

## ORIGINAL ARTICLE

# Opportunistic screening for diabetes among urban Aboriginal adults during emergency department attendance

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## Key words

Aboriginal, Aboriginal and Torres Strait Islander peoples, diabetes, diabetes screening, emergency department, type 2 diabetes.

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## Abstract

**Background:** Aboriginal people have a high risk of type 2 diabetes (T2DM). Routine opportunistic testing using glycated hemoglobin (HbA1c) for diabetes in the emergency department (ED) offers an opportunity to detect undiagnosed diabetes and evaluate glycaemia for pre-existing diabetes.

**Aims:** To evaluate the prevalence of pre-existing diabetes and assess random blood glucose (RBG) and HbA1c as screening tools for undiagnosed diabetes in Aboriginal people attending the ED.

**Methods:** Demographic and RBG data were extracted for all Aboriginal adults presenting to a Sydney hospital ED over 6 months. Practitioners requested blood tests as per routine care, and in the final 3 months, HbA1c was automatically added to routine venous sampling. The primary outcome was change in diabetes diagnosis with the addition of HbA1c.

**Results:** Overall, 1640 adult Aboriginal patients presented to the ED over 6 months (4.1% of all presentations), including 734 unique individuals tested during routine care. The prevalence of pre-existing T2DM was 12.0% ( $n = 88$ ). Among those without known diabetes, 1.4% ( $n = 9$ ) had glucose readings  $\geq 11.1$  mmol/L and 14.3% ( $n = 90$ ) had glucose readings 7.0–11.0 mmol/L. For those without known diabetes with HbA1c measurement, there were 2.7% ( $n = 8$ ) with HbA1c  $\geq 6.5\%$  and 4% ( $n = 12$ ) with HbA1c 6.0%–6.4%. There was no overlap between those who had an HbA1c  $\geq 6.5\%$  and RBG  $\geq 11.1$  mmol/L.

**Conclusions:** There was a high prevalence of pre-existing diabetes among Aboriginal adults attending the ED. New diabetes diagnosis in the ED based on RBG or HbA1c was not common. Confirmatory testing for diabetes should be recommended to the general practitioners of patients in whom elevated HbA1c or RBG are identified.

## Introduction

Aboriginal and Torres Strait Islander (Aboriginal) people in Australia experience a greater burden of disease than the general Australian population.<sup>1</sup> Despite advances in health care, the rate of hospitalisation for Aboriginal people is 2.3 times that of non-Aboriginal Australians.<sup>1,2</sup>

These disparities in health outcomes are further amplified in Aboriginal people with diabetes. Those with type 2 diabetes (T2DM) have a five-fold higher age-standardised mortality and potentially preventable hospitalisations compared to the general population.<sup>3</sup> T2DM is one of the top five leading causes of death in the Aboriginal population and this is not mirrored in the general population.<sup>4</sup> Diabetes plays a crucial role in the development of other high morbidity diseases, contributing to 38% of the disease burden for peripheral

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vascular disease, 25% for chronic kidney disease and 14% and 13% for cardiovascular disease and stroke risk respectively.<sup>5</sup> T2DM remains the leading cause of prolonged hospitalisation and healthcare utilisation in Aboriginal people.<sup>6</sup> These outcomes are further impacted by well-recognised social determinants of health such as racism, remoteness, financial insecurity and unemployment.<sup>1</sup> Moreover, Aboriginal people are at more than three-fold higher risk of T2DM than the general Australian population<sup>7</sup> with prevalence ranging from 8% to 17%.<sup>4,8</sup>

Conducting routine glycated hemoglobin (HbA1c) testing for Aboriginal patients visiting the emergency department (ED) presents a unique opportunity to evaluate the level of glycaemia in those with known T2DM, and to screen for T2DM in those without prior diagnosis. The Royal Australasian College of General Practitioners (RACGP) guidelines recommend annual blood testing (fasting plasma glucose, random venous glucose or HbA1c) from 18 years of age for Aboriginal people.<sup>9</sup> Screening should also consider appropriate follow-up with culturally sensitive and appropriate services.

To explore the role of routine HbA1c testing, we conducted a sequential two-cohort study. The main objectives of this cohort study were to determine the prevalence of pre-existing diabetes in Aboriginal people who attended the ED and, for those without diabetes, to assess whether random blood glucose (RBG) and/or HbA1c are performed and whether this increases the rate of diagnosis of diabetes.

## Methods

### Study site

This was a single-site study conducted in a Sydney hospital with a high prevalence of diabetes<sup>10</sup> and a proportion of Aboriginal people (4.1%) higher than the national average (3.2%).<sup>11</sup>

### Study design

The study was co-designed with the help of NJ, the Director of Aboriginal Health for the Local Health District as well as the Aboriginal Liaison Officer (ALO) and members of the Aboriginal Chronic Care Program (ACCP) Team (AS). 'Aboriginal people' is used throughout the manuscript to refer to Aboriginal and Torres Strait Islander people, as we were advised that this was the preferred term following years of previous consultations and conversations with staff, community members and Aboriginal Community Organisations within the Local Health District. The ALO advised us that her

routine work included supporting all Aboriginal people admitted to hospital and requested to be informed of all known admissions during the study so she could support them during their hospital stay. The ACCP team felt that all patients with a chronic disease who had required hospital admission or presentation to the ED should be followed up by their team after discharge as part of routine care. While this study would potentially increase workload for the ALO and ACCP team, it was felt that this study would help identify people who should already be supported by these services and may otherwise be missed. The ACCP team also felt that they could support follow-up blood testing with the local general practitioners (GPs) or in the local Aboriginal Medical Service (AMS).

All adult (aged  $\geq 18$  years) patients who identified as Aboriginal on their electronic medical record (EMR) who presented to the ED for urgent care over 6 months (1 November 2019 to 30 April 2020) were selected. Participants who visited the ED were included if they identified as Aboriginal and had a blood test collected as part of routine clinical care. Patients were excluded if they did not identify as Aboriginal, were pregnant or aged  $< 18$  years. Those who were unable to opt out of the study including those who attended the ED with self-harm or mental health problems as the presenting complaint or had a reduced level of consciousness were also excluded. The researchers extracted demographic and clinical data from the hospital EMR including blood results. In the first 3 months, ED practitioners requested blood tests as per routine clinical practice, while in the final 3 months of the study, HbA1c testing was added automatically to patients' blood requests prospectively in addition to routinely requested blood tests, unless patients opted out, which they were asked on arrival to the ED.

### Follow-up arrangements

All HbA1c and RBG results were reviewed on business days by W. Yu and K. P. Myint during the study, and those with an elevated HbA1c ( $\geq 6.0\%$ ) or RBG ( $\geq 7.0$  mmol/L) as an indicated threshold in the study were referred to the ALO in the hospital and with the ACCP team in the community, and a letter with the results was sent to their GP recommending confirmatory testing to rule out diabetes. As mentioned above, during the study co-design, the ALO and ACCP teams felt that this should be part of their routine practice and should not significantly impact their workload. Those with an elevated HbA1c or RBG who were hospitalised were managed by their admitting team.

## Statistics

All statistical analysis was conducted using R Statistical Software (version 4.3.0; R Foundation for Statistical Computing, Vienna, Austria). Two-sided confidence intervals were calculated, and statistical significance was set at  $P < 0.05$ . Descriptive statistics were reported as frequencies and percentages for categorical variables and means with standard deviations for continuous variables. Chi-square testing or Fisher's exact test was conducted for discrete variables and one-way analysis of variance for continuous variables to assess the differences between groups.

## Ethics approval and funding

Ethics approval was obtained from both the South Western Sydney Local Health District Research Ethics Committee (2019\_ETH12109) and the Aboriginal Health & Medical Research Council (AH&MRC, approval number 1572/19). Funding was provided by the Agency for Clinical Innovation (ACI), NSW Health and was endorsed by the ACI's Aboriginal Chronic Conditions Network as well as the ACI's Diabetes Taskforce.

## Results

There were 40,149 presentations to the ED over the study period, of which 1640 (4.1%) involved adult Aboriginal presentations by 999 unique individuals. Of these, 734 (73.5%) individuals had their first presentation with a valid glucose test as part of routine care and were included in the study. The prevalence of T2DM was

12.0% ( $n = 88$ ) and type 1 diabetes was 1.9% ( $n = 14$ ) with no new diagnosis of diabetes based on screening results. HbA1c testing was available for 350 patients, of whom 35 had established T2DM. Table 1 shows the baseline demographics of participants, and those with type 1 diabetes were excluded from the tables and the analysis.

Participants with T2DM were more likely to be admitted to hospital compared to those without T2DM (45.4% vs 29.2%,  $P < 0.05$ ). For participants with known T2DM, 13.6% ( $n = 12$ ) of the ED presentations were due to diabetes-related problems.

All participants with a blood test at presentation had a blood glucose requested, of which 99.3% ( $n = 729$ ) was a venous sample. The average venous glucose was  $10.4 \pm 6.1$  mmol/L in participants with known T2DM and  $6.0 \pm 1.4$  mmol/L in those without pre-existing diabetes ( $P < 0.01$ ) at presentation. Of the 628 participants without diabetes, nine (1.4%) had RBG readings of  $\geq 11.1$  mmol/L (Table 2), and all HbA1c results for those without pre-existing diabetes ( $n = 305$ ) were from the last 3 months of the study as the ED practitioners did not request HbA1c as part of routine care.

Of the 305 participants with recorded HbA1c without pre-existing diabetes, 1.3% had RBG  $\geq 11.1$  mmol/L and 2.6% had an HbA1c  $\geq 6.5\%$ . There was no overlap between these two groups (Table 3). When the threshold for detection of T2DM risk was lowered to correspond to the International Expert Committee High Risk category (RBG  $\geq 7$  mmol/L, and HbA1c  $\geq 6\%$ ), above-threshold readings were observed in 11 out of 40 (27.5%) participants.<sup>12</sup>

Australian Diabetes Society (ADS) guidelines for the diagnosis of diabetes in patients during stress

**Table 1** Baseline demographics of the participants

Variables	With type 2 diabetes ( $n = 88$ )	Without diabetes ( $n = 632$ )		P-value comparing those with and without type 2 diabetes	
		Overall	Without HbA1c testing ( $n = 327$ )		With HbA1c testing ( $n = 305$ )
Age, years	$60.3 \pm 16.7$	$37.8 \pm 16.7$	$38.6 \pm 17.4$	$37.0 \pm 15.9$	<0.001
Gender, female (%)	54 (61.4)	404 (63.9)	206 (63.0)	198 (64.9)	0.64
Plasma glucose, mmol/L	$10.4 \pm 6.1$	$6.0 \pm 1.4$	$6.0 \pm 1.4$	$5.9 \pm 1.4$	<0.001
Systolic blood pressure, mm Hg	$137.8 \pm 23.7$	$131.9 \pm 19.6$	$133.7 \pm 20.2$	$129.9 \pm 18.8$	0.037
Creatinine, $\mu\text{mol/L}$	$116.0 \pm 98.1$	$86.2 \pm 98.1$	$85.7 \pm 94.3$	$86.7 \pm 102.3$	0.011
Comorbidities, $n$ (%)					
Hypertension	59 (67.0)	75 (11.9)	46 (14.1)	29 (9.5)	<0.001
Hypercholesterolaemia	36 (40.9)	55 (8.7)	32 (9.8)	23 (7.5)	<0.001
Smoker	20 (22.7)	203 (32.1)	106 (32.4)	97 (31.8)	<0.05
Ex-smoker	10 (11.4)	40 (6.3)	20 (6.1)	20 (6.6)	
Obstructive sleep apnoea	13 (14.8)	8 (1.3)	5 (1.5)	3 (1.0)	<0.001
Obesity	14 (15.9)	18 (2.8)	6 (1.8)	12 (3.9)	<0.001

HbA1c, glycated hemoglobin.

**Table 2** Distribution of random venous blood glucose by diagnostic criteria

RBG (mmol/L)	With T2DM, <i>n</i> (%), ( <i>n</i> = 87)	Without diabetes, <i>n</i> (%), ( <i>n</i> = 628)
≥11.1	28 (32.2%)	9 (1.4%)
7.0–11.0†	29 (33.3%)	90 (14.3%)
6.1–6.9‡	15 (17.2%)	118 (18.8%)
5.6–6.0§	4 (4.5%)	131 (20.9%)
<5.6	13 (14.9%)	280 (44.6%)

†Range inclusive of minimum fasting blood glucose for diagnosis of diabetes.

‡Range of fasting blood glucose for World Health Organisation criteria for impaired fasting glucose.

§Range of fasting blood glucose for American Diabetes Association for diagnosis of impaired fasting glucose. RBG, random blood glucose; T2DM, type 2 diabetes.

hyperglycaemia suggest an RBG threshold of ≥7.8 mmol/L paired with an HbA1c of ≥6.5%.<sup>13</sup> When using those criteria, 1.3% (*n* = 4) of our participants met the diagnostic criteria for diabetes. None of these presented to the ED with a diabetes-specific issue. Comparisons with other thresholds are additionally detailed in Table 3.

Of patients with known diabetes, 26.1% (*n* = 23) had their glucose and/or diabetes management recorded in the discharge summary from the hospital to their GP. In comparison, among those without pre-existing diabetes (*n* = 632), only one person (0.16%) with an elevated glucose reading (8.0 mmol/L) had this information recorded in their discharge summary.

## Discussion

This study demonstrated that there was a high prevalence of pre-existing diabetes in Aboriginal people

attending an ED, in keeping with nationally available data for Aboriginal people. Participants with diabetes were more likely to be older and be admitted to hospital compared to those with no known diabetes. RBG was performed for nearly all patients with valid blood tests, while HbA1c was not performed routinely. No patient without pre-existing diabetes fulfilled both RBG ≥11.1 mmol/L and an HbA1c ≥6.5%, leading to few diagnoses of new diabetes, but a sizeable proportion of patients were in the high-risk category requiring further confirmatory testing after discharge. The addition of HbA1c did not increase the diagnosis rate of diabetes, and communication of high glucose results to the participants' GPs in discharge letters was limited.

The prevalence of T2DM was 12.0% in our cohort, which is within reported ranges among Aboriginal communities.<sup>4,8</sup> This is also higher than the 8.6% prevalence of diabetes in the same ED for all adults aged ≥60 years.<sup>14</sup> While that study only looked at ED attendance for all patients ≥60 years old, the mean age for that study was around 74.6 years compared to 60.3 years in the current study. The higher T2DM prevalence despite the lower age among Aboriginal people (12% vs 8.6%) in the same ED suggests that there is a higher rate of T2DM prevalence among Aboriginal people in this study, in keeping with current literature. In this study, measurement of HbA1c led to an opportunity to discuss glycaemic control in people with T2DM. This is relevant, given that Aboriginal people with T2DM do not necessarily receive timely HbA1c testing – only 62% had an HbA1c test in the past 12 months in the National Key Performance Indicator(s) (nKPI) dataset.<sup>15</sup> This also allowed for the patients with pre-existing diabetes to connect with the ACCP team and arrange follow-up.

There was no overlap between those with an HbA1c of ≥6.5% and those with an RBG ≥11.1 mmol/L,

**Table 3** HbA1c and RBG outcomes of prospective participants without diabetes

RBG (mmol/L)		HbA1c (%)				Total, <i>n</i> (%)
		≥6.5	6.0–6.4	5.7–5.9	≤5.6	
≥11.1		0	1	0	3	4 (1.3)
7.0–11.0†		6	4	7	19	36 (12.1)
6.1–6.9‡		1	5	7	47	60 (20.2)
5.6–6.0§		1	2	9	51	63 (21.2)
≤5.5		0	0	6	128	134 (45.1)
Total, <i>n</i> (%)		8 (2.7)	12 (4.0)	29 (9.8)	248 (83.5)	297
Criteria		Diabetes	IEC high risk	ADA high risk	Normal	

Test statistic:  $\chi^2 = 63.29$ , *df* = 12, *P*-value ≤ 0.001.

†Range inclusive of minimum fasting blood glucose for diagnosis of diabetes.

‡Range of fasting blood glucose for World Health Organization criteria for impaired fasting glucose.

§Range of fasting blood glucose for American Diabetes Association for diagnosis of impaired fasting glucose. ADA, American Diabetes Association; HbA1c, glycated hemoglobin; IEC, International Expert Committee; RBG, random blood glucose.

resulting in no new documented diagnoses of diabetes, as two separate tests for the diagnosis are required in asymptomatic patients. Of interest, a previous study conducted in another hospital in Sydney found that nearly 40% of adults attending the ED were diagnosed with previously undiagnosed diabetes when utilising HbA1c as a screening tool, albeit using a lower HbA1c cut-off of 5.7% and a single measurement.<sup>16</sup> This may be the result of the availability of screening/support for chronic disease at the time, and the disparity in glucose readings and HbA1c could potentially be explained by a few factors in the ED presentations. Glucose readings lower than expected could be explained by factors including fasting state, vomiting or reduced oral intake. Conversely, glucose readings higher than expected could be explained by stress hyperglycaemia. HbA1c could be influenced by patient factors such as erythrocyte lifespan, iron deficiency and hepatic and renal impairment.<sup>17</sup> HbA1c has significant variation in test performance (i.e. sensitivity and specificity) when considering ethnicity.<sup>18</sup>

When considering the higher cost, additional clinical time for follow-up and the fact that HbA1c results were often reported after discharge from the ED, the routine use of HbA1c for screening through ED presentations may not be justified for this patient cohort for diagnostic purposes based on the findings of this study. However, given the large number of participants who had intermediate hyperglycaemia based on RBG or HbA1c, further testing may have led to a greater diagnosis of diabetes. It is also reassuring to see that the high rates of known T2DM suggest that there is a system of screening and diagnosis of T2DM in the local community before the need for ED admission for the detection of 'new diabetes'. The local Aboriginal Health team has won multiple NSW Health Awards for Excellence in Aboriginal Healthcare over the years, and given our experience of working with the ACCP team and collaboration with the local AMS, this may have influenced the higher detection rate of diabetes prior to the person needing hospital admission, leading to a lower detection rate of high glucose among those without pre-existing diabetes in ED. However, this may not be the case in all communities, and results from diabetes screening could be different in regions where there is less support for chronic disease and screening for Aboriginal people. While an additional letter was sent to the GP with the blood results for all participants (normal and abnormal results) as part of this study, the clinical handover to the participants' GPs based on the discharge letters was inadequate for hyperglycaemia in patients with or without a pre-existing diagnosis of diabetes. The reasons for non-inclusion of hyperglycaemia in discharge summaries was not formally evaluated in this study.

## Strengths and limitations

The study included all unselected presentations of Aboriginal adults to an ED, which reduced the risk of selection bias. Additionally, the co-design with the Director of Aboriginal Health for the Local Health District as well as collaboration with the ACCP team and ALO ensured that the study was culturally sensitive and participants had follow-up arranged for their clinical care with their GP or local Aboriginal Medical Service. Despite these strengths, there are several limitations in this study. This was a single-site study and mid-way through this study period, the COVID pandemic emerged. However, there were no major differences in the numbers of presentations/admissions or data between the first half of the study, which collected data before the COVID pandemic, and the second half. Additionally, we had limited follow-up data for confirmatory diagnostic tests performed for at-risk participants following discharge, with follow-up testing potentially impacted by COVID pandemic lockdowns at the time.

## Conclusion

There was a high prevalence of pre-existing diabetes among Aboriginal people attending the ED. The measurement of venous glucose or the addition of HbA1c testing routinely among Aboriginal adults without known diabetes presenting to the ED did not increase the detection of undiagnosed diabetes. However, these tests did detect patients who were at high risk of having diabetes, who would benefit from further confirmatory testing. Future multi-site studies should examine the utility or models of diagnosis of undetected diabetes in Aboriginal people in ED or community settings.

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