Pre-publication Stakeholder Report

Evaluation of the Care Coordination through Emergency Department, Residential Aged Care and Primary Health Collaboration (CEDRiC) project

Authors:
Marianne Wallis[1&2], Elizabeth Marsden[2], Alison Craswell[1&2], Andrea Taylor[2], Kaye Coates[3], Marc Broadbent[1], Amanda Glenwright[4], Adrian Barnett[5], Kim-Huong Nguyen[6], Colleen Johnston[1], Nicolette Bannink[1] & Julia Crilly[6&7]

[1]University of the Sunshine Coast
[2]Sunshine Coast Hospital and Health Service, Queensland.
[3]Sundale Ltd.
[4]Central Queensland, Wide Bay and Sunshine Coast PHN
[5]Australian Centre for Health Services Innovation (AusHSI)
[6]Griffith University
[7]Gold Coast Health

Contact: Marianne Wallis RN PhD, Associate Dean of Health, Professor of Nursing, School of Nursing, Midwifery and Paramedicine, University of the Sunshine Coast, Locked Bag 4, Maroochydore DC, Queensland 4558, Australia.
Email: mwallis@usc.edu.au

Acknowledgements
This study was funded by the Department of Social Services, through the Aged Care Service Improvement and Healthy Ageing Grant scheme, now being administered by the Commonwealth Department of Health.

NB: Research results are embargoed until publication.

Project teams

To conduct the evaluative study, the grant recipients engaged a team with both research and clinical expertise. The team members were:

Research Team

- Prof. Marianne Wallis - University of the Sunshine Coast, Chief investigator
- Dr Elizabeth Marsden - Sunshine Coast Hospital and Health Service, Emergency Physician & GEDI team leader, Chief investigator
- Ms Andrea Taylor - Sunshine Coast Hospital and Health Service, Clinical Nurse Consultant GEDI, Chief investigator
- Ms Kaye Coates - Sundale Ltd., Nurse Practitioner Candidate, Chief Investigator
- Dr Marc Broadbent - University of the Sunshine Coast, Senior Lecturer, Chief Investigator
- Ms Amanda Glenwright - Central Queensland, Wide Bay and Sunshine Coast PHN, Regional Program Coordinator, Chief Investigator
- Prof. Julia Crilly - Gold Coast Health, Griffith University, Adjunct Professor, University of the Sunshine Coast, Chief Investigator
- Dr Alison Craswell - University of the Sunshine Coast, Research Fellow, Project Manager
- Ms Colleen Johnston - University of the Sunshine Coast , Senior Research Officer
- Ms Nicolette Bannink - University of the Sunshine Coast, Research Assistant

Consultants

- Prof. Adrian Barnett - Australian Centre for Health Services Innovation, Statistician
- Dr Kim-Huong Nguyen - Griffith University, Health Economist

Clinical Teams

GEDI - Sunshine Coast Hospital and Health Service

- Dr Elizabeth Marsden - Sunshine Coast Hospital and Health Service, Emergency Physician & GEDI team leader
- Ms Andrea Taylor - Sunshine Coast Hospital and Health Service, Clinical Nurse Consultant GEDI
- Ms Caroline Gibb - Sunshine Coast Hospital and Health Service, Clinical Nurse GEDI
- Ms Sam Butler - Sunshine Coast Hospital and Health Service, Clinical Nurse GEDI
- Ms Jane Tomlinson - Sunshine Coast Hospital and Health Service, Clinical Nurse GEDI
- Ms Amanda John - Sunshine Coast Hospital and Health Service, Clinical Nurse GEDI

- Ms Tamara Hills - Sunshine Coast Hospital and Health Service, Clinical Nurse GEDI

HIPS - Sundale Ltd.

- Ms Kaye Coates - Sundale Ltd., Nurse Practitioner Candidate
- Ms Catherine Horne - Sundale Ltd., Clinical Nurse
- Mr David Anderson - Sundale Ltd., Administrative Officer
- Ms Morag Oakley - Sundale Ltd., Care Director

Central Queensland, Wide Bay and Sunshine Coast PHN

- Ms Amanda Glenwright - Central Queensland, Wide Bay and Sunshine Coast PHN
- Mr Clinton Bazley - Central Queensland, Wide Bay and Sunshine Coast PHN - Support

Expert Advisory Committee

- Dr Ruth Devin - Geriatrician, Sunshine Coast Hospital and Health Service
- Dr Zoltan Bourne - GP, Medicine on Maple, Sunshine Coast
- Mr Matt Sierp - Chief Operations Officer, Sundale Ltd.
- Ms Pattie Hudson - Chief Executive Officer, Central Queensland, Wide Bay and Sunshine Coast PHN
- Ms Sylvia Hood - A/Manager, funding information and costing services, Sunshine Coast Hospital and Health Service
- Mr Barry McCarthy - Nursing Director, Emergency and Renal Services, Sunshine Coast Hospital and Health Service
- Mr Graham Chapman - Consumer Representative
- Mrs Joan Chapman - Consumer Representative

Partner Organisations

- Sunshine Coast Hospital and Health Service (SCHHS)
- Sundale Ltd.
- Central Queensland, Wide Bay and Sunshine Coast PHN
- Australian Centre for Health Services Innovation (AusHSI)
- Griffith University
- Gold Coast Health

Research Outputs

Large projects require dissemination of information to wide ranging audiences. To this end we have published and presented widely. A list of research outputs from this study can be found in Appendix 1.

Executive Summary

Background

Ageing populations are placing increasing pressure on health services for the management of acute illness and exacerbation of chronic conditions. This is particularly true on the Sunshine Coast where in 2015, more than 20% of residents were aged 65 years and over compared to 15% in the general Australian population [1]. Emergency department (ED) presentation and hospital admission for older adults is associated with an increased risk of complications compared to younger cohorts [2-7]. Appropriate care for this vulnerable cohort, when an episode of acute illness occurs, is critical to improving patient outcomes and to the efficient management of the healthcare system.

The **C**are Coordination through **E**mergency **D**epartment, **R**esidential Aged Care and Pr**i**mary Health **C**ollaboration (CEDRiC) project took a systems approach to health services redesign, incorporating robust evaluative research. The CEDRiC project incorporated two interventions: the Health Intervention Program for Seniors (HIPS) in three residential aged care facilities (RACFs) and the Geriatric Emergency Department Intervention (GEDI), implemented in the ED of the local public hospital. HIPS involved a Nurse Practitioner Candidate (NPC) and an experienced registered nurse (RN) providing enhanced primary care in collaboration with visiting General Practitioners (GPs) for acutely unwell residents. GEDI provided a nurse-led, physician-championed model of care to streamline service delivery and disposition planning for frail older persons in the ED. The HIPS nurses coordinated with the GEDI team if transfer to hospital was required for a resident.

Research Design

The CEDRiC project was evaluated using the Donabedian (2003) Structure, Process and Outcomes framework. Structure and process evaluation was undertaken via qualitative interviews and descriptive analysis of staff activity. Outcome evaluation incorporated quasi-experimental methods comparing the intervention period with historical controls.

The primary outcome measure for HIPS was transfer of residents to the ED, with secondary outcomes including: disposition if transferred, length of stay in the ED or hospital if admitted, re-presentation within 28 days, mortality, number of consultations, type of consultation, and being seen by the GP or HIPS nurse prior to transfer. The primary outcome measure for GEDI was disposition with secondary outcomes including: ED length of stay, hospital length of stay and re-presentation within 28 days. An health economic analysis was completed to determine cost implications of the CEDRiC model.

Data collection and intervention time periods were:

- Pre-Intervention – HIPS Apr 2013 – Mar 2014; GEDI Jan 2012 - Dec 2012
- Developing (Interim) Intervention – GEDI Jan 2013 - Aug 2015
- Full Intervention – HIPS Jul 2015 – Jun 2016; GEDI Sept 2015 – Aug 2016

Data related to hospital presentation was relatively easy to access as the hospital and health service have extensive coding practices and searchable databases. Databases employed in the RACF were not designed to be searched in the same way and data analysis from the two settings reflects these differences.

Results

HIPS: RACF residents referred to HIPS were on average 86 years of age and 67% female. During the 12-month intervention period, HIPS completed 1,790 consultations and of these 44% were identified by the NPC rather than referred by staff, or self-referred. The majority of HIPS consultations were for review and ongoing management of previously identified conditions. Most transfers to the ED (61.8%) occurred when the NPC was not on duty and only 21.5% of residents transferred had been seen by the NPC in the 48 hours prior to transfer.

Similar proportions of residents were admitted, transferred, or discharged from the ED when comparing pre-HIPS and HIPS intervention groups. However, compared with pre-HIPS, HIPS residents transferred to hospital had a significantly shorter length of stay in the ED (316mins Pre-HIPS, 280mins HIPS, $P<0.05$) with more meeting the National Emergency Access Target (NEAT) of less than 4 hours in the ED (38.5% Pre-HIPS, 48.5% HIPS, $\chi^2(df) = 6.3$ (1); $P<=0.01$). The number of residents with advance care planning in place increased greatly from 25.3% pre-HIPS to 74.7% during the HIPS intervention period ($P<0.001$). Residents who were reviewed directly by HIPS had a much lower risk of ED transfer compared to residents who were consulted by HIPS indirectly via RACF staff (i.e. NPC did not directly see the resident). This resulted in an average saving to the ED of $68 [95% CI: $25, $110] per resident transferred. During the HIPS intervention period, residents transferred to the ED from the RACF where the intervention was in place cost less than residents from other local RACFs: the average cost differences per ED presentation was $62 [95% CI: $12, $111]. HIPS reduced unplanned GP visits by an average of 10 visits per week resulting in a reduction in Medicare billing in the range of $41,000 - $56,000 per year.

Structure and process evaluation determined that RACF staff and visiting GPs found the HIPS NPC provided thorough assessment and was highly regarded. RACF staff also reported that the NPC worked in conjunction with care staff to assist in problem solving to enhance care and provide education to staff as necessary.

GEDI: Older people presenting to the ED were statistically similar across all GEDI data collection periods, being on average 81 years old and 51% female. Older persons who presented to the ED during the full GEDI period experienced a statistically significant reduction in ED length of stay and increased likelihood of discharge compared to pre-GEDI. No statistically significant difference in risk of mortality or risk of same cause re-presentation within 28 days was found. The average cost savings during the GEDI Intervention period were: $35 [95% CI: $21, $49] per ED presentation and savings of $1,469 [95% CI: $1,105, $1,834] per hospital admission. Aggregated structure and process evaluation data from interviews with seven GEDI patients, families and carers and 23 staff determined that the service has become an integral part of ED patient care. It facilitates efficient time management with improved patient and staff satisfaction.

Conclusions

These results demonstrate that the CEDRiC interventions greatly improved outcomes for residents of the study RACFs and for older persons presenting to the ED across the Sunshine Coast, while saving costs for the Hospital and Health Service and assisting GPs to provide enhanced primary care.

Table of Contents

Project teams ..... **i**
Research Outputs ..... **ii**
Executive Summary ..... **iii**
Background iii
Research Design iii
Results iv
Conclusions iv
CEDRiC Evaluation Project **7**
Introduction 7
Project Aims 7
Research Study Methods **7**
Structure and Process Evaluation 8
Outcome Evaluation Design 8
HIPS Outcome Evaluation 8
GEDI Outcome Evaluation 8
Settings 9
Interventions 9
Health Intervention Program for Seniors (HIPS) 9
Geriatric Emergency Department Intervention (GEDI) 9
CEDRiC Care Coordination 10
Data Analysis 10
HIPS Data Analysis 10
GEDI Data Analysis 10
Health Economic Analysis 11
Structure and Process Qualitative Data Analysis 11
Ethics 11
HIPS Results - Structure and Process Evaluation **12**
Description of the Study Participants and the Services Provided by HIPS 12
Referrals to HIPS 12
Consultations with HIPS 12
Location of Resident: Main site or Offsite 14
Process Prior To Transfer, Presenting Conditions and Previous Care 14
Qualitative Interview Findings 15
Structure 15

Process 15
Summary of Key Features of the NPC Role 17
Role of HIPS in Advance Care Planning 19
HIPS RESULTS – Outcome Evaluation 20
HIPS Outcomes – Comparison Between Those Transferred to ED in the Pre-HIPS And HIPS Intervention Groups 20
HIPS Health Economics 21
GEDI RESULTS – Structure and Process Evaluation 24
GEDI RESULTS – Outcomes Evaluation 27
Primary Outcome - Survival Models for Discharge 27
Secondary Outcomes 29
GEDI Health Economics 31
Summary 32
Limitations 33
Conclusion 33
References 34
Appendices 37

CEDRiC Evaluation Project

Introduction

As people age, there is an increased risk of developing chronic illness, cognitive deficit and frailty [8]. In Australia, emergency department (ED) presentations of persons aged 65 years and over from community and residential aged care are reported at 20% of total presentations [9]. Despite this high presentation rate, staff in EDs do not have specific geriatric assessment skills [10] and the incorrect medical diagnosis of older people is reported to be around 12% [10]. This is found to correlate with an increased hospital length of stay [11]. Innovations that may improve care for older people in their place of residence can assist in decreasing the iatrogenic complications of inappropriate hospital transfer when transfer can be avoided [10,12-14]. Further, if older adults do present to an ED, a number of studies have suggested that specialist care can fast-track service delivery and improve outcomes [15,16].

The **C**are Coordination through **E**mergency **D**epartment, **R**esidential Aged Care and Pr**i**mary Health **C**ollaboration (CEDRiC) project began in 2013 in response to high hospital admission rates of acutely unwell older adults presenting to a regional ED in South-East Queensland. The project built on the designs of previous interventions that reported improved outcomes and aimed to overcome cited implementation difficulties [16-23]. Utilising a system-wide approach to care for older people, the CEDRiC project included the Geriatric Emergency Department Intervention (GEDI) based in the ED at the local regional hospital and the Health Intervention Program for Seniors (HIPS) based in three RACFs operated by one provider across different locations within the same region. These services communicated with General Practices (GPs) and existing services offered under the umbrella of community health: community gerontology, rapid response community discharge liaison, and the Aged Care Assessment Team.

Project Aims

This study was designed to evaluate the efficacy of the CEDRiC interventions and identify areas for model development. The aims of the evaluative research study were to:

- Describe the characteristics of ED clients included in the GEDI program and describe the structures and processes involved in the delivery of these services;
- Describe the characteristics of RACF residents managed by the HIPS program and describe the structures and processes involved in the delivery of these services;
- Compare the outcomes in terms of rates of ED re-presentation within 28 days, ED length of stay (LoS), hospital LoS, and hospital admission rates and costs between patients aged 70 years and older who presented to the study ED following the implementation of the CEDRiC program and patients aged 70 years and older who presented to the study ED in the 12 months prior to the implementation of the program.

Research Study Methods

The overall aim of the study was to assess the efficacy and acceptability of the CEDRiC program. A Structure, Process, Outcomes framework [24] provided the overarching approach to the evaluation.

Structure and Process Evaluation

Qualitative description of the structures and processes employed in both the HIPS and GEDI services were obtained by interviews with staff involved in the interventions, staff who interacted with HIPS, or GEDI staff and clients. In addition, both the HIPS and GEDI teams kept records of their activities and these were analysed descriptively. For the HIPS process, evaluation of the processes described included: number of consultations with HIPS, type of consultation and being seen by the GP or HIPS nurse prior to transfer. For the GEDI, the processes included: consultations, diagnostic test facilitation and referral activities.

Outcome Evaluation Design

Outcome evaluation of both services had to be undertaken slightly differently due to the different data available in the two institutions. A quasi-experimental design was adopted with outcomes in the intervention period compared to historical controls. While the randomised control trial is the gold standard for testing the efficacy of interventions, this was not deemed possible given the complexity of the intervention and issues related to gaining consent from frail, unwell, and frequently cognitively impaired, older adults. A longitudinal analysis using the quasi-experimental design enabled examination of outcomes as the intervention was developed and implemented [25].

HIPS Outcome Evaluation

Data for the outcome evaluation of the HIPS program were obtained in two ways. For all residents transferred to hospital in both pre-HIPS and HIPS implementation periods, EDIS and linked HBCIS and financial data were obtained. The methods were the same as for the GEDI outcomes evaluation. Additionally, data were collected for all occasions of service by the HIPS team and included outcome data. The primary outcome measure for HIPS was transfer to the ED with secondary outcomes including: disposition if transferred, length of stay in the ED or hospital if admitted, re-presentation within 28 days, and mortality.

GEDI Outcome Evaluation

For the GEDI outcome evaluation, de-identified data for all adults aged 70 years and older who presented to the study ED from January 2012 through to 30 August 2016 were obtained. Over this period, three distinct phases of intervention implementation were identified: pre-GEDI implementation, interim GEDI implementation and full GEDI implementation. The dates for these periods are presented in Table 1 below.

Quantitative data were retrieved from the Emergency Department Information Service (EDIS; Healthcare Group, CSC®), Hospital Based Corporate Information System (HBCIS; iSoft), and financial databases. Data extraction was undertaken by SCHHS data managers with deterministic linking of the EDIS, HBCIS and financial data completed. These data were manually cleaned to identify RACF residents based on their home addresses. This was important as RACFs often have independent living community residents at their facilities who needed to be excluded from the cohort for evaluation [26]. The patient's diagnosis in EDIS was identified by an ICD-10 code for which there are thousands of selections. This code was mapped to 25 major diagnostic code (MDC) groups so similar reasons for presentation could be identified for comparison.

The primary outcome measure for the GEDI is disposition with secondary outcomes being rates of ED representation within 72 h and 28 days, mortality, and ED and hospital length of stay.

Table 1: Data collection and intervention time periods

	HIPS	**GEDI**
Pre-Intervention	Apr 2013 – Mar 2014	Jan 2012 - Dec 2012
Developing (Interim) Intervention	N/A	Jan 2013 - Aug 2015
Full Intervention	Jul 2015 – Jun 2016	Sept 2015 – Aug 2016

Settings

HIPS: The setting for HIPS was one residential, aged care provider offering care in multiple locations. The main site is located in Nambour ('main-site') and has approximately 184 beds; and the two other sites are geographically close, one in Palmwoods (72 beds) and one in Burnside (50 beds), hereon grouped together and referred to as 'off-site'.

GEDI: The GEDI service operated out of a large regional public hospital ED that had over 53,000 patient presentations in 2015/2016 [27]. The hospital contains 373 beds. The proportion of people aged 65 years and over in the region is the highest in South East Queensland [28] increasing at a disproportionately higher rate than the overall increase Australia wide [29]. This therefore is an area ideal for research into care of older persons as it is representative of predicted future Australian population demographics.

Interventions

Health Intervention Program for Seniors (HIPS)

The HIPS aspect of the CEDRiC intervention consisted of a full-time Nurse Practitioner Candidate (NPC) and a 0.4 full-time equivalent clinical nurse (CN) (a senior RN with extensive aged care experience and additional education). The HIPS NPC role consisted of both clinical and administrative responsibilities. The clinical role of the NPC was to provide primary care for acutely unwell residents. The NPC worked Monday to Friday from 0700 until 1600 reviewing residents across several sites. The NPC was supported by a CN two days each week, which enabled the NPC to visit sites other than the main site, or when undertaking external clinical placement at the local public hospital for multi-disciplinary team meetings and geriatrician ward rounds at the Cognitive Assessment and Management Unit.

Geriatric Emergency Department Intervention (GEDI)

GEDI is a nurse-led, physician-championed service that aims to streamline care delivery and reduce the ED length of stay for frail older persons living in the community or RACF by maximising the provision of care during the patient's ED journey. The GEDI team was made up of an ED physician who provided medical leadership, a Clinical Nurse Consultant (CNC) to develop, refine and manage the nursing intervention, and CNs to deliver the intervention [25]. The GEDI nurses provide early, rapid and targeted geriatric assessment of frail older persons within the ED settings and, through careful inter-facility and interdisciplinary management and planning, aim to prevent inappropriate admissions to hospital. GEDI nurses provide

advanced knowledge and expertise to the care of older patients in the ED focused on shared decision making, influencing disposition planning and improving outcomes for this cohort. During the research project, there were 2.4 full-time equivalent GEDI CNs and a Clinical Nurse Consultant (CNC) employed by the ED. Two CNs were present in the ED from 0700 to 1730 Monday to Friday on overlapping shifts and one GEDI CN on weekends from 0700 to 1530.

CEDRiC Care Coordination

Coordination of these interventions (HIPS and GEDI) aimed to combat siloed service delivery provided by acute hospital services and aged care services. Although the interventions were independent of each other, care coordination and communication between services were purposely included. The NPC communicated with the GEDI team to discuss both potential action and to plan transfer. Additionally, the GEDI team facilitated professional education and clinical experience in the ED for the NPC to enhance acquisition of skills and knowledge related to advanced practice in the care of acutely unwell older adults. This was additionally enhanced due to the ED GEDI team physician consultant who provided formal mentoring to the NPC.

Data Analysis

HIPS Data Analysis

Descriptive statistics were used to describe the intervention and control groups including frequencies, percentages, appropriate measures of central tendency, and distribution. Comparison of variables in pre-HIPS and HIPS intervention periods, and between locations (main site and offsite) were made with appropriate tests of difference and association. A p-value less than 0.05 was considered statistically significant.

GEDI Data Analysis

Descriptive statistics were used to describe the intervention and control groups including frequencies, percentages, appropriate measures of central tendency, and distribution. Survival analysis was used to jointly model ED and hospital admission length of stay and disposition from ED, with the three destinations of home, admission and death as competing risks [30]. For ED re-presentations, survival analysis was used with out-of-hospital mortality as a competing risk. All models adjust for the patient level factors of gender, age, triage score, season, day of the week and time of presentation. A linear trend (based on date) was used in all models to account for gradual changes that are not captured in the individual variables, e.g. experience of healthcare workforce to control for confounding by other changes over time that may be attributed to the intervention [31]. We adjusted for season using a sinusoid with an annual cycle to control for the winter peak in morbidity [32]. The survival analyses used Cox models and the proportional hazards assumptions were checked. The models' residuals were checked for outliers and correlation over time. Relatively large outliers were examined using Cook's influential statistic. The variance inflation factor was used and variables with a score above five were removed on the basis that they are co-linear. The mean effect of the intervention together with 95% confidence intervals is reported for all outcomes.

Health Economic Analysis

HIPS

There were two main methodologies used in this analysis. For individual patient-level data from RACF, HIPS, and EDIS databases, we used multiple variable models to control for important predictors such as acuity of the patient (age, mode of arrival, and triage category). In most cases, the ordinary least squared method was not applicable due to the highly skewed data (of cost and length of stay), or the dichotomous nature of the dependent variable (e.g. whether a resident was reviewed directly by HIPS). Appropriate methods used included propensity score matching using probit or logit models for dichotomous dependent variable, generalised linear mixed method (with log link and gamma distribution), recursive model with log-log functions for cost and length of stay, and a two-part method using both probit and generalised linear modelling. For the intervention data from HIPS, we used a mixed costing framework, in which the data were sourced using both bottom-up and top-down measures. Interviews with GPs who provided regular visits to Sundale were conducted to understand the impact of HIPS on the reduction of unplanned GP visits.

GEDI

A generalised linear model with a log link and gamma distribution, to account for the skewedness of the ED cost data, was used to determine any difference in length of stay and costs of ED presentation over each period. A two-part model was used to first estimate the probability of being admitted after an ED presentation and then once admitted, to estimate the determinants of cost variations between the three periods (pre, interim and full GEDI). In both methods, we controlled for relevant characteristics including demographics (gender, age), acuity of presentation (mode of arrival, triage category), and condition (i.e. diagnosis).

Structure and Process Qualitative Data Analysis

A priori categorisation was used to ensure the analysts coded the interviews relevant to the research questions during the analysis [33]. For each qualitative data section relating to the relevant *a priori* category, the transcripts of interviews were read and re-read with an initial label then assigned to sections of text. The use of *a priori* labels provides a separate accounting scheme for the analysis of qualitative data by limiting the analysis to focus on the structures and processes experienced by participants relevant to the intervention [34]. Development of categories by assigning textual data to emerging categories, enabled comparison and discussion with the research team [34]. NVivo 10 was used to manage the transcribed interview data.

Ethics

This study was approved by the Human Research Ethics Committees of The Prince Charles' Hospital and University of Sunshine Coast. Public Health Act and site-specific approvals for SCHHS were obtained. Reference: HREC/14/QPCH/220, HREC/15/QPCH/290, A/15/718, SSA/15/QNB/40 and SSA/16/QNB/17. Contractual agreements were in place between all partner organisations.

HIPS Results - Structure and Process Evaluation

Description of the Study Participants and the Services Provided by HIPS

Ideally the pre-HIPS and HIPS groups would have similar characteristics so that any changes in outcomes and costs could be ascribed to the interventions. The mean age and proportion of males in the RACF who were transferred to the ED were similar for each study group. For residents from all three RACF locations, who were transferred to the ED, there were no statistically significant differences between the pre-HIPS group and the HIPS intervention group for the following variables:

- month or day of the week of presentation
- mode of arrival to the ED
- triage priority (Assessment: 1-=immediate, 2=within 10 minutes, 3= within 30 minutes, 4=within 60 minutes, 5=within 120 minutes)
- ED diagnosis (based on Major Diagnostic Code (MDC))

Comparison between pre-HIPS and HIPS group residents transferred to the ED revealed that the most common reasons for presentation (MDC) were similar; the main four being Trauma (Pre-HIPS 30%; HIPS 27.4%), Cardiac (Pre-HIPS 14.8%; HIPS 17.1%), Respiratory (Pre-HIPS 11.7%; HIPS 10.6%), and Infection (Pre-HIPS 7.8%; HIPS 9.4%). The differences in proportions of residents with the different categories of MDC, between the two groups, did not reach statistical significance (χ^2(df) =14.95 (20); p=0.779).

During the intervention period HIPS consulted with 266 residents in the three RACF locations 1,790 times. The median number of consults per patient was four (IQR=7) (See Figure 1). Due to the difficulties in accessing RACF data for all residents, it is unclear how many residents were housed in the various RACFs during the study periods and for how many days. Thus, it was not possible to calculate rates of consultation nor compare hospital bed days between residents transferred in the different study periods.

NB: All HIPS statistics from hereon are calculated on per transfer to the ED or per consult with HIPS, not per resident.

Referrals to HIPS

HIPS identified the need for 795 (44.4%) of consultations. Other referrals to HIPS were made by RACF RNs (n=394, 22.0%) and ENs for (n=297, 16.6%). The majority of reason for referral to HIPS clustered around assessment or management of acute illness (n=794, 44.9%) and assessment or ongoing management of chronic conditions (n=828, 46.4%).

Consultations with HIPS

HIPS consultations were classified as new (for a new problem) (n=531, 29.6%), review (returning for an ongoing problem) (n=841, 47.0%) or indirect (HIPS spoke to the care staff about a resident but did not see the resident directly) (n=420, 23.4%). The most common reason for a consultation was monitoring of a previously diagnosed condition (n=1000, 56.0%).

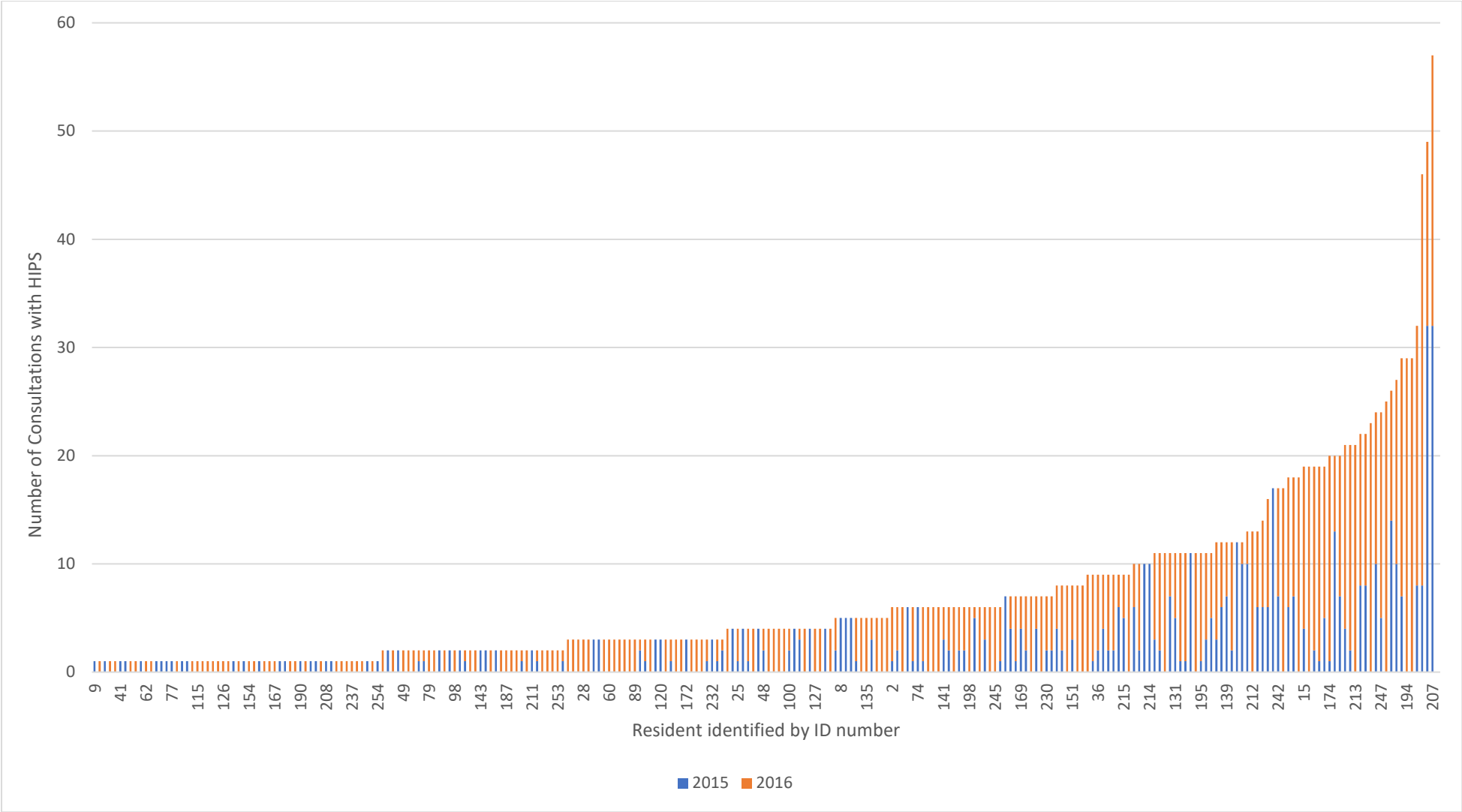

Figure 1: Number of consultations with HIPS for each individual resident ordered by the number of consultations

Location of Resident: Main site or Offsite

Of the 1,790 consultations by HIPS, the majority (n=1,478; 83%) occurred at the main site with 310 (17%) occurring offsite. Between the main site and offsite locations for HIPS service provision, there were statistically significant differences in the proportions of residents assigned specific diagnostic codes by the HIPS team (χ^2(df) =30.12 (5); p<0.001), (see Table 2).

Table 2: Comparison of HIPS diagnostic code by site location

HIPS diagnostic code	**Main site freq (%)**	**Offsite freq (%)**
Acute physical problem	359 (24.4%)	48 (15.4%)
Acute exacerbation chronic condition	209 (14.2%)	31 (9.9%)
Acute psychological problem	27 (1.8%)	0 (0.0%)
Acute cognitive problem of unknown origin	6 (0.4%)	3 (1.0%)
Problem could not be diagnosed	77 (5.2%)	24 (7.7%)
Monitoring	794 (53.9%)	206 (66.2%)
Totals	1472	312

NB: Totals vary due to missing data
Inferential Statistic for overall difference in codes: χ^2(df) =30.12 (5); p<0.001

Process Prior To Transfer, Presenting Conditions and Previous Care

During the HIPS Intervention period, most transfers (62.2%) occurred when the NPC was not on duty. Additionally, only 25% of all residents transferred to the ED had been seen by the NPC in the 48 hours prior to transfer. Similar results are observed for residents seen by a GP with only 27.5% (pre-HIPS) and 38.5% (HIPS intervention period) being seen in the 48 hours prior to transfer.

Where a resident was seen by both the GP and NPC (n=164), the primary care interventions suggested by the NPC were the same as those suggested by the GP in 143 (87.2%) cases. In most cases where prescriptions or investigations such as pathology were required (n=214), the prescription or investigation suggested to the GP by the NPC matched the GP request (n=151, 70.6%). In 974 (55.2%) cases, the NPC prompted the clinical care team to provide particular care for a resident based on assessment of their condition. In 132 cases, the NPC requested the GP to provide a prescription or test. In 60 of these cases, the GP was able to prescribe immediately. In the remaining cases, had the NPC been endorsed, the median reduction in time to ordering of test/prescription would have been 10.5 hours per resident (IQR = 25.38).

The number of residents with any advance care planning in place increased significantly from 25.3% pre-HIPS to 74.7% during the HIPS intervention period (P<0.001).

Qualitative Interview Findings

A total of 34 people participated in semi-structured interviews or focus groups, nine residents, 13 Sundale staff (6 nurses and 7 carers) and 12 visiting GPs. All residents interviewed lived at the main site with six being female and three male. Clinical staff were mostly female and had been employed at Sundale between 1.5 to 12 years. GPs had been visiting residents at Sundale for between 1 and over 40 years (mean 16.55 years, SD 13.28). The findings of the Structure and Process evaluation are summarised below.

Structure

The structural evaluation revealed components related to the provision of the intervention including equipment required, nursing resources, and physical and social structures to operate the service. Examples of these for the HIPS service are outlined in Table 3.

Table 3: HIPS structures

HIPS Structures	Examples of HIPS structures in place during evaluation period	Structures identified to improve HIPS
Resources - Equipment	Personal vehicle, laptop/workspace	RACF vehicle; bladder scanner, ECG machine, practice management software required
Resources - Human	NPC role	More registered nurses (RNs)
Barriers	NPC role uncertainty	NPC role to be more defined in policy and procedure
	Lack of non-clinical time to establish functional working relationships	A well-developed business case prior to NPC starting to clearly outline scope and responsibility
Physical structures	NPC role implemented across multiple sites Mobile workspace created to facilitate documentation and timely care	
Social structure	Relationships with General Practitioners and RACF staff	
Setting	Multi-site facility supporting approximately 300 elders	
Staffing	NPC role requiring support, senior RN appointed to backfill NPC during leave	

Process

The interviews also revealed information around the processes required for the HIPS intervention to operate. The processes identified included event chronology, referral practices, role development, communication, and quality improvement. Examples of these for the HIPS intervention are summarised in Table 4.

Table 4: HIPS processes

HIPS Process category	HIPS processes	Potential solutions identified
Events		
Event chronology	Inability to issue prescriptions predisposed hospital transfer NPC provided in-depth assessment data and facilitated residents being treated in place rather than being transferred	Alternate plans to access medications were developed
Irregular events	During acute deterioration of the resident the NPC spent more time, was more thorough and intervened earlier than RNs and GPs	Transitioning role from NPC to NP will improve response time
Regular events	Referral by clinical and care staff to NPC and NPC to GPs NPC provided increased surveillance of residents who were generally unwell NPC able to intervene earlier to identify and respond to acute deterioration	Transitioning role from NPC to NP will improve response time
Referral		
Referral practice post-HIPS	Structured rounds by the NPC identified unwell residents The NPC is now the conduit through which most referrals to GPs are made during working hours	Increase direct referral to hospital specialist once transitioned to NP
Role		
Changing work practices	Established relationships with care staff and GPs Care staff supported by NPC to deliver high level of care No additional workload generated by HIPS GPs reported less contact from the RACF and less pressure to respond in an acute situation due to the presence of the NPC	
Communication		
Inter-facility communication	RNs may transfer a resident without notifying GP or NPC Practice nurses act as gate keepers to GP	ED staff or GEDI informed of transfer of a resident by NPC NPC negotiates access to GP
Inter-personal communication	NPC has high-level communication skills	
Resident involvement or satisfaction with NPC	NPC identified as knowledgeable, calming and reassuring	
Quality Improvement		
Program improvement - residents	Formal and informal surveying of residents	No areas for improvements to the role of the NPC were elicited from residents and families

HIPS Process category	HIPS processes	Potential solutions identified
Program improvement - provider	Staff meetings included review of HIPS program	Extend hours of service Extend role to service independent living and community residents, chronic disease management, wound care clinics and routine vaccination administration
Program improvement - role	Review of NPC role undertaken with stakeholders	Enhanced notification of pending transfers of residents to the ED Enhanced education of staff by NPC Ensure establishment, updating and completion of Advance Care Plans

Summary of Key Features of the NPC Role

Several key features of the HIPS role emerged from the data. These included:

- The ability to provide a comprehensive assessment due to having advanced knowledge and a mandate to practice autonomously;
- The ability to elicit a response from the GPs where others may not have been able to do so because of advanced knowledge, practice, and a closer collaborative relationship with GPs;
- The NPC had the respect of her peers, GPs, residents, and care staff;
- By virtue of the role being independent of the usual routine provision of care, the NPC saved the time of GPs, RNs, and other care staff as they were able to continue normal duties while the NPC conducted a thorough assessment and arranged immediate and ongoing care;
- The NPC was identified as a provider of education and support that motivated other staff to perform at a higher level; and
- The NPC followed up on important items such as ACPs and medication review that provide a more holistic approach to care.

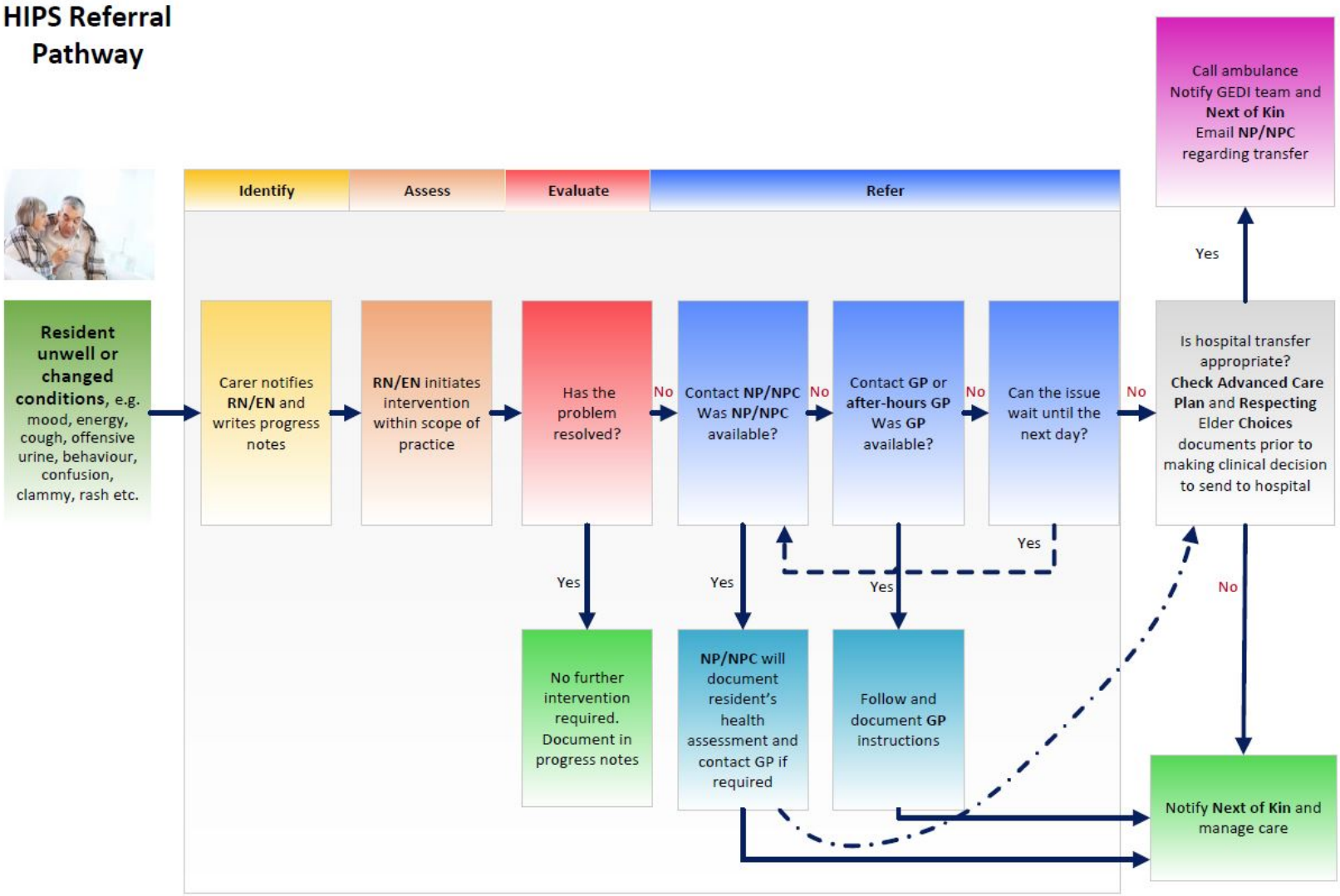

Figure 2: Element one of the HIPS model: Management of the acutely unwell RACF resident.

Role of HIPS in Advance Care Planning

The preparation of an Advance Care Plan (ACP) is raised by clinical staff when a resident comes to Sundale with a goal to have it in place within eight weeks of residence. HIPS nurses do not play a primary role in the process of completing the ACP with the resident and their family. However, HIPS play a role in troubleshooting where there are areas of confusion or potential conflicts of interest in the writing of an ACP for a resident. An example is when the plan was written 10 years ago when the resident was independent, but now has cognitive impairment and there is conflict about whether the listed enduring power of attorney's (EPOA) wishes would override the resident's. The HIPS team regularly search for the current planning in place identifying where plans need completion or updates. They may also be involved if there is difficulty getting a plan in place or presence of a recurrent illness that requires alteration of treatment for a condition, and helping residents and families understand the implications of the document.

Notable change was made to the falls pathway in Sundale over the HIPS intervention period. The changes indicated that any resident who experienced an unwitnessed fall, and particularly if the resident is taking anti-coagulant medication, must be reviewed by a medical practitioner. If this could not occur, then the resident was transferred to the ED for review. Approximately halfway through the HIPS intervention period, the NPC was added to the pathway as also being able to review a resident who experienced an unwitnessed fall. Other pathways that were updated either by the NPC or in consultation with the NPC during the intervention period included those for: shortness of breath, asthma, chronic obstructive pulmonary disease, palliative pain management, indwelling catheter troubleshooting, naso-gastric tube insertion and care, gastrostomy tube care and chest pain. It is not clear what effect the introduction of these pathways would have had on the primary outcome if the HIPS program had not been in place.

HIPS RESULTS – Outcome Evaluation

HIPS Outcomes – Comparison Between Those Transferred to ED in the Pre-HIPS and HIPS Intervention Groups

Comparison of outcomes for residents transferred to the ED during the pre-HIPS and HIPS Intervention periods, showed no statistically significant between-group differences for disposition outcomes (admissions, discharges, transfers), proportions of residents admitted to hospital, nor for ED re-presentations. The lengths of stay in the ED and the hospital if the resident was admitted, however, were significantly less for the HIPS intervention group compared to pre-HIPS. In addition, more of the HIPS group met the National Emergency Access Target (NEAT) (<4 hours in the ED) than pre-HIPS group (see Table 5).

Table 5: Comparison of pre-HIPS and HIPS intervention group transfer outcomes

Variable	Pre-HIPS Group 1	HIPS Group 2	Inferential statistic	p value
ED length of stay (Mins) Median (IQR)	342.5 (227)	283 (166)	MWU=40578.0	p=0.004
Met NEAT (ED <4 hours) freq (%)	109 (38.5%)	165 (48.5%)	$\chi 2(df) = 6.3\ (1)$	p=0.01
Admitted to hospital freq (%)	125 (44.2%)	142 (41.8%)	$\chi^2(df) = 1.1\ (2)$	p=0.57
Hospital length of stay (Days) Median (IQR)	2.4 (5.0)	1.7 (3.5)	MWU=8700.5	p=0.037
All cause re-presentation to 72 hours - freq (%)	6 (2.1%)	12 (3.5%)	$\chi^2(df) = 1.08\ (1)$;	p=0.30
All cause re-presentation to 28 days - freq (%)	41 (14.5%)	65 (19.1%)	$\chi^2(df) = 2.35\ (1)$;	p=0.13
Same cause re-presentation to 72 hours - freq (%)	3 (1.1%)	7 (2.1%)	$\chi^2(df) = 0.98\ (1)$;	p=0.32
Same cause re-presentation to 28 days - freq (%)	15 (5.3%)	18 (5.3%)	$\chi^2(df) = 0.00\ (1)$;	p=1.0

NB: MWU = Mann-Whitney U test

The increasing number of transfers from 283 in the pre-HIPS period to 335 in the HIPS intervention period, was similar to the trend in the majority of the largest RACFs in the region who had transfers to the ED (see Table 6).

Table 6: Number of Pre-HIPS and HIPS intervention period transfers to the ED from large RACFs in the region

RACF	Pre-Hips freq	Intervention Hips freq	% increase
Sundale	283	335	18%
RACF 1	162	203	25%
RACF 2	59	76	29%
RACF 3	26	51	96%
RACF 4	32	27	-16%
All other RACFs	676	750	11%
Totals	1,235	1,439	17%

HIPS Health Economics

The aim of the health economic analysis was to:

- quantify the effect of the introduction of HIPS on per resident risk of ED transfer or inpatient admission;
- quantify if the effect of the introduction of HIPS on per resident cost associated with ED and hospitalisation; and
- estimate the total investment and annual operating costs of HIPS.

Residents who were reviewed by HIPS directly, compared to those diagnosed and reviewed by HIPS over the phone with RACF staff, had a much lower risk of being transferred. This suggests that "direct consultation by HIPS" performed a strong "preventative" function: residents were directly diagnosed by HIPS in a timely manner (when there was a medical requirement) to decrease future health deteriorations. Costs did not differ between residents who were directly reviewed by HIPS and then transferred and residents who were consulted indirectly by HIPS. Again, the results using two ED length of stay definitions were very similar in both impact direction and magnitude. A comparable ED cost was shown after adjusting for residents' characteristics (age, gender) and severity (admission urgency and length of stay in ED).

Using the two-part model, it was found that those who were reviewed directly by a HIPS nurse had a much lower risk of ED transfer (see Table 8). This, in turn, resulted in an (average) ED cost saving of $68 [p=0.002, 95% CI: $25, $110] per RACF resident; controlling for a range of other variables that could have affected ED length of stay. It can be seen from Table 7 that other factors affecting costs associated with ED length of stay included increased costs associated with having a physical illness or an undiagnosed illness, having a lower acuity illness and being seen by GEDI in ED.

Table 7: Impact of HIPS on ED cost

Variable	Cost ($)	Std. Error	p value	95% CI	
Direct review by NPC	-67.9	21.6	0.002	–110.3	–25.5
Age	0.8	1.2	0.51	–1.6	3.2
Sex	20.9	19.1	0.27	–16.5	58.2
Diagnosis					
Acute Physical problem or acute exacerbation of chronic condition	98.3	13.8	<0.001	71.2	125.4
Acute Psychological problem	8.5	23.5	0.71	–37.5	54.6
Acute Cognitive problem	89.2	95.7	0.35	–98.4	276.7
Problem could not be diagnosed	44.1	20.7	0.033	3.6	84.6
Seen by GEDI in ED	15.0	7.5	0.044	0.3	29.7
Triage category					
3 (within 30 mins)	-33.3	11.2	0.003	–55.3	–11.4
4 (within 60 mins)	-71.4	12.8	<0.001	–96.5	–46.4
5 (within 120 mins)	-110.7	15.0	<0.001	–140.0	–81.4
LoS in ED	2.6	1.3	0.039	0.1	5.1

NB: Reference for Triage category is 1&2 (immediate to within 10 mins).

Conservatively, it was estimated that the presence of HIPS in Sundale reduced GP visits by an average of 10 visits per week, or 440 visits per year. Each GP visit was billed with a range of $93 to $127.56, resulting in reduced Medicare billing in the range of $40,000 - $56,000 per year. Other costs saved but difficult to quantify might include ambulance cost for ED transfer, opportunity cost of GP travelling to attend unplanned visits, and intangible costs associated with stress and administrative procedure for ED transfer borne by residents, family members and Sundale.

Cost of Sundale Resident in ED Compared to Other RACF Resident

Sundale residents and other RACF residents transferred to the ED have similar characteristics (demographic and clinical). Using the Propensity Score Matching method, we found that during the HIPS intervention period 2015–16, residents transferred to the ED from Sundale cost the ED less than residents from other RACFs. The average cost difference per ED presentation was $62 [95 CI: $12, $111]. There was no statistically significant difference in cost per hospital admission of residents from Sundale when compared to hospital admissions from other RACFs (p=0.13).

Operating Costs for HIPS

The costing of the HIPS service was based on a mixed costing framework, in which the data were sourced using both bottom-up and top-down measures. The initial investment for HIPS included two main components, (1) equipment and working capital, and (2) orientation training, which took up one full day (8 hours). The total equipment and working capital was calculated to be $13,033 and the training costs $1,127. The HIPS model employed three staff during the full intervention period, a NPC, an Administrative Officer and a CN. Each of these positions had different salary levels. The operating costs consisted of salary (including on-costs) for the three staff running the HIPS intervention, and recurrent expenditure to run their working space (within Sundale) and consumption of office supplies and utilities. The average recurrent expenditure was calculated as a monthly cost, and then converted to an annual cost. Staff salary accounted for the largest share (93%) of the operating cost (totalling $244,800 per annum) while recurrent expenditure was estimated to be $18,036.

GEDI RESULTS – Structure and Process Evaluation

A total of 23 semi-structured interviews were conducted. The health professional participants included two GEDI nurses, one GEDI clinical nurse consultant, 10 ED nurses, one ED nurse unit manager, one ED director, four junior doctors and four ED consultants. Structural components identified in the evaluation of the GEDI service included those concerning the staff and the organisation (Table 8).

Table 8: Structural components of GEDI

Structural item	**Structures in place**
GEDI staff experience and education	Experienced, aged care background
Organisation structures	Organisational structure of the department GEDI as additional consultative service
Physical Structures	
Operational	
Policies and protocols	National Clinical standards
Documentation	Hospital medical record, screening tools, ED discharge letter
Educational material	Resource folder, non-government organisation information leaflets, GEDI leaflets
Resource	
Service availability	Business hours of operation 8 hour shifts, 7 days a week, two full time advanced practice nurses and one fulltime Clinical Nurse Consultant (CNC)
Equipment	Clinical supplies, telephone, computer access, photocopier, facsimile, pocket talker, four wheeled walker, hopper frame, walking stick, and GEDI referral books
Funding	ED department funding
Social structures	
Role of healthcare professionals	Intervention director – ED consultant, Intervention manager – GEDI CNC GPs, ED staff, ward staff, RACF staff
Role of resource personnel	Geriatricians, allied health, pathology services, medical imaging services
Referral pathways	Guidelines/protocols

Participants discussed whether it was easier to train a geriatric nurse to adapt to the fast-paced ED environment than to teach the complexities of geriatric and community care to an ED trained nurse.

> "*Initially the thought was to choose ED nursing staff with an interest in geriatrics, to up-skill and step into those roles. We found the transition for them, to change their thinking (…) and to learn about geriatrics, to be a longer process than we had first anticipated" Participant A*

It was clear to ED staff that the role of the GEDI was adjunctive to the primary nurse. This minimised confusion as to who was the main care provider in the ED ensuring usual ED practice was not affected after hours when GEDI was not available.

> *"…they've (GEDI nurses) integrated extraordinarily well into the department both with the medical staff and the nursing staff … I haven't seen any evidence of demarcation disputes or anything "that's my role, that's your role" Participant B*

Process components for the service have primarily been discussed in terms of the GEDI nursing role. These process components included independent, clinical care-related and interdependent roles (Table 9).

Table 9: Process components of GEDI

Process	**Example of process**
Independent role (Nursing Interventions)	Patient assessment, education
Clinical care-related role (medically directed care, expanded scope of nursing practice)	Referral, communication, hospital admission, geriatric expertise
Interdependent role (team communication) care (case management)	Service development and expansion, care coordination, case management, shared decision making and disposition planning

Communication skills were highly regarded by the GEDI nursing and ED staff. The GEDI nurses worked with a multidisciplinary and collaborative team approach. The GEDI team is critical in the referral and communication pathways required to coordinate the care for these complex patients between relevant key stakeholders, such as GPs, carers and intra or inter-facilities.

> *"Communicating is a big key, and trying to figure out the disposition of the patients. Also conversing with GP's, service providers and carers to get the full collateral of what's going on with the patients" Participant D*

GEDI nurses were a constant advocate for the patient as they journeyed through the ED. They liaise with the patient, family and /or carer explaining what is happening and asking what their goals of treatment are for this and subsequent visits. They liaised with medical staff ensuring patient advocacy regarding the extent of treatment and investigation.

> *"It's all about advocating for the patient and getting in there pretty much from the get go and having these discussions with the doctor that's looking after the patient as well. So there's no overkill with ordering tests and what not if it's not really appropriate" Participant A*

RACFs are also able to contact GEDI nurses directly to advise them of a patient transfer**.** GEDI nurses liaised with the RACF at the beginning of the patient ED journey to ascertain collateral history, determine who has an EPOA or if there has been any end of life care planning. They then facilitated the discharge back to the RACF where appropriate, ensuring the discharge plan is understood and facility staff are capable of looking after the patient on their return. This task was seen as onerous by some ED nurses and involved some degree of tact by the GEDI staff.

> *"To be honest I often hear stories of how nursing staff have a run in with an RACF trying to get someone back. I have never had that. …..Maybe it's that planting the seed at the beginning so then when I make a phone call an hour or two later, they're not surprised to hear that she is coming back" Participant C.*

GEDI RESULTS – Outcomes Evaluation

In this section, we used survival analysis to examine the predictors of admission (compared with discharge). Survival analysis examines the time to an event and therefore uses more information than the simpler categorical variable (e.g., admitted or discharged) as described in methods. For information on understanding hazard ratios and controlling for predictors, see Appendix 2.

Time dependent Variables

A time-dependent variable changes over time, whereas a time-fixed variable (e.g., gender) does not. The key variable of whether patients experienced care with the GEDI nurse is time-dependent because: i) it was introduced after a specific date, ii) after this date the nurses did not work at night, plus there were a few days where there were no GEDI nurses. We created a time-dependent categorical variable to estimate the impact of the GEDI nurse. The five categories were:

- Pre-intervention
- Interim intervention during GEDI working hours
- Interim intervention during non-GEDI working hours
- Full intervention during GEDI working hours
- Full intervention during non-GEDI working hours

Primary Outcome - Survival Models for Discharge

The total follow-up time is over 240,000 days. The peak month for discharge risk (more likely to be discharged) was December with lower risks for discharge in winter (less likely to be discharged). The peak time for discharge risk (more likely to be discharged) was from 9am to 2pm. The peak days for discharge risk (more likely to be discharged) were Thursday and Friday. Figure 3 presents the results demonstrating graphically that if a person of 70 years of age or over presented to the ED, they were more likely to be discharged and less likely to be admitted during both the interim and full GEDI periods. Table 10 and Figure 3 present the multiple variable model and cumulative incidence for discharge.

Table 10: Hazard ratios and 95% confidence intervals for discharge using a Cox survival model with 5 GEDI groups, Hazard ratios over 1 indicate an increased risk of discharge

Predictor	Hazard Ratio	Lower CI	Upper CI
Time (+100 days)	1.02	1.02	1.03
Age (+10 years)	0.95	0.94	0.97
Male gender	1.01	0.99	1.04
Arrival by ambulance	0.72	0.70	0.75
Australian Triage Score 1 and 2	0.94	0.90	0.97
Australian Triage Score 3	0.82	0.80	0.85
Presented from RACF	0.92	0.89	0.95
Diagnosis = Cardiac	0.95	0.92	0.97
Diagnosis = Trauma	1.22	1.18	1.25
GEDI = Interim outside GEDI hours	1.31	1.23	1.39
GEDI = Interim inside GEDI hours	1.20	1.11	1.29
GEDI = Full outside GEDI hours	1.47	1.41	1.53
GEDI = Full inside GEDI hours	1.19	1.13	1.24

NB: Reference for GEDI is pre-intervention. Reference for ATS is 4&5.

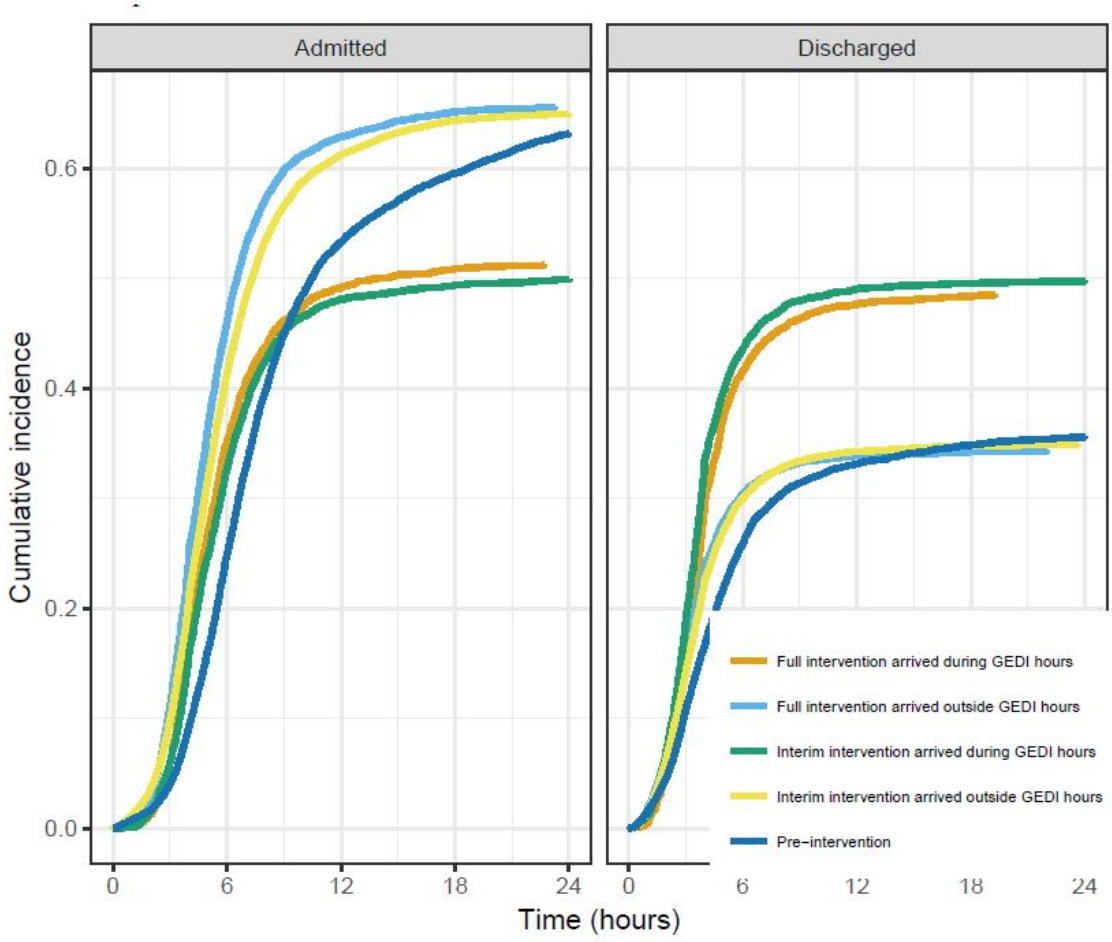

Figure 3: Cumulative incidence of admission or discharge for the five categories.

Secondary Outcomes

The results for secondary outcomes are outlined in Table 11. The GEDI intervention had no impact on outcomes between groups for risk of death during admission, same cause re-presentation within 28 days to the ED and length of stay in the ED.

A difference was seen for the any cause re-presentations to the ED during the interim GEDI period, arriving during GEDI working hours. Risk of re-admission to hospital up to 28 days for the same cause increased for those admitted during both the interim and full GEDI periods, outside GEDI hours. When compared to pre-GEDI, the risk of re-admission for any cause increased for males and for those admitted during the interim GEDI period during working hours. However, it should be noted that the numbers of re-admissions were very small. An increased risk for longer length of stay if admitted was also seen for those in the interim GEDI periods, arriving during GEDI working hours but was not seen for all other GEDI groups.

Table 11: Secondary outcomes for GEDI Intervention

OUTCOME	**Interim during GEDI hours** Ratio (95% CI)	**Interim outside GEDI hours** Ratio (95% CI)	**Full during GEDI hours** Ratio (95% CI)	**Full outside GEDI hours** Ratio (95% CI)	**Time (+100 days)** Ratio (95% CI)	**Age (+10 years)** Ratio (95% CI)	**Male sex** Ratio (95% CI)	**Arrived by QAS** Ratio (95% CI)	**From RACF** Ratio (95% CI)	**Triage priority = ATS 1-2** Ratio (95% CI)	**Triage Priority = ATS 3** Ratio (95% CI)	**MDC CVD** Ratio (95% CI)	**MDC trauma** Ratio (95% CI)
*ED LoS	1.40† (1.32, 1.48)	1.48† (1.42, 1.54)	1.28† (1.19, 1.38)	1.42† (1.33, 1.52)	1.02† (1.02, 1.03)	0.96† (0.94, 0.97)	1.02 (1.00, 1.04)	0.73† (0.71, 0.74)	0.93† (0.90, 0.95)	N/A	N/A	0.96† (0.94, 0.98)	1.23† (1.20, 1.26)
*In-Hospital LoS	1.15† (1.07, 1.23)	1.04 (0.99, 1.09)	1.00 (0.91, 1.11)	0.98 (0.90, 1.06)	1.02† (1.01, 1.03)	1.02 (1.00, 1.04)	0.97† (0.95, 0.99)	0.97 (0.94, 1.00)	1.07† (1.03, 1.11)	0.98 (0.94, 1.01)	0.98 (0.95, 1.01)	1.57† (1.52, 1.61)	0.88† (0.84, 0.91)
**Risk of Death	0.32 (0.08, 1.08)	0.52 (0.23, 1.14)	1.01 (0.23, 4.43)	0.77 (0.18, 3.22)	1.02 (0.93, 1.13)	1.47† (1.10, 1.96)	1.55† (1.05, 2.29)	5.47† (2.26, 18.00)	2.27† (1.43, 3.53)	N/A	N/A	1.59† (1.05, 2.38)	0.37† (0.16, 0.74)
*Same cause ED re-presentation within 28 days	1.13 (0.89, 1.42)	1.04 (0.89, 1.22)	1.21 (0.88, 1.66)	1.19 (0.89, 1.58)	0.98 (0.96, 1.00)	0.88† (0.83, 0.94)	1.25† (1.15, 1.35)	0.84† (0.76, 0.93)	1.02 (0.90, 1.16)	1.14† (1.02, 1.27)	0.95 (0.86, 1.05)	N/A	N/A
*Any cause ED re-presentation within 28 days	1.18† (1.02, 1.37)	1.06 (0.96, 1.18)	1.21 (0.99, 1.49)	1.10 (0.91, 1.32)	0.99 (0.98, 1.00)	0.96† (0.92, 0.99)	1.23† (1.17, 1.29)	0.85† (0.80, 0.91)	1.12† (1.04, 1.21)	0.79† (0.73, 0.85)	0.88† (0.83, 0.93)	N/A	N/A
*Same cause re-admission within 28 days	1.16 (0.80, 1.68)	1.32† (1.04, 1.67)	1.15 (0.69, 1.90)	1.10† (1.10, 2.52)	0.97 (0.95, 1.00)	0.82† (0.75, 0.90)	1.23† (1.03, 1.30)	1.08 (0.92, 1.27)	0.81 (0.65, 1.00)	N/A	N/A	N/A	N/A
*Any cause re-admission within 28 days	1.33† (1.05, 1.68)	1.18 (1.00, 1.38)	1.36 (0.99, 1.89)	1.45† (1.09, 1.92)	0.98 (0.96, 1.00)	0.92† (0.87, 0.98)	1.12† (1.04, 1.22)	0.95 (0.85, 1.05)	0.91 (0.80, 1.05)	N/A	N/A	N/A	N/A

NB: Reference for GEDI is pre-intervention. Reference for triage priority is `Less urgent/Non-urgent' (Whole cohort). *= hazard ratio; ** = prevalence ratio; † = statistically significant. Legend: QAS = Queensland ambulance service; MDC = major diagnostic code; CVD = cardiovascular disease; ATS = Australian Triage Score

GEDI Health Economics

The aim of the health economic analysis was to:

- quantify the effect of the introduction of GEDI on per patient cost associated with ED and hospitalisation
- quantify the effect of the introduction of GEDI on preventing the costs associated with avoidable inpatient admissions (following an ED admission); and
- estimate the total investment and annual operating costs of GEDI.

We observed a reduction in ED length of stay, ED cost, risk of admission following an ED presentation and in-patient cost for the full- and interim-GEDI periods, compared to the pre-GEDI period. During the full-GEDI period, patients experienced an extra 15 minutes of reduction in waiting time compared to the interim period, and therefore, a total of two hour and 15 minutes' reduction of ED time compared to the pre-GEDI period. The ED cost reduction was larger for the interim-GEDI period but the hospital admission cost reduction was larger for the full-GEDI period. The main driver of cost reduction for hospital admission was the reduction in length of stay in hospital.

Cost per ED presentation (holding all other things constant) in both the full-GEDI and interim-GEDI period were lower with savings of $35 [95% CI: $21, $49] for the full-GEDI period, and $74 [95% CI: $61, $86] for the interim-GEDI period when compared to pre-GEDI period. Once patients were admitted, the average cost per in-patient admission (holding all other things constant) in both the full-GEDI and interim-GEDI period were also lower: $1,469 [95% CI: $1,105, $1,834] for the full-GEDI period, and $1,018 [95% CI: $709, $1,326] for the interim-GEDI period. Further investigation of the source of cost reduction in hospital in-patient admissions for the period of interim-GEDI and full-GEDI revealed that the main driver was the reduction in length of stay in hospital.

Estimation of the Investment and Operating Costs of GEDI

The costing was based on a mixed costing framework, in which the data were sourced using both bottom-up and top-down measures. The initial investment for GEDI includes two main components, (1) equipment and working capital, and (2) conference, workshop and orientation training. The total equipment and working capital was calculated to be $3,929 and the conference, workshop and training costs $4,486. The GEDI model consists of two main staff of different salary levels. The operating costs consist of salary (including on-cost) for the GEDI staff (0.1 FTE), CNC (level 2, FTE 0.8) and CN (level 2, FTE 2.8), and recurrent expenditure to run their working space in the ED and consumption of office supplies and utilities. The average recurrent expenditure was calculated as a monthly cost, and then converted to an annual cost. Staff salary accounted for the largest share (95%) of the operating cost (totally $322,000 per annum) while recurrent expenditure was estimated to be $15,000.

Summary

The CEDRiC project, including both GEDI and HIPS interventions, was successful in improving the care of older adults experiencing an acute illness. Improved outcomes and processes were seen in both the RACF and in the acute hospital setting. Overall, CEDRiC improved outcomes by **reducing length of ED stay**, **reducing admissions to hospital** and **increasing advance care planning** while **cost saving in the hospital and health service and primary care** sector (GP and Medicare). The reduction in ED length of stay for Sundale residents, with an increase in the proportion staying in ED for less than four hours, directly reflects the coordination of care this project set out to achieve. The associated reduction in hospital length of stay for admitted residents with no increase in re-presentation rates for this cohort confirms the positive outcomes of the CEDRiC project for residents of Sundale.

As a stand-alone intervention, the presence of GEDI in the ED was highly effective in improving outcomes for all people aged 70 years and over who presented, resulting in cost saving for the SCHHS. As result of the GEDI implementation the average cost savings per ED presentation was $35 [95% CI: $21, $49] and per hospital admission was $1,469 [95% CI: $1,105, $1,834]. While it is acknowledged that these are not actual costs, as hospital-wide staffing levels are not reduced, the opportunity to admit patients in other cohorts (e.g. acute medical and elective surgery) as a result of the bed days saved is extensive. On average, patients who presented to ED when the GEDI service was available and who were subsequently admitted stayed in hospital 24 hours less than those who presented before GEDI was implemented. As approximately 6,000 adults, aged over 70 years, were admitted in the 12-month study period the extrapolation is that 6,000 bed days were saved in this time.

The cohort of older people in this study generally have multiple co-morbid conditions which has been reflected in the increased risk of re-presentation for any cause in the interim period, during GEDI working hours. This difference was not seen in the full GEDI period. As GEDI nurses aim to see the most difficult and complex people presenting to the ED, re-presentation for another condition might be expected. Re-admission in both interim and full GEDI periods after GEDI working hours for the same cause might be an indicator that GEDI would make an even bigger impact on re-admission rates if they were present in the ED for longer working hours.

Similar proportions of residents were admitted, transferred or discharged from the ED when comparing pre-HIPS and HIPS intervention groups. However, compared with pre-HIPS, residents transferred to hospital had a significantly shorter length of stay in the ED (280mins HIPS, 316mins Pre-HIPS, $P<0.05$) with more meeting the National Emergency Access Target (NEAT) of less than 4 hours in the ED (38.5% Pre-HIPS, 48.5% HIPS; $\chi^2(df) = 6.3\ (1)$; $p<=0.01$). The majority of HIPS consultations involved reviewing residents with previously identified conditions highlighting that the NPC provided ongoing case management for residents.

Implementation of tools such as the 'Stop and Watch' checklist [35] was recognised as a need during this study and attempts were made to implement this tool. The number of residents with any advance care planning in place increased greatly from 25.3% pre-HIPS to 74.7% during the Intervention HIPS period ($P<0.001$). Residents who were reviewed directly by HIPS had a much lower risk of ED transfer compared to residents who were consulted by

HIPS indirectly via RACF staff (NPC did not directly see the resident) resulting in an average cost saving to the ED of $68 [95% CI: $25, $110] per resident transferred. During the HIPS intervention period, residents transferred to the ED cost less than residents from other RACFs: the average cost differences per ED presentation was $62 [95 CI: $12, $111]. HIPS reduced GP visits by an average of 10 visits per week resulting in savings in the range of $40,920 - $56,126 per year from unplanned GP visits.

Trauma was the most frequently identified major diagnostic category related to ED presentation for this cohort including the subset of Sundale residents. During this study, the falls pathway in Sundale was altered to recommend that all unwitnessed falls be reviewed by a GP or transferred to the ED. This change was promoted by a coronial inquiry unrelated to the study sites. The results of this inquiry and subsequent changes in RACF policy may have had a direct effect on high number of transfers from Sundale and of all ED presentations for this diagnostic category.

The number of residents transferred to the ED from the RACF increased during the intervention period when compared to pre-HIPS. This was comparable to other large RACF's in this region. Seasonal changes were not considered, however the year prior to the intervention period, the first year the NPC was in place, had a much lower number of transfers (238) than pre-HIPS. This may be explained by the activity of the NPC being only on the high acuity unit at the main site during the first year. Once the model expanded to other facilities on the main site and offsite, the impact of this reduction in transfers was diluted.

Limitations

Implementation of health interventions such as HIPS and GEDI are limited by the types of research design used to measure their impact. The quasi-experimental design used in this evaluation was a viable pragmatic alternative that is commonly used in research. To control for other changes taking place in the ED over the study period, the data analysis for GEDI used survival analysis with multiple individual patient characteristics. This was not viable for the HIPS analysis as equivalent data were not able to be obtained from Sundale. It is recognised that commencing the study with an established NP may have improved the outcomes. However, this makes the results a reflection of the real world where a RACF decides to implement this model of care. It is recommended to collect similar data now that the model is being operated with a registered NP.

Conclusion

These results demonstrate that the CEDRiC interventions significantly improved outcomes for residents of the study RACFs and for older persons presenting to the ED across the Sunshine Coast while saving costs for the Hospital and Health Service and assisting GPs to provide enhanced primary care.

References

1. Australian Bureau of Statistics. Sunshine Coast LGA: Regional Summary. 2017; http://stat.abs.gov.au/itt/r.jsp?RegionSummary&region=36720&dataset=ABS_REGIONAL_LGA&geoconcept=REGION&maplayerid=LGA2014&measure=MEASURE&datasetASGS=ABS_REGIONAL_ASGS&datasetLGA=ABS_REGIONAL_LGA&regionLGA=REGION&regionASGS=REGION. Accessed 20 Sept, 2017.
2. Ackroyd-Stolarz S, Guernsey JR, Mackinnon NJ, Kovacs G. The association between a prolonged stay in the emergency department and adverse events in older patients admitted to hospital: a retrospective cohort study. *BMJ Qual Saf.* 2011;20.
3. Briggs R, Coughlan T, Collins R, O'Neill D, Kennelly SP. Nursing home residents attending the emergency department: clinical characteristics and outcomes. *QJM.* 2013;106(9):803-808.
4. Dwyer R, Gabbe B, Stoelwinder J, Lowthian J. A systematic review of outcomes following emergency transfer to hospital for residents of aged care facilities. *Age Ageing.* 2014;43(6):759-766.
5. Mudge AM, Denaro CP, O'Rourke P. Improving hospital outcomes in patients admitted from residential aged care: results from a controlled trial. *Age Ageing.* 2012;41(5):670-673.
6. Schnitker L, Martin-Khan M, Beattie E, Gray L. Negative health outcomes and adverse events in older people attending emergency departments: a systematic review. *Australas Emerg Nurs J.* 2011;14.
7. Schnitker L, Beattie E, Martin-Khan M, Burkett E, Gray L. Characteristics of older people with cognitive impairment attending emergency departments: A descriptive study. *Australas Emerg Nurs J.* 2016;19(2):118-126.
8. Gray LC, Peel NM, Costa AP, et al. Profiles of older patients in the emergency department: findings from the interRAI Multinational Emergency Department Study. *Ann Emerg Med.* 2013;62(5):467-474.
9. Australian Institute of Health and Welfare. *Emergency department care 2014–15: Australian Hospital Statistics.* Canberra: AIHW;2015.
10. Gruneir A, Silver MJ, Rochon PA. Emergency department use by older adults: a literature review on trends, appropriateness, and consequences of unmet health care needs. *Med. Care Res. Rev.* 2011;68(2):131-155.
11. Ong TJ, Ariathianto Y, Sinnappu R, Lim WK. Lower rates of appropriate initial diagnosis in older emergency department patients associated with hospital length of stay. *Australas J Ageing.* 2014;34(2):121-126.
12. Crilly J, Chaboyer W, Wallis M, Thalib L, Polit D. An outcomes evaluation of an Australian Hospital in the Nursing Home admission avoidance programme. *J Clin Nurs.* 2011;20(7-8):1178-1187.
13. Adams JG, Gerson LW. A new model for emergency care of geriatric patients. *Acad Emerg Med.* 2003;10(3):271-274.
14. Schnitker L, Martin-Khan M, Beattie E, Gray L. Negative health outcomes and adverse events in older people attending emergency departments: A systematic review. *Australas Emerg Nurs J* 2011;14(3):141-162.
15. Yuen TMY, Lee LLY, Or ILC, Yeung KL, Chan JTS, Chui CPY, et al. Geriatric consultation service in emergency department: How does it work? *Emerg Med J.* 2013;30(3):180-5.

16. Wright PN, Tan G, Iliffe S, Lee D. The impact of a new emergency admission avoidance system for older people on length of stay and same-day discharges. *Age Ageing.* 2014;43(1):116-121.
17. Aldeen A, Courtney D, Lindquist L, Dresden S, Gravenor S. Geriatric Emergency Department Innovations: Preliminary Data for the Geriatric Nurse Liaison Model. *J Am Geriatr Soc.* 2014;62:1781–1785.
18. Christian R, Baker K. Effectiveness of nurse practitioners in nursing homes: a systematic review. *JBI Library of Systematic Reviews.* 2009;7(30):1359-1378.
19. Arendts G, Howard K. The interface between residential aged care and the emergency department: a systematic review. *Age Ageing.* 2010;39(3):306-312.
20. Castilho-Weinert L, Sibele Yoko Mattozo T, Bittencourt Guimãraes A, et al. Functional Performance and Quality of Life in Institutionalized Elderly Individuals. *Top Geriatr Rehabil.* 2014;30(4):270-275 276p.
21. Conroy S, Ansari K, Williams M, et al. A controlled evaluation of comprehensive geriatric assessment in the emergency department: the 'Emergency Frailty Unit'. *Age Ageing.* 2014;43(1):109-114.
22. Conway J, Higgins I, Hullick C, Hewitt J, Dilworth S. Nurse-led ED support for Residential Aged Care Facility staff: An evaluation study. *International Emergency Nursing.* 2015;23(2):190-196.
23. Silvester KM, Mohammed MA, Harriman P, Girolami A, Downes TW. Timely care for frail older people referred to hospital improves efficiency and reduces mortality without the need for extra resources. *Age Ageing.* 2014;43(4):472-477.
24. Donabedian A. The quality of care. How can it be assessed? *Jama.* 1988;260.
25. Sanson-Fisher RW, Bonevski B, Green LW, D'Este C. Limitations of the randomized controlled trial in evaluating population-based health interventions, *Am J Prev Med.* 2007;33(2):155-161.
26. Marsden E, Taylor A, Wallis M, et al. A structure, process and outcome evaluation of the Geriatric Emergency Department Intervention model of care: a study protocol. *BMC Geriatr.* 2017;17(1):76.
27. AIHW. My Hospitals: Nambour General Hospital - Time spend in hospitals and emergency departments. 2017; https://www.myhospitals.gov.au/hospital/310000049/nambour-general-hospital/emergency-department. Accessed 3 May, 2017.
28. Queensland Government Statistician's Office. Population growth highlights and trends, Queensland regions, 2015 edition. In: Treasury Q, ed. Brisbane: Queensland Government; 2015.
29. Queensland Treasury. Population projections to 2031: local government areas, 2011 edition. In: Office of Economic and Statistical Research, ed. Brisbane: Queensland Government; 2011.
30. Dobson AJ, Barnett AG. *An Introduction to Generalized Linear Models.* Third ed. Boca Raton, FL.: Chapman & Hall/CRC Press; 2008.
31. Shadish WR, Cook TD, Campbell DT. *Experimental and Quasi-experimental Designs for Generalized Causal Inference.* Houghton Mifflin; 2002.
32. Barnett AG, Dobson AJ. *Analysing seasonal health data.* Berlin: Springer; 2010.
33. Miles MB, Huberman AM. *Qualitative data analysis: an expanded sourcebook.* Sage Publications; 1994.

34. Oliver D, Roos J. *Constructing Organizational Identity.* Switzerland: Imagination Lab Foundation; June, 2004.
35. Ouslander JG, Bonner A, Herndon L, Shutes J. The Interventions to Reduce Acute Care Transfers (INTERACT) Quality Improvement Program: An Overview for Medical Directors and Primary Care Clinicians in Long Term Care. *J Am Med Dir Assoc.* 2014;15(3):162-170.

Appendices

Appendix 1 - Research outputs at time of writing.

Peer reviewed publications

Marsden EJ, Taylor A, Wallis M, Craswell A, Broadbent M, Barnett A, Nguyen K, Crilly J, Johnston C & Glenwright A. (2017). A structure, process and outcome evaluation of the Geriatric Emergency Department Intervention model of care: a study protocol. BMC Geriatrics, 17: 76.

Craswell A, Marsden EJ, Taylor A, Wallis M. Emergency Department presentation of frail older people and interventions for management: Geriatric Emergency Department Intervention. Safety in Health. 2016;2(14):6.

Marsden E, Craswell A, Taylor A, Coates K, Crill J, Broadbent M, Glenwright G, Johnston C, & Wallis M. (In Press 2018) Nurse-led multidisciplinary initiatives to improve outcomes and reduce hospital admissions for older persons: the CEDRiC project. *Australasian Journal on Ageing*.

Non-peer reviewed publications

Wallis M, Coates K, Johnston C, Bannink and Craswell A. (2017) The CEDRiC toolkit development project: Changing the care of older adults with an acute illness. Nurse Click, Australian College of Nursing Online Journal, Aug 2017: 21-22.

Craswell, A., Taylor, A., Coates, K. & Broadbent, M. (2016). Care collaboration through emergency department residential aged care and primary health collaboration. Australian Nursing and Midwifery Journal, 23(7): 45.

Presentations as Invited Speaker

Marsden EJ, Taylor A, Wallis M (2017) GEDI information implementation workshop. RBWH, Brisbane, Australia 23 Feb.

Wallis M, Marsden EJ. (2016) Keynote Address: Care Coordination through Emergency Department, Residential Aged Care and Primary Health Collaboration: The CEDRiC Trial. At: Preventing Unnecessary Hospital Emergency Department Transfers for Older People Conference, Melbourne, Australia 5-6 May.

Marsden EJ, Taylor A. (2016) Overcoming the Discombobulation. Emergency Department Management Conference, Sydney, Australia 20-21 July.

Marsden EJ, Taylor A. (2016). The GEDI model. Presentation at Statewide Older Persons Acute Care Network Survey Forum, Brisbane, Australia, 7 June.

Johnston C. (2016). Care Coordination through Emergency Department Residential Aged Care and Primary Health Collaboration. AHHA Data and Innovation Collaboration Networks Meeting, Caloundra, Australia, 25 May.

Conference presentations
2017

Marsden EJ, Wallis M, Craswell A, Taylor A, Broadbent M. (2017) Collaboration through health research to improve outcomes for acutely ill older adults presenting to emergency. ACEM Scientific meeting, Sydney, Australia, 19-23 Nov.

Marsden EJ, Wallis M, Craswell A, Taylor A, Bannink N, Broadbent M, Johnston C, Glenwright A, Crilly J, Coates K. (2017) Changeing care of the elderly in the RACFs and EDs: The CEDRiC project toolkit implementation. 41st IHF World Hospital Congress, Taipei, Taiwan, 7-9 Nov.

Wallis M, Marsden EJ, Broadbent M, Craswell A, Coates K, Taylor A, Glenwright A, Johnston C, Barnett A, Nguyen K, Crilly J. (2017). The CEDRiC Project: Care Coordination Through Emergency Department, Residential Aged Care Facility and Primary Health Collaboration 41st International Healthcare Foundation World Congress. International Convention Centre, Taipei, Taiwan, 7-9 Nov. *NB: winner of the best poster prize*

Wallis M, Marsden EJ, Taylor A, Coates K, Craswell A, Broadbent M, Barnett A, Nguyen K, Johnston C, Glenwright A & Crilly J (2017) Symposium presentation, Improving acute and emergency care of older people: The results of the CEDRiC project, 10th Health Services Research Australia and New Zealand (HSRAANZ), Gold Coast, Australia, 1-3 Nov.

Taylor A, Marsden EJ, Wallis M, Craswell A, Broadbent M. (2017) Improving the quality of care of elderly patients in the ED: Geriatric Emergency Department Intervention. 15th Annual International Conference for Emergency Nurses, Sydney, Australia, 11-13 Oct.

Broadbent M, Taylor A, Marsden E, Craswell A, Johnston C, Glenwright A, Wallis M. (2017) Reducing the cost associated with care of elder patients in the ED: Impact of enhanced primary care in an aged care facility. 15th Annual International Conference for Emergency Nurses, Sydney, Australia, 11-13 Oct.

Coates K, Wallis M, Craswell A, Johnston C, Broadbent M. (2017) Boldly Exploring New Frontiers in Aged Care – A Nurse Practitioner candidate to Nurse Practitioner model of care. Leading Age Services Associate National Congress, Gold Coast, Australia, 15-18 Oct.

Craswell A, Nguyen K, Coates K, Johnston C, Wallis M. (2017) Repeated measures Quality of Life assessment in an age care facility over one year. Leading Age Services Associate National Congress, Gold Coast Australia, 15-18 Oct.

Craswell A, Coates K, (2017) Streamlining care of older people in residential aged care: Nurse practitioner candidate and emergency department care coordination. Australian College of Nurse Practitioners conference, Brisbane, Australia, 4-7 Sept

Coates K, Wallis M, Craswell A, Glenwright, A (2017) A Nurse Practitioner Candidate: A model for change in aged care. Australian College of Nurse Practitioners conference, Brisbane, Australia, 4-7 Sept

Coates K, Johnston C, Craswell A, Taylor A, Marsden EJ, Broadbent M, Wallis M. (2017) Changing care of the elderly in RACFs and EDs: The CEDRiC project toolkit implementation. National Nursing Forum, Sydney, Australia, 21-23 Aug

Coates K, Glenwright A, Craswell A, Johnston C, Taylor A, Marsden EJ, Broadbent M, Wallis M. (2017) Health Intervention Project for Seniors (HiPS): Outcomes of a model of care aimed to support acute care for Older People in primary health care (PHC) setting. Primary Health Care Research and Information Service Conference, Brisbane, Australia, 7-9 Aug

Glenwright A, Coates K, Wallis M, Craswell A, Taylor A, Marsden EJ, Crilly J, Broadbent M, Johnston C. (2017). Care coordination between Emergency Departments, Residential aged care facilities and primary care Collaboration (CEDRiC). Primary Health Care Research and Information Service Conference, Brisbane, Australia, 7-9 Aug

Glenwright A, Coates K, Craswell A, Wallis M. (2017) Nurses at the forefront of system redesign: Advanced practice nurses improving quality of life for elders in residential aged care. International Council of Nurses Congress, Barcelona, Spain: 27 May – 1 June

Craswell A, Taylor A, Marsden E (2017) Passionate about Practice: Conference of the Chief Nurse and Midwifery Officer. RBWH, Brisbane, Australia 9 May *NB: winner of the best poster prize*

2016

Glenwright A. (2016). A cost analysis of a Geriatric Emergency Department Intervention (GEDI). Presentation at the International Federation of Ageing Conference, Brisbane, Australia, 21 June.

Coates K. (2016). A collaborative model for enhanced elder care. Presentation at Nurses: The Heart of Primary Care APNA National Conference, Melbourne, Australia, 5-6th May.

Craswell A, Wallis M, Broadbent M, Marsden EJ, Coates K, Taylor A, Glenwright A, Crilly J, Johnston C. (2016). The CEDRiC project: Care coordination through emergency department, residential aged care and primary health collaboration. Presentation at Forum on Quality and Safety in Healthcare, Goteborg, Sweden, 13-15 April.

2015

Craswell A, Wallis M, Marsden EJ, Coates K, Taylor A, Broadbent M, Crilly J & Johnston C. (2015). Supporting appropriate transfer of older people: The CEDRiC model of care. Presentation at Australian Associate of Gerontology QLD Branch, Brisbane, Australia. 23 November.

Wallis M, Broadbent M, Marsden EJ, Taylor A, Coates K, Craswell A, Crilly J, Johnston C. (2015). The CEDRiC Trial. Presentation at HITH @21 – Maturity, Responsibility, Quality Conference, Sydney, Australia, 11-13 November.

Wallis M, Broadbent M, Marsden E, Taylor A, Coates K, Craswell A, Crilly J, Johnston C. (2015). The CEDRiC Trial. Presentation at USC School of Nursing, Midwifery and Paramedicine Research School, Sippy Downs, Australia, 12 November.

Wallis M, Broadbent M, Marsden EJ, Taylor A., Coates K, Craswell A, Crilly J, Johnston C. (2015). Who or what is CEDRiC? Presentation at USC Faculty of Science, Health, Engineering and Education Research Day, Sippy Downs, Australia, 24 November.

Craswell A, Johnston C, Taylor A. (2015) The GEDI Service. Nambour General Hospital Patient Safety Day, Nambour, Australia, 13 August.

Marsden EJ, Taylor A. (2015) GEDI & the Grey Tsunami. Presentation at Emergency Department Management Conference: Showcasing Innovation and Exploring Improvement Strategies, Sydney, Australia, 16-17 July.

2014
Coates K, Wallis M. (2014). Innovative Partnerships for Improved Elder Care. Presentation at LASA International Conference, Adelaide, Australia, 20-23 October.

Other presentations
Marsden E, Taylor A. (2016). The GEDI model. Presentation at Statewide Older Persons Acute Care Network Survey Forum, Brisbane, Australia, 7 June

Other news publications
Barr J. (2014, 18 Aug) SCML Senior's Week – Innovative program reduces hospital admissions for seniors (Media Release) (WIN TV) Nambour, Australia.

University of the Sunshine Coast. (2015, Jul). Better care for older residents. Engaged USC, p18-19.

Keeping seniors at home and out of emergency (2015, October 8). Nambour Weekly, p. 5.

Martin K. (2015, Nov-Dec). Future Forecasting: Sundale positions itself for change. Australian Ageing Agenda, p36-39.

Nolan A. (2016, 10 March). Emergency time halved: Special program ensures elderly receive medical care they need quickly. Nambour Weekly, p.3.

AHHB (2016, 19 September) GEDI nurses – front line geriatric care. Australian Hospital and Healthcare Bulletin, Australia.
http://www.hospitalhealth.com.au/news/aged-care/new-hope-gedi-nurses-bringing-geriatric-care-front-line/

Appendix 2: Understanding Hazard Ratios and controlling for predictors

The statistical method used to interpret the GEDI data was survival analysis. Survival analysis examines the time to an event and therefore uses more information than the simpler categorical variable (e.g., admitted or discharged). We use the established Cox proportional hazards survival model and include multiple predictors with the aim of estimating the independent effect of each predictor. We used the variance in inflation factor to check for collinearity.

The results are shown as *hazard ratios* which represent the change in risk of an event on a multiplicative scale. A hazard ratio of 1 means no change in risk. For example, if the hazard ratio for blondes compared with redheads was 1 that would mean there was no change in the risk of admission for blondes compared with redheads (as the risk of discharge for blondes is 1 times the risk for redheads, which is no different). A hazard ratio greater than 1 means an increased risk, whereas a hazard ratio less than 1 means a reduced risk. We give confidence intervals for the hazard ratios to show the uncertainty in the risk. If the confidence interval includes 1 then we cannot be statistically sure that there is a real change in risk, because no change in risk cannot be ruled out.

The simplest way to visualise an hazard ratio that is statistically significant can be seen in figure 1a. Each variable identified in words has a line with a circle or dot in the centre. This circle or dot represents the mean hazard ratio and the line to each side extends to the 95% confidence intervals. Therefore, if this horizontal line does not cross the vertical dotted line at 1, the result is statistically significant either towards or against the variable outcome. In Figure 1a, the results to the left of the line show discharge is less likely and the results to the right of the line show discharge is more likely.

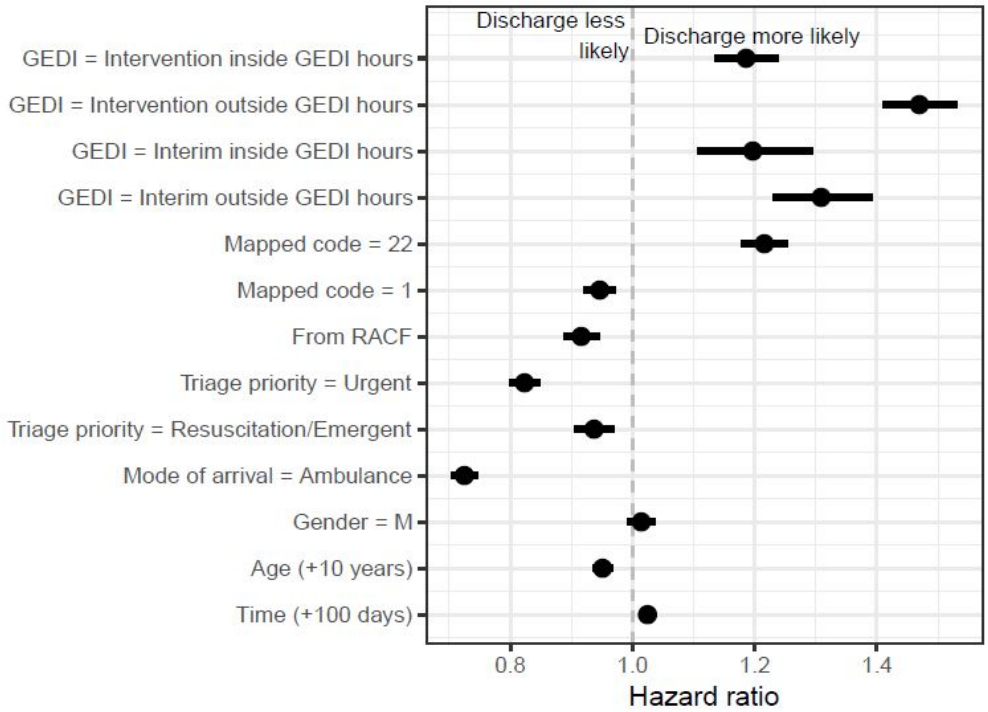

Figure 1a: Example plot to interpret hazard ratios for discharge. Hazard ratios and 95% confidence intervals for discharge using a Cox survival model. Reference for GEDI is pre-intervention. Reference for triage priority is “Less urgent-Non-urgent”.

A time-dependent variable changes over time, whereas a time-fixed variable (e.g., hair colour) does not. The key variable of whether patients experienced care with the GEDI nurse is time-dependent because: i) it was introduced after a specific date, ii) after this date the nurses did not work at night, plus there were a few days where there were no GEDI nurses. We created a time-dependent categorical variable to estimate the impact of the GEDI nurse. The five categories were:

- Pre-intervention
- Interim intervention during GEDI working hours
- Interim intervention during non-GEDI working hours
- Full intervention during GEDI working hours
- Full intervention during non-GEDI working hours

We would expect to see the largest impact during the full intervention combined with working hours, but may also see large effects during the interim intervention. We would expect to see any positive impacts reduce during non-working hours.