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ORIGINAL ARTICLE

Rapid Access Chest Pain Clinics: An Australian Cost-Benefit Study

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Objective Chest pain is a large health care burden in Australia and around the world. Its management requires specialist assessment and diagnostic tests, which can be costly and often lead to unnecessary hospital admissions. There is a growing unmet clinical need to improve the efficiency and management of chest pain. This study aims to show the cost-benefit of rapid access chest pain clinics (RACC) as an alternative to hospital admission.

Design Retrospective cost-benefit analysis for 12 months.

Setting RACCs in three Sydney tertiary referral hospitals.

Main outcome measures Cost per patient.

Results Hospitals A, B and C implemented RACCs but each operating with slightly different staffing, referral patterns, and diagnostic services. All RACCs had similar costs per patient of AUD$455.25, AUD$427.12 and AUD$474.45, hospitals A, B and C respectively, and similar cost benefits per patient of AUD$1,168.75, AUD$1,196.88 and AUD$1,149.55, respectively. At least 28%, 26% and 29% of these RACC patients for hospitals A, B, and C, respectively, would have otherwise had to have been admitted to hospital for the model to be cost-beneficial.

Conclusion This study shows that a RACC model of care is cost-beneficial in the state of NSW as an alternative strategy to inpatient care for managing chest pain. Scaling up to a national level could represent an even larger benefit for the Australian health system.

Keywords Chest pain • Clinic • Economic evaluation

Introduction

Cardiovascular disease (CVD) has the highest level of health care expenditure of any disease group in Australia, costing ~AUD$7.6 billion (12% of all national health expenditure) in 2008–09, with almost 60% of that expenditure was for hospital admitted patient services [1]. In 2016–17, an estimated 11% of all hospital admissions in Australia were associated

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with CVD [2]. The number of acute hospitalisations for CVD as the principal diagnosis increased by 32% between 2000–01 and 2016–17, despite the age-standardised rate declining by 14% over this period [2].

Chest pain is one of the most common presentations to adult emergency departments, and typically requires specialist assessment and diagnostic investigation/s. Concerns regarding patient safety related to potential underlying cardiac causes leads to potentially unnecessary and costly hospitalisations. However, only a small proportion (11–28%) of chest pain patients actually have an acute coronary syndrome [3]. Thus, there is a growing unmet need to improve the efficiency of chest pain management—and this has been identified as a major goal of the three local health districts partnered with the University of Sydney as Sydney Health Partners. Across this Advanced Health and Research Translation Centre (AHRTC), we have implemented a network of outpatient rapid access chest pain clinics (RACC) and an associated research platform to facilitate real-time assessment and innovative opportunities to improve diagnosis and management of chest pain.

RACC services are hospital located cardiologist-led outpatient clinics providing prompt assessment, risk stratification, and management of acute chest pain. The RACC model of care is common in the United Kingdom (UK) [3] where it has been shown to be safe and effective in managing troponin negative low-to-intermediate risk chest pain [4]. Good safety and acceptability have also been shown in Australia [5], as well as high patient satisfaction [6]. However, there have not been any published health economic assessments on the RACC model in Australia.

The aims of this study were A) to characterise the contemporary utility of different RACC models in three hospitals across Sydney Health Partners, and B) to assess the potential cost-benefit of these different RACC models of care using Australian costings from a public hospital perspective.

Methods

Each participating hospital was coded A, B, and C for the purpose of this study.

Part A – *Characterising RACC utility*. This included the assessment of contemporary characteristics and utility of the RACCs in three Sydney hospitals associated with Sydney Health Partners AHRTC, with quantitative and qualitative descriptors. The study period occurred from 1 November 2017 to 31 October 2018.

Part B – *Modelling*. A cost-benefit analysis of chest pain hospital admission avoidance by different RACC models was performed from a public hospital perspective. Costings were collected from the New South Wales Health staffing awards (for staff salaries in 2018), and the Independent National Pricing Authority's National Hospital Cost Data Collection [7] using AR-DRG F74b—chest pain, for the financial year 2016–17. The Australian Refined Diagnosis Related Groups *(AR-DRGs)* is an Australian admitted patient classification system, in which each AR-DRG represents a class of patients with similar clinical conditions requiring similar hospital services. AR-DRG F74b encompasses patients with chest pain of 'minor complexity' and equates to actual total costs of AUD$1,635 and an average length of stay of 1.1 days. This is in contrast to AR-DRG 74a, which includes patients with chest pain of 'major complexity' and holds actual total costs of AUD$3,367 and an average length of stay of 1.8 days. The estimated average cost per patient was calculated as the total staffing cost divided by number of patients. The net cost-benefit per patient was calculated as the difference between the average cost per RACC patient and the predicted cost of admission per patient (which was calculated as the cost per patient-cost of AR-DRG F74b). The threshold percentage of RACC patients that would otherwise have needed to have been admitted to hospital for the model to 'break even' and be cost-beneficial was calculated as $\%\ \text{of patients} \geq \frac{(\text{cost of RACC} \div \text{cost of AR} - \text{DRG F74b})}{\text{total number of patients}} \times 100$.

Results

Part A

Characteristics of the RACCs in three hospitals

We characterised RACC utility at each of the three hospitals, examining the period from 1 November 2017 to 31 October 2018. Hospital A implemented their RACC full-time in February 2017, hospital B in July 2015, and hospital C in August 2008. Figure 1 displays a generalised RACC model of care. However, each site has integrated the RACC model differently according to the specific needs and existing services in their local health district (LHD). Hospital A and B used their own site-specific chest pain pathways based on the NSW Health Chest Pain Pathway in conjunction with the history, electrocardiogram (ECG), age, risk factors, and troponin (HEART) Score, and hospital C uses the NSW Health Chest Pain Pathway [8]. Each has different inclusion/exclusion criteria and referral patterns based on local needs and funding (Table 1). Hospital A only accepts referrals from the emergency department and for patients deemed intermediate risk by the emergency physician based on the HEART Score [9]. Hospital B accepts low-to-intermediate risk patients (based on the HEART Score) and has the broadest referral pattern from the emergency department, hospital outpatient clinics, hospital inpatient discharge follow-ups, general practitioners (GPs), and other external referrers. Hospital C accepts referrals for low-to-intermediate risk patients (based on the chest pain pathway). and predominantly from the emergency department, but also accepts referrals from GPs and hospital outpatient clinics.

Hospital A has five RACC sessions per week (one per day) with capacity for four patients per session; hospital B runs six RACC sessions per week with capacity for 10–18 patients per session; and hospital C runs two sessions per week with capacity for four patients per session. Patients are seen on average within 24–48 hours at hospital A; 48 hours–5 days at

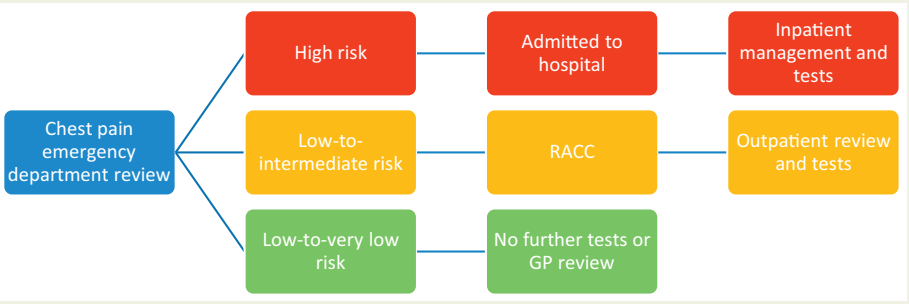

Figure 1 The RACC model.
Abbreviations: RACC, rapid access chest pain clinics; GP, general practitioner.

Table 1 Comparison of RACC inclusion criteria.

	Hospital A	Hospital B	Hospital C
Low risk chest pain	No	Yes	Yes
Intermediate risk chest pain	Yes	Yes	Yes
High risk chest pain	Yes, discouraged	Yes, discouraged	No
Preoperative assessment	No	Yes	Occasional
CVD risk factor assessment	No	Yes	Yes

Abbreviations: RACC, rapid access chest pain clinics; CVD, cardiovascular disease.

Table 2 Available diagnostic tests and time to attain.

	Hospital A	Hospital B	Hospital C
	Time to Attain	Time to Attain	Time to Attain
TTE	Same d	2 sessions per wk	Same d
EST	Same d	2 sessions per wk	Pre clinic
ESE	Same d	Limited	Within a wk
MIBI	Variable	Variable	Variable
CTCA	Same d or 24–48 hr	48 hr	Within a wk
CMR	Within a wk	Weeks	N/A
Holter	As required	As required	As required

Abbreviations: TTE, transthoracic echocardiograph; EST, exercise stress test; ESE, exercise stress echocardiography; MIBI, myocardial perfusion imaging; CTCA, computed tomography coronary angiography; CMR, cardiac magnetic resonance.

hospital B; and 5–10 days at hospital C but with a preceding exercise stress test within 48–72 hours of referral.

A variety of dedicated staff are used at the different clinics. Hospital A works with two doctors per session (a staff specialist cardiologist and a cardiology advanced trainee) plus a cardiac technologist (grade 2) to operate the stress tests. Hospital B works with four doctors per session (a staff specialist cardiologist, a cardiology advanced trainee, and two junior doctors) plus two nurse supports. Hospital C works with two doctors per session (a staff specialist cardiologist and a cardiology advanced trainee) plus one nurse support. No RACC has dedicated administrative staff but rather uses administrative staff already working in the cardiology departments of each hospital.

All three RACCs are located in their respective hospitals' outpatient facilities. The diagnostic services utilised by each RACC are summarised in Table 2 and as follows:

Hospital A uses primarily either stress echocardiography or computed tomography (CT) coronary angiography (CTCA) as the first line investigation. CTCA occurs at a local private radiology facility on the same day immediately prior to the clinic review. Stress echocardiography occurs during the clinic visit, in the clinic facility. Alternative tests are available to patients who cannot exercise or for other reasons, and these include stress cardiovascular magnetic resonance (CMR, at a local private radiology facility) and nuclear stress perfusion imaging (MIBI, at a local private facility or the public hospital). Echocardiography and Holter monitors are available on the same day as required, in the cardiology department of the hospital.

Hospital B primarily uses exercise stress electrocardiography (ECG) as the first line investigation, which are performed in the cardiology department twice weekly. It also frequently utilises CTCA at a local private radiology facility, available within 48 hours of the clinic visit. Other tests are available if required but with varying waiting times, such as stress echocardiography (performed in the public hospital, limited availability), MIBI (performed at a local private radiology facility or the public hospital). Echocardiography and Holter monitors are available within 1–2 days in the cardiology department of the hospital.

Hospital C primarily orders exercise stress ECG prior to the clinic visit and these are done in the cardiology department within 1–5 days prior to the clinic appointment. It also utilises other investigations after the clinic visit, such as stress echocardiography (performed in the cardiology department), and MIBI and CTCA located within the hospital's nuclear medicine and radiology departments, respectively. Echocardiography and Holter monitors are also available in the cardiology department as required.

Table 3 Costs involved in each RACC, the estimated cost per patient, and the estimated net cost benefit per patient during the study period.

RACC - Hospital A		RACC - Hospital B		RACC - Hospital C	
Expenses		Expenses		Expenses	
RACC staffing		RACC staffing		RACC staffing	
Cardiologist, 0.5 FTE	$124,136	Cardiologist, 0.6 FTE	$148,963	Cardiologist, 0.2 FTE	$49,654
Advanced Trainee, 1.0 FTE	$121,393	Advanced Trainee, 1.0 FTE	$121,393	Advanced Trainee, 0.2 FTE	$24,279
Cardiac technologist, 0.5 FTE	$48,561	Nurse, 2 x 0.6 FTE	$131,430	Nurse, 0.2 FTE	$21,905
		Junior doctor, 2 x 0.6 FTE	$93,246		
Total	$294,090	Total	$495,032	Total	$95,838
Number of RACC patients	646	Number of RACC patients	1159	Number of RACC patients	202
Cost per patient	$455.25	Cost per patient	$427.12	Cost per patient	$474.45
Savings		Savings		Savings	
Chest pain admission cost (AR-DRG 74b)	$1,624	Chest pain admission cost (AR-DRG 74b)	$1,624	Chest pain admission cost (AR-DRG 74b)	$1,624
Net benefit per patient	$1,168.75	Net benefit per patient	$1,196.88	Net benefit per patient	$1,149.55

$=AUD (Australian dollars).
Abbreviations: RACC, rapid access chest pain clinics; FTE, full-time equivalent; AR-DRG, Australian Refined Diagnosis Related Groups.

All clinics saw each patient at least once, and if a patient required a second or third test the patient would return for follow-up to discuss their results. After all tests are completed, each RACC discharges their patients with planned follow-up to general practitioners, and/or other outpatient services if required (public and private options available at each site). All clinics can admit patients directly to hospital, according to local protocol, for inpatient investigations including on-site invasive angiography and intervention if clinically required.

Part B

We next calculated the potential cost per patient in each RACC model of care, and thus estimated the potential cost-benefit per patient compared to inpatient care. Our key assumptions were, firstly, that all the patients treated in each RACC would have otherwise been admitted to hospital if they hadn't been treated in the RACC and that hospital admission would have cost that of AR-DRG F74b. Secondly, we assumed that these low-to-intermediate risk patients would all be clinically appropriate to be managed in an outpatient setting from a safety and logistical point of view. And thirdly, the number of diagnostic investigations would be the same for both inpatient and RACC care and thus these costs were not factored into the RACC models.

During the study period, hospital A treated 646 individual patients in their RACC, hospital B treated 1,159 patients, and hospital C treated 202 patients. The included patients were only those referred from the respective hospital's emergency departments. Those patients referred from other outpatient methods were not included due to different billing strategies. Table 3 summarises the costs involved with each RACC during the 12-month study period. All three RACCs had similar costs per patient of AUD$455.25, AUD$427.12 and AUD$474.45, hospital A B and C respectively, and similar net cost-benefits per patient of AUD$1,168.75, AUD$1,196.88 and AUD$1,149.55, hospital A, B and C respectively.

The cost per patient and net benefit per patient assumes that 100% of the patients seen in each RACC would have otherwise been admitted to hospital. This assumption is debatable, and thus we next calculated the threshold percentage of patients that would have needed to have been admitted to hospital for each RACC to 'break even' and be cost-beneficial. This equated to $\geq$ 28%, 26% and 29% for hospitals A, B, and C, respectively.

Discussion

This study highlights that RACCs are a cost-beneficial model of care as an alternative to inpatient hospital care for patients presenting with chest pain suspicious of being cardiac in origin. The RACCs included in this study operated slightly differently but despite this showed a similar cost per patient in the range of AUD$427.12–$474.75, and a similar net cost-benefit per patient in the range of AUD$1,149.55–$1,196.88.

The variations between the clinics ranged from differences in referral patterns, staffing, diagnostic investigations and patient/clinic numbers. These variations were likely a reflection of the availability of inpatient/outpatient health care resources and alternative pathways (particularly the private sector); variations in local chest pain management protocols including access to tests and services; and population density and differences in socioeconomic and ethnic characteristics. Despite these variations, we showed in the economic models that there were similar cost-benefits per patient in the different public hospitals. This supports using a RACC model of care across different local health networks in Australia.

We demonstrated substantial cost benefits from an Australian hospital perspective. Of note, we did not calculate costs involved in a RACC from a public health system perspective, which would be interesting if considering implementing RACCs across Australia. The figures presented were conservative and based on simple costings—staffing and AR-DRG costs. We chose to use the F74b minor complexity code as it was the most conservative costing. Some of the chest pain patients may indeed have been suitable to be coded under the F74a major complexity code (a costly AR-DRG), which would have resulted in further cost savings per patient if these patients would have been treated in a RACC rather than as an inpatient.

These models assumed that all patients seen in each RACC would have otherwise been admitted to hospital. This may not be the case—hospital A referred intermediate risk patients (which typically are admitted to hospital), however hospitals B and C refer both low and intermediate risk patients (typically low risk patients are discharged home from emergency departments with no or limited follow-up). Therefore, we calculated the threshold at which each RACC would remain cost beneficial, and these admission rates (ie, proportion of patients deemed intermediate risk) were low, in the range of 26–29%. As a comparison, the unpublished local admission rates for chest pain presentations at the study hospitals in 2016 were in the range of 34–66%. These admission rates emphasise the importance of specific selection criteria for referring to a RACC in order to capture particular at-risk patients. For example, if the majority of patients who attend are low risk and would otherwise not be admitted to hospital for investigations, then the cost-benefit in this scenario would fall. We were unable to retrospectively gather data on our cohorts about their risk categorisation (i.e., the proportion of low-intermediate-high risk chest pain) nor the likelihood of admission status if a RACC wasn't available.

In our model, we assumed the number of investigations would remain the same between inpatients and outpatients, but this may not be the case, and hence the savings could be more with a RACC if it did less investigations compared to inpatient care. There is data from the UK that shows a RACC model of care reduces the number of investigations per patient [10]. Of note, our model did not factor in that some of the clinic investigations utilised diagnostics in the private health care setting. Nor did it consider the private health care sector in general where many patients are managed in Australia [11]. The modelling also did not account for indirect economic costs such as the value of time (e.g. patient and carer time spent off work whilst in hospital or a RACC), transport costs, other out of pocket expenses, and future downstream costs of cardiovascular disease.

There are additional limitations to our study. The figures used in the modelling are based on national averages for chest pain (AR-DRG74b), and these could be an over- or under-estimate of actual costings in different hospitals and local health districts around Australia. We were unable to do a formal cost-effectiveness analysis utilising randomised clinical trial evidence to estimate the incremental effectiveness of RACCs on costs or cardiovascular outcomes.

The Australian population is predicted to grow and thus there is potential for growth in chest pain presentations. From a historical perspective, in Australia between 1993–94 and 2007–08, the age-standardised rate of hospitalisation with acute myocardial infarction increased by 80% and that of unstable angina by 33%, in contrast to hospitalisations for chest pain which increased by more than 200% over the same time period [12,13]. We know that the majority of chest pain presentations to Australian emergency departments are not an acute coronary syndrome (ACS), and that the assessment of such patients in emergency departments and hospitals is costly, lengthy and consumes significant resources [14]. Consequently, there is a need for more efficient models of care to manage this growth. The presented cost-benefit of a RACC model of care supports the utility of RACCs as one potential solution.

In summary, this study shows that a RACC model of care is cost-beneficial in the state of NSW as an alternative strategy to inpatient care for managing chest pain. Scaling up to a national level could represent an even larger benefit for the Australian public health system, but further modelling and research is required to make this assessment.

Declarations

There are no conflicts of interest to disclose.

We report no competing interest associated with the work reported in this manuscript.

Ethics Approval

Not required for this study.

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Nil.

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