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Protocol for a mixed methods and multi-site assessment of the implementation process and outcomes of a new community-based frailty programme

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Protocol for a mixed methods and multi-site assessment of the implementation process and outcomes of a new community-based frailty programme

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Abstract

Background: Frailty is increasing in prevalence internationally with population ageing. Frailty can be managed or even reversed through community-based interventions delivered by a multidisciplinary team of professionals, but to varying degrees of effectiveness. However, many of these care models' implementation insights are contextual and may not be applicable in different cultural contexts. The Geriatric Service Hub (GSH) is a novel frailty care programme in Singapore, that includes key components of frailty care such as comprehensive geriatric assessments, care coordination and the assembly of a multidisciplinary team. This study aims to gain insights on the factors influencing the implementation approaches adopted by five participating sites, and the effectiveness of the programme.

Methods: We will adopt a mixed methods approach that includes a qualitative evaluation among key stakeholders and participants in the programme, through in-depth interviews and focus group discussions. The main topics covered include factors that affected the development and implementation of each programme, operations and other contextual factors that influenced implementation outcomes. The quantitative evaluation (1) monitors each programme's care process through quality indicators, (2) a multiple-time point survey study to compare programme participants' pre- and post- outcomes on patient engagement (collaboRATE and 13-item Patient Activation Measure; PAM), healthcare experiences (Consumer Assessment of Healthcare Providers and System Clinician and Group Survey Version 3.0; CG-CAHPS), health status and quality of life (Barthel Index of Activities of Daily Living, fall counts, the EuroQol questionnaire and the Control, Autonomy, Self-realisation and Pleasure scale; CASP-19), impact on caregivers (Zarit Burden Interview) and societal costs (Client Service Receipt Inventory). (3) A

retrospective cohort design to assess healthcare and cost utilisation between participants of the programme and a propensity score matched comparator group.

Discussion: The GSH sites share a common goal to increase the accessibility of essential services to frail older adults and provide comprehensive care. The results of this evaluation study will provide valuable evidence to the impact and effectiveness of the GSH and inform the design of similar programmes targeting frail older adults.

Trial Registration: To be provided

Keywords: Frailty care, comprehensive geriatric assessment, care coordination, multidisciplinary team care

List of Abbreviations used in manuscript:

UK	United Kingdom
CGAs	Comprehensive Geriatric Assessments
GSH	Geriatric Services Hub
RHS	Regional Healthcare Systems
CFS	Clinical Frailty Scale
GPs	General Practitioners
NTFGH	Ng Teng Fong General Hospital
PAM-13	13-item Patient Activation Measure
CG-CAHPS	Consumer Assessment of Healthcare Providers and System Clinician & Group Survey Version 3.0
ADL	Activities of Daily Living
CASP-19	19-item Quality of Life Scale
ZBI	Zarit Burden Interview
CSRI	Client Service Receipt Inventory
NRIC	National Registration Identity Card
GLM	Generalised Linear Models
IRRs	Incident-rate Ratios

Background

Frailty denotes a state of increased vulnerability due to age-associated decline in function and reserve such that the ability to cope with day-to-day or acute stressors is compromised (1). As a result, frail older adults are usually more susceptible to adverse outcomes including disability, hospitalisation, and mortality (2). A representative population study in the United States reported a frailty prevalence of 15% amongst community-dwelling older adults (3). Meanwhile, a study of older adults conducted based on the United Kingdom (UK) biobank reported 39% as prefrail and 4% as frail. Similar trends are observed in Singapore, an Asian island-state of 5.7 million (4), which is also one of the most rapidly ageing countries in the world (5). The reported prevalence of frailty in Singapore ranged from 5.7% to 6.2% with corresponding 37% to 46% for pre-frailty (6-8) among community-dwelling older adults, depending on the population studied and identification tool used (9).

Frailty can be managed and even reversed (10). With almost 40% of our population assessed as frail or in danger of becoming frail, there is a strong need to equip the Singapore healthcare system to identify and manage frailty (11). In order to accomplish this whilst addressing the complex care needs of frail older adults, care has shifted from a disease-specific to a comprehensive approach (12). Comprehensive care for frail older adults usually comprises several components, including comprehensive geriatric assessments (CGAs), multidisciplinary teams, integrated care plans and a variety of services to cater to the healthcare and social needs of these frail older adults (13). Screening for frailty can identify individuals who are most likely to benefit from a CGA and targeted interventions (14). In 2017, England became the first in the world to mandate the assessment of frailty in adults aged 65 years old and older. The widespread

78 deployment of the electronic frailty index, which automatically grades frailty using data available
79 in the primary care electronic medical records (15), supported this national effort.

80 Innovative care models involving a combination of the above components of care have
81 emerged to grow the capacity for more comprehensive care of frail older adults, (16) and to
82 improve health and social outcomes (17). Greater integration of care among healthcare
83 professionals of different disciplines and across settings for frail older adults has reduced
84 unnecessary hospitalisations (18) and supported the maintenance of functional mobility over a 12-
85 month period (19). A systematic review of integrated or coordinated care found that
86 multicomponent care models were more likely to increase patient satisfaction, perceived quality
87 of care and patients' accessibility to care (20). However, there was inconsistent and limited
88 evidence on the impact of such models of care on health care costs and outcomes of frail older
89 adults (20-22). Taken together, this suggests that more evidence is needed to determine the
90 effectiveness of such comprehensive and integrated care models for frail older adults.

91 Integrated or coordinated care usually comprised partnerships or collaborations between at
92 least two healthcare service providers, such as hospitals and primary care service providers (23).
93 Partners in these care models collaborate by sharing expertise through training, whereby members
94 of the geriatric expert teams train the primary care staff and nurses to build capabilities in
95 comprehensive care of frail older adults (24, 25). Other care models have also found that
96 collaborators conduct comprehensive healthcare and needs screening to identify relevant health
97 and social needs, and in turn, follow up patients through home visits (26) or by directing them to
98 suitable care services (27). Most of the care models also include shared discussions about the
99 patients through the platform of multidisciplinary team meetings. In a review of 28 integrated care
100 programmes (28), provider commitment and trusting relationships were found to be foundational

to effective collaborations, communication and knowledge sharing among multidisciplinary teams. Successful programme implementation was dependent on the quality of leadership and the leaders' efforts to instil a shared vision and to create an organisational culture that supports practice changes and joint governance.

The purpose of this paper is to describe the protocol for a mixed method, multi-site evaluation of the Geriatric Services Hub (GSH), a programme for frail older adults in Singapore, to gain insights for improving the projects as they are being implemented and the effects of the programme. The GSH is a novel intervention in the local context and comprises core components of multicomponent frailty care programmes including CGAs and individually-tailored multifactorial intervention delivered by a multidisciplinary team (29). The transferability of implementation insights and outcomes from prior frailty programmes which are largely derived from Western studies cannot be assumed, since the eventual results of implementation are dependent on the context and culture that the health system is situated within. Current evidence on the effectiveness of these interventions programme is moreover mixed (17, 22), with little insight into whether the programme logic or the delivery process needs to be adjusted. Better understanding of the conditions of implementation would support practitioners and policymakers to consider how to ensure complex interventions achieve their intended impact. Hence, the specificity of cultural context in the unique healthcare system of Singapore and the lack of understanding of stakeholder perceptions warrant a comprehensive evaluation of the GSH model. In the next segment, we will briefly describe the GSH programme and its position in Singapore's healthcare system.

Geriatric Services Hubs

The Singapore Healthcare System consists of three regional healthcare systems (RHS) in the central, eastern, and western regions of Singapore. These RHS were established to coordinate and organise healthcare service providers, integrate care across providers, and manage population health for their respective regions. Hence, each RHS consists of a network led by a major public hospital in collaboration with other healthcare providers such as primary care, day rehabilitation, and community hospitals within the same geographical region (30). Each RHS is provided with funding to implement programmes to deliver comprehensive care beyond the hospital to the community. However, fragmentation in healthcare delivery continues to exist between and within each RHS. There are other forms of commonly utilised care services that are privately owned and not under the jurisdiction of the RHS, which include daycare, day rehabilitation centres, private clinics and other variations of healthcare and allied health services. Therefore, although geographically located within the same region, differences in governance and financing structures between the RHS funded services and privately-owned facilities result in insufficient information transfer, in capabilities and capacities between healthcare providers, and acute hospital-centricity.

Currently, as part of a national effort to engage and support older adults in Singapore, community volunteers are screening for frailty amongst older adults. Community nurses have also started to perform rapid and targeted geriatric and frailty assessments at neighbour-based nursing posts (31). However, the link between frailty assessments and the wider network of community care providers needs to be strengthened. To address this gap, the Singapore Ministry of Health provided funding to test the effectiveness of a new programme for frail adults aged 65 years old and older – the GSH –, which will be piloted by five sites. While there is no national consensus on the tools for identifying or grading frailty, the Ministry has specified the use of the Clinical Frailty Scale (CFS) (32) to support the enrollment of older adults living with mild, moderate or severe

146 frailty into the GSH programme. This study protocol will focus on the evaluation of these five
147 pilot sites. Due to geographical locations, the five pilot sites fall under the jurisdiction of two
148 different RHS in Singapore. Each site focuses on its existing strengths and resources to ride on or
149 build new partners within their RHS to provide community-anchored referral-gated geriatric care.
150 Through these partnerships, the GSH functions as a network of providers led by a core team of
151 acute hospital-based healthcare professionals (33). Each site acts as a consolidation point in the
152 community by actively receiving referrals from various services providers. All GSH sites share
153 the following goals:

154 • To provide early identification of frailty and offering comprehensive and coordinated care
155 in the community through collaborative working arrangements with partners, including
156 polyclinics, general practitioners (GPs), and community health and social service providers
157 • To provide CGAs to identify needs of frail older adults and to establish a care plan for each
158 individual patient
159 • To increase frail older adults access to essential services and transit across shared primary
160 care and other community-based providers more seamlessly
161 • To provide core services of geriatric assessments, nursing support, therapy service and case
162 management/care coordination
163 • To build capabilities by providing training to the primary care staff in identifying, caring
164 and managing frail older adults.

165 Despite these common goals, each GSH was designed differently to best harness their
166 existing strengths and resources. As a result, each GSH site focuses on a different mode of
167 operation. Table 1 provides an overview of the different programmes based on their funded
168 components.

Table 1. Differences in care models

Study Site	Programme Description	Population Targeted	Primary Referral Source	Main Setting and delivery	Programme Lead(s)
Alexandra Hospital	Geriatrician assesses older adults for frailty and manages patients in the primary care setting	Age: 65 + CFS: 5-7	General Practice (Public), social service agencies	General Practice (Public)	Geriatrician
Changi General Hospital	Geriatrician and community nurse supports primary care clinicians to assess and manage patients in the primary care setting	Age: 65 + CFS: 5-7	Hospital Emergency Department	General Practice (Private, Public)	Geriatrician
Ng Teng Fong General Hospital	Geriatrician builds competency of primary care staff to assess and manage patients in primary care and in the community	Age: 65 + CFS: 5-7	General Practice (Public), social service agencies	General Practice (Public), social service agencies	Geriatrician
Singapore General Hospital	Community nurses screen, assess and manage patients in the community supported by family physicians	Age: 65 + CFS: 5-7	Community Nurse Posts, social service agencies	Community Nurse Posts	Family Doctor and Nurse
Sengkang General Hospital	Geriatrician and multidisciplinary team supports primary care clinicians to assess and manage patients in the primary care setting	Age: 65 + CFS: 5-7 Includes patients with dementia	General Practice (Private, Public), social service agencies, national senior care coordination agency	General Practice (Private, Public), community geriatrics nursing and rehabilitation facilities	Geriatrician

Legend: CFS = Clinical Frailty Score

Although all five sites are designed and implemented differently, they share the common goal of providing comprehensive healthcare services to frail older adults in Singapore. Therefore, this evaluation serves as a common platform to holistically assess the pilot GSH models using a standardised process and outcomes framework but yet incorporating contextual information about the implementation and care experience across the five sites. For complex interventions, it is important to go beyond evaluating outcomes and to create a response loop to feed qualitative insights back to the development and improvement of the care models.

Study Aims

Our purpose is to describe the evaluation protocol. Through this evaluation, we hope to gain a comprehensive understanding of the factors influencing the effectiveness of the implementation approaches adopted by the GSH programmes and their impacts. Our specific evaluation objectives are:

1) To assess the development and implementation process of the new programme;
2) To assess the health status, quality of life, and user experience effects on care recipients and the burden of care on primary caregivers; and
3) To determine the impact on healthcare utilisation and cost impact

Methods

Evaluation Design

The GSH is a complex intervention with multiple interacting components involving different organisational partners providing various types of care to frail older persons living in the community. We chose to adopt a mixed methods approach, relying on the principle of complementarity, to achieve the specific study objectives (Table 2). The qualitative approach has the advantage of supporting our understanding of circumstantial and programmatic factors that influence the implementation outcomes (34). This allows the evaluation team to examine the processes adopted to deliver frailty care in the community, the different configurations of the intervention aimed at facilitating this, and perceived conditions that facilitated or impeded its implementation. This will be complemented by quantitative approaches to measure the processes and impacts stemming from the GSH.

The quantitative and qualitative components are equally weighted, designed, and analysed (35). The Framework on Implementation Research developed for Client-Centred Medical Homes (36) is used as a sensitising framework to structure the work phases of this evaluation, and for the

reporting of the results. In adopting this pragmatic approach, we recognise that there are singular, as well as multiple realities, that can be empirically observed (37). Quantitative research approaches are complemented with an in-depth exploration of contextual factors using a qualitative approach (35, 38). Quantitative data allows for the assessment of processes and multidimensional impact outcomes.

Table 2. Objectives and methods

Evaluation objectives	**Focus of inquiry**	**Methods**
To assess the process of development and implementation of the new programme	• To examine the perceptions, roles, responsibilities, and experience in developing and implementing each programme • To understand the workflow from the perspective of each profession for each of the new programmes • To improve competency of primary care providers in identifying, caring and managing geriatric patients in the community • To explore differences in contextual factors across the five sites that have influenced implementation experiences and outcomes • To understand care recipients' experiences in receiving frailty care in the community	Qualitative - Semi-structured in-depth interview with key policy and programme decision-makers Qualitative - Semi-structured focus group discussions with health and social care professionals and care recipients Qualitative – Participant observations Quantitative – Longitudinal monitoring of process indicators
To assess the health, quality of life, and user experience effects on care recipients and the burden of care on primary caregivers	• To compare outcomes between baseline, 3- and 6-months for each programme	Quantitative - Pre-test post-test design using survey-based data collection
To determine the impact on healthcare utilisation and cost impact of the new programme	• To assess the use of healthcare services and costs between participants and non-participants for each programme	Quantitative - Retrospective cohort design with propensity score matched comparators

Based on the components the sites are funded for (Table 1), we will evaluate the GSH program conducted by Ng Teng Fong General Hospital (NTFGH) based on evaluation objective 1 – to assess the process of development and implementation of the new programme. The focus is on competency building, with the funding being utilised to cover the time spent by trainers and trainees. In addition, the funding will not be used to cover healthcare costs incurred by patients.

Based on these considerations, evaluation objectives 2 and 3 would not be representative of the results of the program. The remaining four sites will be evaluated on all three evaluation objectives as their funding structures includes subsidising the healthcare costs of patients.

Qualitative Evaluation

Given the multi-agency and multi-professional setup of the new programme, it is important to consider the competency building process and implementation experiences across organisations and professional groups (39). We aim to elicit the perspectives of professional stakeholders playing critical roles in the development and implementation of the new model of community-based frailty care (Table 2). The conceptual framework for integrated care by Kodner and Kyriacou (40) guided the qualitative inquiry. We aim to conduct interviews first to gain an understanding of the programme details before moving on to the focus group discussion to understand the implementation experiences, and finally carrying out participant observations to clarify and substantiate our understanding of the processes of care.

First, we will conduct one-on-one semi-structured interviews with key decision-makers to explore their perspectives and experiences (41). This will allow insights into the complex decisions involved in the development of the programme and its implementation. An interview format will allow the collection of information across a diverse range of opinions and experiences, and easier expression of non-conformity.

Second, we will conduct focus group discussions with the core implementation team and staff members from partner provider organisations. A focus group format was selected to bring participants together to discuss and comment upon their personal experience in implementing the new programme, and observe the process of collective sense-making (42).

Third, we will carry out participant observation to collect more detailed information about each site's culture and workflow to supplement the in-depth interviews and focus group discussions. The observation will help us generate a more holistic understanding of the context and operations (43) involved in the new programme and treatment processes including but not limited to the conduct of the CGAs, development of the individualised care plan and execution, observing team dynamics and multidisciplinary team meetings, and interaction with patient and caregivers.

Quantitative Evaluation

The quantitative evaluation comprises three different components. First, process indicators describe the key processes, which can be observed and documented to support the achievement of desired outcomes. We will monitor quantitative process outcomes longitudinally on a quarterly basis over the three-year pilot timeframe to assess the level of receptivity towards the new programme, partner organisations' ability to accurately screen for frailty, provision of personalised and goal-oriented care, and care-continuity.

Second, a single cohort, pre-test post-test design (pre-experimental design) will be used to quantify the impact of participation in the programme on care recipient-reported health outcomes, experience of care, and caregiver's burden. There will be no randomised parallel control group due to programmes' reluctance, as they expect high refusal rates from patients. In addition, the new model encompasses different care components tailored to each patient's needs, which renders it impractical to conduct a 'true' experimental design with randomisation and a separate control group (44).

Third, a retrospective pre-post, matched-groups design will be implemented to compare healthcare utilisation and cost. Due to the absence of a parallel control group, we have opted for a

quasi-experimental design to determine the cost impact of introducing the new programme within the current healthcare landscape.

Study Sample

Qualitative Evaluation

For semi-structured in-depth interviews, at least two participants representing each of the five implementation sites and the Ministry of Health will be purposefully sampled. They will include decision-makers who are higher-level administrators or clinicians who have the authority to make policy and implementation decisions. It will also include individuals who are familiar with the hospital's overall frailty strategy, and those who led the development and implementation of the programme.

We will conduct a series of focus group discussions where multiple stakeholders are identified through purposive sampling. First, we will conduct focus group discussions with members of the core implementation team at each of the five sites– defined as individuals with time funded through the programme who have been providing services in the GSH for at least six months. They may include doctors, nurses, allied health professionals, and administrative or operations personnel. Second, for each site, at least five members of the staff from partner organisations including primary care clinics, and aged care facilities will be identified for another round of focus group discussions. They may include the heads of doctors, nurses and administrative staff who provided services within the new programme for at least six months. Third, we aim to identify at least ten participants who receive care under the new model for at least three months for the last round of focus group discussions. They must be able to take part in conversation for at least 60 minutes. For individuals who do not have the capacity to participate, his/her primary caregiver is eligible for participation.

We will conduct participant observations to better understand the processes involved by shadowing 3 to 5 members of the staff over the course of one week per site to account for day-to-day variations and job role differences.

Quantitative Evaluation

First, quality indicators will be developed to measure the processes of care for all individuals enrolled into each programme. The relevant sub-populations accessing each care component will form the denominator for computation of the indicators.

Second, we aim to recruit patients enrolled in the new programme. A target sample of 300 participants per site will be recruited. The sample was calculated based on the Barthel Index (100 points) – a scale to assess physical functioning, the key health outcome expected to improve as a result of participation in the GSH. We computed the sample size for each participating site using the dependent t-test to detect a small effect size of 0.2 (based on ß = .80, a = .05) (45). The result was a minimum sample size of 156 per participating site. Allowing 20% rejection rate at the first instance and a subsequent attrition rate of 30%, we would need to approach 300 individuals at the first instance.

(Insert) Figure 1 Study sample for quantitative evaluation

Third, propensity score matching will be used to match programme enrollees and a constructed comparator group. Both groups will be matched based on their probability of being enrolled into the programme conditional on baseline covariates (46). The propensity score can be used to mitigate selection bias in a non-randomised study. All programme enrollees will be included as cases. Data on comparators will be derived from a Ministry of Health dataset containing information on the health status of community-dwelling older adults that were collected

as part of the government's efforts to communicate government policies to older adults and connect them to relevant healthy ageing programmes.

Study Procedure

Qualitative Evaluation

Written informed consent will be obtained from all participants. They will first be invited to complete a simple survey packet that consists of a basic demographic questionnaire and a scale to assess their experiences in the programme. To obtain a thick description of the programme at each site, possible explanations for why things are such, and to identify key strengths and challenges of implementation at each site, interview guides were developed based on 12 out of 15 factors identified by Kodner and Kyriacou (2000) to be integral to the development and implementation of integrated care (40). We chose this framework as it provided sufficient components to evaluate the different GSH site holistically. The framework also provides structure to evaluate similarities and differences in the operations of the different GSH sites.

The 15 factors include patient screening, multidisciplinary assessment, primary care, comprehensive service package, network relationships, care management, continuity and coverage of care, seamlessness/ease of transitions, teamwork, information sharing, focus on continuum of care, strategic planning, governance and management, funding mechanism and system outcomes. Of the 15 factors, the research team deliberated and identified 12 that were key to understanding the GSH implementation across the four sites. We renamed one of the factors "focus on continuum of care" as "patient-centred care" to reflect work done by providers to align with patients' needs and preferences but at the same time to better differentiate this factor from "continuity of coverage and care" or having control over transitions between services and providers. A brief description of their relevance to the GSH is outlined in Table 3 below.

Table 3. Factors integral to understanding GSH implementation

Factors	Brief description
Patient screening	Identification of frail older persons in the community.
Multidisciplinary assessment	Performing a comprehensive, multidimensional patient evaluation and developing a care plan to meet identified needs.
Comprehensive service package	Putting together a broad range of health and social care services to meet identified needs.
Care management	Planning of care, coordination of care and follow-up across time, place and discipline.
Continuity of coverage and care	Provider's ability to help patients access the broad range of health and social care services across different settings and providers.
Ease of transition	Patient's ability to access the broad range of health and social care services and to navigate between different settings and providers.
Patient-centred care	The extent to which clinicians and patients work together to make decisions and select tests, treatments and care plans based on evidence that balances risks and intended outcomes with patient preferences and values.
Teamwork	Roles and responsibilities of GSH core team members; ongoing communication and collaboration among the multidisciplinary group of providers.
Network relationships	Nature of working arrangements among and between institutions and providers, including information sharing.
Strategic planning	Stakeholder involvement in joint planning and community needs assessment
System outcomes	Overall responsibility for the intended outcomes.
Funding mechanism	Structure of funding for health and social care.

All interviews and focus group discussions will be audio-recorded and transcribed verbatim. Each interview is expected to last 90 to 120 minutes, whereas each focus group discussions are expected to last 120 minutes. For the focus group discussions, we aim to balance homogeneity against the need for constructive tension by having separate sessions for the core implementation team and community-based providers. Focus group discussions will not be conducted according to professional groupings but each group will have similar frames of reference based on their job roles. This will allow for group interaction but prevent the situation where participants may have to defend their viewpoints (47).

For the participant observation component of this study, the research team will embed themselves in the day-to-day operations of the programme environment and take extensive field notes. Informal interviews will also be conducted to support our observations of the activities. The

observational components serve to explore professional practices in service implementation, coordination, and collaborative interactions.

Quantitative Evaluation

Quantitative process indicators will be developed based on the logic model within inputs from each of the five implementing sites to ensure agreement that they accurately describe the key processes, which can be observed and described to support the achievement of desired outcomes. Indicators are computed for each month and at quarterly intervals for each GSH site. Table 4 outlines the full list of requested process indicators.

Table 4. List and description of process indicators

Indicators	**Measure**	**Definition**	**Data collection time-points**
Patient recruitment			
Number of patients recruited by GSH sites	Receptivity towards GSH	No. of enrollees recruited into each GSH site after being referred	Monthly
Number, proportion of referred patients who fall within CFS 5-7	Accurate identification of frailty	CFS profiles of patients referred as scored by referral sources	Monthly
Patient-focused care management			
Number, proportion of CGA completed	Personalised care	No. of CGA completed vis-à-vis no. of assessments initiated	Monthly
Number, proportion of ICP developed	Personalised, goal-oriented care	Total no. of ICP developed vis-à-vis the no. of CGA completed	Monthly
Coordination of care			
Number of multidisciplinary rounds/discussions	Team-based care	No. of multidisciplinary team discussions conducted	Monthly
Number, proportion of referrals to services	Efficiency in care continuity	No. of referrals made to different services and the share of each service to the total no. of referrals	Monthly
Number, proportion of actualised referrals	Care continuity	No. of actualised first referrals at respective services vis-à-vis the no. of referrals made to each service	Monthly
Appointment waiting time to first appointment	Efficiency in care continuity	Waiting time for a first appointment to a referred service	Monthly
Competency building			
Number of community-based staff trained to conduct specific activities (CGA, exercise)	Competency building	No. of community-based healthcare participants in training sessions organised by the GSH[1]	Quarterly

Legend: CFS = Clinical Frailty Score; CGA = Comprehensive Geriatric Assessments; ICP = Individualised Care Plans; GSH = Geriatric Service Hub

[1]Training sessions include preceptorship-based training and case discussions

The evaluation aims to assess the impact of GSH. We hypothesised that

1. GSH sites offer a range of medical, social and other services through either direct provision or referrals. Given that the model is intended to bridge service gaps (conduct of CGA in the community), in the short-term, we hypothesis **an increase in the utilisation of appropriate services** (rehabilitation, ambulatory services) in this time-limited programme.
2. GSH participants are expected to benefit from the comprehensive package of health and social services and multidisciplinary team approach. With **better care coordination and improved access**, it is likely to elicit a **higher level of satisfaction** relative to comparator groups.
3. Education of the client about self-care and making decisions about potential care options with inputs from a multidisciplinary team is expected to result in **higher level of shared decision making** and **engagement** relative to comparator groups.
4. It is hypothesised to result in **better functional status and health outcomes**, might **reduce the healthcare utilisation** (emergency hospitalisation, nursing home admission), **caregiver burden** and **the associated indirect cost**. In turn, we might expect **overall costs to be lower** compared to the comparison group.

An interviewer-administered survey will be conducted to collect data on demographic and baseline health status, and data measuring the impact of the programme on patient activation, user experience and satisfaction with care, health status, quality of life, the burden of care on primary caregivers, and health utilisation and cost. The data are collected at baseline, 3-months and 6-months (Table 5). After obtaining informed consent, participants will be asked to complete a survey estimated to take about 45 to 90 minutes. Participants will complete the survey up to three

time-points – baseline (within 1 month of programme enrollment) and at 3-months and 6-months. The primary caregiver will also be asked to complete a 5 to 10-minute survey at the same three time points on caregiver burden. In the event a participant is clinically certified to have dementia, we will allow a proxy respondent to answer on behalf of the main participant. Participants will receive a token of appreciation for their involvement in the study.

Table 5. List of indicators for measuring programme impacts

Impact outcomes	Assessment	Measure
Patient engagement		
Shared decision making	collaboRATE For Patient – 5-point anchor scale	Patient's experience of shared decision making
Patient activation	13-item Patient Activation Measure (PAM-13)	Level of patient activation, including ability to self-manage, maintain functioning, collaborate with healthcare providers, and access healthcare services
Healthcare experiences		
Experience of care delivered	Consumer Assessment of Healthcare Providers and System Clinician & Group Survey Version 3.0 (CG-CAHPS)	Patients' experience with healthcare providers and staff in doctors' offices
Health status, adverse outcomes and quality of life		
Functional status	Barthel Index of Activities of Daily Living (ADL)	Functional independence in ADL such as feeding, bathing, and continence
Frequency of falls	Count of falls	Marker of poor health and declining function
Health-related quality of life	EuroOol-5D-5L	Health-related quality of life in domains including mobility, self-care, usual activities, pain, anxiety and depression
	19-item Quality of Life Scale (CASP-19)	Quality of life in later life in domains including control, autonomy, self-realisation, and pleasure
Impact on caregivers		
Level of caregiver burden	Zarit Burden Interview (ZBI)	Level of burden experienced by primary caregivers of older adults with dementia
Direct and indirect cost		
Societal cost	Client Service Receipt Inventory (CSRI)	Health, social and informal care use and cost

To compare the healthcare utilisation and cost between programme enrollees and a comparator group, an anonymised analytical dataset comprising existing information drawn from datasets maintained by each of the five GSH sites, the evaluation team and the Ministry of Health

will be established. Given that all persons residing lawfully in Singapore are issued a unique National Registration Identity Card (NRIC) number by the government, the NRIC for each enrollee will be assigned a unique identifier by a third party. This unique identifier will subsequently be used to merge data across the datasets. The anonymised data set will comprise sociodemographic variables, all information collected from the above survey, and information on the use and system cost of healthcare services (primary care, specialist care, emergency services, inpatient care) across all public healthcare institutions in Singapore as well as mortality data.

Data Analysis

Qualitative evaluation

The Framework Analysis approach (48) will be used to analyse the data to generate important categories and themes that encapsulate the elements that have influenced the development and implementation of the new programme. Key steps outlined by Gale et al. (2013) will be adopted (49). To begin, we will familiarise ourselves with the data by thoroughly reading the transcript and listening back to the recorded interviews, if necessary. Field notes made during and after the interviews will be read alongside the transcripts to ensure that the context was taken into consideration. Based on the 12 factors outlined used to describe the model and process of care at each of the five sites (Table 3), we will identify overarching categories where codes that are conceptually related will be grouped.

A preliminary list of codes was derived from the literature (28, 50-54) as well as from our initial first impressions. Initially, three members of the research team will independently code the same two transcripts, allowing the codes to emerge inductively from the data in this open coding process. Subsequently, the team will compare and discuss the codes, agree on a set of codes, assign code labels, and provide each with a brief definition. This will form the working analytical

framework which will be applied to subsequent transcripts using NVivo (Release 1.0) (released in March 2020). Once the data has been coded using the analytical framework, we will group codes that are conceptually similar under the identified categories in a matrix. We will refine and create new categories, if necessary. Key themes will be generated from the codes by reviewing the matrix and making connections within and between categories. This process will be guided by the research objectives and analytical framework as well as new concepts generated inductively from the data. During the interpretation stage, we plan to take the analysis beyond describing the implementation at each site towards developing themes to offer possible explanations for what was happening across sites. The interpretation of findings will be discussed within the team and presented to selected respondents from the implementation sites for member checking.

Quantitative evaluation

The process indicators will be computed for each month and at quarterly intervals monitor the progress of the programme. Baseline characteristics will be described with mean and SD for continuous variables, and number and percentage for categorical variables.

For survey-collected outcomes, Generalised Linear Models (GLM) will be used to allow us to make inferences about the population when accounting for the within-subject correlation.

A propensity score conditional upon observed covariates will be computed for all cases (Figure 1). Variables will include sociodemographic information, disease burden measured by the Charlson Comorbidity Index (55), and physical functional status. We will match 2 comparators to 1 case using nearest-neighbour matching. In a Monte Carlo simulation, the mean squared error for a 2:1 match was minimised in 84 percent of the simulations compared with 68 percent for a 1:1 match (56). Nearest neighbour matching based on a calliper of 0.01 of the standard deviation of the propensity score will be used (46, 57). Only cases and comparators with propensity scores

falling within a common support region range will be included in the analysis to ensure comparability of the two groups.

In the multivariable regression analysis of count data, Poisson distribution or Negative Binomial distribution (variance greater than the mean) will be used. Negative Binomial regression can be used for over-dispersed count data when the conditional variance exceeds the conditional mean. GLM will be used for modelling non-normally distributed continuous data such as length of stay and healthcare cost. The results will be presented as incidence-rate ratios (IRRs). All analyses will be performed using Stata/SE 16.1(58), with the level of significance set at 5%.

Integration of qualitative and quantitative data

Qualitative and quantitative data are collected concurrently and analysed separately. In the final interpretation of the data, we will bring together and triangulate the results from the various coordinated parts (59). Findings from each component of a study will be listed to allow the evaluation team to look for convergence in findings, offer complementary information on the same issues and to highlight discrepancies (60). Findings from interviews, focus group discussions and participant observations will be used to contextualise quantitative process indicators and for corroboration. Qualitative findings could offer explanations for the effectiveness of the GSH in terms of the impacts on health status, quality of life, user experience, and healthcare resource use and costs.

Discussion

The purpose of the GSH programme is to provide comprehensive and coordinated care for frail older adults in the community, and the programme aims to achieve this through collaborative working arrangements with various health and social service providers in the community. The suite of services provided includes conducting CGA to identify the needs of older adults, and to

increase accessibility of frail older adults to essential services. Five GSH pilot sites share these common goals but due to differences in their innate organisational operations, the design of the GSH model was different to harness their existing relationships and organisational strengths.

The motivation to conduct a multiple methods evaluation is driven by the need to provide good quality evidence on the organisation of community-based frailty care. Integration between acute care and other forms of care in the community is becoming increasingly advocated (61). As GSH is a model of care that aims to provide comprehensive care to frail older adults, it is essential to gain rich insights into the development and implementation of the programme. The understanding of underlying mechanisms will help us determine each programme's effects on patients' health outcomes, programme cost-effectiveness, and the programme replicability. Variations in the operations at each site demands that our evaluation methods be rigorous and consistent across all sites. This will enable us to identify essential links in each model and contribute more effectively to the planning of future models that provide comprehensive care.

Strengths and limitations

The study protocol has several strengths. Firstly, the multiple method approach allows in-depth understanding of the programme from the point of view of different stakeholders, as well as the programme's attributed health outcomes and costs impact. Secondly, this approach also enables us to triangulate our findings, and cross compare the validity and reliability of our findings through the different mediums of data collection. Finally, the choice of propensity score to match patients will allow a close match in baseline characteristics between treatment and comparator groups. This method attempts to replicate the balance in characteristics achieved by randomisation, and thereby minimise selection bias. As a result, it contributes to the validity of conclusions to be made on healthcare utilisation and cost outcomes.

The research protocol also has several limitations. Firstly, the data collection process will only account for enrollees who agree to receive services delivered by the GSH programme. This inadvertently excludes patients who seek alternative care in other care services in Singapore. As a result, this exclusion might lead to an underestimation of the true treatment effect. Secondly, although we can reduce selection bias through propensity score matching, there might be unmeasured confounders that introduce hidden biases in our analyses.

In summary, the GSH aims to provide comprehensive health care services to frail older adults in Singapore. They achieve this by partnering with health and social service providers in the community and aim to increase accessibility and ease transition across different health services. We believe that this evaluation study can provide valuable evidence of the impact and effectiveness of the GSH. Lessons learnt from this study will be disseminated to programme implementers and inform the design of similar programmes nationally.

Declarations

Ethics approval and consent to participate

This protocol describes the proposed evaluation of the Geriatrics Services Hub programme. The described study has received ethical approval from the NHG Domain Specific Review Board (DSRB Ref: 2019/00925).

Consent for publication

Not applicable

Availability of data and materials

Not applicable

Competing interest

The authors declare no conflict of interest with respect to the research, authorship and/or publication of this article.

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Authors' Contribution

TWS conceived and designed the study, drafted and revised the article. NZL, THTR, SN, RC, MLG, ET and PHJT designed the study, drafted and revised the article. DYY, WCH and LWS conceived the study, obtained funding and revised the article. All authors gave final approval of the manuscript to be published.

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