Continuous quality improvement and metabolic screening during pregnancy at primary health centres attended by Aboriginal and Torres Strait Islander women

Abstract

Objective: To investigate associations between the provision of routine metabolic screening and follow-up in pregnancy and participation by primary health care centres in a large-scale continuous quality improvement (CQI) initiative.

Design: Longitudinal analysis of 2592 audited maternal health records.

Setting and participants: Seventy-six community-controlled or government-operated primary health care centres serving predominantly Aboriginal and Torres Strait Islander communities, in urban, regional or remote locations in five Australian states and territories.

Intervention: Up to four CQI cycles supported by the Audit and Best Practice for Chronic Disease Research Partnership.

Main outcomes measures: Screening and follow-up for body mass index (BMI), blood pressure and diabetes in pregnancy.

Results: Overall, 87.9% of women attending the participating health centres were Aboriginal or Torres Strait Islander. Women attending a health centre after it had conducted one or more CQI cycles were more likely to receive BMI, blood pressure and diabetes screening. For example, the proportion of women receiving diabetes screening at baseline (before the first CQI cycle) was 56.1%; after cycle 1 it was 63.7% (odds ratio [OR], 1.3; 95% CI, 1.0–1.6), after cycle 2, 61.6% (OR, 1.2; 95% CI, 0.9–1.7), after cycle 3, 63.7% (OR, 1.7; 95% CI, 1.1–2.6), and after cycle 4, 75.5% (OR, 3.4; 95% CI, 1.9–5.9). Diabetes screening was associated with higher self-ratings of overall organisational systems ($P = 0.03$), self-management support ($P = 0.04$) and organisational influence and integration ($P = 0.01$).

Conclusion: These findings support the value of CQI approaches that focus on systems-level issues in primary care to improve the provision of recommended pregnancy care at primary health care centres in predominantly Aboriginal and Torres Strait Islander communities.

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Attending to perinatal risk factors, such as diabetes and hypertension during pregnancy, obesity and excess gestational weight gain,[1-5] is important for optimising maternal and infant health outcomes. Pregnancy is also a key period for implementing strategies that prevent long-term adverse health outcomes, as excess gestational weight gain and gestational diabetes mellitus (GDM) are respectively predictors of long-term obesity[6] and the development of type 2 diabetes.[7]

Screening for and follow-up of metabolic risk factors are components of recommended pregnancy care in Australia.[8] Ensuring that Aboriginal and Torres Strait Islander (respectfully referred to in this article as Indigenous) women receive such care is expected to contribute to giving babies a healthy start to life and to improving the health of their mothers. In Australia, low birth weight, premature birth and perinatal death are substantially more frequent in Indigenous than in non-Indigenous pregnancies.[9] Obesity, pre-existing diabetes and GDM are some of the risk factors that are more common in Indigenous women.[3,4,10] Later in life, cardiovascular disease and diabetes are major contributors to the difference in life expectancy between Indigenous and non-Indigenous Australians.[11]

As care can differ between health centres with different characteristics, such as urban and rural or remote locations,[8] effective long-term strategies are needed across a range of settings to facilitate the provision of all components of recommended pregnancy care.[12] The Audit and Best Practice for Chronic Disease (ABCD) National Research Partnership[13,14] aims to improve the provision of care by primary health care centres (PHCs) serving mainly Indigenous populations. It uses a continuous quality improvement (CQI) framework to increase the efficiency and effectiveness of organisational systems. Previous ABCD Partnership research indicates that increases in self-ratings of organisational systems are associated with improvements in the delivery of health care for those with type 2 diabetes.[15]

We investigated screening for metabolic risk factors during pregnancy and follow-up actions by PHCs participating in the ABCD partnership. We also investigated associations between self-ratings by organisational systems and the proportion of women who undergo metabolic screening.

Methods

The study was approved by human research ethics committees in the relevant states and territories, and by Indigenous subcommittees where required.[16] The analyses were approved by the Monash University Human Research Ethics Committee (CF12/3434-2012001670).

Study design and setting

The ABCD National Research Partnership study protocol has been

described in detail elsewhere.[13,16] This partnership links multiple PHCs and stakeholders across the health system in collaborative CQI research.[14] One21seventy, the National Centre for Quality Improvement in Indigenous Primary Health Care, supports CQI in PHCs by providing evidence-based practical tools and training.[14] The ABCD Partnership has access to One21seventy data from PHCs that have volunteered to participate in research.[13,14] This article reports longitudinal analysis of data from 76 PHCs (2592 health records) involved in the ABCD Partnership across five Australian states and territories. The PHCs conducted up to four CQI cycles, comprising 58.5% (168 of 287) of the One21seventy maternal health audits conducted between 2007 and 2012. Twenty-one of the 76 PHCs began maternal health auditing in 2007; 13 commenced in 2008, 13 in 2009, 11 in 2010, 10 in 2011, and 8 in 2012. Depending on their needs, PHCs may focus in some years on CQI activities in other clinical areas; of 50 PHCs that had completed two or more maternal health audits, 11 (22.0%) conducted audits in non-consecutive years.

Intervention: continuous quality improvement cycles

At baseline, systems assessments and audits of health records were conducted and the results provided to PHCs in real-time by an automated CQI reporting system. PHCs use the reports for participatory interpretation and goal setting, and this is followed by the initiation of relevant actions. Data collection was repeated in subsequent years to assess success in improving care (end of cycle 1), and to identify new priorities for improvement (start of cycle 2). PHCs are encouraged to complete one cycle each year.

Maternal health audit tool

Recorded pregnancy care was assessed by auditing the health records of women with a recent pregnancy (mothers with an infant aged 2–14 months, who resided in the community during their pregnancy and attended for pregnancy care at least once).[13,16] Audits were conducted by trained auditors (local PHC staff, staff from other PHCs, or CQI facilitators) supported by a standard protocol and regional CQI facilitators. The audit tool and parameters of the outcome measures were based on best practice guidelines, policy and research reports, and stakeholder consultations.[16] At each PHC, the auditor used a standard sampling protocol to select a random sample of at least 30 records to audit (if fewer than 30 eligible records were available, all were audited).[13]

The Systems Assessment Tool

Structured assessments of PHC system strengths and weaknesses were conducted by PHC staff together with a trained external CQI facilitator using the Systems Assessment Tool (SAT).[13,15] This consensus process produces a self-reported overall mean score (range, 0–11) for the state of development of PHC organisational systems, and five subscale scores (delivery system design, information systems and decision support, self-management support, external links, and organisational influence and integration).

Key outcome measures

The audit tool collected information on documentation of the following items in each health record:[16]

- body weight, body mass index (BMI) and blood pressure (BP) screening in women attending at earlier than 13 weeks' gestation;
- BP checks at any point during the pregnancy;
- a 50 or 75 gram glucose challenge test (GCT) and, if indicated, an oral glucose tolerance test (OGTT) at 20–30 weeks' gestation;
- for women with a BMI under 20 or over 30 kg/m^2: development of a BMI management plan;
- for women with high BP ($\geq$ 140/90 mmHg): repeated BP measurements, urine tests for protein, examination by or referral to a general practitioner or obstetrician, or prescription of antihypertensive medication;
- an OGTT for those with an abnormal GCT result (plasma glucose concentration $\geq$ 7.8 mmol/L 1 hour after a 50 g glucose load (morning, non-fasting), or $\geq$ 8.0 mmol/L after a 75 g glucose load).

"Follow-up" in this article refers to taking the next appropriate action after an abnormal screening result.

Statistical methods

Analyses were conducted using Stata version 12.1 (StataCorp). $P < 0.05$ (2-sided) was defined as statistically significant. Differences in screening proportions at baseline and at the final audit were assessed with respect to PHC governance, location, population size (*t* tests or Mann–Whitney *U* tests) and state or territory (one-way analysis of variance or Kruskal–Wallis tests). Paired *t* tests assessed differences between the first and last SAT scores. Using each health record as the unit of analysis, random effects logistic regression analysis (generating odds ratios) assessed any associations between metabolic screening and CQI cycle number (Stata *xtlogit* command). Random effects logistic regression allowed for repeated measures of each outcome (eg, did a patient receive a BP check: yes or no) at each cycle per PHC. This method also allowed for adjustment for similarities in women within each PHC. The reference group comprised audit data from the PHCs before they had conducted a CQI cycle (ie, cycle 0 or baseline). We also tested for a trend to increased metabolic screening with each additional CQI cycle (Stata *nptrend* command).

For each PHC, the proportion of women receiving screening after each CQI cycle was calculated. Treating each PHC as the unit of analysis, univariable linear regression (generating β coefficients) assessed associations between:

- the average proportion of women who underwent screening across all cycles, and average overall or subscale SAT scores;
- the total change (from first to final cycle) in the proportion of women who underwent screening, and the total change in overall or subscale SAT scores.

Results

A range of PHC settings were included in the study. Most women who attended these PHCs for pregnancy care were Indigenous Australians (87.9%) (Box 1).

While most women who attended during the first trimester were weighed, the BMI was calculated for less than a third; but women attending after the PHC had conducted at least one CQI cycle were more likely to have had their BMI assessed than women attending PHCs that had not done so. Similar patterns were observed for BP checks at any point during the pregnancy and diabetes screening. Improvements in screening appeared to be sustained over sequential CQI cycles, and there were trends for additional improvements with each additional cycle (Box 2).

At baseline, the only significant differences in screening were those between states and territories for first trimester BP checks ($P = 0.04$), BP checks at any stage of the pregnancy ($P = 0.02$) and diabetes screening ($P = 0.002$). These differences were not significant at the PHCs' final audits (all $P > 0.05$).

There were also indications of sustained improvements in the provision of follow-up actions after CQI participation, but the sample sizes were too small for statistical analysis. Follow-up actions for high BP included repeated BP assessment (pre-26 weeks, 88.1%; post-26 weeks, 91.9%), urine tests (pre-26 weeks, 88.1%, post-26 weeks, 83.9%), referral (pre-26 weeks, 85.7% post-26 weeks, 94.3%) and antihypertensive medication (pre-26 weeks, 42.9%, post-26 weeks, 26.4%). Follow-up OGTTs were reported for most women who received an abnormal GCT result. Few women with an abnormal BMI, however, had a documented BMI management plan (Box 3).

Systems assessment data were available for 35 PHCs (46.1%); data were available for more than one time point for 21. The mean overall SAT score at the final cycle (7.36) was statistically significantly higher than at the first cycle (6.23; $P = 0.009$), but there were no significant differences in SAT subscale scores between the first and final cycles (data not shown). Higher average self-ratings of some organisational systems were associated with greater provision of metabolic screening (Box 4). For example, the average provision of first trimester BP screening was 3.7 percentage points higher for each additional point scored on the SAT information systems and decision support domain. Diabetes screening was associated with higher overall self-ratings, as well as with higher ratings of self-management support systems, and of organisational influence and integration.

In addition, there was a statistically significant association between a one-point increase from first to final assessment in information systems and decision support scores and an increase of 5.7 percentage points in the proportion of women receiving diabetes screening between the first and final audits ($\beta = 5.7$; 95% CI, 0.6–10.9; $P = 0.03$). However, no

1 Characteristics of the 76 primary health care centres included in the study, and of the 2592 women whose records were audited

Characteristics of the primary health care centres	
Governance structure	
Government-operated	49 (64.5%)
Community-controlled	27 (35.5%)
Location	
Remote	56 (73.7%)
Urban or regional	20 (26.3)
Service population size	
≥ 1000 people	39 (51.3%)
< 1000 people	37 (48.7%)
State or territory	
Northern Territory	28 (36.8%)
Queensland	27 (35.5%)
Western Australia	11 (14.5%)
New South Wales	6 (7.9%)
South Australia	4 (5.3%)
Characteristics of the women	
Indigenous status*	2141 (87.9%)
Aboriginal	2028 (83.3%)
Torres Strait Islander	57 (2.3%)
Aboriginal and Torres Strait Islander	56 (2.3%)
Age†	
Median, years	24.4 (IQR, 20.6–29.6)
< 20 years	545 (21.1%)
20–34 years	1807 (69.9%)
≥ 35 years	233 (9.0%)
First attendance for pregnancy care occurred before 13 weeks' gestation‡	1321 (51.0%)
Median number of pregnancy care visits	7 (IQR, 5–10)

IQR = interquartile range. * $n = 2435$ (data missing for 157 women). † $n = 2585$ (data missing for 7 women). ‡ $n = 2591$ (data missing for 1 woman). ◆

2 Documented metabolic screening during pregnancy after completion of each continuous quality improvement (CQI) cycle, and associations between metabolic screening and primary health care centre (PHC) participation in each CQI cycle

Metabolic screening	CQI cycle 0 76 PHCs	1 50 PHCs	2 28 PHCs	3 8 PHCs	4 6 PHCs	*P* (for trend)
Weight measured in first trimester (1321 women)	440/562 (78.3%)	344/418 (82.3%)	153/202 (75.7%)	49/65 (75.4%)	56/74 (75.7%)	
Odds ratio (95% CI)	1.0	1.4 (0.9–2.0) *P* = 0.10	1.0 (0.6–1.6) *P* = 0.89	1.2 (0.6–2.4) *P* = 0.59	1.4 (0.7–2.8) *P* = 0.34	0.38
BMI calculated in first trimester (1321 women)	132/562 (23.5%)	126/418 (30.1%)	63/202 (31.2%)	25/65 (38.5%)	31/74 (41.9%)	
Odds ratio (95% CI)	1.0	2.4 (1.6–3.5) *P* < 0.001	3.4 (2.0–5.6) *P* < 0.001	5.1 (2.4–10.7) *P* < 0.001	9.4 (4.6–19.4) *P* < 0.001	< 0.001
Blood pressure check in first trimester (1321 women)	485/562 (86.3%)	370/418 (88.5%)	180/202 (89.1%)	56/65 (86.2%)	59/74 (79.7%)	
Odds ratio (95% CI)	1.0	1.3 (0.8–1.9) *P* = 0.27	1.5 (0.9–2.7) *P* = 0.15	1.6 (0.7–3.7) *P* = 0.24	1.1 (0.5–2.3) *P* = 0.78	0.51
Blood pressure check at any point during the pregnancy (2592 women)	1123/1201 (93.5%)	745/758 (98.3%)	383/388 (98.7%)	131/135 (97.0%)	110/110 (100.0%)	
Odds ratio (95% CI)	1.0	3.7 (1.9–7.3) *P* < 0.001	7.0 (2.5–19.4) *P* < 0.001	2.0 (0.6–6.5) *P* = 0.25	—	< 0.001
Diabetes screening (2541 women)*	669/1192 (56.1%)	469/736 (63.7%)	234/380 (61.6%)	86/135 (63.7%)	74/98 (75.5%)	
Odds ratio (95% CI)	1.0	1.3 (1.0–1.6) *P* = 0.04	1.2 (0.9–1.7) *P* = 0.15	1.7 (1.1–2.6) *P* = 0.02	3.4 (1.9–5.9) *P* < 0.001	< 0.001

BMI = body mass index. * In 2010, the audit tool was refined to include "not applicable" if women had already been diagnosed with diabetes, or were offered but declined BMI or blood pressure assessment or diabetes screening. Since 2010, 26 women were recorded as having pre-existing diabetes, and 25 women declined diabetes screening. This reduced the denominator for diabetes screening to 2541. There were no recorded instances of women declining BMI or blood pressure checks. ◆

other significant associations between changes in SAT scores and screening were detected (data not shown).

Discussion

This large longitudinal study of PHCs found substantial improvements in routine metabolic screening in pregnancy associated with participation in a CQI initiative. Improvements were sustained over multiple cycles, with evidence for additional improvements with each consecutive CQI cycle. Initiation of follow-up actions also improved after CQI participation. Higher self-ratings of some organisational systems were significantly associated with greater metabolic screening.

Screening at baseline was incomplete for all the metabolic risk factors investigated, consistent with reports from other Indigenous communities.[17] It is unclear whether metabolic screening coverage in other maternity care settings is incomplete, as this information is not reported in other routine perinatal data collections. However, improvements associated with CQI participation were observed with respect to BMI and BP assessment and screening for diabetes during pregnancy. Measurement of BMI early in pregnancy is important because maternal and neonatal morbidity increases with maternal BMI,[3] and the recommended gestational weight gain depends on the BMI category.[1] Measurement of BMI may be influenced by both the mothers' and health professionals' understanding of the importance of healthy gestational weight gain and awareness of weight gain guidelines, and by the confidence of health professionals that they can discuss weight with women without causing undue concern.[18] It is encouraging that we encountered no instances of women who declined to be weighed. Similarly, first trimester BP assessment and universal second trimester GDM screening are also recommended in Australia, and these remain areas for improvement. It is important to explore potential barriers to GDM screening, both because the prevalence of diabetes during pregnancy is higher among Indigenous women than in non-Indigenous women[4] and because of the importance of diabetes management during pregnancy.[4]

Pregnancy is an opportune time for health practitioners to discuss weight management with women.[19] However, few women in this study with an abnormal BMI had a management plan, which may reflect suboptimal action taken, a lack of documentation of the actions taken, or both. Excess weight gain increases pregnancy

3 Recorded metabolic abnormalities during pregnancy and subsequent follow-up after each continuous quality improvement (CQI) cycle

	CQI cycle				
Metabolic risk factors and follow-up	0 76 PHCs	1 50 PHCs	2 28 PHCs	3 8 PHCs	4 6 PHCs
Abnormal BMI in first trimester (377 women)	39/132 (29.6%)	34/126 (27.0%)	17/63 (27.0%)	5/25 (20.0%)	8/31 (25.8%)
BMI management plan (103 women)	6/39 (15.4%)	10/34 (29.4%)	6/17 (35.3%)	4/5 (80.0%)	4/8 (50.0%)
High blood pressure in first trimester (1150 women)	11/485 (2.3%)	12/370 (3.2%)	5/180 (2.8%)	1/56 (1.8%)	0/59
Blood pressure follow-up < 26 weeks (73 women)	13/32 (40.6%)	17/27 (63.0%)	7/9 (77.8%)	2/2 (100.0%)	3/3 (100.0%)
High blood pressure at any time during pregnancy (2492 women)	72/1123 (6.4%)	51/745 (6.8%)	25/383 (6.5%)	2/131 (1.5%)	8/110 (7.3%)
Blood pressure follow-up ≥ 26 weeks (110 women)	34/49 (69.4%)	30/35 (85.7%)	17/20 (85.0%)	no cases	6/6 (100.0%)
Abnormal GCT result (1530 women)	120/667 (18.0%)	92/469 (19.6%)	41/234 (17.5%)	15/86 (17.4%)	9/74 (12.2%)
Follow-up OGTT (277 women)	104/120 (86.7%)	81/92 (88.0%)	40/41 (97.6%)	14/15 (93.3%)	7/9 (77.8%)

PHC = primary health care centre; BMI = body mass index; GCT = glucose challenge test; OGTT = oral glucose tolerance test. ◆

risks, such as macrosomia, preterm birth and the need for caesarean delivery,[1] as well as the long-term risk of obesity,[6] making active management vital for the wellbeing of mother and child. Potential barriers to developing weight management plans include limited resources for referral, food security concerns, and inadequate staff time, especially in remote communities. Development of resources or programs for gestational weight management tailored to the needs of Indigenous women may assist.

Most women with an abnormal GCT result subsequently underwent a diagnostic OGTT. Recent controversy about diabetes screening[20] may have created barriers to screening and follow-up. While large-scale implementation of the International Association of Diabetes in Pregnancy Study Group guidelines, starting in 2015,[21] may partially resolve these problems, the number of women diagnosed with GDM will also increase,[22] with potential resource implications for PHCs.

The positive associations between self-ratings of organisational systems and first trimester BP and diabetes screening in our study support targeting of organisational systems as a strategy for improving the provision of metabolic screening during pregnancy. However, further large-scale improvements in systems and processes that support health professionals in conducting metabolic screening and management are vital if the long-term consequences of these complications in pregnancy are to be reduced. We hope that our

4 Associations between the average proportions of women undergoing metabolic screening and average Systems Assessment Tool scores (across all cycles) for 35 primary health care centres (β-coefficient, 95% CI)

	Overall score	Delivery system design	Information systems and decision support	Self-management support	External links	Organisational influence and integration
BMI calculated in first trimester	4.2 (−3.5 to 11.9)	2.7 (−4.8 to 10.2)	5.5 (−1.3 to 12.2)	3.5 (−1.6 to 8.6)	1.9 (−4.5 to 8.4)	1.2 (−5.1 to 7.4)
Blood pressure check in first trimester	2.6 (−0.6 to 5.8)	1.9 (−1.3 to 5.0)	3.7* (0.9 to 6.4)	1.5 (−0.6 to 3.7)	−0.6 (−3.4 to 2.1)	2.5 (−0.0 to 5.1)
Blood pressure check at any point during pregnancy	0.9 (−0.9 to 2.6)	0.5 (−1.2 to 2.2)	1.3 (−0.2 to 2.9)	0.3 (−0.9 to 1.5)	0.3 (−1.2 to 1.8)	0.7 (−0.8 to 2.1)
Diabetes screening	5.3* (0.6 to 10.1)	4.6 (−0.1 to 9.3)	3.8 (−0.6 to 8.2)	3.4* (0.2 to 6.7)	1.2 (−3.1 to 5.4)	4.9* (1.1 to 8.6)

BMI = body mass index. * $P < 0.05$. ◆

findings encourage further discussion about how pregnancy care for Indigenous women might be improved. All levels of the health system have roles to play, and systems-based research networks, such as the ABCD Partnership, are ideally placed to develop appropriate strategies.

Our study was limited by the fact that SAT data were available for only some PHCs (35 of 76, 46.1%), reducing the statistical power of our analysis to detect associations. Selection bias was also possible, as this study included only the One21seventy PHCs that volunteered their data for research (58.5% of the audits conducted overall). Our data may not be representative of PHCs not participating in the One21seventy initiative, but this extensive network includes a large population, and there are currently no other comparable data sources in Australia. Bias caused by the possibility that PHCs with lesser improvement would be less likely to remain in the CQI initiative is difficult to gauge, as commencement years varied and PHCs may have conducted maternal health audits in non-consecutive years. However, the generalisability of our results may have been enhanced by the fact that PHCs used the audit tool according to their needs, rather than as a research requirement. As we performed multiple statistical tests, there was a risk of finding significant associations by chance. This possibility was reduced by not undertaking statistical tests for follow-up actions, as the small numbers involved were inadequate for meaningful comparisons.

The CQI initiative continues, and further assessment of its effects on service delivery and health outcomes is planned as the sample size increases. Future directions include investigating the effects on service provision of the audit year, the year of commencement, and the duration of CQI participation. A cluster randomised controlled trial is an alternative study design that could be used to test hypotheses arising from the current findings.

Despite the limitations, our study has significant strengths that increase the generalisability of its findings. Most previous CQI research in pregnancy care has been hospital-based, implemented in a single service, not focused on metabolic screening, or not conducted in Australia.[23-25] Our research applied a unique system-wide participatory approach to assess systemic issues commonly affecting provision of care.[14] It used a detailed, longitudinal dataset to investigate long-term sustainability, and included many PHCs across several settings.

Our study shows the potential of a CQI initiative supported by a systems-based research network to improve the provision of recommended pregnancy care at PHCs attended by Indigenous women. These findings are encouraging, and suggest a successful approach for achieving further improvement in pregnancy care provision.

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