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The updated author list should appear as below:

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We apologise for the error and any confusion this may have caused.

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The cost savings of the rural accelerated chest pain pathway for low-risk chest pain in rural general practice: a cost minimisation analysis

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ABSTRACT

Introduction. The rural accelerated chest pain pathway (RACPP) has been shown to safely reduce the number of transfers to hospital for patients who present with chest pain to rural general practice. **Aim.** This study aimed to estimate the costs associated with assessing patients with low-risk chest pain using the RACPP in rural general practice compared with transporting such patients to a distant emergency department (ED). **Methods.** This was a retrospective cost minimisation analysis. All patients with low-risk chest pain that were assessed in New Zealand (NZ) rural general practice using the RACPP between 1 June 2018 and 31 December 2019 were asked to participate. The costs incurred by patients were determined by an online survey. Patients were also asked to estimate the costs if they would have been transferred to ED. System costs were obtained from the relevant healthcare organisations. The main outcome measure was the total cost for patients who present with low-risk chest pain. **Results.** In total, 15 patients (22.7% response rate) responded to the survey. Using the RACPP in general practice resulted in a median cost saving of NZ\$1184 (95% CI: \$1111 to \$1468) compared with transferring the same patient to ED. **Discussion.** Although limited by low enrolment, this study suggests that there are significant savings if the RACPP is used to assess patients with low-risk chest pain in rural NZ general practice.

Keywords: chest pain, cost minimisation, cost of illness, diagnostic pathways, point-of-care, rural communities, rural general practice, transfer, troponin.

Introduction

Accelerated diagnostic chest pain pathways (ADP) are able to rapidly identify a cohort of patients that are low-risk for major adverse cardiac events (MACE) who can be discharged safely, reducing hospital admissions and shortening time in emergency departments (ED).^{1,2} All urban ED in New Zealand (NZ) have implemented ADP that incorporate high-precision (sensitivity) troponin.¹ Some rural general practices have access to lower precision point-of-care troponin (POC-cTn) and have adopted the rural accelerated chest pain pathway (RACPP) that incorporates POC-cTn.^{3,4}

A recent prospective evaluation of the RACPP demonstrated that the clinical outcomes (30-day MACE) are equivalent to ADP used in urban emergency departments. The RACPP reduced the requirement for patients with low-risk chest pain (44% of all patients with chest pain) who presented to rural general practice to travel to a distant ED.³ The adoption of the RACPP by rural general practices, therefore, has the potential to reduce costs for both patients and the healthcare system.

This study aimed to estimate the costs associated with assessing patients with low-risk chest pain using the RACPP in rural general practice compared with transporting such patients to a distant ED.

WHAT GAP THIS FILLS

What is already known: To access the current standard-of-care for chest pain assessment, patients in rural and remote areas have historically had to travel large distances to hospital emergency departments. The rural accelerated chest pain pathway that incorporates point-of-care troponin allows assessment in rural general practice and patients assessed as low-risk can remain in their communities. The comparative costs of these two assessment approaches are unknown.

What this study adds: There are potential savings to both the patient and the health system when assessment for low-risk chest pain is completed in rural general practice using the rural accelerated chest pain pathway.

Methods

A retrospective cost minimisation analysis was conducted to quantify the costs for patients with chest pain who were assessed with the RACPP and subsequently discharged as low-risk from rural general practice. These were compared with the estimated costs if the patient had been transferred for assessment in a Waikato District Health Board ED. The primary outcome was total costs, but costs were also considered for both the patient and the health system separately.

Study setting

The Waikato region is in the North Island of New Zealand and has a large rural population. It has a tertiary level hospital based in Hamilton, with four rural hospitals within the region. For many rural towns, acute care is provided by rural general practice, with referral to a rural or urban hospital if required.

Patient inclusion

All patients aged >18 years who had chest pain and that were assessed as low-risk in rural general practices using the RACPP between 1 June 2018 and 31 December 2019 were invited to participate. Low-risk patients were eligible to be discharged and managed in the community. Full low-risk criteria are described elsewhere.⁵

Patient exclusion

Patients that did not respond or did not consent were excluded.

Patient identification

Patients were identified using the Pinnacle Primary Healthcare Organisation's RACPP database and invited by email and follow-up phone call to complete an online survey in June 2020 using the web-based Qualtrics (Provo, UT)

platform. Patients who could not complete the online survey were offered the opportunity to answer questions on the phone (with co-investigator, MS).

Data collection

Information about the patient's gender, age, ethnicity, address, registered general practitioner and annual income were collected. Patients were also asked to specify the cost of seeing the GP and any prescriptions related to the chest pain episode, time away from home or work, the need for a support person, and whether they used an ambulance to access the general practice during the chest pain episode. The distance from the patient's location at the time of chest pain symptoms to the referral hospital was calculated using Google Maps. Socioeconomic deprivation was measured using NZ Deprivation Index 2018 (NZDep18) quintiles.^{6,7}

Costs not provided by the patient were calculated, as described in Box 1. Where the patient did not provide their income, or they were unwaged, the national average income was substituted.⁸ Patients were also asked to estimate the time spent and distance travelled by a support person, if appropriate.

A sensitivity analysis for productivity losses was performed, which included the Jobseeker support benefit, NZ superannuation payment, NZ minimum wage and no productivity losses.^{9–11} All costs were in NZ dollars and current as of 31 December 2019.

Power calculation

There are no applicable cost-of-illness studies to guide power calculation, and international studies have shown wide variation in costs incurred for coronary artery disease.^{12,13} We estimated that 35 patients will show a difference in the costs incurred at an alpha of 0.05 and with 80% power, where the only difference between the assessment strategies is related to travel (estimated to be NZ\$100). Predicting a 50% survey return rate, we anticipated inviting 70 patients to complete the survey.

Statistical analysis

Frequency (percentage) and median (interquartile range (IQR)) of the costs are presented for categorical and continuous data respectively. The median difference in the total costs, as well as the cost to the patient and system, were calculated. For the differences in costs, 95% confidence intervals (95% CI) were estimated by resampling the data with 1000 bootstrapped samples.

Ethics

Ethical approval was obtained through the University of Otago's Human Ethics Committee (H20/033), and consultation was undertaken with the Ngāi Tahu Research

Consultation Committee. Consent was obtained from each patient using the Qualtrics (Provo, UT) survey software. Identifying patient information was removed from the

data record once the online survey had been completed. All data were encrypted and will be kept securely for a duration of 10 years and then destroyed, as per University of Otago policy.

Box 1. Assumptions for both patient and system costs where they were not known. All costs are in New Zealand Dollars and current as of 31 December 2019

Patient costs		
General practice consultation fee	Substituted with costs from registered general practice's website	
Productivity losses (time away from home or work)	New Zealand (NZ) national average income ⁸	\$997/week (24.97/h)
	Jobseeker support benefit ⁹	\$218.98/week (\$5.47/h)
	NZ superannuation ¹⁰	\$411.15/week (\$10.28/h)
	NZ minimum wage ¹¹	\$708/week (\$17.70/h)
	No income	\$0/week (\$0/h)
Ambulance transfer	St John member	\$0
	Not St John member ¹⁶	\$98
Travel	Travel rate per kilometre (km) ¹⁷	\$0.77/km
	GP visit	1 × return trip
	Hospital presentation	1 × one-way trip for patient and return trip for support
Accommodation		\$120/night
System costs		
General practice	Primary Health Care Organisation – Primary Options Acute Care funding stream (public funding available for acute care provided in general practice that avoids a hospital admission): • gloves • needles • blood tubes • two iSTAT troponin cartridges • two electrocardiogram (ECG) • follow-up appointment	\$450
Emergency department (ED)	Triage 2 presentation (GT - Waikato DHB, pers. comm.): ¹⁸ • nursing and medical • clinical supplies • laboratory • radiology	\$812
Ambulance	St John ¹⁶	\$615

Results

Sixty-six patients were identified and invited to complete the survey. The response rate was 22.7% (15/66). Most respondents were female (12/15, 80%) and eligible for NZ

Table 1. Respondent characteristics for those who participated in the rural accelerated chest pain pathway (RACPP).

Number of respondents	15	
Sex		
Female	12	(80%)
Male	3	(20%)
Ethnicity		
NZ European/Pakeha	15	(100%)
Age (years)		
Median (interquartile range)	65	(55.5–66.5)
Paid employment		
Yes	7	(46.7%)
No	8	(53.3%)
NZDep18 ^A quintile		
1 (least deprived)	1	(6.7%)
2	2	(13.4%)
3	5	(26.7%)
4	6	(40%)
5 (most deprived)	2	(13.4%)
Members of St John Ambulance	5	(33.3%)
Partner required to support patient at general practice	4	(26.7%)
Partner required to support patient if transferred to hospital	6	(40%)
Required ambulance transfer to general practice	1	(6.7%)
Anticipated will have required accommodation if transferred to hospital	2	(13.3%)
Median distance travelled to general practice (IQR)	2 km	(1.2–19.2)
Median distance travelled if transferred to an emergency department (IQR)	46.9 km	(21.6–56.2)
Referral centre		
Waikato Hospital	6	(40%)
Rural Hospital within Waikato District Health Board	7	(60%)
30-day MACE	0	(0%)

^ANew Zealand Index of Deprivation 2018 quintile based on the mesh block of the patient's home address.⁶

superannuation (8/15, 53.3%). All were NZ European/Pakeha. Patient demographic information is shown in Table 1. There were no 30-day MACE recorded.

Primary outcome

The median total cost (combined patient and system costs) attributed to patients who were assessed using the RACPP in general practice was NZD\$593 (IQR NZ\$550 to NZ\$618), whereas the median total cost attributed to patients who would have presented to the emergency department via ambulance was NZ\$1896 (IQR NZ\$1731 to NZ\$2049).

There was a median difference of NZ\$1184 (95% CI NZ\$1111 to NZ\$1468) between the total costs of the two assessment strategies. The median difference in costs for patients was NZ\$344 (95% CI NZ\$136 to NZ\$458), and the median difference in costs for the health system was NZ\$977 (95% CI NZ\$977 to NZ\$977). Table 2 shows the costs incurred by the patient, the health system and the total costs. The difference in costs for individual patients are presented in Supplementary Fig. S1.

Sensitivity analysis

Lost productivity costs range between NZ\$0 (IQR NZ\$0 to NZ\$60) and NZ\$91 (IQR NZ\$49 to NZ\$111) for patients

assessed in general practice with the RACPP and NZ\$0 (IQR NZ\$0 to NZ\$137) and NZ\$326 (IQR NZ\$195 to NZ\$391) for patients assessed in the ED depending on the amount substituted for unknown wage (Supplementary Table S1).

Discussion

The main finding of this cost minimisation analysis is that there is a potential saving per low-risk chest pain episode (median saving NZD\$1184) when the patient is assessed in rural general practice rather than transferred to an ED within the Waikato region. These savings were to both the patient and the healthcare system. Patients had reduced transportation costs and productivity losses. Total cost savings were present regardless of the substituted income level of the patient. The costs of ED assessment and ambulance transfer to the health system exceeded the costs of Primary Options Acute Care funding streams paid to general practices.

This is the first study that we are aware of that provides an estimate of the cost savings of performing acute chest pain assessment in rural general practice compared with performing this same assessment in a distant ED. These findings are consistent with a previous study that has demonstrated that rural patients are faced with considerable

Table 2. Median cost and interquartile range for (a) the patient, (b) the healthcare system and (c) total costs for the assessment of low-risk chest pain.

	RACPP		ED	
	Median	IQR	Median	IQR
Patient costs				
Lost productivity ^A	91	(49–124)	326	(195–391)
Travel	3	(2–22)	108	(18–128)
General practice co-payment	35	(20–40)	NA	NA
Prescription fees	0	(0–0)	NA	NA
Ambulance charges	0	(0–0)	95	(0–95)
Accommodation	0	(0–0)	0	(0–0)
Total patient costs	143	(101–168)	469	(270–612)
System costs				
Primary options ^B	450	(450–450)	NA	
ED costs ^C	NA	NA	812	(812–812)
Ambulance transfer	0	(0–0)	615	(615–615)
Total system costs	450	(450–450)	1427	(1427–1427)
Total costs	593	(550–618)	1896	(1731–2049)

Estimated costs are presented for the use of the Rural Accelerated Chest Pain Pathway (RACPP) in rural general practice and if the patient was transferred directly to the ED (all costs are in New Zealand Dollars).

NA, not applicable.

^ALost productivity: Where income was unknown, the median New Zealand income (\$24.97/h) was substituted.

^BPrimary options for acute care: public funding available for acute care provided in general practice that avoids a hospital admission.

^CEmergency department costs based on a triage 2 presentation with chest pain.

extra costs if they are required to travel to urban centres to access 'free' outpatient specialist health care.¹⁵

Major limitations to this study included the low survey response rate, despite efforts to email and phone invited participants. The absence of Māori or other ethnic groups in the study cohort limits the widespread applicability of this study to rural NZ. There is a risk of recall bias as participants were asked to recount their historic costs. Fortunately, most of these costs were able to be verified. Asking participants to make educated guesses about potential time away from home or work for themselves and their partners also adds the potential for bias and error; however, this methodology has been successfully used elsewhere.¹⁵

Given the voluntary nature of the study, response bias may have influenced the results. Similarly, ready access to the internet might also have limited responses, although this was mitigated by follow-up phone-calls by investigators. There may also be additional costs that we have not accounted for. These include the costs of major equipment (analysers), the cost of training and on-going quality assurance in either general practice or ED settings. The potential savings from implementing the RACPP will likely outweigh these costs over time. Assumptions made in this study (e.g. regarding fixed costs such as ambulance costs and charges) might also limit the study's generalisability.

A cost minimisation study is considered a less attractive methodology than other health economic analyses;¹⁴ however, it is a simple and pragmatic methodology that can be justified in this instance, as we have already demonstrated that the clinical outcomes (no recorded 30-day MACE) were comparable to accelerated chest pain pathways used in urban EDs.^{1,3}

Although limited by sample size, this study suggests that the assessment of chest pain in general practice results in cost savings for low-risk patients compared with transporting the patient to a urban hospital ED. Widespread investment and roll-out of the RACPP in rural (and other) settings has the potential to reduce costs for both patients and the NZ health service.

Supplementary material

Supplementary material is available [online](#).

References

- 1 Than MP, Pickering JW, Dryden JM, *et al*. ICare-ACS (Improving Care Processes for Patients With Suspected Acute Coronary Syndrome): a study of cross-system implementation of a National Clinical Pathway. *Circulation* 2018; 137(4): 354–63. doi:10.1161/CIRCULATIONAHA.117.031984
- 2 Than M, Herbert M, Flaws D, *et al*. What is an acceptable risk of major adverse cardiac event in chest pain patients soon after discharge from the Emergency Department? *Int J Cardiol* 2013; 166(3): 752–4. doi:10.1016/j.ijcard.2012.09.171
- 3 Miller R, Nixon G, Pickering JW, *et al*. A prospective multi-centre study assessing the safety and effectiveness following the implementation of an accelerated chest pain pathway using point-of-care troponin for use in New Zealand rural hospital and primary care settings. *Eur Heart J Acute Cardiovasc Care* 2022; 11: 418–27. doi:10.1093/ehjacc/zuac037
- 4 Miller R, Stokes T, Nixon G. Point-of-care troponin use in New Zealand rural hospitals: a national survey. *N Z Med J* 2019; 132(1493): 25–37.
- 5 Miller R, Young J, Nixon G, *et al*. Study protocol for an observational study to evaluate an accelerated chest pain pathway using point-of-care troponin in New Zealand rural and primary care populations. *J Prim Health Care* 2020; 12(2): 129–38. doi:10.1071/HCI19059
- 6 Atkinson J, Salmond C, Crampton P. NZDep2018 Index of Deprivation. Wellington, New Zealand: Department of Public Health, University of Otago, Wellington; 2019. Available at <https://www.otago.ac.nz/wellington/departments/publichealth/research/hirp/otago020194.html> [Accessed 1 August 2020].
- 7 Giffney S. Addressable: A simple RESTful JSON web API. New Zealand; 2020. Available at <https://api.addressable.co.nz> [Accessed 31 August 2020].
- 8 StatsNZ:Tatauranga Aotearoa. Labour market statistics (income): June 2018 quarter. August. 2018. Available at <https://www.stats.govt.nz/information-releases/labour-market-statistics-income-june-2018-quarter> [Accessed 29 November 2019].
- 9 Work and Income. Jobskeeper Support cut-out points (current). 2019. Available at <https://www.workandincome.govt.nz/map/deskfile/main-benefits-cut-out-points/jobseeker-support-cut-out-points-current.html> [Accessed 14 February 2020].
- 10 Work and Income. New Zealand Superannuation and Veterans Pension rates (current). 2019. Available at <https://www.workandincome.govt.nz/map/deskfile/nz-superannuation-and-veterans-pension-tables/new-zealand-superannuation-and-veterans-pension-ra.html> [Accessed 14 February 2020].
- 11 Employment New Zealand. Current minimum wage rates. 2018. Available at <https://www.employment.govt.nz/hours-and-wages/pay/minimum-wage/minimum-wage-rates/> [Accessed 14 February 2020].
- 12 Zhao Z, Winget M. Economic burden of illness of acute coronary syndromes: medical and productivity costs. *BMC Health Serv Res* 2011; 11(1): 35. doi:10.1186/1472-6963-11-35
- 13 Le C, Fang Y, Linxiong W, *et al*. Economic burden and cost determinants of coronary heart disease in rural southwest China: a multi-level analysis. *Public Health* 2015; 129(1): 68–73. doi:10.1016/j.puhe.2014.11.002
- 14 Dakin H, Wordsworth S. Cost-minimisation analyses versus cost-effective analyses, revisited. *Health Econ* 2013; 22(1): 22–34. doi:10.1002/hec.1812
- 15 Fearnley D, Kerse N, Nixon G. The price of 'free'. Quantifying the costs incurred by rural residents attending publicly funded outpatient clinics in rural and base hospitals. *J Prim Health Care* 2016; 8(3): 204–9. doi:10.1071/HCI16014
- 16 St John. Charges: Ambulance charges explained. 2019. Available at <https://www.stjohn.org.nz/globalassets/documents/st-john-ambulance-charges-explained--english-opsno031july2016.pdf> [Accessed 29 November 2019].
- 17 Inland Revenue Department. Kilometre rates for business use of vehicles 2018-2019 income year. 2020. Available at <https://www.ird.govt.nz/income-tax/income-tax-for-businesses-and-organisations/types-of-business-expenses/claiming-vehicle-expenses/kilometre-rates-2018-2019>
- 18 Australasian College of Emergency Medicine. Guidelines on the implementation of the Australasian Triage Scale in Emergency Departments. 2016. Available at https://acem.org.au/getmedia/51dc74f7-9ff0-42ce-872a-0437f3db640a/G24_04_Guidelines_on_Implementation_of_ATS_Jul-16.aspx [Accessed 9 January 2020].

Data availability. De-identified data will be made available upon reasonable request to the corresponding author.

Conflicts of interest. Tim Stokes is an Editor of *The Journal of Primary Health Care*, but was blinded from the peer review process for this paper.

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