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## Evaluating a novel Integrated Community of Care (ICoC) for patients from an urbanized low-income community in Singapore using the Participatory Action Research (PAR) methodology: A Study Protocol

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3 **Title: Evaluating a novel Integrated Community of Care (ICoC) for patients**  
4 **from an urbanized low-income community in Singapore using the**  
5 **Participatory Action Research (PAR) methodology: A Study Protocol**  
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52 5131 words  
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## **Abstract**

**Objectives:** Poorer health outcomes and disproportionate healthcare utilization in socioeconomically disadvantaged patients is well established. However there is sparse literature on effective integrated care interventions that specifically target these high-risk individuals. The Integrated Community of Care (ICoC) is a novel care model that integrates hospital-based transitional care with health and social care in the community for high-risk individuals living in socially deprived communities. This study aims to evaluate the effectiveness of the ICoC in improving acute hospital utilization and investigate the implementation process and its effects on clinical outcomes using a mixed-methods participatory action research (PAR) approach.

**Methods and Analysis:** This is a single-centre prospective, controlled, observational study performed in the SingHealth Regional Health System. A total of 250 eligible patients from an urbanized low-income community in Singapore will be enrolled during their index hospitalization. Our PAR model combines two research components: quantitative and qualitative, at different phases of the intervention. Outcomes of acute hospital utilization and health related quality of life are compared to controls, at 30 days and one year. The qualitative study aims at developing a more context-specific social ecological model of health behaviour. This model will identify how influences within one's social environment: individual, interpersonal, organizational, community and policy factors affect people's experiences and behaviors during care transitions from hospital to home. Knowledge on the operational aspects of ICoC will enrich our evidence-based strategies to understand the impact of the ICoC. The blending of qualitative and quantitative mixed methods recognizes the dynamic implementation processes as well as the complex and evolving needs of community stakeholders in shaping outcomes.

**Ethics and Dissemination:** Ethics approval was granted by the SingHealth Centralized Institutional Review Board (CIRB 2015/2277). The findings from this study will be disseminated by publications in peer-reviewed journals, scientific meetings, and presentations to government policy makers.

**Trial registration number:** NCT02678273

**Key words:** Low-income community; action research; integrated care; community-based care; transitional care

## **Article Summary**

### **Strengths and Limitations of study**

1. The Integrated Community of Care (ICoC) is a novel care model that integrates hospital-based transitional care with health and social care in the community for high-risk individuals living in socially deprived communities.
2. Study utilized a mixed method participatory action research (PAR) methodology to evaluate the effectiveness of a complex intervention program for a high-risk urbanized low-income community.
3. A randomized controlled trial design is not possible for this study.

## **Background**

Elderly<sup>(1)</sup>, socioeconomically disadvantaged and socially isolated patients such as those residing in public rental housing are at highest risk of ill health. Low socioeconomic status (SES) is well recognized as an independent risk factor for various adverse health outcomes, such as readmission

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2  
3 risk <sup>(2-4)</sup> and hospital utilization<sup>(5)</sup>. In Singapore, public rental housing is an area-level measure of SES  
4 and is independently associated with increased readmission risk and being a frequent hospital  
5 admitter and emergency department (ED) user.<sup>(6)</sup> The reasons behind these poor outcomes include  
6 poor knowledge of personal health status, inappropriate health behaviors <sup>(7)</sup>, inability to navigate the  
7 complicated healthcare system <sup>(3, 8)</sup>, lower health literacy and misalignment between patient and  
8 care team with regard to goals of care <sup>(9)</sup>. These factors for poor outcome are common among  
9 residents of rental flats in Singapore. In addition, such residents are more likely to have  
10 comorbidities, poor social support, more likely to suffer from mental health conditions and more  
11 likely to be on anti-depressant treatment <sup>(6, 10)</sup>. The confluences of these factors in a sub-population  
12 of patients who tend to live together in socially deprived communities create challenges as well as  
13 opportunities to improve the health of the population.  
14

15  
16 While there is abundant literature highlighting the poorer health outcomes and disproportionate  
17 healthcare utilization in socioeconomically disadvantaged patients, there is sparse literature on  
18 integrated care interventions that specifically target these high-risk individuals. Englander et al <sup>(11)</sup>  
19 described the implementation of a nurse and pharmacist-led multicomponent transitional care  
20 program which included coaching and education; home visits for highest risk patients; provision of  
21 30 days of medications for low-income adults who were uninsured or on public insurance. However,  
22 the intervention did not reduce 30-day readmission rates or emergency department re-attendances.  
23 The authors concluded that the diverse needs of this population were too overwhelming for a nurse  
24 and pharmacist-based intervention. In Singapore, community-based initiatives led by social work  
25 professionals and para-professionals have been described <sup>(12)</sup>. However, the program faced similar  
26 problems and was hampered by the lack of a multi-disciplinary healthcare team to address complex  
27 health and social needs across different settings of care. Three reviews on effectiveness of  
28 transitional care trials by Hansen <sup>(13)</sup>, Kansagara <sup>(14)</sup>, and Kriplani <sup>(15)</sup> independently concluded that  
29 transitional care interventions must be comprehensive, going beyond single component  
30 intervention. Integrating medical and social care across settings that span the different phases of  
31 care from hospitalization, discharge planning to post-discharge surveillance. The programs also  
32 need the flexibility to respond to individual needs.  
33  
34

35  
36 In Singapore, it is estimated that 900,000 citizens living in the city state will be 65 years or older by  
37 2030 and at least 50,000 (5.3%) would be staying in rental housing.<sup>(16)</sup> A shift from a hospital centric  
38 model of care to a community centric model of care is widely accepted as a strategy that will enable  
39 us to provide sustainable and cost-effective care for our rapidly aging population. In response to this  
40 need, many new models of care were developed and tested for effectiveness. The Integrated  
41 Community of Care (ICoC) is a novel model of integrated care developed by the Singapore General  
42 Hospital that was designed to bring together best practices in transitional care <sup>(17-20)</sup>. This care model  
43 provides multidisciplinary transitional care, which fully integrates health, and social care across the  
44 full cycle of care for high-risk individuals living in socially deprived communities.  
45

46  
47 The aim of this evaluation is to answer the following questions while providing feedback to key  
48 decision makers over the 2 years of the project: (1) What is the overall effectiveness of the ICoC  
49 program in improving acute hospital utilization? (2) What are the different components of the ICoC  
50 programme: their structure, their stakeholders (targeted patients and practitioners), their operating  
51 process and their effects on clinical outcomes? (3) What are the strengths and aspects to improve of  
52 each programme from the perspective of the concerned stakeholders in view of a better services  
53 integration? (4) What characteristics of the patients and the ICoC programme contribute to positive  
54 impacts on use of services, quality of life, patient activation and patient experience with care?  
55

## 56 57 58 **Methods/Design**

### *Study Site*

Adopting a population health approach, the Ministry of Health Singapore has been advocating for the transformation of our health care system from a hospital centric to a community centric. In 2011, public healthcare delivery was re-organized into regional health systems (RHS). The aim of which was to organize regional health assets into an integrated structure that will promote care integration of care across the care continuum. There is to be vertical and horizontal integration of healthcare institutions. In addition, the regional health systems will work to integrate health and social care by working closely with social care agencies within each region. Six RHSs were created, each being responsible to integrate care for a specific geographic region in Singapore. Each RHS is anchored by a tertiary hospital, supported by a community hospital providing intermediate and rehabilitation care and complete with linkages to primary care and long term care services in the region. In 2014, the Singapore Health Services (SingHealth) RHS was officially launched and consisted of primary to tertiary care institutions that account for the care of nearly a million residents in Singapore.

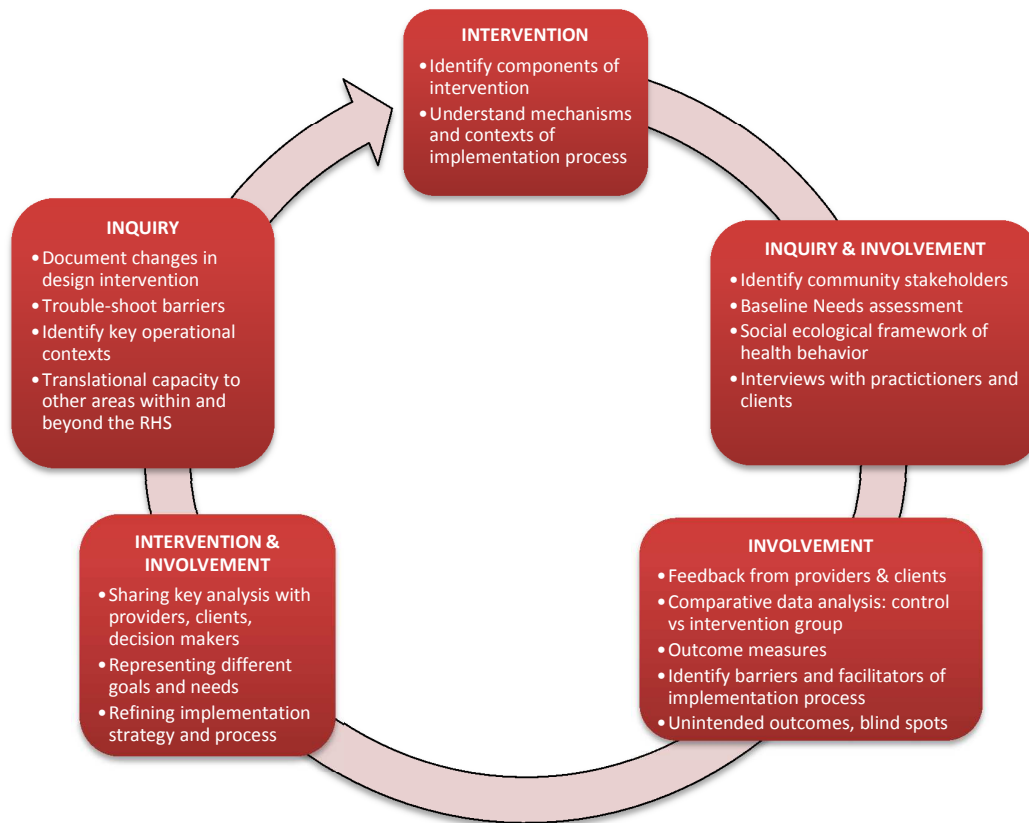
### *Conceptual Framework for Evaluation*

The strategy of using multidisciplinary case management that we have adopted for our model of care have been widely used in many care integration programs aimed at reducing health care utilization and improve quality of care for frail older adults with multimorbidities.<sup>(21)</sup> The evaluation of this model of care is challenging because it contains multiple components. For example, the medical, social and personal care components may act both independently of each other and interdependently in affecting the outcome of patient care. The assessment of individual components of intervention becomes complicated.<sup>(22)</sup> This creates a need for a novel adaptation of the mixed method strategy of evaluation. In addition to quantitative studies of outcome, our multidisciplinary research team will also use participatory action research (PAR) as part of the overall evaluation of the effectiveness of the ICOC program. PAR has been defined as “systematic inquiry, with the participation of those affected by the problem being studied, for the purposes of education and action or effecting social change”.<sup>(23)</sup>

In Singapore, the recent and rapid transformation of health services delivery for the aging population had created unprecedented shifts in the power relationship between users, policy makers and service providers in the healthcare system. In such circumstances the use of PAR is preferable as a research method because it is driven not only by the learning objectives of investigators but also by the circumstances and contexts of the community involved. Sandberg et al notes that in complex cases, intervention may affect important factors that were not planned for and not measured by quantitative methods. Rather, these factors could be better accounted for through qualitative methods.<sup>(22)</sup> In this regard, PAR is intended to be both highly localized and comparative. Investigation of the programme structure, its operating processes and stakeholders’ experiences can be captured through qualitative methods while the comparative assessment of health outcomes between the intervention and control group will be valuably complemented through quantitative research methods.

The combination of both quantitative and qualitative methods of research will facilitate a more comprehensive assessment of the ICOC, particularly to understand the multiple outcomes of the program in terms of what works, for what and for whom. The PAR includes a learning component, which will synergize the 3 “Is” of Intervention (Action), Involvement (Participation in the Community) and Inquiry (Research) into a feedback cycle. The 3 Is mutually augment each other to contribute to the social transformation of integrated elderly care. The approach requires the co-partnership of stakeholders, implementation teams and research units to collect data, reflect upon findings of outcomes and refine the intervention process further to develop and achieve better delivery and results of ICOC.

Fig 1. Research Design: Intervention, Involvement and Inquiry Feedback Cycle



### Research Design

The ICoC study is a single-centre prospective, controlled, observational study performed in the SingHealth Regional Health System.<sup>(24, 25)</sup> Participatory action research with community-dwelling socially-at-risk elderly Singaporeans has the potential to explore some of the complex health and social problems that poor and socially-isolated elderly face, while also contributing to individual and community capacity building. Additionally, PAR has been found to be an appropriate process for evaluating patient-centred models of care. Nolan & Hazelton (1996) found similarities in nursing processes with PAR, particularly through the steps of assessment, planning, implementation, evaluation and replanning<sup>(26)</sup>. PAR has also been engaged successfully to facilitate improvements in healthcare services (Hart and Bond, 1995)<sup>(27)</sup>. The mixed-methods PAR approach to the ICoC model is significant to health systems research because it attempts to triangulate both medical practitioners' and elderly patients' perspectives of intervention delivery. In this regard, our evaluation method is designed to be sensitive to outcomes beyond only the intended hypothesis. Additionally, while evaluation studies utilizes quantitative data to measure intervention outcomes, a qualitative approach may address issues with regards to using a single metric of examining hospital admissions, which have been found to be less suitable for complex and vulnerable patients where many other factors contribute to the need for hospitalization.<sup>(28)</sup>

### Study Aims and Hypotheses

Our participatory action research (PAR) model combines two research components, quantitative and qualitative, at different phases of the intervention. The primary objective of the quantitative study is

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2  
3 to evaluate the effectiveness of the ICoC program in achieving a significant reduction in the  
4 proportion of patients in the intervention group with unscheduled hospital readmissions within 30  
5 days of the index discharge date relative to controls. The secondary aims of this study are to  
6 evaluate the effectiveness of the ICoC program in achieving (i) a lower proportion of patients in the  
7 intervention group with three or more unscheduled hospital readmissions within one year of index  
8 discharge; (ii) a lower emergency department attendance rate in the intervention group at 30 days,  
9 and one year from index discharge; (iii) a lower specialist outpatient clinic attendance rate in the  
10 intervention group at 30 days, and one year from index discharge; (iv) Improving health related  
11 quality of life in the intervention group relative to baseline as measured by the EQ-5D at 30 days,  
12 and one year compared to the control group.  
13

14  
15 For the quantitative study, we hypothesize that the ICoC program will significantly reduce the  
16 proportion of patients who had an unscheduled readmission within 30 days of index discharge,  
17 compared to the control group. The secondary hypotheses are that the ICoC program can  
18 significantly reduce hospital readmissions at one year; emergency department and specialist  
19 outpatient clinic attendance rate at 30 days, and one year compared to the control group; and  
20 health related quality of life at 30 days, and one year compared to baseline.  
21

22 The qualitative study aims at developing a more context-specific social ecological model of health  
23 behavior.<sup>(29)</sup> We propose a social ecological framework of health behavior in the manner below:  
24

- 25 a. Care recipients' and caregivers' conditions and experiences (individual level)
- 26 b. Interactions between elderly patient, caregivers and healthcare providers (interpersonal  
27 level)
- 28 c. Elderly's and caregivers' access to experiences with service use and health care delivery  
29 (institutional/ organizational level)
- 30 d. Elderly patients' connections with and support from the community (community level)
- 31 e. How public initiatives and access to other healthcare programmes affect the experience  
32 of transitional care post-discharge (policy level)  
33

34 This model helps to identify how influences within one's social environment: individual,  
35 interpersonal, organizational, community and policy factors affect people's experiences and  
36 behaviors during care transitions from hospital to home. The knowledge of how this model operates  
37 on the ground will enrich our evidence-based strategies to understand the impact of the ICoC. The  
38 blending of qualitative and quantitative mixed methods recognizes the dynamic implementation  
39 processes as well as the complex and evolving needs of community stakeholders in shaping  
40 outcomes. The PAR operates on a feedback loop that is sensitive to changes experienced by  
41 practitioners and patients in real-time. In this project, both the implementation and research team  
42 work in tandem to evaluate and improve the intervention on-the-go.  
43  
44

#### 45 *Inclusion and Exclusion Criteria*

46 Patients are eligible if they:

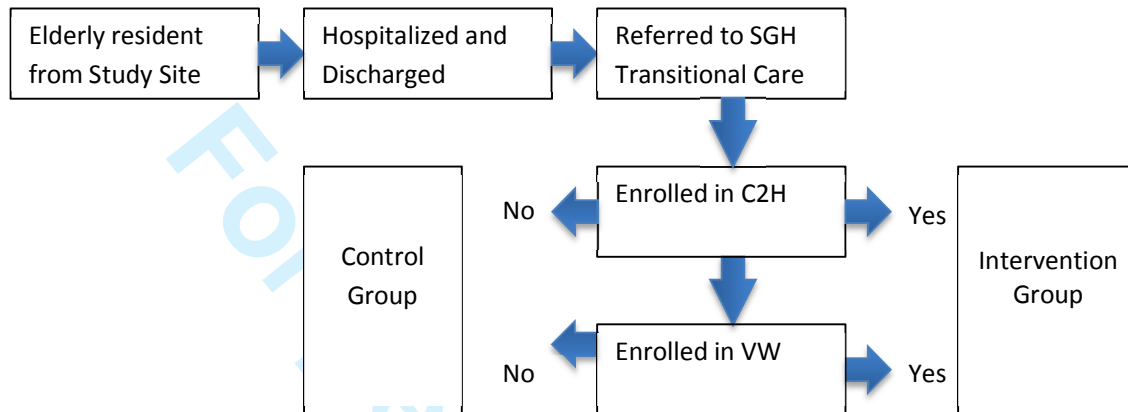
- 47 1) Age  $\geq$  60 years at time of recruitment
- 48 2) Staying in public rental housing in Blocks 51, 52 Chin Swee or Block 5 Banda Street in  
49 Singapore  
50  
51  
52

53 We will exclude patients who decline our program or dementia patients who are incapable of  
54 independent living and do not have a caregiver. Patients who have mild dementia and are capable of  
55 independent living or have a caregiver are suitable to be enrolled into the ICoC program, which will  
56 support care in the community. Patients in the intervention group will be recruited during their first  
57 admission (thereby known as the index admission) upon study commencement. Based on the  
58  
59  
60



electronic medical records, close to 180 unique patients were admitted to SGH in 2014. Assuming a low 5% rejection and exclusion rate (confirmed by our feasibility study), the recruitment period is estimated to be take 1.5 years. Recruitment will close when the sample size of 250 is reached. Control patients will be identified retrospectively at the end of the study period and data extracted from the SGH patient database using the index admission as the start date.

Figure 2: Patient Recruitment and Comparison between Intervention and Control Groups.



For the qualitative component, the research team will purposively extract a sample size of 40 elderly patients/ clients based on the sample of 300 elderly residents who are enrolled in C2H intervention programme and who are also under the supervision of the VW. The elderly patients/ clients are recruited into the study through referrals from medical and care team, where we hope to get a representative sample in terms of gender, age, ethnicity, health and physical status and living arrangements. The research team will also be interviewing 10 community practitioners who are providing care in the study site.

The ICoC intervention program (Figure 3)

#### 1. SGH Transitional Care (TC) team for care transitions of hospitalized residents

The SGH TC team (comprising a senior family physician and a medical officer) is a dedicated service that will provide inpatient care or co-management with specialists for all enrolled patients, with emphasis on comprehensive discharge planning, formulation of a care plan post-discharge and proper hand-over care to the community virtual ward and C2H teams. This intervention incorporates the best principles in transitional care that includes both pre-discharge and post-discharge components (27-29). The hand-over care will be executed via a daily half-hour video conferencing meeting between the three teams.

#### 2. Community Virtual Ward (VW) for coordinating community care and home-based primary care

The community-based VW team comprises of a staff nurse and resident physician seconded by SGH to provide continuing community care, home-based primary and nursing care to enrolled patients. This intervention is supported by strong evidence for home-based primary care and continuing care for frail elders (24, 25). The team's responsibilities include: (i) comprehensive geriatric assessment; (ii) continuing care and at least weekly surveillance of discharged patients for up to one month post-discharge; (iii) monitoring at risk patients for compliance to the prescribed care plans and medications; (iv) health promotion and education to enrolled patients; (v) developing patient-specific action plans for patients with high risk diseases such as heart failure and diabetes and (vi)

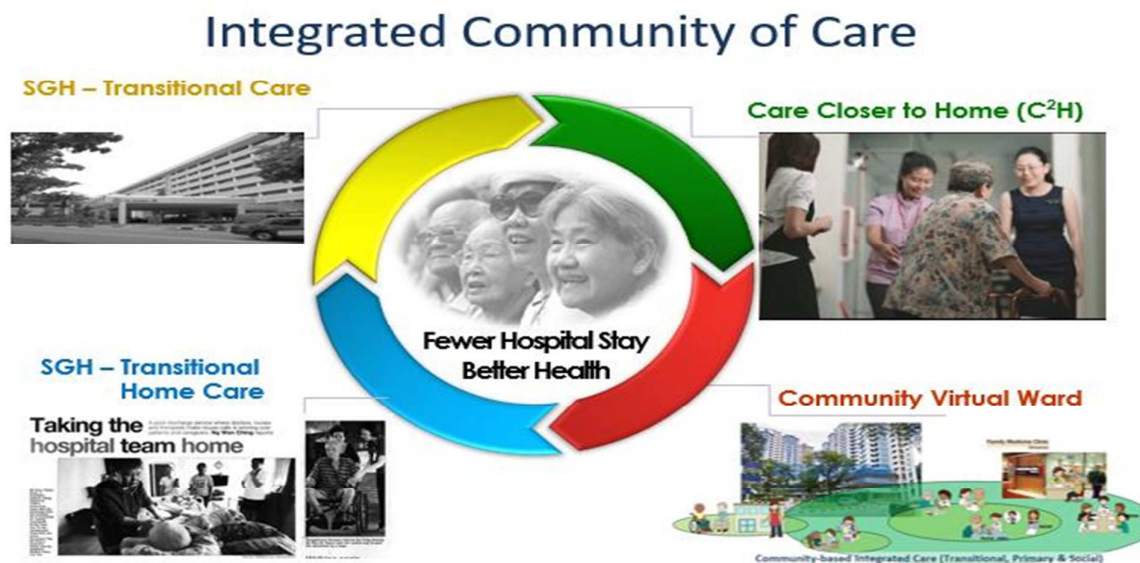
coordinating and integrating the primary, transitional and social care for enrolled patients; and (vii) hand-over care to community service providers for long term follow up upon stabilization of patients and according to clinical protocol. The community VW team is physically located in the community.

### 3. Care Closer to Home (C2H) team for social case management and home help

Since October 2014, the C2H is a program by the Agency for Integrated Care comprising a case manager, a social work assistant and five nursing aides to put in place health, personal and social services, e.g. medication management, home help services to assist with basic activities of daily living e.g. showering to help seniors to age in place. To date, the program has enrolled close to 300 residents. AIC closely supports and provides professional guidance for the C2H program.

All three components of the ICoC program will be provided to enrolled patients. To ensure this, we have harmonized our inclusion and exclusion criteria for entry into all three components.

Figure 3: Conceptual Model of Care for the ICoC Program



### Control group participants

The control group of approximately 1100 participants will receive current hospital standard of care when they are hospitalized. Patients will be managed by their specialists in charge depending on their admitting diagnoses. Patients may be referred to the SGH THC program and/or various community services on discharge if deemed necessary by their specialists. Continuing care post-discharge may be provided at the specialist outpatient clinics or a primary care provider identified by the hospital specialist. The community VW and C2H teams would not be available for control group patients.

### Data Collection strategies to Measure Outcomes

#### Basic Characteristics

**Intervention Group:** The research team will take informed consent from the intervention group participants and interview them for demographic, socioeconomic status, medical comorbidities and

health-related quality of life (EQ-5D). This information will be verified with SingHealth's Electronic Health Intelligence System (eHIntS) system, which is a data warehouse capturing detailed demographic, socioeconomic and clinical data.

Control Group: Control group patients will be retrieved from the eHIntS system. A waiver of patient consent will be sought from the centralized institutional review board for extraction of de-identified routinely collected information. Similar demographic, socioeconomic status and medical comorbidities data (predictors used for propensity scores calculation listed in Annex 1) will be collected for both groups to allow calculation of propensity scores as a basis for comparability. We have shown in our previous study (22) that these data can be extracted from our data warehouse for inclusion in a propensity score model.

#### Outcome Measures at 30 days and one-year

The research team and the ICoC team will follow up with study participants for the primary and secondary outcomes at 30 days, and one year (Table 1). An unscheduled readmission is defined as a readmission for a non-elective indication. Unscheduled readmission at 30 days (short-term outcome) is a universally accepted indicator of transitional care quality and one year outcomes (long-term outcome) is chosen to reflect the quality of community and continuing care. The research team will conduct a face-to-face survey interview at 30 days and one year to repeat the EQ-5D scales. Healthcare utilization data of intervention and control group participants will be extracted from SingHealth's eHIntS system and merged with Ministry of Health (MOH)'s Omnibus data resource. This will ensure complete and accurate healthcare utilization outcomes and overcome the issue of cross utilization.

A checklist will be developed to measure fidelity to components of ICoC program and ensure standardization of intervention. The nature (routine/emergency) and number of home visits e.g. doctor/nurse/C2H will be retrieved from the clinical documentation notes.

**Table 1: Data collection sources at Baseline, 30 days and One Year outcomes for participants**

Variable	Method of Collection	Baseline	Follow-up (30 days)	Follow-up (One year)
Demographic, Socio-economic status, Health information and prior healthcare utilization, Abbreviated Mental Test, Modified Barthel Index, Instrumental activities of daily living, health related quality of life	Questionnaire, EQ-5D, eHIntS	X		
<b>Primary Outcome Measure –</b> Unscheduled hospital readmission within 30 days of index discharge	eHIntS, Omnibus		X	
<b>Secondary Outcome Measures –</b> Unscheduled hospital readmissions at one year; Emergency department attendances, specialist outpatient clinic attendances and health related quality of life at 30 days and one year	EQ-5D, eHIntS, Omnibus		X	X

Sample Size calculation

1  
2  
3 The primary aim is to evaluate the effectiveness of the ICoC program in achieving a significant  
4 reduction in the proportion of patients in the intervention group with unscheduled hospital  
5 readmissions within 30 days of the index discharge date relative to controls. Data from a previous  
6 study shows a historical 30-day re-admit rate of 17.5% for patients in the three proposed  
7 Intervention HDB blocks and 16.8% in the Control blocks. The prospectively recruited sample size for  
8 the Intervention will be  $n_1 = 250$  and, based on 2014 data, we anticipate about  $n_2 = 1100$  patients in  
9 the Control group. The figure shows the proposed sample sizes will provide  $\geq 80\%$  power using a two-  
10 sided Fisher's exact test ( $\alpha=0.05$ ) to detect the following range of differences (unadjusted) in 30-day  
11 re-admit rates between Control (P2) vs. Intervention (P1): 18.0 vs. 10.7, 17.0 vs. 9.9, 16.0 vs. 9.1,  
12 15.0 vs. 8.3, 14.0 vs. 7.5 and 13.0 vs. 6.7. Targeted reductions in Intervention group readmission  
13 rates range from 40.5–48.5% and would certainly be considered clinically meaningful. In our virtual  
14 ward study, we achieved 33% reduction in 30-day readmission rates and it is likely this can be  
15 improved with additional home visits and social care case management. Control and Intervention  
16 30-day re-admission rates will also be compared using logistic regression using propensity scores to  
17 adjust for effects of confounders.  
18  
19

## 20 21 22 Qualitative Data Collection Design and Strategies

23  
24 The qualitative research component of the PAR will be conducted in three phases.

### 25 26 Phase 1: *Intervention & Involvement*

#### 27 28 1a. *Understanding mechanisms and contexts of intervention (Practitioners and Patients)*

29  
30 The research team will engage in 'go-along' interviews to understand the complexities around  
31 integrated care in a low-income rental neighbourhood. The "go-along" combines both participant  
32 observation and interview methods and will be conducted with VW nurses and the C2H team ( $n=10$ )  
33 as they go about their daily care-rounds around the study site. Data collected will provide  
34 information in terms of patient/clients' receptivity to medical intervention, relationship between  
35 practitioners and their elderly patients/clients. The objective of go-along interviews is to capture the  
36 practitioners' perspective of the barriers and facilitators in the implementation of ICoC to their  
37 patients/ clients. Research team will document processes in which medical practitioners understand,  
38 implement and apply appropriate practices of care to the elderly residents in low-income rental  
39 dwelling. For triangulation, the research team will conduct content analysis of practitioners' case  
40 summaries over the period of intervention to trace the chronology and outcome of individualized  
41 interventions.  
42

#### 43 44 1b. *Elderly Residents' Qualitative Needs Assessment based on Case Summaries and Complementary 45 Quantitative Study*

46  
47 Based on case summaries by community practitioners, research team will work with implementation  
48 team to identify and categorically group elderly residents based on complexity of case and specific  
49 health conditions. Medical team and nurses will refer 40 cases/ elderly residents to the research  
50 team for Phase 2b of in-depth semi-structured/ informal interviews. Elderly residents will be  
51 grouped according to similarities in terms of case complexity (1<sup>st</sup> strata) followed by whether they  
52 show improvements in health behavior or not.  
53

### 54 55 Phase 2: *Action Learning through Involvement and Inquiry*

56  
57 2a. Interpreting, explaining, translating and refining identified problems, priorities and strengths in  
58 concert with key community members- clinicians, nurses, resident leaders and elderly residents  
59 ( $n=10$ ). Through focus group discussions, the aim of this phase is to: 1) to understand how  
60

1  
2  
3 practitioners define care and how their vision of care is being expressed through their practices and  
4 2) to obtain a profile of “complex” cases and how practitioners manage these issues.

5  
6 2b. ICoC User Experience (n=40 based on referral in Phase 1b)

7  
8 Research team will establish rapport with elderly residents in intervention group and conduct in-  
9 depth interviews to explore the experiences and attitudes of older people who are in the  
10 intervention group (VW and C2H). Objective is to gain an understanding of the strengths and  
11 weaknesses of community care from the perspective of recipients in the study site.

12  
13 Upon approval from the IRB, participants are invited to participate in research study through case  
14 referrals by nurses and community health partners. Upon receiving referrals, research team will  
15 administer Montreal Cognitive Assessment – Singapore (MoCA - Singapore) screener to determine  
16 participants’ eligibility and whether elderly respondents are cognitively impaired and if they would  
17 require a professional or lay proxy (if applicable) to respond to questions on their behalf. Research  
18 team will obtain consent from the elderly respondent/ their proxy and inform them that  
19 participation in the study is voluntary and care services will not be withdrawn should they decide to  
20 not participate or withdraw from the study. After obtaining consent, interviews will largely follow a  
21 life history format, where research team will ask about their personal histories to get to know them  
22 better and to gain rapport. When comfort is established through repeated interactions (following  
23 nurses around and being a familiar face), the research team will begin asking about the recipient’s  
24 feedback on care services (refer to interview guide). Sessions will be about max. 30 mins each time  
25 so as to not tax the elderly resident and will continue until all questions in the guide have been  
26 completed.  
27

28  
29 *Phase 3. Inquiry and Intervention*

30  
31 Data analysis and findings from phase 1 and 2 will provide feedback on the delivery of the  
32 intervention. These findings will be analyzed together with the post-30 days and post 1 year  
33 quantitative outcome measures to identify which mechanisms of the intervention has been  
34 successful and which ones require improvements. Additionally, the objective of Phase 3 is to also  
35 highlight unintended outcomes of the intervention that clients and practitioners consider as  
36 beneficial to their experiences. The team will further analyze implications of findings and  
37 translational capacity to other low-income rental community-dwelling areas in Singapore.  
38

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40  
41 **Statistical Analysis**

42  
43 *Quantitative Data Analysis*

44  
45 The secondary aim 1 analysis will use Fisher’s exact test and logistic regression and compare groups  
46 on proportions of patients with three or more unscheduled hospital readmissions within one year of  
47 index discharge. Secondary aims 2 and 3 will involve Poisson regression analysis on numbers of visits  
48 per three-month and one-year intervals, and aim 4 will involve standard analysis of variance  
49 methods to compare quality of life scores. All analyses will incorporate propensity score adjustment.  
50 All analyses will be performed using SAS V9.4 software (SAS© Cary, NC, USA).  
51

52  
53 All in-depth interviews with key personnel and focus group discussions will be audiotaped and  
54 transcribed and uploaded onto qualitative software database nVivo 11. While ‘go-along’ interviews  
55 with nurses and case workers and interviews with more cognitively-impaired elderly recipients will  
56 not be audio-recorded due to the long duration of such sessions and difficulty in capturing speech  
57 respectively. Written notes will be used instead to record such observations and conversations and  
58 will be type- written once fieldwork for the day is over. Typed written notes will be uploaded onto  
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3 nVivo 11. The research team will use nVivo to code responses for emergent themes regarding  
4 practitioner and client/patient (provider-user) experience of the ICoC programme.  
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### 8 **Ethics and Dissemination**

9  
10 Informed consent for participation in the ICoC intervention programme will be taken from each  
11 enrolled patient. Informed consent to participate in the research study will be taken another time  
12 for patients/ clients who have been referred to research team and also practitioners who will be  
13 interviewed and/or participating in focus group discussions. SingHealth Centralized Institutional  
14 Review Board (CIRB 2015/2277) approved this study.  
15

16 Findings will be disseminated by publications in peer-reviewed journals, scientific meetings, and  
17 presentations to policy makers and practice partners.  
18  
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### 20 *Status of the study*

21  
22 The ICoC program is expected to last 2 years, from July 2016 to June 2018.  
23  
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25

### 26 **Discussion**

27  
28 It is increasingly recognized that non-biological determinants of health such as social, environmental  
29 and individual behaviors impact significantly on health outcomes.<sup>(30, 31)</sup> These non-biological  
30 determinants of health interact in a complex relationship a person's biological health determinants  
31 such as gender, age, inherited and acquired health conditions. Therefore, quality healthcare alone  
32 cannot achieve optimal outcomes in health. The ICoC program is the first step to achieving optimal  
33 health in a high-risk population by systematically addressing biological, social and individual risk  
34 factors for poor health. Components of the ICoC program will address social determinants of health  
35 such as social connectedness, loneliness; individual behaviors such patient activation, locus of  
36 control and environmental determinants such as access to health services and facilities. Policy  
37 changes and intervention (the ICoC program in this case) that can modify health seeking behavior  
38 and affect delivery of healthcare services may affect health determinants and health outcomes.  
39 Implementing a complex ICoC intervention program and understanding the complex interaction  
40 between determinants, policy and outcomes therefore require an innovative approach to evaluation  
41 such as the participatory action research (PAR) model.  
42  
43

44 The findings from ICoC program will directly inform policy makers on the feasibility of  
45 implementation and effectiveness of integrating traditional silos of practice on reducing acute  
46 hospital utilization. This has direct policy implications on the funding model and quantum to support  
47 such a program. In the short to medium term, the study will develop a novel model of integrated  
48 care that shifts care from a hospital centric system to an integrated community centric system for  
49 high-risk communities. In the long term, the study has policy implications on the feasibility and  
50 effectiveness of empanelment of high-risk communities to a community based integrated care team  
51 supported by the regional health system. The systematic inquiry, with the participation of those  
52 affected by the problem being studied, will enable the ICoC program and policy makers to  
53 understand the complex interaction between health determinants, intervention and health  
54 outcomes. This knowledge will facilitate design of better interventions and policies that  
55 systematically address health determinants and policies in future iterations of the ICoC program.  
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3 However, our study has potential limitations. Firstly, a randomized controlled trial design would  
4 have been most rigorous for evaluation of the ICoC program. However, we had wanted to evaluate  
5 the effectiveness of the synergism achieved by all three components of the ICoC program. The  
6 restriction of the C2H program to the three intervention blocks precluded us from randomizing the  
7 rental housing blocks or patients for intervention. We will minimize bias in the statistical comparison  
8 of the intervention and control groups by using propensity scores to balance baseline covariates.  
9 Second, this study is limited to a single rental housing community, so generalizability to other rental  
10 housing communities would be unknown. If results from the ICOC program are promising, we intend  
11 for this model of care to be propagated to other rental housing communities throughout RHS and  
12 Singapore.  
13

14  
15 In summary, this is the first study to develop a novel integrated community of care that integrates  
16 hospital-based transitional care with health and social care in the community for high-risk individuals  
17 living in socially deprived communities. The ICoC program will be rigorously evaluated using a  
18 participatory action research methodology. The study findings will directly inform policy makers on  
19 the feasibility of implementation and effectiveness of integrating traditional silos of practice on  
20 reducing acute hospital utilization, and the funding model and quantum to support such a program.  
21  
22

23  
24 **Study status:** At the point of manuscript submission, the enrollment of participants is ongoing.

25  
26 **Contributorship Statement:** LLL, AM and LKH conceived and designed the study. LLL and AM wrote  
27 the first draft of the paper, and all authors critically revised the paper and gave final approval for  
28 publication.  
29

30  
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35

36  
37 **Funding Statement:** This study is supported by the SingHealth Regional Health System and Duke-  
38 NUS Medical School Centre for Aging Research and Education. No additional grant funding was  
39 obtained.  
40

41  
42 **Data Sharing statement:** Details of ongoing data collection (indicators and outcomes) is available  
43 from the corresponding author at [low.lian.leng@singhealth.com.sg](mailto:low.lian.leng@singhealth.com.sg)  
44

45  
46 **Competing interests:** The authors declare that they do not have competing interests.  
47

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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 Page 1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found Page 2
<b>Introduction</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Pages 2-3
Objectives	3	State specific objectives, including any prespecified hypotheses Page 3
<b>Methods</b>		
Study design	4	Present key elements of study design early in the paper Page 4 onwards
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Page 4 onwards
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Page 6
		(b) For matched studies, give matching criteria and number of exposed and unexposed Page 9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Page 8-9
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 Pages 9
Bias	9	Describe any efforts to address potential sources of bias Page 9
Study size	10	Explain how the study size was arrived at Page 10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Page 11
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding Page 11
		(b) Describe any methods used to examine subgroups and interactions Not applicable in our study.
		(c) Explain how missing data were addressed Not applicable in our study.
		(d) If applicable, explain how loss to follow-up was addressed We are able to retrieve utilization data from our electronic health record system.
		(e) Describe any sensitivity analyses Not applicable in our study.
<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 No results are available yet.
		(b) Give reasons for non-participation at each stage No results are available yet.
		(c) Consider use of a flow diagram No results are available yet.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders No results are available yet.
		(b) Indicate number of participants with missing data for each variable of interest No results are available yet.
		(c) Summarise follow-up time (eg, average and total amount) No results are available yet.

Outcome data	15*	Report numbers of outcome events or summary measures over time <b>No results are available yet.</b>
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>No results are available yet.</b> (b) Report category boundaries when continuous variables were categorized <b>No results are available yet.</b> (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period <b>No results are available yet.</b>
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses <b>No results are available yet.</b>
<b>Discussion</b>		
Key results	18	Summarise key results with reference to study objectives <b>No results are available yet.</b>
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 <b>Page 12-13</b>
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence <b>Pages 12-13</b>
Generalisability	21	Discuss the generalisability (external validity) of the study results <b>Page 12-13</b>
<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 <b>Page 14</b>

\*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

## Evaluating a novel Integrated Community of Care (ICoC) for patients from an urbanized low-income community in Singapore using the Participatory Action Research (PAR) methodology: A Study Protocol

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<b>Primary Subject Heading</b>:	Health services research
Secondary Subject Heading:	General practice / Family practice, Geriatric medicine, Health policy, Qualitative research
Keywords:	Integrated Care, Community-based care, Transitional care, Low-income elderly community, participatory action research

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3 **Title: Evaluating a novel Integrated Community of Care (ICoC) for patients**  
4 **from an urbanized low-income community in Singapore using the**  
5 **Participatory Action Research (PAR) methodology: A Study Protocol**  
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49 **Word Count**  
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52 5131 words  
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## **Abstract**

**Introduction:** Poorer health outcomes and disproportionate healthcare utilization in socioeconomically disadvantaged patients is well established. However there is sparse literature on effective integrated care interventions that specifically target these high-risk individuals. The Integrated Community of Care (ICoC) is a novel care model that integrates hospital-based transitional care with health and social care in the community for high-risk individuals living in socially deprived communities. This study aims to evaluate the effectiveness of the ICoC in improving acute hospital utilization and investigate the implementation process and its effects on clinical outcomes using a mixed-methods participatory action research (PAR) approach.

**Methods and Analysis:** This is a single-centre prospective, controlled, observational study performed in the SingHealth Regional Health System. A total of 250 eligible patients from an urbanized low-income community in Singapore will be enrolled during their index hospitalization. Our PAR model combines two research components: quantitative and qualitative, at different phases of the intervention. Outcomes of acute hospital utilization and health related quality of life are compared to controls, at 30 days and one year. The qualitative study aims at developing a more context-specific social ecological model of health behaviour. This model will identify how influences within one's social environment: individual, interpersonal, organizational, community and policy factors affect people's experiences and behaviors during care transitions from hospital to home. Knowledge on the operational aspects of ICoC will enrich our evidence-based strategies to understand the impact of the ICoC. The blending of qualitative and quantitative mixed methods recognizes the dynamic implementation processes as well as the complex and evolving needs of community stakeholders in shaping outcomes.

**Ethics and Dissemination:** Ethics approval was granted by the SingHealth Centralized Institutional Review Board (CIRB 2015/2277). The findings from this study will be disseminated by publications in peer-reviewed journals, scientific meetings, and presentations to government policy makers.

**Trial registration number:** NCT02678273

**Key words:** Low-income elderly community; participatory action research; integrated care; community-based care; transitional care

## **Article Summary**

### **Strengths and Limitations of study**

1. The Integrated Community of Care (ICoC) is a novel care model that integrates hospital-based transitional care with health and social care in the community for high-risk individuals living in socially deprived communities.
2. Study utilized a mixed method participatory action research (PAR) methodology to evaluate the effectiveness of a complex intervention program for a high-risk urbanized low-income community.
3. A randomized controlled trial design is not possible for this study.

## **Introduction**

Elderly, socioeconomically disadvantaged and socially isolated patients such as those residing in public rental housing are at highest risk of ill health. Low socioeconomic status (SES) is well recognized as an independent risk factor for various adverse health outcomes, such as readmission

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3 risk <sup>(1-3)</sup> and hospital utilization<sup>(4)</sup>. In Singapore, public rental housing is an area-level measure of SES  
4 and is independently associated with increased readmission risk and being a frequent hospital  
5 admitter and emergency department (ED) user.<sup>(5)</sup> The reasons behind these poor outcomes include  
6 poor knowledge of personal health status, inappropriate health behaviors <sup>(6)</sup>, inability to navigate the  
7 complicated healthcare system <sup>(2, 7)</sup>, lower health literacy and misalignment between patient and  
8 care team with regard to goals of care <sup>(8)</sup>. These factors are common among residents of rental flats  
9 in Singapore. To qualify for heavily subsidized rental housing from the government, the gross  
10 household income must be very low at 1,500 Singapore dollars per month. The median household  
11 income in Singapore is 8,290 Singapore dollars per month <sup>(5)</sup>. In addition, such residents are more  
12 likely to have comorbidities, poor social support, more likely to suffer from mental health conditions  
13 and more likely to be on anti-depressant treatment <sup>(5, 9)</sup>. The confluences of these factors in a sub-  
14 population of patients who tend to live together in socially deprived communities create challenges  
15 as well as opportunities to improve the health of the population.  
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17  
18 While there is abundant literature highlighting the poorer health outcomes and disproportionate  
19 healthcare utilization in socioeconomically disadvantaged patients, there is sparse literature on  
20 integrated care interventions that specifically target these high-risk individuals. Englander et al. <sup>(10)</sup>  
21 described the Care Transitions Intervention (C-Traln) program, a nurse and pharmacist-led  
22 multicomponent transitional care program conducted at an urban academic medical centre in  
23 Portland, Oregon. The C-Traln program included coaching and education; home visits for highest risk  
24 patients; provision of 30 days of medications for low-income adults who were uninsured or on public  
25 insurance. However, the intervention did not reduce 30-day readmission rates or emergency  
26 department re-attendances. The authors concluded that the diverse needs of this population were  
27 too overwhelming for a nurse and pharmacist-based intervention. In Singapore, community-based  
28 initiatives led by social work professionals and para-professionals have been described <sup>(11)</sup>. However,  
29 the program faced similar problems and was hampered by the lack of a multi-disciplinary healthcare  
30 team to address complex health and social needs across different settings of care. Three reviews on  
31 effectiveness of transitional care trials by Hansen <sup>(12)</sup>, Kansagara <sup>(13)</sup>, and Kriplani <sup>(14)</sup> independently  
32 concluded that transitional care interventions must be comprehensive, going beyond single  
33 component intervention. Integrating medical and social care across settings that span the different  
34 phases of care from hospitalization, discharge planning to post-discharge surveillance. The programs  
35 also need the flexibility to respond to individual needs.  
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39 In Singapore, it is estimated that 900,000 citizens living in the city state will be 65 years or older by  
40 2030 and at least 50,000 (5.3%) would be staying in rental housing.<sup>(15)</sup> A shift from a hospital centric  
41 model of care to a community centric model of care is widely accepted as a strategy that will enable  
42 us to provide sustainable and cost-effective care for our rapidly aging population. In response to this  
43 need, many new models of care were developed and tested for effectiveness. The Integrated  
44 Community of Care (ICoC) is a novel model developed by the Singapore General Hospital that was  
45 designed to bring together best practices in transitional care <sup>(16-19)</sup>. This care model provides  
46 multidisciplinary transitional care, which fully integrates health and social care for high-risk  
47 individuals living in socially deprived communities. The ICoC program is the first step to achieving  
48 optimal health in a high-risk population by systematically addressing biological, social and individual  
49 risk factors for poor health. Components of the ICoC program will address social determinants of  
50 health such as social connectedness, loneliness; individual behaviors such patient activation, locus of  
51 control and environmental determinants such as access to health services and facilities.  
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53  
54 The aim of this evaluation is to answer the following questions while providing feedback to key  
55 decision makers over the 2 years of the project: (1) What is the overall effectiveness of the ICoC  
56 program in improving acute hospital utilization? (2) What are the different components of the ICoC  
57 programme: their structure, their stakeholders (targeted patients and practitioners), their operating  
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3 process and their effects on clinical outcomes? (3) What are the strengths and aspects to improve of  
4 each programme from the perspective of the concerned stakeholders in view of a better services  
5 integration? (4) What characteristics of the patients and the ICoC programme contribute to positive  
6 impacts on use of services, quality of life, patient activation and patient experience with care?  
7

## 8 **Methods/Design**

### 9 *Study Site*

10  
11 Adopting a population health approach, the Ministry of Health Singapore has been advocating for  
12 the transformation of our health care system from a hospital centric to a community centric. In  
13 2011, public healthcare delivery was re-organized into regional health systems (RHS). The aim of  
14 which was to organize regional health assets into an integrated structure that will promote care  
15 integration of care across the care continuum. There is to be vertical and horizontal integration of  
16 healthcare institutions. In addition, the regional health systems will work to integrate health and  
17 social care by working closely with social care agencies within each region. Six RHSs were created,  
18 each being responsible to integrate care for a specific geographic region in Singapore. Each RHS is  
19 anchored by a tertiary hospital, supported by a community hospital providing intermediate and  
20 rehabilitation care and complete with linkages to primary care and long term care services in the  
21 region. In 2014, the Singapore Health Services (SingHealth) RHS was officially launched and consisted  
22 of primary to tertiary care institutions that account for the care of nearly a million residents in  
23 Singapore.  
24  
25

### 26 *Intervention and Control*

27  
28 The ICoC intervention program (Figure 1)

#### 29 1. SGH Transitional Care (TC) team for care transitions of hospitalized residents

30  
31 The SGH TC team (comprising a senior family physician and a medical officer) is a dedicated service  
32 that will provide inpatient care or co-management with specialists for all enrolled patients, with  
33 emphasis on comprehensive discharge planning, formulation of a care plan post-discharge and  
34 proper hand-over care to the community virtual ward and C2H teams. This intervention incorporates  
35 the best principles in transitional care that includes both pre-discharge and post-discharge  
36 component<sup>(13, 19)</sup>. The hand-over care will be executed via a daily half-hour video conferencing  
37 meeting between the three teams.  
38  
39

#### 40 2. Community Virtual Ward (VW) for coordinating community care and home-based primary care

41  
42 The community-based VW team comprises of a staff nurse and resident physician seconded by SGH  
43 to provide continuing community care, home-based primary and nursing care to enrolled patients.  
44 This intervention is supported by strong evidence for home-based primary care and continuing care  
45 for frail elders<sup>(20, 21)</sup>. The team's responsibilities include: (i) comprehensive geriatric assessment; (ii)  
46 continuing care and at least weekly surveillance of discharged patients for up to one month post-  
47 discharge; (iii) monitoring at risk patients for compliance to the prescribed care plans and  
48 medications; (iv) health promotion and education to enrolled patients; (v) developing patient-  
49 specific action plans for patients with high risk diseases such as heart failure and diabetes and (vi)  
50 coordinating and integrating the primary, transitional and social care for enrolled patients; and (vii)  
51 hand-over care to community service providers for long term follow up upon stabilization of patients  
52 and according to clinical protocol. The community VW team is physically located in the community.  
53  
54

#### 55 3. Care Closer to Home (C2H) team for social case management and home help



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3 Since October 2014, the C2H is a program by the Agency for Integrated Care comprising a case  
4 manager, a social work assistant and five nursing aides to put in place health, personal and social  
5 services, e.g. medication management, home help services to assist with basic activities of daily  
6 living e.g. showering to help seniors to age in place. To date, the program has enrolled close to 300  
7 residents. AIC closely supports and provides professional guidance for the C2H program.  
8

9 All three components of the ICoC program will be provided to enrolled patients. To ensure this, we  
10 have harmonized our inclusion and exclusion criteria for entry into all three components.  
11

#### 12 Control group participants

13  
14 The control group of approximately 1100 participants from other rental housing blocks in our  
15 regional health system will receive current hospital standard of care when they are hospitalized.  
16 Patients will be managed by their specialists in charge depending on their admitting diagnoses.  
17 Patients may be referred to the SGH THC program and/or various community services on discharge if  
18 deemed necessary by their specialists. Continuing care post-discharge may be provided at the  
19 specialist outpatient clinics or a primary care provider identified by the hospital specialist. The  
20 community VW and C2H teams would not be available for control group patients.  
21  
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23

24 Figure 1: Conceptual Model of Care for the ICoC Program  
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#### 28 *Conceptual Framework for Evaluation*

29  
30 The strategy of using multidisciplinary case management that we have adopted for our model of  
31 care has been widely used in many care integration programs aimed at reducing health care  
32 utilization and improve quality of care for frail older adults with multimorbidities.<sup>(22)</sup> The evaluation  
33 of this model of care is challenging because it contains multiple components. For example, the  
34 medical, social and personal care components may act both independently of each other and  
35 interdependently in affecting the outcome of patient care. The assessment of individual  
36 components of intervention becomes complicated, creating the need for a novel adaptation of a  
37 mixed-method strategy of evaluation. Thus, our multidisciplinary research team combines the use of  
38 both quantitative and qualitative methods through a participatory action research (PAR) approach as  
39 part of the overall evaluation of the effectiveness of the ICOC program.  
40

41 PAR has been defined as “systematic inquiry, with the participation of those affected by the problem  
42 being studied, for the purposes of education and action or effecting social change”.<sup>(23)</sup> In Singapore,  
43 the recent and rapid transformation of health services delivery for the aging population had created  
44 unprecedented shifts in the power relationship between users, policy makers and service providers  
45 in the healthcare system. Participatory action research with community-dwelling socially-at-risk  
46 elderly Singaporeans has the potential to explore some of the complex health and social problems  
47 that poor and socially-isolated elderly face, while also contributing to individual and community  
48 capacity building. Additionally, PAR has been found to be an appropriate process for evaluating  
49 patient-centred models of care. Nolan & Hazelton found similarities in nursing processes with PAR,  
50 particularly through the steps of assessment, planning, implementation, evaluation and  
51 replanning<sup>(24)</sup>. PAR has also been engaged successfully to facilitate improvements in healthcare  
52 services<sup>(25)</sup>.  
53  
54

55 A mixed-methods PAR approach will facilitate a more comprehensive assessment of the ICoC,  
56 particularly to understand the multiple outcomes of the program in terms of what works, for what  
57 and for whom. In this regard, PAR is intended to be both highly localized and comparative.  
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3 Investigation of the programme structure, its operating processes and stakeholders' experiences can  
4 be captured through qualitative methods while the comparative assessment of health outcomes  
5 between the intervention and control group will be valuably complemented through quantitative  
6 research methods. Our preferred approach is driven not only by the learning objectives of  
7 investigators but also by the circumstances and contexts of the community involved.  
8

### 9 *Research Design*

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11 The ICoC study is a single-centre prospective, controlled, observational study performed in the  
12 SingHealth Regional Health System.<sup>(26, 27)</sup> Drawing upon established trends in PAR praxis<sup>(28, 29)</sup>, our  
13 research design similarly includes a learning component, that we have conceptualized as a synergy  
14 between the 3 "Is" of Intervention (Action), Involvement (Participation in the Community) and  
15 Inquiry (Research) into a feedback cycle (Figure 2). The 3 Is mutually augment each other to  
16 contribute to the social transformation of integrated elderly care. The approach requires the co-  
17 partnership of stakeholders, implementation teams and research units to collect data, reflect upon  
18 findings of outcomes and refine the intervention process further to develop and achieve better  
19 delivery and results of ICoC.  
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24 Figure 2. Research Design: Intervention, Involvement and Inquiry Feedback Cycle  
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28 The mixed-methods PAR approach to the ICoC model is significant to health systems research  
29 because it attempts to triangulate both medical practitioners' and elderly patients' perspectives of  
30 intervention delivery. In this regard, our research design intends to capture sensitivity to outcomes  
31 beyond only the intended hypothesis. Additionally, while evaluation studies utilizes quantitative  
32 data to measure intervention outcomes, a qualitative approach may address issues with regards to  
33 using a single metric of examining hospital admissions, which have been found to be less suitable for  
34 complex and vulnerable patients where many other factors contribute to the need for  
35 hospitalization.<sup>(30) (31)</sup>  
36

### 37 *Study Aims and Hypotheses*

38  
39 Our participatory action research (PAR) model combines two research components, quantitative and  
40 qualitative, at different phases of the intervention. The primary objective of the quantitative study is  
41 to evaluate the effectiveness of the ICoC program in achieving a significant reduction in the  
42 proportion of patients in the intervention group with unscheduled hospital readmissions within 30  
43 days of the index discharge date relative to controls. The index admission and index discharge dates  
44 are defined as the date of the patient's first admission to the hospital and discharge from the  
45 hospital respectively. The secondary aims of this study are to evaluate the effectiveness of the ICoC  
46 program in achieving (i) a lower proportion of patients in the intervention group with three or more  
47 unscheduled hospital readmissions within one year of index discharge; (ii) a lower emergency  
48 department attendance rate in the intervention group at 30 days, and one year from index  
49 discharge; (iii) a lower specialist outpatient clinic attendance rate in the intervention group at 30  
50 days, and one year from index discharge; (iv) Improving health related quality of life in the  
51 intervention group relative to baseline as measured by the EQ-5D at 30 days, and one year  
52 compared to the control group.  
53  
54

55 The qualitative study aims at developing a more context-specific social ecological model of health  
56 behavior.<sup>(32)</sup> We propose a social ecological framework of health behavior in the manner below:  
57

- 58 a. Care recipients' and caregivers' conditions and experiences (individual level)  
59  
60

- b. Interactions between elderly patient, caregivers and healthcare providers (interpersonal level)
- c. Elderly's and caregivers' access to experiences with service use and health care delivery (institutional/ organizational level)
- d. Elderly patients' connections with and support from the community (community level)
- e. How public initiatives and access to other healthcare programmes affect the experience of transitional care post-discharge (policy level)

This model helps to identify how influences within one's social environment: individual, interpersonal, organizational, community and policy factors affect people's experiences and behaviors during care transitions from hospital to home. The knowledge of how this model operates on the ground will enrich our evidence-based strategies to understand the impact of the ICoC. The PAR operates on a feedback loop that is sensitive to changes experienced by practitioners and patients in real-time. In this project, both the implementation and research team work in tandem to evaluate and improve the intervention on-the-go.

#### Sample Size calculation

Data from a previous study shows a historical 30-day re-admit rate of 17.5% for patients in the three proposed Intervention HDB blocks and 16.8% in the Control blocks. The prospectively recruited sample size for the Intervention will be 250 and, based on 2014 data, we anticipate about 1100 patients in the Control group. The figure shows the proposed sample sizes will provide  $\geq 80\%$  power using a two-sided Fisher's exact test ( $\alpha=0.05$ ) to detect the following range of differences (unadjusted) in 30-day re-admit rates between Control vs. Intervention: 18.0 vs. 10.7, 17.0 vs. 9.9, 16.0 vs. 9.1, 15.0 vs. 8.3, 14.0 vs. 7.5 and 13.0 vs. 6.7. Targeted reductions in Intervention group readmission rates range from 40.5–48.5% and would certainly be considered clinically meaningful. In our previously published virtual ward study<sup>(19)</sup>, we achieved 33% reduction in 30-day readmission rates and it is likely this can be improved with additional home visits and social care case management.

#### *Inclusion and Exclusion Criteria*

Patients are eligible if they:

- 1) Age  $\geq 60$  years at time of recruitment
- 2) Staying in public rental housing in Chinatown area in Singapore

We will exclude patients who decline our program or dementia patients who are incapable of independent living and do not have a caregiver. Patients who have mild dementia and are capable of independent living or have a caregiver are suitable to be enrolled into the ICoC program, which will support care in the community. Patients in the intervention group will be recruited during their first admission upon study commencement (Figure 3). Based on the electronic medical records, close to 180 unique patients were admitted to Singapore General Hospital (SGH) in 2014. Assuming a low 5% rejection and exclusion rate (confirmed by our feasibility study), the recruitment period is estimated to be take 1.5 years (1<sup>st</sup> August 2016 to 31<sup>st</sup> January 2018). Recruitment will close when the sample size of 250 is reached. Control patients will be identified retrospectively at the end of the study period and data extracted from the SGH patient database using the index admission as the start date.

Figure 3: Patient Recruitment and Comparison between Intervention and Control Groups.

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12 For the qualitative component, the research team will purposively extract a sample size of 40 elderly  
13 patients/ clients based on the sample of 300 elderly residents who are enrolled in C2H intervention  
14 programme and who are also under the supervision of the VW. The elderly patients/ clients are  
15 recruited into the study through referrals from medical and care team, where we hope to get a  
16 representative sample in terms of gender, age, ethnicity, health and physical status and living  
17 arrangements. The research team will also be interviewing 10 community practitioners who are  
18 providing care in the study site.  
19

#### 20 *Data Collection strategies to Measure Outcomes*

##### 21 Basic Characteristics

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23  
24 Intervention Group: The research team will take informed consent from the intervention group  
25 participants and interview them for demographic, socioeconomic status, medical comorbidities,  
26 abbreviated Mental Test, and modified Barthel Index, instrumental activities of daily living and  
27 health-related quality of life (EQ-5D). These information will allow the investigators to characterize  
28 and identify needs in our intervention group patients better.  
29

30  
31 Control Group: Control group patients will be retrieved from the eHIntS system. A waiver of patient  
32 consent will be sought from the centralized institutional review board for extraction of de-identified  
33 routinely collected information. Similar demographic, socioeconomic status and medical  
34 comorbidities data (predictors used for propensity scores calculation listed in Appendix A  
35 supplementary file) will be collected for both groups to allow calculation of propensity scores as a  
36 basis for comparability. We have shown in our previous study<sup>(27)</sup> that these data can be extracted  
37 from our data warehouse for inclusion in a propensity score model. Information such as abbreviated  
38 mental test, modified barthel index, instrumental activities of daily living and health related quality  
39 of life will not be available for the control group,  
40

##### 41 Outcome Measures at 30 days and one-year

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43 The research team and the ICoC team will follow up with study participants for the primary and  
44 secondary outcomes at 30 days, and one year (Table 1). An unscheduled readmission is defined as a  
45 readmission for a non-elective indication. Unscheduled readmission at 30 days (short-term outcome)  
46 is a universally accepted indicator of transitional care quality and one year outcomes (long-term  
47 outcome) is chosen to reflect the quality of community and continuing care. The research team will  
48 conduct a face-to-face survey interview at 30 days and one year to repeat the EQ-5D scales.  
49 Healthcare utilization data of intervention and control group participants will be extracted from  
50 SingHealth's eHIntS system and merged with Ministry of Health (MOH)'s Omnibus data resource.  
51 This will ensure complete and accurate healthcare utilization outcomes and overcome the issue of  
52 cross utilization. Similarly, predictors of 30-day readmission that will be used for propensity score  
53 matching will be available from eHIntS and Omnibus databases.  
54  
55

56 A checklist will be developed to measure fidelity to components of ICoC program and ensure  
57 standardization of intervention. The nature (routine/emergency) and number of home visits e.g.  
58 doctor/nurse/C2H will be retrieved from the clinical documentation notes.  
59  
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Table 1: Data collection sources at Baseline, 30 days and One Year outcomes for participants

Variable	Method of Collection	Baseline	Follow-up (30 days)	Follow-up (One year)
Demographic, Socio-economic status, Health information and prior healthcare utilization, Abbreviated Mental Test, Modified Barthel Index, Instrumental activities of daily living, health related quality of life	Questionnaire, EQ-5D, eHIntS	X		
<b>Primary Outcome Measure</b> – Unscheduled hospital readmission within 30 days of index discharge	eHIntS, Omnibus		X	
<b>Secondary Outcome Measures</b> – Unscheduled hospital readmissions at one year; Emergency department attendances, specialist outpatient clinic attendances and health related quality of life at 30 days and one year	EQ-5D, eHIntS, Omnibus		X	X

#### Qualitative Data Collection Design and Strategies

The qualitative research component of the PAR will be conducted in three phases.

##### Phase 1: *Intervention & Involvement*

##### 1a. *Understanding mechanisms and contexts of intervention* (Practitioners and Patients)

The research team will engage in ‘go-along’ interviews to understand the complexities around integrated care in a low-income rental neighbourhood. The “go-along” combines both participant observation and interview methods and will be conducted with VW nurses and the C2H team (n=10) as they go about their daily care-rounds around the study site. Data collected will provide information in terms of patient/clients’ receptivity to medical intervention, relationship between practitioners and their elderly patients/clients. The objective of go-along interviews is to capture the practitioners’ perspective of the barriers and facilitators in the implementation of ICoC to their patients/ clients. Research team will document processes in which medical practitioners understand, implement and apply appropriate practices of care to the elderly residents in low-income rental dwelling. For triangulation, the research team will conduct content analysis of practitioners’ case summaries over the period of intervention to trace the chronology and outcome of individualized interventions.

##### 1b. *Elderly Residents’ Qualitative Needs Assessment based on Case Summaries and Complementary Quantitative Study*

Based on case summaries by community practitioners, research team will work with implementation team to identify and categorically group elderly residents based on complexity of case and specific health conditions. Medical team and nurses will refer 40 cases/ elderly residents to the research team for Phase 2b of in-depth semi-structured/ informal interviews. Elderly residents will be grouped according to similarities in terms of case complexity (1<sup>st</sup> strata) followed by whether they show improvements in health behavior or not.

## Phase 2: *Action Learning through Involvement and Inquiry*

2a. Interpreting, explaining, translating and refining identified problems, priorities and strengths in concert with key community members- clinicians, nurses, resident leaders and elderly residents (n=10). Through focus group discussions, the aim of this phase is to: 1) to understand how practitioners define care and how their vision of care is being expressed through their practices and 2) to obtain a profile of “complex” cases and how practitioners manage these issues.

### 2b. ICoC User Experience (n=40 based on referral in Phase 1b)

Research team will establish rapport with elderly residents in intervention group and conduct in-depth interviews to explore the experiences and attitudes of older people who are in the intervention group (VW and C2H). Objective is to gain an understanding of the strengths and weaknesses of community care from the perspective of recipients in the study site.

Once the Institutional Review Board (IRB) has given ethics approval to conduct the research, the investigators will invite residents in the intervention group to participate in research study through case referrals by nurses and community health partners. Due to the nature of the User Experience research which requires substantial feedback from participants, nurses and community health partners will only refer elderly clients who are able to respond to questions without requiring a proxy. Research team will obtain consent from the elderly respondent and inform them that participation in the study is voluntary and care services will not be withdrawn should they decide to not participate or withdraw from the study. After obtaining consent, the qualitative research team will build rapport of elderly participants further through regular interactions facilitated by frequent house visits with community nurses and health partners. When comfort and trust has been established between the research team and participants, investigators will conduct interviews following a life history format. We will ask about their personal histories to gain a deeper and better understanding of their current circumstances and health behaviors. We will also seek their feedback as recipients of the care intervention. Interviews will be carried out over multiple sessions and visits, instead of a block session, so as to not tax elderly participants. Each session would last about approximately 30 minutes and will continue until all questions in the interview guide (Appendix B supplementary file) have been satisfactorily completed.

## Phase 3. *Inquiry and Intervention*

Data analysis and findings from phase 1 and 2 will provide feedback on the delivery of the intervention. These findings will be analyzed together with the post-30 days and post 1 year quantitative outcome measures to identify which mechanisms of the intervention has been successful and which ones require improvements. Additionally, the objective of Phase 3 is to also highlight unintended outcomes of the intervention that clients and practitioners consider as beneficial to their experiences. The team will further analyze implications of findings and translational capacity to other low-income rental community-dwelling areas in Singapore.

## **Analysis**

### *Quantitative Data Analysis*

To analyze our primary aim, Control and Intervention 30-day re-admission rates will be compared using logistic regression using propensity scores to adjust for effects of confounders.

The secondary aim 1 analysis will use Fisher’s exact test and logistic regression and compare groups on proportions of patients with three or more unscheduled hospital readmissions within one year of index discharge. Secondary aims 2 and 3 will involve Poisson regression analysis on numbers of visits per three-month and one-year intervals, and aim 4 will involve standard analysis of variance

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3 methods to compare quality of life scores. All analyses will incorporate propensity score adjustment.  
4 All analyses will be performed using SAS V9.4 software (SAS© Cary, NC, USA).  
5

#### 6 *Qualitative Data Analysis*

#### 7

8 All in-depth interviews with key personnel and focus group discussions will be audiotaped and  
9 transcribed and uploaded onto qualitative software database nVivo 11. While 'go-along' interviews  
10 with nurses and case workers and interviews with elderly recipients with speech difficulties (eg. slow  
11 speech, inaudible voice) will not be audio-recorded due to the anticipated long duration of such  
12 sessions and difficulty in capturing speech respectively. Written notes will be used instead to record  
13 such observations and conversations and will be type-written once fieldwork for the day is over.  
14 Typed written notes will also be uploaded onto NVivo 11. The research team will use NVivo to code  
15 responses for theoretical and emergent themes regarding practitioner and client/patient (provider-  
16 user) experience of the ICoC programme.  
17

18 The team will analyze data, by coding for broad themes that correspond to influences at the  
19 individual, interpersonal, organizational, community and policy level according to the social  
20 ecological framework of health behavior, while simultaneously code for emergent themes. The  
21 combination of both deductive and inductive analytical approaches will provide further granularity  
22 for the evaluation of the ICoC intervention programme. Data will be independently coded by two  
23 qualitative analysts and codings will be compared for agreement through NVivo, to achieve inter-  
24 rater reliability.  
25

#### 26 **Ethics and Dissemination**

#### 27

28 Informed consent for participation in the ICoC intervention programme will be taken from each  
29 enrolled patient. Informed consent to participate in the research study will be taken another time  
30 for patients/ clients who have been referred to research team and also practitioners who will be  
31 interviewed and/or participating in focus group discussions. SingHealth Centralized Institutional  
32 Review Board (CIRB 2015/2277) approved this study.  
33

34 Findings will be disseminated by publications in peer-reviewed journals, scientific meetings, and  
35 presentations to policy makers and practice partners.  
36

#### 37 *Status of the study*

#### 38

39 The ICoC program is expected to last 2 years, from July 2016 to June 2018.  
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#### 43 **Discussion**

#### 44

45 It is increasingly recognized that non-biological determinants of health such as social, environmental  
46 and individual behaviors impact significantly on health outcomes.<sup>(33, 34)</sup> These non-biological  
47 determinants of health interact in a complex relationship a person's biological health determinants  
48 such as gender, age, inherited and acquired health conditions. Therefore, quality healthcare alone  
49 cannot achieve optimal outcomes in health. Policy changes and interventions (the ICoC program in  
50 this case) that can modify health seeking behavior and affect delivery of healthcare services may  
51 affect health determinants and health outcomes. Implementing a complex ICoC intervention  
52 program and understanding the complex interaction between determinants, policy and outcomes  
53 therefore require an innovative approach to evaluation such as the participatory action research  
54 (PAR) model.  
55

56 The findings from ICoC program will directly inform policy makers on the feasibility of  
57 implementation and effectiveness of integrating traditional silos of practice on reducing acute  
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3 hospital utilization. This has direct policy implications on the funding model and quantum to support  
4 such a program. In the short to medium term, the study will develop a novel model of integrated  
5 care that shifts care from a hospital centric system to an integrated community centric system for  
6 high-risk communities. In the long term, the study has policy implications on the feasibility and  
7 effectiveness of empanelment of high-risk communities to a community based integrated care team  
8 supported by the regional health system. The systematic inquiry, with the participation of those  
9 affected by the problem being studied, will enable the ICoC program and policy makers to  
10 understand the complex interaction between health determinants, intervention and health  
11 outcomes. This knowledge will facilitate design of better interventions and policies that  
12 systematically address health determinants and policies in future iterations of the ICoC program.  
13

14  
15 However, our study has potential limitations. Firstly, a randomized controlled trial design would  
16 have been most rigorous for evaluation of the ICoC program. However, we had wanted to evaluate  
17 the effectiveness of the synergism achieved by all three components of the ICoC program. The  
18 restriction of the C2H program to the three intervention blocks precluded us from randomizing the  
19 rental housing blocks or patients for intervention. We will minimize bias in the statistical comparison  
20 of the intervention and control groups by using propensity scores to balance baseline covariates.  
21 Second, this study is limited to a single rental housing community, so generalizability to other rental  
22 housing communities would be unknown. If results from the ICOC program are promising, we intend  
23 for this model of care to be propagated to other rental housing communities throughout RHS and  
24 Singapore.  
25

26 **Study status:** At the point of manuscript submission, the enrollment of participants is ongoing.  
27

28 **Contributorship Statement:** LLL, AM and LKH conceived and designed the study. LLL and AM wrote  
29 the first draft of the paper, and all authors critically revised the paper and gave final approval for  
30 publication.  
31

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36  
37

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39

40 **Data Sharing statement:** Details of ongoing data collection (indicators and outcomes) is available  
41 from the corresponding author at low.lian.leng@singhealth.com.sg  
42

43 **Competing interests:** The authors declare that they do not have competing interests.  
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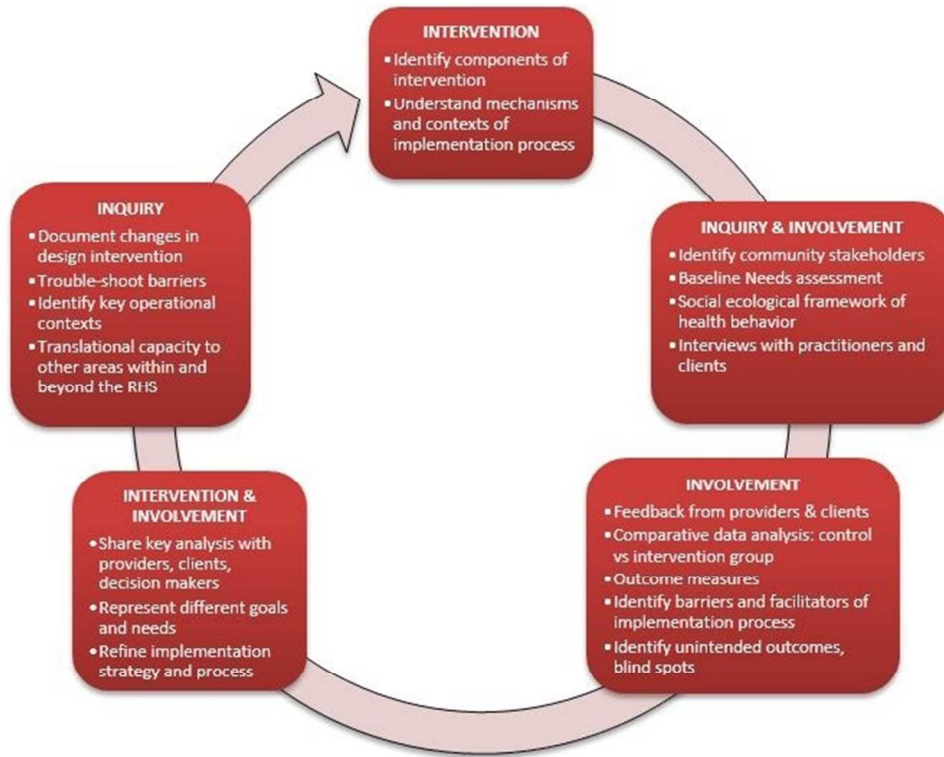
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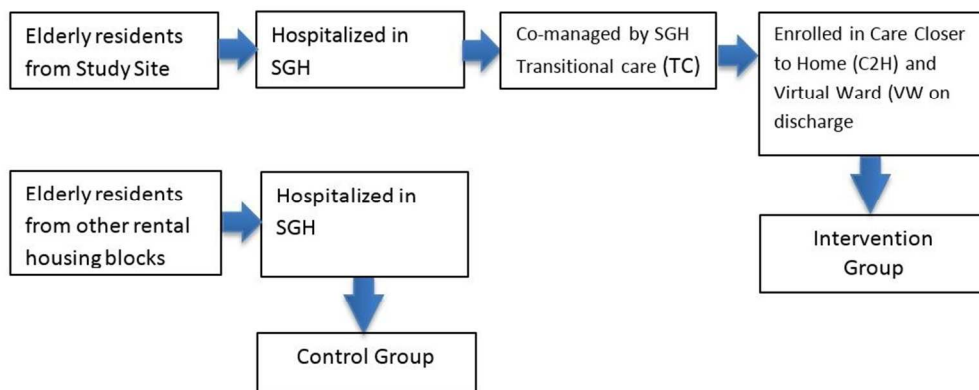
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### Appendix A: Predictors of 30-day readmission risk for propensity score matching

Domains	Predictor
Patient demographics	Age Gender Required financial assistance using Medifund
Past healthcare utilization	Emergency department visits six months before index admission Hospital admissions one year before index admission
Index admission	Urgent / Emergency admission Stayed in a subsidized ward Required inpatient dialysis Required intravenous furosemide 40mg and above Length of stay
Medical comorbidities	Depression History of alcoholism Osteoarthritis Spine fracture Charlson comorbidity index
	Total 15 predictors

## Appendix B: Interview Guide with the Elderly Care Recipient

1. Introduction/ building rapport
  - a. Establish life history: past employment, family life, social support etc.
2. Ask about who has been helping them out with their health, care and medication, physical therapy
3. What kind of help have they been receiving? How did they come to be a care recipient?
4. Describe the care routine.
  - a. Medicine management
  - b. Hospital admission and post-discharge care
  - c. Social care
  - d. Home cleanliness
  - e. Support and reassurance
  - f. Mental health
  - g. Access to health services
  - h. Information giving/ health literacy
  - i. Connection to other social agencies
  - j. Post-op treatment and follow-up
5. Has the care they received met their needs or are there needs that remain unmet?
6. What is their relationship with community nurses, health aide workers and case manager? What do they perceive of their services?
7. Why do they think they have been allocated care?
8. What is their understanding of the role of community care workers?
9. Ask to give an account of their health issues, how they perceive their health, how their health affects their life situation or vice-versa, impacts of their health on relationships with others
10. What do they think about the help they are receiving? Have they observed any personal changes?
11. What have they learned from community care workers?
12. Has it improve their life situation or changed the way they think about their health?
13. Share about their experiences the last time they were admitted to the hospital. What do they think was the cause of their admission and if they feel the situation could have been avoided
14. How confident are they about managing their health? Do they feel that they have more understanding/ information about how to take care of themselves?
15. What about the health care they received was most helpful to their everyday life? What do they like best about it? What did they least like about it? How can the services be improved?



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 Page 1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found Page 2
<b>Introduction</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Pages 2-3
Objectives	3	State specific objectives, including any prespecified hypotheses Page 3
<b>Methods</b>		
Study design	4	Present key elements of study design early in the paper Page 4 onwards
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Page 4 onwards
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Page 6 (b) For matched studies, give matching criteria and number of exposed and unexposed Page 9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Page 8-9
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 Pages 9
Bias	9	Describe any efforts to address potential sources of bias Page 9
Study size	10	Explain how the study size was arrived at Page 10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Page 11
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding Page 11 (b) Describe any methods used to examine subgroups and interactions Not applicable in our study. (c) Explain how missing data were addressed Not applicable in our study. (d) If applicable, explain how loss to follow-up was addressed We are able to retrieve utilization data from our electronic health record system. (e) Describe any sensitivity analyses Not applicable in our study.
<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 No results are available yet. (b) Give reasons for non-participation at each stage No results are available yet. (c) Consider use of a flow diagram No results are available yet.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders No results are available yet. (b) Indicate number of participants with missing data for each variable of interest No results are available yet. (c) Summarise follow-up time (eg, average and total amount) No results are available yet.

Outcome data	15*	Report numbers of outcome events or summary measures over time <b>No results are available yet.</b>
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>No results are available yet.</b> (b) Report category boundaries when continuous variables were categorized <b>No results are available yet.</b> (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period <b>No results are available yet.</b>
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses <b>No results are available yet.</b>
<b>Discussion</b>		
Key results	18	Summarise key results with reference to study objectives <b>No results are available yet.</b>
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 <b>Page 12-13</b>
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence <b>Pages 12-13</b>
Generalisability	21	Discuss the generalisability (external validity) of the study results <b>Page 12-13</b>
<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 <b>Page 14</b>

\*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

## Evaluating a novel Integrated Community of Care (ICoC) for patients from an urbanized low-income community in Singapore using the Participatory Action Research (PAR) methodology: A Study Protocol

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-017839.R2
Article Type:	Protocol
Date Submitted by the Author:	27-Jul-2017
Complete List of Authors:	Low, Lian Leng; Singapore General Hospital, Family Medicine and Continuing Care; Duke-NUS Medical School Maulod, Adlina; Duke-NUS Medical School Lee, Kheng Hock; Singapore General Hospital, Family Medicine and Continuing Care; Duke-NUS Medical School
<b>Primary Subject Heading</b>:	Health services research
Secondary Subject Heading:	General practice / Family practice, Geriatric medicine, Health policy, Qualitative research
Keywords:	Integrated Care, Community-based care, Transitional care, Low-income elderly community, participatory action research

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3 **Title: Evaluating a novel Integrated Community of Care (ICoC) for patients**  
4 **from an urbanized low-income community in Singapore using the**  
5 **Participatory Action Research (PAR) methodology: A Study Protocol**  
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## **Abstract**

**Introduction:** Poorer health outcomes and disproportionate healthcare utilization in socioeconomically disadvantaged patients is well established. However there is sparse literature on effective integrated care interventions that specifically target these high-risk individuals. The Integrated Community of Care (ICoC) is a novel care model that integrates hospital-based transitional care with health and social care in the community for high-risk individuals living in socially deprived communities. This study aims to evaluate the effectiveness of the ICoC in reducing acute hospital utilization and investigate the implementation process and its effects on clinical outcomes using a mixed-methods participatory action research (PAR) approach.

**Methods and Analysis:** This is a single-centre prospective, controlled, observational study performed in the SingHealth Regional Health System. A total of 250 eligible patients from an urbanized low-income community in Singapore will be enrolled during their index hospitalization. Our PAR model combines two research components: quantitative and qualitative, at different phases of the intervention. Outcomes of acute hospital utilization and health related quality of life are compared to controls, at 30 days and one year. The qualitative study aims at developing a more context-specific social ecological model of health behaviour. This model will identify how influences within one's social environment: individual, interpersonal, organizational, community and policy factors affect people's experiences and behaviours during care transitions from hospital to home. Knowledge on the operational aspects of ICoC will enrich our evidence-based strategies to understand the impact of the ICoC. The blending of qualitative and quantitative mixed methods recognizes the dynamic implementation processes as well as the complex and evolving needs of community stakeholders in shaping outcomes.

**Ethics and Dissemination:** Ethics approval was granted by the SingHealth Centralized Institutional Review Board (CIRB 2015/2277). The findings from this study will be disseminated by publications in peer-reviewed journals, scientific meetings, and presentations to government policy makers.

**Trial registration number:** NCT02678273

**Key words:** Low-income elderly community; participatory action research; integrated care; community-based care; transitional care

## **Article Summary**

### **Strengths and Limitations of study**

1. The Integrated Community of Care (ICoC) is a novel care model that integrates hospital-based transitional care with health and social care in the community for high-risk individuals living in socially deprived communities.
2. Study utilized a mixed method participatory action research (PAR) methodology to evaluate the effectiveness of a complex intervention program for a high-risk urbanized low-income community.
3. A randomized controlled trial design is not possible for this study.

## **Introduction**

Elderly, socioeconomically disadvantaged and socially isolated patients are at highest risk of ill health. Low socioeconomic status (SES) is well recognized as an independent risk factor for various adverse health outcomes, such as readmission risk<sup>(1-3)</sup> and hospital utilization<sup>(4)</sup>. In Singapore, public

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3 rental housing is an area-level measure of SES and is independently associated with increased  
4 readmission risk, frequent hospital admission and emergency department (ED) utilisation.<sup>(5)</sup> The  
5 reasons behind these poor outcomes include poor knowledge of personal health status,  
6 inappropriate health behaviors<sup>(6)</sup>, inability to navigate the complicated healthcare system<sup>(2, 7)</sup>, lower  
7 health literacy and misalignment between patient and care team with regard to goals of care<sup>(8)</sup>.  
8 These factors are common among residents of rental flats in Singapore. To qualify for heavily  
9 subsidized rental housing from the government, the gross household income must be 1,500  
10 Singapore Dollars or lower per month. The median household income in Singapore is 8,290  
11 Singapore dollars per month<sup>(5)</sup>. In these low SES communities, residents are known to have more  
12 comorbidity, poorer social support, more mental health disorders and depression<sup>(5, 9)</sup>. The  
13 confluences of these factors in a sub-population of patients who tend to live together in socially  
14 deprived communities create challenges as well as opportunities to improve the health of the  
15 population.  
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17  
18 While there is abundant literature highlighting the poorer health outcomes and disproportionate  
19 healthcare utilization in socioeconomically disadvantaged patients, there is sparse literature on  
20 integrated care interventions that specifically target these high-risk individuals. Englander et al.<sup>(10)</sup>  
21 described the Care Transitions Intervention (C-Train) program, a nurse and pharmacist-led  
22 multicomponent transitional care program conducted at an urban academic medical centre in  
23 Portland, Oregon. The C-Train program included coaching and education; home visits for highest risk  
24 patients; provision of 30 days of medications for low-income adults who were uninsured or on public  
25 insurance. However, the intervention did not reduce 30-day readmission rates or emergency  
26 department re-attendances. The authors concluded that the diverse needs of this population were  
27 too overwhelming for a nurse and pharmacist-based intervention. In Singapore, community-based  
28 initiatives led by social work professionals and para-professionals have been described<sup>(11)</sup>. However,  
29 the program faced similar problems and was hampered by the lack of a multi-disciplinary healthcare  
30 team to address complex health and social needs across different settings of care. Three reviews on  
31 effectiveness of transitional care trials by Hansen<sup>(12)</sup>, Kansagara<sup>(13)</sup>, and Kriplani<sup>(14)</sup> independently  
32 concluded that transitional care interventions must be comprehensive, going beyond a single  
33 component intervention. Multi-component interventions integrating medical and social care to span  
34 the different phases of care from hospitalization, discharge planning to post-discharge surveillance is  
35 required improve the health outcomes of such a high-risk community. The programs also need the  
36 flexibility to respond to individual needs. This current gap in caring for such high-risk communities is  
37 what our multi-component intervention program aims to address.  
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41 In Singapore, it is estimated that 900,000 citizens living in the city state will be 65 years or older by  
42 2030 and at least 50,000 (5.3%) would be staying in rental housing.<sup>(15)</sup> A shift from a hospital centric  
43 model of care to a community centric model of care is widely accepted as a strategy that will enable  
44 us to provide sustainable and cost-effective care for our rapidly aging population. In response to this  
45 need, many new models of care were developed and tested for effectiveness. The Integrated  
46 Community of Care (ICOC) is a novel model developed by the Singapore General Hospital (SGH) that  
47 was designed to bring together best practices in transitional care<sup>(16-19)</sup>, in addition to a Community  
48 Virtual Ward to coordinate community care and home-based primary care, and a Care Closer to  
49 Home (C2H) team for social case management and home help (fully elaborated under methods). In  
50 this care model, the ICOC fully integrates health and social care for high-risk individuals living in  
51 socially deprived communities. The ICOC program is the first step to achieving optimal health in a  
52 high-risk population by systematically addressing biological, social and individual risk factors for poor  
53 health. Components of the ICOC program will address social determinants of health such as social  
54 connectedness, loneliness; individual behaviors such patient activation, locus of control and  
55 environmental determinants such as access to health services and facilities.  
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3 The aim of this evaluation is to answer the following questions while providing feedback to key  
4 decision makers over the two years of the project: (1) what is the overall effectiveness of the ICoC  
5 program in improving acute hospital utilization? (2) What are the different components of the ICoC  
6 programme: their structure, their stakeholders (targeted patients and providers), their operating  
7 process and their effects on clinical outcomes? (3) What are the strengths and aspects to improve of  
8 each programme from the perspective of the concerned stakeholders in view of a better services  
9 integration? (4) What characteristics of the patients and the ICoC programme contribute to positive  
10 impacts on use of services, quality of life, patient activation and patient experience with care?  
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## 12 **Methods/Design**

### 13 *Study Site*

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16 Adopting a population health approach, the Ministry of Health Singapore has been advocating for  
17 the transformation of our health care system from a hospital centric to a community centric. In  
18 2011, public healthcare delivery was re-organized into regional health systems (RHS). The aim of  
19 which was to organize regional health assets into an integrated structure that will promote care  
20 integration of care across the care continuum. There is to be vertical and horizontal integration of  
21 healthcare institutions. In addition, the regional health systems will work to integrate health and  
22 social care by working closely with social care agencies within each region. Six RHSs were created,  
23 each being responsible to integrate care for a specific geographic region in Singapore. Each RHS is  
24 anchored by a tertiary hospital, supported by a community hospital providing intermediate and  
25 rehabilitation care and complete with linkages to primary care and long term care services in the  
26 region. In 2014, the Singapore Health Services (SingHealth) RHS was officially launched and consisted  
27 of primary to tertiary care institutions that account for the care of nearly a million residents in  
28 Singapore.  
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### 31 *Inclusion and Exclusion Criteria*

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33 Patients are eligible if they:

- 34 1) Age  $\geq$  60 years at time of recruitment
- 35 2) Staying in public rental housing in Chinatown area in Singapore

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38 Chinatown was chosen as the Care Closer to Home (C2H) team had already started a social care case  
39 management and home help program in this area since October 2014. We will exclude patients who  
40 decline our program or dementia patients who are incapable of independent living and do not have  
41 a caregiver. Patients who have mild dementia and are capable of independent living or have a  
42 caregiver are suitable to be enrolled into the ICoC program, which will support care in the  
43 community. Patients in the intervention group will be recruited during their first admission upon  
44 study commencement (Figure 1) on a consecutive sampling basis. Based on the electronic medical  
45 records, close to 180 unique patients were admitted to SGH in 2014. Assuming a low 5% rejection  
46 and exclusion rate (confirmed by our feasibility study), the recruitment period is estimated to be  
47 take 1.5 years (1st August 2016 to 31st January 2018). Recruitment will close when the sample size  
48 of 250 is reached. Control patients will be identified retrospectively at the end of the study period  
49 and data extracted from the SGH patient database using the index admission as the start date.  
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52 Figure 1: Patient Recruitment and Comparison between Intervention and Control Groups.

### 53 54 55 *Intervention and Control*

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57 The ICoC intervention program (Figure 2)

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3 1. Singapore General Hospital (SGH) Transitional Care (TC) team for care transitions of hospitalized  
4 residents

5  
6 The SGH TC team (comprising a senior family physician and a medical officer) is a dedicated service  
7 that will provide inpatient care or co-management with specialists for all enrolled patients, with  
8 emphasis on comprehensive discharge planning, formulation of a care plan post-discharge and  
9 proper hand-over care to the community virtual ward and C2H teams. This intervention incorporates  
10 the best principles in transitional care that includes both pre-discharge and post-discharge  
11 component<sup>(13, 19)</sup>. The hand-over care will be executed via a daily half-hour video conferencing  
12 meeting between the three teams.  
13

14 2. Community Virtual Ward (VW) for coordinating community care and home-based primary care  
15

16 The community-based VW team comprises of a staff nurse and resident physician seconded by SGH  
17 to provide continuing community care, home-based primary and nursing care to enrolled patients.  
18 This intervention is supported by strong evidence for home-based primary care and continuing care  
19 for frail elders<sup>(20, 21)</sup>. The team's responsibilities include: (i) comprehensive geriatric assessment; (ii)  
20 continuing care and at least weekly surveillance of discharged patients for up to one month post-  
21 discharge; (iii) monitoring at risk patients for compliance to the prescribed care plans and  
22 medications; (iv) health promotion and education to enrolled patients; (v) developing patient-  
23 specific action plans for patients with high risk diseases such as heart failure and diabetes and (vi)  
24 coordinating and integrating the primary, transitional and social care for enrolled patients; and (vii)  
25 hand-over care to community service providers for long term follow up upon stabilization of patients  
26 and according to clinical protocol. The community VW team is physically located in the community.  
27  
28

29 3. Care Closer to Home (C2H) team for social case management and home help  
30

31 Since October 2014, the C2H is a program by the Agency for Integrated Care (AIC) comprising a case  
32 manager, a social work assistant and five nursing aides to put in place health, personal and social  
33 services, e.g. medication management, home help services to assist with basic activities of daily  
34 living e.g. showering to help seniors to age in place. To date, the program has enrolled close to 300  
35 residents. AIC closely supports and provides professional guidance for the C2H program.  
36

37 All three components of the ICoC program will be provided to enrolled patients. To ensure this, we  
38 have harmonized our inclusion and exclusion criteria for entry into all three components. The ICoC  
39 program has been implemented since August 2016.  
40

41 Control group participants  
42

43 The control group of approximately 1100 participants from other rental housing blocks in our  
44 regional health system will receive current hospital standard of care when they are hospitalized.  
45 Patients will be managed by their specialists in charge depending on their admitting diagnoses.  
46 Patients may be referred to the SGH TC program and/or various community services on discharge if  
47 deemed necessary by their specialists. Continuing care post-discharge may be provided at the  
48 specialist outpatient clinics or a primary care provider identified by the hospital specialist. The  
49 community VW and C2H teams would not be available for control group patients.  
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53 Figure 2: Conceptual Model of Care for the ICoC Program  
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57 *Conceptual Framework for Evaluation*  
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3 The strategy of using multidisciplinary case management that we have adopted for our model of  
4 care has been widely used in many care integration programs aimed at reducing health care  
5 utilization and improve quality of care for frail older adults with multimorbidities.<sup>(22)</sup> The evaluation  
6 of this model of care is challenging because it contains multiple components. For example, the  
7 medical, social and personal care components may act both independently of each other and  
8 interdependently in affecting the outcome of patient care. The assessment of individual  
9 components of intervention becomes complicated, creating the need for a novel adaptation of a  
10 mixed-method strategy of evaluation. Thus, our multidisciplinary research team combines the use of  
11 both quantitative and qualitative methods through a participatory action research (PAR) approach as  
12 part of the overall evaluation of the effectiveness of the ICOC program.  
13

14  
15 PAR has been defined as “systematic inquiry, with the participation of those affected by the problem  
16 being studied, for the purposes of education and action or effecting social change”.<sup>(23)</sup> In Singapore,  
17 the recent and rapid transformation of health services delivery for the aging population had created  
18 unprecedented shifts in the power relationship between users, policy makers and service providers  
19 in the healthcare system. PAR with community-dwelling socially-at-risk elderly Singaporeans has the  
20 potential to explore some of the complex health and social problems that poor and socially-isolated  
21 elderly face, while also contributing to individual and community capacity building. In the context of  
22 our research site, PAR is an appropriate process for evaluating patient-centred models of care,  
23 especially since the action research strategies that we are proposing are common to processes in the  
24 field of nursing—particularly through the steps of assessment, planning, implementation, evaluation  
25 and replanning<sup>(24)</sup>. The “PIE method”, for instance, has been used among nurses to document  
26 patients’ progress, where its acronym stands for identifying Problems, proposing Interventions and  
27 Evaluation<sup>(25)</sup>. PAR has also been engaged successfully to facilitate improvements in healthcare  
28 services<sup>(26)</sup>.  
29

30  
31 A mixed-methods PAR approach will facilitate a more comprehensive assessment of the ICOC,  
32 particularly to understand the multiple outcomes of the program in terms of what works, for what  
33 and for whom. In this regard, PAR is intended to be both highly localized and comparative.  
34 Investigation of the programme structure, its operating processes and stakeholders’ experiences can  
35 be captured through qualitative methods while the comparative assessment of health outcomes  
36 between the intervention and control group will be valuably complemented through quantitative  
37 research methods. Our preferred approach is driven not only by the learning objectives of  
38 investigators but also by the circumstances and contexts of the community involved.  
39

#### 40 *Research Design*

41  
42 The ICOC study is a single-centre prospective, controlled, observational study performed in the  
43 SingHealth RHS.<sup>(27, 28)</sup> Drawing upon established trends in PAR praxis which emphasizes collective  
44 processes of investigation and involvement as well as experimentation grounded in experience and  
45 social history<sup>(29, 30)</sup>, our research design similarly includes a learning component. We have  
46 conceptualized our design in terms of a synergy between the 3 “Is” of Intervention (Action),  
47 Invovement (Participation in the Community) and Inquiry (Research) into a feedback cycle (Figure  
48 3). The 3 Is mutually augment each other to contribute to the social transformation of integrated  
49 elderly care. The approach requires the co-partnership of stakeholders, implementation teams and  
50 research units to collect data, reflect upon findings of outcomes and refine the intervention process  
51 further to develop and achieve better delivery and results of ICOC.  
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56 Figure 3. Research Design: Intervention, Involvement and Inquiry Feedback Cycle  
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3 The mixed-methods PAR approach to the ICoC model is significant to health systems research  
4 because it attempts to triangulate both medical providers' and elderly patients' perspectives of  
5 intervention delivery. In this regard, our research design intends to capture sensitivity to outcomes  
6 beyond only the intended hypothesis. Additionally, while evaluation studies utilizes quantitative  
7 data to measure intervention outcomes, a qualitative approach may address issues with regards to  
8 using a single metric of examining hospital admissions, which have been found to be less suitable for  
9 complex and vulnerable patients where many other factors contribute to the need for  
10 hospitalization.<sup>(31) (32)</sup>

### 11 *Study Aims and Hypotheses*

12  
13  
14 Our participatory action research (PAR) model combines two research components, quantitative and  
15 qualitative, at different phases of the intervention. The primary objective of the quantitative study is  
16 to evaluate the effectiveness of the ICoC program in achieving a significant reduction in the  
17 proportion of patients in the intervention group with acute hospital readmissions within 30 days of  
18 the index discharge date relative to controls. The index admission and index discharge dates are  
19 defined as the date of the patient's first admission to the hospital and discharge from the hospital  
20 respectively. The secondary aims of this study are to evaluate the effectiveness of the ICoC program  
21 in achieving (i) a lower proportion of patients in the intervention group with three or more  
22 unscheduled hospital readmissions within one year of index discharge; (ii) a lower emergency  
23 department attendance rate in the intervention group at 30 days, and one year from index  
24 discharge; (iii) a lower specialist outpatient clinic attendance rate in the intervention group at 30  
25 days, and one year from index discharge; (iv) Improving health related quality of life in the  
26 intervention group relative to baseline as measured by the EQ-5D at 30 days, and one year  
27 compared to the control group.

28  
29  
30 The qualitative study aims at developing a more context-specific social ecological model of health  
31 behavior.<sup>(33)</sup> We propose a social ecological framework of health behaviour in the manner below:

- 32 a. Care recipients' and caregivers' conditions and experiences (individual level)
- 33 b. Interactions between elderly patient, caregivers and healthcare providers (interpersonal  
34 level)
- 35 c. Elderly's and caregivers' access to experiences with service use and health care delivery  
36 (institutional/ organizational level)
- 37 d. Elderly patients' connections with and support from the community (community level)
- 38 e. How public initiatives and access to other healthcare programmes affect the experience  
39 of transitional care post-discharge (policy level)

40  
41  
42 This model helps to identify how influences within one's social environment: individual,  
43 interpersonal, organizational, community and policy factors affect people's experiences and  
44 behaviours during care transitions from hospital to home. The knowledge of how this model  
45 operates on the ground will enrich our evidence-based strategies to understand the impact of the  
46 ICoC. The PAR operates on a feedback loop that is sensitive to changes experienced by providers and  
47 patients in real-time. In this project, both the implementation and research team work in tandem to  
48 evaluate and improve the intervention once primary outcomes have been measured or unintended  
49 outcomes have been reported.

### 50 *Sample Size calculation*

51  
52  
53 Data from a previous feasibility study shows a historical 30-day re-admit rate of 17.5% for patients in  
54 the three proposed Intervention HDB blocks and 16.8% in the Control blocks. The prospectively  
55 recruited sample size for the Intervention will be 250 and, based on 2014 data, we anticipate about  
56 1100 patients in the Control group. The figure shows the proposed sample sizes will provide  $\geq 80\%$   
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3 power using a two-sided Fisher's exact test ( $\alpha=0.05$ ) to detect the following range of differences  
4 (unadjusted) in 30-day re-admit rates between Control vs. Intervention: 18.0 vs. 10.7, 17.0 vs. 9.9,  
5 16.0 vs. 9.1, 15.0 vs. 8.3, 14.0 vs. 7.5 and 13.0 vs. 6.7. Targeted reductions in Intervention group  
6 readmission rates range from 40.5–48.5% and would certainly be considered clinically meaningful. In  
7 our previously published virtual ward study<sup>(19)</sup>, we achieved 33% reduction in 30-day readmission  
8 rates and it is likely this can be improved with additional home visits and social care case  
9 management.

10  
11 For the qualitative component, the research team will purposively select a sample size of 40 elderly  
12 patients/ clients based on the sample of 300 elderly residents who are enrolled in C2H intervention  
13 programme and who are also under the supervision of the VW. The elderly patients/ clients are  
14 recruited into the study through referrals from medical and care team based on their health status  
15 and case severities (eg. Polypharmacy, multiple comorbidities, frailty). We hope to get a diverse  
16 sample in terms of gender, age, ethnicity and living arrangements. The research team will also be  
17 interviewing all community health providers (n=10) who are providing care in the study site.

#### 18 19 *Data Collection strategies to Measure Outcomes*

##### 20 21 Basic Characteristics

22  
23 Intervention Group: The research team will take informed consent from the intervention group  
24 participants and interview them for demographic, socioeconomic status, medical comorbidities,  
25 abbreviated Mental Test, and modified Barthel Index, instrumental activities of daily living and  
26 health-related quality of life (EQ-5D). These information will allow the investigators to characterize  
27 and identify needs in our intervention group patients better.

28  
29 Control Group: Control group patients will be retrieved from the eHIntS system. The eHIntS system is  
30 SingHealth's electronic health record system, that integrates information from multiple sources  
31 including administrative data (for example, patient demographics), clinical data and ancillary data  
32 into our enterprise data warehouse. A waiver of patient consent will be sought from the centralized  
33 institutional review board for extraction of de-identified routinely collected information. Similar  
34 demographic, socioeconomic status and medical comorbidities data (predictors used for propensity  
35 scores calculation listed in Appendix A supplementary file) will be collected for both groups to allow  
36 calculation of propensity scores as a basis for comparability. We have shown in our previous study  
37<sup>(28)</sup> that these data can be extracted from our data warehouse for inclusion in a propensity score  
38 model. Information such as abbreviated mental test, modified Barthel index, instrumental activities  
39 of daily living and health related quality of life will not be available for the control group.

##### 40 41 Outcome Measures at 30 days and one-year

42  
43 The research team and the ICoC team will follow up with study participants for the primary and  
44 secondary outcomes at 30 days, and one year (Table 1). An unscheduled readmission is defined as a  
45 readmission for a non-elective indication. Unscheduled readmission at 30 days (short-term outcome)  
46 is a universally accepted indicator of transitional care quality and one year outcomes (long-term  
47 outcome) is chosen to reflect the quality of community and continuing care. The research team will  
48 conduct a face-to-face survey interview at 30 days and one year to repeat the EQ-5D scales.  
49 Healthcare utilization data of intervention and control group participants will be extracted from  
50 SingHealth's eHIntS system and merged with Ministry of Health (MOH)'s Omnibus data resource.  
51 This will ensure complete and accurate healthcare utilization outcomes and overcome the issue of  
52 cross utilization. Similarly, predictors of 30-day readmission that will be used for propensity score  
53 matching will be available from eHIntS and Omnibus databases.

54  
55 A checklist will be developed to measure fidelity to components of ICoC program and ensure  
56 standardization of intervention and the designed interventions are faithfully adhered to. The nature  
57  
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60

(routine/emergency) and number of home visits e.g. doctor/nurse/C2H will be retrieved from the clinical documentation notes.

Table 1: Data collection sources at Baseline, 30 days and One Year outcomes for participants

Variable	Method of Collection	Baseline	Follow-up (30 days)	Follow-up (One year)
Demographic, Socio-economic status, Health information and prior healthcare utilization, Abbreviated Mental Test, Modified Barthel Index, Instrumental activities of daily living, health related quality of life	Questionnaire, EQ-5D, eHIntS	X		
<b>Primary Outcome Measure</b> – Unscheduled hospital readmission within 30 days of index discharge	eHIntS, Omnibus		X	
<b>Secondary Outcome Measures</b> – Unscheduled hospital readmissions at one year; Emergency department attendances, specialist outpatient clinic attendances and health related quality of life at 30 days and one year	EQ-5D, eHIntS, Omnibus		X	X

#### Qualitative Data Collection Design and Strategies

The qualitative research component of the PAR will be conducted in three phases.

##### Phase 1: *Intervention & Involvement*

##### 1a. *Understanding mechanisms and contexts of intervention (Providers and Patients)*

The research team will engage in 'go-along' interviews with nurses and community healthcare providers to understand the complexities around integrated care in a low-income rental neighbourhood. The 'go-along' combines both participant observation and interview methods and will be conducted with all of the VW nurses and the C2H team (n=10) as they go about their daily care-rounds around the study site. Data collected will provide information in terms of patient/clients' receptivity to medical intervention, relationship between providers and their elderly patients/clients. The objective of go-along interviews is to capture the providers' perspective of the barriers and facilitators in the implementation of ICoC to their patients/ clients. Research team will document processes in which medical providers understand, implement and apply appropriate practices of care to the elderly residents in low-income rental dwelling. For triangulation, the research team will conduct content analysis of providers' case summaries over the period of intervention to trace the chronology and outcome of individualized interventions.

##### 1b. *Elderly Residents' Qualitative Needs Assessment based on Case Summaries and Complementary Quantitative Study*

Based on case summaries by healthcare providers, research team will work with implementation team to identify and categorically group elderly residents based on complexity of case and specific health conditions. Medical team and nurses will refer 40 cases/ elderly clients with different physical and health status as well as across gender, ethnicity, age and living arrangements to the research

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2  
3 team for Phase 2b of in-depth semi-structured/ informal interviews. Elderly residents will be  
4 grouped according to similarities in terms of case complexity (1<sup>st</sup> strata) followed by whether they  
5 show improvements in health behaviour or not.  
6

### 7 Phase 2: *Action Learning through Involvement and Inquiry*

8  
9 2a. This phase involves interpreting preliminary data, explaining contexts, translating findings and  
10 refining identified problems, priorities and strengths together with key community members-  
11 clinicians, nurses, resident committee members and elderly residents who are physically and  
12 cognitively able to participate and be involved in discussions. Through focus group discussions, the  
13 aim of this phase is to: 1) to understand how providers define care and how their vision of care is  
14 being expressed through their practices and 2) to understand the background profile of clients and  
15 develop case-studies of “complex” cases and how both the providers, resident committee and  
16 patients manage these issues.  
17

### 18 2b. ICoC User Experience (n=40 based on referral in Phase 1b)

19  
20 Research team will establish rapport with elderly residents in intervention group and conduct in-  
21 depth interviews to explore the experiences and attitudes of older people who are in the  
22 intervention group (VW and C2H). Objective is to gain an understanding of the strengths and  
23 weaknesses of community care from the perspective of recipients in the study site.  
24

25  
26 Once the Institutional Review Board (IRB) has given ethics approval to conduct the research, the  
27 investigators will invite residents in the intervention group to participate in research study through  
28 case referrals by nurses and community health providers. Due to the nature of the User Experience  
29 research which requires substantial feedback from participants, nurses and community health  
30 providers will only refer elderly clients who are able to respond to questions without requiring a  
31 proxy. When comfort and trust has been established between the research team and participants,  
32 investigators will conduct interviews following a life history format. We will ask about their personal  
33 histories to gain a deeper and better understanding of their current circumstances and health  
34 behaviours. We will also seek their feedback as recipients of the care intervention. Interviews will be  
35 carried out over multiple sessions and visits, instead of a block session, so as to not tax elderly  
36 participants. Each session would last about approximately 30 minutes and will continue until all  
37 questions in the interview guide (Appendix B supplementary file) have been satisfactorily completed.  
38

### 39 Phase 3. *Inquiry and Intervention*

40  
41 Data analysis and findings from phase 1 and 2 will provide feedback on the delivery of the  
42 intervention. These findings will be analysed together with the post-30 days and post 1 year  
43 quantitative outcome measures to identify which mechanisms of the intervention have been  
44 successful and which require improvements. Improvements to the intervention will only be  
45 implemented and executed only after our primary outcomes have been collected and analysed.  
46 Additionally, the objective of Phase 3 is to also highlight unintended outcomes of the intervention  
47 that clients and providers consider as beneficial to their experiences. The team will further analyse  
48 implications of findings and translational capacity to other low-income rental community-dwelling  
49 areas in Singapore.  
50

## 51 **Analysis**

### 52 *Quantitative Data Analysis*

53  
54  
55 To analyze our primary aim, control and intervention 30-day re-admission rates will be compared  
56 using logistic regression using propensity scores to adjust for effects of confounders.  
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3 The secondary aim 1 analysis will use Fisher's exact test and logistic regression and compare groups  
4 on proportions of patients with three or more unscheduled hospital readmissions within one year of  
5 index discharge. Secondary aims 2 and 3 will involve Poisson regression analysis on numbers of visits  
6 per three-month and one-year intervals, and aim 4 will involve standard analysis of variance  
7 methods to compare quality of life scores. All analyses will incorporate propensity score adjustment.  
8 All analyses will be performed using SAS V9.4 software (SAS© Cary, NC, USA).  
9

### 10 *Qualitative Data Analysis*

11  
12 All in-depth interviews with key personnel and focus group discussions will be audiotaped and  
13 transcribed and uploaded onto qualitative software database nVivo 11. While 'go-along' interviews  
14 with nurses and case workers and interviews with elderly recipients with speech difficulties (e.g.  
15 slow speech, inaudible voice) will not be audio-recorded due to the anticipated long duration of such  
16 sessions and difficulty in capturing speech respectively. Written notes will be used instead to record  
17 such observations and conversations and will be type-written at the end of each day. Typed written  
18 notes will also be uploaded onto NVivo 11. The research team will use NVivo to code responses for  
19 theoretical and emergent themes regarding practitioner and client/patient (provider-user)  
20 experience of the ICoC programme.  
21

22  
23 The team will analyse data, by coding for broad themes that correspond to influences at the  
24 individual, interpersonal, organizational, community and policy level according to the social  
25 ecological framework of health behaviour, while simultaneously code for emergent themes. The  
26 combination of both deductive and inductive analytical approaches will provide further granularity  
27 for the evaluation of the ICoC intervention programme. Data will be independently coded by two  
28 qualitative analysts and codings will be compared for agreement through NVivo, to achieve inter-  
29 rater reliability.  
30

### 31 **Ethics and Dissemination**

32  
33 Informed consent for participation in the ICoC intervention programme will be taken from each  
34 enrolled patient. Participation in the study is voluntary and care services will not be withdrawn  
35 should elderly patients decide to not participate or withdraw from the study. After obtaining  
36 consent, the qualitative research team will build rapport of elderly participants further through  
37 regular interactions facilitated by frequent house visits with community nurses and health providers.  
38 Additional informed consent to participate in the research study will be taken for patients/ clients  
39 who have been referred to research team and for providers who will be interviewed and/or  
40 participating in focus group discussions. SingHealth Centralized Institutional Review Board (CIRB  
41 2015/2277) and National University of Singapore Institutional Review Board (NUS IRB: H-17-035) has  
42 approved this study.  
43

44 Findings will be disseminated by publications in peer-reviewed journals, scientific meetings, and  
45 presentations to policy makers and practice providers.  
46

### 47 *Status of the study*

48  
49 The ICoC program is expected to last 2 years, from July 2016 to June 2018.  
50

### 51 **Discussion**

52  
53 It is increasingly recognized that non-biological determinants of health such as social, environmental  
54 and individual behaviors impact significantly on health outcomes.<sup>(34, 35)</sup> These non-biological  
55 determinants of health interact in a complex relationship a person's biological health determinants  
56 such as gender, age, inherited and acquired health conditions. Therefore, quality healthcare alone  
57 cannot achieve optimal outcomes in health. Policy changes and interventions (the ICoC program in  
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60

1  
2  
3 this case) that can modify health seeking behavior and affect delivery of healthcare services may in  
4 turn affect health determinants and health outcomes. Implementing a complex ICoC intervention  
5 program and understanding the complex interaction between determinants, policy and outcomes  
6 therefore require an innovative approach to evaluation such as the PAR model.  
7

8 The findings from ICoC program will directly inform policy makers on the feasibility of  
9 implementation and effectiveness of integrating traditional silos of practice on reducing acute  
10 hospital utilization. This has direct policy implications on the funding model and quantum to support  
11 such a program. In the short to medium term, the study will develop a novel model of integrated  
12 care that shifts care from a hospital centric system to an integrated community centric system for  
13 high-risk communities. In the long term, the study has policy implications on the feasibility and  
14 effectiveness of empanelment of high-risk communities (assigning individuals to care teams) to a  
15 community based integrated care team supported by the regional health system. The systematic  
16 inquiry, with the participation of those affected by the problem being studied, will enable the ICoC  
17 program and policy makers to understand the complex interaction between health determinants,  
18 intervention and health outcomes. This knowledge will facilitate design of better interventions and  
19 policies that systematically address health determinants and policies in future iterations of the ICoC  
20 program.  
21  
22

23 Our study has potential limitations. Firstly, a randomized controlled trial design would be most  
24 appropriate for evaluating the effectiveness, but it is not always the best design for process  
25 indicators. Moreover, we had wanted to evaluate the effectiveness of the synergism achieved by all  
26 three components of the ICoC program. The restriction of the C2H program to the three intervention  
27 blocks precluded us from randomizing the rental housing blocks or patients for intervention. We will  
28 minimize bias in the statistical comparison of the intervention and control groups by using  
29 propensity scores to balance baseline covariates. Second, this study is limited to a single rental  
30 housing community, so generalizability to other rental housing communities would be unknown. If  
31 results from the ICOC program are promising, we intend for this model of care to be propagated to  
32 other rental housing communities throughout RHS and Singapore.  
33

34  
35 **Study status:** At the point of manuscript submission, the enrollment of participants is ongoing.

36  
37 **Contributorship Statement:** LLL, AM and LKH conceived and designed the study. LLL and AM wrote  
38 the first draft of the paper, and all authors critically revised the paper and gave final approval for  
39 publication.  
40

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44 support.  
45  
46

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48

49 **Data sharing statement:** Details of ongoing data collection (indicators and outcomes) is available  
50 from the corresponding author at [low.lian.leng@singhealth.com.sg](mailto:low.lian.leng@singhealth.com.sg)  
51

52 **Competing interests:** The authors declare that they do not have competing interests.  
53

54 **Figure legends:**  
55

56 Figure 1: Patient Recruitment and Comparison between Intervention and Control Groups  
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3 Figure 2: Conceptual Model of Care for ICoC program  
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5 Figure 3: Research Design Intervention, Involvement and Inquiry Feedback Cycle  
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9 References  
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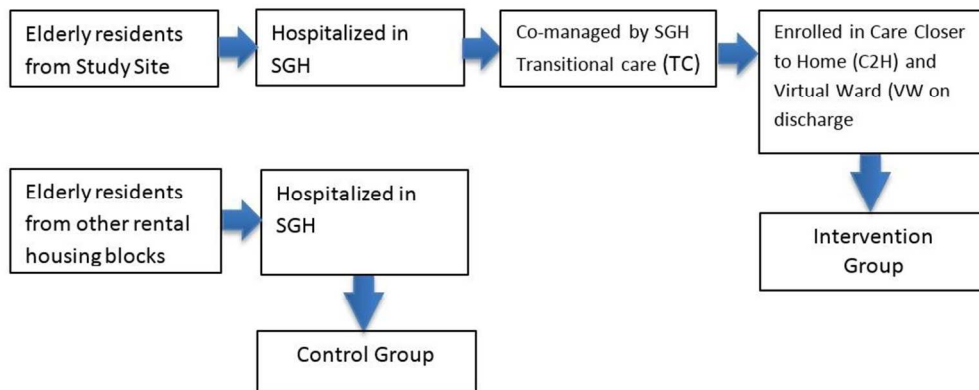
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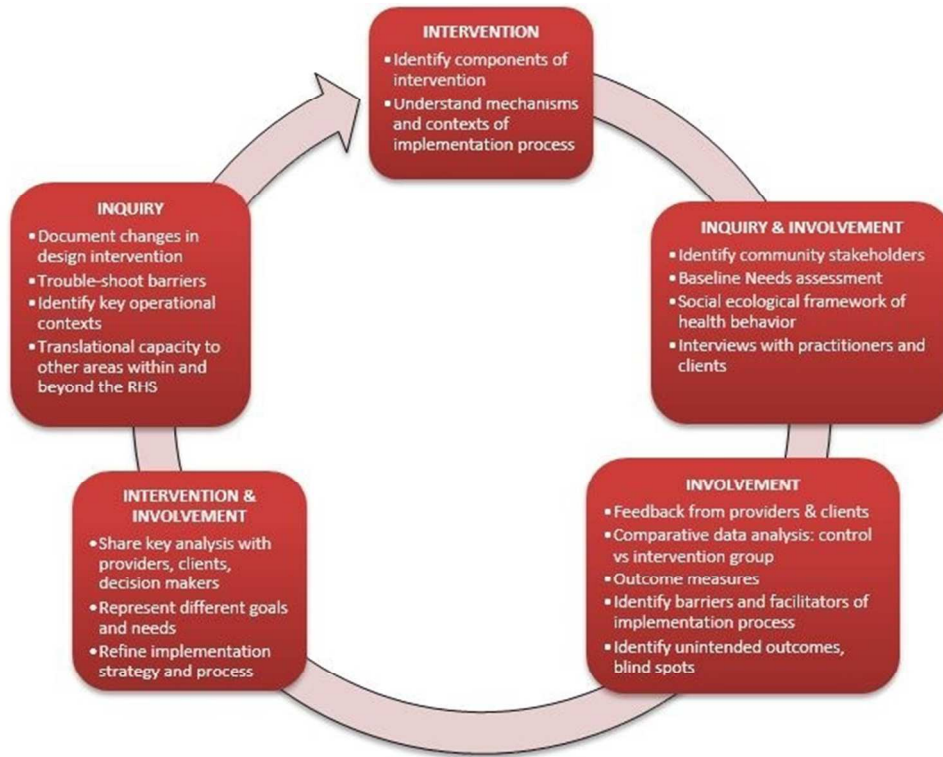
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### Appendix A: Predictors of 30-day readmission risk for propensity score matching

Domains	Predictor
Patient demographics	Age Gender Required financial assistance using Medifund
Past healthcare utilization	Emergency department visits six months before index admission Hospital admissions one year before index admission
Index admission	Urgent / Emergency admission Stayed in a subsidized ward Required inpatient dialysis Required intravenous furosemide 40mg and above Length of stay
Medical comorbidities	Depression History of alcoholism Osteoarthritis Spine fracture Charlson comorbidity index
	Total 15 predictors

## Appendix B: Interview Guide with the Elderly Care Recipient

1. Introduction/ building rapport
  - a. Establish life history: past employment, family life, social support etc.
2. Ask about who has been helping them out with their health, care and medication, physical therapy
3. What kind of help have they been receiving? How did they come to be a care recipient?
4. Describe the care routine.
  - a. Medicine management
  - b. Hospital admission and post-discharge care
  - c. Social care
  - d. Home cleanliness
  - e. Support and reassurance
  - f. Mental health
  - g. Access to health services
  - h. Information giving/ health literacy
  - i. Connection to other social agencies
  - j. Post-op treatment and follow-up
5. Has the care they received met their needs or are there needs that remain unmet?
6. What is their relationship with community nurses, health aide workers and case manager? What do they perceive of their services?
7. Why do they think they have been allocated care?
8. What is their understanding of the role of community care workers?
9. Ask to give an account of their health issues, how they perceive their health, how their health affects their life situation or vice-versa, impacts of their health on relationships with others
10. What do they think about the help they are receiving? Have they observed any personal changes?
11. What have they learned from community care workers?
12. Has it improve their life situation or changed the way they think about their health?
13. Share about their experiences the last time they were admitted to the hospital. What do they think was the cause of their admission and if they feel the situation could have been avoided
14. How confident are they about managing their health? Do they feel that they have more understanding/ information about how to take care of themselves?
15. What about the health care they received was most helpful to their everyday life? What do they like best about it? What did they least like about it? How can the services be improved?

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

	Item No	Recommendation
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract Page 1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found Page 2
<b>Introduction</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Pages 2-3
Objectives	3	State specific objectives, including any prespecified hypotheses Page 3
<b>Methods</b>		
Study design	4	Present key elements of study design early in the paper Page 4 onwards
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Page 4 onwards
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Page 6
		(b) For matched studies, give matching criteria and number of exposed and unexposed Page 9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Page 8-9
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 Pages 9
Bias	9	Describe any efforts to address potential sources of bias Page 9
Study size	10	Explain how the study size was arrived at Page 10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Page 11
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding Page 11
		(b) Describe any methods used to examine subgroups and interactions Not applicable in our study.
		(c) Explain how missing data were addressed Not applicable in our study.
		(d) If applicable, explain how loss to follow-up was addressed We are able to retrieve utilization data from our electronic health record system.
		(e) Describe any sensitivity analyses Not applicable in our study.
<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 No results are available yet.
		(b) Give reasons for non-participation at each stage No results are available yet.
		(c) Consider use of a flow diagram No results are available yet.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders No results are available yet.
		(b) Indicate number of participants with missing data for each variable of interest No results are available yet.
		(c) Summarise follow-up time (eg, average and total amount) No results are available yet.



Outcome data	15*	Report numbers of outcome events or summary measures over time <b>No results are available yet.</b>
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>No results are available yet.</b> (b) Report category boundaries when continuous variables were categorized <b>No results are available yet.</b> (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period <b>No results are available yet.</b>
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses <b>No results are available yet.</b>
<b>Discussion</b>		
Key results	18	Summarise key results with reference to study objectives <b>No results are available yet.</b>
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 <b>Page 12-13</b>
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence <b>Pages 12-13</b>
Generalisability	21	Discuss the generalisability (external validity) of the study results <b>Page 12-13</b>
<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 <b>Page 14</b>

\*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

## Evaluating a novel Integrated Community of Care (ICoC) for patients from an urbanized low-income community in Singapore using the Participatory Action Research (PAR) methodology: A Study Protocol

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2017-017839.R3
Article Type:	Protocol
Date Submitted by the Author:	30-Aug-2017
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<b>Primary Subject Heading</b>:	Health services research
Secondary Subject Heading:	General practice / Family practice, Geriatric medicine, Health policy, Qualitative research
Keywords:	Integrated Care, Community-based care, Transitional care, Low-income elderly community, participatory action research

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3 **Title: Evaluating a novel Integrated Community of Care (ICoC) for patients**  
4 **from an urbanized low-income community in Singapore using the**  
5 **Participatory Action Research (PAR) methodology: A Study Protocol**  
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## **Abstract**

**Introduction:** Poorer health outcomes and disproportionate healthcare utilization in socioeconomically disadvantaged patients is well established. However there is sparse literature on effective integrated care interventions that specifically target these high-risk individuals. The Integrated Community of Care (ICoC) is a novel care model that integrates hospital-based transitional care with health and social care in the community for high-risk individuals living in socially deprived communities. This study aims to evaluate the effectiveness of the ICoC in reducing acute hospital utilization and investigate the implementation process and its effects on clinical outcomes using a mixed-methods participatory action research (PAR) approach.

**Methods and Analysis:** This is a single-centre prospective, controlled, observational study performed in the SingHealth Regional Health System. A total of 250 eligible patients from an urbanized low-income community in Singapore will be enrolled during their index hospitalization. Our PAR model combines two research components: quantitative and qualitative, at different phases of the intervention. Outcomes of acute hospital utilization and health related quality of life are compared to controls, at 30 days and one year. The qualitative study aims at developing a more context-specific social ecological model of health behaviour. This model will identify how influences within one's social environment: individual, interpersonal, organizational, community and policy factors affect people's experiences and behaviours during care transitions from hospital to home. Knowledge on the operational aspects of ICoC will enrich our evidence-based strategies to understand the impact of the ICoC. The blending of qualitative and quantitative mixed methods recognizes the dynamic implementation processes as well as the complex and evolving needs of community stakeholders in shaping outcomes.

**Ethics and Dissemination:** Ethics approval was granted by the SingHealth Centralized Institutional Review Board (CIRB 2015/2277). The findings from this study will be disseminated by publications in peer-reviewed journals, scientific meetings, and presentations to government policy makers.

**Trial registration number:** NCT02678273

**Key words:** Low-income elderly community; participatory action research; integrated care; community-based care; transitional care

## **Article Summary**

### **Strengths and Limitations of study**

1. The Integrated Community of Care (ICoC) is a novel care model that integrates hospital-based transitional care with health and social care in the community for high-risk individuals living in socially deprived communities.
2. Study utilized a mixed method participatory action research (PAR) methodology to evaluate the effectiveness of a complex intervention program for a high-risk urbanized low-income community.
3. A randomized controlled trial design is not possible for this study.

## **Introduction**

Elderly, socioeconomically disadvantaged and socially isolated patients are at higher risk of ill health<sup>(1-4)</sup>. Low socioeconomic status (SES) is well recognized as an independent risk factor for various adverse health outcomes, such as readmission risk<sup>(3, 5, 6)</sup> and hospital utilization<sup>(7)</sup>. In Singapore,

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3 public rental housing is an area-level measure of SES and is independently associated with increased  
4 readmission risk, frequent hospital admission and emergency department (ED) utilisation.<sup>(8)</sup> The  
5 reasons behind these poor outcomes include poor knowledge of personal health status,  
6 inappropriate health behaviors<sup>(9)</sup>, inability to navigate the complicated healthcare system<sup>(6, 10)</sup>,  
7 lower health literacy and misalignment between patient and care team with regard to goals of care  
8<sup>(11)</sup>. These factors are common among residents of rental flats in Singapore. To qualify for heavily  
9 subsidized rental housing from the government, the gross household income must be 1,500  
10 Singapore Dollars or lower per month. The median household income in Singapore is 8,290  
11 Singapore dollars per month<sup>(8)</sup>. In these low SES communities, residents are known to have more  
12 comorbidity, poorer social support, more mental health disorders and depression<sup>(8, 12)</sup>. The  
13 confluences of these factors in a sub-population of patients who tend to live together in socially  
14 deprived communities create challenges as well as opportunities to improve the health of the  
15 population.  
16

17  
18 While there is abundant literature highlighting the poorer health outcomes and disproportionate  
19 healthcare utilization in socioeconomically disadvantaged patients, there is sparse literature on  
20 integrated care interventions that specifically target these high-risk individuals. Englander et al.<sup>(13)</sup>  
21 described the Care Transitions Intervention (C-Train) program, a nurse and pharmacist-led  
22 multicomponent transitional care program conducted at an urban academic medical centre in  
23 Portland, Oregon. The C-Train program included coaching and education; home visits for highest risk  
24 patients; provision of 30 days of medications for low-income adults who were uninsured or on public  
25 insurance. However, the intervention did not reduce 30-day readmission rates or emergency  
26 department re-attendances. The authors concluded that the diverse needs of this population were  
27 too overwhelming for a nurse and pharmacist-based intervention. In Singapore, community-based  
28 initiatives led by social work professionals and para-professionals have been described<sup>(14)</sup>. However,  
29 the program faced similar problems and was hampered by the lack of a multi-disciplinary healthcare  
30 team to address complex health and social needs across different settings of care. Three reviews on  
31 effectiveness of transitional care trials by Hansen<sup>(15)</sup>, Kansagara<sup>(16)</sup>, and Kriplani<sup>(17)</sup> independently  
32 concluded that transitional care interventions must be comprehensive, going beyond a single  
33 component intervention. Multi-component interventions integrating medical and social care to span  
34 the different phases of care from hospitalization, discharge planning to post-discharge surveillance is  
35 required improve the health outcomes of such a high-risk community. The programs also need the  
36 flexibility to respond to individual needs. This current gap in caring for such high-risk communities is  
37 what our multi-component intervention program aims to address.  
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40  
41 In Singapore, it is estimated that 900,000 citizens living in the city state will be 65 years or older by  
42 2030 and at least 50,000 (5.3%) would be staying in rental housing.<sup>(18)</sup> A shift from a hospital centric  
43 model of care to a community centric model of care is widely accepted as a strategy that will enable  
44 us to provide sustainable and cost-effective care for our rapidly aging population. In response to this  
45 need, many new models of care were developed and tested for effectiveness. The Integrated  
46 Community of Care (ICoC) is a novel model developed by the Singapore General Hospital (SGH) that  
47 was designed to bring together best practices in transitional care<sup>(19-22)</sup>, in addition to a Community  
48 Virtual Ward to coordinate community care and home-based primary care, and a Care Closer to  
49 Home (C2H) team for social case management and home help (fully elaborated under methods). In  
50 this care model, the ICoC fully integrates health and social care for high-risk individuals living in  
51 socially deprived communities. The ICoC program is the first step to achieving optimal health in a  
52 high-risk population by systematically addressing biological, social and individual risk factors for poor  
53 health. Components of the ICoC program will address social determinants of health such as social  
54 connectedness, loneliness; individual behaviors such patient activation, locus of control and  
55 environmental determinants such as access to health services and facilities.  
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3 The aim of this evaluation is to answer the following questions while providing feedback to key  
4 decision makers over the two years of the project: (1) what is the overall effectiveness of the ICoC  
5 program in improving acute hospital utilization? (2) What are the different components of the ICoC  
6 programme: their structure, their stakeholders (targeted patients and providers), their operating  
7 process and their effects on clinical outcomes? (3) What are the strengths and aspects to improve of  
8 each programme from the perspective of the concerned stakeholders in view of a better services  
9 integration? (4) What characteristics of the patients and the ICoC programme contribute to positive  
10 impacts on use of services, quality of life, patient activation and patient experience with care?  
11

## 12 **Methods/Design**

### 13 *Study Site*

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16 Adopting a population health approach, the Ministry of Health Singapore has been advocating for  
17 the transformation of our health care system from a hospital centric to a community centric. In  
18 2011, public healthcare delivery was re-organized into regional health systems (RHS). The aim of  
19 which was to organize regional health assets into an integrated structure that will promote care  
20 integration of care across the care continuum. There is to be vertical and horizontal integration of  
21 healthcare institutions. In addition, the regional health systems will work to integrate health and  
22 social care by working closely with social care agencies within each region. Six RHSs were created,  
23 each being responsible to integrate care for a specific geographic region in Singapore. Each RHS is  
24 anchored by a tertiary hospital, supported by a community hospital providing intermediate and  
25 rehabilitation care and complete with linkages to primary care and long term care services in the  
26 region. In 2014, the Singapore Health Services (SingHealth) RHS was officially launched and consisted  
27 of primary to tertiary care institutions that account for the care of nearly a million residents in  
28 Singapore.  
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### 31 *Inclusion and Exclusion Criteria*

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33 Patients are eligible if they:

- 34 1) Age  $\geq$  60 years at time of recruitment
- 35 2) Staying in public rental housing in Chinatown area in Singapore

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38 Chinatown was chosen as the Care Closer to Home (C2H) team had already started a social care case  
39 management and home help program in this area since October 2014. We will exclude patients who  
40 decline our program or dementia patients who are incapable of independent living and do not have  
41 a caregiver. Patients who have mild dementia and are capable of independent living or have a  
42 caregiver are suitable to be enrolled into the ICoC program, which will support care in the  
43 community. Patients in the intervention group will be recruited during their first admission upon  
44 study commencement (Figure 1) on a consecutive sampling basis. Based on the electronic medical  
45 records, close to 180 unique patients were admitted to SGH in 2014. Assuming a low 5% rejection  
46 and exclusion rate (confirmed by our feasibility study), the recruitment period is estimated to be  
47 take 1.5 years (1st August 2016 to 31st January 2018). Recruitment will close when the sample size  
48 of 250 is reached. Control patients will be identified retrospectively at the end of the study period  
49 and data extracted from the SGH patient database using the index admission as the start date.  
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52 Figure 1: Patient Recruitment and Comparison between Intervention and Control Groups.

### 53 54 55 *Intervention and Control*

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57 The ICoC intervention program (Figure 2)

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3 1. Singapore General Hospital (SGH) Transitional Care (TC) team for care transitions of hospitalized  
4 residents

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6 The SGH TC team (comprising a senior family physician and a medical officer) is a dedicated service  
7 that will provide inpatient care or co-management with specialists for all enrolled patients, with  
8 emphasis on comprehensive discharge planning, formulation of a care plan post-discharge and  
9 proper hand-over care to the community virtual ward and C2H teams. This intervention incorporates  
10 the best principles in transitional care that includes both pre-discharge and post-discharge  
11 component<sup>(16, 22)</sup>. The hand-over care will be executed via a daily half-hour video conferencing  
12 meeting between the three teams.  
13

14 2. Community Virtual Ward (VW) for coordinating community care and home-based primary care  
15

16 The community-based VW team comprises of a staff nurse and resident physician seconded by SGH  
17 to provide continuing community care, home-based primary and nursing care to enrolled patients.  
18 This intervention is supported by strong evidence for home-based primary care and continuing care  
19 for frail elders<sup>(23, 24)</sup>. The team's responsibilities include: (i) comprehensive geriatric assessment; (ii)  
20 continuing care and at least weekly surveillance of discharged patients for up to one month post-  
21 discharge; (iii) monitoring at risk patients for compliance to the prescribed care plans and  
22 medications; (iv) health promotion and education to enrolled patients; (v) developing patient-  
23 specific action plans for patients with high risk diseases such as heart failure and diabetes and (vi)  
24 coordinating and integrating the primary, transitional and social care for enrolled patients; and (vii)  
25 hand-over care to community service providers for long term follow up upon stabilization of patients  
26 and according to clinical protocol. The community VW team is physically located in the community.  
27  
28

29 3. Care Closer to Home (C2H) team for social case management and home help  
30

31 Since October 2014, the C2H is a program by the Agency for Integrated Care (AIC) comprising a case  
32 manager, a social work assistant and five nursing aides to put in place health, personal and social  
33 services, e.g. medication management, home help services to assist with basic activities of daily  
34 living e.g. showering to help seniors to age in place. To date, the program has enrolled close to 300  
35 residents. AIC closely supports and provides professional guidance for the C2H program.  
36

37 All three components of the ICoC program will be provided to enrolled patients. To ensure this, we  
38 have harmonized our inclusion and exclusion criteria for entry into all three components. The ICoC  
39 program has been implemented since August 2016.  
40

41 Control group participants  
42

43 The control group of approximately 1100 participants from other rental housing blocks in our  
44 regional health system will receive current hospital standard of care when they are hospitalized.  
45 Patients will be managed by their specialists in charge depending on their admitting diagnoses.  
46 Patients may be referred to the SGH TC program and/or various community services on discharge if  
47 deemed necessary by their specialists. Continuing care post-discharge may be provided at the  
48 specialist outpatient clinics or a primary care provider identified by the hospital specialist. The  
49 community VW and C2H teams will not be available for control group participants.  
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53 Figure 2: Conceptual Model of Care for the ICoC Program  
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57 *Conceptual Framework for Evaluation*  
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3 The strategy of using multidisciplinary case management that we have adopted for our model of  
4 care has been widely used in many care integration programs aimed at reducing health care  
5 utilization and improve quality of care for frail older adults with multimorbidities.<sup>(25)</sup> The evaluation  
6 of this model of care is challenging because it contains multiple components. For example, the  
7 medical, social and personal care components may act both independently of each other and  
8 interdependently in affecting the outcome of patient care. The assessment of individual  
9 components of intervention becomes complicated, creating the need for a novel adaptation of a  
10 mixed-method strategy of evaluation. Thus, our multidisciplinary research team combines the use of  
11 both quantitative and qualitative methods through a participatory action research (PAR) approach as  
12 part of the overall evaluation of the effectiveness of the ICoC program.  
13

14  
15 PAR has been defined as “systematic inquiry, with the participation of those affected by the problem  
16 being studied, for the purposes of education and action or effecting social change”.<sup>(26)</sup> In Singapore,  
17 the recent and rapid transformation of health services delivery for the aging population had created  
18 unprecedented shifts in the power relationship between users, policy makers and service providers  
19 in the healthcare system. PAR with community-dwelling socially-at-risk elderly Singaporeans has the  
20 potential to explore some of the complex health and social problems that poor and socially-isolated  
21 elderly face, while also contributing to individual and community capacity building. In the context of  
22 our research site, PAR is an appropriate process for evaluating patient-centred models of care,  
23 especially since the action research strategies that we are proposing are common to processes in the  
24 field of nursing—particularly through the steps of assessment, planning, implementation, evaluation  
25 and replanning<sup>(27)</sup>. The “PIE method”, for instance, has been used among nurses to document  
26 patients’ progress, where its acronym stands for identifying Problems, proposing Interventions and  
27 Evaluation<sup>(28)</sup>. PAR has also been engaged successfully to facilitate improvements in healthcare  
28 services<sup>(29)</sup>.  
29

30  
31 A mixed-methods PAR approach will facilitate a more comprehensive assessment of the ICoC,  
32 particularly to understand the multiple outcomes of the program in terms of what works, for what  
33 and for whom. In this regard, PAR is intended to be both highly localized and comparative.  
34 Investigation of the programme structure, its operating processes and stakeholders’ experiences can  
35 be captured through qualitative methods while the comparative assessment of health outcomes  
36 between the intervention and control group will be valuably complemented through quantitative  
37 research methods. Our preferred approach is driven not only by the learning objectives of  
38 investigators but also by the circumstances and contexts of the community involved.  
39

#### 40 *Research Design*

41  
42 The ICoC study is a single-centre prospective, controlled, observational study performed in the  
43 SingHealth RHS.<sup>(30, 31)</sup> Drawing upon established trends in PAR praxis which emphasizes collective  
44 processes of investigation and involvement as well as experimentation grounded in experience and  
45 social history<sup>(32, 33)</sup>, our research design similarly includes a learning component. We have  
46 conceptualized our design in terms of a synergy between the 3 “Is” of Intervention (Action),  
47 Invovement (Participation in the Community) and Inquiry (Research) into a feedback cycle (Figure  
48 3). The 3 Is mutually augment each other to contribute to the social transformation of integrated  
49 elderly care. The approach requires the co-partnership of stakeholders, implementation teams and  
50 research units to collect data, reflect upon findings of outcomes and refine the intervention process  
51 further to develop and achieve better delivery and results of ICoC.  
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55 Figure 3. Research Design: Intervention, Involvement and Inquiry Feedback Cycle  
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3 The mixed-methods PAR approach to the ICoC model is significant to health systems research  
4 because it attempts to triangulate both medical providers' and elderly patients' perspectives of  
5 intervention delivery. In this regard, our research design intends to capture sensitivity to outcomes  
6 beyond only the intended hypothesis. Additionally, while evaluation studies utilize quantitative data  
7 to measure intervention outcomes, a qualitative approach may address the limitations of using a  
8 single metric of examining hospital admissions, which have been found to be less suitable for  
9 complex and vulnerable patients where many other factors contribute to the need for  
10 hospitalization.<sup>(34) (35)</sup>

### 11 *Study Aims and Hypotheses*

12  
13  
14 Our participatory action research (PAR) model combines two research components, quantitative and  
15 qualitative, at different phases of the intervention. The primary objective of the quantitative study is  
16 to evaluate the effectiveness of the ICoC program in achieving a significant reduction in the  
17 proportion of patients in the intervention group with acute hospital readmissions within 30 days of  
18 the index discharge date relative to controls. The index admission and index discharge dates are  
19 defined as the date of the patient's first admission to the hospital and discharge from the hospital  
20 respectively. The secondary aims of this study are to evaluate the effectiveness of the ICoC program  
21 in achieving (i) a lower proportion of patients in the intervention group with three or more  
22 unscheduled hospital readmissions within one year of index discharge; (ii) a lower emergency  
23 department attendance rate in the intervention group at 30 days, and one year from index  
24 discharge; (iii) a lower specialist outpatient clinic attendance rate in the intervention group at 30  
25 days, and one year from index discharge; (iv) Improving health related quality of life in the  
26 intervention group relative to baseline as measured by the EQ-5D at 30 days, and one year  
27 compared to the control group.

28  
29  
30 The qualitative study aims at developing a more context-specific social ecological model of health  
31 behavior.<sup>(36)</sup> We propose a social ecological framework of health behaviour in the manner below:

- 32 a. Care recipients' and caregivers' conditions and experiences (individual level)
- 33 b. Interactions between elderly patient, caregivers and healthcare providers (interpersonal
- 34 level)
- 35 c. Elderly and caregiver's access experiences with service use and health care delivery
- 36 (institutional/ organizational level)
- 37 d. Elderly patients' connections with and support from the community (community level)
- 38 e. How public initiatives and access to other healthcare programmes affect the experience
- 39 of transitional care post-discharge (policy level)
- 40
- 41
- 42

43 This model helps to identify how influences within one's social environment: individual,  
44 interpersonal, organizational, community and policy factors affect people's experiences, behaviours  
45 and clinical outcomes during care transitions from hospital to home. The knowledge of how this  
46 model operates on the ground will enrich our evidence-based strategies to understand the impact of  
47 the ICoC. The PAR operates on a feedback loop that is sensitive to changes experienced by providers  
48 and patients in real-time. In this project, both the implementation and research team work in  
49 tandem to evaluate and improve the intervention once primary outcomes have been measured or  
50 unintended outcomes have been reported.

### 51 *Sample Size calculation*

52  
53  
54 Data from a previous feasibility study shows a historical 30-day re-admit rate of 17.5% for patients in  
55 the three proposed Intervention blocks and 16.8% in the Control blocks. The prospectively recruited  
56 sample size for the Intervention will be 250 and, based on 2014 data, we anticipate about 1100  
57 patients in the Control group. The figure shows the proposed sample sizes will provide  $\geq 80\%$  power  
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3 using a two-sided Fisher's exact test ( $\alpha=0.05$ ) to detect the following range of differences  
4 (unadjusted) in 30-day re-admit rates between Control vs. Intervention: 18.0 vs. 10.7, 17.0 vs. 9.9,  
5 16.0 vs. 9.1, 15.0 vs. 8.3, 14.0 vs. 7.5 and 13.0 vs. 6.7. Targeted reductions in Intervention group  
6 readmission rates range from 40.5–48.5% and would certainly be considered clinically meaningful. In  
7 our previously published virtual ward study<sup>(22)</sup>, we achieved 33% reduction in 30-day readmission  
8 rates and it is likely this can be improved with additional home visits and social care case  
9 management.

10  
11 For the qualitative component, the research team will purposively select a sample of 40 elderly  
12 patients/ clients based on the sample of 250 elderly residents who are enrolled in C2H intervention  
13 programme and who are also under the supervision of the VW. The elderly patients/ clients are  
14 recruited into the study through referrals from medical and care team based on their health status  
15 and case severities (eg. Polypharmacy, multiple comorbidities, frailty). Since the qualitative study will  
16 be conducted over a year, we derived the sample size (n=40) elderly clients based on feasibility in  
17 terms of time, recruitment and limited manpower resources. We projected our sample size based on  
18 the concept of information power, which indicates that the more information the sample holds that  
19 will be relevant for the actual study, the lower the number of participants needed.<sup>(37)</sup> We appraised  
20 the information power of our sample based on the following factors:

- 21  
22
- 23 a. Sample specificity: All qualitative participants are elderly clients enrolled in the ICoC and  
24 share specific similarities for example, in terms of poor socio-economic status, low-literacy,  
25 living alone, mental impairment and difficulties in managing chronic illness. The variations  
26 that we intend to represent in our sample would be medical complexities, sex, race,  
27 caregiving arrangements and age (60-90 above).
  - 28 b. Applying mixed-use of deductive and inductive/ grounded theory approaches necessitate  
29 that the sample needs to provide a solid foundation to ground conclusions
  - 30 c. Strong quality of dialogue: Experienced research team conducting multiple in-depth  
31 interviews with each client will produce rich and meaningful data to evaluate the user  
32 perspective of the ICoC intervention
  - 33 d. Exploratory and thematic cross-case analysis will be conducted based on in-depth interview  
34 responses.
- 35  
36

37 From the factors above, we are confident that our study can obtain sufficient information power  
38 with a sample size of 40, without compromising depth and rigour.

39 The research team will also be interview all community health providers (n=10) who are providing  
40 care in the study site.

#### 41 *Data Collection strategies to Measure Outcomes*

##### 42 Basic Characteristics

43  
44  
45 Intervention Group: The research team will obtain informed consent from the intervention group  
46 participants and interview them for demographic, socioeconomic status, medical comorbidities,  
47 abbreviated Mental Test, and modified Barthel Index, instrumental activities of daily living and  
48 health-related quality of life (EQ-5D). This information will allow the investigators to characterize  
49 and identify needs in our intervention group patients better.

50  
51  
52 Control Group: Control group patients will be retrieved from the eHIntS system. The eHIntS system is  
53 SingHealth's electronic health record system, that integrates information from multiple sources  
54 including administrative data (for example, patient demographics), clinical data and ancillary data  
55 into our enterprise data warehouse. A waiver of patient consent will be sought from the centralized  
56 institutional review board for extraction of de-identified routinely collected information. Similar  
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demographic, socioeconomic status and medical comorbidities data (predictors used for propensity scores calculation listed in Appendix A supplementary file) will be collected for both groups to allow calculation of propensity scores as a basis for comparability. We have shown in our previous study<sup>(31)</sup> that these data can be extracted from our data warehouse for inclusion in a propensity score model. Information such as abbreviated mental test, modified Barthel index, instrumental activities of daily living and health related quality of life will not be available for the control group.

#### Outcome Measures at 30 days and one-year

The research team and the ICoC team will follow up with study participants for the primary and secondary outcomes at 30 days, and one year (Table 1). An unscheduled readmission is defined as a readmission for a non-elective indication. Unscheduled readmission at 30 days (short-term outcome) is a universally accepted indicator of transitional care quality and one year outcomes (long-term outcome) is chosen to reflect the quality of community and continuing care. The research team will conduct a face-to-face survey interview at 30 days and one year to repeat the EQ-5D scales. Healthcare utilization data of intervention and control group participants will be extracted from SingHealth's eHIntS system and merged with Ministry of Health (MOH)'s Omnibus data resource. The MOH's Omnibus data resource contains national-level healthcare utilization data and will ensure complete and accurate healthcare utilization outcomes and overcome the issue of cross utilization to different healthcare clusters in Singapore. Similarly, predictors of 30-day readmission that will be used for propensity score matching will be available from eHIntS and Omnibus databases.

A checklist will be developed to measure fidelity to components of ICoC program and ensure standardization of intervention and the designed interventions are faithfully adhered to. The nature (routine/emergency) and number of home visits e.g. doctor/nurse/C2H will be retrieved from the clinical documentation notes.

**Table 1: Data collection sources at Baseline, 30 days and One Year outcomes for participants**

Variable	Method of Collection	Baseline	Follow-up (30 days)	Follow-up (One year)
Demographic, Socio-economic status, Health information and prior healthcare utilization, Abbreviated Mental Test, Modified Barthel Index, Instrumental activities of daily living, health related quality of life	Questionnaire, EQ-5D, eHIntS	X		
<b>Primary Outcome Measure –</b> Unscheduled hospital readmission within 30 days of index discharge	eHIntS, Omnibus		X	
<b>Secondary Outcome Measures –</b> 1. Unscheduled hospital readmissions at one year; 2. & 3. Emergency department attendances, specialist outpatient clinic attendances at 30 days and one year 4. Health related quality of life at 30 days and one year	EQ-5D, eHIntS, Omnibus		X	X

#### Qualitative Data Collection Design and Strategies

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3 The qualitative research component of the PAR will be conducted in three phases.  
4

5 Phase 1: *Intervention & Involvement*

6  
7 1a. *Understanding mechanisms and contexts of intervention* (Providers and Patients)

8  
9 The research team will engage in 'go-along' interviews with nurses and community healthcare  
10 providers to understand the complexities around integrated care in a low-income rental  
11 neighbourhood. The 'go-along' combines both participant observation and interview methods and  
12 will be conducted with all of the VW nurses and the C2H team (n=10) as they go about their daily  
13 care-rounds around the study site. Data collected will provide information in terms of  
14 patient/clients' receptivity to medical intervention, relationship between providers and their elderly  
15 patients/clients. The objective of go-along interviews is to capture the providers' perspective of the  
16 barriers and facilitators in the implementation of ICoC to their patients/ clients. Research team will  
17 document processes in which medical providers understand, implement and apply appropriate  
18 practices of care to the elderly residents in low-income rental dwelling. For triangulation, the  
19 research team will conduct content analysis of providers' case summaries over the period of  
20 intervention to trace the chronology and outcome of individualized interventions.  
21

22 1b. *Elderly Residents' Qualitative Needs Assessment based on Case Summaries and Complementary*  
23 *Quantitative Study*

24  
25 Based on case summaries by healthcare providers, research team will work with implementation  
26 team to identify and categorically group elderly residents based on complexity of case and specific  
27 health conditions. The medical team and nurses will refer 40 cases/ elderly clients with different  
28 physical and health status as well as across gender, ethnicity, age and living arrangements to the  
29 research team for Phase 2b of in-depth semi-structured/ informal interviews. Elderly residents will  
30 be grouped according to similarities in terms of case complexity (first strata) followed by whether  
31 they show improvements in health behaviour or not (second strata).  
32

33  
34 Phase 2: *Action Learning through Involvement and Inquiry*

35  
36 2a. This phase involves interpreting preliminary data, explaining contexts, translating findings and  
37 refining identified problems, priorities and strengths together with key community members-  
38 clinicians, nurses, resident committee members and elderly residents who are physically and  
39 cognitively able to participate and be involved in discussions. Through focus group discussions, the  
40 aim of this phase is to: 1) to understand how providers define care and how their vision of care is  
41 being expressed through their practices and 2) to understand the background profile of clients and  
42 develop case-studies of "complex" cases and how both the providers, resident committee and  
43 patients manage these issues.  
44

45 2b. *ICoC User Experience* (n=40 based on referral in Phase 1b)

46  
47 Research team will establish rapport with elderly residents in intervention group and conduct in-  
48 depth interviews to explore the experiences and attitudes of older people who are in the  
49 intervention group (VW and C2H). Objective is to gain an understanding of the strengths and  
50 weaknesses of community care from the perspective of recipients in the study site.  
51

52  
53 Once the Institutional Review Board (IRB) has given ethics approval to conduct the research, the  
54 investigators will invite residents in the intervention group to participate in research study through  
55 case referrals by nurses and community health providers. Due to the nature of the User Experience  
56 research which requires substantial feedback from participants, nurses and community health  
57 providers will only refer elderly clients who are able to respond to questions without requiring a  
58 proxy. When comfort and trust has been established between the research team and participants,  
59  
60

1  
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3 investigators will conduct interviews following a life history format. We will ask about their personal  
4 histories to gain a deeper and better understanding of their current circumstances and health  
5 behaviours. We will also seek their feedback as recipients of the care intervention. Interviews will be  
6 carried out over multiple sessions and visits, instead of a block session, so as to not tax elderly  
7 participants. Each session would last about approximately 30 minutes and will continue until all  
8 questions in the interview guide (Appendix B supplementary file) have been satisfactorily completed.  
9

### 10 Phase 3. *Inquiry and Intervention*

11  
12 Data analysis and findings from phase 1 and 2 will provide feedback on the delivery of the  
13 intervention. These findings will be analysed together with the post-30 days and post 1 year  
14 quantitative outcome measures to identify which mechanisms of the intervention have been  
15 successful and which require improvements. Improvements to the intervention will only be  
16 implemented and executed only after our primary outcomes have been collected and analysed.  
17 Additionally, the objective of Phase 3 is to also highlight unintended negative consequences or  
18 beneficial outcomes of the intervention that clients and providers experience. The team will further  
19 analyse implications of findings and translational capacity to other low-income rental community-  
20 dwelling areas in Singapore.  
21

### 22 **Analysis**

#### 23 *Quantitative Data Analysis*

24  
25 To analyze our primary aim (Table 1), control and intervention 30-day re-admission rates will be  
26 compared using logistic regression using propensity scores to adjust for effects of confounders.  
27  
28

29 The secondary aim 1 analysis (Table 1) will use Fisher's exact test and logistic regression and  
30 compare groups on proportions of patients with three or more unscheduled hospital readmissions  
31 within one year of index discharge. Secondary aims 2 and 3 (Table 1) will involve Poisson regression  
32 analysis on numbers of emergency department and specialist outpatient clinic visits respectively, per  
33 three-month and one-year intervals, and aim 4 (Table 1) will involve standard analysis of variance  
34 methods to compare quality of life scores. All analyses will incorporate propensity score adjustment.  
35 All analyses will be performed using SAS V9.4 software (SAS© Cary, NC, USA).  
36  
37

#### 38 *Qualitative Data Analysis*

39  
40 All in-depth interviews with key personnel and focus group discussions will be audiotaped and  
41 transcribed and uploaded onto qualitative software database nVivo 11. While 'go-along' interviews  
42 with nurses and case workers and interviews with elderly recipients with speech difficulties (e.g.  
43 slow speech, inaudible voice) will not be audio-recorded due to the anticipated long duration of such  
44 sessions and difficulty in capturing speech respectively. Written notes will be used instead to record  
45 such observations and conversations and will be type-written at the end of each day. Typed written  
46 notes will also be uploaded onto NVivo 11. The research team will use NVivo to code responses for  
47 theoretical and emergent themes regarding practitioner and client/patient (provider-user)  
48 experience of the ICoC programme.  
49

50 The team will analyse data, by coding for broad themes that correspond to influences at the  
51 individual, interpersonal, organizational, community and policy level according to the social  
52 ecological framework of health behaviour, while simultaneously code for emergent themes. The  
53 combination of both deductive and inductive analytical approaches will provide further granularity  
54 for the evaluation of the ICoC intervention programme. Data will be independently coded by two  
55 qualitative analysts and codings will be compared for agreement through NVivo, to achieve inter-  
56 rater reliability.  
57  
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### Ethics and Dissemination

Informed consent for participation in the ICoC intervention programme will be taken from each enrolled patient. Participation in the study is voluntary and care services will not be withdrawn should elderly patients decide to not participate or withdraw from the study. After obtaining consent, the qualitative research team will build rapport of elderly participants further through regular interactions facilitated by frequent house visits with community nurses and health providers. Additional informed consent to participate in the research study will be taken for patients/ clients who have been referred to research team and for providers and stakeholders who will be interviewed and/or participating in focus group discussions. SingHealth Centralized Institutional Review Board (CIRB 2015/2277) and National University of Singapore Institutional Review Board (NUS IRB: H-17-035) has approved this study.

Findings will be disseminated by publications in peer-reviewed journals, scientific meetings, and presentations to policy makers and practice providers.

#### *Status of the study*

The ICoC program is expected to last 2 years, from July 2016 to June 2018.

### Discussion

It is increasingly recognized that non-biological determinants of health such as social, environmental and individual behaviors impact significantly on health outcomes.<sup>(38, 39)</sup> These non-biological determinants of health interact in a complex relationship a person's biological health determinants such as gender, age, inherited and acquired health conditions. Therefore, quality healthcare alone cannot achieve optimal outcomes in health. Policy changes and interventions (the ICoC program in this case) that can modify health seeking behavior and affect delivery of healthcare services may in turn affect health determinants and health outcomes. Implementing a complex ICoC intervention program and understanding the complex interaction between determinants, policy and outcomes therefore require an innovative approach to evaluation such as the PAR model.

The findings from ICoC program will directly inform policy makers on the feasibility of implementation and effectiveness of integrating traditional silos of practice on reducing acute hospital utilization. This has direct policy implications on the funding model and quantum to support such a program. In the short to medium term, the study will develop a novel model of integrated care that shifts care from a hospital centric system to an integrated community centric system for high-risk communities. In the long term, the study has policy implications on the feasibility and effectiveness of empanelment of high-risk communities (assigning individuals to care teams) to a community based integrated care team supported by the regional health system. The systematic inquiry, with the participation of those affected by the problem being studied, will enable the ICoC program and policy makers to understand the complex interaction between health determinants, intervention and health outcomes. This knowledge will facilitate design of better interventions and policies that systematically address health determinants and policies in future iterations of the ICoC program.

Our study has potential limitations. Firstly, a randomized controlled trial design would be most appropriate for evaluating the effectiveness, but it is not always the best design for process indicators. Moreover, we had wanted to evaluate the effectiveness of the synergism achieved by all three components of the ICoC program. The restriction of the C2H program to the three intervention blocks precluded us from randomizing the rental housing blocks or patients for intervention. We will minimize bias in the statistical comparison of the intervention and control groups by using propensity scores to balance baseline covariates. Second, this study is limited to a single rental housing community, so generalizability to other rental housing communities would be unknown. If

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2  
3 results from the ICoC program are promising, we intend for this model of care to be propagated to  
4 other rental housing communities throughout RHS and Singapore.

5  
6 **Study status:** At the point of manuscript submission, the enrollment of participants is ongoing.

7  
8 **Contributorship Statement:** LLL, AM and LKH conceived and designed the study. LLL and AM wrote  
9 the first draft of the paper, and all authors critically revised the paper and gave final approval for  
10 publication.

11  
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16

17  
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19  
20 **Data sharing statement:** Details of ongoing data collection (indicators and outcomes) is available  
21 from the corresponding author at low.lian.leng@singhealth.com.sg  
22

23  
24 **Competing interests:** The authors declare that they do not have competing interests.

25  
26 **Figure legends:**

27  
28 Figure 1: Patient Recruitment and Comparison between Intervention and Control Groups

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30 Figure 2: Conceptual Model of Care for ICoC program

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32 Figure 3: Research Design Intervention, Involvement and Inquiry Feedback Cycle  
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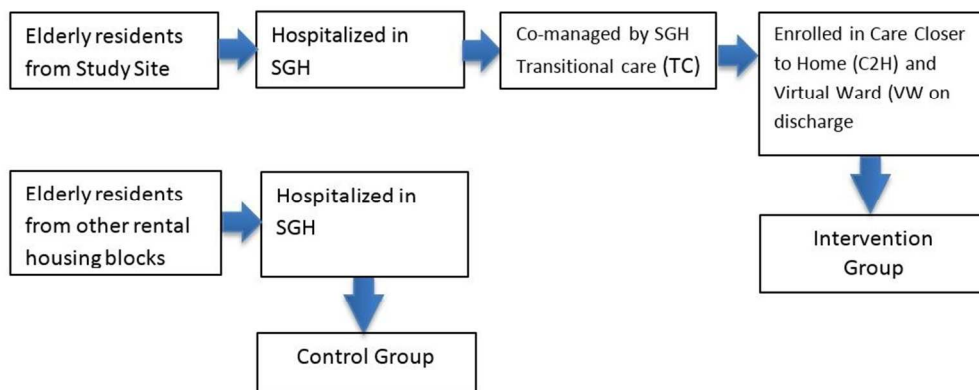


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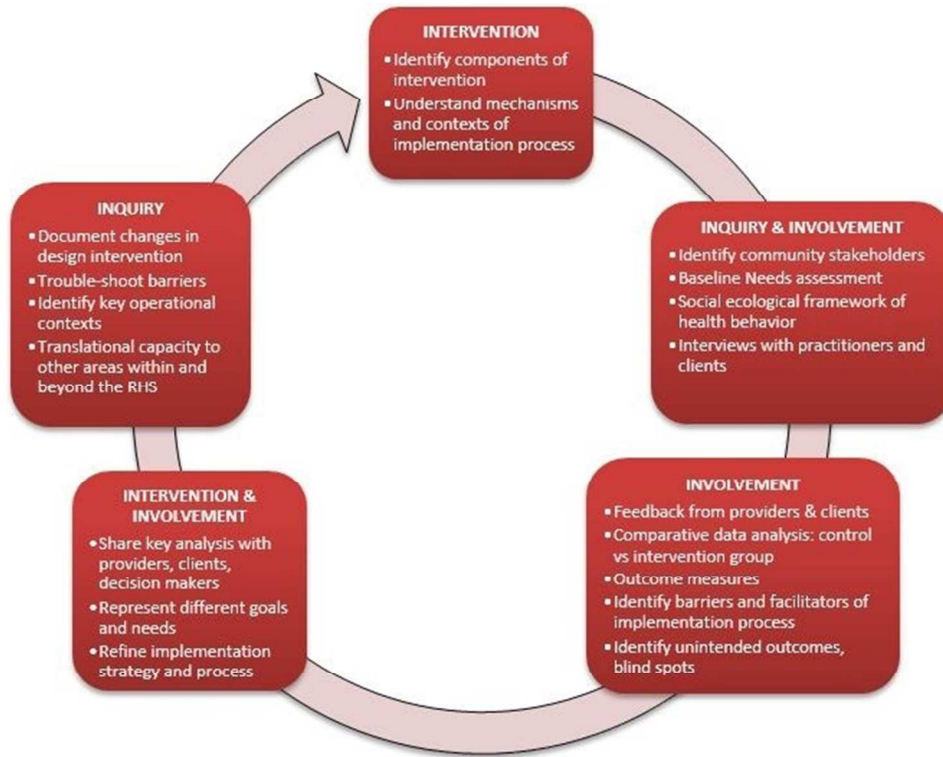
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### Appendix A: Predictors of 30-day readmission risk for propensity score matching

Domains	Predictor
Patient demographics	Age Gender Required financial assistance using Medifund
Past healthcare utilization	Emergency department visits six months before index admission Hospital admissions one year before index admission
Index admission	Urgent / Emergency admission Stayed in a subsidized ward Required inpatient dialysis Required intravenous furosemide 40mg and above Length of stay
Medical comorbidities	Depression History of alcoholism Osteoarthritis Spine fracture Charlson comorbidity index
	Total 15 predictors

## Appendix B: Interview Guide with the Elderly Care Recipient

1. Introduction/ building rapport
  - a. Establish life history: past employment, family life, social support etc.
2. Ask about who has been helping them out with their health, care and medication, physical therapy
3. What kind of help have they been receiving? How did they come to be a care recipient?
4. Describe the care routine.
  - a. Medicine management
  - b. Hospital admission and post-discharge care
  - c. Social care
  - d. Home cleanliness
  - e. Support and reassurance
  - f. Mental health
  - g. Access to health services
  - h. Information giving/ health literacy
  - i. Connection to other social agencies
  - j. Post-op treatment and follow-up
5. Has the care they received met their needs or are there needs that remain unmet?
6. What is their relationship with community nurses, health aide workers and case manager? What do they perceive of their services?
7. Why do they think they have been allocated care?
8. What is their understanding of the role of community care workers?
9. Ask to give an account of their health issues, how they perceive their health, how their health affects their life situation or vice-versa, impacts of their health on relationships with others
10. What do they think about the help they are receiving? Have they observed any personal changes?
11. What have they learned from community care workers?
12. Has it improve their life situation or changed the way they think about their health?
13. Share about their experiences the last time they were admitted to the hospital. What do they think was the cause of their admission and if they feel the situation could have been avoided
14. How confident are they about managing their health? Do they feel that they have more understanding/ information about how to take care of themselves?
15. What about the health care they received was most helpful to their everyday life? What do they like best about it? What did they least like about it? How can the services be improved?

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 Page 1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found Page 2
<b>Introduction</b>		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Pages 2-3
Objectives	3	State specific objectives, including any prespecified hypotheses Page 3
<b>Methods</b>		
Study design	4	Present key elements of study design early in the paper Page 4 onwards
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Page 4 onwards
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Page 6
		(b) For matched studies, give matching criteria and number of exposed and unexposed Page 9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Page 8-9
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 Pages 9
Bias	9	Describe any efforts to address potential sources of bias Page 9
Study size	10	Explain how the study size was arrived at Page 10
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why Page 11
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding Page 11
		(b) Describe any methods used to examine subgroups and interactions Not applicable in our study.
		(c) Explain how missing data were addressed Not applicable in our study.
		(d) If applicable, explain how loss to follow-up was addressed We are able to retrieve utilization data from our electronic health record system.
		(e) Describe any sensitivity analyses Not applicable in our study.
<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 No results are available yet.
		(b) Give reasons for non-participation at each stage No results are available yet.
		(c) Consider use of a flow diagram No results are available yet.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders No results are available yet.
		(b) Indicate number of participants with missing data for each variable of interest No results are available yet.
		(c) Summarise follow-up time (eg, average and total amount) No results are available yet.



Outcome data	15*	Report numbers of outcome events or summary measures over time <b>No results are available yet.</b>
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>No results are available yet.</b> (b) Report category boundaries when continuous variables were categorized <b>No results are available yet.</b> (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period <b>No results are available yet.</b>
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses <b>No results are available yet.</b>
<b>Discussion</b>		
Key results	18	Summarise key results with reference to study objectives <b>No results are available yet.</b>
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 <b>Page 12-13</b>
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence <b>Pages 12-13</b>
Generalisability	21	Discuss the generalisability (external validity) of the study results <b>Page 12-13</b>
<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 <b>Page 14</b>

\*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>.