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Coronary artery bypass graft surgery in New Zealand's Auckland region: a comparison between the clinical priority assessment criteria score and the actual clinical priority assigned

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Abstract

Aims To describe the cohort of patients waiting for Coronary Artery Bypass Graft (CABG) surgery in the Auckland region; compare the Clinical Priority Assessment Criteria (CPAC) score with the actual priority assigned; and to assess the impact of a patient's demographic characteristics on the CPAC score and the assigned priority.

Methods An electronic register was developed to capture all patients who had a CPAC form completed for isolated CABG surgery during the period June 2002 to September 2004 in the Auckland region. CPAC scores and clinical priority assigned were collected from the CABG booking form. Demographic characteristics came from the booking form (age, gender) or linkage via the National Health Index (NHI) number (ethnicity, deprivation score).

Results The cohort displayed severe coronary artery disease and symptoms: 70% had class 3 or class 4 angina; 89% had their ability to work, live independently, or care for dependents threatened; 65% had three-vessel coronary disease; and 26% had left-main coronary disease. The CPAC score correlated only modestly with the actual clinical priority assigned, with an extremely wide range of scores for any given clinical priority. The mean CPAC score varied by the age of the patient, level of deprivation, and ethnicity—with higher mean scores among male patients who were Maori, Pacific, or more socioeconomically deprived. Clinical priority varied less by demographic characteristics than did the CPAC score, except more women than men were assigned the 'emergency' category. Despite higher CPAC scores for Maori and Pacific men, these did not translate to greater urgency in clinical priority.

Conclusions The CPAC scoring system is used to limit access onto the CABG surgery waiting list in Auckland, but is not used to prioritise patients as to the urgency of surgery once on the list. The challenge is to determine why clinicians do not consider that the CPAC score is adequate to prioritise the urgency of surgery and to build in a process whereby any such score can be continuously evaluated and improved. We have demonstrated that the establishment of an electronic register of such patients can provide timely analysis of patterns of practice and could be used on a national scale to improve future CPAC scoring systems.

Coronary Artery Bypass Graft (CABG) surgery is effective in ameliorating angina symptoms and in some patients it improves survival.[1] In New Zealand, access to this surgery is rationed using the Clinical Priority Assessment Criteria (CPAC) scoring tool. The CPAC was developed in 1996 by a panel of clinicians using a consensus method.[2] When the score was introduced, the Ministry of Health set the threshold for

access at 35 points (of a possible 100) based on the average cost of an operation in that year and the available funding. As a result, nationally more than 50% of patients waiting for CABG surgery in 1996 were removed from the waiting list.[2] At the time, cardiologists advised that a clinically acceptable threshold was 25 points.[3]

In Auckland, clinicians use the CPAC score only to determine access to CABG and a separate clinical prioritisation process to determine a patient's priority for timing of surgery.

In this paper we describe a cohort of patients assessed for CABG surgery and investigate how the CPAC scores compare with the clinical prioritisation process and the waiting list category assigned. We also examine whether demographic characteristics (age, gender, ethnicity, and deprivation) affect these prioritisation methods.

Methods

Patients assessed for lone CABG surgery (who had a CPAC form completed during the period June 2002 to September 2004 in the Auckland region) were included in this study. An electronic CPAC database was developed, and the booking clerk for the region transferred the data from the standard paper CPAC form (see the end of this article) currently completed by clinicians into this database.

The CPAC score consists of five components that add up to a maximum of 100 points:

1. The degree of coronary artery obstruction (maximum 26 points);
2. Severity of angina (23 points);
3. Results of the exercise stress test (20 points);
4. The left ventricular ejection fraction (10 points); and
5. A 'social score'—an estimation of whether a patient's "ability to work, give care to dependents or live independently" is threatened (15 points).

The clinical prioritisation is performed either at weekly joint cardiology/cardiothoracic surgery meetings (where all patients who score more than 35 CPAC points are presented) or by direct discussion with a surgeon (in the case of emergencies).

The clinical priority categories are:

1. (E) emergency—patients requiring in hospital surgery;
2. (H) urgent waiting at home;
3. (O) semi-urgent out of hospital; and
4. (A) active review;

The active review list was designed for patients just below the financial cut-off point (35 CPAC points) who were either referred back to their General Practitioners or followed with regular review in outpatients.

Ethnicity and deprivation status was identified from the New Zealand Health Information Service (NZHIS). This used each patient's unique National Health Index (NHI) number, which appears on all medical records. This number was encrypted and sent to NZHIS where it was linked to existing records—ethnicity from medical documents and place of residence in the 2001 census were identified as a result. The place of residence was converted into the ordinal New Zealand Deprivation (NZDep) index and all the information was encrypted by NZHIS. No personal identifying information was available to the researchers. This information was then linked with the information already gathered from the CPAC database.

The (NZDep) 2001 used in analysis combines nine variables from the 2001 census which reflect eight dimensions of deprivation (e.g. income, education, access to a phone).[4] It provides a deprivation score for each mesh-block in New Zealand. Mesh-blocks are geographical units defined by Statistics New Zealand, containing a median of approximately 90 people in 2001. The index of deprivation ordinal scale ranges from 1 to 10, where 1 represents the areas with the least deprived scores and 10 the areas with the most deprivation.[5]

A Student's t-test was used to test differences in mean CPAC scores between men and women. Trend tests were conducted using Cochrane-Armitage trend tests. The association of age with CPAC score was assessed in gender-specific regression models. Differences between ethnic groups were tested using analysis of variance. Generalised linear models tested for men and women separately; these models were also used to test the interactions of ethnicity and age on the CPAC score.

Results

There were very few patients in the 'active review' clinical prioritisation category (n=7), and they were excluded from the analysis leaving a total of 1351 patients.

The demographic data reflected a predominantly male, older, New Zealand (NZ) European cohort (Table 1). Women referred for CABG surgery were an average 3.2 years older than men (mean 66.8 vs 63.6 years; p=0.02). The Maori, Pacific, and Asian populations were all younger on average than the NZ European (59.6, 59.3, 59.5 vs 66.3 years; each comparison p<0.0001).

Table 1. Demographics of cohort

Variable	N	% of all
Gender		
Men	1057	78%
Women	294	22%
Mean age (SD): 64.3 (±10.1) years		
Ethnicity		
New Zealand European	897	67%
Maori	117	9%
Pacific	146	11%
Asian:	143	11%
- Indian	85	6%
- Chinese	24	2%
- Other Asian	34	3%
Other	35	3%
Not stated	13	1%
NZ Dep		
Dep 1 or 2 (least deprived)	186	14%
Dep 3 or 4	219	17%
Dep 5 or 6	257	19%
Dep 7 or 8	284	21%
Dep 9 or 10 (most deprived)	391	29%
Total number of patients	**1351**	

Data on the individual components of the CPAC score revealed a cohort of patients with severe coronary disease based on anatomy and symptoms (Table 2). The majority had three-vessel disease (65%), with a further 26% having significant left main disease. Likewise, most (70%) patients had class III or IV[*] angina.

[*] Canadian Cardiovascular Society Angina Classification:[6,7]

- Class III angina—Marked limitation of ordinary physical activity; angina occurs on walking 1 to 2 blocks on level ground or climbing 1 flight of stairs at a normal pace in normal conditions;
- Class IV angina—Inability to perform any physical activity without discomfort; anginal symptoms may be present at rest

Both the exercise stress test and the 'social' score (the ability to work, give care to dependents, or live independently) were skewed towards high scores. However, only 6% had left ventricular ejection fractions below 35%.

Table 2. Clinical Priority Assessment Criteria components for cohort

Variable	CPAC points allocated	n	%
Coronary anatomy			
1- or 2-vessel disease	6–18	126	9
3-vessel disease, no proximal Left Anterior Descending (LAD) involvement	18–20	535	40
3-vessel disease and proximal LAD	21–24	337	25
Left main artery disease	25–32	353	26
Angina class			
Nil, I, or II	0–2	400	30
III	8	326	24
IV	16–23	625	46
Exercise stress test			
Negative	0	21	2
Mildly positive	4	20	1
Positive	8	245	18
Very positive	16	330	24
Markedly positive	20	735	54
Left ventricular ejection fraction			
>50%	0	1012	75
35–50%	6	254	19
<35%	10	85	6
Ability to work, live independently, or care for dependents			
Not threatened	1	160	12
Threatened but not immediately	5	440	33
Immediately threatened	15	751	56

CPAC scores compared with actual priority assigned

There was general concordance between the mean CPAC score and the actual clinical priority assigned (Figure 1). Mean CPAC scores were higher in those patients assessed by the clinicians as having greater urgency. Those assigned as 'emergency' cases had a mean CPAC score of 65.6 (SD=13.3), while those considered 'urgent waiting at home' and 'routine out of hospital' had scores of 55.2 (10.5), and 45.2 (7.9), respectively. However, the range of scores in each clinical category was broad, with many patients in the 'routine out of hospital' group having higher CPAC scores than those in the 'emergency' category.

CPAC scores by demographic characteristics (age, gender, ethnicity, and deprivation index); see Table 3

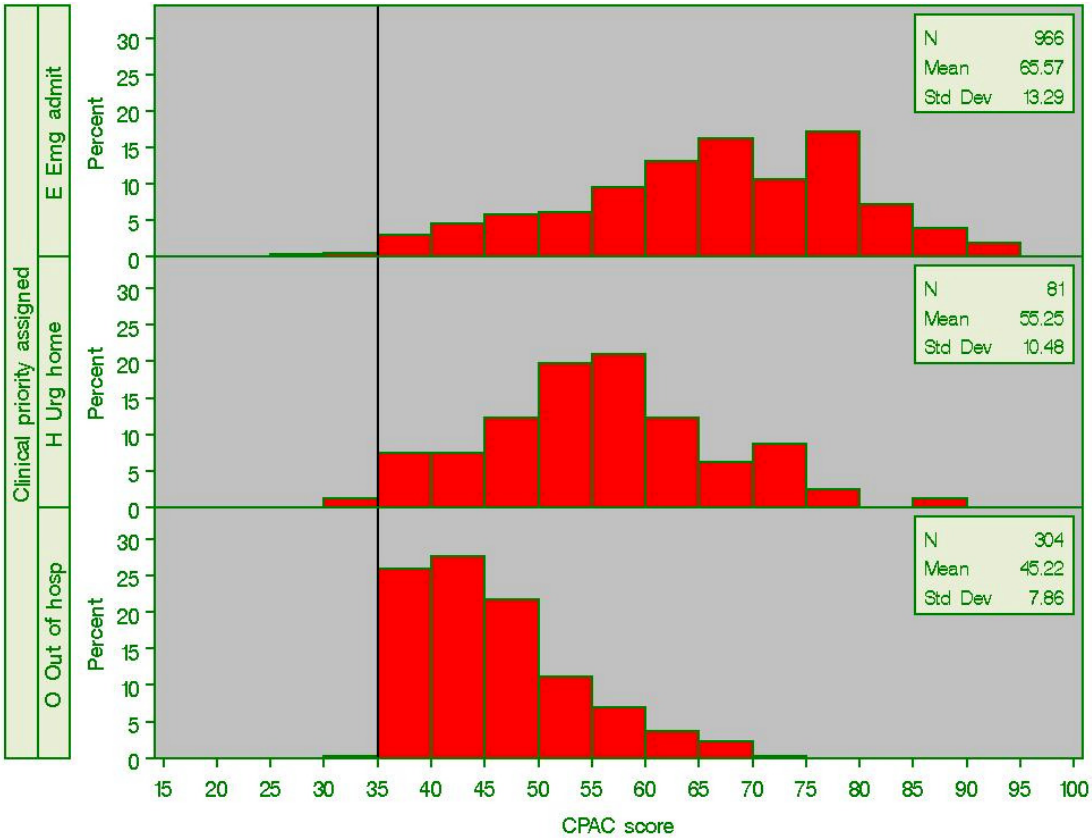
Age—For men, CPAC scores did not differ with age but for women there was a statistically significant increase of 3.3 CPAC points with each 10-year increase in age (p=0.0002).

Gender—Mean CPAC scores for women were not significantly higher than for men (61.7 vs 60.0; p=0.09).

Ethnicity—Unadjusted CPAC scores did not differ significantly between the four ethnicity groups (p=0.18) with scores for Maori and Pacific populations being 62.2, NZ Europeans and others 60.1, and Asians 59.0. After adjusting for age, there were no differences in CPAC scores among women of different ethnicities. However, among men, CPAC scores were (on average) 2 points higher for Maori and Pacific people than for other ethnicities.

Level of deprivation—The CPAC scores were associated with the level of deprivation (based on the NZDep 2001 classification) for men but not for women: on average rising 1 CPAC point for each deprivation quintile, with those most deprived scoring the highest CPAC scores (mean=62.1).

Figure 1. Clinical Priority Assessment Criteria (CPAC) scores by actual clinical priority assigned



Clinical priority assigned by demographic characteristics

Age—The clinical priority assignment did not differ significantly by age. The proportion assigned 'emergency' priority were 71%, 68%, 72%, and 76% (p=0.2) for those aged 35–54, 55–64, 65–74, and over 75 years respectively.

Gender—Women were more likely to be assigned to the 'emergency' category by the clinicians (79% versus 69%; p=0.002*).* This difference persisted after adjusting for age.

Ethnicity—The clinical assignment for 'emergency' priority did not differ between the ethnic groups.

Level of deprivation—There was no significant difference by deprivation score in the proportion assigned 'emergency' priority: 66% for the least deprived (NZDep 1–2) versus 70% (NZDep 9–10) for the most deprived (p=0.4).

Table 3. Clinical Priority Assessment Criteria (CPAC) scores and assigned clinical priority by demographic characteristics

Variable	N	CAPC score	Clinical priority assigned		
		Mean (std err)	Emergency	Urgent waiting at home	Out of hospital
All	1351	60.4 (0.4)	72%	6%	23%
Gender & age					
Men	1057	60.0 (0.5)	69%	7%	24%
30–54 years	209	60.5 (1.0)	71%	7%	22%
55–64	322	59.3 (0.9)	67%	7%	27%
65–74	353	59.7 (0.8)	70%	6%	25%
75+	173	61.4 (1.1)	72%	8%	20%
Women	294	61.7 (0.8)	79%	4%	17%
30–54 years	30	57.3 (2.5)	70%	3%	27%
55–64	76	58.7 (1.6)	74%	4%	22%
65–74	120	62.1 (1.2)	82%	3%	15%
75+	68	66.1 (1.8)	84%	4%	12%
Ethnicity					
Maori	117	62.2 (1.3)	75%	6%	19%
Pacific	145	62.1 (1.3)	72%	4%	24%
Asian	143	59.0 (1.2)	69%	5%	26%
NZ European & all other	946	60.1 (0.5)	71%	7%	22%
NZ deprivation (NZDep) score					
(least deprived)					
1–2	186	58.7 (1.1)	66%	10%	24%
3–4	219	59.7 (1.0)	74%	6%	20%
5–6	257	59.4 (0.9)	73%	6%	21%
7–8	284	60.5 (0.9)	73%	5%	22%
9–10	391	62.1 (0.8)	70%	5%	25%
(most deprived)					

Social functioning score by CPAC and demographic characteristics

The 'social score' (ability to work, give care to dependents or live independently) has three levels:

- Immediately threatened (15 points);
- Threatened but not immediately (5 points); and
- Not threatened but more difficult (1 point).

Neither age nor gender was associated with the proportion of patients assessed as 'immediately threatened' (male 55%, female 58%). No association was observed between the 'social score' and deprivation levels (p=0.99). There were differences by

ethnic group with 68% of Maori scoring as the highest category 'immediately threatened' compared with 56%, 49%and 48% for NZ Europeans, Pacific people, and Asians respectively (p=0.002).

There were highly significant differences in the proportion graded as 'immediately threatened' among those with scores 45–54 compared with those who had just made the 35 point cut-off (35–45). In the 35–45 point category, only 4.3% were categorised as 'immediately threatened' compared with 11.3% for those over 45 points (p<0.001).

Discussion

The CPAC score was introduced to prioritise patients based on their clinical need and their ability to benefit from CABG surgery.[2] In this review of patients accepted for CABG surgery in the Auckland region in 2002-4, the three principal findings were:

- The CPAC score correlated only modestly with the priority assigned by clinicians, with wide overlap between categories;
- The patients waiting for CABG surgery were a cohort with severe coronary artery disease and symptoms; and
- The most subjective component of the CPAC score (the social component) does not appear to have been used to artificially inflate the score to overcome the access threshold.

The mean CPAC scores correlated with the clinical priority assignment process, but the range within each category was so large as to cause concern. Some patients with low CPAC scores were assigned an 'emergency' category, while others with much higher CAPC scores were sent home to wait. These findings are similar to previous studies in this area.[8 9]

The reasons for this disparity may stem from suspicion of the process of developing the CPAC score,[3] or from an assertion that the score does not accurately reflect the risk of delayed surgery. For example, clinical priority is often driven by severity of angina symptoms; however, such symptoms account for only 23% of the available points.[9] Furthermore, the score was introduced in 1996 and has remained essentially unchanged, despite the emergence of other predictors of risk such as troponins and newer imaging modalities such as stress echocardiography.[10] It does not include a measure of surgical risk, scoring for redo operations, or the requirement for CABG surgery to allow another operation (e.g. hip replacement) to be undertaken safely.

The CPAC score as it is used in Auckland is in conflict with how the Ministry of Health thought that it would be implemented — i.e. used for access and to prioritise urgency. However, this is not a problem peculiar to Auckland as a recent report for the Ministry confirmed large regional variation in the CPAC process.[11]

CPAC scores were not affected by gender. However the score did vary by age (in women), ethnicity (higher in Maori), and degree of deprivation (higher for the most deprived). These differences were not reflected in the priority actually assigned by the clinicians with no difference in those classified as 'emergency' cases for Maori or the most deprived. The 'emergency' category was more likely to be assigned for women than men.

This paper provides a picture of the clinical and demographic characteristics of patients accepted for CABG in the Auckland region. It builds on earlier small studies[8,9] and confirms that most patients have severe anatomical disease and symptoms which is limiting their ability to participate in activities. Doogue et al[12] published data on 88 patients in Christchurch and like us found a significant proportion had severe coronary obstruction (25% left main, 60% multi-vessel disease) and limiting angina.

The 'social score' component of the CPAC score was examined individually as it was regarded by some as highly subjective and therefore open to clinician bias. We were interested to see whether assignment to the highest category ("immediately threatened") was affected by a patient's demographic characteristics. It was postulated that cardiologists may have equated this component of the score with the patient's ability to be in paid employment, rather than considering those not paid for work (e.g. housewives, volunteers, and the retired), who make major contributions to society. However we found no differences by age, gender, or level of deprivation. Maori patients were significantly more likely to score higher in this category than other ethnic groups.

It has also been suggested that this social component may have been used by clinicians as a potential 'fudge factor' — used to push a patient over the 35-point access threshold. To assess whether this was the case in practice, we compared the scores for those who were just above the 35-point threshold (35–44), versus those with high scores (45–54). The finding that those who just made the access threshold were less likely to score the top points in this component, suggests that this particular component of the score was not adjusted upwards to move patients above the threshold.

To our knowledge, this is the only study that has attempted to prospectively collect CPAC data on patients accepted for CABG surgery. In a relatively short time, data on 1300 patients was collected with a staff member keying-in information from the paper CPAC forms as they were completed by clinicians, which meant that data were readily available for analyses. We have demonstrated that an electronic data collection method is a viable and an effective way to collect this information, both for research and for clinical practice improvement. Our original plan was to have clinicians key data directly onto a web-based template, but this method of data capture is still under development and is currently being piloted. It is hoped that in the future all CPAC assessments throughout the country will be scored electronically.

There have been few studies that have attempted to evaluate the CPAC score. Two retrospective studies[8,9] attempted to assess the utility of the CPAC score in predicting adverse outcomes on the waiting list. Both concluded that the CPAC score did not predict cardiac events (death or admission with acute coronary syndromes). These studies were done when there were very long waiting times for CABG surgery. Our data suggests the majority of patients in the Auckland region are actually assigned an 'emergency' priority and are therefore not subject to these long waiting times.

There has only been one study which has actively reviewed the outcomes for patients who scored less than 35 points.[3] It found that for the 130 patients taken off the Auckland list, there was significant morbidity (myocardial infarction and acute coronary syndromes), transformation to emergency status, and mortality. Our study,

being based on the completion of the CPAC form has not been able to capture data on this very important group of patients.

There are other limitations in our study. We may not have been able to capture all patients accepted for publicly funded CABG surgery, with some accepted as 'emergency' cases not having had a CPAC form completed. There were also problems with the accuracy and completeness of the paper CPAC form (something that an electronic process would remedy). It became apparent that the exercise stress test component of the score was not completed in a standardised way.

There appear to be three ways for patients to be scored as having a 'markedly positive' result:

- They were exercised and met the criteria;
- They had class IV angina and it would be irresponsible to exercise them. Some cardiologists would enter 'markedly positive' on the basis that if such patients were exercised then they would return a markedly positive test.
- If this section was left blank, the booking clerk's default position was to record them as 'markedly positive.'

Also hospital assigned ethnic classifications as used in this study are known to undercount the number of Maori patients by 15–20%.[13,14] While Maori patients received higher CPAC scores than non-Maori, it is unlikely that this differential accurately reflected the unmet need in this population. It is known that both Maori and Pacific people have higher rates of coronary artery disease, mortality, and morbidity.[15] Furthermore, despite slightly higher CPAC scores, Maori and Pacific men were not assigned greater urgency by clinicians.

Conclusion

There has been little evaluation of what was a radical approach to address resource constraints and consistency of prioritisation in cardiac services in New Zealand. This paper demonstrates that the national CPAC scoring system is used to regulate access onto the CABG surgery waiting list in Auckland, but is not used to prioritise the urgency of surgery for patients once on the list. This remains the domain of cardiologists and surgeons.

The challenge for policymakers is to develop a score that can both prioritise access to and the urgency of, surgery and to build in a process whereby any such score can be continuously evaluated and updated. The Ministry of Health in conjunction with the Australasian Cardiac Society is currently developing a new CPAC score for CABG surgery which will need to be evaluated for its face and predictive validity.

To this end, we are currently developing a web-based interface that allows clinicians to input their patients' CPAC scores directly, so that a national register of all patients can be established and linked to patient outcomes. This work is part of a larger programme which has been designed to deliver good quality data on patients waiting for CABG surgery in a way that satisfies clinical demands and allows development of improved prioritisation tools over time.

Conflict of interest statement: No conflicts identified.

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CARDIAC SURGERY

National Clinical Priority Assessment Criteria (CPAC)

SURGICAL CORONARY REVASCULARISATION

Patient ID: Complete patient details or place patient sticker here

Nat. Hospital No.: _____ Consultant: _____

Name: _____ D.O.B. ___/___/___

Address: _____

_____

Name of Assessor: _____

Date of Assessment: ___/___/___

Degree of coronary artery obstruction	
No CAD > 50%	0
1 VD 50-74%	6
> 1 VD 50-74%	7
1 VD ≥ 75%	7
1 VD ≥ 90%	10
2 VD 50-89%	12
2 VD both ≥ 90%	13
1 VD ≥ 90% proximal LAD	15
2 VD ≥ 90% LAD	15
2 VD ≥ 90% proximal LAD	18
3 VD	18
3 VD ≥ 90% in at least 1	20
3 VD ≥ 75% proximal LAD	21
3 VD ≥ 90% proximal LAD	24
Left main ≥ 50%	25
Left main ≥ 75%	26
Left main ≥ 90%	32

Note: Assign patients to most severe category that applies to them. % obstruction refers to diameter loss.
LAD: left anterior descending artery
VD: vessel disease

Maximum 32

Angina	
Nil	0
Class I	1
Class II	2
Class III	8
Class IV - A	16
Class IV - B	20
Class IV - C	23

Maximum 23

Exercise stress test	
Markedly positive	20
Very positve	16
Positive	8
Mildly positive	4
Negative	0

Maximum 20

Ability to work, give care to dependents or live independently	
Immediately threatened	15
Threatened but not immediate	5
Not threatened but more difficult	1

Maximum 15

Left ventricular ejection fraction	
< 35%*	10
35 - 50%	6
> 50%	0

Notes: Applies only to patients with proximal LAD or multi-vessel disease.
* If EF <20%, evidence of reversible myocardial ischaemia is needed, eg. thallium, stress echo.

Maximum 10

Degree of coronary artery obstruction	
Angina	
Exercise stress test	
Ability	
Left ventricular ejection fraction	
Total Score =	