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Original Study

Integration of Inpatient and Residential Care In-Reach Service Model and Hospital Resource Utilization: A Retrospective Audit



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A B S T R A C T

Keywords:

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Objective: In parts of Australia, Residential In-Reach (RIR) services have been implemented to treat residential aged care (RAC) residents for acute conditions in their place of residence to avoid preventable hospital presentation. Our service was initiated in 2009 and restructured in 2014. We compared acute healthcare resource utilization (RIR activity and emergency hospital presentations) by RAC residents under 2 RIR models of care.

Design: Acute RAC RIR service model of care was changed from existing nurse/emergency physician-led service to nurse/geriatrician-led service and incorporate inpatient liaison nurse consultant into the team. **Setting:** RAC episodes and hospital presentations from a single tertiary referral hospital and its associated RAC RIR service.

Methods: Retrospective audit comparing RIR activity, hospital presentations, and associated costs from 2 12-month periods, prior to and postimplementation. Data were expressed as a proportion of the total number of RAC beds in the hospital RIR catchment.

Results: After implementation of the new model of care, RIR episodes of care increased from 589 to 985 (15.3 vs 24.7 episodes/100 RAC beds, $P < .001$). Emergency department (ED) presentations fell from 1616 to 1478 (41.9 vs 37.2 presentations/100 RAC beds, $P < .001$). There were fewer unplanned ED presentations by RIR patients (2.4% vs 0.8%, = 0.03) and fewer 28-day ED re-presentations (16.8% vs 13.7%, $P = .01$) under the new model of care. ED cost [AUD \$30,830 vs \$28,030/100 RAC beds (\$USD 21,344 vs \$19,407), $P < .001$] and inpatient admission costs [\$145,607 vs \$117,531/100 RAC beds (\$USD 100,814 vs \$81,380), $P < .001$] were each lower in the second period.

Conclusions and Implications: In the 12 months following implementation of the new model of care, an increase in RIR activity, and a decrease in ED presentations was observed. Further research is necessary to validate these retrospective findings and better evaluate clinical outcomes and consumer satisfaction of the service.

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Aging and frail populations place increasing demands on health-care systems.¹ Older hospital inpatients often experience longer inpatient length of stay (LOS) and higher mortality rates compared with younger patients^{2–5} and are more likely to experience adverse effects such as delirium, functional decline, and falls during hospitalization.^{6–8}

In Australia, residential aged care (RAC) homes provide accommodation and care to older adults who are no longer able to live independently.⁹ Aged care residents are among the most vulnerable

and frail within our population.⁵ With increasing life expectancy, the number of older adults living with cognitive or physical impairment is also on the rise, resulting in greater demands for places, and greater frailty of residents within RAC.¹⁰ Aged care homes in Australia are staffed by nurses and care attendants with visiting general practitioners (GPs). They are usually able to provide palliative care, but unlike skilled nursing facilities elsewhere, cannot provide intravenous antibiotics or fluids.

Compared with community-dwelling older individuals, RAC residents are more likely to present to hospital emergency departments (EDs), and once there, are more likely to require admission and to die in hospital.¹¹ However, as many ED transfers are potentially avoidable,^{12,13} there is considerable interest in development of more efficient models of healthcare, to improve outcomes in older patients

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requiring acute medical care, while reducing ED utilization and hospital admission.¹⁴

Within the Australian context, several models of outreach services have been implemented. Subacute models of care incorporate principles of comprehensive geriatric assessment, case management, and advance care planning to complement primary care.^{15,16}

By contrast, acute models [eg Residential In-Reach (RIR) or hospital in the nursing home] models provide acute care within RAC as a substitute for emergency presentation or hospitalization, to ease the growing demands on hospital services^{14,17–22}; others (eg, enhanced primary care) also demonstrate corollary benefits such as opportunistic advance care planning and RAC staff education.²²

This study reports service data for a tertiary referral hospital in Melbourne, Australia. Our hospital's RIR service was established in 2009 and restructured in 2014. We compare patterns of RIR activity, ED and hospital resource utilization by RAC residents before and after the introduction of a new model of care.

Our primary a priori hypothesis was that introduction of a new model, with increased activity, may be associated with a reduction in ED presentations from aged care homes within the catchment serviced by the RIR. Secondary outcome measures compared include proportion of RIR episodes with unplanned hospital presentation (ie, unplanned presentation while being managed by RIR as an alternative to hospital presentation) and costs of ED and hospital presentations.

Methods

Intervention: Service Redesign

Since 2009 our health service has provided a RAC in-reach service to treat acute health conditions not able to be managed by primary care, in lieu of hospital presentation. Common services provided include rapid access to pathology investigations, acute care interventions including intravenous or intramuscular antibiotics, subcutaneous hydration, targeted goals of patient care discussions, prescription of palliative care medications (including anticipatory prescribing), suturing and wound review, emergency indwelling or suprapubic catheter replacement or percutaneous gastrostomy replacement, and urgent workup for new or worsening falls, changed behaviour or delirium. Conditions requiring invasive management or hospital intervention, such as fractures, or acute surgical conditions are excluded. Referrals are received from RAC staff, GPs, patients and families, or hospital staff. At time of audit, the RIR team consisted of a nurse [1.0 equivalent full time (EFT)] and consultant physician (0.5 EFT), Monday–Friday, 9:00 AM–5:00 PM. In 2014, the service was redesigned to improve care without incurring any increase in operating cost or EFT allocation:

- (1) Change of medical staff from rotating ED physician support to a consistent consultant geriatrician with experience in acute care of the older patients including in RAC settings.
- (2) Co-location of an existing ward-based RAC liaison nurse role to work with the RIR team. This role historically assisted with discharge planning for RAC residents in hospital. Integrating this role with the RIR team provided greater clinical support and governance to the role, improved communication between hospital, RACs, and RIR team and enabled education to patients, families and RAC staff of the availability of RIR service for future acute care needs.
- (3) Stakeholder engagement by RIR geriatrician, RIR nurse, and RAC liaison nurse with inpatient and ED teams, to encourage referrals for review postdischarge from hospital for continuation of acute medical care and palliative care in aged care homes.

Study Population

Convenience sample of all emergency attendances by RAC residents and RIR service episodes between February 1, 2013 and January 31, 2015: 12 months prior to, and postchange to model of care (February 1, 2014). This period was chosen to provide 2 comparable periods of sufficient duration to minimize the risk of sampling bias because of extrinsic factors such as seasonal variation in presentations. As such, an a priori sample size was not calculated.

Setting

Tertiary referral hospital in metropolitan Melbourne, with RIR catchment covering 3 local government areas, including 52 aged care homes (3857 RAC beds at first audit period).

Data Collection

Retrospective audit of 2 clinical databases collected during usual care and Department of Health reporting requirements.

RIR activity

Service episode details were accessed from a clinical database conceived at service inception, to meet Victorian Integrated Non-Admitted Health data requirements. This includes information regarding episodes of care provided by our institution's RIR, including patient demographics, condition treated, and outcomes [condition treated at RAC, resident died, planned hospital admission (avoiding ED), planned and unplanned ED presentation]. RIR episode details were confirmed by accessing patients' electronic medical record to address any problems with missing data.

ED attendances and hospital admissions

The second database is obtained from hospital administration admission/registration software that is used for all ED presentations (Medtrak/Firstnet). An automated list is generated for all presentations from residential facilities, including RAC, retirement villages, boarding homes, supported residential services, and disability accommodation. This is manually cross-checked daily against ED presentations in the hospital electronic medical record by a RIR team member and individuals are coded according to accommodation type. Only ED presentations from RAC facilities from within the hospital catchment were included in this analysis. If an individual's address is incorrect at time of presentation (eg, they have recently moved to a nursing home) this is identified and amended by ED triage clerks. This database includes demographics, admission, and discharge destination. All ED presentations for RAC residents within our institution's area catchment during the audit period were included. Those from aged care homes in other hospital catchment areas were excluded.

The estimated cost of ED presentations was calculated using the average cost spent per ED triage category in year 2013–2014 for the institution, provided by the hospital business intelligence unit.

Patients were considered as “discharged from ED” if they were only treated by ED team within the ED (including in short stay observation unit) with LOS < 24 hours. Patients were considered as “admitted” if they were transferred to a treating inpatient unit bed card (even if LOS < 24 hours). For RAC patients admitted to hospital, actual hospital LOS and bed-day costs were also provided by the hospital.

To adjust for change in RAC bed numbers within the hospital catchment during the study period, numbers of beds were obtained for each aged care home from published RAC directories for each period. Twelve-month RIR activity and ED presentations were compared as a proportion of total RAC beds (per 100 RAC beds) for the 2 periods.

Statistical Analysis

Statistical analysis was performed using SPSS V 22 (SPSS, Inc, Chicago, IL) and [Openepi.com](#). For continuous data, Shapiro-Wilk test determined non-normality of distribution and pre-and post-intervention groups were compared using Mann-Whitney U test. Categorical outcomes were compared between groups using Pearson χ^2 test. RIR activity, ED presentations, and cost per 100 RAC beds were compared between time periods using z score. Test of significance were 2-tailed and level of significance was set at $P < .05$.

Ethics

Prior approval was obtained from our institution's Ethics Committee (LNR/15/Austin/9).

Results

RIR Activity

The total number of RAC beds in the catchment increased from 3857 to 3975 (3.1%) from the first to second periods. After implementation of the new model of care, RIR episodes of care increased from 589 to 985 (15.3 vs 24.7 episodes/100 RAC beds, $P < .001$, [Figure 1A/Table 1](#)). Patients seen by RIR were marginally older in the second period [median age pre: 86 years, interquartile range (IQR): 80–91, vs post: 87 years, IQR: 81–91, $P = .003$]. There was no difference in sex distribution between periods. Compared with the first period, in the second period, there was a higher proportion of in-person attendances and a lower proportion of service episodes limited to phone advice only ([Table 1](#)).

The 5 most common conditions that were treated during RIR visits were skin conditions (eg, lacerations/wounds/cellulitis, 14.1%), respiratory (including pneumonia, exacerbation chronic obstructive airways disease, congestive heart failure, 13.3%), "other geriatric assessment" (including undifferentiated or mixed presentations, functional decline, and advance care planning, 12.5%), end-of-life care (EOLC, 8.6%), and catheter care (including blocked indwelling urinary catheter or catheter-associated urinary tract infections; routine catheter changes were not performed, 7.1%). The prevalence of these 5 conditions did not differ significantly between the 2 periods.

Proportion of outcomes of RIR attendances differed between the 2 periods ([Table 1](#)). During the second period, patients were significantly less likely to be referred to another service (eg, GP, or other service provider) for completion of treatment (pre: 9.7% vs post: 3.3%, $P < .001$) and more likely to have their treatment completed (79.3% vs 83.7%, $P = .07$) or die (receiving end-of-life care) (2.9% vs 5.3%, $P = .06$)

at the RAC during the RIR episode. There were significantly fewer unplanned ED presentations by RIR patients in period 2 (2.4% vs 0.8%, $P = .03$).

ED Presentations and Hospital Admissions

There were 4619 ED presentations from RAC residents during the entire study period, of which 3094 presentations were from RAC in the catchment area visited by our RIR service. Of these, 1616 and 1478 presentations were observed during the first and second time period respectively (the remaining 1524 presentations from Aged Care Homes out of catchment/serviced by other RIRs were excluded from analysis). There was a significant reduction in the annual rate of ED presentations from 41.9 to 37.2 per 100 RAC beds ($P < .001$, [Figure 1B/ Table 2](#)). There was a small decrease in age (median 88 years vs 87 years, $P = .02$) but no difference in sex distribution nor proportion of ED triage categories between the 2 periods.

The proportion of ED presentations admitted to hospital did not differ significantly between the 2 periods (45.4% vs 46.3%, $P = .59$). However, the proportion of ED re-presentations (ie, with a prior presentation within 28 days) was lower in period 2 compared with period 1 (16.8% vs 13.7%, $P = .01$).

The (estimated) total cost of ED presentations was \$1,189,128 (\$USD 823,305) in period 1 and \$1,114,199 (\$USD 771,437) in period 2. There was a significant difference in the estimated cost of ED presentations per 100 RAC beds: \$30,830 vs \$28,030 (\$USD 21,349 vs \$19,410), $P < .001$.

For those ED presentations that required hospital admission, the median LOS was similar in both periods [2 (IQR 1–6) days vs 2 (IQR 1–5), $P = .98$] and the median cost per inpatient admission did not differ significantly between the 2 periods [\$3712 vs. \$3787 (\$USD 2570 vs \$2622), $P = .27$]. However, the cost of inpatient care per 100 RAC beds was lower in period 2 [\$145,607 vs \$117,531 (\$USD 100,829 vs \$81,383), $P < .001$].

Discussion

Increase in emergency care required by frail RAC residents presents a significant challenge to healthcare systems. In 2012–2013, up to 13.3 billion of the Australian government expenditure was spent on aged care, 6.1% increase in government expenditure compared with the previous year.⁹ In order to ensure financial sustainability and adequate provision of healthcare services without compromising quality standards, there has been considerable interest in further optimizing pre-existing models of care and development of new strategies. RAC-based acute intervention programs across a range of countries have demonstrated benefit/noninferiority to hospital care and with

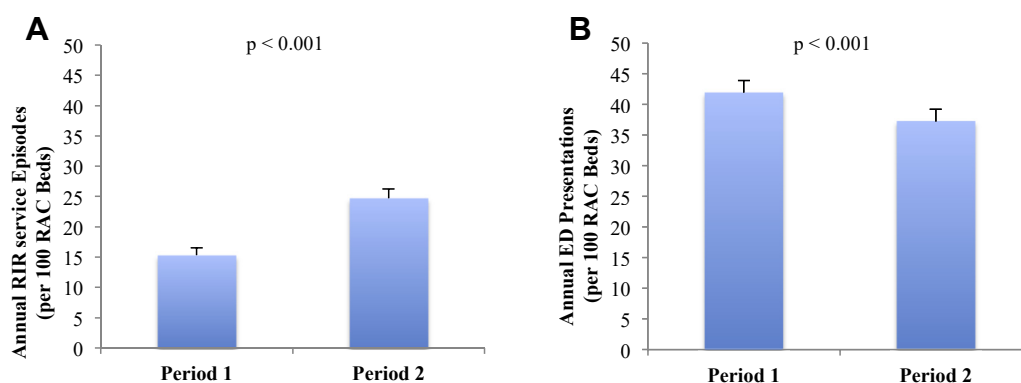


Fig. 1. (A) Bar graph of RIR service episodes and (B) ED presentations per 100 RAC beds in time period 1 and 2. Error bars denote 95% confidence intervals.

Table 1
RIR Activity

	Period 1	Period 2	All	P
Total RIR service episodes, n	589	985	1574	
Catchment size (number of RAC beds)	3857	3985		
RIR service episodes/100 RAC beds (95% CI)	15.3 (14.1–16.6)	24.7 (23.2–26.3)	20.1 (19.1–21.1)	<.001*
Age, y, median (IQR)	86 (80–91)	87 (81–91)	86 (81–91)	.003 [†]
Sex, male: female, n (%)	353: 236 59.9: 40.1	627: 358 63.7: 36.3	980: 594 62.3: 37.7	.18 [‡]
Contact type, n (%)				<.001 [‡]
Phone only	208 (35.3)	208 (21.1)	416 (26.4)	
In-person visit	381 (64.7)	777 (78.9)	1158 (73.6)	
Day of referral, n (%)				.80 [‡]
Monday	94 (16.0)	154 (15.6)	248 (15.8)	
Tuesday	92 (15.6)	163 (16.5)	255 (16.2)	
Wednesday	91 (15.4)	139 (14.1)	230 (14.6)	
Thursday	90 (15.3)	172 (17.5)	262 (16.6)	
Friday	114 (19.4)	197 (20.0)	311 (19.8)	
Saturday	65 (10.5)	86 (8.7)	148 (9.4)	
Sunday	46 (7.8)	74 (7.5)	120 (7.6)	
Diagnosis at RIR attendance (top 5), n (%)				
Skin conditions (cellulitis/wounds/lacerations)	60 (15.7)	103 (13.3)	163 (14.1)	.30 [‡]
Respiratory (pneumonia/COPD/CHF)	50 (13.1)	104 (13.4)	154 (13.3)	.90 [‡]
Other geriatric assessment	39 (10.2)	106 (13.6)	145 (12.5)	.09 [‡]
End-of-life care	27 (7.1)	73 (9.4)	100 (8.6)	.12 [‡]
Urinary catheter care	28 (7.3)	54 (6.9)	82 (7.1)	.79 [‡]
Outcome of RIR attendance (%)				
Treatment completed at aged care home	302 (79.3)	650 (83.7)	952 (82.2)	.07 [‡]
Died (end-of-life care provided)	11 (2.9)	41 (5.3)	52 (4.5)	.06 [‡]
Referred to another service	37 (9.7)	26 (3.3)	63 (5.4)	<.001 [‡]
Planned ED presentation	14 (3.7)	30 (3.9)	44 (3.8)	.89 [‡]
Planned direct hospital admission [§]	8 (2.1)	24 (3.1)	32 (2.8)	.34 [‡]
Unplanned ED presentation	9 (2.4)	6 (0.8)	15 (1.3)	.03 [‡]

CHF, congestive heart failure; CI, confidence interval; COPD, chronic obstructive pulmonary disease.

P value for difference between period 1 and period 2.

*Using z-test.

[†]Using Mann-Whitney U-test.[‡]Using Pearson χ^2 test.[§]Planned direct hospital admission bypassing ED.**Table 2**
ED Presentations and Hospital Resource Utilization

	Period 1	Period 2	Total	P
ED presentations (n)	1616	1478	3094	
Catchment size (number of RAC beds)	3857	3975		
ED presentations/100 RAC beds (95% CI)	41.9 (39.9–44.0)	37.2 (35.3–39.1)	39.5 (38.1–40.9)	<.001*
Age, y, median (IQR)	88 (82–92)	87 (82–91)	88 (83–92)	.02 [‡]
Sex: female: male, n (%)	1053: 563 (65.2: 34.8)	939: 539 (63.5: 36.5)	1992: 1102 (64.4: 35.6)	.35 [‡]
ED triage category, n (%)				.20 [‡]
1	29 (1.8)	23 (1.6)	52 (1.7)	
2	237 (14.7)	251 (17.0)	488 (15.8)	
3	805 (49.8)	743 (50.3)	1548 (50.0)	
4	509 (31.5)	46.3 (29.7)	948 (30.6)	
5	36 (2.2)	22 (1.5)	58 (1.9)	
Disposition				.59 [‡]
Admitted to hospital, n (%) [§]	733 (45.4)	685 (46.3)	1418 (45.8)	
Discharged from ED, n (%)	883 (54.6)	793 (53.7)	1676 (54.2)	
ED re-presentation within 28 d, n (%)	272 (16.8)	203 (13.7)	475 (15.4)	.01 [‡]
Total ED cost (\$AUD)	\$1,189,128	\$1,114,199	\$2,303,327	
ED cost/100 RAC beds (95% CI)	\$30,830 (\$30,770–\$30,890)	\$28,030 (\$27,980–\$28,080)	\$29,410 (\$293,700–\$294,500)	<.001*
Admitted patient LOS, median (IQR)	2 (1–6)	2 (1–5)	2 (1–6)	.98 [‡]
Total inpatient admission cost, \$AUD	\$5,616,076	\$4,671,859	\$10,287,935	
Cost per inpatient admission, median (IQR), \$AUD	\$3712 (\$1245–\$6622)	\$3787 (\$1262–\$6410)	\$3748 (\$1245–\$6591)	.27 [‡]
Inpatient admission cost/100 RAC beds (95% CI) \$AUD	\$145,607 (\$145,500–\$145,700)	\$117,531 (\$117,400–\$117,600)	\$131,400 (\$131,300–\$131,400)	<.001

CI, confidence interval.

P value for difference between period 1 and period 2.

*Using z test.

[†]Using Mann-Whitney U test.[‡]Using Pearson χ^2 test.[§]Includes patients who died within ED.^{||}ED costs estimated from average cost per triage category for 2013–2014 financial year.

consumer and health-system benefits^{17,19,21,23–26} including physical function²³ and mortality.^{18,19}

Following implementation of the RIR redesign there was a 67% increase in RIR activity and 11% reduction in the rate of ED presentations. Per 100 RAC beds, there was also a 9% reduction in (estimated) cost of ED presentations and 19% reduction in (actual) inpatient costs.

Increase in RIR activity may be attributed to several factors, including staffing, physician practices, proactive stakeholder engagement, and catchment changes. In the original model, rotating emergency physicians provided medical support, whereas the new model of care comprised a single consultant with expertise in acute geriatric medicine leading the program. Incorporation of the inpatient liaison nurse meant that vulnerable patients were identified at discharge from hospital or ED and proactively followed up in the community to reduce re-presentations. With the redesigned program, there was also greater emphasis on stakeholder engagement by in-person visits and educating RAC staff, GPs, and residents on services available (evidenced by the increase in proportion of episodes conducted in aged care homes and decrease in phone-only episodes), leading to greater opportunity for RAC staff to become familiar with the team and develop a closer working relationship. Improved consumer awareness of the service may also mean that residents would be more likely to opt for management in their aged care homes for future medical concerns. In addition, the increase in RAC catchment size may have also contributed to the increase in RIR activity, in that increased RAC bed numbers could have resulted in increased demand for the RIR service.

In our study, more than one-half of RAC residents that presented to the ED did not require an inpatient admission. Literature suggests that a proportion of presentations can be avoided if there is rapid access to medical support in the primary care setting.^{12,13} Frail older patients are particularly prone to adverse outcomes during hospitalization^{5–8} and as such, any intervention reducing this potential for harm would be welcome. Our study has demonstrated that following the implementation of the new model of care, there were significantly fewer patients referred elsewhere in lieu of RIR follow-up and a reduction in RIR patients experiencing unplanned ED presentations ($P = .03$), which could support improved safety, governance, and follow-up processes under the revised RIR model of care. Although hospital transfers may be necessary and appropriate in some cases, they are not always in the residents' best interest if equivalent or superior care can be provided in the community setting, and many consumers express a preference for treatment of acute conditions in the aged care home where possible.²⁷

RAC residents often represent the most vulnerable and frail individuals in the community.⁵ Residents in the final year of their life are frequently transferred to hospital for conditions in which appropriate care could have been offered in their aged care homes.^{28–30} Our RIR service redesign prioritized provision of timely quality end-of-life care within RAC, and although increases were observed in patients receiving end-of-life care in the second period (nonsignificant, $P = .06$), there is no information about quality of care or symptom management provided at end of life. Future research is required to identify consumer and stakeholder perspectives into provision of quality acute and end-of-life care in the RAC setting to guide further service development.

RAC patients tend to have a longer LOS as an in-patient and higher rates of complications and mortality when admitted.^{2–5} Apart from reducing potentially avoidable ED presentations, integration of inpatient and community teams could conceivably improve discharge planning, LOS, and reduce readmissions. We did observe a reduction in ED presentations and 28-day re-presentations following the implementation of the redesigned program, although there was no observable reduction in inpatient LOS. Since this model was

implemented, the service has been maintained with largely stable design. With passing time and increasing demands of a growing RAC population and the coronavirus pandemic, there will be need for ongoing service review and opportunities for further study. Future research could compare outcomes for specific units and services most engaged with RIR, or conditions most amenable to RIR referral. Greater engagement with treating inpatient units is also an area of planned service development.

Limitations

As this is a retrospective observational study with a historical control group (ie, pre- and post-), it lacks adequate controls for potential confounding variables and we cannot necessarily infer any causal link between the implementation of the new model and the reduction in ED presentations observed in the second time period. The analysis assumes 100% RAC occupancy rate which may not be true. Overall numbers for some comparisons are small (eg, RIR service outcomes) are small and so results should be interpreted with caution, and findings in one hospital catchment in may not be generalizable to other Australian regions or countries. That said, our ED presentation rate was similar to that reported in other Australian services (between 16–211 visits/100 RACs/year).^{25,31}

Other factors not accounted for include change in practices of GPs and RAC nursing skill-mix and resident frailty, which could all vary across the study. However, we hypothesize that the complexity and acuity of RAC residents (and as such, hospital presentation rates) should be to be similar or greater in the latter period. By auditing 2 successive 12-month periods we sought to mitigate seasonal variation and RAC staffing changes.

Because of the retrospective nature of this study, important clinical outcome measures such as morbidity and functional outcomes were not analyzed. These are important indicators of quality of care, together with consumer satisfaction. Future prospective data collection should allow for measurement of functional outcomes and consumer satisfaction measures, to fully appreciate the impacts of the service.

Conclusions and Implications

This study has demonstrated that a redesigned RIR program to increase geriatric medical expertise, continuity of care and handover between hospital and RAC settings, and engagement with key stakeholders (RAC staff, primary care, ED, and inpatient units) has enabled the service to increase its engagement with RAC and increase the number of visits. During this period a reduction in ED presentations, 28-day re-presentations and costs per 100 RAC beds was also observed, although because of the retrospective nature of the data, and inability to account for important confounders, a causal relationship cannot be inferred.

Given that the provision of quality care is one of the main aims of the RIR program, further research is necessary to better evaluate consumer satisfaction and clinical outcomes of this service.

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