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# BMJ Open

## Evaluating an acute geriatric community hospital for older adults in a prospective cohort study compared with two historical control groups: a study protocol

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3 1 **Evaluating an acute geriatric community hospital for older adults in a prospective cohort study**  
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5 2 **compared with two historical control groups: a study protocol**  
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33 **Keywords:** geriatric medicine, older adults, community hospital, intermediate care facilities,  
34 readmissions, functional decline.

For peer review only

## 53 Abstract

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

61 **Methods and analysis:** This prospective cohort study compared with two historical control groups  
62 will investigate the effectiveness of care delivery at the AGCH on patient outcomes, by comparing  
63 AGCH patients to hospital patients. Propensity score matching will correct for potential population  
64 differences. The primary outcome is the three month unplanned readmission rate. Secondary  
65 outcomes include: functional decline, institutionalization, healthcare utilization, occurrence of  
66 delirium or a fall, health-related quality of life, mortality and patient satisfaction. Measurements will  
67 be conducted at admission, discharge and one, three and six months after discharge. Furthermore,  
68 an economic evaluation and qualitative process evaluation to assess facilitators and barriers for  
69 implementation is planned.

70 **Ethics and dissemination:** The study will be conducted according to the Declaration of Helsinki. The  
71 Medical Ethics Research Committee (METC) confirmed that the Medical Research Involving Human  
72 Subjects Act did not apply to this research project and official approval was not required. The  
73 findings of this study will be disseminated through academic and public lectures, scientific  
74 conferences and in peer-reviewed journals. Furthermore, the findings of this study will aid in the  
75 implementation and financing of this concept (inter)nationally.

76 **Trial Registration Number** NL7896; pre-results

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79 **Strengths and limitations of this study:**

- 80 - The strengths of this proposed study include: a mixed-methods evaluation of hospital, patient-  
81 reported and economic outcomes; aiming to evaluate this complex intervention versus care as  
82 usual.
- 83 - Further strengths involve including patients and informal caregivers in the design, financing and  
84 implementation of the Acute Geriatric Community Hospital.
- 85 - Limitations associated with the design include: selection of appropriate controls from the two  
86 historic cohorts, potential follow-up response rates to the questionnaires (conducted by  
87 telephone), organizational challenges on chart review and collecting data on readmissions.

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## 108 Introduction

### 109 *Background*

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

116 Many older adults come to the hospital with complex and atypical health problems.<sup>5,7</sup> When older  
117 persons are subsequently hospitalized, health outcomes are known to be poor,<sup>8</sup> particularly in  
118 patients with geriatric syndromes such as cognitive impairment or mobility impairment.<sup>9,10</sup> For  
119 example, previous research showed that 30% of older persons gained new disabilities and 20% were  
120 readmitted within 30 days postdischarge.<sup>11,12</sup> Hospitalization itself may contribute to these poor  
121 outcomes as hospital older adult inpatients often have reduced mobility while bedbound for  
122 approximately 20 hours daily.<sup>13,14</sup> Low physical activity, in combination with poor nourishment and  
123 increased caloric demand due to acute illness can lead to loss of muscle mass and may contribute to  
124 the development of new disabilities, particularly in frail patients.<sup>15,16</sup> Together with noise in a hospital  
125 environment and different personnel rotating through patient rooms, this contributes to sensory  
126 overstimulation and sleep deprivation, which may lead to confusion and the occurrence of  
127 delirium.<sup>17,18,19</sup> Not only is the patient affected during hospitalization, informal caregivers also find  
128 hospital admissions stressful.<sup>20</sup> Furthermore, previous research showed that lack of discharge  
129 planning in the hospital can result in the care needs of patients being unmet.<sup>21</sup> Hospital care as usual  
130 compared to discharge planning and follow-up showed an increased on early readmissions.<sup>22</sup>  
131 Readmissions can further effect patients recovery and increase healthcare costs.<sup>23</sup>



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3 132 The complex medical needs of older persons, combined with their more dependent social situation  
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5 133 requires care delivery that offers guidance and support of realistic health and life goals.<sup>24</sup> Perhaps a  
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7 134 'gap' exists between what care can be provided in hospital, that is specialist care, with a focus on  
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9 135 medical treatment and diagnostics, versus what can be provided in the community, that is primary  
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11 136 care focused on rehabilitation, nursing care and wellbeing.  
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15 137 Several alternative strategies to hospital admission and (nurse-led) intermediate care have been  
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17 138 developed in the past as a substitute to conventional hospitalization.<sup>25</sup> Examples include (nurse-led)  
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19 139 intermediate care and subacute geriatric care units, low-tech but with geriatric expertise.<sup>26,27</sup> In  
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21 140 general, these types of care have comparable outcomes to hospital care as usual. Moreover, nurse-  
22  
23 141 led care in the US, observation units and hospital at home care all showed a cost reduction compared  
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25 142 to care as usual.<sup>25,26</sup> Until recently, the Netherlands however, had limited alternatives to  
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27 143 hospitalization for older persons who required acute care. Therefore, our research group sought to  
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29 144 create an acute care alternative and opened the Acute Geriatric Community Care Hospital (AGCH) in  
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31 145 July 2018, partnering with an academic hospital, an insurance company and a home care agency.  
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33 146 This acute geriatric care unit, which is based within an intermediate care facility, provides an  
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35 147 alternative to conventional hospitalization and delivers acute care closer to home.  
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40 148 The AGCH delivers hospital care that is focused on early mobilization and rehabilitation. Older  
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42 149 persons with common medical problems (such as urinary tract infections, pneumonia or heart  
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44 150 failure) and geriatric syndromes requiring hospital admission can be admitted to the AGCH. The  
45  
46 151 AGCH provides a form of *intermediate* care between primary and secondary care. In the Netherlands,  
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48 152 primary care includes general practice, community nursing and (temporary) admission to nursing  
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50 153 home. Secondary care includes medical specialist care and hospital admission. Care is supervised by a  
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52 154 geriatrician and provided by nurses trained in geriatric care who have experience as either a hospital  
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54 155 or community nurse. The rooms are designed to accommodate respite for the informal caregivers.  
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3 156 Our hypothesis is that with the provision of integrated medical and nursing care close to home, the  
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5 157 AGCH is better suited to the needs of older adults with multiple chronic conditions and will lead to  
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7 158 better patient health outcomes and reduced post-acute care costs. Therefore, this study is designed  
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10 159 to compare care provided for older patients in the AGCH versus care provided in a hospital setting.

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12 160 Specifically we aim to:

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15 161 ➤ Evaluate the 90-day readmission rate of patients acutely admitted to AGCH compared to  
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17 162 patients admitted a traditional hospital (usual care). Secondary outcomes include: functional  
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19 163 decline, institutionalization, healthcare utilization, the occurrence of geriatric syndromes such  
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21  
22 164 as delirium, health-related quality of life, mortality, and patient satisfaction;
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24 165 ➤ Assess the cost-effectiveness of the AGCH versus usual care by performing an economic  
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26 166 evaluation from a health care provider and societal perspective;
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28 167 ➤ Conduct a process evaluation using interviews with key stakeholders to identify facilitators  
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30 168 and barriers to the implementation of the AGCH.

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36 170 Methods

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39 171 *Setting*

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41 172 The Acute Geriatric Community Hospital opened in July 2018. It serves both the south-eastern part of  
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43 173 Amsterdam and its surrounding areas (an area with approximately 147 500 inhabitants).<sup>28</sup> The AGCH  
44  
45 174 is a 20 -bed facility within an skilled nursing facility. The hospital has 24-hour geriatric and nursing  
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47 175 assistance, physiotherapy and routine laboratory testing during the workweek and simple x-ray  
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49 176 available once a week. The population that is eligible for admission to the AGCH includes patients  
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51 177 with 1) acute medical problems requiring hospitalization (e.g. pneumonia, exacerbation of heart  
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53 178 failure or an urinary tract infection) 2) geriatric conditions (e.g. delirium, cognitive impairment, falls,  
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55 179 functional impairment), who are 3) hemodynamically stable and 4) not in need of complex diagnostic  
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59 180 testing. In general, patients will not be admitted if they: 1) require care that can only be provided at  
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3 181 an intensive care unit 2) require surgery 3) require urgent treatments or diagnostic tests that can  
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5 182 only be provided in-hospital (e.g. endoscopy, interventional radiology) 4) do not need hospital care,  
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7 183 but require transfer to a skilled nursing facility and 5) live in another region of the Netherlands.  
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10 184 Patients are directly admitted to the AGCH from the emergency department (ED) of the Amsterdam  
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12 185 UMC- location Academic Medical Centre (AMC) in Amsterdam which is a 1000-bed academic hospital  
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14 186 with approximately 30,000 ED visits yearly. After the on-call geriatrician has assessed that patient is  
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16 187 eligible for AGCH admission and the patient or representative has agreed to admission, the patient is  
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18 188 transferred to the AGCH by ambulance. Patients are admitted between 8.00 am and 11.00 pm, 7  
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20 189 days a week. At admission, a Comprehensive Geriatric Assessment (CGA) is conducted.<sup>29</sup> The CGA  
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22 190 gives an overview of all medical, functional, psychological and social problems that are discussed  
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24 191 during multidisciplinary team meetings and are used to formulate a care plan for each patient.  
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### 193 *Study design*

194 This study is a prospective, observational, cohort study with two historical control groups to evaluate  
195 the clinical and economic effects of the AGCH. The STROBE statement was used in preparing the  
196 study protocol.<sup>30</sup> Participants will be compared to hospital controls. The participants are recruited  
197 into the study and are assessed at admission, discharge, one month, three and six months after  
198 discharge. The recruitment phase of this study started in February 2019. We plan to recruit for 18 to  
199 24 months. The first three months of data collection will consist of a piloting phase to assess the  
200 feasibility of data-collection and follow-up. Moreover, we will assess the level of implementation of  
201 the AGCH care program alongside our investigation (see box 1). In addition, a qualitative process  
202 evaluation for the study on facilitators and barriers of the implementation of the AGCH will be  
203 conducted.

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## 206 *Participants*

207 Patients admitted to the AGCH are eligible for inclusion to the study. However, patients are excluded  
208 from the study if: 1) the attending physician judges that the patient is too ill to participate e.g. is  
209 terminally ill 2) the patient or legal representative does not consent to participate. 3) the patient or  
210 legal representative does not speak or understand Dutch or English. In the case of cognitively  
211 impaired or delirious patients, patients can only be included if a legal representative consents to  
212 participation and participates on their behalf. Cognitive functioning or the presence of delirium is  
213 assessed by the attending physician and confirmed by the researcher by conducting a Mini Mental  
214 State Exam (MMSE). A MMSE score of 15 or less indicates severe cognitive impairment, in which the  
215 approval of a legal representative will be sought.<sup>31</sup>

## 217 *Historical control groups*

218 The first control group from the Transitional Care Bridge Study consists of 674 patients that were  
219 recruited between September 2010 and March 2014 originating from the greater Amsterdam area in  
220 the Netherlands.<sup>32</sup> Participants were patients of 65 years and older admitted for at least 48 hours to  
221 an internal medicine ward. Proxy consent was provided for participants suffering from severe  
222 cognitive impairment: Mini Mental State Exam<sup>31</sup> (MMSE)  $\leq 15$ . They participated in a negative  
223 randomized controlled trial that assessed the effectiveness of a nurse-led transitional care program  
224 in preventing functional decline.<sup>32</sup>

225 The second control group (Hospital-ADL study<sup>10</sup>) consists of 401 patients that were recruited  
226 between October 2015 and June 2017 also originating from the greater Amsterdam area. These  
227 participants were enrolled in a prospective cohort studying the trajectory of functional decline in  
228 older hospitalized adults. Participants were aged 70 years and older, hospitalized for at least 48  
229 hours. Patients suffering from severe cognitive impairment (MMSE  $\leq 15$ ) and delirium were excluded  
230 from participation.

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3 231 *Patient and public involvement*  
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6 232 Older persons living in the Amsterdam area were involved in the design of the AGCH concept. There  
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8 233 was no patient involvement in the design of this study.  
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13 235 *Outcomes*  
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15 236 The primary outcome measure is the 3-month unplanned readmission rate to the AGCH or hospital.

16 237 Secondary outcomes measured at 1,3 and 6 months will include:

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18 238 1) ADL-functioning as defined by the KATZ-ADL scale.<sup>33</sup>  
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20 239 2) Healthcare utilization, including institutionalization in a long-term care facility.  
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22 240 3) Occurrence of delirium and/or falls.  
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24 241 4) Health-related quality of life (HRQoL).<sup>34</sup>  
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26 242 5) All-cause mortality.  
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28 243 6) Satisfaction of patients and primary care givers with the care provided.  
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35 245 *Data collection*  
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39 246 Eligible patients and/or legal representatives will be contacted and informed about the study  
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41 247 procedures after which written informed consent is obtained. Inclusion and interviewing of patients  
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43 248 is conducted by an onsite researcher. Routine data on functioning and risk assessments are collected  
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45 249 by a trained registered nurse and physiotherapist as part of the CGA for each patient.<sup>35</sup> Table 1 gives  
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47 250 an overview of measurement of primary and secondary outcomes over time. Measurements during  
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49 251 admission are at H1 which is within 48 hours after admission and H2 which is within 48 hours before  
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51 252 discharge. Follow-up is completed by telephone at 1,3 and 6 months after discharge (P1, P3 and P6).  
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55 253 Data collection includes:  
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58 254 1. Medical and demographical data  
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3 255 *Sociodemographic data.* These will include age, gender, highest level of education, ethnicity, marital  
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5 256 status and living arrangement.  
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8 257 *Time spent at the ED, admission diagnosis, date and time of admission.*  
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11 258 *Chronic conditions.* The number and severity of chronic conditions will be assessed using the Charlson  
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13 259 Comorbidity Index.<sup>36</sup> This index is commonly used to indicate the risk of mortality; each condition is  
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16 260 scored 1, 2, 3 or 6 points, with a higher total number of points indicating a greater risk at death.  
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19 261 *Polypharmacy.* Polypharmacy will be assessed by counting the number of individual drugs that are  
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21 262 chronically prescribed to a participant, in which a number of 5 or more drugs is considered  
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23 263 polypharmacy.  
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26 264 *Mortality.* This will be assessed during follow-up, where possible by reporting from patients electronic  
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28 265 files, otherwise from registries of the general practitioner.  
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32 266 2. Cognitive functioning.  
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35 267 *Cognitive impairment.* This will be assessed by reviewing the score of the Mini Mental State Exam  
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37 268 (MMSE) that is performed within 48 hours of admission. The MMSE includes 23 items (total score 0-  
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39 269 30) that screen for cognitive impairment. A score of 23 or less is defined as possible cognitive  
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41 270 impairment.<sup>31</sup>  
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44 271 *Delirium.* The Confusion Assessment Method (CAM), the short 4 item version, is used to assess the  
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46 272 presence and duration of delirium.<sup>37</sup> The CAM is widely used by physician and nurse practitioners to  
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48 273 diagnose delirium (sensitivity of 53-90% and specificity of 84-100%).<sup>38</sup> It consists of four items: 1)  
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50 274 presence of acute onset and fluctuation 2) inattention 3) disorganized thinking and 4) altered level of  
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52 275 consciousness.<sup>37</sup> The CAM is filled out within 24 hours of admission. Moreover, the risk on  
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54 276 developing delirium is assessed using the Dutch VMS criteria for risk on delirium.<sup>39</sup> Nurse  
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56 277 practitioners will score the CAM daily from day 1 till day 8 of admission, if there are signs of possible  
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3 278 delirium at day 8, these measurements are continued until discharge. In addition, during the first  
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5 279 three days of admission the Delirium Observation Screening Scale (DOSS) is scored during each  
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7 280 nursing shift and is continued when there is a clinical suspicion of delirium.<sup>40</sup>  
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### 10 281 3. Psychosocial functioning and quality of life

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13 282 *Apathy.* We use three items of the *Geriatric Depression Scale* (GDS-15) to assess apathy (sensitivity of  
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15 283 69% and specificity of 85 %). These items include the following questions: 1) 'Do you prefer to stay at  
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17 284 home, rather than going out and doing new things' 2) 'Have you dropped many of your activities and  
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19 285 interests?' And 3) 'Do you feel full of energy'. A score of >2 points is classified as 'apathy present'.<sup>41</sup>  
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23 286 *Social network and informal care.* Participants are asked if they receive informal care, how many  
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25 287 hours a week, what type of care (housekeeping and/or personal care) and from which persons  
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27 288 (partners, children, other family members or neighbours/volunteers).  
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31 289 *Health-Related Quality of Life.* This will be measured by determining Health-Related Quality of Life  
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33 290 using the EuroQoL-5D (EQ-5D). The EQ-5D is a broadly used and validated instrument for measuring  
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35 291 generic health-related quality of life.<sup>34</sup> It consists of 5 dimensions: 1) mobility 2) self-care 3) usual  
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37 292 activities 4) pain/discomfort 5) anxiety/depression. We will use the EQ-5D-3L which has three  
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39 293 options: no problems, some problems or severe problems. In addition, the following questions will  
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41 294 be used to assess self-reported quality of life: 1) How would you rate your quality of life in general ?  
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43 295 (excellent, very good, good, moderate, bad) 2) How would you rate your quality of life in general at  
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45 296 this time compared to 6 months ago? (much better, somewhat better, more or less the same,  
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47 297 somewhat worse, much worse) 3) How would you grade your life at this moment, with a range  
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49 298 between 0 and a 100? <sup>42</sup>  
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### 54 299 4. Physical functioning

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3 300 *Risk of functional decline.* Patients are assessed for risk of functional decline using the Identification  
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5 301 of Seniors at Risk- Hospitalized patients (ISAR-HP), scores of two and up indicate at an increased risk  
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7 302 for functional decline.<sup>43</sup>  
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10 303 *Functioning level.* The 15-item modified KATZ score is used to measure Activities of Daily Living (ADL)-  
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12 304 functioning. This included assessment of performance in basic ADL- KATZ-6), as in instrumental ADL  
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14 305 (KATZ-9).<sup>44,45</sup> We measure KATZ-score both currently (at admission), as two weeks before admission,  
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16 306 reflecting pre-morbid level of functioning. (I)ADL-functional is also included in follow-up  
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18 307 measurements.  
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22 308 *(Im)mobility.* We will assess mobility by reviewing three questions that are in the admission  
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24 309 assessment regarding: 1) use of a walking aid (from KATZ-15), and from the CGA: 2) being able to  
25  
26 310 walk outside of the house for five minutes (two weeks before and currently) and 3) performing, and  
27  
28 311 frequency of, physical activity.<sup>46</sup>  
29  
30  
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32 312 *Handgrip strength.* Physiotherapists measure muscle weakness in all admitted patients using  
33  
34 313 maximum handgrip strength (JAMAR).<sup>47</sup>  
35  
36

37 314 *Gait speed.* Gait speed is measured as part of the Short Physical Performance Battery (SPBB) that is  
38  
39 315 part of the physiotherapist' admission assessment.<sup>48</sup>  
40  
41

42 316 *Falls.* Fall history is assessed by asking the number of falls in the past six months, if yes, how many  
43  
44 317 times did you fall?<sup>39</sup> During the discharge assessment the occurrence of falls in the AGCH and the  
45  
46 318 consequences of falls (indication for prolonged stay, diagnostics or injury) are recorded.  
47  
48

49 319 *Fear of falling.* We will use a Numeric Rating Scale (NRS, score 0-10) to assess fear of falling, 0  
50  
51 320 indicates no fear of falling, and 10 the greatest fear of falling possible.<sup>49</sup>  
52  
53

54 321 *Pain.* Widely used in clinical practice the standard for pain assessment is the Numeric Rating Scale,  
55  
56 322 ranging from 0 to 10, in which a score of 0 represents no pain and 10 represents the worst possible  
57  
58 323 pain.<sup>50</sup>  
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3 324 *Fatigue.* A Numeric Rating Scale from 0-10 is used, 0 indicating no fatigue and 10 indicating the  
4  
5 325 greatest fatigue ever felt by the participant.<sup>51</sup>  
6  
7

8 326 *Sleep.* Participants are asked if there have been difficulties with sleeping in the past month and  
9  
10 327 whether participants have used sleep medication.  
11  
12

13 328 *Nutrition.* We will use the Short Nutritional Assessment Questionnaire (SNAQ) for identifying  
14  
15 329 malnourished patients. The SNAQ consists of three questions on weight loss, appetite and drink/tube  
16  
17 330 nutrition, resulting in a score ranging from 0 to 5. 0 and 1 are defined as 'no malnutrition' 2 as  
18  
19 331 'moderate malnutrition' and 3 or more as 'severe malnutrition'.<sup>52</sup>  
20  
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22

23 332 5. Healthcare utilization and satisfaction with care  
24  
25

26 333 *Medical care during admission and process of discharge.* The following are collected from patient  
27  
28 334 electronic health records: the diagnostics performed in the AGCH, revisits to the hospital, admission  
29  
30 335 to the hospital, length of stay of the AGCH, discharge destination and time needed to send medical  
31  
32 336 handovers to the general practitioner.  
33  
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35

36 337 *Hospital readmission.* This outcome will be assessed during follow-up. Follow-up will consist of three  
37  
38 338 telephone interviews at 1, 3 and 6 months after discharge. Readmission will be both assessed by  
39  
40 339 interview as by checking care data from an aggregated database of expense claims of various  
41  
42 340 healthcare insurers. Data that will be collected are: number of readmissions, total days of  
43  
44 341 readmission, reasons for readmission and whether the readmission was planned or unplanned.  
45  
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48 342 *Emergency department (ED) visits.* ED visits will be assessed during follow-up and checked in  
49  
50 343 insurance data, we will record the number of separate ED visits.  
51  
52

53 344 *Outpatient hospital visits.* We will ask patients if there have been any outpatient visits in the past  
54  
55 345 month(s), and if so how many.  
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3 346 *Consultations by general practitioner.* We will ask patients if there have been any consultations by  
4  
5 347 the general practitioner (both during the day as during out-of-office hours) visits in the past  
6  
7 348 month(s), and if so how many.  
8  
9

10 349 *Consultations by physiotherapist or dietician.* We will ask patients if there have been any  
11  
12 350 consultations by a physiotherapist or dietician in the past month(s), and if so how many.  
13  
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15  
16 351 *Home care.* This includes questions on frequency of home care, including housekeeping, personal  
17  
18 352 care and nursing care. We will also include days of day care and hours of informal care provided by  
19  
20 353 family members or friends.  
21  
22

23 354 *Temporary admission to a nursing home.* Days of (temporary) admission to a skilled nursing facility or  
24  
25 355 rehabilitation facility.  
26  
27

28  
29 356 *Permanent Institutionalization.* This concerns long-term admission to a skilled nursing facility and  
30  
31 357 date of admission to this facility.  
32  
33

34 358 *Patient satisfaction with care.* Patients or informal caregivers are asked to fill out an 8-question  
35  
36 359 questionnaire regarding their satisfaction with the care that they received. Questions are answered  
37  
38 360 on a 5- level Likert scale.<sup>53</sup>  
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41 361

### 42 362 *Sample Size calculation*

43  
44  
45 363 The dataset of the transitional care bridge includes data of 674 patients of conventionally  
46  
47 364 hospitalized; approximately 26% experienced a readmission at 90 days.<sup>32</sup> Assuming that 19% of  
48  
49 365 patients admitted to the AGCH will experience a 90 day readmission, data from 523 patients of AGCH  
50  
51 366 will give us 80% power to detect an absolute difference of 7% in readmission rate (which is a 27%  
52  
53 367 reduction in relative risk) using a two-sided Fisher's Exact Test with an alpha of 0.05. As we expect  
54  
55 368 10% loss to follow-up, we will aim to include a total of 576 (= 523\*1.1) patients from the AGCH.  
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### 369 *Planned statistical analysis*

370 The participant flow diagram according to the STROBE guidelines will show a summary of admissions  
371 and study recruitment at the AGCH and will provide study discontinuation rates at 1, 3 and 6 months  
372 follow-up.<sup>30</sup> We will describe demographic, clinical and prognostic characteristics of the study  
373 participants at baseline. The number of participants with missing data will be collected and described  
374 alongside our variables to check for the pattern of missingness. Inversely-weighted propensity scores  
375 will be used to control for any imbalances between the treatment groups.<sup>54</sup> Propensity scores will be  
376 calculated using generalized booted methods. Balance and overlap of propensity scores distribution  
377 will be assessed. Propensity score weights for the estimation of the average treatment effect will be  
378 created using all covariates where groups differed on baseline or that were associated with 90-day  
379 readmission rate. As this is a repeated measures design, we will assume equal weighting for all  
380 measurements.<sup>55</sup>

381 All hypotheses will be tested using two-tailed- significance level of 0.05. Descriptive analyses will be  
382 performed to examine participant's characteristics. Differences in changes over time in outcomes will  
383 be compared between groups using multilevel models. All models will include a main effect of  
384 treatment group, a linear term for time and an interaction between time and treatment group.  
385 Models will be checked with residual and appropriate goodness-of-fit statistics.

386

### 387 *Economic evaluation*

388 A healthcare and societal perspective is planned for this economic evaluation.<sup>56</sup> The evaluation from  
389 the healthcare perspective will only include direct medical costs accrued in the six months after the  
390 admission to the AGCH. Propensity scores will also be used in the economic evaluation. Missing data  
391 will be imputed using multiple imputation chained equations if necessary, for cost and effect data.  
392 We plan to use generalized linear regression models with a gamma distribution and an identity link  
393 to account for the right skew of cost data. A generalized linear regression model will be used to

1  
2  
3 394 estimate the incremental effect in quality adjusted life years (QALYs) adjusted for baseline utility  
4  
5 395 estimates with a Gaussian distribution and identify link.<sup>57</sup> Incremental cost-effectiveness ratios will  
6  
7 396 be calculated using the pooled cost and effect estimates. Bootstrapped cost-effect pairs will be  
8  
9 397 plotted on a cost-effectiveness plane and used to estimate cost-effectiveness acceptability curves.<sup>58</sup>  
10  
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12 398

### 13 14 399 *Process evaluation; adherence, barriers and facilitators to implementation.*

15  
16  
17 400 We plan to use a qualitative study design to describe barriers and facilitators to implementation of  
18  
19 401 the AGCH. This will include semi-structured interviews with various stakeholders, emergency  
20  
21 402 department staff, geriatricians, nurses, physiotherapists, discharge nurses, home care, hospital  
22  
23 403 administrators, and insurance companies. We will assess barriers and facilitators to implementation  
24  
25 404 at different levels: micro (healthcare professionals), meso (care organizations) and macro level (legal  
26  
27 405 and financial framework). Interviews will be typed verbatim and analysed by two researchers  
28  
29 406 independently, using thematic analysis.<sup>59</sup> The findings will be summarized in matrices with facilitators  
30  
31 407 and barriers at different levels (micro, meso, macro) to develop a guideline for implementation of the  
32  
33 408 AGCH elsewhere.<sup>60</sup>  
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### 38 409 Discussion

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41 410 The complex acute medical needs of older patients require the delivery of specialized geriatric care,  
42  
43 411 however the traditional hospital environment may not support recovery and maintaining  
44  
45 412 independence. The AGCH aims to deliver care that focusses both on medical treatment, early  
46  
47 413 rehabilitation and proper transitions of care for older adults with multiple chronic conditions.<sup>29,61</sup> The  
48  
49 414 AGCH is unique in the Netherlands in its aim to combine multiple evidenced-based components of  
50  
51 415 care for frail older persons in an alternative location for hospital care. The proposed research will  
52  
53 416 provide insight into the clinical and economic effectiveness of care delivered at the AGCH, compared  
54  
55 417 to hospital care. Limitations to the design are that it is non-randomized study and that historic  
56  
57 418 cohorts are used as control groups. Strengths are that patients and informal caregivers were  
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3 419 involved in the design of the concept of the AGCH. Moreover, a process evaluation will address the  
4  
5 420 barriers and facilitators to implementation of a community hospital such as the AGCH in the existing  
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7 421 health care system of the Netherlands. This research will provide valuable insights into the  
8  
9 422 implementation of this concept of care in other regions of the Netherlands and abroad.  
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### 13 423 Ethics and Dissemination

14  
15  
16 424 This trial will be carried out in accordance with the declaration of Helsinki and current ethical  
17  
18 425 requirements. The Medical Ethics Research Committee (METC) confirmed that the Medical Research  
19  
20 426 Involving Human Subjects Act did not apply to this research project and official approval was not  
21  
22 427 required. The outcomes of this trial will be reported according to STROBE guidelines for cohort  
23  
24 428 studies.<sup>30</sup> This study will evaluate both the effectiveness of this type of care delivery as of the costs  
25  
26 429 that are involved, allowing for implementation elsewhere. The findings of this study will be published  
27  
28 430 in peer-reviewed journals.  
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32 431

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#### 41 437 Author contributions

42 438 MER, JMV and RS contributed to the design of the protocol and drafting of the manuscript. IO and  
43 439 BMB made substantial contributions to the design and clinical aspects of the of the protocol. BMB  
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45 441 approved the final version of this manuscript.  
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48

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57 449

#### 58 450 Patient consent

59 451 Not required.

60 452

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3 453 Competing interests statement- None Declared

4 454 Ethics approval –The Medical Ethics Research Committee (METC) of the Amsterdam University  
5 455 Medical Centres, location Amsterdam Medical Centre (AMC) confirmed that the Medical Research  
6 456 Involving Human Subjects Act did not apply to this research project and official approval was not  
7 457 required, January 2019. (ref W17\_474 # 19.001)

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3 **Box 1** - Components of Acute Geriatric Care (AGCH) Hospital intervention and goals  
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6 1) Patients receive a full CGA work-up and interdisciplinary assessment, including physiotherapy  
7 treatment plan.  
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10 2) There is special attention paid to discharge and follow-up planning; if needed, patients are seen  
11 post-discharge at the outpatient clinic or through a community nurse. Community nurses receive  
12 warm-handovers from AGCH staff.<sup>62</sup>  
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15 3) 50% of discharge letters are sent to the general practitioner within 24 hours after the patient is  
16 discharged.<sup>63,64</sup>  
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**Table 1** Overview of the content and description of (outcome) measurements and timing of measurements at the Acute Community Care Hospital ('WijkKliniek')

	Description and/or instrument	H1	H2	P1	P3	P6
<i>1. Medical and demographical data</i>						
<b>Sociodemographic data</b>	Date of birth, age at admission, sex, level of education, living conditions, marital state	R				
<b>Data on admission</b>	Time spent at the ED, admission diagnosis, date and time of admission	R				
<b>Chronic conditions</b>	Charlson Comorbidity index <sup>36</sup>	R				
<b>Polypharmacy</b>	Number of drugs <sup>65</sup>	R				
<b>Mortality</b>	Date of death		R	R	R	R
<i>2. Cognitive functioning</i>						
<b>Cognitive impairment</b>	Mini Mental State Exam (MMSE) <sup>31</sup>	R				
<b>Delirium</b>	Safety management system patient screening (VMS) <sup>39</sup> Confusion Assessment Method (CAM) <sup>37</sup> Delirium Observation Scale (DOS) <sup>40</sup>	N/ D	N/ D			
<i>3. Psychosocial functioning and quality of life</i>						
<b>Apathy</b>	Geriatric Depression Scale (GDS-3) <sup>41</sup>	N	R	R	R	R
<b>Social network and informal care</b>	Presence and frequency of informal care	R		R	R	R
<b>Quality of life and health status</b>	EQ-5D-3L <sup>34</sup>	R		R	R	R
<i>4. Physical functioning</i>						
<b>Identifying at-risk-patients</b>	ISAR-HP- Identifying Seniors at Risk score <sup>43</sup>	N				
<b>Functional status</b>	Activities of daily Living (ADL) modified Katz-ADL score <sup>33</sup>	N				
<b>(Im)mobility</b>	Using walking aid, information in KATZ-15 questions on exercise	N				
<b>Handgrip strength</b>	Jamar <sup>47</sup>	P				
<b>Gait speed</b>	Short Physical Performance Battery SPPB <sup>48</sup>	P				
<b>Falling</b>	Fall history Falls in the AGCH	N	R	R	R	R
	Numeric Rating scale (NRS) fear of falling <sup>49</sup>	N	R	R	R	R
<b>Pain</b>	Numeric Rating Scale (NRS) pain <sup>50</sup>	N	R	R	R	R
<b>Fatigue</b>	Numeric Rating Scale (NRS) fatigue <sup>51</sup>	N	R	R	R	R
<b>Nutrition</b>	Short Nutritional Assessment Questionnaire (SNAQ- Score) <sup>52</sup>	N				
<i>5. Healthcare utilization and satisfaction with care</i>						
<b>Medical care during admission</b>	Diagnostics performed in the AGCH Readmission to university hospital Length of stay at the AGCH		R			
<b>Hospital readmission</b>	Readmission rate to the hospital or AGCH		R	R	R	R

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<b>Health care utilization</b>	Home care, medical specialist care, temporary institutional care, primary care.	R		R	R	R
<b>Satisfaction with Care</b>	8 question questionnaire <sup>53</sup>		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

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

	Item No	Recommendation
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found
<b>Introduction</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
<b>Methods</b>		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
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
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses
<b>Results</b>		
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 (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)
Outcome data	15*	Report numbers of outcome events or summary measures over time
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 (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period

1	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and
2			sensitivity analyses
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4	<b>Discussion</b>		
5	Key results	18	Summarise key results with reference to study objectives
6	Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or
7			imprecision. Discuss both direction and magnitude of any potential bias
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9	Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations,
10			multiplicity of analyses, results from similar studies, and other relevant evidence
11	Generalisability	21	Discuss the generalisability (external validity) of the study results
12			
13	<b>Other information</b>		
14	Funding	22	Give the source of funding and the role of the funders for the present study and, if
15			applicable, for the original study on which the present article is based
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18 \*Give information separately for exposed and unexposed groups.

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

# BMJ Open

## An acute geriatric community hospital for older adults: a study protocol for a prospective controlled observational study.

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<b>Primary Subject Heading</b>:	Geriatric medicine
Secondary Subject Heading:	Health services research, Public health
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3 1 **An acute geriatric community hospital for older adults: a study protocol for a prospective**  
4 **controlled observational study.**  
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8 4 Marthe E. Ribbink MD<sup>1</sup>, Janet L. MacNeil Vroomen PhD<sup>1,2</sup>, Rosanne van Seben PhD<sup>1</sup>, Irène Oudejans  
9 MD, PhD<sup>1</sup>, Bianca M. Buurman RN, PhD<sup>1,3</sup> on behalf of the AGCH-study group.  
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35 **Keywords:** geriatric medicine, older adults, community hospital, intermediate care facilities,  
36 readmissions, functional decline.

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## 55 Abstract

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

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

72 **Ethics and dissemination:** The study will be conducted according to the Declaration of Helsinki. The  
73 Medical Ethics Research Committee (METC) confirmed that the Medical Research Involving Human  
74 Subjects Act did not apply to this research project and official approval was not required. The  
75 findings of this study will be disseminated through academic and public lectures, scientific  
76 conferences and in peer-reviewed journals. Furthermore, the findings of this study will aid in the  
77 implementation and financing of this concept (inter)nationally.

78 **Trial Registration Number** NL7896; pre-results

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81 **Strengths and limitations of this study:**

- 82 - This study will be the first to evaluate an acute geriatric community hospital in the Netherlands
- 83 on both patient reported and economic outcomes.
- 84 - Patients, informal caregivers and professionals were involved in the design, and implementation
- 85 of the Acute Geriatric Community Hospital.
- 86 - A process evaluation is planned to describe the experience of various stakeholders with this new
- 87 concept and reveal barriers and facilitators to its' implementation.
- 88 - A limitation of this study is the use of two historic cohorts as control population, as this may
- 89 result in baseline differences between the control and intervention population

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## 110 Introduction

### 111 *Background*

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

118 Many older adults come to the hospital with complex and atypical health problems.<sup>5,7</sup> When older  
119 persons are subsequently hospitalized, health outcomes are known to be poor,<sup>8</sup> particularly in  
120 patients with geriatric syndromes such as cognitive impairment or mobility impairment.<sup>9,10</sup> For  
121 example, previous research showed that 30% of older persons gained new disabilities and 20% were  
122 readmitted within 30 days postdischarge.<sup>11,12</sup> Hospitalization itself may contribute to these poor  
123 outcomes as hospitalized older adults often have reduced mobility while bedbound for  
124 approximately 20 hours daily.<sup>13,14</sup> Low physical activity, in combination with poor nourishment and  
125 increased caloric demand due to acute illness can lead to loss of muscle mass and may contribute to  
126 the development of new disabilities, particularly in frail patients.<sup>15,16</sup> Together with noise in a hospital  
127 environment and different personnel rotating through patient rooms, this contributes to sensory  
128 overstimulation and sleep deprivation, which may lead to confusion and the occurrence of  
129 delirium.<sup>17,18,19</sup> Not only is the patient affected during hospitalization, informal caregivers also find  
130 hospital admissions stressful.<sup>20</sup> Furthermore, previous research shows that lack of discharge planning  
131 in the hospital can result in the care needs of patients being unmet.<sup>21</sup> Hospital care as usual  
132 compared to discharge planning and follow-up showed an increase in early readmissions.<sup>22</sup>  
133 Readmissions can further effect patients' recovery and increase healthcare costs.<sup>23</sup>

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3 134 The complex medical needs of older persons, combined with their more dependent social situation  
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5 135 requires care delivery that offers guidance and support of realistic health and life goals.<sup>24</sup> Perhaps a  
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7 136 'gap' exists between what care can be provided in an acute care hospital, that is secondary care, with  
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10 137 a focus on medical treatment and diagnostics, versus what can be provided in the community, that is  
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12 138 primary care focused on rehabilitation, nursing care and wellbeing.

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15 139 Several alternative strategies to hospital admission and (nurse-led) intermediate care have been  
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17 140 developed in the past as a substitute to conventional hospitalization.<sup>25</sup> Examples include (nurse-led)  
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19 141 intermediate care and subacute geriatric care units, low-tech but with geriatric expertise.<sup>26,27</sup> In  
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22 142 general, these types of care have comparable outcomes to hospital care as usual. Moreover, nurse-  
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24 143 led care in the US, observation units and hospital at home care all showed a cost reduction compared  
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26 144 to care as usual.<sup>25,26</sup> Until recently, the Netherlands however, had limited alternatives to  
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29 145 hospitalization for older persons who required acute care. Therefore, our research group sought to  
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31 146 create an acute care alternative and opened the Acute Geriatric Community Care Hospital (AGCH) in  
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33 147 July 2018, partnering with an academic hospital (Amsterdam UMC, location AMC), an insurance  
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35 148 company (Zilveren Kruis) and a home care and nursing home agency (Cordaan). This acute geriatric  
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37 149 care unit, which is based within an intermediate care facility, provides an alternative to conventional  
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40 150 hospitalization and delivers acute care closer to home.

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43 151 The AGCH delivers acute care that is focused on early mobilization and rehabilitation. Older persons  
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45 152 with common medical problems (such as urinary tract infections, pneumonia or heart failure) and  
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47 153 geriatric syndromes requiring hospital admission can be admitted to the AGCH. The AGCH provides a  
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49 154 form of *intermediate* care between primary and secondary care. In the Netherlands, primary care  
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52 155 includes general practice, community nursing and (temporary) admission to nursing home.  
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54 156 Secondary care includes medical specialist care and hospital admission. Care is supervised by a  
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56 157 geriatrician and provided by nurses trained in geriatric care who have experience as either a hospital  
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58 158 or community nurse. The single rooms are designed to accommodate respite for the informal  
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3 159 caregivers. This concept of care is new to the Netherlands, to our knowledge there is only one  
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5 160 example in Europe to which it compares: a “subacute care unit” in intermediate care, which has been  
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7 161 implemented in Spain.<sup>27</sup>

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10 162 Our hypothesis is that with the provision of integrated medical and nursing care close to home, the  
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12 163 AGCH is better suited to the needs of older adults with multiple chronic conditions and will lead to  
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14 164 better patient health outcomes and reduced post-acute care costs. Therefore, this study is designed  
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16 165 to compare care provided for older patients in the AGCH versus care provided in a hospital setting.

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19 166 Specifically we aim to:

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22 167 ➤ Evaluate the 90-day readmission rate of patients acutely admitted to AGCH compared to a  
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24 168 traditional hospital (usual care). Secondary outcomes include: functional decline,  
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26 169 institutionalization, healthcare utilization, the occurrence of geriatric syndromes such as  
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28 170 delirium, health-related quality of life, mortality, and patient satisfaction;
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30 171 ➤ Assess the cost-effectiveness of the AGCH versus usual care by performing an economic  
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32 172 evaluation from a health care provider and societal perspective;
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34 173 ➤ Conduct a process evaluation using interviews with key stakeholders to identify facilitators  
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36 174 and barriers to the implementation of the AGCH.

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## 41 42 43 176 Methods

### 44 45 177 *Setting*

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48 178 The Acute Geriatric Community Hospital opened in July 2018. It serves both the south-eastern part of  
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50 179 Amsterdam and its surrounding areas (an area with approximately 147 500 inhabitants).<sup>28</sup> The AGCH  
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52 180 is a 23 -bed facility within an skilled nursing facility. The hospital has 24-hour geriatric and nursing  
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54 181 assistance, physiotherapy and routine laboratory testing during the workweek and simple x-ray  
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56 182 available once a week. The population that is eligible for admission to the AGCH includes patients  
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58 183 with 1) acute medical problems requiring hospitalization (e.g. pneumonia, exacerbation of heart  
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3 184 failure or an urinary tract infection) 2) geriatric conditions (e.g. delirium, cognitive impairment, falls,  
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5 185 functional impairment), who are 3) hemodynamically stable and 4) not in need of complex diagnostic  
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7 186 testing. In general, patients will not be admitted if they: 1) require care that can only be provided at  
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10 187 an intensive care unit 2) require surgery 3) require urgent treatments or diagnostic tests that can  
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12 188 only be provided in-hospital (e.g. endoscopy, interventional radiology) 4) do not need hospital care,  
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14 189 but require transfer to a skilled nursing facility and 5) live in another region of the Netherlands.  
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16 190 Patients are directly admitted to the AGCH from the emergency department (ED) of the Amsterdam  
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18 191 UMC- location Academic Medical Centre (AMC) in Amsterdam which is a 1000-bed academic hospital  
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20 192 with approximately 30,000 ED visits yearly. After the on-call geriatrician has assessed that patient is  
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22 193 eligible for AGCH admission and the patient or representative has agreed to admission, the patient is  
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24 194 transferred to the AGCH by ambulance. Since October 2019 patients can also be transferred from  
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26 195 EDs of other hospitals in Amsterdam. In the future we plan to admit patients from home or a General  
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28 196 Practice office. Patients are admitted between 8.00 am and 11.00 pm, 7 days a week. At admission, a  
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30 197 Comprehensive Geriatric Assessment (CGA) is conducted.<sup>29</sup> The CGA gives an overview of all medical,  
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32 198 functional, psychological and social problems that are discussed during multidisciplinary team  
33  
34 199 meetings and are used to formulate a care plan for each patient. For an overview of the admission  
35  
36 200 process, admission criteria and components of this intervention see figure 1.  
37  
38  
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41  
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43

## 44 202 *Study design*

45  
46 203 This study is a prospective, observational, cohort study with two historical control groups to evaluate  
47  
48 204 the clinical and economic effects of the AGCH. The STROBE statement was used in preparing the  
49  
50 205 study protocol.<sup>30</sup> (Appendix 1) Participants will be compared to hospital controls. The participants  
51  
52 206 are recruited into the study and are assessed at admission, discharge, one month, three and six  
53  
54 207 months after discharge. The recruitment phase of this study started in February 2019. We plan to  
55  
56 208 recruit for 18 to 24 months. The first three months of data collection will consist of a piloting phase  
57  
58 209 to assess the feasibility of data-collection and follow-up. In addition, a qualitative process evaluation  
59  
60

1  
2  
3 210 on facilitators and barriers to the implementation of the AGCH and patient experience will be  
4  
5 211 conducted.

6  
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8 212

9  
10 213 *Participants*

11  
12 214 Patients admitted to the AGCH are eligible for inclusion to the study. However, patients are excluded  
13  
14 215 from the study if: 1) the attending physician judges that the patient is too ill to participate e.g. is  
15  
16 216 terminally ill 2) the patient or legal representative does not consent to participate. 3) the patient or  
17  
18 217 legal representative does not speak or understand Dutch or English. In the case of cognitively  
19  
20 218 impaired or delirious patients, patients can only be included if a legal representative consents to  
21  
22 219 participation and acts as healthcare-proxy. Cognitive functioning is assessed by the attending  
23  
24 220 physician and confirmed by the researcher by conducting a Mini Mental State Exam (MMSE). A  
25  
26 221 MMSE score of 15 or less Indicates severe cognitive impairment, in which the approval of a legal  
27  
28 222 representative will be sought.<sup>31</sup>

29  
30  
31  
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33 223

34  
35 224 *Historical control groups*

36  
37 225 Two completed studies conducted by our research group were selected as historical control groups.  
38  
39 226 These control groups were selected based on characteristics of the participants -primary admission  
40  
41 227 diagnosis, department, area of residence- and the availability and reproductively of the data. The  
42  
43 228 first control group from the Transitional Care Bridge Study consists of 674 patients that were  
44  
45 229 recruited between September 2010 and March 2014 originating from the greater Amsterdam area in  
46  
47 230 the Netherlands.<sup>32</sup> Participants were patients of 65 years and older admitted for at least 48 hours to  
48  
49 231 an internal medicine ward. Proxy consent was provided for participants suffering from severe  
50  
51 232 cognitive impairment (Mini Mental State Exam<sup>31</sup> (MMSE)  $\leq 15$ ). They participated in a negative  
52  
53 233 randomized controlled trial that assessed the effectiveness of a nurse-led transitional care program  
54  
55 234 in preventing functional decline.<sup>32</sup> The second control group (Hospital-ADL study<sup>10</sup>) consists of 401

1  
2  
3 235 patients that were recruited between October 2015 and June 2017, also originating from the greater  
4  
5 236 Amsterdam area. These participants were enrolled in a prospective cohort studying the trajectory of  
6  
7 237 functional decline in older hospitalized adults. Participants were aged 70 years and older,  
8  
9 238 hospitalized for at least 48 hours. Patients suffering from severe cognitive impairment (MMSE  $\leq 15$ )  
10  
11 239 and delirium were excluded from participation. For the detailed methodology and inclusion criteria  
12  
13 240 of the two control cohorts we refer to the study protocols and papers of these studies.<sup>10,32-34</sup>  
14  
15  
16  
17 241

### 18 19 242 *Patient and public involvement*

20  
21 243 Older persons living in Amsterdam were involved in the design of the AGCH concept. There was no  
22  
23 244 patient involvement in the design of this study.  
24  
25

### 26 245 27 28 246 *Outcomes*

29  
30  
31 247 The primary outcome measure is the 3-month unplanned readmission rate to the AGCH or hospital.

32  
33 248 Secondary outcomes measured at 1,3 and 6 months will include:

- 34  
35 249 1) ADL-functioning as defined by the KATZ-ADL scale.<sup>35</sup>  
36  
37 250 2) Healthcare utilization, including institutionalization in a long-term care facility.  
38  
39 251 3) Occurrence of delirium and/or falls.  
40  
41 252 4) Health-related quality of life (HRQoL).<sup>36</sup>  
42  
43 253 5) All-cause mortality.  
44  
45 254 6) Satisfaction of patients and primary care givers with the care provided.  
46  
47  
48

49 255

### 50 51 256 *Data collection*

52  
53  
54  
55 257 Eligible patients and/or legal representatives will be contacted and informed about the study

56  
57 258 procedures after which written informed consent is obtained. Inclusion and interviewing of patients

58  
59 259 is conducted by an onsite researcher. Routine data on functioning and risk assessments are collected  
60

1  
2  
3 260 by a trained registered nurse and physiotherapist as part of the CGA for each patient.<sup>37</sup> Table 1 gives  
4  
5 261 an overview of measurement of primary and secondary outcomes over time. These measurements  
6  
7 262 were chosen based on the assessments and data collected from the two historic control groups.  
8  
9  
10 263 Measurements during admission are at H1 which is within 48 hours after admission and H2 which is  
11  
12 264 within 48 hours before discharge. Follow-up is completed by telephone at 1,3 and 6 months after  
13  
14 265 discharge (P1, P3 and P6).

15  
16  
17 266 Data collection includes:

18  
19  
20 267 1. Medical and demographical data

21  
22  
23 268 *Sociodemographic data.* These will include age, gender, highest level of education, ethnicity, marital  
24  
25 269 status and living arrangement.

26  
27  
28  
29 270 *Time spent at the ED, admission diagnosis, date and time of admission.*

30  
31  
32 271 *Chronic conditions.* The number and severity of chronic conditions will be assessed using the Charlson  
33  
34 272 Comorbidity Index.<sup>38</sup> This index is commonly used to indicate the risk of mortality; each condition is  
35  
36 273 scored 1, 2, 3 or 6 points, with a higher total number of points indicating a greater risk at death.

37  
38  
39 274 *Polypharmacy.* Polypharmacy will be assessed by counting the number of individual drugs that are  
40  
41 275 chronically prescribed to a participant, in which a number of 5 or more drugs is considered  
42  
43 276 polypharmacy.

44  
45  
46  
47 277 *Mortality.* This will be assessed during follow-up, where possible by reviewing patients electronic  
48  
49 278 files, otherwise from general practice registries.

50  
51  
52 279 2. Cognitive functioning.

53  
54  
55 280 *Cognitive impairment.* This will be assessed by reviewing the score of the Mini Mental State Exam  
56  
57 281 (MMSE) that is performed within 48 hours of admission. The MMSE includes 23 items (total score 0-

1  
2  
3 282 30) that screen for cognitive impairment. A score of 23 or less is defined as possible cognitive  
4  
5 283 impairment.<sup>31</sup> When a patient is delirious upon inclusion the MMSE is not conducted.  
6  
7  
8 284 *Delirium.* The Confusion Assessment Method (CAM), the short 4 item version, is used to assess the  
9  
10 285 presence and duration of delirium.<sup>39</sup> The CAM is widely used by physician and nurse practitioners to  
11  
12 286 diagnose delirium (sensitivity of 53-90% and specificity of 84-100%).<sup>40</sup> The CAM is filled out within 24  
13  
14 287 hours of admission. Moreover, the risk on developing delirium is assessed using the Dutch VMS  
15  
16 288 criteria for risk on delirium.<sup>41</sup> Nurse practitioners will score the CAM daily from day one till day three  
17  
18 289 of admission, if there are signs of possible delirium at day 3, these measurements are continued until  
19  
20 290 the symptoms are resolved. In addition, during the first three days of admission the Delirium  
21  
22 291 Observation Screening Scale (DOSS) is scored during each nursing shift and is continued when there  
23  
24 292 is a clinical suspicion of delirium.<sup>42</sup>

### 293 3. Psychosocial functioning and quality of life

294 *Apathy.* We use three items of the *Geriatric Depression Scale* (GDS-15) to assess apathy (sensitivity of  
295 69% and specificity of 85 %). These items include the following questions: 1) 'Do you prefer to stay at  
296 home, rather than going out and doing new things' 2) 'Have you dropped many of your activities and  
297 interests?' And 3) 'Do you feel full of energy'. A score of >2 points is classified as 'apathy present'.<sup>43</sup>

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

301 *Health-Related Quality of Life.* This will be measured by determining Health-Related Quality of Life  
302 using the EuroQoL-5D (EQ-5D). The EQ-5D is a broadly used and validated instrument for measuring  
303 generic health-related quality of life.<sup>36</sup>

304

1  
2  
3 305 4. Physical functioning  
4  
5

6 306 *Risk of functional decline.* Patients are assessed for risk of functional decline using the Identification  
7  
8 307 of Seniors at Risk- Hospitalized patients (ISAR-HP), scores of two and up indicate at an increased risk  
9  
10 308 for functional decline.<sup>44</sup>  
11  
12

13 309 *Functioning level.* The 15-item modified KATZ score is used to measure Activities of Daily Living (ADL)-  
14  
15 310 functioning. This included assessment of performance in basic ADL- KATZ-6), as in instrumental ADL  
16  
17 311 (KATZ-9).<sup>45,46</sup> We measure KATZ-score both currently (at admission), as two weeks before admission,  
18  
19 312 reflecting pre-morbid level of functioning. (I)ADL-functional is also included in follow-up  
20  
21 313 measurements.  
22  
23

24  
25 314 *(Im)mobility.* We will assess mobility by reviewing three questions that are in the admission  
26  
27 315 assessment regarding: 1) use of a walking aid (from KATZ-15), and from the CGA: 2) being able to  
28  
29 316 walk outside of the house for five minutes (two weeks before and currently) and 3) performing, and  
30  
31 317 frequency of, physical activity.<sup>47</sup>  
32  
33

34  
35 318 *Handgrip strength.* Physiotherapists measure muscle weakness in all admitted patients using  
36  
37 319 maximum handgrip strength (JAMAR).<sup>48</sup>  
38  
39

40 320 *Gait speed.* Gait speed is measured as part of the Short Physical Performance Battery (SPBB) that is  
41  
42 321 part of the physiotherapist' admission assessment.<sup>49</sup>  
43  
44

45 322 *Falls.* Fall history is assessed by asking the number of falls in the past six months<sup>41</sup> During the  
46  
47 323 discharge assessment the occurrence of falls in the AGCH and the consequences of falls (indication  
48  
49 324 for prolonged stay, diagnostics or injury) are recorded.  
50  
51

52  
53 325 *Fear of falling.* We will use a Numeric Rating Scale (NRS, score 0-10) to assess fear of falling, 0  
54  
55 326 indicates no fear of falling, and 10 the greatest fear of falling possible.<sup>34</sup>  
56  
57  
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2  
3 327 *Pain.* Widely used in clinical practice the standard for pain assessment is the Numeric Rating Scale,  
4  
5 328 ranging from 0 to 10, in which a score of 0 represents no pain and 10 represents the worst possible  
6  
7 329 pain.<sup>50</sup>  
8  
9

10  
11 330 *Fatigue.* A Numeric Rating Scale from 0-10 is used, 0 indicating no fatigue and 10 indicating the  
12  
13 331 greatest fatigue ever felt by the participant.<sup>51</sup>  
14

15  
16 332 *Sleep.* Participants are asked if they have had difficulties with sleeping in the past month and  
17  
18 333 whether participants have used sleep medication.  
19

20  
21 334 *Nutrition.* We will use the Short Nutritional Assessment Questionnaire (SNAQ) for identifying  
22  
23 335 malnourished patients. The SNAQ consists of three questions on weight loss, appetite and drink/tube  
24  
25 336 nutrition, resulting in a score ranging from 0 to 5. 0 and 1 are defined as 'no malnutrition' 2 as  
26  
27 337 'moderate malnutrition' and 3 or more as 'severe malnutrition'.<sup>52</sup>  
28  
29

30  
31 338 5. Healthcare utilization and satisfaction with care  
32  
33

34 339 *Medical care during admission and process of discharge.* The following are collected from patient  
35  
36 340 electronic health records: the diagnostics performed in the AGCH, revisits to the hospital, admission  
37  
38 341 to the hospital, length of stay of the AGCH, discharge destination and time needed to send medical  
39  
40 342 handovers to the general practitioner.  
41  
42

43  
44 343 *Hospital readmission.* This outcome will be assessed during follow-up. Follow-up will consist of three  
45  
46 344 telephone interviews at 1, 3 and 6 months after discharge. Readmission will be both assessed by  
47  
48 345 interview as by checking care data from an aggregated database of expense claims of various  
49  
50 346 healthcare insurers. Data that will be collected are: number of readmissions, total days of  
51  
52 347 readmission, reasons for readmission and whether the readmission was planned or unplanned.  
53  
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55  
56 348 *Emergency department (ED) visits.* ED visits will be assessed during follow-up and checked in  
57  
58 349 insurance data. We will record the number of separate ED visits.  
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3 350 *Outpatient hospital visits.* We will ask patients if there have been any outpatient visits in the past  
4  
5 351 month(s), and if so how many.  
6  
7

8 352 *Consultations by general practitioner.* We will ask patients if there have been any consultations by  
9  
10 353 the general practitioner (both during the day as during out-of-office hours) visits in the past  
11  
12 354 month(s), and if so how many.  
13  
14

15  
16 355 *Consultations by physiotherapist or dietician.* We will ask patients if there have been any  
17  
18 356 consultations by a physiotherapist or dietician in the past month(s), and if so how many.  
19  
20

21 357 *Home care.* This includes questions on frequency of home care, including housekeeping, personal  
22  
23 358 care and nursing care. We will also include days of day care and hours of informal care provided by  
24  
25 359 family members or friends.  
26  
27

28  
29 360 *Temporary admission to a nursing home.* Days of (temporary) admission to a skilled nursing facility or  
30  
31 361 rehabilitation facility.  
32  
33

34 362 *Permanent Institutionalization.* This concerns long-term admission to a skilled nursing facility and  
35  
36 363 date of admission to this facility.  
37  
38

39 364 *Patient satisfaction with care.* Patients or informal caregivers are asked to fill out an 8-question  
40  
41 365 questionnaire regarding their satisfaction with the care that they received. Questions are answered  
42  
43 366 on a 5- level Likert scale.<sup>53</sup>  
44  
45

#### 46 47 367 *Sample Size calculation*

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50 368 In the Hospital-ADL study 34 % of participants experienced a readmission at 90 days.<sup>34</sup> Assuming that  
51  
52 369 26% of patients admitted to the AGCH will experience a 90 day readmission, data from 515 patients  
53  
54 370 of AGCH will yield 80% power to detect an absolute difference of 8% in readmission rate (which is a  
55  
56 371 25% reduction in relative risk) using a two-sided test with an alpha of 0.05.<sup>54</sup> As we expect 10% loss  
57  
58 372 to follow-up, we will aim to include a total of 567 (= 515\*1.10) patients from the AGCH.  
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60



### 373 *Planned statistical analysis*

374 The complete participant flow diagram will show a summary of admissions and study recruitment at  
375 the AGCH and will provide study discontinuation rates at 1, 3 and 6 months follow-up.<sup>30</sup> We will  
376 describe demographic, clinical and prognostic characteristics of the study participants at baseline.  
377 The number of participants with missing data will be collected and described alongside our variables  
378 to check for the pattern of missingness. Inversely-weighted propensity scores will be used to control  
379 for any imbalances between the treatment groups.<sup>55</sup> Propensity scores will be calculated using  
380 generalized booted methods. Balance and overlap of propensity scores distribution will be assessed.  
381 Propensity score weights for the estimation of the average treatment effect will be created using all  
382 covariates where groups differed on baseline or that were associated with 90-day readmission rate.  
383 As this is a repeated measures design, we will assume equal weighting for all measurements.<sup>56</sup>  
384 All hypotheses will be tested using two-tailed- significance level of 0.05. All secondary outcomes will  
385 be adjusted for multiple testing using a Hochberg method.<sup>57,58</sup> Descriptive analyses will be performed  
386 to examine participant's characteristics. Differences in changes over time in outcomes will be  
387 compared between groups using multilevel models. All models will include a main effect of  
388 treatment group, a linear term for time and an interaction between time and treatment group.  
389 Models will be checked with residual and appropriate goodness-of-fit statistics.

390

### 391 *Economic evaluation*

392 A healthcare and societal perspective is planned for this economic evaluation. The evaluation from  
393 the healthcare perspective will only include direct medical costs accrued in the six months after the  
394 admission to the AGCH. Direct medical cost will only include costs that are funded through the Dutch  
395 healthcare system. The evaluation from a societal perspective will include an estimation of the cost  
396 of informal care. Costs will be based on the reference prices found in the Dutch Manual for Costing  
397 studies and will be set for final year of data collection (2020 or 2021). According to this guideline

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2  
3 398 costs will be discounted at 4% and quality adjusted life years (QALYs) will be discounted at 1,5 %.<sup>59</sup>  
4  
5 399 Propensity scores will also be used in the economic evaluation. Missing data will be imputed using  
6  
7 400 multiple imputation chained equations if necessary, for cost and effect data. We plan to use  
8  
9 401 generalized linear regression models with a gamma distribution and an identity link to account for  
10  
11 402 the right skew of cost data. A generalized linear regression model will be used to estimate the  
12  
13 403 incremental effect in QALYs, adjusted for baseline utility estimates with a Gaussian distribution and  
14  
15 404 identify link.<sup>60</sup> Incremental cost-effectiveness ratios will be calculated using the pooled cost and  
16  
17 405 effect estimates. Bootstrapped cost-effect pairs will be plotted on a cost-effectiveness plane and  
18  
19 406 used to estimate cost-effectiveness acceptability curves.<sup>61</sup>  
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25

### 26 408 *Process evaluation and patient experience*

27  
28 409 We plan to use a qualitative study design to describe barriers and facilitators to implementation of  
29  
30 410 the AGCH- concept and describe experiences of patients and healthcare professionals with the AGCH.  
31  
32 411 We will conduct semi-structured interviews with various stakeholders, such as geriatricians, nurses,  
33  
34 412 physiotherapists and hospital administrators. These interviews will concern the implementation of  
35  
36 413 the AGCH concept. In addition, semi-structured interviews with patients and informal caregivers will  
37  
38 414 be conducted in order to describe the patient experience and satisfaction with this new form of care.  
39  
40 415 A representative sample of patients and/or caregivers who participate in the prospective cohort  
41  
42 416 study will be approached and invited to be interviewed shortly after the discharge from the AGCH.  
43  
44 417 Stakeholders and healthcare professionals will be selected by a researcher and will be invited for an  
45  
46 418 interview to discuss their experience and opinion on the AGCH. Interviews will be typed verbatim  
47  
48 419 and analysed by two researchers independently, using thematic analysis.<sup>62</sup> In our analysis of barriers  
49  
50 420 and facilitators to implementation, we will describe these factors at different levels: micro  
51  
52 421 (healthcare professionals), meso (care organizations) and macro level (legal and financial  
53  
54 422 framework).<sup>63</sup> The findings will be summarized in matrices with facilitators and barriers at different  
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3 423 levels (micro, meso, macro) and can be used to develop a guideline for implementation of the AGCH  
4  
5 424 elsewhere.<sup>64</sup>  
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9 425

## 12 426 Preliminary results

15  
16 427 Between February 1<sup>st</sup> and December 20<sup>th</sup> 2019 there were 362 consecutive admissions to the AGCH.  
17  
18 428 Of these admissions 26 were readmissions of patients who were already study participants. Of the  
19  
20 429 remaining 336 admissions 90 were by patients who did not meet the inclusion criteria. Of the  
21  
22 430 remaining patients 246 patients or legal representatives and healthcare-proxy were approached for  
23  
24 431 participation; 212 consented to participation. (figure 2) The healthcare –proxy provided informed  
25  
26 432 consent in 62 (29.2 %) of cases. 16 patients did not consent to follow-up by telephone but did  
27  
28 433 consent to medical record review. The total study sample as of December 20<sup>th</sup> 2019 consisted of 212  
29  
30 434 participants at baseline. Table 2 displays the baseline characteristics of this group. Participants had a  
31  
32 435 mean age (standard deviation) of 81.8 (8.4) years, 47.6 % were male. Most participants were living  
33  
34 436 independently before admission (81.1%). Most frequent admission diagnosis were infectious  
35  
36 437 diseases (28.3%, mostly urinary tract infections), respiratory-related (25.5%, including pneumonia  
37  
38 438 which was over half respiratory-related and exacerbations of COPD), and other (geriatric) diagnoses  
39  
40 439 such as falls, delirium or sudden unexplained functional decline (30.2%). Cardiac (9.4%) admission  
41  
42 440 diagnosis concerned mostly exacerbations of heart failure. Median length of stay was (interquartile  
43  
44 441 range) 8.0 days (5.0-12.0) and 83.7 % were discharged to their original living situation.  
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50 442

## 53 443 Discussion

56  
57 444 The complex acute medical needs of older patients require the delivery of specialized geriatric care.  
58  
59 445 The traditional hospital environment may however not support recovery and maintaining  
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3 446 independence. The AGCH aims to deliver care that focusses both on medical treatment, early  
4  
5 447 rehabilitation and proper transitions of care for older adults with multiple chronic conditions.<sup>29,65</sup> The  
6  
7 448 AGCH is unique in the Netherlands in its aim to combine multiple evidenced-based components of  
8  
9 449 care for frail older persons at an alternative location for hospital care. The proposed research will  
10  
11  
12 450 provide insight into the clinical and economic effectiveness of care delivered at the AGCH, compared  
13  
14 451 to hospital care.

15  
16  
17 452 Our preliminary results show that data collection at the AGCH is feasible and we expect to recruit  
18  
19 453 enough patients to evaluate the primary outcome. There are also limitations to the design of this  
20  
21 454 study. It is a non-randomized study and that historic cohorts are used as control groups. Therefore  
22  
23 455 baseline differences between intervention and control groups may hamper the matching between  
24  
25 456 the groups. Also, as the data from the cohorts were not collected in the same time period as the  
26  
27 457 AGCH cohort there may be external non-observed differences in the Dutch healthcare system and  
28  
29 458 work processes in hospitals may have changed over the years. However, the two control populations  
30  
31 459 were not self-selected and do represent a geriatric population suffering from common exacerbations  
32  
33 460 of chronic conditions and acute illness that occur in older persons. Strengths are that patients and  
34  
35 461 informal caregivers were involved in the design of the concept of the AGCH. Moreover, a process  
36  
37 462 evaluation will address the barriers and facilitators to implementation of a community hospital such  
38  
39 463 as the AGCH in the existing health care system of the Netherlands. This research will provide valuable  
40  
41 464 insights into the implementation of this concept of care in other regions of the Netherlands and  
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43 465 abroad.

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## 51 52 53 467 Ethics and Dissemination

54  
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56  
57 468 This study will be carried out in accordance with the declaration of Helsinki and current ethical  
58  
59 469 requirements. The outcomes of this study will be reported according to STROBE guidelines for cohort  
60

1  
2  
3 470 studies.<sup>30</sup> This study will evaluate both the effectiveness of this type of care delivery as of the costs  
4  
5 471 that are involved, allowing for implementation elsewhere. The findings of this study will be published  
6  
7 472 in peer-reviewed journals.  
8  
9

473

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15 478 are the clinicians who work at the Geriatrics Department of the Amsterdam University Medical  
16 479 Centres and who support the data-collection at the AGCH.  
17  
18  
19

480

#### 481 Author contributions

21 482 MER, JMV and RS contributed to the design of the protocol and drafting of the manuscript. IO and  
22 483 BMB made substantial contributions to the design and clinical aspects of the of the protocol. BMB  
23 484 conceived the study and wrote funding applications. All authors critically revised the manuscript and  
24 485 approved the final version of this manuscript.  
25  
26  
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486

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33 492 financially supported by Zilveren Kruis, a health insurance company.  
34  
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493

#### 494 Patient consent

38 495 Not required.  
39  
40

496

#### 497 Competing interests statement- None Declared

498

#### 499 Ethics approval

44 500 Based on the study protocol, the Ethics Committee (METC) of the Amsterdam University Medical  
45 501 Center waived the obligation for the study to undergo formal ethical approval as is described under  
46 502 Dutch law in the Medical Research in Humans Act, January 2019. (ref W17\_474 # 19.001) As this is a  
47 503 prospective study and pseudonymized data is used written informed consent was obtained from the  
48 504 participants prior participation. This is in line with current European legislation under the General  
49 505 Data Protection Regulation (GDPR).  
50  
51  
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3 **Figure 1** – Patient admission process and criteria, components of AGCH intervention and goals  
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10 CGA= Comprehensive Geriatric Assessment<sup>29</sup>

11 GP= General Practitioner  
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**Figure 2** Diagram of patient participation between February 1<sup>st</sup> and December 20<sup>th</sup> 2019.

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**Table 1** Overview of the content and description of (outcome) measurements and timing of measurements at the Acute Community Care Hospital ('WijkKliniek')

	Description and/or instrument	H1	H2	P1	P3	P6
<i>1. Medical and demographical data</i>						
<b>Sociodemographic data</b>	Date of birth, age at admission, sex, level of education, living conditions, marital state	R				
<b>Data on admission</b>	Time spent at the ED, admission diagnosis, date and time of admission	R				
<b>Chronic conditions</b>	Charlson Comorbidity index <sup>38</sup>	R				
<b>Polypharmacy</b>	Number of drugs	R				
<b>Mortality</b>	Date of death		R	R	R	R
<i>2. Cognitive functioning</i>						
<b>Cognitive impairment</b>	Mini Mental State Exam (MMSE) <sup>31</sup>	R				
<b>Delirium</b>	Safety management system patient screening (VMS) <sup>41</sup> Confusion Assessment Method (CAM) <sup>39</sup> Delirium Observation Scale (DOS) <sup>42</sup>	N/ D	N/ D			
<i>3. Psychosocial functioning and quality of life</i>						
<b>Apathy</b>	Geriatric Depression Scale (GDS-3) <sup>43</sup>	N	R	R	R	R
<b>Social network and informal care</b>	Presence and frequency of informal care	R		R	R	R
<b>Quality of life and health status</b>	EQ-5D-3L <sup>36</sup>	R		R	R	R
<i>4. Physical functioning</i>						
<b>Identifying at-risk-patients</b>	ISAR-HP- Identifying Seniors at Risk score <sup>44</sup>	N				
<b>Functional status</b>	Activities of daily Living (ADL) modified Katz-ADL score <sup>35</sup>	N				
<b>(Im)mobility</b>	Using walking aid, information in KATZ-15 questions on exercise	N				
<b>Handgrip strength</b>	Jamar <sup>48</sup>	P				
<b>Gait speed</b>	Short Physical Performance Battery SPPB <sup>49</sup>	P				
<b>Falling</b>	Fall history Falls in the AGCH	N	R	R	R	R
	Numeric Rating scale (NRS) fear of falling <sup>34</sup>	N	R	R	R	R
<b>Pain</b>	Numeric Rating Scale (NRS) pain <sup>50</sup>	N	R	R	R	R
<b>Fatigue</b>	Numeric Rating Scale (NRS) fatigue <sup>51</sup>	N	R	R	R	R
<b>Nutrition</b>	Short Nutritional Assessment Questionnaire (SNAQ- Score) <sup>52</sup>	N				
<i>5. Healthcare utilization and satisfaction with care</i>						
<b>Medical care during admission</b>	Diagnostics performed in the AGCH Readmission to university hospital Length of stay at the AGCH		R			
<b>Hospital readmission</b>	Readmission rate to the hospital or AGCH		R	R	R	R

<b>Health care utilization</b>	Home care, medical specialist care, temporary institutional care, primary care.	R		R	R	R
<b>Satisfaction with Care</b>	8 question questionnaire <sup>53</sup>		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 assessment was missed at H2

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**Table 2** Baseline characteristics of study participants

Variable	N=212
<b>Age in years, mean (SD)</b>	81.8 (8.4)
<b>Male, N(%)</b>	101 (47.6)
<b>Living arrangements before admission, N (%)</b>	
Independent	172 (81.1)
Assisted living/ senior residence	31 (14.6)
Nursing home/other	9 (4.2)
<b>Marital status, N (%)</b>	
Widow/widower	94 (44.5)
Married or living together	71 (33.6)
Single or divorced	46 (21.8)
<b>Education, N(%)</b>	
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)
<b>Born in the Netherlands, N (%)</b>	158 (76.0)
<b>ADL-score upon admission (KATZ-6<sup>a</sup>), median (IQR)</b>	3.0 (1.0-5.0)
<b>MMSE score<sup>b</sup>, mean (SD)</b>	23.7 (4.7)
<b>Polypharmacy<sup>c</sup>, N(%)</b>	159 (75.0)
<b>Hospitalization in past 6 months, N (%)</b>	61 (31.1)
<b>Charlson Comorbidity Index<sup>d</sup> (mean, SD)</b>	2.8 (2.0)
<b>Primary admission diagnosis, N (%)</b>	
Infectious diseases	60 (28.3)
Respiratory (including pneumonia)	54 (25.5)
Gastrointestinal	9 (4.2)
Cardiac	20 (9.4)
Neurology	16 (7.5)
Other (e.g. falls, delirium, sudden unexplained functional decline)	53 (30.2)

SD, standard deviation; IQR, interquartile range

<sup>a</sup>Score ranging from 0-6, with a higher score indicating more dependence in activities of daily living<sup>35</sup>

<sup>b</sup>Score ranging from 0-30, with a score of  $\leq 23$  indicating possible cognitive impairment<sup>31</sup>

<sup>c</sup>Use of 5 drugs or more

<sup>d</sup>Range of 0-31, with a higher score indicating more severe comorbidity<sup>38</sup>

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## Admission criteria

- Medical and geriatric problem: hospitalization is required
- Expected stay: maximum of 14 days
- Patient from community/region

Emergency department  
of acute hospital

Geriatrician

Acute Geriatric Community Hospital (AGCH)

Geriatrician

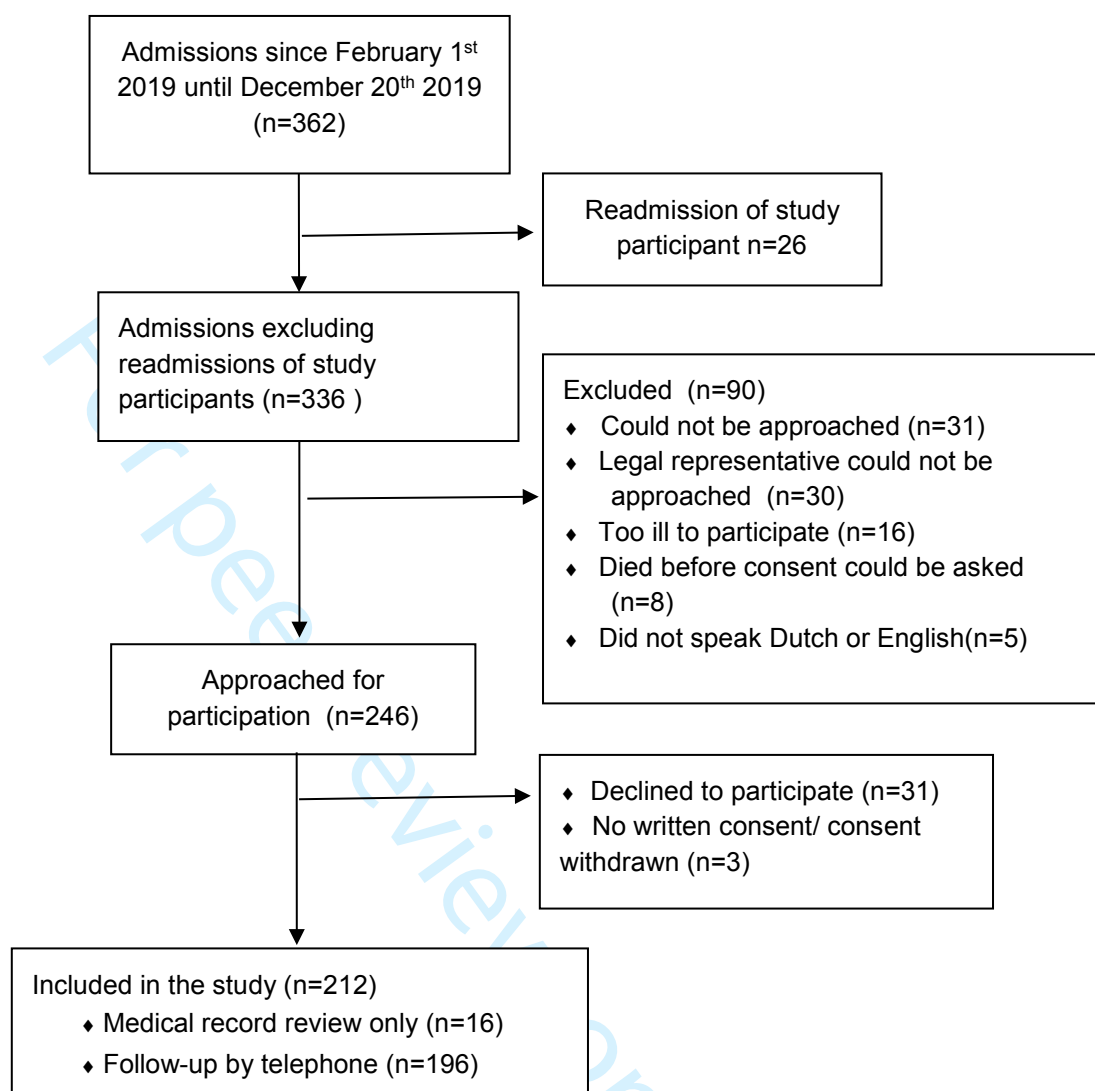
In the future: home  
or General Practice

## During admission to the AGCH

- Full CGA and interdisciplinary assessment, physiotherapy
- Early discharge and follow-up planning
- Discharge letters are sent to GPs within 48 hours



**Figure 2** Diagram of patient participation between February 1<sup>st</sup> and December 20<sup>th</sup> 2019.



**Appendix 1** STROBE statement checklistSTROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Item found on page
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1 and 3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 3
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 5-7
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 7
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	Page 8 -9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 7-15
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Page 7-10 and 11
		(b) For matched studies, give matching criteria and number of exposed and unexposed	Page 9 and 10
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 11 – 15
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	Page 11-15
Bias	9	Describe any efforts to address potential sources of bias	Page 16
Study size	10	Explain how the study size was arrived at	Page 15
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 16
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Page 16

		(b) Describe any methods used to examine subgroups and interactions	n/a
		(c) Explain how missing data were addressed	Page 16
		(d) If applicable, explain how loss to follow-up was addressed	Page 16
		(e) Describe any sensitivity analyses	n/a
<b>Results</b>			
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	Page 18 and 26 (figure 2)
		(b) Give reasons for non-participation at each stage	Page 18 and 26 (figure 2)
		(c) Consider use of a flow diagram	Page 26, figure 2
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 18 and 29
		(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	Page 29
		(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
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	Page 19

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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	Page 19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 19
Generalisability	21	Discuss the generalisability (external validity) of the study results	n/a
<b>Other information</b>			
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	Page 20

\*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>.

# BMJ Open

## 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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3 1 **Investigating the effectiveness of care delivery at an acute geriatric community hospital for older**  
4 **adults in the Netherlands: a protocol for a prospective controlled observational study**  
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8 4 Marthe E. Ribbink MD<sup>1</sup>, Janet L. MacNeil Vroomen PhD<sup>1,2</sup>, Rosanne van Seben PhD<sup>1</sup>, Irène Oudejans  
9 MD, PhD<sup>1</sup>, Bianca M. Buurman RN, PhD<sup>1,3</sup> on behalf of the AGCH study group.  
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**Keywords:** geriatric medicine, older adults, community hospital, intermediate care facilities, readmissions, functional decline.

For peer review only



## 55 Abstract

56 **Introduction:** Hospital admission in older adults with multiple chronic conditions is associated with  
57 unwanted outcomes like readmission, institutionalization, functional decline, and mortality.

58 Providing acute care in the community and integrating effective components of care models might  
59 lead to a reduction in negative outcomes. Recently, the first geriatrician-led Acute Geriatric  
60 Community Hospital (AGCH) was introduced in the Netherlands. Care at the AGCH is focused on the  
61 treatment of acute diseases, comprehensive geriatric assessment, setting patient-led goals, early  
62 rehabilitation and streamlined transitions of care.

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

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

78 **Trial Registration Number** NL7896; pre-results

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81 **Strengths and limitations of this study:**

- 82 - This study will be the first to evaluate an acute geriatric community hospital in the Netherlands
- 83 on both patient-reported and economic outcomes.
- 84 - Patients, informal caregivers and professionals were involved in the design and implementation
- 85 of the Acute Geriatric Community Hospital (AGCH).
- 86 - A process evaluation is planned to describe the experience of various stakeholders with this new
- 87 concept and reveal barriers and facilitators to its implementation.
- 88 - A limitation of this study is the use of two historic cohorts as the control population, which may
- 89 result in baseline differences between the control and intervention population.

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## 110 Introduction

### 111 *Background*

112 Throughout the western world, there is an increase in older adults requiring acute care. Inpatient

113 services are mostly consumed by those over the age of 65.<sup>1,2</sup> The Netherlands, like many other

114 countries, recently (2015) implemented stay-at-home policies leading to an increase in frail older

115 persons living longer in the community.<sup>3</sup> These reforms juxtaposed with an increased ageing

116 population contribute to increased acute care utilization.<sup>4</sup> There has been a 19% increase in

117 emergency department (ED) visits by Dutch older adults based on data from 2015 versus 2017.<sup>5,6</sup>

118 Many older adults come to the hospital with complex and atypical health problems.<sup>5,7</sup> When older

119 persons are subsequently hospitalized, health outcomes are known to be poor,<sup>8</sup> particularly in

120 patients with geriatric syndromes such as cognitive impairment or mobility impairment.<sup>9,10</sup> For

121 example, previous research showed that 30% of older persons gained new disabilities and 20% were

122 readmitted within 30 days postdischarge.<sup>11,12</sup> Hospitalization itself may contribute to these poor

123 outcomes, as hospitalized older adults often have reduced mobility because they are bedbound for

124 approximately 20 hours a day.<sup>13,14</sup> Low physical activity, in combination with poor nourishment and

125 increased caloric demand due to acute illness, can lead to the loss of muscle mass and may

126 contribute to the development of new disabilities, particularly in frail patients.<sup>15,16</sup> Together with the

127 noise in a hospital environment and the different personnel rotating between patient rooms, this

128 contributes to sensory overstimulation and sleep deprivation, which may lead to confusion and the

129 occurrence of delirium.<sup>17,18,19</sup> Not only is the patient affected during hospitalization but the informal

130 caregivers also find hospital admissions stressful.<sup>20</sup> Furthermore, previous research shows that a lack

131 of discharge planning in the hospital can result in patients' care needs being unmet.<sup>21</sup> Hospital care

132 as usual compared to discharge planning and follow-up show a higher rate of early readmissions.<sup>22</sup>

133 Readmissions can further affect patients' recovery and increase healthcare costs.<sup>23</sup>

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3 134 The complex medical needs of older persons, combined with their more dependent social situation,  
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5 135 requires care delivery that offers guidance and support for realistic health and life goals.<sup>24</sup> Perhaps a  
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7 136 'gap' exists between what care can be provided in an acute care hospital versus what can be  
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10 137 provided in the community (primary care). Acute hospital care is secondary care with a focus on  
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12 138 medical treatment and diagnostics, whilst primary care focuses on rehabilitation, nursing care and  
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14 139 wellbeing.

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17 140 Several alternative strategies to hospital admission and (nurse-led) intermediate care have been  
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19 141 developed in the past as a substitute to conventional hospitalization.<sup>25</sup> Examples include (nurse-led)  
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21 142 intermediate care and subacute geriatric care units, which are low-tech but with geriatric  
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23 143 expertise.<sup>26,27</sup> In general, these types of care have comparable outcomes to hospital care as usual.  
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25 144 Moreover, nurse-led care in the United States, observation units and hospital at home care all show a  
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27 145 cost reduction compared to care as usual.<sup>25,26</sup> Until recently, the Netherlands had limited alternatives  
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29 146 to hospitalization for older persons who required acute care. Therefore, our research group sought  
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31 147 to create an acute care alternative and opened the Acute Geriatric Community Care Hospital (AGCH)  
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33 148 in July 2018, partnering with an academic hospital (Amsterdam UMC, location AMC), an insurance  
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35 149 company (Zilveren Kruis) and a home care and nursing home agency (Cordaan). This acute geriatric  
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37 150 care unit, which is based within an intermediate care facility, provides an alternative to conventional  
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39 151 hospitalization and delivers acute care closer to home.

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45 152 The AGCH delivers acute care that is focused on early mobilization and rehabilitation. Older persons  
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47 153 with common medical problems (such as urinary tract infections, pneumonia or heart failure) and  
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49 154 geriatric syndromes requiring hospital admission can be admitted to the AGCH. The AGCH provides a  
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51 155 form of *intermediate* care between primary and secondary care. In the Netherlands, primary care  
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53 156 includes general practice, community nursing and (temporary) admission to a nursing home.  
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55 157 Secondary care includes specialist medical care and hospital admission. The care at the AGCH is  
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57 158 supervised by a geriatrician and provided by nurses trained in geriatric care who have experience as  
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3 159 either a hospital or community nurse. The single rooms are designed to accommodate respite for the  
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5 160 informal caregivers. This concept of care is new to the Netherlands, and to our knowledge, there is  
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7 161 only one comparable example in Europe: a “subacute care unit” in intermediate care, which has been  
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9 162 implemented in Spain.<sup>27</sup>

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12 163 Our hypothesis is that with the provision of integrated medical and nursing care close to home, the  
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14 164 AGCH is better suited to the needs of older adults with multiple chronic conditions and will lead to  
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16 165 better patient health outcomes and reduced post-acute care costs. Therefore, this study is designed  
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18 166 to compare care provided for older patients in the AGCH versus care provided in a hospital setting.

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21 167 Specifically, we aim to:

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24 168 ➤ Evaluate the 90-day readmission rate of patients acutely admitted to the AGCH compared to  
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26 169 a traditional hospital (usual care). Secondary outcomes include functional decline,  
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28 170 institutionalization, healthcare utilization, the occurrence of geriatric syndromes such as  
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30 171 delirium, health-related quality of life, mortality, and patient satisfaction;
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33 172 ➤ Assess the cost-effectiveness of the AGCH versus usual care by performing an economic  
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35 173 evaluation from a health care provider and societal perspective;
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37 174 ➤ Conduct a process evaluation using interviews with key stakeholders to identify facilitators  
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39 175 and barriers to the implementation of the AGCH.

## 41 42 176 43 44 45 177 Methods

### 46 47 178 *Setting*

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50 179 The AGCH opened in July 2018. It serves the south-eastern part of Amsterdam and its surrounding  
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52 180 areas (an area with approximately 147 500 inhabitants).<sup>28</sup> The AGCH is a 23-bed facility within a  
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54 181 skilled nursing facility. The hospital has 24-hour geriatric and nursing assistance. Physiotherapy and  
55  
56 182 routine laboratory testing are available during the workweek and simple X-ray is available once a  
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58 183 week. The population that is eligible for admission to the AGCH are patients with a combination of an  
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3 184 acute medical problem requiring hospitalization (e.g., pneumonia, exacerbation of heart failure or a  
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5 185 urinary tract infection), and a geriatric condition (e.g., delirium, cognitive impairment, falls, or  
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7 186 functional impairment). Additionally, patients have to be haemodynamically stable and should not  
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9 187 require complex diagnostic testing. In general, patients will not be admitted if they have the  
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11 188 following exclusion criteria: 1) require care that can only be provided at an intensive care unit, 2)  
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13 189 require surgery, 3) require urgent treatments or diagnostic tests that can only be provided in-hospital  
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15 190 (e.g., endoscopy, interventional radiology), 4) do not need hospital care but require transfer to a  
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17 191 skilled nursing facility and 5) live in another region of the Netherlands.  
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19 192 Patients are directly admitted to the AGCH from the ED of the Amsterdam UMC-location Academic  
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21 193 Medical Centre (AMC) in Amsterdam, which is a 1000-bed academic hospital with approximately 30  
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23 194 000 ED visits yearly. After the on-call geriatrician has assessed whether the patient is eligible for  
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25 195 AGCH admission and the patient or representative has agreed to admission, the patient is transferred  
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27 196 to the AGCH by ambulance. Since October 2019, patients can also be transferred from the EDs of  
28  
29 197 other hospitals in Amsterdam. In the future, we plan to admit patients from home or general practice  
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31 198 offices. Patients are admitted between 8.00 am and 11.00 pm, seven days a week. At admission, a  
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33 199 Comprehensive Geriatric Assessment (CGA) is conducted.<sup>29</sup> The CGA gives an overview of all medical,  
34  
35 200 functional, psychological and social problems. The CGA is discussed during multidisciplinary team  
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37 201 meetings and used to formulate a care plan for each patient. For an overview of the admission  
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39 202 process, the admission criteria and the components of this intervention, see figure 1.  
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## 48 204 *Study design*

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50 205 This study is a prospective, observational, cohort study with two historical control groups to evaluate  
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52 206 the clinical and economic effects of the AGCH. The STROBE statement was used in preparing the  
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54 207 study protocol (appendix 1).<sup>30</sup> Participants will be compared to hospital controls. The participants are  
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56 208 recruited into the study and are assessed at admission, discharge, and one, three and six months  
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58 209 after discharge. Recruitment for this study started in February 2019. We plan to recruit for 18 to 24  
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3 210 months. The first three months of data collection consisted of a piloting phase to assess the  
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5 211 feasibility of data collection and follow-up. In addition, a qualitative process evaluation on the  
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7 212 facilitators and barriers to the implementation of the AGCH and patient experience will be  
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9 213 conducted.  
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### 15 215 *Participants*

17 216 Patients admitted to the AGCH are eligible for inclusion in the study. However, patients are excluded  
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19 217 from the study if: 1) the attending physician judges that the patient is too ill to participate, e.g., the  
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21 218 patient is terminally ill, 2) the patient or legal representative does not consent to participate, or 3)  
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23 219 the patient or legal representative does not speak or understand Dutch or English. In the case of  
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25 220 cognitively impaired or delirious patients, patients can only be included if a legal representative  
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27 221 consents to participation and acts as healthcare proxy. Cognitive functioning is assessed by the  
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29 222 attending physician and confirmed by the researcher by conducting a Mini-Mental State Examination  
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31 223 (MMSE).<sup>31</sup> An MMSE score of 15 or less indicates severe cognitive impairment, in which the approval  
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33 224 of a legal representative will be sought.  
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### 40 226 *Historical control groups*

42 227 We selected two completed cohort studies that were conducted by our research group as historical  
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44 228 control groups. We expect that the patients from these cohorts have similar admission diagnoses as  
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46 229 those who can be admitted to the AGCH, namely, diagnoses that are ambulatory care sensitive  
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48 230 conditions such as infections and exacerbations of COPD or heart failure. Patients in these two  
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50 231 cohorts were admitted to internal medicine, cardiology, pulmonology and geriatrics departments.  
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52 232 These departments admit patients with diagnoses similar to those that can be admitted to the AGCH.  
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54 233 In addition, we have selected these cohorts as control groups as the patients come from the same  
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56 234 area as the studied population admitted to the AGCH, that is, the greater Amsterdam area. The first  
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3 235 control group from the Transitional Care Bridge Study consists of 674 patients who were recruited  
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5 236 between September 2010 and March 2014.<sup>32</sup> Participants were patients of 65 years and older  
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7 237 hospitalized for at least 48 hours. Proxy consent was provided for participants suffering from severe  
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9 238 cognitive impairment (MMSE  $\leq$ 15). They participated in a negative randomized controlled trial that  
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11 239 assessed the effectiveness of a nurse-led transitional care programme in preventing functional  
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13 240 decline.<sup>32</sup> The second control group from Hospital-ADL study consists of 401 patients who were  
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15 241 recruited between October 2015 and June 2017.<sup>10</sup> These participants were enrolled in a prospective  
16  
17 242 cohort studying the trajectory of functional decline in older hospitalized adults. Participants were  
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19 243 aged 70 years and older and were hospitalized for at least 48 hours. Patients suffering from severe  
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21 244 cognitive impairment (MMSE  $\leq$ 15) and delirium were excluded from participation. For the detailed  
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23 245 methodology and inclusion criteria of the two control cohorts, please refer to the study protocols  
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25 246 and papers of these studies.<sup>10,32-34</sup>  
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### 32 248 *Patient and public involvement*

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35 249 Older persons living in Amsterdam were involved in the design of the AGCH concept. No patients  
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37 250 were involved in the design of this study.  
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### 41 252 *Outcomes*

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44 253 The primary outcome measure is the 3-month unplanned readmission rate to the AGCH or hospital.

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46 254 Secondary outcomes measured at one, three and six months will include:

- 47 255 1) Activities of daily living (ADL)-functioning, as defined by the Katz-ADL scale.<sup>35</sup>
  - 48 256 2) Healthcare utilization, including institutionalization in a long-term care facility.
  - 49 257 3) Occurrence of delirium and/or falls.
  - 50 258 4) Health-related quality of life (HRQOL).<sup>36</sup>
  - 51 259 5) All-cause mortality.
  - 52 260 6) Satisfaction of the patients and primary caregivers with the provided care.
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3 261 *Data collection*  
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7 262 Eligible patients and/or legal representatives will be contacted and informed about the study  
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9 263 procedures after which written informed consent is obtained. Inclusion and interviewing of patients  
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11 264 is conducted by an onsite researcher. Routine data on functioning and risk assessments are collected  
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13 265 by a trained registered nurse and physiotherapist as part of the CGA for each patient.<sup>37</sup> Table 1 gives  
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15 266 an overview of measurement of the primary and secondary outcomes over time. These  
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17 267 measurements were chosen based on the assessments and data collected from the two historic  
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19 268 control groups. The supplementary table provides an overview of the content and timing of  
20  
21 269 measurements in the AGCH-group compared to the two historic control groups. Measurements  
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23 270 during admission are at H1, which is within 48 hours after admission, and H2, which is within 48  
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25 271 hours before discharge. Follow-up is completed by telephone at one, three and six months after  
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27 272 discharge (P1, P3 and P6).  
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32 273 Data collection includes:  
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35 274 1. Medical and demographical data  
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38 275 *Sociodemographic data.* These will include age, gender, highest level of education, ethnicity, marital  
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40 276 status and living arrangement.  
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43 277 *Time spent at the ED, admission diagnosis, and date and time of admission.*  
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46 278 *Chronic conditions.* The number and severity of chronic conditions will be assessed using the Charlson  
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48 279 Comorbidity Index.<sup>38</sup> This index is commonly used to indicate the risk of mortality; each condition is  
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50 280 scored 1, 2, 3 or 6 points, with a higher total number of points indicating a greater risk of death.  
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54 281 *Polypharmacy.* Polypharmacy will be assessed by counting the number of individual drugs that are  
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56 282 chronically prescribed to a participant, in which a number of 5 or more drugs is considered  
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58 283 polypharmacy.  
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3 284 *Mortality*. This will be assessed during follow-up, either from the patients' electronic files or from  
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5 285 general practice registries.  
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8 286 2. Cognitive functioning.  
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11 287 *Cognitive impairment*. This is assessed by reviewing the score of the MMSE that is performed within  
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13 288 48 hours of admission. The MMSE includes 23 items (total score 0-30) that screen for cognitive  
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15 289 impairment. A score of 23 or less is defined as possible cognitive impairment.<sup>31</sup> When a patient is  
16  
17 290 delirious upon inclusion, the MMSE is not conducted.  
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21 291 *Delirium*. The Confusion Assessment Method (CAM), 4 item short version, is used to assess the  
22  
23 292 presence and duration of delirium.<sup>39</sup> The CAM is widely used by physicians and nurse practitioners to  
24  
25 293 diagnose delirium (sensitivity of 53-90% and specificity of 84-100%).<sup>40</sup> The CAM is filled out within 24  
26  
27 294 hours of admission. Moreover, the risk on developing delirium is assessed using the Dutch Safety  
28  
29 295 Management Programme (*Veiligheidsmanagementsysteem (VMS)*) criteria for risk of delirium.<sup>41</sup>  
30  
31 296 Nurse practitioners will score the CAM daily from day one till day three of admission; if there are  
32  
33 297 signs of possible delirium at day 3, these measurements are continued until the symptoms are  
34  
35 298 resolved. In addition, during the first three days of admission, the Delirium Observation Screening  
36  
37 299 Scale (DOSS) is scored during each nursing shift and is continued when there is a clinical suspicion of  
38  
39 300 delirium.<sup>42</sup>  
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44 301 3. Psychosocial functioning and quality of life  
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46  
47 302 *Apathy*. We use three items of the *Geriatric Depression Scale (GDS-15)* to assess apathy (sensitivity of  
48  
49 303 69% and specificity of 85 %). These items include the following questions: 1) 'Do you prefer to stay at  
50  
51 304 home, rather than going out and doing new things', 2) 'Have you dropped many of your activities and  
52  
53 305 interests?', and 3) 'Do you feel full of energy'. A score of >2 points is classified as 'apathy present'.<sup>43</sup>  
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3 306 *Social network and informal care.* Participants are asked if they receive informal care, how many  
4  
5 307 hours a week, what type of care (housekeeping and/or personal care) and from which persons  
6  
7 308 (partners, children, other family members or neighbours/volunteers).  
8  
9

10 309 *Health-related quality of life.* This will be measured by the EuroQoL-5D (EQ-5D). The EQ-5D is a  
11  
12 310 broadly used and validated instrument for measuring generic health-related quality of life.<sup>36</sup>  
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14

#### 15 311 4. Physical functioning

16  
17  
18 312 *Risk of functional decline.* Patients are assessed for risk of functional decline using the Identification  
19  
20 313 of Seniors at Risk- Hospitalized Patients (ISAR-HP) tool; scores of two and up indicate an increased  
21  
22 314 risk for functional decline.<sup>44</sup>  
23  
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25  
26 315 *Functioning level.* The 15-item modified Katz-ADL score is used to measure ADL functioning. This  
27  
28 316 includes statements about independence in performing basic activities of daily living (ADL) and in  
29  
30 317 instrumental activities of daily living (IADL).<sup>45,46</sup> We measure the Katz-ADL both currently (at  
31  
32 318 admission), as well as two weeks before admission, reflecting pre-morbid level of functioning. The  
33  
34 319 Katz-ADL is also measured during follow-up.  
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38 320 *(Im)mobility.* Mobility is assessed by reviewing three questions that are in the admission assessment  
39  
40 321 regarding: 1) the use of a walking aid, 2) being able to walk outside of the house for five minutes (two  
41  
42 322 weeks before and currently) and 3) the performance and frequency of physical activity.<sup>47</sup>  
43  
44

45  
46 323 *Handgrip strength.* Measure muscle weakness is measured by physiotherapists in all admitted patients  
47  
48 324 using the maximum handgrip strength (Jamar).<sup>48</sup>  
49

50 325 *Gait speed.* Gait speed is measured as part of the Short Physical Performance Battery (SPBB), which is  
51  
52 326 part of the physiotherapists' admission assessment.<sup>49</sup>  
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3 327 *Falls.* Fall history is assessed by asking about the number of falls in the past six months.<sup>41</sup> During the  
4  
5 328 discharge assessment, the occurrence of falls in the AGCH and the consequences of falls (indication  
6  
7 329 for prolonged stay, diagnostics or injury) are recorded.

9  
10 330 *Fear of falling.* The Numeric Rating Scale (NRS, score 0-10) is used to assess the fear of falling; 0  
11  
12 331 indicates no fear of falling, and 10 indicates the greatest fear of falling possible.<sup>34</sup>

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14  
15 332 *Pain.* The standard clinical measure for pain is the NRS, ranging from 0 to 10, in which a score of 0  
16  
17 333 represents no pain and 10 represents the worst possible pain.<sup>50</sup>

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19  
20 334 *Fatigue.* A NRS from 0-10 is used, with 0 indicating no fatigue and 10 indicating the greatest fatigue  
21  
22 335 ever felt by the participant.<sup>51</sup>

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24  
25 336 *Sleep.* Participants are asked if they have had difficulties with sleeping in the past month and  
26  
27 337 whether participants have used sleep medication.

28  
29  
30 338 *Nutrition.* We will use the Short Nutritional Assessment Questionnaire (SNAQ) to identify patients  
31  
32 339 with malnourishment. The SNAQ consists of three questions concerning weight loss, appetite and  
33  
34 340 drink/tube nutrition, resulting in a score ranging from 0 to 5. Scores of 0 and 1 are defined as 'no  
35  
36 341 malnutrition', 2 as 'moderate malnutrition' and 3 or more as 'severe malnutrition'.<sup>52</sup>

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39 342 5. Healthcare utilization and satisfaction with care

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42 343 *Medical care during admission and the process of discharge.* The following items are collected from  
43  
44 344 patients' electronic health records: the diagnostics performed in the AGCH, revisits to the hospital,  
45  
46 345 admissions to the hospital, length of stay at the AGCH, discharge destination and time needed to  
47  
48 346 send medical handovers to the general practitioner.

49  
50  
51 347 *Hospital readmission.* This outcome will be assessed during follow-up. Follow-up will consist of three  
52  
53 348 telephone interviews at one, three and six months after discharge. Readmission will be both assessed  
54  
55 349 during the follow-up interviews and by checking care data from an aggregated database of expense  
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3 350 claims from various healthcare insurers. Data that will be collected are as follows: number of  
4  
5 351 readmissions, total days of readmission, reasons for readmission and whether the readmission was  
6  
7 352 planned or unplanned.  
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9

10 353 *Emergency department (ED) visits.* ED visits will be assessed during follow-up and checked in the  
11  
12  
13 354 insurance data. We will record the number of separate ED visits.  
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15

16 355 *Outpatient hospital visits.* We will ask patients if there have been any outpatient visits in the past  
17  
18 356 month(s), and if so, how many.  
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21 357 *Consultations by general practitioners.* We will ask patients if, and how many times, they have  
22  
23 358 consulted with their general practitioner (both during the day and during out-of-office hours).  
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26 359 *Consultations by physiotherapists or dieticians.* We will ask patients if, and how many times, they  
27  
28 360 have consulted with a physiotherapist or dietician in the past month(s).  
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31 361 *Home care.* This includes questions on the frequency of home care, including housekeeping, personal  
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33 362 care and nursing care. We will also include hours of informal care provided by family members or  
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35 363 friends.  
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39 364 *Temporary admission to a nursing home.* This includes days of (temporary) admission to a skilled  
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41 365 nursing facility or rehabilitation facility.  
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44 366 *Permanent institutionalization.* This concerns long-term admission to a skilled nursing facility and the  
45  
46 367 date of admission to this facility.  
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50 368 *Patient satisfaction with care.* Patients or informal caregivers are asked to fill out an 8-question  
51  
52 369 questionnaire regarding their satisfaction with the care that they received. Questions are answered  
53  
54 370 on a 5-point Likert scale.<sup>53</sup>  
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### 372 *Sample size calculation*

373 In the Hospital-ADL study, 34% of participants experienced a readmission at 90 days.<sup>34</sup> Assuming that  
374 26% of patients admitted to the AGCH will experience a 90-day readmission, data from 515 patients  
375 at the AGCH will yield 80% power to detect an absolute difference of 8% in the readmission rate  
376 (which is a 25% reduction in the relative risk) using a two-sided test with an alpha of 0.05.<sup>54</sup> As we  
377 expect 10% loss to follow-up, we aim to include a total of 567 (= 515\*1.10) patients from the AGCH.

378

### 379 *Planned statistical analyses*

380 The complete participant flow diagram will show a summary of admissions and study recruitment at  
381 the AGCH and will provide study discontinuation rates at one, three and six months follow-up.<sup>30</sup> We  
382 will describe the demographic, clinical and prognostic characteristics of the study participants at  
383 baseline. The number of participants with missing data will be collected and described alongside our  
384 variables to check for the pattern of missingness. Inversely weighted propensity scores will be used  
385 to control for any imbalances between the treatment groups.<sup>55</sup> Propensity scores will be calculated  
386 using generalized booted methods. Balance and overlap of propensity score distribution will be  
387 assessed. Propensity score weights for the estimation of the average treatment effect will be created  
388 using all covariates where groups differed at baseline or that were associated with the 90-day  
389 readmission rate. As this is a repeated measures design, we will assume equal weighting for all  
390 measurements.<sup>56</sup>

391 All hypotheses will be tested using a two-tailed significance level of 0.05. All secondary outcomes will  
392 be adjusted for multiple testing using a Hochberg method.<sup>57,58</sup> Descriptive analyses will be performed  
393 to examine the participants' characteristics. Differences in changes over time in outcomes will be  
394 compared between groups using multilevel models. All models will include a main effect of  
395 treatment group, a linear term for time and an interaction between time and treatment group.  
396 Models will be checked with residual and appropriate goodness-of-fit statistics.

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3 3974  
5 398 *Economic evaluation*

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8 399 A healthcare and societal perspective is planned for the economic evaluation. The evaluation from  
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10 400 the healthcare perspective will only include direct medical costs accrued in the six months after the  
11  
12 401 admission to the AGCH. Direct medical costs will only include costs that are funded through the  
13  
14 402 Dutch healthcare system. The evaluation from a societal perspective will include an estimation of the  
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16 403 costs of informal care. Costs will be based on the reference prices found in the Dutch Manual for  
17  
18 404 Costing studies and will be set for the final year of data collection (2020 or 2021). According to this  
19  
20 405 guideline, costs will be discounted at 4% and quality adjusted life years (QALY) will be discounted at  
21  
22 406 1.5%.<sup>59</sup> Propensity scores will also be used in the economic evaluation. Missing data will be imputed  
23  
24 407 using multiple imputation chained equations, if necessary, for the cost and effect data. We plan to  
25  
26 408 use generalized linear regression models with a gamma distribution and an identity link to account  
27  
28 409 for the right skew of the cost data. A generalized linear regression model will be used to estimate the  
29  
30 410 incremental effect in QALY adjusted for baseline utility estimates with a Gaussian distribution and  
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32 411 identify link.<sup>60</sup> Incremental cost-effectiveness ratios will be calculated using the pooled cost and  
33  
34 412 effect estimates. Bootstrapped cost-effect pairs will be plotted on a cost-effectiveness plane and  
35  
36 413 used to estimate cost-effectiveness acceptability curves.<sup>61</sup>

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44 415 *Process evaluation and patient experience*

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46 416 We plan to use a qualitative study design to describe the barriers and facilitators to implementation  
47  
48 417 of the AGCH concept and describe the experiences of the patients and healthcare professionals with  
49  
50 418 the AGCH. We will conduct semi-structured interviews with various stakeholders, such as  
51  
52 419 geriatricians, nurses, physiotherapists and hospital administrators. These interviews will concern the  
53  
54 420 implementation of the AGCH concept. In addition, semi-structured interviews with patients and  
55  
56 421 informal caregivers will be conducted in order to describe the patient experience and satisfaction  
57  
58 422 with this new form of care. A representative sample of patients and/or caregivers who participate in  
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3 423 the prospective cohort study will be approached and invited to be interviewed shortly after discharge  
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5 424 from the AGCH. Stakeholders and healthcare professionals will be selected by a researcher and will  
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7 425 be invited for an interview to discuss their experiences and opinions on the AGCH. Interviews will be  
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10 426 typed verbatim and analysed independently by two researchers using thematic analyses.<sup>62</sup> In our  
11  
12 427 analysis of the barriers and facilitators to implementation, we will describe these factors at three  
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14 428 different levels: micro (healthcare professionals), meso (care organizations) and macro (legal and  
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16 429 financial framework).<sup>63</sup> The findings will be summarized in matrices with the facilitators and barriers  
17  
18 430 at these three different levels and can be used to develop a guideline for implementation of the  
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21 431 AGCH elsewhere.<sup>64</sup>  
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27 433 Preliminary results  
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31 434 Between February 1<sup>st</sup> and December 20<sup>th</sup>, 2019, there were 362 consecutive admissions to the AGCH.  
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33 435 Of these admissions, 26 were readmissions of patients who were already study participants. Of the  
34  
35 436 remaining 336 admissions, 90 were by patients who did not meet the inclusion criteria. The  
36  
37 437 remaining 246 patients or legal representatives and healthcare-proxy were approached for  
38  
39 438 participation; 212 consented to participation (figure 2). The healthcare-proxy provided informed  
40  
41 439 consent in 62 (29.2 %) of cases. Sixteen patients did not consent to follow-up by telephone but did  
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43 440 consent to medical record review. The total study sample as of December 20<sup>th</sup>, 2019, consisted of  
44  
45 441 212 participants at baseline. Table 2 displays the baseline characteristics of this group. Participants  
46  
47 442 had a mean age (standard deviation) of 81.8 (8.4) years and 47.6 % were male. Most participants  
48  
49 443 were living independently before admission (81.1%). The most frequent admission diagnoses were  
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51 444 infectious diseases (28.3%, mostly urinary tract infections), respiratory-related diseases (25.5%, of  
52  
53 445 which half were pneumonia), and other (geriatric) diagnoses such as falls, delirium or sudden  
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55 446 unexplained functional decline (30.2%). The main cardiovascular (9.4%) admission diagnosis was  
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3 447 exacerbation of heart failure. The median (interquartile range) length of stay was 8.0 days (5.0-12.0),  
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5 448 and 83.7 % of patients were discharged to their original living situation.  
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## 10 11 450 Discussion 12 13

14  
15 451 The complex acute medical needs of older patients require the delivery of specialized geriatric care.  
16

17 452 The traditional hospital environment may however not support recovery and maintaining  
18  
19 453 independence. The AGCH aims to deliver care that focuses on medical treatment, early rehabilitation  
20  
21 454 and proper transitions of care for older adults with multiple chronic conditions.<sup>29,65</sup> The AGCH is  
22  
23 455 unique in the Netherlands in its aim to combine multiple evidenced-based components of care for  
24  
25 456 frail older persons at an alternative location for hospital care. The proposed research will provide  
26  
27 457 insight into the clinical and economic effectiveness of care delivered at the AGCH, compared to  
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29 458 hospital care.  
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34 459 Our preliminary results show that data collection at the AGCH is feasible and we expect to recruit  
35  
36 460 enough patients to evaluate the primary outcome. There are also limitations to the design of this  
37  
38 461 study. It is a non-randomized study and historic cohorts are used as control groups. Therefore,  
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40 462 baseline differences between the intervention and control groups may hamper the matching  
41  
42 463 between the groups. Additionally, the data from the historic cohorts were not collected in the same  
43  
44 464 time period as the AGCH cohort. This is a limitation as work processes in hospitals may have changed  
45  
46 465 over the years, which could influence our results. However, the two control populations do represent  
47  
48 466 a geriatric population that was admitted for exacerbations of chronic conditions and acute illnesses  
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50 467 that frequently occur in older persons. The strengths of the study are the involvement of patients  
51  
52 468 and informal caregivers in the design of the concept of the AGCH. Moreover, a process evaluation  
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54 469 will address the barriers and facilitators to implementation of the AGCH in the Dutch Healthcare  
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3 470 system. In short, this research will provide valuable insights into the implementation of this concept  
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5 471 of care in other regions of the Netherlands and abroad.  
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## 8 472 Ethics and Dissemination

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12 473 This study will be carried out in accordance with the Declaration of Helsinki and current ethical  
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14 474 requirements. The outcomes of this study will be reported according to the STROBE guidelines for  
15  
16 475 cohort studies.<sup>30</sup> This study will evaluate both the effectiveness of this type of care delivery and the  
17  
18 476 costs that are involved, allowing for the system to be implementation elsewhere. The findings of this  
19  
20 477 study will be published in peer-reviewed journals.  
21  
22

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31

### 32 485 33 486 Author contributions

34  
35 487 MER, JMV and RS contributed to the design of the protocol and drafting of the manuscript. IO and  
36 488 BMB made substantial contributions to the design and clinical aspects of the protocol. BMB  
37 489 conceived the study and wrote the funding applications. All authors critically revised the manuscript  
38 490 and approved the final version of this manuscript.  
39

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48

### 49 498 50 499 Patient consent

51 500 Not required.  
52

### 53 501 54 502 Competing interests statement- None Declared

### 55 503 56 504 Ethics approval

57  
58 505 Based on the study protocol, the Ethics Committee (METC) of the Amsterdam University Medical  
59 506 Centre waived the obligation for the study to undergo formal ethical approval as is described under  
60

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3 507 Dutch law in the Medical Research in Humans Act, January 2019 (ref W17\_474 # 19.001). As this is a  
4 508 prospective study and pseudonymised data is used, written informed consent was obtained from the  
5 509 participants prior to participation. This is in line with current European legislation under the General  
6 510 Data Protection Regulation (GDPR).  
7  
8

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3 **Figure 1** Patient admission process and criteria, components of the AGCH intervention and goals.  
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6 (uploaded separately as an image)  
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10 CGA= Comprehensive Geriatric Assessment<sup>29</sup>

11 GP= General Practitioner  
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**Figure 2** Diagram of patient participation between February 1<sup>st</sup> and December 20<sup>th</sup>, 2019.

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**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
<i>1. Medical and demographical data</i>						
<b>Sociodemographic data</b>	Date of birth, age at admission, sex, level of education, living conditions, marital status	R				
<b>Data on admission</b>	Time spent at the ED, admission diagnosis, date and time of admission	R				
<b>Chronic conditions</b>	Charlson Comorbidity Index <sup>38</sup>	R				
<b>Polypharmacy</b>	Number of drugs	R				
<b>Mortality</b>	Date of death		R	R	R	R
<i>2. Cognitive functioning</i>						
<b>Cognitive impairment</b>	Mini-Mental State Examination (MMSE) <sup>31</sup>	R				
<b>Delirium</b>	Safety management system patient screening (VMS) <sup>41</sup> Confusion Assessment Method (CAM) <sup>39</sup> Delirium Observation Scale (DOS) <sup>42</sup>	N/ D	N/ D			
<i>3. Psychosocial functioning and quality of life</i>						
<b>Apathy</b>	Geriatric Depression Scale (GDS-3) <sup>43</sup>	N	R	R	R	R
<b>Social network and informal care</b>	Presence and frequency of informal care	R		R	R	R
<b>Quality of life and health status</b>	EQ-5D <sup>36</sup>	R		R	R	R
<i>4. Physical functioning</i>						
<b>Identifying at-risk-patients</b>	ISAR-HP- Identifying Seniors at Risk score <sup>44</sup>	N				
<b>Functional status</b>	Activities of daily Living (ADL) modified Katz-ADL score <sup>35</sup>	N				
<b>(Im)mobility</b>	Using a walking aid, information from the Katz-ADL questions on exercise	N				
<b>Handgrip strength</b>	Jamar <sup>48</sup>	P				
<b>Gait speed</b>	Short Physical Performance Battery (SPPB) <sup>49</sup>	P				
<b>Falling</b>	Fall history Falls in the AGCH	N	R	R	R	R
	Numeric Rating Scale (NRS) on the fear of falling <sup>34</sup>	N	R	R	R	R
<b>Pain</b>	Numeric Rating Scale (NRS) on pain <sup>50</sup>	N	R	R	R	R
<b>Fatigue</b>	Numeric Rating Scale (NRS) on fatigue <sup>51</sup>	N	R	R	R	R
<b>Nutrition</b>	Short Nutritional Assessment Questionnaire (SNAQ) <sup>52</sup>	N				
<i>5. Healthcare utilization and satisfaction with care</i>						
<b>Medical care during admission</b>	Diagnostics performed in the AGCH Readmission to university hospital Length of stay at the AGCH		R			

<b>Hospital readmission</b>	Readmission rate to the hospital or AGCH		R	R	R	R
<b>Health care utilization</b>	Home care, medical specialist care, temporary institutional care, primary care	R		R	R	R
<b>Satisfaction with Care</b>	Eight question questionnaire <sup>53</sup>		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.

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**Table 2** Baseline characteristics of the study participants

Variable	N=212
<b>Age in years, mean (SD)</b>	81.8 (8.4)
<b>Male, N (%)</b>	101 (47.6)
<b>Living arrangements before admission, N (%)</b>	
Independent	172 (81.1)
Assisted living/senior residence	31 (14.6)
Nursing home/other	9 (4.2)
<b>Marital status, N (%)</b>	
Widow/widower	94 (44.5)
Married or living together	71 (33.6)
Single or divorced	46 (21.8)
<b>Education, N (%)</b>	
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)
<b>Born in the Netherlands, N (%)</b>	158 (76.0)
<b>Katz-ADL (6 item) score<sup>a</sup> upon admission, median (IQR)</b>	3.0 (1.0-5.0)
<b>MMSE score<sup>b</sup>, mean (SD)</b>	23.7 (4.7)
<b>Polypharmacy<sup>c</sup>, N (%)</b>	159 (75.0)
<b>Hospitalization in past 6 months, N (%)</b>	61 (31.1)
<b>Charlson Comorbidity Index<sup>d</sup>, mean (SD)</b>	2.8 (2.0)
<b>Primary admission diagnosis, N (%)</b>	
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

<sup>a</sup>Score ranging from 0-6, with a higher score indicating more dependence in activities of daily living<sup>35</sup>

<sup>b</sup>Score ranging from 0-30, with a score of ≤23 indicating possible cognitive impairment<sup>31</sup>

<sup>c</sup>Use of 5 drugs or more

<sup>d</sup>Ranging from 0-31, with a higher score indicating more severe comorbidity<sup>38</sup>

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## Admission criteria

- Medical and geriatric problem: hospitalization is required
- Expected stay: maximum of 14 days
- Patient from community/region

Emergency department  
of acute hospital

Geriatrician

Acute Geriatric Community Hospital (AGCH)

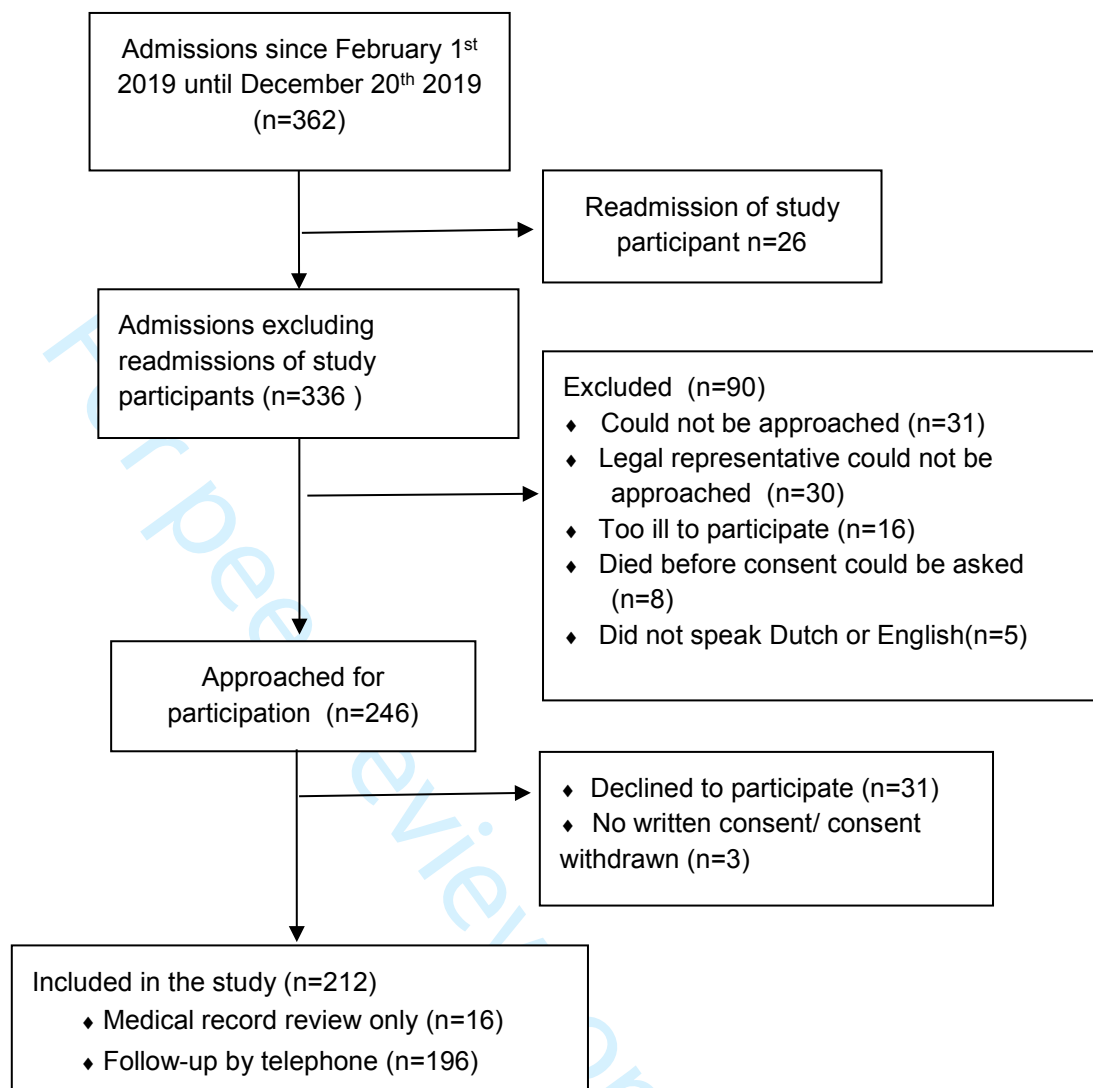
Geriatrician

In the future: home  
or General Practice

## During admission to the AGCH

- Full CGA and interdisciplinary assessment, physiotherapy
- Early discharge and follow-up planning
- Discharge letters are sent to GPs within 48 hours

**Figure 2** Diagram of patient participation between February 1<sup>st</sup> and December 20<sup>th</sup> 2019.



**Supplementary table** Overview of the content and description of (outcome) measurements and timing of measurements at the Acute Geriatric Community Hospital compared to the measurements available in the two control groups.

	Description and/or instrument	H1	H2	P1	P3	P6
<i>1. Medical and demographical data</i>						
<b>Sociodemographic data</b>	Date of birth, age at admission, sex, level of education, living conditions, marital status	T A				
<b>Data on admission</b>	Time spent at the ED*, admission diagnosis, date and time of admission	T A				
<b>Chronic conditions</b>	Charlson Comorbidity Index <sup>38</sup>	T A				
<b>Polypharmacy</b>	Number of drugs	T A				
<b>Mortality</b>	Date of death			T A		
<i>2. Cognitive functioning</i>						
<b>Cognitive impairment</b>	Mini Mental State Examination (MMSE)	T A				
<b>Delirium</b>	Safety management system patient screening (VMS) <sup>41</sup>	T				
	Confusion Assessment Method (CAM) <sup>39</sup>	TA <sup>†</sup> T <sup>†</sup>	T			
	Delirium Observation Scale (DOS) <sup>42</sup>					
<i>3. Psychosocial functioning and quality of life</i>						
<b>Apathy</b>	Geriatric Depression Scale (GDS-3) <sup>43</sup>	A	A	A	A	
<b>Social network and informal care</b>	Presence and frequency of informal care	T		-	-	T
<b>Quality of life and health status</b>	EQ-5D <sup>36</sup>	T A		A	A	T A
<i>4. Physical functioning</i>						
<b>Identifying at-risk-patients</b>	ISAR-HP- Identifying Seniors at Risk score <sup>44</sup>	T				
<b>Functional status</b>	Activities of daily Living (ADL) modified Katz-ADL score <sup>35</sup>	T A	A	A	A	T
<b>(Im)mobility</b>	Using walking aid, information from the Katz-ADL questions on exercise	T A				
<b>Handgrip strength</b>	Jamar <sup>48</sup>	T A	A			
<b>Gait speed</b>	Short Physical Performance Battery SPPB <sup>49</sup>	T A	A			
<b>Falling</b>	Fall history	T A	-	A	A	T
	Falls in the AGCH	n/a	n/a	n/a	n/a	n/a
	Numeric Rating Scale (NRS) on the fear of falling <sup>34</sup>	A	A	A	A	-
<b>Pain</b>	Numeric Rating Scale (NRS) on pain <sup>50</sup>	T A	A	A	A	-
<b>Fatigue</b>	Numeric Rating Scale (NRS) on fatigue <sup>51</sup>	T A	A	A	A	-
<b>Nutrition</b>	Short Nutritional Assessment Questionnaire (SNAQ) <sup>52</sup>	T A				
<i>5. Healthcare utilization and satisfaction with care</i>						
<b>Medical care during admission</b>	Diagnostics performed in the AGCH Readmission to university hospital		n/a			

	Length of stay at the AGCH					
<b>Hospital readmission</b>	Readmission rate to the hospital or AGCH			A	T A	T
<b>Health care utilization</b>	Home care, medical specialist care, temporary institutional care, primary care.	T		A	A	T
<b>Satisfaction with Care</b>	Eight question questionnaire <sup>53</sup>		-	-		

Grey tone= measurement in prospective cohort study at the AGCH.

H1= at admission, H2= at discharge, P1= one month after discharge, P3 = three months after discharge, P6 = six months after discharge.

T= available from *Transitional Care Bridge study(TCB)*<sup>1</sup>

A= available from *Hospital- ADL study(H-ADL)*<sup>2</sup>

\* and - =Not available from TCB or H-ADL

†=Single baseline measurement

n.a.= not applicable



**Appendix 1** STROBE statement checklistSTROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Item found on page
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1 and 3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 3
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 5-7
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 7
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	Page 8 -9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 7-15
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Page 7-10 and 11
		(b) For matched studies, give matching criteria and number of exposed and unexposed	Page 9 and 10
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 11 – 15
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	Page 11-15 (supplementary table)
Bias	9	Describe any efforts to address potential sources of bias	Page 16
Study size	10	Explain how the study size was arrived at	Page 16
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 16

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3	Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding
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6			(b) Describe any methods used to examine subgroups and interactions
7			n/a
8			
9			(c) Explain how missing data were addressed
10			Page 16
11			
12			(d) If applicable, explain how loss to follow-up was addressed
13			Page 16
14			
15			(e) Describe any sensitivity analyses
16			n/a
17	<b>Results</b>		
18	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
19			Page 18 and 26 (figure 2)
20			
21			(b) Give reasons for non-participation at each stage
22			Page 18 and 26 (figure 2)
23			
24			(c) Consider use of a flow diagram
25			Page 26, figure 2
26			
27	Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
28			Page 18,19 and 29
29			
30			(b) Indicate number of participants with missing data for each variable of interest
31			n/a
32			
33			(c) Summarise follow-up time (eg, average and total amount)
34			n/a
35			
36	Outcome data	15*	Report numbers of outcome events or summary measures over time
37			n/a
38			
39	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
40			n/a
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42			(b) Report category boundaries when continuous variables were categorized
43			Page 29
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45			(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
46			n/a
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57	Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
58			n/a
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<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	Page 19
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	Page 19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 19
Generalisability	21	Discuss the generalisability (external validity) of the study results	n/a
<b>Other information</b>			
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	Page 20

\*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>.