Original Article

Acute Coronary Syndromes in Indigenous Australians: Opportunities for Improving Outcomes Across the Continuum of Care

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Background: **Amongst a long list of health issues driving the disparity experienced by Indigenous Australians, cardiovascular disease (CVD) remains the primary target. It is the principal cause of death and of excess death among Indigenous people in Australia, and accounts for almost one-third of the life expectancy gap. Most attention has focused on the higher burden of traditional risk factors experienced by Indigenous people to explain CVD disparity. Far less attention has focused on the quality and outcomes of health system performance in explaining these differentials.**

The CASPA study was a retrospective, mixed-methods clinical registry and quality improvement program established in the NT of Australia, focused on the patterns, burdens, provision of care, experience of services, adverse outcomes and their determinants among 492 patients (214 Indigenous and 278 non-Indigenous).

Results: **Indigenous patients were significantly younger and more likely to have existing CVD risk factors and co-morbid chronic disease. During hospitalisation they received similar rates of evidence-based care with the exception of lower rates of diagnostic angiography (36.2% vs. 47.6%, $p = 0.012$), lower rates of in-patient cardiac rehabilitation (8.9% vs. 15.3%, $p = 0.03$) and lower prescription of discharge statin (44.8% vs. 57.8%, $p = 0.006$). Indigenous patients were more likely to die during two years of follow-up (30% vs. 17.8%, $p = 0.002$). Both Indigenous and non-Indigenous patients were similarly under-prescribed evidence based therapy after discharge. Exploratory qualitative examination of the experience of Indigenous patients in Alice Springs identified significant barriers to care across the continuum.**

Conclusion: **Improvements in the delivery of known effective therapies will make a significant impact on adverse outcomes in Indigenous and non-Indigenous patients alike. Comprehensive and sustained prospective data collection to compliment system reform is essential to improve outcomes and reduce disparity in CVD outcomes experienced by Indigenous Australians.**

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Keywords. Indigenous; Acute coronary syndromes; Mixed-methods; Secondary prevention; Outcomes

Background

The Burden of CVD in Indigenous Australians

Cardiovascular disease (CVD) is the leading cause of death and one of the principal contributors to disability in most economically developed countries throughout the world, across all ethnic, racial, social and gender groups [1–3]. Despite the documented falls in cardiovascular mortality in Australia, CVD remain the leading cause of death, accounting for 36% of all deaths in 2004 [4] and conservatively costing Australian society $14 billion in direct and indirect health costs [5].

Cardiovascular disease is the biggest single cause of death for the Aboriginal and Torres Strait Islander population [6], accounting for 30% of all deaths. It is also the primary contributor to life expectancy differentials between Indigenous and non-Indigenous Australians. In an analysis performed in the Northern Territory [7], CVD accounted for 33% of the almost 20 year life expectancy gap between 1996 and 2000, and analysis of national data from 2001 to 2003 demonstrated that coronary heart disease accounted for approximately 20 years of life lost among Indigenous males and females [8].

Age-adjusted CVD death rates and coronary heart disease (CHD) rates in Aboriginal and Torres Strait Islander people are approximately 3 times as high as in the non-Indigenous population, with age-specific mortality rates higher than for the non-Indigenous populations throughout adult life. For the years 1996–2000, age-specific death rates from CHD in Western Australia, South Australia and the Northern Territory were 8–16 times as high among Aboriginal males between the ages of 25 and 54 when compared to their non-Aboriginal counterparts [9].

Analysis of recent secular trends among Aboriginal people in Western Australia, South Australia and the

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Northern Territory demonstrated some improvements between 1991 and 2002 [10]. In Western Australia and South Australia, cardiovascular mortality declined across the entire period. However, on the whole, these improvements are not keeping pace with those demonstrated within Australia's non-Indigenous population. As a consequence, the large mortality differentials and hence relative disadvantage experienced by Indigenous Australians is growing rather than contracting.

Explaining CVD Disparity

Population differences in traditional risk factors are likely to be important contributors to disparity in cardiovascular health. The INTERHEART Study [11], demonstrated that smoking, diabetes, hypertension, abdominal obesity, psychosocial "stress", dietary fruit and vegetable intake, exercise, alcohol consumption and adverse lipid profiles accounted for most if not all of the population attributable risk of myocardial infarction (MI) regardless of sex and age across 52 countries. These risk factors demonstrated similar effects in all ethnic groups. In relation to all of these predictors, Indigenous Australians fare worse than their non-Indigenous counterparts [12].

Despite the increased prevalence of conventional risk factors in the Aboriginal and Torres Strait Islander population, this does not fully explain the high incidence of CHD in this population [12]. Wang and Hoy [13] have demonstrated the under-estimation inherent in the use of the Framingham Risk Equation [14], which predicted less than half of the documented CHD first events in a community sample of Aboriginal Australians, across all ages and in both sexes. The most critical underestimation occurred among those under 35 years of age.

Access, Quality of Care and Disparities in CVD Outcomes

Data exploring the differences in access and availability of appropriate cardiovascular therapies for Indigenous Australians is limited. In a review of 122 separate cardiac events in the Northern Territory [15], Aboriginal people experienced delays in presenting to acute care facilities, lower rates of thrombolysis and delivery of nitrate therapy, heparin and lipid lowering drugs.

Access to specialist cardiology services, appropriate interventional diagnostics and acute care modalities is limited in remote and regional areas where large Indigenous groups reside [16]. Furthermore, even when health care facilities are available, Aboriginal people are less likely to receive cardiac procedures than non-Indigenous people during hospital admission. National and jurisdictional data points to marked disparities in access to, receipt of, and outcomes from, necessary cardiovascular therapies for Aboriginal people with CHD [17,18]. Utilising hospitalisation and mortality data between 2002 and 2003, Mathur and colleagues found that Aboriginal people were 3 times more likely to suffer major coronary events than non-Aboriginal Australians, and 40% more likely to die out of hospital from CHD. After controlling for age, Aboriginal people suffered case fatality rates 1.5 times that of other Australians. Further still, even when Aboriginal were admitted to hospital they were twice as likely to die during hospitalisation, 40% less likely to receive angiography or percutaneous coronary interventions and 20% less likely to undergo coronary artery bypass grafting [17].

Across the continuum of care, post-discharge management of cardiac disease is enhanced by enrolment in a cardiac rehabilitation (CR) program. However, access to CR is impaired for Indigenous Australians. During the development of CR services in the Top End of the Northern Territory, it was noted that only 8% of eligible patients admitted to the Royal Darwin Hospital were referred to rehabilitation services [19]. Amongst Aboriginal patients, the uptake of CR may be less, with a Queensland study indicating only 5% of eligible patients progressing through specific rehabilitation programs [20].

The utilisation of standard treatment guidelines and clinical pathways for the assessment, treatment and prevention of CHD have been long advocated as an important part of controlling CVD at the national and international level [21]. The value of standardised treatment guidelines, however, is impeded by the considerable gaps that exist between best practice and usual practice. In the USA, observational studies [22] suggest that routine hospital practice is less than ideal when compared against treatment guidelines. Results from the Kanyini Vascular Collaboration audit of the identification and management of vascular risk has shown significant opportunities for improvements in the delivery of evidence-based care for Aboriginal and Torres Strait Islander people in primary care [23].

Clinical performance measurement can improve the process and outcomes of CVD care for acute cardiac events [24,25]. Unfortunately, little is known about the quality and outcomes of care following acute coronary syndromes (ACS) among Indigenous Australians.

The development of meaningful, sustainable public health, clinical and continuous quality improvement policy in the provision of CVD care for Indigenous Australians requires urgent attention, and must be used to drive the development of better service delivery at both the individual and health system levels.

The Central Australian Secondary Prevention of Acute Coronary Syndromes (CASPA) Project was established with the following aims:

1. To develop clinical and process of care indicators for the measurement of quality of care for patients suffering an ACS.
2. To develop a system of data collection and reporting for patients with ACS that can be used for ongoing quality assessment and improvement across the care continuum in the Northern Territory.
3. To measure the proportion of patients meeting standardised clinical outcomes, process outcomes and defined targets of secondary prevention and compare by ethnicity, sex and place of usual residence.
4. To identify failures of the health care system in relation to the provision of secondary CVD care, particularly for Indigenous and remote patients; and

5. To reduce disparity in cardiovascular outcomes experienced by Indigenous people with CVD.

Methods

The CASPA Project was a mixed-methods clinical registry and quality improvement program established in Alice Springs in the Northern Territory of Australia.

Setting and Participants

The CASPA study was established as a retrospective audit of patients with acute coronary syndromes presenting to two regional hospitals in the Northern Territory of Australia between January 2001 and December 2002. The study focused on Alice Springs Hospital, a 164 bed hospital with no on-site cardiology services; and Royal Darwin Hospital [RDH] a 363 bed referral hospital based in the Top End of the Northern Territory with on-site cardiologists, angiographic and coronary care facilities [26].

Hospital separation data from both hospitals was collated. Patients were considered eligible if they had a hospital separation code corresponding to ACS or complication post-myocardial infarction (ICD-10AM I20.0–I23.8). Patients were excluded if they did not meet standard clinical definitions of ACS [27,28], if they died within 24 h of admission or if they did not usually reside within either region. In total, 575 hospitalisation separations fulfilled the criteria for inclusion, representing 492 individual patients experiencing an *index* ACS during the study period. All analyses are limited to these 492 individuals.

Clinical Data

Baseline data on demographics, cardiac risk factors, medical history, presentation characteristics, ECG findings, clinical management, in-hospital events, investigations and discharge status were collated by trained abstractors according to standardised clinical definitions with a single investigator coding all outcomes of interest.

Developing the Performance Indicators

The delivery of clinical services was assessed according to performance indicators developed specifically for this study, based on methods outlined for the development of performance measures for the management of acute stroke [29]. A list of potential performance/quality indicators was built from an extensive search of currently available national and international clinical guidelines, national health priority area indicators and reports and with reference to National Health Performance Committee guidelines. This list was further augmented by performance measures used in published quality improvement projects involving the care of patients with ACS, with a particular focus on the needs and service dynamics of rural, remote and Aboriginal patients. Process of care, target achievement and outcome indicators for the treatment and prevention of ACS/CVD across the continuum of care were generated then graded by 40 external content experts through mailed questionnaires according to strict criteria: Strength of evidence; feasibility of measurement; plausibility of effects from quality improvement; impact on outcomes; and an assessment of the overall utility of the measure. Each potential indicator was graded according to a 1–5 scale (1 representing the lowest possible and 5 the highest score for each criteria). Results from each person's grading were then collated and averaged across each individual criterion, then across all summed criteria. Indicators that were graded as high priority, frequently recorded, very plausible and would have a large impact on outcomes (average $\geq$4.0) were included in the final list. Indicators with several criteria averaging over 4.0, but a total below 4.0 were taken to a workshop of experts held in Alice Springs and consensus to include or exclude was reached. In total, there were 29 'quality of care' indicators and 8 pre-specified 'outcome' indicators included.

Study End Points

The primary end point was all-cause mortality. Secondary end-points included the combined pre-specified composite of death, subsequent ACS, stroke, or unplanned coronary intervention; attendance at cardiac rehabilitation; and delivery of evidence-based care across the continuum (from onset of pain through to discharge management).

More specific secondary prevention information was collected for the Central Australian component of the cohort (n = 228 patients discharged alive following ACS) including the achievement of blood pressure and cholesterol targets and the prescription of aspirin, blood pressure and cholesterol lowering therapies over 2 years of follow up. Targets were defined according to available evidence based guidelines (at the time of follow-up) [30]. Secondary prevention process of care (prescription rates) and surrogate clinical indicators (blood pressure and lipid targets) were based on attendance at the patients' self-nominated primary care centre over 2 years of follow-up. Patients were considered eligible for inclusion into assessment of these indicators if they attended at least one time within the pre-specified window period of 1 month ($\pm$) of 6, 12 or 24 months following an ACS, were alive at the pre-specified time point, and had no documented contra-indication to individual therapies.

Available hospital patient information, clinical databases and primary care information systems were interrogated for evidence of outcomes of interest. Missing information was supplemented from referral hospital discharge summaries and angiographic suite documentation. Vital status at follow-up was determined by collation of available clinical and hospitalisation data, death certificates and reports of autopsy and coded using standardised definitions by a single physician. Patients whose vital status was unknown were propensity matched through national mortality data linkage systems [NDI]. Patients still unable to be matched were censured at the last documented point of contact.

Ethical approval was received from the Central Australian Human Research Ethics Committee and the Top End Human Research Ethics Committee in the Northern Territory. All eligible participants in the Central Australian

group (or their appropriate next of kin if deceased) gave individual consent for linkage of hospital and primary care data and qualitative data collection.

Qualitative Data Collection and Analysis

Given the choice to individually consent each of the Central Australian participants for inclusion in the registry, and the paucity of qualitative information about Indigenous Australians suffering ACS, we sought to augment the consent process with exploratory qualitative examination of the experience of ACS among Aboriginal people in Central Australia. In total, 110 (of 140 possible) Indigenous participants (or their next-of-kin) agreed to more detailed discussion of the events surrounding their acute cardiac event. Four, open-ended questions were asked of each participant by a single researcher, to allow broad discussions of the participants' experiences. The questions were:

1. Can you describe what happened when you had your heart attack/event?
2. How did you know you were having a heart attack/event?
3. What do you remember about the treatment you received when you went to hospital?
4. How has your heart attack/event affected your life?

For participants who had passed away during or following their ACS but prior to the consent process, their next-of-kin were asked to recall the events surrounding the ACS presentation of their family member. This usually involved a single person, but in several instances, a number of family members were involved in the discussions.

Given the open-ended nature of the enquiry, the majority of participants recounted their experiences in the form of narratives, reconstructing their experience as a story. However, many were short, direct responses to questions. All responses were collected utilising detailed field-notes, which were later transcribed. Each transcription was checked and coded by two researchers and final coding agreed by negotiated consensus. Analysis focused on major themes across the continuum of care, to provide a basis for more detailed qualitative work into the future, and to help explore some of the quantitative findings we anticipated to come from the clinical audit.

Results

Baseline Characteristics

In total, 492 individual patients fulfilled the study criteria for ACS, and had suffered an index event during the eligibility window period (Table 1). 43.5% ($n = 214$) of the cohort were Indigenous. The Indigenous group were significantly younger than their non-Indigenous counterparts, with a mean age of 50.1 (±12.5) years compared to 59.3 (±12.5) years ($p < 0.001$). Just over half of the Indigenous group were male (57%), compared to almost 70% of the non-Indigenous group ($p = 0.003$). Indigenous patients were more likely to have a history of hypertension (62.1% vs. 45%; $p < 0.001$), cigarette smoking (42.5% vs. 35.3%; $p = 0.001$), diabetes (55.6% vs. 30.2%; $p < 0.001$), or chronic kidney disease (39.3% vs. 24.7%; $p = 0.001$). Indigenous patients were significantly more likely to experience a high risk ACS (largely as a consequence of the high rates of diabetes).

Initial Presentation

Almost half of the Indigenous cohort had the onset of their ACS in a rural/remote location (>100 km from a regional hospital) (47.7% vs. 8.0%; $p < 0.001$). Almost one third of the Indigenous cohort presented to hospital >12 h after

Table 1. *Clinical and demographic features of the CASPA Cohort.*

	Indigenous, $N = 214$	Non-Indigenous, $N = 278$	p-Value
Mean age (±SD) years	50.1 (12.5)	59.3 (12.5)	**<0.001**
Male (%)	57.0%	69.8%	**0.003**
History of CHD	39.3%	45.5%	0.166
Prior CABG	3.3%	9.4%	**0.008**
Hypertension	62.1%	45.0%	**<0.001**
Smoker (current)	42.5%	35.3%	**0.001**
Dyslipidaemia	34.1%	38.5%	0.318
Diabetes mellitus	55.6%	30.2%	**<0.001**
CKD (GFR <60)	39.3%	24.7%	**0.001**
End stage renal failure	16.4%	1.8%	**<0.001**
ACS risk stratification			
NSTEACS – high risk	65.9%	49.3%	**<0.001**
STEMI	22.9%	20.5%	0.402
ACS onset in rural location	112 (47.7%)	23 (8.0%)	**<0.001**
Late presentation >12 h	63 (28.5%)	46 (17.1%)	**0.002**
First contact: Ambulance	44 (20.6%)	64 (23.0%)	0.5
ED	62 (29.0%)	161 (57.9%)	**<0.001**
GP	0 (0%)	20 (7.2%)	**<0.001**
PHC	94 (43.9%)	25 (9.0%)	**<0.001**

ACS = acute coronary syndrome; CABG = coronary artery bypass grafting; CKD = chronic kidney disease; Ed = emergency department; GFR = glomerular filtration rate; GP = general practitioner; NSTEACS = non-ST elevation acute coronary syndrome; PHC = primary health care clinic; STEMI = ST elevation myocardial infarction.

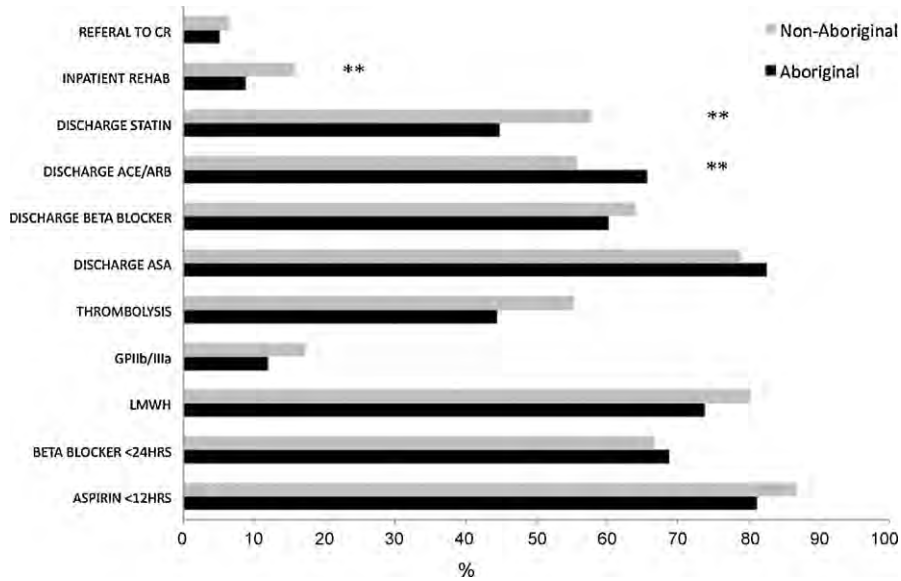

Figure 1. *Management and discharge guideline-recommended therapies in acute coronary syndrome clients by ethnicity, CASPA Cohort (**p < 0.05). CR, cardiac rehabilitation; ACE/ARB, angiotensin converting enzyme inhibitor/angiotensin receptor blockers; ASA, aspirin; GPIIb/IIIa, glycoprotein IIb/IIIa inhibitors; LMWH, low molecular-weight heparin.*

onset of first symptoms (28.5% vs. 17.1%; $p = 0.002$). There were also significant differences in the pattern of first presentations between Indigenous and non-Indigenous participants. Indigenous patients were as likely to call an ambulance as their as their non-Indigenous counterparts (20.6% vs. 23.0%; $p = 0.5$), but were less likely to present directly to a general practice (0% vs. 7.2%; $p < 0.001$), or emergency department (29% vs. 57.9%; $p < 0.001$). The most frequent site of immediate care for Indigenous patients experiencing ACS was a rural or urban Primary Health Care Centre (43.9% vs. 9.0%; $p < 0.001$).

Quality of Care across the Continuum

Among participants that did not present directly to emergency departments, Indigenous patients were more likely to receive pre-hospital aspirin (45% vs. 25%; $p < 0.001$), and oxygen (76.3% vs. 50.7%; $p = 0.001$) but as likely to receive nitrates (45.6% vs. 34.3%; $p = 0.143$) as their non-Indigenous counterparts (data not shown).

Throughout hospitalisation, there were differences in the delivery of evidence-based care according to ethnicity (Fig. 1). Indigenous participants were less likely to receive in-patient cardiac rehabilitation (CR) (8.9% vs. 15.8%; $p = 0.03$) and be discharged on lipid lowering therapy (44.8% vs. 57.8%; $p = 0.006$), but more likely to be prescribed an angiotensin-converting enzyme inhibitor (ACE) or angiotensin-receptor blocking agent (ARB) at time of discharge (65.7% vs. 55.8%; $p = 0.033$). For all other indicators, there were no statistically significant differences between Indigenous and non-Indigenous patients. This included early management with aspirin and beta-blockers, antithrombotic agents, and thrombolysis among patients experiencing ST elevation myocardial infarction (STEMI).

The most marked differences demonstrated between the groups were noted in relation to receipt of invasive procedures. Whilst there were no demonstrable differentials in receipt of percutaneous coronary interventions (PCI) (11.3% vs. 15.3%; $p = 0.2$) or coronary artery bypass grafting (CABG) (5.7% vs. 6.8%; $p = 0.62$), Indigenous patients were significantly less likely to undergo diagnostic angiography (36.2% vs. 47.6%; $p = 0.012$).

Major Adverse Cardiac Events at 24 months

Indigenous patients were more likely to experience adverse outcomes after an ACS (Fig. 2). However, this trend only became apparent after discharge from hospital. In-hospital mortality occurred in 8.4% (18/214) of Indigenous patients compared to 6.5% (18/278) of non-Indigenous patients ($p = 0.414$). Among patients discharged alive, within the next two years of follow-up, Indigenous patients were no more likely to experience

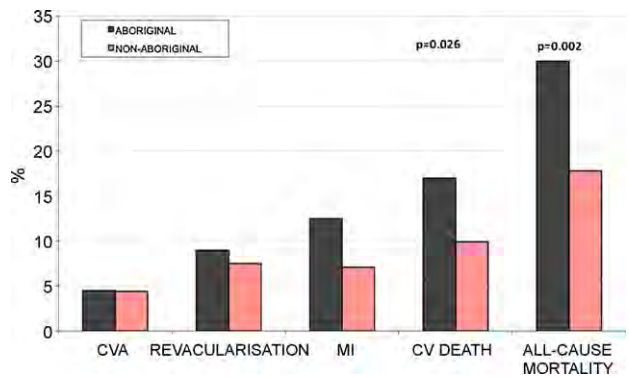

Figure 2. *Major adverse cardiac events (MACE) at 24 months, by ethnicity following acute coronary syndromes in the NT, 2001–2002. CVA, cerebrovascular accident; MI, myocardial infarction; CV death, cardiovascular death.*

stroke (CVA), undergo an unplanned revascularisation or suffer from a non-fatal MI (all $p > 0.05$). However, they were significantly more likely to die from any cause (30.0% vs. 17.8%; $p = 0.002$), or from a cardiovascular event (17.0% vs. 9.9%; $p = 0.026$). Of all deaths during the two years following an ACS, just over one half of all deaths (54.5%) among Indigenous patients were due to CVD (25.4% MI, 18.2% sudden cardiac death, 7.3% heart failure and 3.6% stroke). In the non-Indigenous cohort, 71.3% of all deaths during two years of follow-up were due to CVD (40.0% MI, 17.1% sudden cardiac death, 11.4% heart failure and 2.8% stroke).

Secondary Prevention

Among the Central Australian cohort, extensive efforts were undertaken to capture the provision of evidence-based care and the achievement of blood-pressure and lipid targets in the two years following discharge. In total, 228 patients (126 Indigenous and 102 non-Indigenous) discharged alive following their ACS were eligible for inclusion in these analyses. Unfortunately, only 62.7% of the eligible cohort ($n = 143$) attended their nominated primary care provider more than once in the two years after discharge. As a consequence, the achievement of secondary prevention targets and the delivery

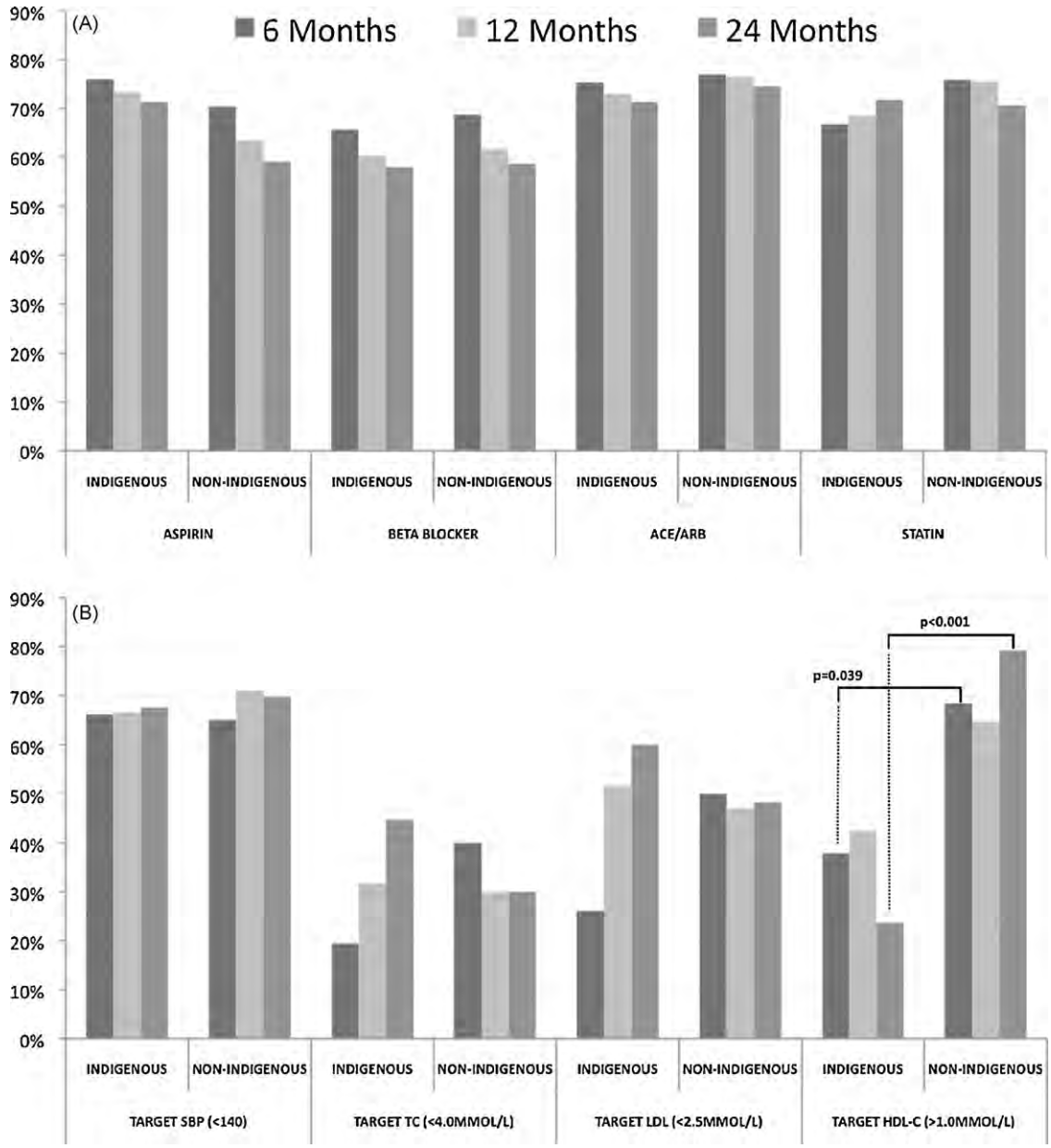

Figure 3. *Proportion of routine primary health care attendees ('Routine attendee' defined as ≥1 presentation to their self-nominated PHC centre within 1 month (±) of the 6, 12 or 24 month window period following an ACS.) within Central Australia prescribed evidence-based therapy [Panel A] and reaching systolic blood pressure and lipid targets [Panel B] at 6, 12 and 24 months following ACS, by ethnicity.*

Table 2. *Exploratory qualitative findings from Indigenous patients experiencing ACS: the CASPA study.*

Domain of Care	Key Themes	Outline
Symptom recognition	Symptom recognition	Majority of patients did not recognise they were having ACS. Primary explanation for pain was gastro-intestinal 'upset' or unknown.
	Failing the 'Hollywood Test'	Patients felt that if they were not experiencing the 'classic' severe chest pain with collapse, they were not experiencing ACS.
Seeking care	Competing Priorities	Patients were unwilling to attend services because of competing priorities within their lives. This usually related to caring for other family members (children or elderly), arranging community, social or other health services for themselves or family, or family/cultural obligations occurring at the same time.
	Mistrust and Fear	Strong historical and personal reasons to mistrust mainstream institutions (e.g. prior racism, 'stolen generation'). Fear of consequences (death, extended hospitalisation, never seeing family again) impacted on decisions to seek care.
	Prior Experiences	Individual, family or community related prior negative experiences of hospital care framed decisions to engage with services.
	Family Coercion	The principal driver for attending services for people experiencing ACS was family pressure/coercion.
Delays to care	Delay until Crisis	The majority of patients delayed care until the point of crisis, where they could no longer cope with their symptoms, or they felt that death was imminent.
	Deprivation	Significant socioeconomic barriers to attending care existed including lack of transportation and access to phones for calling an ambulance.
Emergency management	Extended Wait Times	Despite many stories of 'good care', the principal reason for complaint from patients was extended wait times whilst within the hospital setting. This included prior to triage, awaiting investigation and waiting for team decisions over diagnosis, management and transfer to tertiary services.
In-hospital care	Poor Communication	The hospitalisation experience was littered with examples of poor communication at all levels of interaction: between the patient and providers, different providers within the regional hospital, between providers within the regional hospital and tertiary hospital and between health care teams and families. Poor communication contributed to negative experiences, fear, patients taking leave from hospital and their unwillingness to accept invasive investigations, and perception of organisational chaos with respect to their care.
	Disrespect	There were important discussions about being treated disrespectfully within hospital which contributed to adverse experiences.
	Invisibility	Several patients discussed the sense of feeling 'invisible' at times when they needed support, particularly in relation to pain relief and anxiousness about future care plans.
	Perceived Racism	There were some discussions of the impact of perceived racism within care. This was particularly in the context of poor communication and explanation of care plans which led to perceptions of different treatment for Aboriginal and non-Aboriginal patients.
	Disengaging Families in Care	Of particular relevance to Aboriginal patients, there was a strong sense that families were not allowed to be as involved in the care of patients as they would have liked. This involved decision making/consent processes, decisions to be referred for further investigation and treatment options.
	Clash of Understanding	There were many instances where the understanding of what was happening in terms of causation, treatment, and investigations differed between patient and health care provider.
	Fear	Many patients were scared of the possibility of dying, particularly in relation to transfer to a tertiary hospital. Many had prior knowledge of family who had never returned from 'those big hospitals down south'.
	Lack of Relationship	Many patients felt that the hospital setting did not allow time for patient and provider to develop a trusting relationship on which decisions for care could be negotiated.
Discharge	Poor Continuity	There was a distinct lack of continuity between regional and tertiary hospital and between hospitals and primary health care providers. This related to discharge summaries, care plans, follow-up and provision of secondary prevention.
	Education and Awareness	Most patients felt that they received little education about what had occurred, why various treatments were provided and what was the reason for their illness. This impacted on awareness of heart disease and its management into the future.

Table 2. *(Continued)*

Domain of Care	Key Themes	Outline
Long-term management	Being 'Fixed'	A common perception among patients undergoing PCI was that they were now 'all-fixed'. Poor communication of life-long risk and prevention activities impaired long-term medication adherence and routine PHC follow-up.
	Poor Continuity	Little follow-up after discharge from tertiary centres was frequently discussed, and a key barrier to necessary secondary prevention. There was a sense from patients and family about a lack of continuity and planning for follow-up from all providers.
	Lack of Rehabilitation	The lack of in-patient and out-patient cardiac rehabilitation services was a particularly worrisome issue for patients in urban, rural and remote settings.
	No Outreach Care	Patients and their families felt that improved access to outreach cardiac services would be a valuable service development.
	Difficult Navigation	There were strong discussions of how difficult it was for patients to make their way through 'the maze' of cardiac services, providers, investigations, follow-up and appointment systems.

of evidence-based care were calculated on a sub-set of the cohort that routinely attended for primary health care (Fig. 3). In terms of prescribed therapy (accounting for all documented contra-indications) there were small (non-significant) differentials in the proportion of routine attendees prescribed aspirin, beta blockers, ACE/ARB and lipid-lowering therapy across ethnic groups. Importantly, there were no significant ethnic differentials in any prescribed medication at 6, 12 or 24 months post-discharge. Unfortunately, nothing is known about the therapies prescribed to or received by individuals who were not routinely attending for primary health care.

In terms of the achievement of clinical targets (Panel B), 66% of Indigenous patients had achieved a target systolic blood pressure of <140 at 6 months, a figure that was maintained to 24 months. Similarly, 65%, 71.1% and 69.8% of non-Indigenous patients had achieved the same target at 6, 12 and 24 months respectively. The proportion of routine primary health care attendees who achieved total cholesterol (TC) targets (<4.0 mmol/L) across both ethnic groups was much lower. For Indigenous patients, the proportion reaching TC targets rose from 19.5% at 6 months, to 31.8% at 12 months and 44.7% by 24 months (p for trend = 0.012). For non-Indigenous attendees, 40%, 30% and 30% had reached TC targets at 6, 12 and 24 months respectively. Similar trends (though higher proportions) were noted for achievement of LDL cholesterol targets. For Indigenous patients, 26.1%, 51.6% and 60% achieved LDL-C levels of <2.5 mmol/L (p for trend = 0.014) at 6, 12 and 24 months. In comparison, approximately half of the non-Indigenous patients at each time point had achieved LDL-C targets.

The only clear ethnic differentials were noted in achievement of HDL-C targets. Indigenous patients at 6 months were significantly less likely to demonstrate a HDL-D >1.0 mmol/L than their non-Indigenous counterparts (37.9% vs. 68.4%, $p = 0.039$). There was divergence in the proportion reaching HDL-C targets by 24 months, with the differential more significant (23.7% vs. 79.3%, $p < 0.001$).

Exploratory Qualitative Findings

In total 110 Indigenous patients (or their next-of-kin) were interviewed to gain an initial insight into the possible barriers and enablers to care for Indigenous people experiencing an acute cardiac event in the region, and to broaden our understanding of the quantitative data collated as part of the registry. As can be seen from Table 2, there were many inhibitors to care across the continuum.

Many of these inhibitors framed not only people's experiences of their current hospitalisation, and as a consequence, decisions to accept investigations and therapies, but through transmission to other family and community members, reinforced negative community perceptions of hospital care. As a result, fear, mistrust, misperceptions and perceived racism influenced people's decisions to seek care at a time of acute events.

There were also significant social barriers to accessing necessary services, ranging from the impact of poverty (lack of transportation and communication) and the strong influence of balancing the needs of the individual patient with their family and cultural obligations. These contributed to many patients delaying care until a time of crisis.

Within the hospital environment, there were many stories of 'good care', professional service provision, and caring, respectful staff. However, stories of perceived racism, disrespect and disengagement of family from the patient were noted. Most of these negative experiences were a consequence of poor communication between providers and patients. However, poor communication was the overarching experience of the majority of patients, and this occurred not only between them and their providers, but *across* various levels of the system. These failures had important negative influences on treatment, perceived satisfaction with care, awareness and long-term management.

Discussion

In this retrospective, mixed-methods ACS clinical registry and quality improvement study within the Northern Territory, Indigenous people were over-represented in hospitalisations for ACS. Despite making up 28% of the Northern Territory population [10], Indigenous patients made up over 40% of all ACS hospitalisations, and of index ACS during the period of study.

Importantly this study identified that Indigenous people experiencing ACS (and surviving to hospital): (i) demonstrate a markedly different clinical phenotype to their non-Indigenous counterparts; (ii) receive relatively similar levels of evidence-based care to non-Indigenous ACS patients with the exception of diagnostic angiography; (iii) are more likely to experience adverse outcomes in the two year post-discharge period; (iv) are prescribed medications at 6, 12 and 24 months at levels that are similar to that of non-Indigenous patients; and (v) experience significant barriers to necessary services across the continuum of care.

As has been demonstrated in national [17] and jurisdictional [18] data sets, Indigenous patients experiencing ACS were significantly younger (almost 10 years on average), demonstrated higher rates of background risk factors, and were more likely to have co-morbid chronic disease at time of presentation than their non-Indigenous counterparts. In this cohort, 55% of all Indigenous patients had previously diagnosed diabetes, and almost 40% had chronic kidney disease (as determined by estimated GFR). Chronic kidney disease (CKD) is a strong independent predictor of fatal and non-fatal cardiovascular events among those without established coronary disease [31], and among patients suffering from acute coronary syndromes [32–35]. In addition, diabetes is not only a potent contributor to the risk of developing atherosclerosis [36], it has been identified as an independent predictor of adverse outcomes following ACS in international [37–39] and national literature [40]. The contribution of diabetes to the development of incident CVD in Indigenous Australians has been well documented [41], at levels above that seen in the general population, and has been considered a possible explanation for the loss of the CVD 'protection' witnessed among Indigenous women [41].

Importantly, almost half of all Indigenous patients presenting to hospital with ACS experienced the onset of symptoms whilst in a remote setting and primary care centres were the first point of medical contact for 44% of Indigenous patients. Whilst this is unlikely to be representative of the national pattern of ACS in Indigenous Australians, the high proportion of patients presenting initially to primary care, highlights the importance of supporting the delivery of evidence-based care (including appropriate diagnostic investigations, communication and transfer pathways and protocols and thrombolysis) in pre-hospital settings.

In relation to the quality of care across the continuum, there were conflicting findings. On one hand, there were few ethnic differentials in the assessment, initial management, hospital investigation and pharmacological management of ACS patients in the Northern Territory. However, Indigenous and non-Indigenous patients were under-treated with evidence-based therapies across the continuum of care.

Unfortunately there is no concurrent (2001–2002) national, unselected clinical registry data on which to compare these findings. More contemporary data, collated as part of the ACACIA Registry [42,43] (including data from the Northern Territory) demonstrates higher rates of provision of discharge statin (in particular), aspirin, beta blocker and ACE/ARB in patients experiencing ACS in 2005/2007. There is clearly significant room for improving the provision of effective therapy for ACS patients within the Northern Territory, and this is likely to translate to improved outcomes for both Indigenous and non-Indigenous patients alike.

Of greater concern however, was the low rate of invasive management of Indigenous patients experiencing ACS, particularly given the high proportion of events identified as 'high risk'. Just over one-third of Indigenous patients and less than one-half of non-Indigenous patients underwent invasive management. This is significantly lower than that demonstrated in more recent national data [42,43], but consistent with data highlighting lower rates of intervention among Indigenous patients in Queensland [18] and national hospitalisation data [17].

Despite clear clinical trial data of the value of early invasive management, particularly in high risk individuals, the application of this evidence to Indigenous patients in a real-world clinical setting was lagging. Furthermore, observations of better access to a range of evidence-based therapies among patients treated with an invasive strategy in Australian registry data [43] may suggest additional opportunities for secondary prevention are being missed.

Review of long term therapy also highlighted significant room for improvement in both Indigenous and non-Indigenous patients. Surprisingly, just over 60% of the Alice Springs sub-group (for which secondary prevention information was collated) presented to their nominated primary care providers on a routine basis in the two years after discharge. Those that did were under-prescribed evidence-based therapies, compared to both contemporary evidence and to contemporary registry data [43]. However, there were no immediate differences in prescribing across ethnic groups. Similarly, there were no differences in the achievement of systolic blood pressure and lipid targets at 6, 12 and 24 months between ethnic groups (with the exception of HDL cholesterol levels). Taken together, these findings suggest, in the Northern Territory at least, that when Indigenous and non-Indigenous patients procure routine primary care following an ACS, they are equally likely to receive evidence-based care and achieve clinical targets. In these routine attendees at least, it is unlikely that differentials in provision of secondary prevention are driving the higher rates of adverse outcomes in Indigenous patients. Unfortunately, we were unable to collate data on the provision of care and achievement of targets in those who did not attend primary care after their ACS. Given the higher baseline and ACS-specific risk status of Indigenous patients, it may well be that this group that is falling through the gap may be driving higher mortality post-event.

In terms of adverse outcomes, Indigenous patients were significantly more likely to die in the ensuing two years after ACS, from all causes or cardiovascular specific causes. This was despite being almost a decade younger (on average) than non-Indigenous patients. Despite experiencing higher rates of competing causes of death than

non-Indigenous patients, over half of the Indigenous patients that died, did so as a consequence of CVD. Aggressive approaches to evidence-based secondary prevention are likely to significantly improve outcomes in this group, and must be a critical target for reform.

Finally, we were able to collate previously undocumented qualitative data on the experiences of Indigenous people suffering acute cardiac events. Although exploratory, strong messages of poor continuity, negative experiences, ineffective communication and barriers to evidence-based care were outlined, and should provide key windows for more detailed future work aimed at improving systems of care and outcomes for Indigenous people.

There were several limitations worth consideration in the context of this study. Retrospective audits are by nature, prone to bias, and despite extensive efforts, may still negatively influence the veracity of findings. Further, this data focused on two regional hospitals in a single jurisdiction, and whilst representative of the patients within this region, it cannot be assumed that these findings translate to the heterogeneous Indigenous population across the country. The secondary prevention data proved particularly difficult to collate. Inclusion criteria for this sub-analysis were framed around routine attendance to primary care, during a limited time window period ($\pm$1 month of 6, 12 and 24 months). This may have proven too restrictive for mobile Indigenous patients, who often receive primary care from many centres across the region. However, we found that patients presenting during one of these window periods were likely to be present at the subsequent time periods. The most important omission was data on primary care non-attendees. Future assessment would benefit from prospective, active follow-up, so that the contribution of secondary prevention to adverse outcomes could be more adequately assessed.

Despite these limitations, the study collated the most extensively clinically phenotyped cohort of real-world Indigenous ACS patients across a single jurisdiction. The creation and utilisation of specifically developed performance indicators for health system monitoring for Indigenous patients with ACS is also an important step forward, and provides a baseline for determining the impact of system reform into the future.

Conclusion

The CASPA study provides an important insight into the real world clinical patterns, provision of care and outcomes of ACS among Indigenous and non-Indigenous patients in the Northern Territory of Australia. This is critical for identifying opportunities for system reform focused on the reduction in disparities between Indigenous and non-Indigenous people.

Despite the similarities in the level of care for Indigenous patients experiencing ACS, disparity in the provision of invasive management, long term therapy (and alternative approaches to such), and significantly worse outcomes require urgent and sustained system-wide action.

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