semi-structured interviews with professionals and stakeholders, allowing them to fully describe their individual experiences.[21] Some participants had similar backgrounds and were interviewed in a small group. We used the COREQ-checklist[22] to ensure all items relevant to reporting qualitative research were included (see Appendix 3). The study protocol was submitted to the Amsterdam UMC, location Academic Medical centre Medical Ethics Research Committee and the need for official approval was waived as the Medical Research Involving Human Subjects Act did not apply (file number W19_386#19.451). The local Research Code guidelines and European legislation under the General

Data Protection Regulation (GDPR) were followed while conducting this research. Written informed consent was obtained from all participants

2.2. Setting

The AGCH is located in an SNF. Geriatricians provide daily patient care together with a team of nurses and nurse practitioners. Patients are transferred to the AGCH after being admitted to the emergency department (ED) of a general/university hospital. The admission criteria are presented in Table 1[13, 14] and the goals and interventions of the AGCH are presented in Table 2. The AGCH was developed by three parties: a university hospital, a community care organization, and a health insurer. These parties operate in the Dutch healthcare system, which aims to provide universal access to healthcare while allowing 'managed' competition between care organizations.[23]

Table 1. Criteria for admission to the AGCH

Criteria which should be met upon assessment at the Emergency Department.
1. Acute medical problems in older patients that require hospitalization, e.g., acute events such as pneumonia, exacerbation of chronic conditions such as heart failure, or minor acute events in very frail patients.
2. Hemodynamic stability.
3. No need for complex diagnostic testing such as CT or MRI scans during admission
4. Return to previous living situation expected in 14 days.
5. Geriatric conditions e.g., delirium, cognitive impairment, falls, and/or functional impairment.

2.3. Research team

The interviews and analysis were conducted by MER and student WVM. MER is a PhD candidate with training in qualitative research. WVM was a sixth-year medical student trained by MER in qualitative research. BMB, RF, and JMV are senior researchers who oversaw the design and conduct of the study. RF is an internist working at the ED and AGCH. BMB is also the creator of the AGCH concept was not involved in conducting interviews or analysing the data until the final phase of the data analysis. MR is a geriatrician working at the ED and AGCH and was, together with BMB and RF, involved in recruiting study participants.

2.4. Participants

Participants were eligible for participation if they were involved in the design and implementation of the AGCH, were previously or currently working in the AGCH, and/or were key figures with professional knowledge of the AGCH. A purposive sampling method was used to obtain participants with different professional backgrounds. Participants were recruited from the AGCH, ED, and university hospital via email and following a presentation of the research plan at an AGCH group meeting. Other professionals and stakeholders were approached by email.

2.5. Data collection

The interviews were conducted by MER and WVM between November 2019 and July 2021, which was one to three years after the AGCH had opened. Interviews

Table 2. The intervention elements

Goal of the Acute Geriatric Community Hospital	Intervention
Identify medical conditions, geriatric syndromes, and care needs	Comprehensive geriatric assessment[15]
Prevent functional decline	Early rehabilitation[16, 17] through bidaily physiotherapy and function-focused care (ref); adapted environment with single rooms and open hallways that allow mobilization
Prevent delirium and falls	Multi-component intervention[36] including: - Single rooms - Limited number of care professionals to reduce overstimulation - Continuous non-contact heart, respiration, and position monitoring (Early SenseTM) [37] - Improving orientation through calendars, clocks, and photos of loved ones. - Family involvement and rooming-in
Improve patient handover to primary care and prevent readmissions	- Involve family during admission by organizing meeting within 24 hours after admission and before discharge [38] - Warm handovers (via telephone) to primary care provider (general practitioner and/or home intermediate care organization and/or physiotherapist) [39] - Send discharge letters within 24 hours after discharge [40] - Provide medication in a medication sachet for the first post-discharge week
Improve patient and caregiver experience of admission	- Family involvement through frequent meetings with medical team [38] - Extended visiting hours (10am–8pm) - Eating-in or rooming-in with admitted partner of family member

were performed in-person at the AGCH or by video-call from home (during the COVID-19 pandemic).

The interview guide was drafted based on literature on implementation of geriatric care models.[11, 20, 24] In the pilot phase of the interviews, we used the implementation framework described by Grol and Wensing.[25] However, this framework did not fit well to the levels and phases of implementation because it did not distinguish between micro, meso, and macro level factors. Therefore, we continued with data collection using the adaptive implementation framework, which fitted better to our setting.[18]

The guide was discussed in the research team prior to the first pilot interview. After three pilot interviews, the guide was reviewed and adjusted – new questions were added and some questions were simplified. The guide was also modified for each stakeholder group. The general interview guide can be found in Appendix 2. Questions were added during the study on the chronology of events and phases of implementation. We tried to reduce the risk of time biases during the COVID-19 pandemic. All but two interviews were audio recorded and no interviews were repeated. The audio-recorded interviews were transcribed verbatim and anonymized. Field notes were made during and after the interview to capture the participants' impressions and thoughts. We used two methods of member checking: a summary was given at the end of each interview and these

interview summaries were returned to participants. Participants' comments on the summaries were included in the analysis.

2.6. Data analysis

We conducted a thematic analysis[26] using both a deductive and inductive approach and structured the analysis using the theoretical model of adaptive implementation by Dröes and Meiland.[19, 20] Ten selected semi-structured interviews were coded separately by authors MER and WVM using an open coding approach. After discussing the codes, an initial coding structure was created. The preparation phase was defined as the phase up to six weeks after the AGCH opened, and the execution phase started after this. In the continuation phase, the AGCH care path was further developed and the AGCH was secured within regular care. The remaining interviews were coded by either MER or WVM using the initial coding structure. If relevant, new codes were included in the second coding structure. After all interviews were coded, MER and WVM reviewed the second coding structure and identified all relevant categories and themes. If there were not enough data to support initial categories, these categories were removed. MER and WVM agreed on a final coding structure, categories, and overarching themes. MAXQDA 2020 (VERBI Software, 2019) was used for coding. Saturation was reached for each stakeholder group. The relevance of the material was checked by consulting involved professionals and by discussing the material in the research team. Changes were only made to the final coding structure if they were supported by the data.

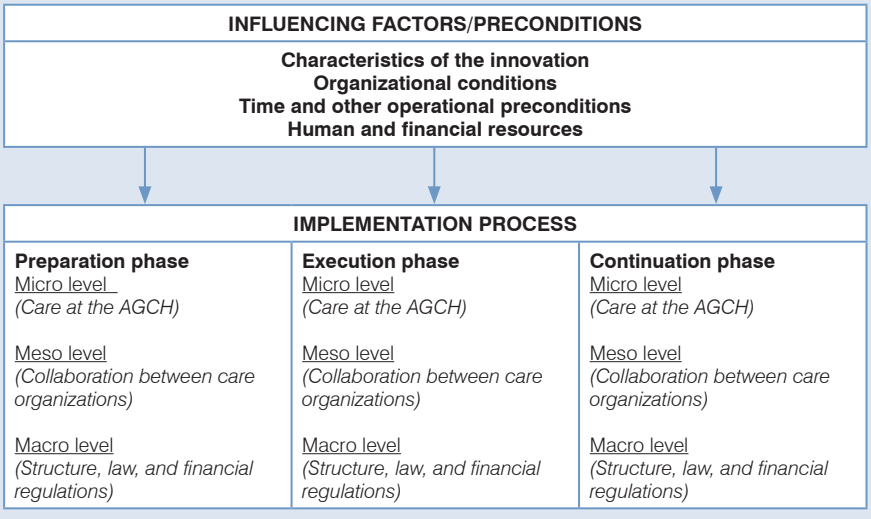

Figure 1a. Theoretical model of adaptive implementation applied to the AGCH context[18-20]

3. Results

3.1. Participants

Thirty professionals responded to the group email and participated in the study (54% response rate). These included team members of the AGCH (n=17), ED nurses (n=7), and staff members of the geriatrics department of the university hospital (n=6). Twelve key persons approached by email also participated in an interview, giving a total participant number of 42. In total, 31 one-to-one interviews, two double interviews, and two group interviews were conducted. Interviews lasted 40 to 70 minutes. We identified influencing factors or preconditions and 20 themes including barriers and facilitators to implementation in the different phases and levels of implementation (Figure 1b). The seven key themes and representative quotes are summarized in Tables 3 and 4. The barriers and facilitators shown in Table 3 were presented according to Brody et al.[11], and provide an overview of challenges, solutions, and implications on scalability per theme.

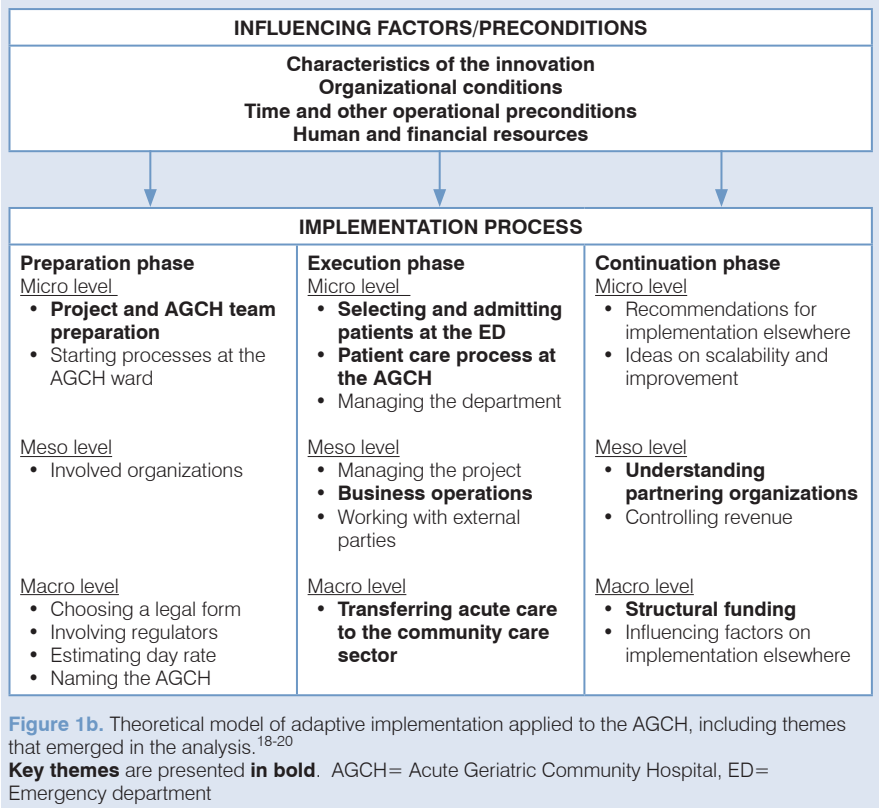

Figure 1b. Theoretical model of adaptive implementation applied to the AGCH, including themes that emerged in the analysis.[18-20]
Key themes are presented **in bold**. AGCH= Acute Geriatric Community Hospital, ED= Emergency department

3.2. Influencing factors and preconditions

Influencing factors and preconditions concern factors that influence the implementation process during all the phases (preparation, execution, and continuation) of implementation.

3.2.1. Characteristics of the innovation

Support for the innovation was an important precondition for implementing the AGCH. The intervention was developed between 2016 and 2018, when the number of older adults visiting the ED was increasing. Healthcare staff noticed that older adults could not go home after visiting the ED, but that there was no better option – hospitalization risked medicalization and deconditioning and short-term residential care (STRC) was not available outside office hours. This, combined with the enthusiasm of the university professor (BMB) who initiated the project, facilitated development of the AGCH. Participants believed strongly that the AGCH concept had a discrete purpose and would fill a gap in geriatric care in the Dutch healthcare system. The AGCH concept is primarily defined by its location (a department providing hospital care in an SNF) and main goal (to activate and mobilize older patients during hospital admission).

3.2.2. Organizational conditions

The AGCH was implemented within an existing community care organization that primarily provides chronic care. Therefore, working processes were much slower than those in the university hospital. In the Dutch healthcare system, short-term care provided by community care organizations and care provide by the university hospital are financed by care insurers through separate billing mechanisms.

3.2.3. Time and other operational preconditions

Designing and opening the first AGCH took approximately two years. After the AGCH had opened, geriatricians reported additional demands on their team because of on-call night and weekend shifts in the AGCH. The operational facilities of the SNF were an important factor for implementation; participants stated that the SNF had fewer resources than a hospital does.

3.2.4. Human and financial resources

The three organizations who initiated the AGCH concept described a strong collaboration and trust between the executive leaders of their organizations. Changes in staffing and the lack of a project team member with experience in business operations within the community care sector also affected implementation. AGCH team disciplines and competencies also influenced implementation; participants noted that the experience and knowledge of both hospital and district nurses were important in the AGCH team. There was large variation in competency and skills among AGCH nurses. Supervising geriatricians from the university hospital were seen as facilitators throughout implementation. Nurse practitioners and physician assistants were seen as suitable for the AGCH because they closed the gap between medical and nursing care. All professionals working at the AGCH needed time to develop their professional role in this new care concept.

Concerning *financial resources*, the three partnering stakeholders agreed to

share investment cost and financial risk during implementation of the AGCH. The AGCH was funded through an experimental financing structure within the Dutch healthcare system. This meant that the cost of care made by the community care organization would be reimbursed by all Dutch health insurers based on a tariff that was negotiated between the community care organization and the health insurers.

3.3. Facilitators and barriers to implementation in different phases of the implementation process

3.3.1. Preparation phase

3.3.1.1. Micro level (care at the AGCH)

Micro level facilitators during the preparation of the *project and AGCH team* were 1) formal preparation sessions for healthcare professionals from the university hospital and the community care organization; and 2) preparation sessions by geriatricians to develop and discuss working processes at the AGCH. Barriers were that formal preparation sessions were no longer continued once the AGCH had opened and that the nursing team was only hired shortly before the AGCH opened. This meant that nurses did not participate in preparatory meetings, which was seen as a disadvantage. Another barrier was that every professional looked at implementation of the AGCH from their own perspective.

Before the AGCH could deliver care, several weeks were needed for the team to *start up various processes*. This start-up was facilitated by clear expectations of the type of care that needed to be delivered. Interviewees working at the AGCH stated that starting the AGCH during renovation of the SNF hampered the startup. There was some collaboration between the AGCH and other wards, but the AGCH operated mostly as an island within the SNF. A frequently mentioned barrier was the layout of the department – it had two different floors and no separate office for the nursing and medical team, which participants found impractical. Participants also mentioned that adjustments necessary for care delivery were not included in the renovation, such as a mediation stockroom and a system for providing oxygen. The lack of supportive services (such as cleaning) when the AGCH opened was also considered a barrier to implementation because patient turnover was much higher in the AGCH than in other departments.

3.3.1.2. Meso level (collaboration between organizations)

Facilitators on the meso level were intensive collaboration between the *organizations* who initiated the AGCH and visits from the university hospital quality manager. These visits provided valuable information for the project team on how to organize working processes. Additional barriers were not involving the laboratory and pharmacy in the preparation phase and not informing all physicians in the community care organization about the AGCH.

3.3.1.3 Macro level (structure, law, and financial regulations)

A macro level facilitator was meetings between both organizations' legal teams during the preparation phase, which helped in choosing a *legal form*. Another facilitator was *involving regulators* such as the Dutch care authority (Nza) early on in the preparation phase, which helped in designing an experimental payment title for the AGCH. The enthusiasm of the partnering healthcare insurer helped

involve regulators, which helped in creating an initial financing title.

A macro level barrier was *estimating the day rate for the AGCH* because the AGCH was a new concept and the exact daily expenses were unknown. Another barrier was the former name of the AGCH *Buurtziekenhuis* (community hospital) because using the Dutch word for 'hospital' did not fit with the national policy of exchanging in-hospital care for care closer to home.

3.3.2. Execution phase

3.3.2.1. Micro level (care at the AGCH)

Micro level facilitators and barriers were experienced when *selecting and admitting patients at the ED* during the execution phase. When the AGCH started admitting patients, there was uncertainty among geriatricians on which patients could be admitted safely— geriatricians wanted to select the 'right' patients and prevent acute unplanned transfers back to hospital. A further barrier was that most patients were not referred by other specialists.

Facilitators for selecting the 'right' patients were admitting low-complex patients and having access to different diagnostics at the ED. Creating a steady flow of admissions was facilitated by informing other specialists about the AGCH and having a geriatric emergency care nurse specialist act as an *ambassador* for the AGCH at the ED. Another facilitator was an ambulance service that transferred patients from the ED to other care organizations, which decreased waiting times for transfer to the AGCH.

A barrier to selecting and admitting patients was that laboratory services at the AGCH were not operating frequently. Furthermore, patients who should have been admitted to STRC were referred to the AGCH. The true barrier here was the unavailability of STRC during out-of-office hours. Another barrier was that few low-complex patients that geriatricians had expected to admit to the AGCH presented at the university hospital ED. This may have been because general practitioners (GPs) were used to referring older patients with low-complex problems to other hospitals. Another barrier was that it was difficult to recruit patients from a second university hospital ED that was added as referring hospital because other projects were recruiting patients from this ED. A new and unexpected barrier was the COVID-19 pandemic; the AGCH was not suited to admitting patients infected with SARS-Cov2.

Micro level facilitators of the patient care process involved the home-like environment of the AGCH, flexibility of professionals, and ongoing education of the AGCH team. The discharge process was facilitated by *Point* – a software interface used by hospitals to communicate with primary care providers. Barriers to the *patient care process* were 1) the absence of protocols, 2) no direct access to hospital services such as consulting specialists and more complex diagnostics, 3) an electronic health record (EHR) that was not suited to hospital care, 4) the high administrative and housekeeping burden, 5) insufficient skills in the nursing team, and 6) unclear discharge pathways. The EHR and electronic prescribing program were designed for providing residential care and were not well suited for acute care settings. Also, the university hospital used a different EHR, which made it impossible to share information directly. A solution to the high administrative and housekeeping burden was hiring medical secretaries and nursing aides. Some stated that a high level of nursing competency was required and that not

all team members had sufficient skills, such as placing IV catheters. Structured communication between nurses and doctors was also important. There were also many barriers to successful discharge, such as knowledge gaps within the team and unclear discharge pathways. These barriers increased the amount of time spent arranging discharge.

On the micro level, *managing the department* was facilitated by having a dedicated department manager and nurse manager. Other facilitators were improving working processes within the AGCH team and the flat hierarchy within the team. This allowed professionals to influence how work was done in the AGCH. Barriers to managing the department were the time needed for the social transition of district and hospital nurses and the time needed to hire and train new nurses. Moreover, because patient turnover was much higher in the AGCH, the community care organization had to continuously change its operations, logistics, and billing for the AGCH. On some occasions, it was not clear whether the community care organization or the university hospital was responsible for facilitating new care processes.

3.3.2.2. Meso level (collaboration between organizations)

During the execution phase, meso level facilitators were *managing the project* with involved stakeholders; sharing costs between the university hospital and community care organization; working with GPs; and the pharmacist visiting the AGCH each week for a medication review. Managing the project was facilitated by regular meetings between 1) AGCH management and the university hospital and 2) management and executive leadership from the university hospital, the community care organization, and the healthcare insurer.

Barriers on the meso level were the running of *business operations* by two organizations, the project being unknown to some GPs, and working with *external partners* that were not used to providing hospital-level care. The AGCH investment costs were higher than the project team expected and the running of *business operations* by both the community care organization and the hospital was complex.

Some external partners such as GPs did not know what the AGCH was because of its name – the Dutch name 'WijkKliniek' (neighbourhood clinic) does not imply what kind of care the AGCH delivers. Another important barrier was that the laboratory could not meet the hospital-level needs of the AGCH. For example, laboratory results would only become available at the end of the day. The pharmacy partner was used to working in primary care rather than hospital care, and was not able to follow some hospital pharmacy protocols or provide certain medication.

3.3.2.3. Macro level (structure, law, and financial regulations)

A *facilitator in transferring acute care to the community care sector* was that the transfer of low-complex patients to the AGCH was in line with the university hospital policy of transferring low-complex patients to other care organizations. Barriers were that the set daily rate for the AGCH was too low and that not all the hospital care and medication was reimbursed based on the experimental financing title that had been designed. This meant there was no specific funding for a dietician, occupational therapy, and speech therapy.

3.3.3. Continuation phase

3.3.3.1 Micro level (providing care at the AGCH)

Supporting nurses and relying on nurses' expertise were micro-level facilitators for continuing and implementing the AGCH elsewhere. Writing an implementation plan with goals for the AGCH before opening and considering the barriers experienced by the AGCH team was recommended when opening the AGCH (the first of its kind in the Netherlands).

On the micro level, participants had five distinct *ideas on how the AGCH concept could be improved and scaled-up* in the continuation phase: 1) implementing a nurse-led hospital where a nurse practitioner would manage care instead of a physician, 2) having an older people's physician[27] supervise care instead of a geriatrician, 3) better integrating AGCH care with community nursing care, 4) admitting patients directly from primary care without transferring them to the ED, and 5) admitting patients primarily from general hospitals instead of university hospitals. Facilitators and barriers to these five ideas are shown in Table 1 of the Appendix.

3.3.3.2. Meso level (collaboration between organizations that provide care)

Meso level facilitators to continuing the AGCH concept elsewhere were *involving and understanding external parties* at an early stage. It also helps if the external parties have experience delivering hospital care and are well informed about the AGCH's goals and working processes. Another facilitator was having involved professionals observe the working processes of the university hospital and community care organization before opening the AGCH. Furthermore, clear agreements on how administrative information should be shared between partnering organizations will facilitate transparency and help in *controlling revenue*. Barriers on the meso level concerned *controlling revenue* because of the high investment cost for the community care organization. Expenses for the AGCH are much higher than for STRC, which makes it more challenging for financial controllers and administrative leadership of the community care organization to manage and control revenue.

3.3.3.3. Macro level (structure, law, and financial regulations)

Macro level facilitators are creating a structural financing title for AGCH care and informing healthcare insurers about the AGCH concept. If structural financing were in place and reimbursement for admissions were possible, it would be possible for other hospitals and care organizations to invest in new AGCHs. Current options for creating a structural financing title have benefits and limitations. Also, in the Dutch healthcare system, any cost that may be saved after AGCH admission in the post-acute phase is not returned to the community care organization but is saved by the healthcare insurer.

Table 3 Summary of key themes, challenges and solutions, based on Brody et al.[11]

Key theme	Examples of challenges	Examples of solutions	Implications for scalability
Project and AGCH team preparation	1. Two or more organizations involved in implementation caused increased complexity 2. The team working at the AGCH was new and had a heterogeneous professional background	1. Plan preparatory meetings between professionals from both organizations before and during the first months after opening; plan visits to partnering organization by nurses 2. Hire team prior to opening and involve team members in the preparation phase; plan schooling sessions prior to opening	1. Hospital and community care organization must work closely together 2. Sufficient funds to pay AGCH team during preparation phase required
Selecting patients at the ED	1. Uncertainty of which patients could be admitted safely 2. Low referrals by specialists at the ED and GPs to the ED	1. Start with admitting low-complex patients and develop professional expertise in selecting patients 2. Having a geriatrician or geriatric nurse practitioner at the ED; inform primary care practitioners/GPs about the AGCH	1. Time is required for geriatricians to gain experience in selecting patients 2. Investment in advocating personnel required
Patient care process	1. No hospital protocols were available at the AGCH 2. EHR is not suited to hospital care 3. Not all hospital diagnostics/ services (CT scans, consulting specialists) are available 4. Discharge to primary care is complex and slow	1. Adjust and transfer hospital protocols to AGCH prior to opening and allow protocols to be exchanged between hospital and AGCH 2. Use a hospital EHR or develop working processes with existing EHR 3. Select patients with no need for complex diagnostics, ascertain that laboratory results can be available on time 4. Implement hospital discharge program Point; develop clear guidelines with regards to discharge	1. Requires policy on sharing protocols and access to a hospital's internal resources 2. Hospital EHR can be expensive and not compatible with EHR in intermediate care; working with existing EHR may not be suited for delivering hospital-level care 3. Only selected group of low-complex and/ or stable patients can be admitted to the AGCH 4. Discharge can be improved by using Point; but discharge problems to other services exist nationally
Business operations	1. Sharing business operations between two organizations was difficult 2. Unstable admission rate to the AGCH	1. Develop a method and platform for sharing information on business operations frequently; do this before opening the AGCH 2. Accept unstable admission rate and be prepared for acute admission; keep some 'overcapacity'	1. Business controllers and middle management need to be involved in implementation before the AGCH opens. 2. Allowing 'empty' beds does not fit the traditional business model of community care

Table 3 *Continued*

Key theme	Examples of challenges	Examples of solutions	Implications for scalability
Transferring acute care to the community care sector	1. Working processes of community care are too slow for delivering acute care 2. Hospital medication and paramedics not reimbursed within community care	1. Create working process allowing the AGCH to speed up while other departments continue operations as usual 2. Create another community care budget to fund medication that is not reimbursed; or include additional cost for medication and paramedics in day tariff	1. Allows the AGCH to operate quickly within 'slower' organization; however, does not improve delivery of acute care in community care sector as a whole 2. Negotiation with healthcare insurer required to include additional costs in a higher day tariff
Understanding partnering organizations	1. Laboratory and pharmacy partner were not used to delivering hospital care 2. Health professionals did not know what the AGCH was, which slowed collaboration and patient referral	1. Understand services that can be delivered by external partner and jointly develop guidelines for service delivery 2. Set up campaign to inform organizations about the AGCH concept; consider using a different name in Dutch	1. Many different (independent) laboratories and pharmacies exist in the Netherlands; a new collaboration is required for each new AGCH location 2. Variance in naming the AGCH nationally could hamper structural implementation in the healthcare system
Structural funding	1. Structural financing title does not exist yet, which hampers long-term implementation	1. Initiating organizations develop financing title with the help of the Dutch care authority	1. The AGCH care 'product' is neither a hospital care product nor a community care product which may make it difficult to develop a financing title

ED= emergency department EHR= electronic health record

Table 4. Representative Quotes per key theme

Project and AGCH team preparation	*'You have to be aware that it is a different way of working than what you are used to. A step-by-step guide to make everything clear and a formal implementation plan to identify accountability is strongly recommended and is important I think […] I think that it just needs to be clear what the goal is, because there are just so many different goals at the AGCH.'*
Selecting patients at the ED	*'You really have to be careful that you admit the right patient, it is a real challenge and much more difficult than I anticipated. The longer you work here [at the AGCH], the more problems you run across when you admit a patient with an unclear diagnosis because you have limited ability for diagnostics etc. compared to the hospital. This is something that I previously underestimated, it is more difficult than you think to admit the 'right' patients to the AGCH. You should not admit patients who lack social support or should go to long-term care. So, this is a challenge, but we are getting better at it'.*
Patient care process	*'The nursing home electronic health system really sucks, especially if you are trying to deliver acute medical care and treatment.'*
Business operations	*'What I find complicated is that there are so many changes through the years, people who come and go, on the side of the community care organization on the side of the hospital, that is the way it is. The format that we use for presenting [business information] has only just been developed. And all the different payment places that we use, that does not help either. The community care organization pays a part, there is the transitional care [government] subsidy, the health insurer pays a part, and the university hospital pays a part. Despite the enthusiasm for the project, it is not always possible to work everything out together.'*
Transferring acute care to the community care sector	*'I think we had to deal with many teething problems […], changes in personnel, getting the basics of providing hospital care in the community organized, that just takes so much time, and it takes more time than you think when you are writing the concept up.'*
Working with external parties	*'The paramedics thought we were a nursing home. They would just say: well, I am not going to bring a patient from a nursing home to the hospital, this patient should be transported by his mother or son.'*
Structural funding	*'Only then you really have to accept the cost price of a product and say that the product is expensive yes. Look at my Miele washing machine, yes, it is expensive, but it lasts 15 years, but over time it is a cheap washing machine. You have to look at the AGCH this way, it is an expensive product, but in the end when looking at the total cost trajectory of a frail older person, it is a cheaper solution.'*

4. Discussion

4.1 Summary

The key facilitators to implementation of the AGCH concept were perceived value of and enthusiasm for the AGCH. Key barriers were providing hospital care in an SNF and financing the AGCH care. Key micro-level facilitators included organizing preparatory sessions, starting with low-complex patients, team leadership, a flat hierarchy, a positive attitude of professionals, and ongoing education of the AGCH team. Key barriers were difficulties selecting patients at the ED, the lack of protocols, the administrative burden, an EHR that was not suited for hospital care, the department layout, and working processes at the SNF, which were designed for chronic care.

Some factors were both facilitators and barriers. For example, having both

district and hospital nurses in the team was a facilitator because of the combined expertise but was also a barrier because not all team members had the same level of knowledge and skills. A meso level facilitator was the strong collaboration between the university hospital and the community care organization. Meso level barriers were that the AGCH concept was unknown to many external partners and that sharing business operations between organizations was complex, leading to a substantial financial loss in the first two years after opening. Macro-level facilitators were the sharing of investment costs by partnering stakeholders and the involvement of regulators. Barriers were the lack of a structural financing title and the transfer of acute care to the community care sector, which led to some care not being reimbursed. Stakeholders found implementation of the AGCH complex and demanding but were convinced that implementation was feasible and that the AGCH intervention was valuable to older patients.

4.2 Comparison with existing literature

Brody et al.[11] also reported that it was important for the Hah to invest in internal and external partnerships before starting the intervention. Similar barriers included uncertainty about patient eligibility and the EHR not meeting the needs of the Hah team.[11] The Hah and the AGCH also had issues with financing and billing care. For Hah, these were mostly related to the absence of a method that would assess how much each organization should receive for the care they provided. For the AGCH, these issues were that some treatments were not reimbursed by the experimental financing title.

Creating structural funding when implementing new care models is challenging.[11, 20] The experimental financing title that was created for the AGCH was an important facilitator for implementation. At the same time, AGCH care was more expensive than expected and any costs that were saved in the post-acute care phase by preventing readmission were not returned to the community care organization that had invested in AGCH care. This is known as the *wrong pockets problem*[28] and is not specific to the Dutch care system; it can occur in any care systems that do not have integrated financing.[29]

Participants also mentioned the importance of the overall attitude in the team and the enthusiasm of the stakeholders, which affect the willingness of the professionals/stakeholders to fully engage in the implementation process.[30] The enthusiasm of stakeholders may be explained by the perceived value and *relative advantage* of the AGCH.[18, 31] Compared with in-hospital care for older adults, many stakeholders described how the AGCH would be better suited to providing care for older patients, both on the patient level (better outcomes) and the system level (expectation of lower societal costs).

4.3 Strengths and limitations

A strength of this study is the purposive sampling to recruit participants, which ensured the sample was representative and enough data was obtained. However, the heterogeneity of interviewees' backgrounds complicated our analysis. Another limitation was that not all interviewees were involved in the implementation from the start and that some interviews had to be conducted via video call because of the COVID-19 pandemic. However, this made it easier to arrange interviews. Furthermore, although the framework of adaptive implementation[18] allowed us to

analyse our data in a structured manner, other conceptual frameworks have been developed more recently.[32] However, we do not think that using these frameworks would have changed our findings. Finally, it may not be possible to generalize some of our findings to the implementation of other AGCHs or care models.[33] For example, the problems we encountered concerning the department layout could be specific to the SNF.

4.4 Implications for science, practice, and policy

Further research should focus on facilitators and barriers to implementing AGCHs elsewhere, particularly in rural areas. When implementing an AGCH, practitioners and local policy makers should consider the facilitators and barriers reported here. A formal stakeholder analysis and analysis of potential facilitators and barriers before implementation could also help.[25, 34] This is especially important because our study shows that implementing an AGCH in the Dutch healthcare system is more complex than was expected. Furthermore, training and educating the nursing team at the start of implementation will assure sufficient knowledge of acute and geriatric care and will ensure that all nurses have the necessary skills. Policy makers involved in regulating and funding hospital and community care in the Netherlands should consider the regulatory and financial barriers to providing hospital care closer to or at home. Providing hospital-level care for low-complex patients outside the hospital does not happen overnight, and does not automatically reduce costs because investment is required. At the same time, the demand for care out of office hours and/or for acute geriatric care will increase as more older adults are living at home for longer.[12] This warrants a holistic approach both at the patient and healthcare system level, which means STRC availability and resources in community care need to be improved. Patient needs rather than service availability should be the leading factor when selecting patients for admission to either a STRC or AGCH ward.[35] Continued research into cost-effectiveness of the AGCH is warranted. AGCH costs should be lower or equal to conventional hospitalization and the AGCH should achieve similar or better outcomes.

5. Conclusion

This qualitative process evaluation shows that implementing an acute geriatric community hospital (AGCH) is feasible in the Netherlands. The most important facilitator to implementation was the perceived value of the AGCH concept. Major barriers were providing hospital care within the community care sector and financing AGCH care. These insights may be helpful for implementing an AGCH elsewhere and for developing solutions for these barriers during the preparation phase of implementation. This will support working processes and operations during the execution phase.

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Appendix 1 Concepts of care that could be implemented when the AGCH is further developed, including the possible facilitators and barriers to implementing these concepts.

Concepts for further development of the AGCH	Facilitating factors	Barriers
1) Nurse-led hospital[41]	a. Interesting career perspective for nurse practitioners (NPs) b. NPs offer more continuity than medical residents	a. Finding enough qualified NPs b. Establishing if and how NPs would be supervised c. May not be cost-effective compared with physician-led care
2) Supervision by an older people's physician[27]	a. Older people's physician may be better able to improve the integration of AGCH care with other primary care services	a. Older people's physician does not have enough training in providing acute and hospital care
3) Improving collaboration and integration with primary care services	a. Is required because many older adults with complex health problems are living independently at home	a. Financial and legislative barriers impede further integration of AGCH with community nursing care b. National policy stimulating older people's physicians to provide care at a patient's home has not been fully implemented
4) Direct admission from primary care to the AGCH as opposed to transferring patients from the emergency department (ED) to the AGCH	a. Would reduce pressure on the university hospital ED	a. Selecting which patients can be transferred directly could be difficult b. Limited diagnostic resources available at the AGCH
5) Admitting patients form general hospitals as opposed to university hospitals	a. Medical care required by patients admitted from EDs of general hospitals better matches AGCH resources as opposed to the more complex medical care that is required for patients presenting at EDs of university hospitals	a. The AGCH would potentially compete with the other departments for admissions

Appendix 2 – General interview guide, adjustments were made to this interview guide based on the interviewee's background and expertise

Professionals' perspectives on the implementation of the Acute Geriatric Community Hospital – Interview guide version 1

Introduction
Thank you for participating in this study. Firstly, we will tell you a bit about ourselves. My name is Wieteke Mols, I am a student researcher at the Acute Geriatric Community Hospital. My name is Marthe Ribbink, I am a PhD candidate and a researcher at the Acute Geriatric Community Hospital. The research we are conducting concerns the implementation of the Acute Geriatric Community Hospital (AGCH). We would like to collect information on how to improve this concept and how it should be implemented elsewhere. Therefore, we would like to ask about your role at the AGCH and your experience with implementing this concept. Please let us know if you do not understand a question. We will provide a summary of the interview at the end of the interview. May we record this interview so that we can use it in our study?

Main questions and optional further questions *in italics*:

Questions concerning the participant's background
Can you tell us about yourself?
Background? Work experience? Current position? How did you get involved with the AGCH? How long have you been involved in/been working at the AGCH?

Questions concerning the characteristics of the AGCH
Why did you want to work at/with the AGCH?

What was your view of the AGCH before it opened/before you got involved?
Type of care? Goals of the AGCH? How did you get this information?

When you compare your work at the AGCH to your previous jobs, what has changed in your work?
Daily tasks? What competencies do you need? Do you feel safe performing your work activities? Work attitude? Flexibility? Work pace compared to geriatric rehabilitation or hospital?

If applicable: Are you satisfied with your work at the AGCH?

In what way does care at the AGCH differ from care at the hospital or in geriatric rehabilitation?
Important differences? What is better and why? What is more difficult and why?

What does care at the AGCH focus on?
Think: goal setting, communication, self-management, rehabilitation, involving family and caregivers

Questions concerning the organization and implementation of the AGCH
How was the AGCH implemented? How was it prepared/started?
What was your role? What happened during implementation/opening? Can you describe different phases of implementation? What went well and why? What was difficult and why was this difficult?

Were there any other (bureaucratic) barriers to implementation?
For example: care not being reimbursed

How was/is the department organized during implementation?
Think of number of staff, required materials, available diagnostics

What are the roles of the different disciplines?
Think of physiotherapists, occupational therapists? How is the collaboration with these paramedics organized? Are there any facilitating factors or barriers to collaborating with paramedics?

What does your workday at the AGCH look like?
Structure? How was care developed? What are facilitating and limiting factors in providing hospital care in a skilled nursing facility?

How is AGCH care implemented?
Influencing factors on implementation?

What competencies in the AGCH team are needed to provide care?
What are the important considerations when setting up the AGCH (elsewhere)?

Questions concerning internal and external collaboration with other organizations
What is the role of the referring hospital in organizing care at the AGCH?
Role of the university hospital? Logistics? Services? Adjustments of existing care paths/systems? Think of: supplying medication? Ambulance services? Policy adjustments on the level of executive leadership?

What is the role of the skilled nursing facility in the implementation of the AGCH?
How is the collaboration with other wards? What is the role of the care organization? Are there barriers in collaborating with other wards/locations? Logistics? Services? Policy adjustments on the level of executive leadership?

How is the collaboration with other parties organized? Is this going well?
Think of university hospital, care organizations, general practitioners, community nursing, pharmacy partner. Do you feel supported by these partners? What are facilitators and barriers to collaboration? Is building partnerships prior to opening required? If yes, why and what is needed in building partnerships prior to opening the AGCH?

How is the transfer of the patient record organized between the university hospital and the AGCH and the AGCH and primary care?
Any issues? Speed? Issues concerning timeliness.

Questions concerning the continuation phase
Can you tell us what you think the possibilities are for continuing and further developing the AGCH?
What possibilities do you see? What is needed to further develop these?

Do you think an older people's physician could supervise AGCH care?
Advantages? Disadvantages? What is needed for this? What value would this add?

Do you think direct admission to the AGCH via primary care is possible?
Advantages? Disadvantages? What is needed for this? What value would this add?

Can you tell us more about the nurse-led hospital? What is this?
Do you have prior experience with nurse practitioners? Physician assistants? What do you think of these specializations? Do you think the AGCH could be nurse-led? How would medical care be supervised in this situation?

Final questions
What would you like this research to contribute?

Do you have any advice for AGCHs in the future?

Is there anything you would like to add?

Do you have any questions?

Additional questions for management
What is your view on funding the AGCH?
Are there facilitating or impeding factors to funding the AGCH? How is the AGCH reimbursed?

What is needed from a management perspective to deliver care at the AGCH?
Can you tell us all the steps in detail? What factors were facilitating or impeding?

Appendix 3. COREQ (COnsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	Section 2.3
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	Title page
Occupation	3	What was their occupation at the time of the study?	
Gender	4	Was the researcher male or female?	Section 2.3
Experience and training	5	What experience or training did the researcher have?	Section 2.3
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	Section 2.4
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	Section 2.4
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Section 3.1
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Section 2.6
Participant selection			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Section 2.4
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	Section 2.4
Sample size	12	How many participants were in the study?	Section 3
Non-participation	13	How many people refused to participate or dropped out? Reasons?	Section 3.1

Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	Section 2.5
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	Section 2.5
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	Section 3.1
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Section 2.5
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	Section 2.5
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	Section 2.5
Field notes	20	Were field notes made during and/or after the interview or focus group?	Section 2.5
Duration	21	What was the duration of the inter views or focus group?	Section 3.1
Data saturation	22	Was data saturation discussed?	Section 2.6
Transcripts returned	23	Were transcripts returned to participants for comment and/or correction?	Section 2.5
Domain 3: analysis and findings			
Data analysis			
Number of data coders	24	How many data coders coded the data?	Section 2.6
Description of the coding tree	25	Did authors provide a description of the coding tree?	Results
Derivation of themes	26	Were themes identified in advance or derived from the data?	Section 2.6
Software	27	What software, if applicable, was used to manage the data?	Section 2.6
Participant checking	28	What software, if applicable, was used to manage the data?	Section 2.5
Reporting			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Table 4
Data and findings consistent	30	Was there consistency between the data presented and the findings?	Results
Clarity of major themes	31	Were major themes clearly presented in the findings?	Results
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	Results

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

Once you have completed this checklist, please save a copy and upload it as part of your submission. DO NOT include this checklist as part of the main manuscript document. It must be uploaded as a separate file.

8

The incidence of delirium in an acute geriatric community hospital: an observational cohort study

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Submitted

Abstract

Objectives: Delirium in hospitalised older adults is associated with negative health outcomes. Admission to an alternative care setting may lower the incidence of delirium. The Acute Geriatric Community Hospital (AGCH) was recently opened in the Netherlands and uses a multi-component non-pharmacological intervention strategy to prevent delirium. The objective of this study was to describe the incidence of delirium at the AGCH and compare this incidence to existing rates from literature. If a possible effect on delirium is seen in this comparison this would support conducting a larger prospectively controlled study on delirium in this new care setting.

Design: Prospective cohort study; exploratory meta-analysis of proportions.

Setting and Participants: The AGCH is an acute geriatric unit in a skilled nursing facility for patients aged >65 years with acute medical conditions.

Methods: Delirium assessment using the Confusion Assessment Method (CAM) upon admission and on day one, two and three or until delirium had resolved. Patients' charts were reviewed if CAM was missing. In an linear mixed-effects model, the delirium incidence rate in AGCH was compared to pooled delirium incidence rates from six studies found in a high-quality review.

Results: 214 patients from the AGCH (mean age 81.9 years, 47% male, 12% with a history of dementia) were included in the analysis. Delirium developed in 8% (18/214) (95% confidence interval [CI] 5-13%) of patients during AGCH admission compared to 16% (95% CI 12-21%) in hospitals. Admission to the AGCH was associated with a decreased delirium incidence rate compared to the hospital control group (OR[odds ratio]= 0.49, 95% CI 0.24-0.98, p-value=0.044).

Conclusions and implications: The delirium incidence in the AGCH was low compared to those incidences found in general hospitals in literature. Based on these findings a controlled observational or randomized study measuring delirium in this care setting is recommended.

Introduction

A common complication of hospitalization in older adults is the development of delirium, an acute disturbance in attention and cognitive functions.[1] The etiology of delirium is considered multifactorial.[2] Delirium is associated with negative health outcomes, including functional and cognitive decline, institutionalization, and mortality.[3,4] The prevalence and incidence of delirium varies between settings and populations, with new-onset delirium during hospitalization ranging from 10% to 56%.[5]

An alternative to conventional hospitalization is admission to an acute geriatric unit outside of a general hospital. This unit may be better adapted to the needs of older adults.[6] In the Netherlands, the Acute Geriatric Community Hospital (AGCH) was introduced in 2018.[7] This geriatrician-led unit located in a skilled nursing facility integrates specialized medical treatment with geriatric nursing care. This is the first unit of its kind in the Netherlands but other examples exist internationally.[8] At the AGCH a non-pharmacological multi-component delirium prevention strategy has been implemented, consisting of encouraging early mobilization, preventing overstimulation (single rooms, noise reduction), management of delirium-inducing drugs and improving orientation through e.g. family involvement.[6,7] It is unknown what the effect of this intervention is on the incidence of delirium in this new care setting.[7] A feasibility study can help to determine if a large effectiveness study regarding delirium incidence at the AGCH should be conducted.[9]

We hypothesize that the non-pharmacological interventions at the AGCH reduce the incidence of delirium compared to usual care. The objective of this study was to determine the incidence of delirium and compare this incidence to those incidences found in literature from general hospitals. In this way we look at two area's of feasibility in this study: implementation of the study itself and the limited efficacy of the intervention.[9] This should help determine if an effect form this intervention in this new care setting is to be expected; and determine if a larger prospectively controlled or randomized study on the incidence of delirium in the AGCH is advisable.

As secondary aims, we determined the duration of delirium and we quantified the use of pharmacological delirium treatment. The duration of delirium is relevant as it can also be shortened by a multi-component non-pharmacological intervention.[10] Moreover, it is clinically relevant to know if patients (with or without delirium) were prescribed antipsychotics and/or benzodiazepines for the pharmacological treatment or prevention of delirium, as this is not recommended for the prevention of delirium.[11-13]

Methods

Design and setting

Data from a prospective cohort study were used. The study protocol was published elsewhere.[7] Data collection started in February 2019 and was ceased in March 2020 during the COVID-19 pandemic.

Patients seen at the emergency department (ED) of the Amsterdam University Medical Centers, location Academic Medical Center were assessed by an on-call

geriatrician. Patients admitted to the AGCH were 65 years or older, presenting with an acute medical problem requiring hospitalization and one or more geriatric conditions, such as a fall, functional impairment or polypharmacy.[14] Patients who did not require hospitalization, but needed short-term residential care in a skilled nursing facility, were excluded from admission to the AGCH. See the study protocol[7] and appendix 1 for complete admission eligibility criteria.

Ethical considerations

The local Ethics Committee of the Amsterdam University Medical Centers, location Academic Medical Center waived the obligation for the study to undergo formal ethical approval as described under Dutch law. We included patients who, or whose legal representative, could provide written informed consent. The study was registered in the Dutch Trial Registry, trial registration number NL7896.

Control population from literature

We did not recruit a control group during the study period and we did not have delirium measurements available in a historical control group.[7] To determine if a larger prospectively controlled study would be advisable we compared the incidence of delirium at the AGCH to existing literature. We searched for sources of aggregated data on the incidence rate of delirium in medical or geriatric (non-surgical) inpatients with a mean age of about 80 years (search strategy and excluded studies- appendix 2 and 3). We selected six studies from a review by Inouye et al. as a control group.[5]

Measurement of incident delirium

Incident delirium, the number of new cases of delirium during admission, was the study outcome.[15] No sample size was calculated. Patients were excluded from our analysis if delirium was present at the ED. The diagnosis of delirium was made by the geriatrician or geriatric nurse specialist by clinical assessment and using the Confusion Assessment Method (CAM).[16] The CAM was filled out upon presentation to the ED and during the first three days of admission or until delirium had resolved. Nurses screened for signs of possible delirium, three times a day, during the first three days of admission using the Delirium Observation Screening Scale (DOSS).[17] Patients were assessed by the same clinician for several consecutive days to recognize changes in mental status. On the weekend an on-call geriatrician assessed delirium status if delirium was clinically suspected. The DOSS and nursing chart covering the previous 24 hours were also considered in the delirium assessment. If there was a possible delirium after day three of admission, CAM assessments were continued until delirium had resolved.

Duration of delirium

The duration of delirium was counted from the day the diagnosis was made until the CAM was permanently negative and/or the treating physician stated the delirium had resolved. In patients with an unresolved delirium at the time of discharge, we defined the first day of delirium until discharge as the duration of delirium.

Use of antipsychotics and/or benzodiazepines

The administration of haloperidol, other antipsychotics, and benzodiazepines was collected from patients' charts. We also checked if patients categorized as not delirious had received antipsychotics. This was 1) a check to see if no patient with a delirium diagnosis was missed and 2) a measure to quantify the use of antipsychotics and/or benzodiazepines as a preventive measure for delirium, although this is not recommended.[11-13]

Statistical analysis

Descriptive statistics, chi-square, t-test, and Mann-Whitney U test were used to compare patients with and without delirium upon admission. To compare incidence rates from literature we pooled studies in a meta-analysis of proportions, using a random-effects model.[18] We tested if the difference in delirium incidence was statistically significant by creating a logistic mixed-effects meta-regression model with the location of the study (hospital versus AGCH) as a moderator.[19] We did not perform meta-regression of other covariates because the number of included studies was limited (<10).[18] All analyses were performed using SPPS version 26.00 (IBM SPSS Statistics, IBM Corporation, Armonk, NY) and R version 3.6.1. We used the metaphor (Viechtbauer, 2010) and meta (Schwarzer et al., 2015) packages in R.

Results

Between January 31, 2019 and March 13, 2020, a total of 466 consecutive patients were admitted to the AGCH (figure 1). Of the 261 patients who participated in the study 47 were excluded because of prevalent delirium or because of missing delirium assessments at the ED. The sample for this study therefore consisted of 214 patients (figure 1). Mean (SD) age was 81.9 (8.1) years, 47.2% was male, 12.1% had a diagnosis of dementia, and 47.2% of the patients was frail (table 1). Development of delirium during admission occurred in 18 out of 214 patients, which is an incidence rate of 8.4% (95% CI [confidence interval] 5-13%). The median (IQR [interquartile range]) duration of delirium in the AGCH was 2.5 days (1.0-5.3) (table 1). Mean length of stay (SD) was 9.6 (7.3) days in all patients, 9.4 (7.4) days in patients with no delirium and 11.9 (6.4) days in patients with delirium. Median length of stay (IQR) was 7.0 (5.0-11.00) days in patients with no delirium and 10 (7.5-16.8) days in patients with delirium.

Pharmacological treatment for delirium

Eleven out of 18 patients (61.1%) with a diagnosis of delirium were administered medication for the treatment of delirium. Haloperidol was administered most frequently (n=11). The regular prescription of haloperidol was 0.5-2.0mg per dose, typically given once a day, or twice in case of severe delirium, with a maximum of three dosages. Five (5 out of 196, 2.6%) patients without delirium were administered haloperidol, either as prevention due to a high risk of delirium or as treatment for pre-existing symptoms unrelated to delirium (table 1).

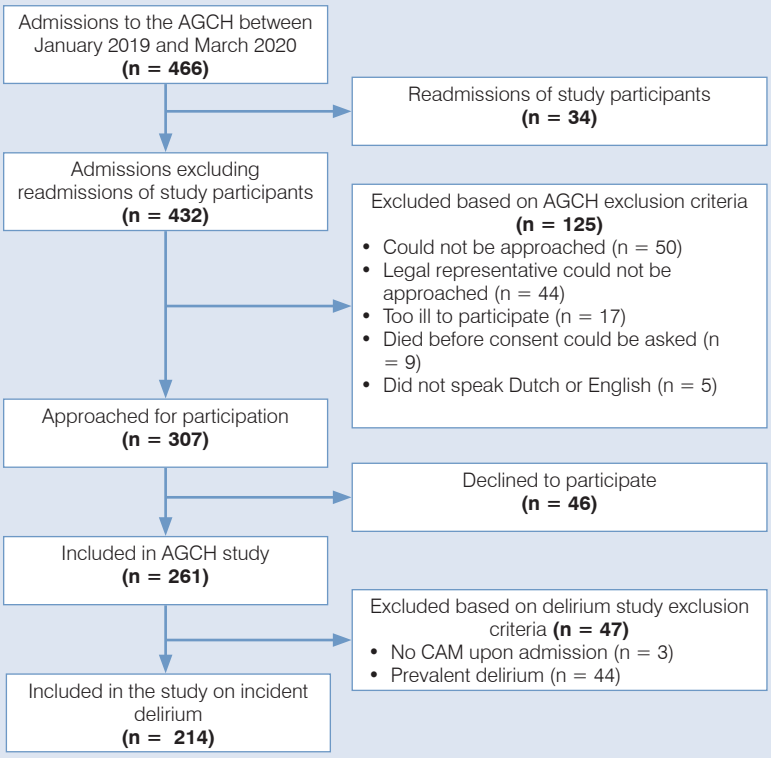

Figure 2 Participant flow-chart Acute Geriatric Community Hospital (AGCH) study.

Table 1 Baseline characteristics of the total study population grouped by patients with and without delirium.

	Total	No delirium	Incident delirium	p value[a]
	(n = 214)	(n = 196)	(n = 18)	
		91.6%	8.4%	
Age (years), mean (SD)	81.9 (8.1)	81.6 (8.0)	85.2 (8.8)	.080
Male, n (%)	101 (47.2)	93 (47.4)	8 (44.4)	.810
Born in the Netherlands, n (%)	160 (74.8)	146 (74.5)	14 (77.8)	.990
Marital status, n (%)				.580
Married/living together	69 (32.2)	65 (33.2)	4 (22.2)	
Single/Divorced	45 (21.0)	40 (20.4)	5 (27.8)	
Widow(er)	99 (46.3)	90 (45.9)	9 (50.0)	
Living arrangement before admission, n (%)				.800
Independent	174 (81.3)	158 (80.6)	16 (88.9)	
Nursing home	5 (2.3)	5 (2.6)	-	
Senior residence	33 (15.4)	31 (15.8)	2 (11.1)	
Other	2 (0.9)	2 (1.0)	-	
Level of education, n (%)				.440
Primary school	37 (17.3)	32 (16.3)	5 (27.8)	
Elementary technical/ domestic science school	45 (21.0)	43 (21.9)	2 (11.1)	
Secondary vocational education	63 (29.4)	58 (29.6)	5 (27.8)	
Higher-level high school/ third-level education	49 (22.9)	43 (21.9)	6 (33.3)	
Polypharmacy (≥ 5 medications), n (%)	160 (74.8)	147 (75.0)	13 (72.2)	.800
Primary admission diagnosis, n (%)				.440
Pneumonia	40 (18.7)	38 (19.4)	2 (11.1)	
Urinary tract infection (UTI)	27 (12.6)	25 (12.8)	2 (11.1)	
Other infections (excl. pneumonia/UTI)	21 (9.8)	8 (4.1)	3 (16.7)	
Congestive heart failure	20 (9.3)	18 (9.2)	2 (11.1)	
Neurologic disorders	19 (8.9)	17 (8.7)	2 (11.1)	
COPD exacerbation	15 (7.0)	15 (7.7)	-	
Fall(s)	13 (6.1)	12 (6.1)	1 (5.6)	
Gastrointestinal disease	10 (4.7)	10 (5.1)	-	
Electrolyte disturbance	6 (2.8)	4 (2.0)	2 (11.1)	

Table 1 *Continued*

	Total	No delirium	Incident delirium	p value[a]
Other	43 (20.1)	39 (19.9)	4 (22.2)	
Katz-ADL[b] score two weeks before admission, median (IQR)	1.0 (0.0-2.0)	1.0 (0.0-2.0)	2.0 (0.8-3.0)	.054
Katz-ADL[b] score upon admission, median (IQR)	2.5 (1.0-4.0)	2.0 (1.0-4.0)	3.5 (0.8-5.3)	.340
Frailty[c], n (%)	101 (47.2)	92 (46.9)	9 (50.0)	.940
Unknown	59 (27.6)	55 (28.1)	4 (22.2)	
MMSE[d] score, median (IQR)	25.0 (22.0-28.0)	25.0 (23.0-28.0)	23.0 (20.0-24.8)	.035
Unknown or not done, n (%)	56 (26.2)	50 (25.5)	6 (33.3)	
History of dementia, n (%)	26 (12.1)	22 (11.2)	4 (22.2)	.170
Cognitive impairment[e], n (%)	88 (41.1)	76 (38.8)	12 (66.7)	.022
Charlson comorbidity index score[f], median (IQR)	3.0 (1.0-4.0)	2.5 (1.0-4.0)	3.0 (1.0-4.0)	.990
History of delirium/ confusion during sickness, n (%)	55 (25.7)	48 (24.5)	7 (38.9)	.230
Duration of delirium, in median days (IQR) NA= not applicable	NA	NA	2.5 (1.0-5.3)	
Pharmacological treatment for delirium, n NA= not applicable	NA	NA	11	
Haloperidol	16	5	11	
Other antipsychotics	NA	NA	1	
Benzodiazepines	NA	NA	4	

[a] Incident delirium compared to no delirium
[b] Katz Index score range 0-6, with a higher score indicating more dependence in activities of daily living (ADL) [26]
[c] Based on Fried criteria for frailty range 0-5 with a score of 3 and higher indicating presence of physical frailty [27]
[d] Mini Mental State Exam score ranging 0-30, MMSE score ≤23 indicating cognitive impairment [28]
[e] All patients with a diagnosis of dementia, a MMSE score ≤23, or, in case of missing MMSE score, subjective cognitive problems
[f] Range of 0-31, with a higher score indicating more or more severe comorbidity [29]

Delirium incidence in comparison to reference group from literature

The control group was based on six studies (appendix 4).[5] In total 1546 study participants with a mean age of 80 years. None of the studies, except for Friedman et al.[20] reported to have implemented multi-component delirium prevention strategies, we therefore assumed usual care was delivered. The pooled delirium incidence rate of these six studies was 16% (95% CI random effects model 12-21%) (figure 2). The meta-analysis showed a high heterogeneity (I^2=84%). In a separate logistic mixed-effects model comparing general hospitals (reference category) versus the AGCH, we found that admission to the AGCH was associated with a decrease in delirium incidence (OR [odds ratio]= 0.49, 95% CI 0.24-0.98, p=.044).

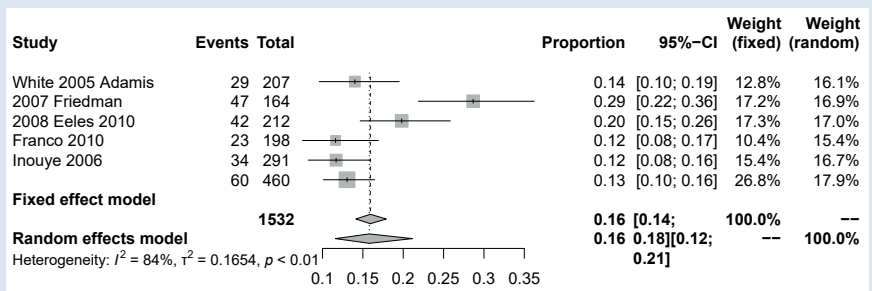

Figure 2 Meta-analysis of proportions of delirium incidences in older hospitalized medical patients found in literature.[5] The pooled incidence rate of these six studies was 16% (95% CI [confidence interval]random effects model 12-21%).

Adherence to CAM evaluations and missing data

In patients with delirium 27.8% of total CAM evaluations and 46.3% of total DOSS scores were missing during the first three days of admission. For patients without delirium 46.9% and 66.7% were missing, respectively. In 15% of all cases all three CAM evaluations were missing. Based on the CAM evaluation and daily delirium assessment by the attending clinician we could ascertain the presence delirium in the first three days of admission in all patients.

Discussion

We measured the effect of a non-pharmacological multi-component delirium prevention strategy at the AGCH and found an incidence rate of delirium of 8.4%. This incidence is lower compared to rates found in hospital medical or geriatric wards found in historical cohorts from literature. This finding is in line with previous literature on multi-component interventions for preventing delirium in hospitalized patients: a 2016 Cochrane review reports moderate quality evidence that multi-component interventions in medical, non-surgical, patients lower delirium incidence.[6] Moreover, the median duration of delirium of 2.5 days at the AGCH is comparable to the duration that is found in literature on non-pharmacological interventions.[21] The prescription rate of medication (61.1%) may be lower in the AGCH compared to other studies, which report rates of 74-86%.[22,23]

The Dutch guideline on delirium, and international guidelines alike, recommends to take a cautious approach to the prescription of medication for the treatment of delirium.[11-13] In addition, only a few patients received medication, in this case haloperidol, for the prevention of delirium, meaning that there were not many non-delirious patients receiving haloperidol. This is relevant because, administration of anti-psychotics such as haloperidol could lower delirium incidence rates in high incidence groups.[11] Moreover, not all CAM measurement on day 1-3 of admission were complete, but it was possible to ascertain the presence of delirium based on daily clinical delirium assessment.

A strength of this study is the relatively large study sample. Furthermore, we looked at two components of feasibility in this study, implementation of the study by evaluating missing measurements and limited efficacy by measuring the incidence of delirum.[9] Limitations of the study include that we did not look at other components of feasibility and that the incidence rate of delirium could have been influenced by selection bias as legal representatives of patients could not always be contacted to obtain consent. Moreover, even though we selected a control group from a high-quality review article; this review was not recently published (2014) and the selected studies were conducted in different countries than the Netherlands.[5] We also did not have insight into all of the baseline characteristics of these studies, which makes it difficult to assess comparability. In addition, we could not definitively ascertain that 'usual care' was delivered in each unit or what this was composed of. Finally, we did not collect data on illness severity, which can be associated with delirium.[24]

Conclusion and implications

This study shows that the incidence rate of delirium in the AGCH may be lower than in general hospitals. Based on this result we would recommend a randomized controlled study or a two-armed observational study using e.g. inversely weighted propensity scores[25] to test if admission to the AGCH is effective in reducing the incidence of delirium. Moreover, attention should be given to collecting complete CAM assessments in this 'real-world'-setting. If in a larger, prospective and controlled study the incidence of delirium at the AGCH is lower than in hospital this would support the implementation of the AGCH model of care elsewhere.

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9 General discussion

General discussion

A 2030 perspective for Mrs. Goslinga
Mrs. Goslinga is an 82-year widow who lives in her own home. Mrs. Goslinga suffers from diabetes, hypertension and was recently diagnosed with Alzheimer's disease. She has a case manager who provides professional support and who refers her to a physiotherapist to improve her balance and maintain her muscle strength. With professional help of her case manager and the informal care and help her four children provide she has been able to manage at home until she falls and breaks her hip. She is rushed to the Emergency Department (ED) where she receives surgery within 24 hours. After her hospital admission she receives post-acute care in a facility for geriatric rehabilitation, the final weeks of rehabilitation take place in her home, and she receives help with bathing and dressing at home from a community nursing and care organization. Advised by her rehabilitation team, her case manager refers her to an acute geriatric community care team; when she starts to feel ill the community nurse alarms the acute geriatric community care team who visit her within an hour. After consulting her general practitioner (GP) the geriatric nurse specialist from the geriatric community care team diagnoses pneumonia and refers her to the Acute Geriatric Community Hospital (AGCH) where she receives antibiotic treatment and physiotherapy. She returns home and is later admitted to the AGCH a second time for a urinary tract infection from which she recovers within a week and returns home. She has become increasingly vulnerable and needs more help with her instrumental activities of daily living at home (preparing coffee, cooking). Together with the AGCH, her GP initiates advance care planning[1] and discusses with her and her family whether she still wants to receive hospital treatment if she becomes ill. Together with her family, she agrees to restrict the number of different treatments she would still like to receive. The following year she has pneumonia again which is not treated with antibiotics but with oral morphine and supportive care provided by the palliative care team which works in close collaboration with the acute geriatric community team. She passes away at home surrounded by her family members.

Reflection on the main findings

The 2030 perspective of Mrs. Goslinga's *patient journey* provides an idea on what acute and palliative care for older adults could look like in the future. The Acute Geriatric Community Hospital could be one of the care models available for older adults in the future. The focus of this thesis was to evaluate the outcomes and implementation this new concept of care in the Netherlands. It is expected that there will be an increase of older adults requiring acute care services in the coming decades. In this general discussion we will reflect on the findings of our research of the ACGH and provide insight into what challenges lay ahead in providing care for older adults in the future. We will do this by presenting the methodological considerations of our research, implications for clinical practice and the overall conclusion of this thesis.

Post-acute care costs and the AGCH intervention

The AGCH concept incorporates existing evidence on how to best deliver hospital care for frail older adults. It aims to reduce unwanted outcomes like unplanned readmissions, functional decline, delirium and falls in frail older adults requiring hospital care. Furthermore, our research in *Chapter 2* shows that frailty is strongly associated with increased care needs and consequently with higher post-acute care costs.[2] Readmissions in the post-acute care period are relatively costly, and permanent admission to long-term residential care following hospitalization is also an important driver of costs.[3-5] This is one of the reasons why we set out to reduce the number of readmissions in patients admitted to the AGCH.[6] Moreover, by improving mobility and independence we try to prevent or delay the need for admission to long-term care.[7] In *Chapter 4* we showed how the AGCH intervention was designed and how it would be evaluated. The model of care of the AGCH includes comprehensive geriatric assessment[8], early rehabilitation7, family involvement[9] and transitional care.[10]

Comparing the AGCH model of care to existing models of care abroad

The AGCH model of care is new to the Netherlands but similar models of care exist internationally: Acute Care for the Elderly units (ACE)[11], Hospital at Home (HaH)[12], nursing led in-patient units (NLU)[13] and post-acute geriatric rehabilitation units in community hospitals.[14] In *Chapter 3* we described how the AGCH differs from these other geriatric care units. ACE for example is hospital-based and provides a full range of hospital diagnostics and services.[11] The AGCH is situated outside of a general hospital, therefore it may allow for a more comfortable environment which is closer to home and this could help in the management of care transitions. NLUs[13] and geriatric rehabilitation units in community hospitals however focus more on the post-acute care phase.[14, 15] Compared to our model these units may not fully replace acute hospital admission because they may not always have resources for providing acute hospital treatment (for example no availability of intravenous medication).[15] HaH is a model of care where hospital care is delivered at home. A recent randomized controlled trial of HaH showed similar outcomes between HaH and conventional hospital admission, with less participants from HaH being admitted to long-term residential care 6 months post-discharge.[16] However, HaH cannot fully replace an acute geriatric unit because HaH care is frequently provided when an informal caregiver is present and/or continuous nursing assistance is not required.[12] Therefore the concept of the AGCH is distinctly different from other models of care and can be seen as a new alternative to conventional hospitalization in older adults.

Evaluating the AGCH model of care

The AGCH has been implemented in one site in the Netherlands with the help of one major healthcare insurer. To provide information on whether implementation elsewhere in the Netherlands is advisable, we wanted to evaluate the AGCH on clinical outcomes (effectiveness) and gain a better understanding of what was needed to set-up the AGCH (implementation). We studied the effectiveness and implementation of the AGCH using mixed methods research, which means that both quantitative and qualitative research methods were used. As a primary outcome we evaluated the effect of AGCH admission on 90-day unplanned

readmission to any hospital, including the AGCH. Mortality upon 90 days post-discharge was added to this outcome to account for differences in mortality between the AGCH and hospital control group.[6] We found that the AGCH admission reduces the rate of 90-day readmission rate or death. All secondary outcomes–functioning, admission to long-term residential care, falls and mortality including time to death were equal between the AGCH and the hospital group. We found, in general, positive patient experience with admission to the AGCH and we showed a potential reduction in incident delirium

It is important to note that the prospective cohort study at the AGCH had to be terminated prematurely during the COVID-19 pandemic and was therefore incomplete. This has limited our statistical power to make inferences regarding the effectiveness of care at the AGCH. Our findings should therefore be interpreted with caution. Nevertheless, we can make a first evaluation of the AGCH using the evidence that is currently gathered; our quantitative findings and qualitative data on patient satisfaction and the implementation of the AGCH. Based on this evidence we provide recommendations for future research and implementation elsewhere.

Patients' experience and satisfaction with the AGCH

In our mixed method study of patients' experience and satisfaction with the AGCH (*Chapter 6*) we showed that patients generally experience the admission to the AGCH as positive. The care pathway of the AGCH, which starts at the ED, was considered well-organized up to the moment of discharge. At this point however, there were some unmet needs and an unexpected change in the discharge date could overwhelm and dissatisfy participants. However, most participants would support the opening of more AGCHs and tend to prefer admission to the AGCH to admission in a general acute hospital. Furthermore, (daily)-goal setting[17] was one of the components of the AGCH intervention, but in this study, we see that patients did not report that they had been involved in this during the admission to the AGCH. This shows us that some components of the AGCH intervention may not have been implemented completely or not have been comprehended by patients.

Qualitative interviews on the implementation of the AGCH

We evaluated the implementation of the AGCH by conducting several interviews with professionals and involved stakeholders. This type of in-depth qualitative analysis provides insight into how the AGCH was implemented.[18] We found that the implementation of the AGCH was an ongoing process and we identified facilitating factors (*facilitators*) and barriers to the implementation of the AGCH. In our study we found similar results to a recent qualitative study of Hospital at Home in the United States.[19] In this paper, Brody et al. illustrate that working towards effective partnerships with all care organizations and professionals involved in providing hospital care outside of the hospital walls is essential. Similarly, our data revealed that lack of understanding by partnering services and other care organizations strongly hindered delivering care at the AGCH. Logically, managing expectations and informing potential partners within the care network seem to be crucial for both models of care.

Also, we found that some barriers in delivering care at the AGCH, such as

unmet requirements in services form partnering organizations, still existed during the execution and continuation phase.[20] The fact that the implementation process was still ongoing during the period in which the prospective cohort study was conducted is a real-world circumstance but may also have influenced our results. It could have diluted the effect of the intervention. On the other hand, waiting for complete implementation of the concept may not always be feasible when implementing a complex and new intervention like the AGCH.

What could have helped us to interpret our findings is knowing more about the degree of implementation of the intervention. This is measured by the implementation *fidelity*—, furthermore *dose, reach and adaptation* are other measures of the degree of implementation.[21] Low fidelity can be one for the reasons for not finding effectiveness of an intervention. High fidelity and clinical effectiveness strongly support the use of an intervention. We will discuss a future mixed methods process evaluation using the Medical Research Council (MRC) Framework in the following sections: *methodological considerations and implications for clinical practice and research*.[21]

Methodological considerations

Study design – using mixed methods to evaluate a complex intervention

The research in this thesis used a mixed methods approach. A prospective cohort study controlled with a historical control group was combined with qualitative interviews with patients, caregivers, professionals, and other stakeholders in the AGCH concept. This design allowed us to use method triangulation which is a form of mixed methods research in which qualitative and quantitative data is collected concurrently.[22] We used this in (*Chapter 6*) when studying patient experience and satisfaction with admission to the AGCH.[23] Method triangulation can improve study validity because it allows the researchers to compare results between methodologies. Meaning that researchers can answer their research question using both quantitative and qualitative data. Using two types of data to answer a research question can compensate for the limitations of each method. For example, qualitative data may not always be generalizable to other settings and quantitative data may not always reflect the personal experience or satisfaction of patients or involved professionals with the intervention. Furthermore different approaches to timing, combining and weighting research results in mixed methods research exist.[22] Timing can be concurrent, as in this thesis, or sequential. The mixed methods study in (*Chapter 6*) was carried out concurrently during data collection for the prospective cohort study at the AGCH. In this way we could combine the input of participants filling out the AGCH questionnaire and the semi-structured interviews to iteratively add and alter questions in our qualitative interview guide. In addition, when using a mixed methods research design researchers can decide on a more qualitative or quantitative emphasis for their study results, which is referred to as weighing quantitative versus qualitative resutls.[22] In (*Chapter 6*) of this thesis we weighted both approaches equally. In the conclusion of this thesis, we weighed the quantitative results as leading and use the qualitative data from (*Chapter 6* and *7*) to shed light on why we think these results were achieved and what can be done to optimize the implementation of the AGCH in the future.

(*Chapter 7*) on the implementation of the AGCH has a qualitative design and no quantitative measures reflecting whether the intervention components were implemented as planned were added to this evaluation. This could limit our ability to combine and link the quantitative results to our qualitative data. For example, when we aimed to reduce the 90-day readmission rate by implementing a care transition intervention at the AGCH, we measured the number of readmissions and asked nurses and patients about their experience of transitional care at the AGCH. Additionally, we could have also measured in what percentage of patients a care transition intervention was carried out completely, which reflects *implementation fidelity*.

The MRC process evaluation framework provides a methodology to study both implementation fidelity and other factors that influence how an intervention was delivered. Specifically, this framework measures 1) the contextual factors in which the intervention was delivered, 2) the implementation including the implementation fidelity of the intervention itself and, 3) how the intervention was provided and impacts outcomes.[21] (Figure 1) We did not use this framework but the framework of adaptive implementation by Droës and Meiland.[20] However there are similarities between this framework and the MRC framework, as the framework of adaptive implementation focuses on influencing factors – similar to 1) contextual factors, and on facilitators and barriers in the different phases of implementation– which is somewhat similar to 3) how the implementation was provided. This leaves however the measure of implementation, including implementation *fidelity, dose, adaptations, and reach*. We would recommend including measures of implementation fidelity in future research of the AGCH, and we will elaborate on this in the *Implications for clinical practice and research* section of this discussion.

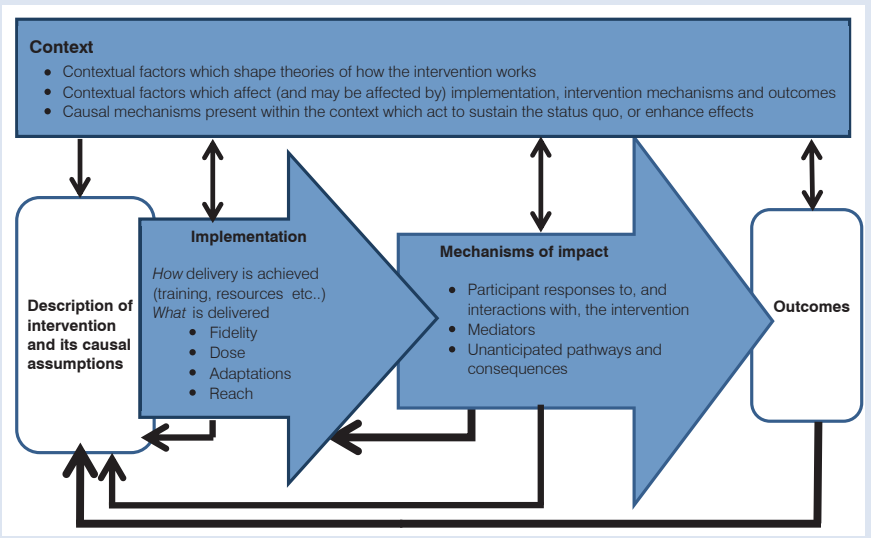

Figure 1 From the Medical Research Council on how to perform process evaluations by Moore et al.,[21] it includes three components 1) Context 2) Implementation including Fidelity 3) Mechanisms of impact.

Using observational data to make causal inferences

In this thesis we used observational data to make causal inferences regarding to clinical outcomes at the AGCH compared to a general hospital. Specifically, we used a prospective cohort study controlled with a historical control group to evaluate our hypothesis that there would be less unplanned 90-day readmissions or death in participants admitted to the AGCH compared to hospital. This design is not a preferred design as the use of non-randomized samples leads to a risk of bias as conditional exchangeability cannot be guaranteed.[24] Conditional exchangeability is achieved when the average treatment effect of admission to the AGCH in those that are admitted to the AGCH is equal to the average treatment effect in those whose who were not admitted to the AGCH. Hence, if the control group that was not admitted to the AGCH had been admitted to the AGCH we would have observed the same outcomes as we now observed in the intervention group that was admitted to the AGCH.[24]

Propensity score methods can make causal inference in observational data possible, that is to emulate conditional exchangeability in observational data.[25] It is however not possible to test if conditional exchangeability has been achieved for those factors that were not measured. Usually, in a randomized controlled trial (RCT) conditional exchangeability is achieved for both measured and unmeasured factors by allocating participants to treatment and control groups at random.[24] Therefore a controlled, if possible, double-blinded, RCT is the gold standard in research and generally provides a higher level of evidence than results obtained from observational studies. Ideally, we would have conducted an RCT to evaluate the clinical effectiveness of the AGCH. But, conducting an RCT is costly and not always feasible for many different reasons. In our case it was not possible to conduct an RCT for financial reasons. Besides, randomization procedures would have led to exclusion of some very frail or cognitively impaired patients. For example, because randomization to AGCH or general hospital would have been too taxing for some patients or because a proxy would not have been available to consent to randomization. However, conducting an RCT of the AGCH versus conventional hospitalization is possible. Shepperd et al.[16] have demonstrated that randomization to HaH from acute hospital units and primary care is feasible. HaH is like the AGCH and has a similar target population. This makes us confident that a study like that of Shepperd et al. is possible for the AGCH-concept. Furthermore compared to our study patients in this multi-center study of HaH were older (average age 83 years) and, had as many or more functional impairments, cognitive impairments or comorbidities, meaning that Shepperd et al. were able to include a population in an RCT that was even more frail than the population that we now studied at the AGCH.[16] Therefore a multi-center randomized controlled trial of the AGCH should also be feasible. On the other hand, some of the HaH services studied in this RCT had been operational prior to the study.[16] In our case starting the AGCH service concurrently with conducting an RCT could have complicated implementation and running the AGCH service. In addition, conducting a high quality RCT is costly which is why conducting an RCT should not be attempted if adequate funding is not available.

When it is not possible to conduct an RCT conducting case-control design such as was conducted by Federman et al. in HaH in the United States would be an alternative.[26] Comparing our design to that of Federman et al. we see that

both studies did not randomize patients, but Federman et al. did collect a control population concurrently with the recruitment of the intervention group. In this study patients received the HaH service based on patient preference or when HaH admission could not be initiated during evenings, nights, and weekends. Therefore, a control group that received care as usual could be recruited concurrently. This approach has important advantages because it reduces time biases that may have occurred in our study and allows researchers to collect the exact same measurements in both the control group and intervention group. A disadvantage of this approach is using patient preference as a means of dividing patients into control or intervention arms of a cohort study. This could lead to *confounding by indication or severity*[27] if patients with either relatively less or more comorbidities, better or worse health, have a preference for admission to the intervention service vs conventional hospitalization. The study's outcomes could then be influenced by baseline differences in comorbidity and health status which may not be fully correct by using propensity score methods.[28]

Outcome measures

The primary outcome of our study was 90-day unplanned readmission or death. This is a clinically meaningful outcome which also reflects cost of post-acute care because readmissions are important drivers of post-acute care costs.[2] However using this outcome has limitations because readmissions are influenced by healthcare system factors.[29] Firstly, this may be problematic because the AGCH intervention cannot fully address the whole care system; it may therefore not be the best measure of the interventions' effectiveness. Secondly, healthcare system factors may have changed between the period that data of the control group, the Hospital-ADL study,[30] was collected (2015-2017) and the period in which the AGCH cohort study was conducted (2019-2020).[6] It is unknown if hospital readmissions in frail older adults were stable, decreased or increased in the study period. Therefore, we cannot be certain if the found effect of our study is, in part, related to a general decline of unplanned readmissions in frail older adults. We do know that in 2015 a major reform of Long-term care (LTC) was implemented in the Netherlands, including changes in financing of post-acute care services.[31] This reform was aimed at reducing LTC and post-acute care costs by means of reducing the use of residential care, to decentralize non-residential care, – that is professional care delivered at home and to cut expenditures in the LTC sector. This reform may have affected the rate of readmission in older adults in various ways. Namely, as the reform was initiated in 2015, the control group, the Hospital-ADL study (conducted between 2015-2017) was conducted during the implementation phase of this reform. This may have led to an increase of readmissions during this time because reorganization of care services may hamper the alignment of care services[32], which then in turn may increase the number of readmissions. The AGCH cohort study was conducted between 2019-2020, during this time the reorganization of LTC and post-acute care had been completed. Therefore we do not expect an increase in readmissions due to reorganization of care services during the study, but the reform of LTC may still influence the number of readmissions as LTC care coordination is still suboptimal older adults may use less residential care.[32] This could lead to more hospital (re)admissions because frail older adults living at home are at high risk of acute health crisis requiring

ED or hospital admission.[33] In conclusion, health care system factors may have influenced our results, but we are not certain how large this effect is.

Furthermore, the evaluation of the AGCH is difficult because the AGCH is a complex intervention which has multiple clinical outcomes such as unplanned readmissions, ADL-functioning, delirium, falls, admissions to residential care and mortality. Perhaps combing a limited number of clinical outcomes with measures of implementation fidelity would be recommended in this setting because it would simplify the study, allowing for better measurement of all outcomes and fidelity measures. This will also make it easier to align clinical outcomes with intervention components. This is important because when clinical outcome measures are studied they are more often achieved if the intervention is successfully aligned with the outcome.[34] Heldmann et al. showed that in older acutely hospitalized adults improvements in ADL-functioning are seldom seen because of misalignment between the intervention and the measurement tool.[34] Furthermore Suijker et al. showed that the measurement properties of the modified Katz-ADL scale are not appropriate to detect meaningful clinical change in how a small sample of patients perform ADLs.[35] At the same time there is no consensus with regards to what instruments should be used to evaluate ADLs and many different instruments are used.[36]

Qualitative research methods and process evaluations

With regards to the qualitative research in this this thesis, specifically (*Chapter 7*) which was a qualitative case study of the implementation of the AGCH: a limitation of qualitative designs is the fact that results are not always generalizable to other settings. On the other hand, the findings of our qualitative process evaluation do provide insight into what facilitators and barriers existed when the AGCH was implemented: much of this information is in part generalizable to other sites in the Netherlands because they are related to healthcare system factors. Also, by using purposive sampling for recruitment of participants in interviews with both patients and professionals we aimed to create a representative and varied sample. This contributed to the obtainment of rich data which can inform policymakers and professionals as they give fist-hand insight into the implementation of the AGCH.

Implications for clinical practice and research

This thesis evaluates the effectiveness and implementation of an acute geriatric community hospital that was recently started in the Netherlands. The implementation of this new model of care was feasible in one site in the Netherlands, but policy change and continued research are required to enable implementation of the AGCH concept elsewhere in the Netherlands and to evaluate it in an even more robust manner.

Further research when implementing the AGCH elsewhere

Future research at other sites where the AGCH is planned should include quantitative and qualitative evaluations. A mixed methods process evaluation could be conducted which should measure the quantity of the intervention that was delivered. Furthermore, a limited number of outcomes such as discharge

destination, ability to perform activities of daily living upon discharge (ADLs) or the Short Physical Performance Battery (SPPB)[37, 38] and incident delirium could be measured. As discussed in the section *methodological considerations-outcome measures* measured clinical outcomes should be well aligned with the intervention components.[34] The alignment of the intervention components with outcomes is complicated in the AGCH, because the AGCH does not have a single goal. Ideally each intervention component should have an outcome that truly measures the effect of the intervention component. This may be complex to achieve for all interventions of the AGCH. Therefore, for future research it would be advisable to select a limited number of clinical outcomes linked with measures of implementation fidelity. For measures of implementation fidelity, one could think of measures such as the percentage of patients receiving physiotherapy, the amount of discharge letters that are sent within 48 hours or the number of warm handovers to primary care. Table 1 shows how three intervention components could be aligned with measures of implementation fidelity and clinical outcomes.

Table 1 Suggestions for alignment of intervention components with implementation fidelity and dose, and clinical outcomes[34]

Intervention	Implementation fidelity measure	Outcome measure
Patient-centered care and training to improve mobility and prevent muscle loss	Percentage of patients receiving daily physical therapy sessions and duration of sessions	SPPB (Short Physical Performance Battery)[34, 37, 38]
Multidisciplinary team work and discharge planning (nurse, medical doctor, physical therapist, community nurse, GP)	Percentage of patients discussed in multidisciplinary team meetings	Return to original living situation
Transitional care and discharge planning[39]	Percentage of: • warm handovers to primary care • home visits after discharge • discharge letters returned to GP within 48 hours	90-day readmissions

Qualitatively we would recommend interviews with patients, informal caregivers and with professionals on how they experience intervention components and whether and how these help patients in their recovery and discharge back home. Early in the feasibility testing phase of the AGCH intervention elsewhere–that is at the start of implementation and research, professionals can be interviewed concurrently with measuring implementation fidelity measurements. Implementation fidelity measurements would include, for example for the outcome of the SPPB the percentage of patients receiving physiotherapy and the durations of sessions (implementation *dose*[21]). If fidelity or dose are low, reflecting that either not all components of the intervention are implemented or they are only implemented to a certain degree, involved professionals could be asked why implementing all intervention components fully is not feasible. Then changes to the delivery of the intervention can be made to improve fidelity and

strengthen the possible intervention effect. This method of planning and starting with the intervention, checking if it has been implemented and making changes accordingly follows phases of the Plan-Do-Change-Act (PDCA) a cycle which has a long history in use in implementing innovations and make improvements in various different organizations.[40]

Following the fidelity testing stage the effectiveness (trial stage) starts. In a trial researchers would preferably not work on quality improvement continuously because this could impact the external validity of the study's results.[21] During the trial stage measuring process measures such as the percentage of cases in which a warm handover to primary care was performed, could be helpful to understand why an effect or no effect on clinical outcomes is found.

Furthermore, future research should focus on studying delirium in this population as we saw a relatively low incidence of delirium in a descriptive study at the AGCH (*Chapter 9*). Preventing delirium is done at the AGCH by a non-pharmacological multi-component delirium prevention strategy, consisting of nurses encouraging early mobilization, preventing overstimulation (single rooms, noise reduction), management of delirium-inducing drugs and improving orientation through e.g. family involvement.[6, 41] A measure of treatment fidelity or dose for this strategy and the outcome of incident delirium could be measuring noise with an on-site and visible decibel meter as is used in a similar unit, the Subacute care unit in Barcelona, Spain (*Chapter 2*). In our study on delirium (*Chapter 8*) we did not recruit a control group. In a future study incident delirium should therefore be measured at both at the AGCH and concurrently in a control population.

In addition, research evaluating the cost-effectiveness of the AGCH compared to conventional hospitalization is necessary. Costs of the AGCH should be lower or equal to conventional hospitalized while achieving similar or improved outcomes, otherwise this service does not contribute to the sustainability of healthcare services.[42] In our prospective cohort study, controlled with a historical control group we did collect health-utilization and cost measurements, but their analysis was not included in this thesis.

Finally, when the AGCH is implemented in a more rural area or an otherwise different setting an analysis of facilitators and barriers to implementation can be repeated. These factors may be different especially when there are fewer different care organizations, and services are more integrated. Typically this is the case in more rural area's compared to urban area's such as the greater Amsterdam region where many different care organizations provide care and integrating services is more difficult.[43]

Recommendations for implementing the AGCH in a decentralized care system

Policy makers involved in the regulation and funding of both hospital and community care in the Netherlands should consider barriers to provision of hospital care closer to or at home that exist in the Dutch healthcare system. The Dutch healthcare system has a decentralized organization and components of managed competition between care organizations exist. This means that the government does not have as strong of a central role and is not responsible for fully regulating the system.[44] Because no single government party regulates and

finances healthcare, removing financial and policy barriers to new models of care is complex and requires action from multiple parties.

In case of the AGCH this means providing hospital-level care for low-complex patients at another location than the hospital is not an easy task; the success of the AGCH is primarily hampered by financial barriers on multiple levels. (*Chapter 7*) Simultaneously, the demand for acute care for geriatric patients is only going to increase in the coming years.[45] This warrants a holistic approach at the patient-care and healthcare system level. This could include increasing short-term residential care (STRC) availability and resources such as frailty teams in community care. STRC (eerstelijnsverblijf, ELV in Dutch) is a form of intermediate medical care for patients without the need for hospital treatment.[46] STRC is available throughout the Netherlands, but often not during out-of-office hours and not on short notice (within hours) such as the AGCH. As described in the *2030 perspective for Mrs. Goslinga acute geriatric community teams or frailty teams* can provide an urgent care response at a patient's home, thereby possibly preventing hospital transfer of frail patients.[47] In the end patient needs, not availability of services, should determine assessment by a frailty team or admission to a STRC or AGCH ward.[46]

Implementing the AGCH concept at another site

With regards to preparing implementation elsewhere, we would advise a number of steps to be taken in the preparation phase: 1) Visiting the community care organization and hospital by involved managers and professionals can help to create awareness regarding the way in which care processes are organized in both settings. 2) Involving both upper and middle management, business controllers and supportive staff in the AGCH's project team. 3) Creating protocols for AGCH procedures and reviewing procedures in the Electronic Health Record before opening the AGCH ward. 4) Training and educating the nursing team to assure that all nurses can perform necessary skills. 5) Allowing time and financing for a feasibility testing phase for the new AGCH ward. 6) Allowing time and financing for evaluating the new AGCH wards in a multicenter study.

Developing a direct admission route to the AGCH

When the AGCH was designed and opened in 2018 it envisioned direct route from primary care to admission.[6] This direct route would make it possible to transfer a patient to the AGCH without visiting the ED. Frequent transfers of frail older adults increases the risk of adverse events (such as delirium) and may contribute to ED overcrowding.[48] Therefore, creating a direct pathway to admission could be beneficial. For HaH direct admission routes already exist.[16] Future research could focus on the options for direct admission to the AGCH. If in certain patient groups required diagnostics can be performed in another place than the ED, this would support the opening of a direct pathway to AGCH admission.

Conclusion

This thesis provides evidence regarding the implementation and effectiveness of the AGCH concept in the Netherlands. Our findings should however be interpreted with caution because the prospective controlled study of the AGCH had to be terminated early because of the COVID-19 pandemic. This study showed a difference in rate of 90-day readmission or death, which was the primary outcome or our study. Secondary outcomes showed mixed results. ADL-dependence over time, falls, institutionalization, mortality and time to death were not different compared to the control group. However, patient satisfaction was high, and incidence rates of delirium were lower compared to control groups from literature. In our qualitative process evaluation, we found that involved healthcare providers, care organizations and health insurers were supportive of the AGCH concept. Furthermore, with a move towards providing care in the community there is a (inter)national demand for this concept of care.

Based on the findings in this thesis and the support for the AGCH by multiple stakeholders, we would advise the implementation and evaluation of the AGCH in different sites in the Netherlands. However, as our current research was single-centered and hampered by the COVID-19 pandemic we would advise future research to include repeating (parts of) the study of effectiveness and cost-effectiveness of the AGCH. Incident delirium should then be studied. Measures for implementation fidelity, that is the delivering the AGCH intervention components as intended, can be added as a measure in future research. A mixed methods process evaluation should then be conducted alongside this study to improve implementation fidelity in the feasibility testing phase and to understand the presence or lack of effect after the study has been completed. At the same time, providing hospital care closer to home as is done in the AGCH is challenging because the way in which the Dutch healthcare system is organized and funded. Therefore, it is important to address financial and regulatory meso- and macro-level barriers in the preparation phase of the implementation process. These factors ultimately influence implementation on the micro-level because they either support or hinder working processes and operations during the execution phase.

In conclusion, admission to the AGCH as an alternative to hospital care is feasible. The evidence presented in this thesis will help to implement and evaluate the AGCH concept of care elsewhere.

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10

Summary
Samenvatting

English Summary

The implementation and evaluation of an acute geriatric community hospital in the Netherlands

Chapter 1 describes the societal and clinical background to the opening of the acute geriatric community hospital (AGCH) otherwise known as the 'Wijkkliniek' in Dutch. The AGCH is an acute geriatric unit located in an intermediate care (skilled nursing) facility. It is an alternative to conventional hospitalization. Hospitalization is a stressful event for older adults and is associated with negative outcomes such as readmission, functional decline, and mortality. The AGCH focuses on preventing negative outcomes of hospitalization and reducing (post-acute) care costs. Intermediate care is defined as care that represents a broad range of time-limited services that aim to ensure continuity and quality of care; promote recovery; restore independence and confidence; or prevent a decline in the functional ability at the interface between hospital, home, long-term care (nursing homes), primary care and community services.

The AGCH is an alternative model to hospital-based care. Care at the AGCH includes the treatment of acute illness, Comprehensive Geriatric Assessment (CGA) and early rehabilitation. We hypothesize that the implementation of the AGCH in intermediate care would lead to a reduction in negative patient outcomes after hospitalization, such as readmission, functional decline, institutionalization, and mortality. Other 'soft' or process-level outcomes of implementation of this new model of care are 1) patient experience and satisfaction with AGCH care and 2) facilitators and barriers associated with the implementation of the AGCH, as experienced by involved professionals and stakeholders. Furthermore, a common complication of hospitalization in older adults is the development of delirium, an acute disturbance in attention and cognitive functions. The etiology of delirium is multifactorial, and its prevalence and incidence vary between settings and populations. Incident or new-onset delirium occurs in 10% to 56% of hospitalizations. We hypothesize that the incidence of delirium at the AGCH may be lower due to the adapted senior-friendly environment and multi-component non-pharmacological intervention strategy implemented at the AGCH.

The overall aim of this thesis is to provide evidence concerning the implementation and effectiveness of the AGCH compared to conventional hospitalization.

Hospital admissions are costly and after hospitalization, post-acute care costs in older hospitalized adults can be high. However, few studies describe what patient characteristics are associated with high post-acute care costs. In **Chapter 2** we describe determinants of post-acute care costs in acutely hospitalized older adults. Detailed information on monthly post-acute healthcare expenditures and the characteristics of patients that make up for a large share of these expenditures is scarce. We calculated costs in acutely hospitalized older patients and identify patient characteristics that are associated with high post-acute care costs. Data from the Hospital-ADL study were used, which is a prospective multicenter cohort study that included 401 acutely hospitalized older persons from internal medicine,

cardiology, and geriatric wards. Our primary outcome was mean post-acute care costs within 90 days post-discharge. Post-acute care costs included costs for unplanned readmissions, home care, nursing home care, general practice, and rehabilitation care. Three costs categories were defined: low [0-50th percentile (p0-50)]; moderate (p50-75); and high (p75-100). Multinomial logistic regression analyses were conducted to assess the associations between costs and frailty, functional impairment, health-related quality of life, cognitive impairment, and depressive symptoms. Costs were distributed unevenly in the population, with the top 10% (n=40) accounting for 52% of total post-acute care costs. Mean post-acute care costs were 4035 euro [standard deviation (SD) 4346 euro]. Frailty, functional impairment and poor health-related quality of life at admission were associated with classification in the high-cost group, compared to the low-cost group. These results show that post-acute care costs are substantial in a small portion of hospitalized older adults. Frailty, functional impairment, and poor health-related quality of life may be used as an indicator of such costs in practice.

In **Chapter 3** two European examples of acute geriatric units located outside of a general hospital are presented. This model of acute medical care includes comprehensive geriatric assessment and rehabilitation. This exploratory cohort study compares patients' diagnoses, characteristics, and outcomes of two European sites where this care occurs. The first site is the Subacute Care Unit (SCU)– introduced in 2012 in Spain, and the second is the Acute Geriatric Community Hospital (AGCH)– introduced in 2018 in the Netherlands. The main admission criteria to these units are acute events or exacerbations of chronic conditions, hemodynamic stability upon admission, and no requirement for complex diagnostics. Patients are admitted from the emergency department or from home. In this study we compared setting, characteristics and outcomes between patients admitted to the two units. We used data from 909 patients admitted to SCU and 174 to AGCH. The mean age was: 85.8 years (standard deviation, SD=6.7) at SCU and 81.9 years (SD=8.5) ($p<.001$) at AGCH. At the SCU, patients were more often delirious (38.7% versus 22.4%, $p<.001$) upon admission. At both units, infection was the main admission diagnosis. Other diagnoses included heart failure or chronic obstructive pulmonary disease. 5% or less of patients were readmitted to general hospitals. Average length of stay was 9 days at the SCU and 10 days at the AGCH. Based on our results we conclude that these acute geriatric units in intermediate care are similar, and both provide an alternative to admission to a general hospital. The comparison of these units to other examples in Europe is recommended and we suggest multicenter studies comparing their performance to usual hospital care.

Chapter 4 presents the protocol for investigating the effectiveness of care delivery of an acute geriatric community hospital (the AGCH) for older adults in the Netherlands. This study will investigate the effectiveness of care delivery at the AGCH on patient outcomes by comparing AGCH patients to a historic cohort of hospitalized patients. Propensity score methods are used to correct for potential population differences. The primary outcome of the study is the 90-day rate of unplanned readmission. Secondary outcomes include functional decline, institutionalization, healthcare utilization, occurrence of delirium or falls,

health-related quality of life, mortality, and patient satisfaction. Furthermore, an economic evaluation and qualitative process evaluation are planned. This process evaluation is planned to describe the experience of various stakeholders with this new concept and reveal barriers and facilitators to its implementation. This study will be the first to evaluate an acute geriatric community hospital in the Netherlands on both patient-reported, economic outcomes and process measures. A limitation of this study is the use of a historic cohort as the control population, which may result in baseline differences between the control and intervention population.

Chapter 5 presents the outcomes of the observational controlled study measuring patient related outcomes at the AGCH. We used inverse probability weighting (IPW) to account for baseline differences between groups. The primary composite outcome was 90-day readmission or death. Secondary outcomes included 30-day readmission or death, admission to long-term residential care, functional dependence over time and occurrence of falls. Generalized logistic regression models and multilevel regression analyses were used to estimate differences in outcomes between groups. AGCH patients had lower rates of 90-day readmission or death compared to controls (odds ratio [OR]: 0.39 95% Confidence Interval [CI] 0.23-0.67). Time to death was not different between groups (hazard ratio 0.93 95% CI 0.51-1.69 p-value= 0.81). There was also a difference in readmission or death at 30 days after discharge (OR 0.42 (95% CI 0.23-0.78). No other secondary outcomes were significant. These findings show the potential of the AGCH as a new model of care for frail older adults, but also warrant further research in prospectively controlled multicenter studies. An economic evaluation is also advised.

Chapter 6 presents a mixed method study of the patient experience and satisfaction with admission to the AGCH. This was a mixed method observational study including a satisfaction questionnaire and qualitative interviews with AGCH patients or informal caregivers. Participants (n=152) filled out the questionnaire and 13 semi-structured interviews were conducted. Eleven categories and four overarching themes emerged in the thematic analysis. In general, study participants experienced the admission to the AGCH as positive and were satisfied with the care they received. Patients were satisfied with the small-scale set up and organization of the care-pathway up till discharge. There were also suggestions for improvement regarding discharge and receiving information from doctors and nurses. Limitations of this study include possible participation bias. This study shows that hospitalized older patients positively value the AGCH as an alternative to hospitalization. This finding supports implementation elsewhere.

Chapter 7 provides an overview of facilitators and barriers to implementing the AGCH in one site in the Netherlands. Semi-structured interviews (n=42) were carried out with clinical and administrative personnel at the AGCH and university hospital, plus stakeholders from the partnering care organizations and health insurance company. Data were analysed using thematic analysis. Facilitating factors to implementing the AGCH concept were enthusiasm for the AGCH concept, organizing preparatory sessions, starting with low-complex patients,

good team leadership, and ongoing education of the AGCH team. Other facilitators included strong collaboration between stakeholders, commitment to shared investment costs, and involvement of regulators. Barriers to implementation were providing hospital care in a skilled nursing facility, financing AGCH care, difficulties selecting patients at the emergency department, lack of protocols and guidelines, electronic health records unsuited for hospital care, department layout on two different floors, and complex shared business operations. Furthermore, transfer of acute care to the community care meant that some care was not reimbursed. In conclusion, the AGCH concept was valued by all stakeholders. The main facilitators included the perceived value of the AGCH concept and enthusiasm of stakeholders. Structural financing is an obstacle to the expansion and continuation of this care model.

Chapter 8 reports the incidence of delirium at the AGCH. Delirium in hospitalised older adults is associated with negative health outcomes. Admission to an alternative care setting such as the AGCH may lower the incidence of delirium. The AGCH uses a multi-component non-pharmacological intervention strategy to prevent delirium. The objective of this prospective controlled study is to describe the incidence of delirium at the AGCH and compare this incidence to existing rates from literature. For this we used exploratory meta-analysis of proportions. If a possible effect on delirium is seen in this comparison, this would support conducting a larger prospectively controlled study on delirium in this new care setting. Delirium was assessed using the Confusion Assessment Method (CAM) upon admission and on day one, two and three or until delirium had resolved. Patients' charts were reviewed if CAM was missing. In a linear mixed-effects model, the delirium incidence rate in AGCH was compared to pooled delirium incidence rates from six studies found in a high-quality review. 214 patients from the AGCH (mean age 81.9 years, 47% male, 12% with a history of dementia) were included in the analysis. Delirium developed in 8% (95% CI 5-13%) of patients during AGCH admission compared to 16% (95% CI 12-21%) in hospitals. Admission to the AGCH was associated with a decreased delirium incidence rate compared to the hospital control group (OR 0.49, 95% CI 0.24-0.98, p-value=0.044). In conclusion the delirium incidence in the AGCH is low compared to incidences found in general hospitals in literature. Based on these findings a controlled observational or randomized study measuring delirium in this care setting is recommended.

Chapter 9 concludes this thesis and presents a general discussion of the main findings. Overall, this thesis provides evidence regarding the implementation and effectiveness of the AGCH concept in the Netherlands. Our findings should however be interpreted with caution because the prospective controlled study of the AGCH had to be terminated early due to the COVID-19 pandemic. This study showed a difference in rate of 90-day readmission or death. Secondary outcomes showed mixed results. ADL-dependence over time, falls, institutionalization, were not different compared to the control group. Patient satisfaction was high and incident rates for delirium were lower compared to control groups from literature. In our qualitative process evaluation, we found that involved healthcare providers, care organizations and the health insurer were supportive of the AGCH concept. Furthermore, with a move towards providing care in the community there is a

national demand for this concept. Based on the findings in this thesis and the support for the AGCH by multiple stakeholders we would advise the implementation and evaluation of the AGCH in different sites in the Netherlands. However, as our current research was single-centered and hampered by the COVID-19 pandemic, we recommend that future research includes a study on the incidence of delirium at the AGCH and the cost-effectiveness of the ACGH intervention. Measures for implementation fidelity, which is delivery of AGCH intervention components as intended, can be added as an outcome measure in future research. A mixed method process evaluation should then be conducted alongside this study to improve implementation fidelity in the feasibility testing phase and to understand the presence or lack of effect after the study has been completed. Providing hospital care closer to home as is done in the AGCH is challenging because the way in which the Dutch healthcare system is organized and funded. Therefore, it is important to address financial and regulatory meso- and macro-level barriers in the preparation phase of the implementation process. These factors ultimately influence implementation on the micro-level because they either support or hinder working processes and operations during the execution phase.

In conclusion, admission to the AGCH as an alternative to hospital care is feasible. The evidence in this thesis can assist in future work on the development, implementation, and evaluation of the AGCH concept of care elsewhere.

Nederlandse samenvatting

De implementatie en evaluatie van een acuut geriatrisch wijkziekenhuis in Nederland

Hoofdstuk 1 beschrijft de maatschappelijke en klinische context waarin de opening van een acuut geriatrisch wijkziekenhuis, de WijkKliniek, heeft plaatsgevonden. De WijkKliniek, of *Acute Geriatric Community Hospital* (AGCH), is een geriatrisch wijkziekenhuis in een intermediate care of VVT(verpleeg, verzorging en thuiszorg)- instelling. Opname in de WijkKliniek is een alternatief voor reguliere ziekenhuisopname. Acute ziekenhuisopname is een stressvolle gebeurtenis voor oudere patiënten en gaat gepaard met negatieve uitkomsten zoals heropname, functionele achteruitgang en overlijden. De WijkKliniek is gericht op het voorkomen van negatieve uitkomsten van ziekenhuisopname en het verlagen van post-acute zorgkosten. *Intermediate care* (anderhalvelijns zorg) wordt gedefinieerd als zorg die een breed scala aan tijdgebonden diensten omvat. Deze zorg is gericht op het waarborgen van continuïteit en kwaliteit van zorg, op het bevorderen van lichamelijke herstel, het herstellen van onafhankelijkheid en vertrouwen en/of het voorkomen van achteruitgang van het functioneren. Anderhalvelijns zorg bevindt zich op raakvlak tussen ziekenhuis, thuis, langdurige zorg (in verpleeghuizen), eerstelijnszorg en maatschappelijke dienstverlening.

De zorg in de WijkKliniek is gericht op de behandeling van acute ziekte, en omvat een uitgebreide geriatrische beoordeling (*Comprehensive Geriatric Assessment, [CGA]*) en vroege revalidatie. Het is een alternatief zorgmodel voor ziekenhuiszorg. Wij hypothetiseren dat een opname in de WijkKliniek zal leiden tot een vermindering van negatieve uitkomsten zoals acute heropname, functionele achteruitgang, permanente opname in een verpleeghuis en overlijden. Andere 'zachte' of procesmatige uitkomsten van de implementatie van dit nieuwe zorgmodel die wij hebben onderzocht zijn: 1) de patiëntervaringen met en tevredenheid over de WijkKliniek-zorg, en 2) de faciliterende en belemmerende factoren voor de implementatie van de WijkKliniek, zoals ervaren door betrokken professionals en belanghebbenden tijdens de implementatie. Daarnaast hebben we gekeken naar het optreden van een delier, wat een veel voorkomende complicatie is van een ziekenhuisopname bij oudere patiënten. Een delier is een acute stoornis in aandacht en cognitieve functies. De etiologie van delier is multifactorieel en de prevalentie en incidentie van delier varieert tussen klinische settingen en populaties. Een incident of nieuw delier treedt bij 10% tot 56% van de opgenomen oudere patiënten op. Wij hypothetiseren dat de incidentie van delier in de WijkKliniek lager is dan in het ziekenhuis door de aangepaste seniorvriendelijke omgeving en de meervoudige en niet-medicamenteuze delier preventieve maatregelen die in de WijkKliniek worden ingezet.

Het doel van dit proefschrift is om de implementatie van de WijkKliniek te beschrijven en de mate van effectiviteit van dit nieuwe zorgconcept in vergelijking met reguliere ziekenhuisopname te onderzoeken.

Ziekenhuisopnames zijn kostbaar en na ziekenhuisopname kunnen de post-acute zorgkosten bij oudere patiënten hoog zijn. Het is echter niet bekend welke patiëntkenmerken geassocieerd zijn met deze hoge post-acute zorgkosten. In **Hoofdstuk 2** beschrijven wij daarom de determinanten (voorspellende factoren) van post-acute zorgkosten bij acuut opgenomen ouderen. Gedetailleerde informatie over maandelijkse post-acute zorguitgaven en de kenmerken van patiënten die de hoogste zorgkosten hebben zijn schaars. In ons onderzoek wilden wij de kosten berekenen van acuut opgenomen oudere patiënten en patiëntkenmerken identificeren die geassocieerd zijn met hoge post-acute zorgkosten. Wij hebben hiervoor gebruik gemaakt van gegevens uit de Hospital-ADL studie, een prospectieve multicenter cohortstudie waarin 401 acuut opgenomen ouderen van de afdelingen interne geneeskunde, cardiologie en geriatrie werden geïncludeerd. De primaire uitkomstmaat van onze studie waren de gemiddelde post-acute zorgkosten binnen 90 dagen na ontslag. De post-acute zorgkosten waren gedefinieerd als kosten voor ongeplande heropnames, thuiszorg, verpleeghuiszorg, huisartsenzorg, revalidatiezorg, fysio- en ergotherapie. We definieerden drie kostengroepen: lage kosten (p0-50, p=percentiel); gemiddelde kosten (p50-75) en hoge kosten (p75-100). Middels een multinomiale regressie analyse onderzochten we de associatie tussen kosten en functionele beperkingen, cognitieve beperkingen, depressieve symptomen, kwetsbaarheid en een lage gezondheidsgerelateerde kwaliteit van leven. Post-acute zorgkosten waren onevenredig verdeeld; de 10% deelnemers met de hoogste kosten hadden een aandeel van 52% in de totale kosten. De gemiddelde kosten voor post-acute zorg waren 4.035 euro (SD [standaard deviatie] 4.346 euro). Kwetsbaarheid, functionele beperking en slechte gezondheidsgerelateerde kwaliteit van leven bij opname waren geassocieerd met classificatie in de groep met hoge kosten, vergeleken met de groep met lage kosten. Deze resultaten laten zien dat de post-acute zorgkosten aanzienlijk zijn bij een klein deel van de opgenomen ouderen. Kwetsbaarheid, functionele beperkingen en lage gezondheidsgerelateerde kwaliteit van leven zouden in de toekomst in de praktijk gebruikt kunnen worden als voorspeller van zorgkosten.

Hoofdstuk 3 beschrijft twee Europese voorbeelden van afdelingen geriatrie op een andere locatie dan in een algemeen ziekenhuis. Dit model van acute medische zorg omvat o.a. een uitgebreide geriatrische beoordeling en vroege revalidatie. Deze verkennende cohortstudie had tot doel de diagnoses, kenmerken en uitkomsten van patiënten te vergelijken van twee Europese locaties waar deze zorg plaatsvindt. De eerste locatie is de Subacute Care Unit (SCU) – geïntroduceerd in 2012 in Spanje, en de tweede is het Acute Geriatric Community Hospital (WijkKliniek) – geïntroduceerd in 2018 in Nederland. De belangrijkste opnamecriteria voor deze afdelingen zijn acute ziektebeelden of exacerbaties van chronische aandoeningen, hemodynamische stabiliteit bij opname en geen indicatie voor complexe diagnostiek. Patiënten worden opgenomen vanaf de spoedeisende hulp of vanuit huis. In deze studie vergeleken we de klinische setting, kenmerken en uitkomsten tussen patiënten opgenomen op de twee afdelingen. We gebruikten gegevens van 909 patiënten die waren opgenomen in de SCU en 174 in de WijkKliniek. De gemiddelde leeftijd was: 85,8 jaar (SD=6.7) bij de SCU en 81,9 jaar (SD=8.5) (p-waarde $<.001$) bij de

WijkKliniek. In de SCU waren patiënten bij opname vaker delirant (38,7% versus 22,4%, p-waarde <.001). Op beide afdelingen was infectie de belangrijkste opnamediagnose. Andere opnamediagnoses waren hartfalen en chronische obstructieve longziekte (COPD). 5% of minder van de patiënten moest tijdens opname worden overgeplaatst naar een algemeen ziekenhuis. De gemiddelde verblijfsduur was 9 dagen bij de SCU en 10 dagen in de WijkKliniek. Op basis van onze resultaten concluderen we dat deze acute geriatrische afdelingen in *intermediate care* (anderhalvelijns zorg) redelijk vergelijkbaar zijn en beide een alternatief bieden voor opname in een algemeen ziekenhuis. Het vergelijken van dit type zorg in Europa bevelen wij aan als toekomstig onderzoek, evenals het verrichten van multicenter studies die de uitkomsten van dit type zorg vergelijken met gebruikelijke ziekenhuiszorg.

Hoofdstuk 4 beschrijft het studieprotocol voor het onderzoek naar de effectiviteit van de zorgverlening van de WijkKliniek in Nederland. Deze studie zal de effectiviteit van de zorg in de WijkKliniek onderzoeken door de uitkomsten van WijkKliniek patiënten te vergelijken met een historisch cohort van in het ziekenhuis opgenomen patiënten uit de Hospital-ADL studie middels een *propensity score* methode. Propensity score methodes wordt gebruikt om te corrigeren voor mogelijke populatieverschillen. De primaire uitkomst van het onderzoek is het percentage ongeplande heropnames 90 dagen na ontslag uit de WijkKliniek. Secundaire uitkomstmaten zijn onder meer functionele achteruitgang, permanente opname in een verpleeghuis, zorggebruik, het optreden van delier, vallen, gezondheidsgerelateerde kwaliteit van leven, mortaliteit en patiënttevredenheid. Daarnaast zal er een economische evaluatie en een kwalitatieve procesevaluatie worden uitgevoerd. Deze procesevaluatie is bedoeld om de ervaringen van verschillende belanghebbenden met dit nieuwe concept te beschrijven en om belemmerende en bevorderende factoren voor de implementatie in kaart te brengen. Deze studie is de eerste die de WijkKliniek in Nederland evalueert op zowel door de patiënt gerapporteerde uitkomsten, als op economische en procesuitkomsten. Een beperking van deze studie is het gebruik van een historisch cohort als controlepopulatie; dit kan ertoe leiden dat er baselineverschillen ontstaan tussen de controle- en interventiepopulatie.

In **Hoofdstuk 5** beschrijven we de resultaten van de observationele gecontroleerde studie naar de patiënt-gerelateerde uitkomsten van de WijkKliniek. We gebruikten inverse probablilty weighting (IPW) om te corrigeren voor baselineverschillen tussen onderzochte cohorten. De primaire samengestelde uitkomstmaat van deze studie was heropname of overlijden 90 dagen na ontslag. Secundaire uitkomsten waren heropname of overlijden 30 dagen na ontslag, permanente opname in het verpleeghuis, functionele afhankelijkheid gemeten over de tijd, vallen en overlijden. Gegeneraliseerde logistische regressiemodellen en multilevel regressieanalyse werden gebruikt om verschillen tussen de cohorten te toetsen. WijkKliniek-patiënten werden minder vaak heropgenomen of overleden minder vaak in vergelijking met patiënten in de controlegroep (odds ratio [OR] 0,39; 95% betrouwbaarheidsinterval [BI] 0,23-0,67). Dertig dagen na ontslag vonden wij ditzelfde resultaat voor heropname of overlijden (OR 0,42; (95% BI 0,23-0,78). Er was geen verschil in de tijd tot overlijden (hazard ratio 0.93; 95% CI 0.51-1.69; p=

0.81). De andere secundaire uitkomsten waren niet significant verschillend. Deze bevindingen tonen het potentieel van de WijkKliniek aan als een nieuw zorgmodel voor kwetsbare ouderen, maar rechtvaardigen daarnaast ook verder onderzoek in de vorm van prospectief gecontroleerde multicenter studies. In toekomstig onderzoek is het belangrijk om een economische evaluatie van dit zorgmodel uit te voeren.

Hoofdstuk 6 beschrijft een *mixed method* studie over de ervaring met, en tevredenheid van patiënten over opname in de WijkKliniek. Dit was een observationeel onderzoek waarin een kwantitatieve vragenlijst en kwalitatieve interviews met WijkKliniek-patiënten of mantelzorgers werden gebruikt. In totaal vulden 152 deelnemers de vragenlijst in en er werden 13 semigestructureerde interviews afgenomen. In de thematische analyse kwamen elf categorieën en vier overkoepelende thema's naar voren. Over het algemeen ervaarden studiedeelnemers de opname in het WijkKliniek als positief en waren ze tevreden over de zorg die ze hadden gekregen. Patiënten waren tevreden over de kleinschalige opzet en over het verloop van het zorgtraject tot aan ontslag. Ook waren er suggesties voor verbetering op het gebied van het ontslag en het ontvangen van voorlichting door artsen en verpleegkundigen. Een beperking van deze studie is de mogelijke participatiebias. Uit dit onderzoek blijkt dat opgenomen oudere patiënten de WijkKliniek positief waarderen en zien als alternatief voor ziekenhuisopname. Deze bevinding ondersteunt implementatie van dit zorgconcept elders.

Hoofdstuk 7 geeft een overzicht van faciliterende en belemmerende factoren voor de implementatie van de WijkKliniek op één locatie in Nederland. Er werden semigestructureerde interviews (n=42) gevoerd met klinisch personeel en managers van de WijkKliniek en het academische ziekenhuis, evenals met betrokken zorgorganisaties en de zorgverzekeraar. De gegevens werden geanalyseerd met behulp van thematische analyse. Faciliterende factoren voor de implementatie van het WijkKliniek-concept waren het enthousiasme voor het concept, het organiseren van voorbereidende vergaderingen, beginnen met het opnemen van laag-complexe patiënten, effectief leiderschap in het team, en het continu trainen van het team. Andere faciliterende factoren waren onder meer een sterke samenwerking tussen de betrokken partijen, het delen van de investeringskosten en betrokkenheid van overheidsinstanties. Belemmeringen voor de implementatie waren het verlenen van ziekenhuiszorg in een verpleeghuis, het financieren van WijkKliniek-zorg, de selectie van patiënten op de spoedeisende hulp, het ontbreken van protocollen en richtlijnen, het elektronisch patiënten dossier dat niet geschikt was voor het leveren ziekenhuiszorg, de indeling van de afdeling op twee verschillende etages, en de complexe bedrijfsvoering die gedeeld werd tussen organisaties. Daarnaast zorgde de verplaatsing van acute zorg naar een VVT- instelling ervoor dat sommige zorg niet werd vergoed. We concludeerden dat het WijkKliniek-concept wordt gewaardeerd door alle betrokken partijen. De belangrijkste bevorderende factoren voor de implementatie waren de waarde van het WijkKliniek-concept en het enthousiasme van de betrokkenen. Het ontbreken van structurele financiering maakt het continueren en elders implementeren van dit zorgmodel een uitdaging.

In **Hoofdstuk 8** onderzochten wij de incidentie van delier in de WijkKliniek. Delier is bij opgenomen oudere patiënten geassocieerd met negatieve gezondheidsuitkomsten. Opname in een alternatieve zorgomgeving zoals de WijkKliniek kan de incidentie van delier verlagen. De WijkKliniek gebruikt niet-medicamenteuze delier preventieve maatregelen om een delier te voorkomen. Het doel van deze prospectieve gecontroleerde studie was om de incidentie van delier in de WijkKliniek te beschrijven en deze incidentie te vergelijken met bestaande cijfers uit de literatuur. Hiervoor gebruikten we een verkennende meta-analyse. Als in deze vergelijking een mogelijk effect op delier wordt gezien, dan zou dit een grotere prospectief gecontroleerde studie naar delier in deze nieuwe zorgomgeving rechtvaardigen. Delier werd beoordeeld met behulp van de Confusion Assessment Method (CAM) bij opname en op dag één, twee en drie of totdat het delier was verdwenen. Het patiëntdossier werd geraadpleegd als de CAM-score ontbrak. In een lineair multilevel model werd de incidentie van delier in WijkKliniek vergeleken met de gepoolde incidentie van delier in zes onderzoeken uit een review van hoge kwaliteit. 214 patiënten in de WijkKliniek (gemiddelde leeftijd 81,9 jaar, 47% man, 12% met een voorgeschiedenis van dementie) werden in de analyse opgenomen. Acht procent van de patiënten in de WijkKliniek kreeg een delier (95% BI 5-13%) vergeleken met 16% (95% BI 12-21%) van de patiënten die opgenomen waren in het ziekenhuis. Opname in de WijkKliniek was geassocieerd met een lagere incidentie van delier (OR 0,49; 95% BI 0,24-0,98; p= 0,044). We concluderen dat de incidentie van delier in de WijkKliniek laag is in vergelijking met de in de literatuur gevonden incidentie in algemene ziekenhuizen. Op basis van onze bevindingen zouden wij aanbevelen om een gecontroleerde observationele of gerandomiseerde studie naar de incidentie van delier in de WijkKliniek uit te voeren.

Hoofdstuk 9 bevat een algemene bespreking van de belangrijkste bevindingen van dit proefschrift. Dit proefschrift levert nieuwe kennis op over de implementatie en effectiviteit van het WijkKliniek-concept in Nederland. Onze bevindingen moeten echter met de nodige voorzichtigheid worden geïnterpreteerd, omdat de prospectieve gecontroleerde studie van de WijkKliniek vroegtijdig moest worden stopgezet vanwege de COVID-19-pandemie. Deze studie toonde een verschil in heropname of overlijden 90 dagen na ontslag. De secundaire uitkomsten lieten gemengde resultaten zien. In de uitkomsten functionele afhankelijkheid over de tijd, vallen, en permanente opname in het verpleeghuis was er geen verschil met de controlegroep. De patiënttevredenheid was hoog en de incidentiecijfers van delier waren lager in vergelijking met controle groepen uit de literatuur. In onze kwalitatieve procesevaluatie stelden we vast dat de betrokken zorgverleners, zorgorganisaties en zorgverzekeraars het WijkKliniek-concept steunen. Bovendien is er met de verplaatsing van zorg uit het ziekenhuis naar een plek dichterbij de patiënten thuis een landelijke vraag naar dit concept. Op basis van de bevindingen in dit proefschrift en de positieve ervaring van meerdere belanghebbenden zouden we de implementatie en evaluatie van de WijkKliniek op verschillende locaties in Nederland aanraden. Omdat ons onderzoek echter maar op één locatie is uitgevoerd en werd belemmerd door de COVID-19-pandemie, adviseren wij om in de toekomst opnieuw onderzoek te doen naar de incidentie van delier in de WijkKliniek en naar de kosteneffectiviteit van de

WijkKliniek-interventie. Het meten van de interventietrouw of *fidelity*, dat wil zeggen het uitvoeren van de interventie zoals bedoeld, kan in toekomstig onderzoek worden meegenomen. Naast dit onderzoek kan er een procesevaluatie worden uitgevoerd om enerzijds de interventietrouw in de pilotfase te verbeteren. Anderzijds geeft dit inzicht in de redenen voor aan- of afwezigheid van een significant effect op de uitkomsten. Het bieden van ziekenhuiszorg dichterbij huis zoals in de WijkKliniek, is een uitdaging door de manier waarop het Nederlandse zorgstelsel is georganiseerd en gefinancierd. Daarom is het belangrijk financiële en organisatorische belemmeringen op meso- en macroniveau aan te pakken in de voorbereidingsfase van het implementatieproces. Deze factoren beïnvloeden uiteindelijk de implementatie op microniveau omdat ze werkprocessen tijdens de uitvoeringsfase kunnen ondersteunen of juist belemmeren.

Kortom, het is mogelijk om in de WijkKliniek ziekenhuiszorg te bieden. De bevindingen in dit proefschrift kunnen helpen bij de verdere ontwikkeling, implementatie en evaluatie van de WijkKliniek elders.

Author contributions
PhD portfolio
Publications
Dankwoord
Over de auteur

Author contributions

Chapter 1

General introduction

Concept and design	Marthe Ribbink
Data collection	Not applicable
Statistical analysis	Not applicable
Interpretation of the data	Not applicable
Drafting of the manuscript	Marthe Ribbink
Critical revision of the manuscript	Janet L MacNeil Vroomen, Remco Franssen, Bianca M Buurman

Chapter 2

Ribbink, ME, van Seben, R, Reichardt, LA, Aarden JJ, van der Schaaf M, van der Esch M, Engelbert RHH, Twisk JWR, Bosch JA, MacNeil Vroomen JL, Buurman BM. Determinants of Post-acute Care Costs in Acutely Hospitalized Older Adults: The Hospital-ADL Study. J Am Med Dir Assoc 2019;20(10):1300-1306 e1301.

Concept and design	Marthe Ribbink, Rosanne van Seben, Janet L MacNeil Vroomen, Jesse J Aarden, Marike van der Schaaf, Raoul HH Engelbert, Martin van der Esch, Jos A Bosch, Jos WR Twisk, Bianca M Buurman
Data collection	Rosanne van Seben, Lucienne A Reichardt, Jesse J Aarden
Statistical analysis	Marthe Ribbink, Rosanne van Seben, Janet L MacNeil Vroomen
Interpretation of the data	Marthe Ribbink, Rosanne van Seben, Janet L MacNeil Vroomen, Jesse J Aarden, Marike van der Schaaf, Raoul HH Engelbert, Martin van der Esch, Jos A Bosch, Jos WR Twisk, Bianca M Buurman
Drafting of the manuscript	Marthe Ribbink, Rosanne van Seben
Critical revision of the manuscript	Marthe Ribbink, Rosanne van Seben, Janet L MacNeil Vroomen, Jesse J Aarden, Marike van der Schaaf, Raoul HH Engelbert, Martin van der Esch, Jos A Bosch, Jos WR Twisk, Bianca M Buurman

Chapter 3

Ribbink ME, Gual N, MacNeil Vroomen JL, Ars Ricart J, Buurman BM, Inzitari M. Two European Examples of Acute Geriatric Units Located Outside of a General Hospital for Older Adults With Exacerbated Chronic Conditions. J Am Med Dir Assoc 2021;22(6):1228-1234.

Concept and design	Marthe Ribbink, Neus Gual, Joan Ars Ricart, Marco Inzitari, Janet L MacNeil Vroomen, Bianca M Buurman
Data collection	Marthe Ribbink, Neus Gual
Statistical analysis	Marthe Ribbink
Interpretation of the data	Marthe Ribbink, Neus Gual, Joan Ars Ricart, Marco Inzitari, Janet L MacNeil Vroomen, Bianca M Buurman
Drafting of the manuscript	Marthe Ribbink, Neus Gual, Joan Ars Ricart
Critical revision of the manuscript	Marthe Ribbink, Neus Gual, Joan Ars Ricart, Marco Inzitari, Janet L MacNeil Vroomen, Bianca M Buurman

Chapter 4

Ribbink, ME, Macneil Vroomen, JL, van Seben, R, Oudejans I, Buurman BM. Investigating the effectiveness of care delivery at an acute geriatric community hospital for older adults in the Netherlands: a protocol for a prospective controlled observational study. BMJ Open 2020;10(3):e033802.

Concept and design	Marthe Ribbink, Janet L MacNeil Vroomen, Rosanne van Seben, Irène Oudejans, Bianca M Buurman
Data collection	Marthe Ribbink
Statistical analysis	N/A
Interpretation of the data	Marthe Ribbink, Janet L MacNeil Vroomen, Rosanne van Seben, Irène Oudejans, Bianca M Buurman
Drafting of the manuscript	Marthe Ribbink, Janet L MacNeil Vroomen, Rosanne van Seben
Critical revision of the manuscript	Marthe Ribbink, Janet L MacNeil Vroomen, Rosanne van Seben, Irène Oudejans, Bianca M Buurman

Chapter 5

Ribbink ME, MacNeil Vroomen JL, Kolk D, Jornada Ben A, Willems HC, Franssen R, Buurman BM. Investigating the effectiveness of care delivery at an acute geriatric community hosptial for older adults in the Netherlands: a prospective controlled observational study. Submitted.

Concept and design	Marthe Ribbink, Janet L MacNeil Vroomen, Daisy Kolk, Hanna C Willems, Remco Franssen, Bianca M. Buurman
Data collection	Marthe Ribbink
Statistical analysis	Marthe Ribbink, Janet L MacNeil Vroomen, Daisy Kolk, Ângela Jornada Ben

Interpretation of the data	Marthe Ribbink, Janet L MacNeil Vroomen, Daisy Kolk, Ângela Jornada Ben, Hanna C Willems, Remco Franssen, Bianca M Buurman
Drafting of the manuscript	Marthe Ribbink
Critical revision of the manuscript	Marthe Ribbink, Janet L MacNeil Vroomen, Daisy Kolk, Ângela Jornada Ben, Hanna C Willems, Remco Franssen, Bianca M Buurman

Chapter 6

Ribbink ME, Roozendaal CCR, MacNeil Vroomen JL., Franssen R Buurman BM, Patient experience and satisfaction with admission to an acute geriatric community hospital in the Netherlands: a mixed method study. Journal of Integrated care 2021;29 (4):390-402.

Concept and design	Marthe Ribbink, Catharina C Roozendaal, Janet L MacNeil Vroomen, Remco Franssen, Bianca M Buurman
Data collection	Marthe Ribbink, Catharina C Roozendaal
Statistical analysis	Not applicable
Interpretation of the data	Marthe Ribbink, Catharina C Roozendaal, Janet L MacNeil Vroomen, Remco Franssen
Drafting of the manuscript	Marthe Ribbink, Catharina C Roozendaal
Critical revision of the manuscript	Marthe Ribbink, Catharina C Roozendaal, Janet L MacNeil Vroomen, Remco Franssen, Bianca M Buurman

Chapter 7

Ribbink ME, Mols-de Vries WM, MacNeil Vroomen JL, Resodikromo M, Franssen R, Buurman BM. Facilitators and barriers to implementing of an acute geriatric community hospital in the Netherlands: a qualitative study. Accepted for publication, Age and Ageing.

Concept and design	Marthe Ribbink, Wieteke M Mols-de Vries, Janet L MacNeil Vroomen, Melissa Resodikromo, Remco Franssen, Bianca M Buurman
Data collection	Marthe Ribbink, Wieteke M Mols-de Vries
Statistical analysis	Not applicable
Interpretation of the data	Marthe Ribbink, Wieteke M Mols-de Vries, Janet L MacNeil Vroomen, Melissa Resodikromo, Remco Franssen
Drafting of the manuscript	Marthe Ribbink, Wieteke M Mols- de Vries

Critical revision of the manuscript	Marthe Ribbink, Wieteke M Mols-de Vries, Janet L MacNeil Vroomen, Melissa Resodikromo, Remco Franssen, Bianca M Buurman

Chapter 8

Ribbink ME*, Stornebrink E*, Franssen R, Jonghe A de, Buurman BM. The incidence of delirium in an acute geriatric community hospital: an observational cohort study. Submitted.

Concept and design	Marthe Ribbink, Emma Stornebrink , Remco Franssen, Annemarieke de Jonghe Janet L MacNeil Vroomen, Bianca M Buurman
Data collection	Marthe Ribbink, Emma Stornebrink
Statistical analysis	Marthe Ribbink, Emma Stornebrink, Janet L MacNeil Vroomen
Interpretation of the data	Marthe Ribbink, Emma Stornebrink , Remco Franssen, Annemarieke de Jonghe Janet L MacNeil Vroomen, Bianca M Buurman
Drafting of the manuscript	Marthe Ribbink, Emma Stornebrink
Critical revision of the manuscript	Marthe Ribbink, Emma Stornebrink , Remco Franssen, Annemarieke de Jonghe Janet L MacNeil Vroomen, Bianca M Buurman

Chapter 9

General discussion

Concept and design	Marthe Ribbink
Data collection	Not applicable
Statistical analysis	Not applicable
Interpretation of the data	Not applicable
Drafting of the manuscript	Marthe Ribbink
Critical revision of the manuscript	Janet L MacNeil Vroomen, Remco Franssen, Bianca M Buurman

PhD Portfolio

Name PhD student:	Marthe E. Ribbink
PhD period:	September 2018- February 2022
Name of PhD supervisor:	Prof. dr. B.M. Buurman - van Es
Names Co-supervisor(s):	dr. J.L. MacNeil Vroomen & dr. R. Franssen

1. PhD training

	Year	ECTS
General courses		
AMC- World of Science	2018	0.7
e-BROK('Basiscursus regelgeving klinisch onderzoek')	2019	1.5
Project management	2019	0.6
Scientific writing in English for publication	2020	1.5
Practical biostatistics	2020	1.1
Observational epidemiology	2020	0.6
Clinical data management	2021	0.3
Programming in R	2021	0.4
Specific courses		
Economic evaluations, master evidence based practice	2019	3.0
Qualitative research methods, master evidence based practice	2019	3.0
Multilevel Modelling and Longitudinal Data Analysis, EpidM	2020	3.0
Causal inference and propensity score methods, EpidM	2021	2.0
Seminars, workshops and master classes		
Masterclass acute geriatric care prof. M. Inzitari	2018	0.2
Monthly geriatric research meeting	2018-2022	1.5
Weekly geriatric meeting	2018-2022	1.5
Hospital-ADL research meeting	2018-2022	1.0
Oral presentations		
Nederlandse Internisten vereniging en Nederlandse vereniging voor Klinische Geriatrie Wetenschapsdag Presentation 'De WijkKliniek', Jaarbeurs Utrecht	2019	0.5

Fellow-onderwijs interne ouderengeneeskunde: Organisatie van zorg- innovatieve zorgconcepten ouderen- 'De WijkKliniek', ErasmusMC, Rotterdam	2019	0.5
Invited speaker to the Research group on Aging, Frailty and care Transitions (RE-FIT), presentation on 'The Acute Geriatric Community Hospital' in Amsterdam, Parc Sanitari Pere Virgili, Universitat Autonoma Barcelona, Barcelona, Spain	2019	0.5
Workshop on Intermediate care and care transitions International Conference on Intermediate Care (ICIC) 2019, San Sebasitan, Spain	2019	0.5
Presentation 'Eerste resultaten van de WijkKliniek-Strategiedag onderzoekslijn Acute ouderenzorg', Amsterdam UMC, Amsterdam	2019	0.5
Presentation 'Acute Geriatric Community Hospital' for a delegation of doctors and nurses from New-Zealand, Cordaan, Amsterdam	2019	0.5
Presentation 'De WijkKliniek', een nieuwe generatie ouderen thuis, conference 2020, Nieuwegein	2020	0.5
Oral presentation: 'Two Examples of acute geriatric units located in Intermediate care' ICIC 2020 conference Sibenik Croatia (online conference)	2020	0.5
Special interest group on intermediate care meeting, International Foundation for Integrated care, presentation on 'Two Examples of acute geriatric units located in Intermediate care' together with Neus Gual, online	2021	0.5
Special interest group on intermediate care, International Foundation for Integrated care, presentation of paper on the 'Patient experience with the AGCH', published in the special issue on intermediate care in the Journal of Integrated care, online	2022	0.5
Presentation on the Acute Geriatric Community hospital for a delegation of doctors, nurses and policy makers from Finland, the Czech Republich and the Netherlands (representatives from Actiz, the Dutch association for nursing homes and care organizations), Cordaan, Amsterdam	2021	0.5
Poster presentations		
"Determinants of post-acute care costs'' Amsterdam Public Health, Annual meeting, Amsterdam	2018	0.5

"Incidence of delirium in an acute geriatric community hospital" EuGMS conference, online	2021	0.5
(Inter)national conferences		
International Conference on Integrated Care, San Sebastian Spain	2019	0.25
Geriatriedagen, den Bosch	2020	0.25
Geriatriedagen, den Bosch	2022	0.25
International Conference on Integrated Care, Sibenik Croatia (online conference)	2021	0.25
EUGMS Athens (online conference)	2022	0.25
Other		
Organizing the monthly geriatric research meeting	2020	0.5
Member of the Ageing and Later Life research line junior council, Amsterdam Public Health	2019-2021	1.0

2. Teaching

Lecturing		
Presentation 'Functieverlies na ziekenhuisopname'- Fit for Practice Hogeschool van Amsterdam	2018	0.25
Tutoring, Mentoring		
Mentor honours program Master, Medicine	2019-2021	3.0
Supervising		
Rick Temminghoff, Master thesis, Medicine	2019	1.0
Katja Roozendaal, Master thesis, Medicine	2019	1.0
Emma Stornebrink, Master thesis, Medicine	2020	1.0
Wieteke Mols, Master thesis, Medicine	2020	1.0
Emma Potgieter, Master thesis, Physician Assistant	2021	1.0
Peer reviewing		
SAGE open	2020	0.25
BMC Health Services Research	2020	0.25
Journal of the American Directors Association	2021	0.25
Clinical Interventions in Aging	2022	0.25

3. Parameters of Esteem

Grants	
Amsterdam Public Health, Ageing and Later Life Travel Grant	2019

Publications

Scientific publications

1. **Ribbink ME**, van Seben R, Reichardt LA, Aarden JJ, van der Schaaf M, van der Esch M, Engelbert RHH, Twisk JWR, Bosch JA, MacNeil Vroomen JL, Buurman BM. Determinants of Post-acute Care Costs in Acutely Hospitalized Older Adults: The Hospital-ADL Study. J Am Med Dir Assoc. 2019;20(10):1300-1306 e1301.

2. **Ribbink ME**, Macneil Vroomen JL, van Seben R, Oudejans I, Buurman BM. Investigating the effectiveness of care delivery at an acute geriatric community hospital for older adults in the Netherlands: a protocol for a prospective controlled observational study. BMJ Open. 2020;10(3):e033802.

3. **Ribbink ME**, Gual N, MacNeil Vroomen JL, Ars Ricart J, Buurman BM, Inzitari M. Two European Examples of Acute Geriatric Units Located Outside of a General Hospital for Older Adults With Exacerbated Chronic Conditions. J Am Med Dir Assoc. 2021;22(6):1228-1234.

4. **Ribbink ME**, Roozendaal CCR, MacNeil Vroomen JL., Franssen R. Buurman BM, Patient experience and satisfaction with admission to an acute geriatric community hospital in the Netherlands: a mixed method study. Journal of Integrated care 2021;29 (4):390-402

5. **Ribbink ME**, Stornebrink E, Franssen R, Jonghe A de, MacNeil Vroomen JL, Buurman BM The incidence of delirium in an acute geriatric community hospital: an observational cohort study. Submitted.

6. **Ribbink ME**, Mols-de Vries WM, MacNeil Vroomen JL, Resodikromo M, Franssen R, Buurman BM. Facilitators and barriers to implementing of an acute geriatric community hospital in the Netherlands: a qualitative study. Accepted for publication, Age and Ageing.

7. **Ribbink ME**, MacNeil Vroomen JL, Kolk D, Jornada Ben A, Willems HC, Franssen R, Buurman BM.Investigating the effectiveness of care delivery at an acute geriatric community hosptial for older adults in the Netherlands: a prospective controlled observational study. Submitted.

Practice publications

1. **Marthe Ribbink**, Hanna Willems, Monique Slee, Melissa Resodikromo, Bianca Buurman. De WijkKliniek: ziekenhuisbehandeling voor oudere patiënten in een VVT-instelling. Tijdschrift voor Ouderengeneeskunde 2020.

Dankwoord

Dit proefschrift had niet tot stand kunnen komen zonder de hulp van vele verschillende mensen, een aantal personen wil ik hierbij graag persoonlijk bedanken.

Mijn promotor prof. dr. B.M. Buurman. Lieve Bianca, dank voor je enthousiasme, energie en raad tijdens dit promotietraject. Dank voor de kansen die je me gegeven hebt en de ondersteuning in de afgelopen vijf jaar tijdens mijn afstuderen, mijn promotietraject en ook bij de stappen naar het werken in de kliniek.

Mijn copromotor dr. J.L. MacNeil Vroomen. Lieve Janet, wat ben ik blij dat je mijn dagelijks begeleider was. Je hebt een sleutelrol gespeeld tijdens mijn promotietraject. Ik heb veel van je geleerd, dank daarvoor.

Mijn copromotor dr. R. Franssen. Beste Remco, dank dat jij halverwege het traject bij mijn promotieteam kwam. Je klinische blik, humor en advies hebben het schrijven van dit proefschrift makkelijker en leuker gemaakt.

Mijn medeauteurs, graag bedank ik jullie voor al jullie tijd, kennis en kritische feedback.

De leden van mijn promotiecommissie wil ik hartelijk bedanken voor het beoordelen van mijn proefschrift en de bereidheid om deel te nemen aan de oppositie.

Lieve Daisy, dr. Kolk, dank voor je adviezen tijdens mijn promotietraject. Ik ben erg dankbaar dat jij mijn paranimf wilt zijn. Jij kent mij soms beter dan ik mezelf ken.

Dan zou ik graag al mijn (oud-)collega's bedanken. In het speciaal mijn mede-promovendi, onderzoekers en projectleiders van de afdeling ouderengeneeskunde van het AMC: Judith, Joost, Kim, Lotta, Marjon, Gercora, Eline, Susanne, Lucienne, Josephine, Vera, Isabelle, Iris, Linda, Patricia, Janet, Oscar en Anouschka. Dank voor de fijne samenwerking en alle gezelligheid in de afgelopen jaren. Rosanne, dank voor je begeleiding bij mijn afstudeerstage en het begin van dit promotietraject: ik heb veel van je geleerd! Ik wil hierbij ook graag de collega's die betrokken waren bij de Hospital-ADL studie bedanken.

De clinici en (oud-)medewerkers van de afdeling ouderengeneeskunde van het AMC: Hanna, Nathalie, Juliette, Eveline, Marjolein, Marieke, Melissa, Marije, Irène, Katja, Nanne, Stephanie, Robert, Marlien, Anouk, Natasha, Karianne, Jacqueline, Lisanne en Joyce, ik wil jullie graag bedanken voor jullie grote rol bij het opzetten en ontwikkelen van de WijkKliniek. Ik heb veel van jullie mogen leren.

Dank aan alle oud-collega's/medestudenten van het Mastertraject. Joyce, Anne-Fleur, Stijn, Job en Alex, ik ben er trots op dat we ook zelf een groep studenten hebben begeleid. Hassina, dank voor het (mede-)opzetten van dit traject en alles

dat ik van je heb mogen leren. Bart, Mario en Gabor, dank voor de begeleiding tijdens het Mastertraject. Helaas hebben we ook een aantal verdrietige momenten meegemaakt, waarop jullie er al altijd voor ons waren.

Beste collega's en voormalige collega's van de WijkKliniek, graag wil ik jullie bedanken voor de prettige samenwerking gedurende mijn promotietraject. In het bijzonder wil ik het team van behandelaren bedanken: Diana, Emma, Merel, Mandy, Joke, Kirsten en Babette. Rianne, dank voor je tips rondom het promoveren. Wieteke, wat leuk dat jij zowel stage hebt gelopen bij de afdeling ouderengeneeskunde, mijn collega onderzoeker en collega basisarts op de WijkKliniek bent geweest. Heel veel succes met het voortzetten van je carrière in Arnhem!

Dank aan het team van fysiotherapeuten dat werkzaam is op de WijkKliniek en wiens werk in belangrijke mate de basis voor de WijkKliniek-interventie vormt. Marlies, jij was vanaf het begin betrokken bij de WijkKliniek en hebt een grote rol gespeeld bij hoe de fysiotherapie op de WijkKliniek vorm heeft gekregen, dank voor de fijne samenwerking.

Graag wil ik alle verpleegkundigen, verzorgenden en helpenden werkzaam op de WijkKliniek bedanken. Gwenda, dank voor jouw inzet bij het opzetten van de WijkKliniek en het onderzoek in dit proefschrift. Aranka, wat tof dat jij nu veel met onderzoek doet in je opleiding tot HBO-verpleegkundige. Adeline, dank voor de fijne samenwerking, ik herinner ons avontuur als keynote sprekers bij het Zuyderland festival in Limburg nog goed. Eveline, we leerden elkaar kennen toen je nog stage liep als HBO-V student, inmiddels ben je mijn leidinggevende en dat is een heel knappe prestatie. Frits, ik heb veel van je mogen leren, geniet van je welverdiende pensioen.

Vincent, Marina, Monique en Mathilde, dank voor jullie rol bij het opzetten en (door)ontwikkelen van de Wijkkliniek. Liesbeth en Margot, dank voor al jullie hulp op de afdeling.

Dan de honderden ouderen en hun familieleden die mee hebben gedaan aan de studies in dit proefschrift: dank voor uw deelname aan dit onderzoek en suggesties voor verbetering van de WijkKliniek.

Ik dank ook alle studenten die hebben meegewerkt aan de studies in dit proefschrift. In het bijzonder Rick, Katja, Vincent, Wietske, Cynthia en Emma, dank voor jullie hulp bij data-verzameling op de Wijkkliniek.

Lieve ouders, dank voor alles wat jullie voor mij gedaan hebben. Pap, ik weet dat je ongelooflijk trots op mij zou zijn geweest en ik ben dat nog steeds op jou. Mam, ik ben trots op hoe je in je werk zo veel voor andere mensen doet. Ik ben blij dat je nu vaak leuke tochten maakt met Kees in de Morgan.

Oma Alice Ribbink-Goslinga, je was een lieve oma en bent nog steeds een grote inspiratiebron voor mij. Tante Philippa, dank voor je rol in mijn leven, zonder jou als voorbeeld was ik nooit geneeskunde gaan studeren. Dank dat je er altijd was wanneer dat belangrijk was. Oom Gerrit en tante Mirian, dank voor alle gezelligheid en alle kennis van de wereld die jullie met mij gedeeld hebben. Tante Liesbeth, dank voor je liefde en betrokkenheid, je bent een inspiratiebron voor mij en weet zo veel te doen voor de mensen om je heen. Oom Andy, Isabel, Anna en Eva, rebels of the Prins Hendriklaan, jullie zijn hele toffe familie! Paul en Fleur in Bussum, lieve broer en schoonzus, dank voor alle gezelligheid. Paul, wat fijn dat jij mijn paranimf wilt zijn. Je bent een kei.

Ellen en Arthur, dank voor jullie zorg, zonder jullie was ik vast niet zo 'n verstandige volwassene geworden.

Lieve vrienden en vriendinnen, Lisanne B, Anne Z, Sophie, Bente, Lisanne V, Lianne, Emmy, Maxim, Yvonne, Margot, Josephine, Anne dB, Tim, Alissa, Annet, Merel, Mirjam, Katja en Nicolette dank voor jullie gezelligheid de afgelopen jaren en alle steun gedurende dit promotietraject. Claar, je bent mijn oudste vriendin. We hebben samen veel beleeft en meegemaakt, en ik vind het heel tof om ceremoniemeester te mogen zijn op jouw huwelijk komend jaar.

Lieve Jelle, je bent een ontzettende baksteen (technisch ingesteld persoon), en mijn rots in de branding. Jouw nuchterheid, humor en steun hebben de afgelopen vijf jaar van mijn leven veel voor mij betekend. Je bent zelf een echte wetenschapper en ik weet zeker dat je jouw eigen proefschrift, hopelijk binnenkort, met verve zal verdedigen. Ik geloof in je. Dank voor alles.

Over de auteur

Marthe Elisabeth Ribbink werd op 21 september 1992 geboren in Amsterdam. Zij groeide op in Bussum en ging naar het Gemeentelijk Gymnasium in Hilversum. In 2011 werd zij toegelaten tot de opleiding geneeskunde aan de Universiteit van Amsterdam. Zij studeerde in 2014 een semester in de Verenigde Staten, aan de University of Washington in Seattle. Tijdens haar coschappen volgde Marthe een nieuw honoursprogramma dat door studenten werd vormgegeven: het Mastertraject. Zij liep haar wetenschappelijke stage bij de Hospital-ADL studie onder leiding van prof. Bianca Buurman. Deze stage mondde in 2018 uit in een promotietraject bij de afdeling ouderengeneeskunde van het Amsterdam UMC, locatie AMC. In 2019 liep zij stage bij de REFiT (Research on Aging, Frailty and Care Transitions) onderzoeksgroep van prof. Marco Inzitari in Barcelona. Marthe werkt sinds februari 2022 als basisarts in de WijkKliniek van Cordaan.

De betovergrootvader van de auteur, dr. H.C.G.L Ribbink (1865-1939) studeerde geneeskunde aan de Universiteit van Amsterdam. Op 18 maart 1892 promoveerde hij aan de Universiteit van Amsterdam op het proefschrift getiteld: 'Een geval van albumosurie'. Hij werkte als huisarts te Rotterdam. Op 18 maart 1992 organiseerden zijn nazaten een bijeenkomst ter gelegenheid van zijn promotie 100 jaar eerder.