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Is Comprehensive Geriatric Assessment admission avoidance hospital at home an alternative to hospital admission for older people? A randomised trial

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Contributions of authors
SS and GE had the original idea, and with CB, AG, PL, LMY, DJS and JY contributed to the design of the study. SS, CB, GE, AG, AH, PK, DJS, LMY, PK, PL, JY obtained funding. ACB and SS were responsible for the day-to-day implementation of the study. SS wrote the first and subsequent drafts of the manuscript, SM with LMY wrote the statistical plan of analysis and did the statistical analysis. JY, GE, PK, SR, RS, AH and AW were site Principle Investigators. All authors critically edited the manuscript. All authors read and approved the final manuscript. SS is guarantor.

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None declared.
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Abstract

Background—Delivering comprehensive geriatric assessment hospital level care in the home is one approach to deal with the increased demand for bed based hospital care, but clinical effectiveness is uncertain.

Objective—To assess the clinical effectiveness of admission avoidance hospital at home with comprehensive geriatric assessment for older people.

Design—Multi-site randomised trial.

Setting—Nine hospital and community sites in the U.K.

Patients—1055 older people who were medically unwell and physiologically stable referred for a hospital admission.

Intervention—Admission avoidance hospital at home with Comprehensive Geriatric Assessment compared with hospital admission with Comprehensive Geriatric Assessment when available, using 2:1 randomization.

Measurements—The primary outcome living at home was measured at six months. Secondary outcomes were new admission to long-term residential care, mortality, health status, delirium and patient satisfaction.

Findings—Participants had a mean age of 83.3 (SD 7.0) years. At six months follow-up 528/672 (78.6%) in hospital at home and 247/328 (75.3%) in the hospital group were living at home (RR 1.05, 95% CI: 0.95 to 1.15, P=0.36); 114/673 (16.9%) vs 58/328 (17.7%) had died (RR 0.98, 95% CI: 0.65 to 1.47, P=0.92); and 37/646 (5.7%) vs 27/311 (8.7%) were in long-term residential care (RR 0.58, 95% CI: 0.45 to 0.76; P<0.001).

Limitation—The findings are most applicable to older people referred from a hospital short-stay acute medical assessment unit; episodes of delirium might have been undetected.

Conclusion—Hospital at home with Comprehensive Geriatric Assessment led to similar outcomes to hospital admission in the proportion of older people living at home, and a reduction in admissions to long-term residential care at six months. This type of service can provide an alternative to hospitalisation for selected older people.

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Background

A long standing ambition in many countries is to establish out-of-hospital services to effectively meet the healthcare needs of older people and contain costs. (1–3) Efforts to develop these services have accelerated over the last year (4) as the COVID-19 pandemic challenges the capacity of healthcare facilities, and increases the susceptibility of older people to the risks associated with hospitals and care homes. (5) Out of hospital services designed for older people who are vulnerable to a decline in health aim to reduce the risk of a loss of independence associated with hospitalisation and subsequent admission to institutional care. (6) Avoiding admission to hospital also aligns with older peoples' preference to receive hospital level healthcare in their home if similar outcomes can be achieved. (7) A central tenet of out-of-hospital care for older people is person centred co-ordinated multi-disciplinary care, (8–10) building on the success of the multi-dimensional assessment and therapeutic process of Comprehensive Geriatric Assessment (CGA) in improving health outcomes of older people admitted to hospital. (11)

Extending Comprehensive Geriatric Assessment (CGA) to admission avoidance hospital at home settings might reduce the risk of serious complications for older adults, (12, 13) who are more likely to maintain their existing care arrangements and routines when receiving healthcare in their home. (14) Evidence to support the expansion of these services is limited to a small number of small single site randomised trials, with imprecise and inconsistent findings. (9) We therefore conducted a multi-site randomised trial of CGA admission avoidance HAH, compared to inpatient care with CGA when possible, to generate evidence for planning health services for older people. (15)

Methods

Design overview

We conducted a participant randomised trial in nine sites in the United Kingdom (Appendix Table 1), using a 2:1 ratio (2 CGA HAH: 1 inpatient hospital) as the services were

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established to ease demand for acute hospital beds. The trial protocol was published, (12) approved by the England and Wales Research Ethics Committee [14/WA/1081] and Scotland Research Ethics Committee [14/SS/1046]; the information sheets and consent forms were approved by the Northern Ireland sub-committee of the Health and Social Care Board. Details of approved amendments are described in Appendix Table 2. All participants provided informed consent before randomisation. The University of Oxford was the Sponsor.

Setting and Participants

We recruited older people considered for an unplanned hospital admission from a hospital short-stay acute assessment unit (a dedicated facility that acts as the focus for acute medical care for patients who have presented as medical emergencies to hospitals), or their home. Participants were referred to the trial by the on-call hospital attending physician or one of their team, emergency department staff, or primary care physicians if recruited from home. A trained research nurse working with an attending geriatrician screened admissions to the assessment unit for potentially eligible participants.

Participants were eligible if they were i) 65 years or older; ii) willing and able to give informed consent, or if lacking capacity to consent they had a personal consultee, healthcare proxy or an Independent Mental Capacity Advocate; iii) had been referred to a geriatrician-led admission avoidance hospital at home service with CGA and would otherwise require hospital admission; and iv) English speaking. The presence of a caregiver was not a requirement for enrolment. Participants were excluded if they had (i) an acute coronary syndrome; (ii) required an acute surgical assessment; (iii) a suspected stroke; (iv) were receiving end of life care; (v) refused admission to CGAHAH or were considered by the clinical staff to be too high risk for home-based care, this could include an unsafe home environment; (vi) patients who lived in a residential care setting. An unsafe home environment was one in which a delirious patient was at risk from falling, the house stairs were too steep or lacked a hand rail, there was no heating, no hot water or public health concern due to poor housing conditions.

The consent process took into account the Mental Capacity Act (2005) in England and Wales, the Mental Capacity Act (2016) in Northern Ireland and the Adults with Incapacity Act (2000) in Scotland. If a participant lacked capacity and their consultee or healthcare proxy lived elsewhere, consent was taken verbally over the phone and paperwork was sent to the consultee or healthcare proxy to be signed and returned to the site. Capacity was assessed at each follow-up visit and participants reconsented if their capacity changed.

Randomization and Interventions

Eligible participants who provided informed consent were randomly allocated to CGAHAH or hospital admission using Sortition, the Oxford University's Primary Care Clinical Trials Unit's validated secure online randomisation system. Randomisation was stratified by site, gender and cognitive status measured prior to randomisation by the Informant Questionnaire on Cognitive Decline in the Elderly. (16)

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Admission avoidance CGAHAH is equivalent to bed based hospital care for older people with frailty who are medically unwell and physiologically stable, (17) it is a rapid response service that assesses a patient within one to two hours of referral and is provided for a limited time. Similar to bed based hospital care for this population, the acute medical problem is treated in the context of physical, psychological, social and functional issues to optimise recovery and that require multidisciplinary care. Radiological investigations are prioritised as if in hospital, with CGAHAH organising transport. During the design of the trial we established four core components (18) that had to be present for the CGAHAH intervention to provide an alternative to hospitalization. These were i) geriatrician-led admission avoidance HAH; ii) a multi-disciplinary team; iii) healthcare guided by the principles of CGA, that included virtual rounds; and iv) direct access acute hospital based healthcare, such as diagnostics and transfer to hospital. The multi-disciplinary team included nurse practitioners who shared responsibility with the attending geriatrician for clinical assessments, arranged investigations, documentation, discharge summaries and prescribing; physiotherapists and occupational therapists. There was access to social care, mental health nurses and old age psychiatrists. Virtual rounds were held at least daily, the majority of services provided home oxygen, and intravenous medications. During the study we monitored the delivery of the CGAHAH by regular site visits, and conference calls with the site teams.(14) Further details of how CGAHAH was organised, who delivered and co-ordinated healthcare are provided in Appendix Table 3.

At the outset we anticipated that the type of hospital care delivered to the hospital group would vary, and due to demand for bed based hospital care approximately 80% of those allocated to the hospital group would receive geriatrician led care with Comprehensive Geriatric Assessment, 20% general medical hospital care without input from an attending geriatrician and all would receive multi-disciplinary care

Outcomes and Follow-up

Our primary outcome was ‘living at home’ (the inverse of death or long-term residential care) at six months, with longer term follow-up at twelve months. We initially planned to measure the primary outcome at twelve months, at the fifth meeting of the Data Monitoring Committee it was decided to amend to six months and to limit the secondary outcomes measured at 12 months to living at home, as it was more likely in the population recruited that any effect would be detected prior to 12 months. This was also agreed by the Trial Steering Committee and approved by the funder.

Secondary outcomes measured at 6 months were each component of the primary outcome (death, and admission to long term residential care (measured as yes or no at each data collection)); cognitive impairment measured by the Montreal Cognitive Assessment; (19) activities of daily living by the Barthel Index; (20) co-morbidity by the Charlson index, (21) readmission or transfer to hospital (also measured at one month), and length of stay (for the cost-effectiveness analysis). Delirium, assessed by the Confusion Assessment Method (CAM), was measured at three and five days and one month. (22). Patient satisfaction, measured by the Patient-Reported Experience questionnaire, was completed by participants

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at one month. (23) The EuroQoL (EQ-5D-5L) was completed by the research nurses at 6 months. (24)

Expected adverse events for this population included falls, pressure sores, hospital or community-acquired infection, transfer to hospital and death; these were also identified as potential risks to participants from the research. All serious adverse events that were unexpected and possibly related to the research were recorded on the case report form by the site research nurse at each follow-up time, and assessed for seriousness by the site clinician. Categories of seriousness were listed as fatal, life threatening, required hospitalization or prolongation of existing hospitalization, significant disability or incapacity, or another important medical event. Relatedness was assessed by a medically qualified research investigator and recorded on the serious adverse event form as 'not related, possibly related, probably related or definitely related.' All serious adverse events related to the research and unexpected were notified to the Research Ethics Committee by the chief investigator (SS) within 15 working days. (25)

Data were collected by trained research nurses using a paper form and were double entered, or were directly entered to an electronic pro forma on Open-Clinical Enterprise V 3.5.

Statistical analysis

Our study effect estimate was based on a hospital event rate of 50% with a 10% reduction in living in a residential setting to 40% in the CGAHAH group, equal to a relative risk of 0.80 which was towards the top end of the 95% confidence interval for a pooled estimate for mortality. (26) (27). Initially we calculated a sample size of 1552, with 90% power, based on 15% attrition for the primary outcome at 12 months. When we observed a lower attrition of 6% and reduced recruitment rate we revised the sample size to 1055 with 83% power and a significance level of 0.05 (2-sided) for the primary outcome.

The primary analysis included all participants for whom data were available, according to the group participants were randomly allocated to regardless of deviation from protocol. For the primary outcome living at home at 6 months, and other binary outcomes (long-term residential care, mortality, readmission or transfer to hospital, cognitive impairment, and delirium), we used a log-Poisson generalised linear mixed-effect model and calculated the predicted probabilities for each outcome to test the assumptions of the model. A mixed-effect logistic regression was used if the assumption of the log-Poisson model failed. A linear mixed-effect model was used for activities of daily living measured by the Barthel Index, and quality of life measured by the EQ-5D. The models adjusted for intervention arm, gender, IQCODE score as fixed effects, and site as a random effect. The models for the binary outcomes (living at home, long-term residential care, mortality, readmission or transfer to hospital, cognitive impairment and delirium) used robust standard errors, included an additional fixed effect for the interaction between intervention arm and time point for living at home, mortality and long-term residential care, a random intercept for each participant and an unstructured covariance matrix of the random effects. The models for cognitive impairment, delirium, and activities of daily living also adjusted for the baseline score as a fixed effect. (28)

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We planned one subgroup analysis of the effect of home versus hospital on delirium in people who were cognitively impaired. (19) Due to the small number of participants with delirium, assessed by the CAM, (22) six individual log-Poisson generalised linear mixed models with robust standard errors were fitted to the data at each time point; the models included site as random effect.

Sensitivity analyses

Pre-planned analysis was conducted for the primary outcome living at home to explore the sensitivity of the results to i) replacing missing data for long-term residential care and/or death status with not living in long-term residential care and/or alive, or living in long-term residential care/or dead; ii) using multiple imputation; iii) adjusting for factors that predicted data were missing (education level, place of assessment, presenting problem); and iv) analysing the six and 12 month outcome of living at home in the same model. For the multiple imputation method, we first explored the association between baseline covariates and the availability of the primary outcome (i.e. missing or not missing) using logistic regression. A multiple imputation was conducted using factors that were either predictive of missingness or associated with the outcome (gender, age, education, place of baseline assessment, site, presenting problems and clinical diagnosis of delirium at baseline) in the model. Missing values were imputed with logistic regression using chained equation. Ten imputed datasets were generated, the primary outcome was re-analyzed and pooled using Rubin's rule (29). Analysis was done using STATA SE version 16.1.

We conducted one post-hoc analysis, using a complier average causal effect to assess the primary outcome for those who received CGAHAH vs hospital, assuming that the non-compliers in each arm would have the same response.

The role of the funding source

The funder had no role in the study design, data collection, analyses, and interpretation of the findings or decision to submit the manuscript for publication.

Results

Between February 9th2015 and June 18th2018, 4805 individuals were screened for eligibility, 2169 (45%) were not eligible, 1581 (33%) were potentially eligible and did not participate, and 1055 (22%) were recruited to the trial using a 2:1 allocation ratio (CGAHAH = 700, 66.4%; hospital n= 355, 33.7%) (Figure 1). The main reason for declining to participate was participant preference for CGAHAH. The majority (77.6%) of participants were recruited from a hospital short stay acute medical assessment unit, and 22.1% from primary care. The first participant was recruited on 14th March 2015, the last follow-up for missing data was September 10th 2019. Details of recruitment by site are available in Appendix Table 1.

Patient characteristics

The average age of participants was 83.3 (SD 7.0) years, 72.3% had some cognitive impairment (Montreal Cognitive Assessment score <26), 6.8% delirium and for 31.7%

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consent was signed by a consultee or healthcare proxy. Participants were referred with health problems and diagnoses that are typically associated with hospital admission for this population (details reported in Table 1), over 60% reported moderate or severe problems with mobility (Appendix Table 4 EQ-5D 5L) and 38% reported difficulties with activities of daily living (Barthel score of <15/20;(30) Appendix Table 5).

Thirty-seven participants allocated to CGAHAH were immediately admitted to hospital due to a further decline in health. Of those randomised to hospital 76/345 (22.0%) were instead admitted to CGAHAH due to participant preference or a high rate of hospital bed occupancy diverted participants to CGAHAH, 64/345 (18.6%) received general medical care without CGA, 138/345 (40.0%) specialist care with CGA, 42/345 (12.2%) care on a general medical ward with geriatrician-led CGA, and for 25/345 (7.3%) the type of hospital based care was not recorded. Characteristics at baseline were similar between groups (Table 1).

All results are reported for CGAHAH versus hospital. Twenty three participants were not included in the analysis due to withdrawing consent to use their data (N=10), a deterioration in health that prevented data collection (N=4), previously recruited (N=4), lived outside the CGAHAH area (N=1), <65 years (N=1) or withdrew after randomization with incomplete data (N=3). Initial average length of stay for those allocated to CGAHAH was 6.89 (SD 5.46) CGAHAH days and 5.25 (SD 8.00) hospital days in the hospital group. The 37 allocated to CGAHAH and who were admitted to hospital had on average 1.39 (SD 4.70) days in hospital (averaged over 678 participants). There was no evidence of a difference in 'living at home' (not being dead and living at home) at six (RR 1.05, 95% CI: 0.95 to 1.15; P=0.36) or 12 months (RR 0.99, 95% CI 0.89 to 1.10; P=0.80) (see Appendix Table 6 for data by site), or in the risk of death at six (RR 0.98, 95% CI 0.65 to 1.47; P=0.92) or 12 months (RR 1.14, 95% CI: 0.80 to 1.62; P=0.47). There was a reduction in long-term residential care in the CGAHAH group at six (RR 0.58, 95% CI: 0.45 to 0.76; P<0.001) and at 12 months (RR 0.61, 95% CI 0.46 to 0.82; P<0.001); an increased risk of readmission or transfer to hospital in the CGAHAH group at one month (RR 1.32, 95% CI 1.06 to 1.64; P=0.012), and not at six months (RR 0.95, 95% CI 0.86 to 1.06; P=0.40) (Table 2). There was no evidence of a difference in the risk of cognitive impairment (Montreal Cognitive Assessment <26) (RR 1.06, 95% CI 0.93 to 1.21, p<0.36; CGAHAH N= 407, Hospital N= 183), activities of daily living measured by the Barthel Index (mean difference 0.24, 95% CI: [-0.33 to 0.80]; P=0.40; CGAHAH N=521, Hospital=256) the Charlson measure of co-morbidity (adjusted mean difference 0.0002, 95% CI -0.15 to 0.15, P=0.10, HAH n= 474, Hospital n= 227) or quality of life (EQ-5D VAS mean difference 0.32, 95% CI -3.08 to 3.73) at six months (Appendix Table 7).

There was no evidence of a difference between groups for the presence of delirium at three (RR 1.12 95% CI: 0.54 to 2.29; P=0.76) or five days (RR 0.93, 95% CI: 0.34 to 2.47; P=0.87), and a relative reduction in the CGAHAH group at one month (RR 0.38, 95% CI: 0.19 to 0.76; P=0.006) (Table 3). On average those who had an episode of delirium had a lower mean Montreal Cognitive Assessment score (CGAHAH mean 10.7 (SD 5.4), hospital mean 13.6 (SD 7.7)), compared with the baseline mean for the study population (20.5, SD 6.7, N=790). Participants who received CGAHAH reported higher levels of satisfaction in response to questions about the length of time waiting for care to start, staff receiving

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information about the patient's condition, the aims of care, how to contact staff, involvement in decisions and discussions with healthcare staff about further health or social care services (Appendix Table 8). There was no evidence of a difference between groups for the presence of delirium in the sub-group with a Montreal Cognitive Assessment score of <26, due to a small number of events a P-value for the sub-group interaction was not calculated (Appendix Table 9).

The majority of the predicted probabilities derived from the log Poisson model for each outcome did not exceed 1. Similar results for the primary outcome living at home were obtained from the sensitivity analyses (Appendix Table 11). Results from a post-hoc CACE analysis of the primary outcome did not differ from the main analysis (Appendix Table 11). A copy of the Stata code is included in Appendix Table 12.

Research related serious adverse events

One participant in the CGAHAH group was reported to have experienced an unexpected serious adverse event that was fatal due to metabolic acidosis caused by alcohol excess and poor diabetic control. This was reported to the Research Ethics Committee.

Insert Table 3 Here

Discussion

This multi-site randomised trial investigated clinical outcome differences between admission avoidance CGAHAH and hospitalisation, and found no difference in the proportion of participants living at home at six months follow-up. There was a relative reduction in long-term residential care for those allocated to CGAHAH at six and 12 months follow-up, and in delirium at one month. There were similar outcomes for mortality and cognitive impairment, and there was no evidence of a difference in activities of daily living or co-morbidity. The CGAHAH group had a 32% relative increase in transfer to hospital at one month follow-up but not at six months. Patient satisfaction was in favour of the CGAHAH service.

Our study has several strengths and limitations. Randomisation led to similar baseline characteristics between groups, there was a high collection rate for the primary outcome and high rates for the remaining outcomes with the exception of cognitive impairment. Bias from participants being aware of their allocation group was minimised by using objective measures of the primary outcome, mortality and new long-term residential care. Sensitivity analyses showed little or no change when missing data were imputed with different outcomes. Our study population comprised "old older" people (average age 83 years), this might explain similar mortality rates at six months. The finding of a reduction in delirium at one month in the CGAHAH group is limited by the small numbers of cases identified, possibly due to the selection of older people considered suitable for home management or under detection of delirium. (31) A higher rate of transfer to hospital suggests the population recruited to the trial had sufficient illness severity to necessitate hospital based care, it is also possible that limited availability of overnight care contributed to the higher transfer rate.

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Generalising the findings from this study to other settings is most appropriate to CGAHAH services that have direct access to elements of acute hospital based healthcare, such as diagnostics and transfer to hospital. We investigated CGAHAH services that were established prior to the study, this might limit the findings to services that are beyond the initial set up phase. A degree of flexibility was necessary to provide healthcare tailored to the individual, to minimise variation we established core features that had to be present for a CGAHAH service to substitute for bed based hospital care. The main difference among sites was that one site recruited from primary care, and the remaining from a hospital short-stay acute medical assessment unit. Thus, our results are more strongly related to patients who were referred after a specialist assessment process in a hospital, this population usually has a sudden decline in function and might differ from the majority referred from primary care. A distinctive feature of this study is the inclusion of old older people during an acute health crisis, a population that does not often participate in research, (1) who had a range of health problems associated with hospital admission and are likely to be representative of an urban or semi-urban older population. This provides some confidence in the generalisability of the trial population to the population that might use this type of healthcare as part of routine care. (32, 33)

Pragmatic explanations for a reduction in admissions to residential care include the lack of opportunity by hospital based staff to observe how an individual manages at home, continuation of existing care arrangements during CGAHAH might also have facilitated remaining at home. Our findings add certainty to the findings of a systematic review of admission avoidance HAH with a similar estimate of mortality, a lower risk for admission to long-term residential care though with some inconsistency for this outcome, (9) and an overview of alternative strategies to hospital based care. (13) Further research that integrates a stronger element of carer support might reduce the risk of additional burden on older people and their often complex support networks from these services, particularly in the context of rising demand for domiciliary and social care. (14, 34) Assessing how the shift of care from hospitals to the home fits with existing hospital and community based services and financing is important to capture any unintended consequences. (35) Employing remote monitoring alongside multi-disciplinary care might also have a role, but would have to be balanced against the care needs of this population.(36)

Among older people who were medically unwell and referred to bed based hospital care, there were similar outcomes for living at home for CGAHAH compared with hospital admission, advantages in favour of home for a reduction in admissions to long-term residential care at six months and delirium at one month follow-up, but an increase in transfer to hospital during the first month. This possible trade-off in resource use is fully explored in a separate economic analysis. A health system that includes admission avoidance CGAHAH can create additional acute healthcare capacity for older people referred for a hospital admission.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Data sharing

Requests for access to data will be considered in line with the Nuffield Department of Population Health's Data Access Policy [https://www.ndph.ox.ac.uk/data-access]. Further information can be obtained from the corresponding author

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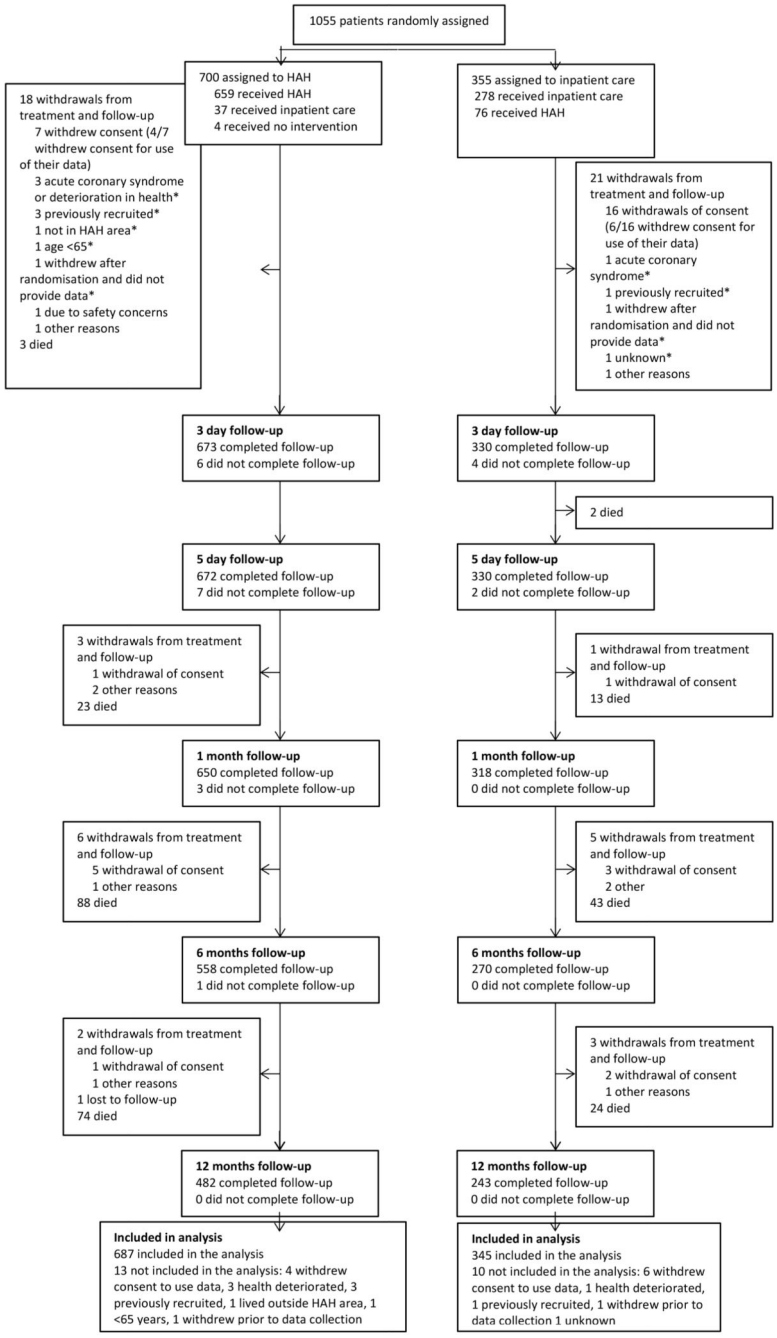

Figure 1. CONSORT flow diagram of trial participants

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Table 1

Baseline characteristics by treatment group*

	CGA hospital at home (N=687)	Hospital (N=345)	Total randomised and included in the analysis (N=1032)
Age (years)			
Mean (sd)	83.3 (7.0)	83.3 (6.9)	83.3 (7.0)
[range]	[65.0 to 102.5]	[65.1 to 102.9]	[65.0 to 102.9]
Missing	*0*	*0*	*0*
Gender			
Male, n(%)	269 (39.2%)	138 (40.0%)	407 (39.4%)
Female, n(%)	418 (60.8%)	207 (60.0%)	625 (60.6%)
Missing	*0*	*0*	*0*
Education level			
Left school < 16 years, n(%)	577 (85.2%)	287 (85.9%)	864 (85.5%)
Upper secondary, n(%)	58 (8.6%)	26 (7.8%)	84 (8.3%)
Higher education, n(%)	42 (6.2%)	21 (6.3%)	63 (6.2%)
Missing	*10*	*11*	*21*
Consent signed by consultee or healthcare proxy	107 (30.9%)	58 (33.3%)	165 (31.7%)
Missing	341	171	512
Presenting problem n (%)			
Acute functional deterioration	254 (37.1% %)	128 (37.1%)	382 (37.01%)
Fall	145 (21.1%)	74 (21.5%)	219 (21.2%)
Shortness of breath	79 (11.5%)	42 (12.2%)	121 (11.8%)
Confusion, dementia, delirium	48 (7.0%)	19 (5.5%)	67 (6.5%)
Respiratory tract infections and other respiratory conditions	36 (5.2%)	20 (5.8%)	56 (5.4%)
Gastrointestinal disorders, that included infection	23 (3.4 %)	17 (4.9%)	40 (3.9%)
Heart failure	16 (2.3%)	6 (1.7%)	22 (2.1%)
Musculoskeletal disorders	15 (5.5%)	9 (6.5%)	24 (5.9%)
Other	69 (10.2%)	30 (8.7%)	99 (9.6%)
Missing	*2*	*0*	*2*
Diagnosis			
Cardiovascular diagnosis, n (%)	90 (13.4%)	35 (10.7%)	125 (12.5%)
Chest pain, n (%)	0 (0.0%)	2 (0.6%)	2 (0.2%)
Infection, n (%)	310 (45.1%)	148 (42.9%)	458 (44.4%)
Delirium, ** n (%)	26 (3.9%)	20 (6.1%)	46 (4.6%)
Respiratory conditions, included infections and COPD, n (%)	49 (7.3%)	24 (7.3%)	73 (7.3%)
Shortness of breath, n (%)	8 (1.2%)	3 (0.9%)	11 (1.1%)
Palpitations, dizziness, vertigo, n (%)	5 (0.7%)	5 (1.5%)	10 (1.0%)

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	CGA hospital at home (N=687)	Hospital (N=345)	Total randomised and included in the analysis (N=1032)
Gastrointestinal disorders, included gastrointestinal infections, n (%)	22 (3.3%)	12 (3.7%)	34 (3.4%)
Urological disorders, included urinary tract infections, n (%)	23 (3.4%)	14 (4.3%)	37 (3.7%)
Acute functional decline, n (%)	11 (1.6%)	13 (4.0%)	24 (2.4%)
Metabolic conditions, n (%)	11 (1.6%)	7 (2.1%)	18 (1.8%)
Haematological conditions, n (%)	10 (1.5%)	3 (0.9%)	13 (1.3%)
Musculoskeletal disorders, n (%)	18 (2.7%)	9 (2.8%)	27 (2.7%)
Neurological disorders, n (%)	4 (0.6%)	3 (0.9%)	7 (0.7%)
Skin conditions, included cellulitis and wound infections, n (%)	17 (2.5%)	5 (1.5%)	22 (2.2%)
Generally unwell, more than one diagnosis n (%)	34 (4.9%)	9 (2.6%)	43 (4.2%)
Fall related diagnosis, n (%)	36 (5.3%)	15 (4.6%)	51 (5.1%)
Missing	*13*	*18*	*31*
Presence of delirium (Confusion Assessment Method)			
Present, n (%)	46 (6.7%)	24 (7.0%)	70 (6.8%)
Absent, n (%)	640 (93%)	319 (93%)	959 (93.%)
Missing	*1*	*2*	*3*
Cognitive impairment (Montreal			
Cognitive Assessment			
Abnormal (score < 26), n (%)	375 (71.6%)	196 (73.7%)	571 (72.3%)
Normal (score ≥ 26), n (%)	149 (28.4%)	70 (26.3%)	219 (27.7%)
Missing	*163*	*79*	*242*
Activities of daily living (Barthel index)			
Mean (sd)	15.3 (4.1)	14.8 (4.7)	15.2 (4.3)
[range]	[0.0 to 20.0]	[0.0 to 20.0]	[0.0 to 20.0]
Number with a score <15	254 (37.1%)	134 (39.6%)	388 (38.0%)
Number with a score ≥ 15	430 (62.9%)	204 (60.4%)	634 (62.0%
Missing	*3*	*7*	*10*
Known cognitive decline (Informant Questionnaire Cognitive Decline in the Elderly)			
Mean (sd)	3.5 (0.6)	3.5 (0.6)	3.5 (0.6)
[range]	[2.0 to 5.0]	[1.0 to 5.0]	[1.0 to 5.0]
< 3.5, n (%)	425 (62.6%)	217 (63.3%)	642 (62.8%)
≥ 3.5, n (%)	254 (37.4%)	126 (36.7%)	380 (37.2%)
Missing	*8*	*2*	*10*
Co-morbidity (Charlson index)			
Mean (sd)	6.0 (1.9)	5.9 (1.8)	6.0 (1.8)
[range]	[1.0 to 15.0]	[1.0 to 12.0]	[1.0 to 15.0]
Missing	*111*	*74*	*185*
Health status - EQ5D-5L VAS			

	CGA hospital at home (N=687)	Hospital (N=345)	Total randomised and included in the analysis (N=1032)
Mean (sd)	56.8 (21.4)	55.6 (22.9)	56.4 (21.9)
[range]	[0.0 to 100.0]	[0.0 to 100.0]	[0.0 to 100.0]
Missing	*13*	*14*	*27*

*Percentages computed using denominator that excludes missing responses

**A clinical diagnosis of deliriumTable 2 Adjusted and unadjusted relative risks for the primary and secondary outcomes

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Table 2
Adjusted and unadjusted relative risks for the primary and secondary outcomes

	CGA HAH (n=687)	Hospital (n=345)	Unadjusted relative risk (95% CI)	P-value	Adjusted relative risk (95% CI)	P-value
Primary Outcome						
Living at home at 6 months *	528 (78.6%)	247 (75.3%)	1.04 (0.94 to 1.16)	0.44	1.05 (0.95 to 1.15)	0.36
Missing	*15*	*17*				
Secondary Outcomes						
Living at home at 12 months *	443 (66.1%)	219 (67.4%)	0.98 [0.88 to 1.10]	0.72	0.99 [0.89 to 1.10]	0.80
Missing	17	20				
Death at 6 months †	114 (16.9%)	58 (17.7%)	0.98 (0.65 to 1.49)	0.94	0.98 (0.65 to 1.47)	0.92
Missing	*15*	*17*				
Death at 12 months †	188 (28.1%)	82 (25.2%)	1.14 (0.80 to 1.63)	0.47	1.14 (0.80 to 1.62)	0.47
Missing	*17*	*20*				
Long-term residential care at 6 months †	37 (5.7%)	27 (8.7%)	0.54 (0.43 to 0.69)	p<0.001	0.58 (0.45 to 0.76)	P<0.001
Missing	*41*	*34*				
Long-term residential care at 12 months †	39 (6.0%)	27 (8.7%)	0.57 [0.45 to 0.73]	p<0.001	0.61 [0.46 to 0.82]	P<0.001
Missing	*41*	*34*				
Readmission or transfer to hospital at 1 month †	173 (25.7%)	64 (19.4%)	1.33 (1.07 to 1.65)	0.011	1.32 [1.06 to 1.64]	0.012
Missing	*15*	*15*				
Readmission or transfer to hospital at 6 month †	343 (54.4%)	171 (56.6%)	0.96 (0.86 to 1.08)	0.49	0.95 [0.86 to 1.06]	0.40
Missing	*56*	*43*				

* Log-Poisson generalised linear mixed model with robust standard errors of living at home at each time point modelled against intervention arm, gender, known cognitive decline (IQCODE score) as fixed effects; and centre as a random effect.

† For mortality, long-term residential care at six and 12 months, and readmission or transfer to hospital at 1 and 6 months: Log-Poisson generalised linear mixed model with robust standard errors and an unstructured covariance matrix of the random effects of the outcomes at both time points modelled against intervention arm, time point, gender, known cognitive decline (IQCODE score), and an interaction between randomised group and time point as fixed effects; centre as a random effect and a random intercept for each participant

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Table 3

Presence of delirium * measured by the Confusion Assessment Method (CAM) at 3 and 5 days, and 1 month

	CGA HAH (n=687)	Hospital (n=345)	Adjusted relative risk* (95% CI)	P-value
Presence of delirium (CAM)				
Baseline	46 (6.7%)	24 (7.0%)		
Missing	1	2		
3 days	25 (3.9%)	11 (3.5%)	1.12 [0.54 to 2.29]	0.76
Missing	42	33		
5 days	17 (2.7%)	9 (3.0%)	0.93 (0.34 to 2.47)	0.87
Missing	49	37		
1 month	10 (1.7%)	13 (4.4%)	0.38 (0.19 to 0.76)	0.006
Missing	85	48		

* Log-Poisson generalised linear mixed model with robust standard errors and site as random effect was fitted separately for each time point. Baseline covariates (i.e. gender and IQCODE score) were not fitted to the model due to low number of events.

* 16 participants were CAM positive at both baseline and 3 days (HAH: 9; Hospital: 7); 12 participants were CAM positive at both 3 days and 5 days (HAH: 8; Hospital: 4) 3 participants were CAM positive at both 5 days and 1 month (HAH: 2; Hospital: 1)