Birthing on country service compared to standard care for First Nations Australians: a cost-effectiveness analysis from a health system perspective

Yu Gao,[a,b] Yvette Roe,[a,b] Sophie Hickey,[a,b] Anvitaa Chadha,[a] Sue Kruske,[a] Carmel Nelson,[c,d] Adrian Carson,[c,d] Kristie Watego,[c] Maree Reynolds,[e] Jo Costello,[e] Sally Tracy,[a,f] and Sue Kildea[a,b,*]

[a]Molly Wardaguga Research Centre, Faculty of Health, Charles Darwin University, Brisbane City, Queensland, 4000, Australia
[b]Mater Research Institute and School of Nursing and Midwifery, University of Queensland, Aubigny Place, Raymond Terrace, South Brisbane, Queensland, 4101, Australia
[c]Institute for Urban Indigenous Health, 22 Cox Rd, Windsor, Queensland, 4030, Australia
[d]The University of Queensland, Poche Centre for Indigenous Health, 31 Upland Road, St Lucia, Queensland, 4067, Australia
[e]Mater Hospital, Aubigny Place, Raymond Terrace, South Brisbane, Queensland, 4101, Australia
[f]The University of Sydney, Sydney, NSW, 2006, Australia

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Summary

Background Preterm birth is the leading cause of morbidity and mortality for children under five years with First Nations babies experiencing twice the rate of other Australians. The Birthing in Our Community (BiOC) service was implemented in a metropolitan centre in Australia and showed a significant reduction in preterm birth. We aimed to assess the cost-effectiveness of the BiOC service in reducing preterm births compared to Standard Care, from a health system perspective.

Methods Women who were carrying a First Nations baby and attending the Mater Mothers Public Hospital (Brisbane, QLD, Australia) were allocated to either BiOC or Standard Care service. Birth records were extracted from the hospital's routinely collected and prospectively entered database. The time horizon extended from first presentation in pregnancy up to six weeks after birth for mothers and 28 days for infants, or until discharged from hospital. All direct antenatal, birth, postnatal and neonatal costs were included. The proportion of preterm birth was calculated, and cost was estimated in 2019 Australian dollars. The incremental cost and proportion of preterm birth differences were adjusted using inverse probability of treatment weighting methods.

Findings Between Jan 1 2013, and Jun 30, 2019, 1816 mothers gave births to 1867 First Nations babies at the Mater Mothers Public Hospital. After exclusions, 1636 mother-baby pairs were included in the analyses: 840 in the Standard Care group and 796 in the BiOC service. Relative to Standard Care, the BiOC service was associated with a reduced proportion of preterm birth (–5.34%, [95% CI –8.69%, –1.98%]) and cost savings (-AU$4810, [95% CI –7519, –2101]) per mother-baby pair. The BiOC service was associated with better outcomes and cost less than Standard Care.

Interpretation The BiOC service offers a cost-effective alternative to Standard Care in reducing preterm birth for Australian First Nations families. The cost savings were driven by less interventions and procedures in birth and fewer neonatal admissions. Investing in comprehensive, community-led models of care improves outcomes at reduced cost.

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Keywords: Indigenous; First Nations; Birthing on country; Preterm; Midwifery; Cost; Cost-effectiveness analysis

*Corresponding author. Molly Wardaguga Research Centre, Faculty of Health, Charles Darwin University, Brisbane City, Queensland, 4000, Australia.
E-mail address: sue.kildea@cdu.edu.au (S. Kildea).

Research in context

Evidence before this study

First Nations Australians experience a disease burden of 2.3 times other Australians, starting during pregnancy. A $4.4 billion gap in Government and private health expenditure has been identified for First Nations health expenditure in Australia, equating to at least $5042 per person. Redesigning maternity services, in line with national policy recommendations (Birthing on Country Guidelines), resulted in the establishment of the Birthing in Our Community service providing greater control by First Nations organisations, increased community-based care, continuity of midwifery care and growth in the First Nations workforce. Many clinical outcomes for mothers and babies, improved including antenatal attendance, preterm birth and exclusive breastfeeding rates.

Added value of this study

This study provides evidence that funds spent on the new service, reduced preterm birth for Indigenous families by 5.34% and saved the health system AUD 4810.02 per mother-baby pair. To our knowledge, this is the first cost-effectiveness analysis comparing different models of care in reducing preterm births for First Nations families in Australia. Our results provide timely evidence of the cost-effectiveness of the Birthing in Our Community service, for the best start in life for First Nations babies.

Implications of all the available evidence

There were 18,086 First Nations babies born in 2019 in Australia. Replication of the Birthing in Our Community service across the country has the potential to reduce the number of First Nations babies born preterm each year by 965 (18,086*5.34%) and save $86,994,021 (18,086*$4810.02) in Australian health expenditure. Removing structural barriers that restrict funding for First Nations maternity service redesign would enable greater investment in services to modify risk factors and prevent poor outcomes. This would be a significant investment in improving the life trajectory for First Nations families, with reduced costs to governments and families.

Introduction

Significant health inequalities exist between First Nations peoples and other Australians, despite efforts being taken at the Federal and State levels to reduce them.[1,2] First Nations Australians experience a disease burden of 2.3 times other Australians and this starts during pregnancy and birth.[3] Gaps in access to healthcare, particularly culturally appropriate care, contribute to poorer health outcomes in expectant women, including preterm birth.[4] In Australia, preterm birth is the leading cause of infant morbidity and mortality under five years of age.[5,6] In 2019, preterm birth rates were 13.2% for babies born to First Nations women compared to 8.3% for other Australians[7] and the difference has remained relatively unchanged over the last decade.[8]

The economic impact of preterm birth is substantial. In the USA, the estimated annual societal economic cost per preterm infant compared with term infant was US$51,600 (in 2005 constant dollars, which has been adjusted for purchasing power due to inflation). This includes more medical care services, early intervention services, special education services and loss of productivity from birth to 7 years of age.[9] Modelling studies show that a baby born preterm will cost £22,885 (UK pounds at 2006 price) more than a term baby in Britain,[10] and between AU$25,000-$236,000 (in 2018 Australian dollars) more than a term baby in Australia,[11] from birth to 18 years. The indirect non-healthcare costs, as well as the direct cost of neonatal care, and ongoing medical care if long-term complications arise from preterm birth, pose a significant burden on individuals, families and the healthcare system.[12] The World Health Organization (WHO) recommends measures be taken to address the rising levels of preterm birth and its associated levels of morbidity, by targeting interventions to promote early engagement with health care, more antenatal care visits, smoking reduction and comprehensive support to reduce other risk factors by developing and testing innovative models of care for population subgroups, including ethnically diverse women.[4]

To increase cultural safety and improve maternal and infant health outcomes during pregnancy, birth and the postnatal period for First Nations families, a prospective, non-randomized, interventional trial was conducted in South East Queensland, Australia.[13–15] The key components of the new service were: a multiagency partnership between two First Nations community-controlled health services (the Institute for Urban Indigenous Health and the Aboriginal and Torres Strait Islander Community Health Service Brisbane) and a large, tertiary maternity hospital (Mater Mothers Public Hospital); redesigned services based in the community; continuity of midwifery care through caseload midwifery group practice (MGP) with staff receiving regular clinical and cultural supervision and additional training and education; and investment in the First Nations workforce (Family Support Workers, drivers, administration support). First Nations governance was enacted through a Steering Committee and operational management with a strength-based holistic approach to the provision of culturally safe care (Supplement Table S1).[13,15] The trial used a participatory action research approach to establish and evaluate the feasibility, acceptability, clinical and cost-effectiveness of the

new 'Birthing in Our Community (BiOC)' service, compared to Standard Care. The study demonstrated that the women receiving BiOC were more likely to attend five or more antenatal visits (adjusted odds ratio 1.54, 95% CI 1.13–2.09; p = 0.0064), less likely to have an infant born preterm (0.62, 0.42–0.93; p = 0.019), and more likely to exclusively breastfeed on discharge from hospital (1.34, 1.06–1.70; p = 0.014), with significant improvements in multiple secondary outcomes.[15] The aim of this study was to estimate the incremental cost-effectiveness of the BiOC service in reducing preterm births compared to Standard Care in an urban First Nations population in Australia.

Methods

Study design and participants

Australia has a national publicly funded universal health care program which funds government-provided community and public hospital care (via jurisdictional funding delivered through formulas based on activity). In the public system there are no out-of-pocket costs to patients. In the private system there are out of pocket costs for individuals for hospital and medical care, subsidies to private health care providers, for example General Practitioners, medical specialists, health insurance providers (e.g. to assist with high cost claims). The Medicare Benefits Scheme (MBS) and Pharmaceutical Benefits Scheme (PBS) set the fee schedules for private healthcare service subsidies.[16] Services to low-income groups, such as women in our study, receive higher subsidies up to 100%. We conducted a cost-effectiveness analysis, from a health system perspective, to compare the BiOC service with Standard Care in reducing preterm birth. The time horizon extended from the first presentation for antenatal care up to six weeks after birth for mothers; and up to 28 days after birth for infants or until discharged from hospital. Full details of study methods are published elsewhere.[13,14] Between the 1st January 2013 and 30th June 2019, a total of 1867 babies identified as First Nations were born to 1816 mothers. Birth records were extracted from the hospital's routinely collected and prospectively entered obstetric clinical database (Matrix) and patient administrative system (IPM).

The procedures to allocate women into either the BiOC or Standard Care were described in detail in the protocol[13] and clinical effectiveness paper.[15] In brief any women who were carrying First Nations babies were referred to the BiOC service, and a midwife or Family Support Worker (FSW) would contact them to offer a choice of services: standard care (at one of the hospital clinics or in standard midwifery group practice) or the BiOC service. Women were not referred to the BiOC service if the midwives were at capacity or if women had specific reasons for referral to a specialist service such as maternal fetal medicine or a clinic for pregnant women with substance addiction. Some women requested other services such as shared care with their family doctor or the First Nations (Murri) antenatal clinic, which had been in existence previously; these options were included in the standard care services. When a woman is allocated to the BiOC service, the first antenatal visit (Welcome visit) usually occurs at home and the remainder of the antenatal visits are at the Community Hub, and occasionally at hospital for women who also require regular medical review. Her primary midwife and First Nations FSW introduce themselves and explain the BiOC program to establish a relationship with the family. One feature of the BiOC service is having a FSW providing social, emotional, and cultural support as well as health education to women and family members throughout pregnancy, birth and postnatal period. Women give birth in the study hospital accompanied by the primary or back-up midwife. After discharge from hospital, her primary midwife and/or FSW will visit her at home for up to six weeks after birth. A First Nations transport officer is available to drive women to their clinical appointments and other Hub activities, when required. The transport officer plays an important role in building trusting relationships and improving access to care.

For women allocated to Standard Care the care pathway differed depending on the service model. Approximately 43% of women received antenatal care at the hospital, most in the general clinics (n = 403) and a smaller number though specialised clinics including an Indigenous antenatal (Murri) clinic (n = 117), Continuity of care by Health professionals attending to Alcohol and drug problems and meeting Mother's needs for Positive family outcomes (CHAMP) clinic for substance users (n = 64), Diabetic clinic for diabetic mothers (n = 36), or Maternal Fetal Medicine clinic for complex pregnancy (n = 92). These women attend antenatal visits at the hospital clinics and see a different rostered provider each time. A proportion of women (n = 118) chose to have Shared Care in which most of the visits were with the General Practitioner (GP) and women often only came to hospital for a booking-in appointment and to give birth. After discharge from hospital, a midwife visits woman at home for postnatal care (or through a phone call) about twice then refers them to their GP for postnatal check-ups. Some women (n = 78) received MGP in which a primary midwife visits her at home for the booking-in appointment and the rest of her visits are at a community-based clinic. Birthing and postnatal care is provided by the primary midwife or back-up midwife. There are no dedicated transport officers for the Standard Care cohort, but an electronic ticket ('go card') is provided to assist a small proportion of women for free public transport, or limited taxi vouchers are used after hours.

During the pregnancy, birth and postnatal period, both groups of women are referred to an obstetrician or

other clinicians such as social worker, dietician, psychologist, allied health worker and other specialists in the study hospital if clinically indicated. All women having a First Nations baby have access to Aboriginal Liaison Workers based at the hospital Monday-Friday in working hours.

The study received ethical approval from the Mater Health Services Human Research Ethics Committee (HREC/15/MHS/24), University of Queensland Human Research Ethics Committee (2015000624), and Charles Darwin University (H19057). This trial was registered with the Australian New Zealand Clinical Trial Registry, ACTRN12618001365257.

Effectiveness

The proportion of babies born preterm (at least 20 weeks of gestation or birthweight 400 g and fewer than 37 weeks of gestation) was chosen to measure the effectiveness of the program. It was one of four primary outcomes in the Indigenous Birthing in an Urban Setting (IBUS) study[15] and considered the most important in both clinical and economic terms for this cost-effectiveness analysis.

Cost estimates

All direct costs related to this pregnancy were included: antenatal care costs in community and hospital, antenatal admission costs, birth costs, postnatal care costs, postnatal admission costs, and neonatal admission costs. The personnel cost including BiOC midwife, FSW and social worker was estimated using their hourly rate plus on-costs. The cost of diagnostic tests, pharmaceuticals and investigations were estimated from the MBS and PBS. All the hospital admission costs were based on Australian Refined Diagnostic Related Groups (AR-DRG). A set of cost assumptions, including number of contacts with GP, FSW, social worker, and transport assistance, were drawn up according to health service guidelines and expert opinion of a group of clinicians and researchers involved in the study when not directly available. Costs were measured in 2019 Australian dollars (AUD): no discounting was applied as the time horizon was less than one year.

All contacts with midwives, obstetricians and other clinicians (e.g. registrars, allied health workers) working in the study hospital were recorded in the hospital database. The cost of each contact was calculated according to the duration of the appointment and the attending clinician's hourly rate.

The number of contacts with GPs was not recorded in the hospital database. We assumed that women visited their GP for all but two (one booking-in appointment and one at 28 weeks if applicable) of the antenatal visits and one postnatal visit at 6-weeks for GP Shared Care. For all other models of care, we assumed one antenatal GP visit and one postnatal GP visit.

Women's contacts with FSWs were not recorded in the hospital database. The intensity of FSW support depends on women's needs: more support is provided to women and families experiencing greater social complexity. A 'complex case' in this study is defined as a woman requiring significant psycho-social support including child safety involvement, family violence assistance, experiencing housing instability, reporting current depression requiring medical treatment or inpatient care, and current user of amphetamines, ecstasy, heroin, hallucinogens and/or cocaine. We assumed a FSW attended every visit with the midwife, and for a complex case an extra 30 min support were provided each time.

The cost of transport assistance for the BiOC cohort included costs for fleet vehicles and drivers. Women in Standard Care received less transport support and we estimated 250 taxi vouchers ($60 each) per year for all women.

Women in both cohorts were provided with social work and mental health support where applicable. We assumed all women who were referred to a psychologist had a mental health care plan which is a plan treating a mental health condition, helping women to access 6–10 visits with an eligible allied health professional such as a psychologist. If a woman was referred to social worker, we assumed 2-h support at each antenatal visit for a BiOC complex case and three 1-h sessions for a Standard Care woman.

Table 1 lists the cost items included in the analysis and their unit cost. Total cost of each mother-baby pair was calculated from the frequencies of resource use and their unit cost.

Statistical analysis

In our study women were not randomized, resulting in different demographics and comorbidities between the cohorts. The characteristics, resource use and cost between the two groups were explored using Pearson's χ^2 test and univariate logistic regression for categorical variables or student *t*-test and simple linear regression for continuous variables. Mean resource use and cost was reported rather than the median to make it easier for relevant decision makers to estimate total cost.

To reduce bias in cost-effectiveness analysis using observational data, propensity score approach has gained wide appeal in estimating average cost and treatment. A propensity score of the woman was defined as the conditional probability of her receiving the BiOC service given the values of observed baseline confounders. We used inverse probability of treatment weighting (IPTW) methods to adjust for selection bias in comparisons between women who received the BiOC service with those who received Standard Care by constructing a weighted cohort of women who only differed in the model of care they received but were similar in other measured characteristics.[17] The conditional probability of a woman receiving the BiOC service was estimated with a logistic regression model from a large

Cost items	Unit cost	Source
Antenatal care attendance		
Antenatal visit with GP	$49.05	MBS item 16500
Midwife hourly rate	$67.27	Study conducted by authors for this paper
Registrar hourly rate	$91.83	Study conducted by authors for this paper
Obstetrician hourly rate	$184.53	Study conducted by authors for this paper
BiOC Family Support Worker (FSW) hourly rate	$40.32	Study conducted by authors for this paper
Social Worker hourly rate	$55.18	Study conducted by authors for this paper
Ultrasound		
Dating scan <12 weeks	$61.45	MBS item 55700
Fetal wellbeing scan	$117.75	MBS item 55712
Nuchal scan (with dating scan or separate 14–20 weeks)	$71.70	MBS item 55707
Morphology scan (18–20 weeks)	$113.95	MBS item 55036
Antenatal blood test		
Maternal serum genetic screen (PAPPA and HCG)	$39.75	MBS item 66750
Full blood examination	$16.95	MBS item 65070
Blood grouping-ABO and Rh	$11.15	MBS item 65090
Hepatitis B, Hepatitis C, HIV, Rubella	$55.70	MBS item 69413
Syphilis serology	$15.65	MBS item 69405
Blood group antibodies	$23.20	MBS item 65111
Antenatal investigation		
Random blood glucose	$9.70	MBS item 66500
Oral Glucose Tolerance Test	$19.90	MBS item 66548
Urine examination (MSU)	$20.55	MBS item 69333
LV swabs for Group B Strep	$33.75	MBS item 69312
Urine test for Chlamydia or Gonorrhoea	$28.65	MBS item 69316
Antenatal complications management		
Insulin injection for insulin dependent gestational diabetes-20 weeks ($211.58/w)	$4231.60	PBS code 8435Y
Oral azithromycin 1 g as a single dose treatment for Chlamydia	$16.47	PBS code 8200 N
Nitrofurantoin 50–100 mg four times daily for treatment UTI-one course	$23.33	PBS code 1692C
Benzathine penicillin, two 1.2 million units injections ($304.82), repeat once	$1219.28	PBS code 2267H
Cephalexin (Keflex) for treatment Group B Strep, 500 mg*20-one week	$15.96	PBS code 10778G
Methyldopa for management of chronic hypertension, 250 mg*100, for 1 year	$83.52	PBS code 1629 R
Mental health		
Mental health assessment, screening for drug, alcohol use and domestic violence after 28 weeks	$148.40	MBS item 16591
Mental health care plan (GP prepare a plan, 6 times psychologist sessions, then GP review the plan, followed by 4 psychologist sessions)	$1693.35	MBS item 2715, 80010, 2712
Postnatal care within 42 days		
GP postnatal visit at 42 days including a mental health assessment	$74.60	MBS item 16407
Hospital admissions	$606.32-$429604.4	National ARDRG
Travel cost		
BiOC travel cost per pregnancy	$695	Study conducted by authors for this paper
Standard travel cost per pregnancy	$176	Study conducted by authors for this paper
Australian minimum hourly wage	$19.49	Australian Fair Work Commission

Note: MBS: Medicare Benefits Schedule; GP: General Practitioner; PAPPA: pregnancy-associated plasma protein A; HCG: human chorionic gonadotrophin; HIV: human immunodeficiency virus; PBS: Pharmaceutical Benefits Scheme; ARDRG: Australian Refined Diagnostic Related Groups.

Table 1: **Resource items included in the study and their unit cost.**

number of baseline covariates (see notes in Tables 3–5). The weights were calculated as 1/propensity score in the BiOC cohort and 1/(1-propensity score) for the Standard Care cohort. To assess the balance of measured baseline variables, we calculated the standardized differences of all covariates before and after weighting. A standardized difference of <10% is considered adequate balance has achieved between groups. The cost difference per mother-baby pair and proportion of preterm birth difference with a 95% confidence interval between the two groups were calculated with IPTW methods. We took health system perspective and used the values presented in Table 1 and baseline assumptions without varying transport, FSW and social worker support to perform uncertainty analysis around the cost-effectiveness estimates. The incremental cost-effectiveness ratio (ICER) with a 95% confidence interval was estimated using nonparametric bootstrap (10,000 replications) methods[18] and the simulation results were graphed on a cost-effectiveness plane. All statistical analyses were performed in Stata 16.0.

Sensitivity analysis

A one-way sensitivity analysis was conducted to test the robustness of the results. We varied the total costs of transport by 25% more or less; FSW provided either no extra or 60 min extra support for a complex case each time; the social worker support for complex case of 4-h or 1-h for BiOC, and three 2-h or half-hour sessions for Standard Care.

Further sensitivity analysis was conducted from a societal perspective. The societal perspective included all costs for healthcare, woman's out-of-pocket expense and cost associated with productivity loss from her and her accompanying person's time out of work. We collected this extra data via surveys with women at 28–36 weeks and two months after birth. Due to the resource limitations, only 223 of the total 1636 women were interviewed: 198 from BiOC and 25 from Standard Care. It was extremely difficult to recruit women from Standard Care as they attended antenatal care in multiple practices. For those women who did not report out-of-pocket expenses, we conducted a multiple imputation analysis by predicted mean matching (n = 10) due to the non-normal distribution of cost data. We calculated the productivity loss by multiplying the time lost from work with the hourly rate of Australian's minimum wage in 2019.[19] Subgroup analysis was performed to address participants heterogeneity by excluding non-First Nations women who carried a First Nations baby. More details on the survey results and sub-group analysis were presented in the supplementary materials.

Role of the funding source

The funder of the study (NHMRC) was independent of study design, data analysis, data interpretation, or writing of this paper.

Results

After we excluded multiple births (n = 48; 15 in BiOC and 33 in Standard Care), women who had less than two antenatal visits (n = 55; 10 in BiOC and 45 in Standard Care) and who were transferred-in from other hospitals (n = 77; 2 in BiOC and 75 in Standard Care), 1636 mother-baby pairs were included in the analysis (796 in the BiOC group and 840 in the Standard Care group). The characteristics of the two cohorts were different: BiOC women were more likely to be First Nations, more socially disadvantaged, had fewer pre-existing haematological conditions, hypertension and thyroid diseases (Table 2). After the IPTW analysis, both cohorts were balanced for all the measured baseline covariates (all had standardized difference <10%, Table S1).

On average, it cost AU$1427.65 more (95% CI 1096.05, 1759.25) for a BiOC woman than a Standard Care woman before birth (Table 5) due to a more comprehensive service that included more contacts with the midwife, more blood tests, more investigations, additional support from FSWs and social worker, and greater transport assistance. More women in BiOC were hospitalized during pregnancy (35.7% vs. 27.2%, adjusted odds ratio 1.32 (95% CI 1.13, 1.54)) (Table 3), however the average cost was not significantly different with a mean difference of $180.53 (95% CI –99.78, 460.83) (Table 4).

About twenty percent (24.2% in BiOC and 23.2% in Standard Care) of total women were socially complex cases who need additional support from FSWs. On average it cost $603.26 for a BiOC woman to receive support from them. There was no FSW support available for Standard Care. More than one third (35.6% in BiOC and 34.7% in Standard Care) of women were referred to social worker and it cost $138.33 (95% CI 107.17, 169.49) more for a BiOC than a Standard Care woman. Slightly more BiOC women (28.7% vs. 24.9%) were referred to a psychologist for mental health issues and it cost $70.53 (95% CI –5.63, 146.69) more than Standard Care though the differences were not statistically significant (Tables 3 and 4).

Ten women (five in each group) birthed at home before arrival to hospital and there was no associated birthing DRG cost for them. The length of stay (day) after birth for BiOC women were significantly shorter (–0.39, 95% CI –0.56, –0.22) than Standard Care, however BiOC women were visited more frequently by their midwife after birth (Table 3). On average the birthing cost for women in BiOC were cheaper (-$225.96, 95% CI -570.95, 119.04) than Standard Care, although this was not statistically significant (Table 5).

Of the 1636 babies born, the gestational ages extended from 20 weeks to 42 weeks and there were 60 (7.5%) preterm babies in BiOC and 125 (14.9%) preterm babies in Standard Care cohort (Fig. 1). There were 13 stillbirths (four in BiOC and nine in Standard Care). Significantly less BiOC babies were admitted to neonatal

	Standard Care	BiOC	p-value
N	840	796	
Maternal age			0.211
Under 20	103 (12.3%)	110 (13.8%)	
20-34	622 (74.1%)	598 (75.1%)	
35 and over	115 (13.7%)	88 (11.1%)	
First Nations mother	507 (60.4%)	697 (87.6%)	<0.0001
Socioeconomic status (Social-Economic Indexes for Areas)			0.076
Quintile 1 (most disadvantaged)	208 (24.8%)	232 (29.1%)	
Quintile 2	114 (13.6%)	77 (9.7%)	
Quintile 3	174 (20.7%)	168 (21.1%)	
Quintile 4	165 (19.6%)	149 (18.7%)	
Quintile 5 (most advantaged)	179 (21.3%)	170 (21.4%)	
Marriage status			0.313
Married or de facto	423 (50.4%)	381 (47.9%)	
Not married or de facto	417 (49.6%)	415 (52.1%)	
BMI Category			0.458
<18.5	91 (10.8%)	70 (8.8%)	
18.5–24.9	371 (44.2%)	350 (44.0%)	
25.0–29.9	165 (19.6%)	173 (21.7%)	
30 or more	213 (25.4%)	203 (25.5%)	
Parity			0.868
Multiparity	519 (61.8%)	495 (62.2%)	
Primiparity	321 (38.2%)	301 (37.8%)	
Smoking status at booking			0.924
non-smoker	531 (63.2%)	505 (63.4%)	
smoker	309 (36.8%)	291 (36.6%)	
Previous caesarean section	151 (18.0%)	126 (15.8%)	0.247
Previous stillbirth	28 (3.3%)	21 (2.6%)	0.410
Previous preterm	93 (11.1%)	66 (8.3%)	0.058
Pre-existing Autoimmune disease	15 (1.8%)	14 (1.8%)	0.967
Pre-existing Diabetes (excluding prior gestational diabetes)	19 (2.3%)	10 (1.3%)	0.123
Pre-existing Haematological disease (excluding anaemia)	28 (3.3%)	11 (1.4%)	0.010
Pre-existing Heart disease	60 (7.1%)	51 (6.4%)	0.554
Pre-existing Hypertension (excluding prior gestational hypertension)	18 (2.1%)	7 (0.9%)	0.037
Pre-existing Liver disease (Hepatitis B, C)	38 (4.5%)	24 (3.0%)	0.110
Pre-existing Kidney renal disease	88 (10.5%)	91 (11.4%)	0.536
Pre-existing Thyroid disease	39 (4.6%)	22 (2.8%)	0.045
Pre-existing - Mental health illness	307 (37.2%)	325 (41.0%)	0.120
Current user of Hallucinogens, Heroin, Amphetamines, Ecstasy or Cocaine	28 (3.3%)	15 (1.9%)	0.067

Table 2: **Maternal characteristics of Birthing in Our Community versus Standard Care cohort.**

nursery and on average neonatal costs for each BiOC baby were significantly less (-$6234.48, 95% CI -8748.55, –3720.41) compared to a Standard Care babies (Table 5). Neonatal cost ranged from $0-$371921 in Standard Care and $0-$215016 in BiOC.

The cost-effectiveness analysis showed that the BiOC group reduced the proportion of preterm births (–5.34%, 95% CI –8.69%, –1.98%) relative to Standard Care and was significantly less expensive (-$4810.02, 95% CI -7518.72, –2101.33). The 95% CI around the mean incremental cost-effectiveness ratio varied from -$210,108 (blue dot line) to -$44,822 (red dot line) per 1% preterm birth rate reduction. The point estimate and the majority (99.8%) of the replicated ICERs are in the south-east quadrant, indicating that the BiOC dominates Standard Care (less costly and fewer preterm births) (Fig. 2).

The incremental cost difference of BiOC relative to Standard Care for different scenarios explored in the sensitivity analyses are presented in Table 6. The total cost was robust to change of varying FSW support, social worker support and transport assistant. Reducing 25% of transport assistance from a societal perspective resulted in the largest savings (-$4965) and the scenario of a social worker providing more support from the health system perspective had the smallest savings

	Unweighted cohort			Inverse probability weighted cohort		
	Standard Care (n = 840) (Mean)	Birthing in Our Community (n = 796) (Mean)	Mean difference (95% CI)	Standard Care (n = 840) (Mean)	Birthing in Our Community (n = 796) (Mean)	Adjusted mean difference (95% CI)
Number of antenatal contacts with midwife	7.61	12.71	5.10 (4.56, 5.64)	7.62	12.80	5.18 (4.56, 5.80)
Number of antenatal contacts with obstetrician	1.13	1.15	0.019 (−0.097, 0.13)	1.11	1.16	0.047 (−0.071, 0.16)
Number of antenatal contacts with other clinicians	1.10	1.19	0.082 (−0.22, 0.39)	0.96	1.29	0.33 (0.083, 0.59)
Number of postnatal contacts with midwife	2.17	6.96	4.79 (4.53, 5.04)	2.15	6.90	4.75 (4.49, 5.02)
Number of postnatal contacts with obstetrician	0.0012	0.0013	0.000066 (−0.0033, 0.0035)	0.00081	0.00091	0.00010 (−0.0023, 0.0025)
Number of postnatal contacts with other clinicians	0.063	0.053	−0.010 (−0.044, 0.023)	0.047	0.065	0.018 (−0.017, 0.053)
Number of ultrasounds	3.82	3.53	−0.29 (−0.69, 0.11)	3.76	3.55	−0.20 (−0.54, 0.13)
Number of maternal serum genetic screen (PAPPA and HCG) tests	0.54	0.40	−0.13 (−0.18, −0.087)	0.53	0.42	−0.10 (−0.15, −0.052)
Number of full blood count tests	2.02	2.36	0.35 (0.27, 0.43)	2.02	2.35	0.34 (0.26, 0.42)
Number of blood group (ABO and Rh) tests	0.98	1.00	0.015 (0.006, 0.025)	0.99	1.00	0.013 (0.0042, 0.022)
Number of blood tests for Rubella, Hepatitis B, Hepatitis C, and HIV serology	0.98	0.99	0.0043 (−0.0058, 0.014)	0.99	0.99	0.00080 (−0.0083, 0.0099)
Number of blood tests for syphilis serology	0.98	0.99	0.016 (0.0042, 0.028)	0.98	0.99	0.014 (0.0027, 0.025)
Number of blood tests for antibody	0.052	0.034	−0.018 (−0.039, 0.0024)	0.053	0.036	−0.017 (−0.040, 0.0061)
Number of random blood glucose tests	0.48	0.52	0.040 (−0.0084, 0.089)	0.46	0.52	0.052 (−0.0016, 0.10)
Number of glucose tolerance tests	0.81	0.91	0.10 (0.042, 0.16)	0.81	0.91	0.099 (0.036, 0.16)
Number of midstream urine analysis	0.92	0.97	0.051 (0.029, 0.073)	0.93	0.98	0.046 (0.025, 0.067)
Number of low vaginal swab for group B streptococcus	0.056	0.085	0.029 (0.0047, 0.054)	0.052	0.081	0.028 (0.0028, 0.054)
Number of urine tests for Chlamydia	0.50	0.64	0.13 (0.087, 0.18)	0.52	0.62	0.10 (0.053, 0.15)
Length of stay post birth (day)	2.29	1.74	−0.55 (−0.67, −0.42)	2.25	1.86	−0.39 (−0.56, −0.22)
	%	%	**Odds ratio (95% CI)**	%	%	**Adjusted odds ratio (95% CI)**
Complex case needing Family Support Worker support	22.4%	23.7%	1.08 (0.86, 1.36)	23.2%	24.2%	1.08 (0.90, 1.28)
Referral to social worker	34.5%	35.9%	1.06 (0.87, 1.30)	34.7%	35.6%	1.03 (0.90, 1.18)
Referral to psychologist	24.4%	28.1%	1.21 (0.97, 1.51)	24.9%	28.7%	1.17 (0.99, 1.38)
Positive blood test for syphilis serology	1.7%	1.0%	0.60 (0.25, 1.44)	1.6%	1.3%	0.79 (0.32, 1.94)
Insulin dependent diabetes	1.2%	1.9%	1.59 (0.71, 3.57)	1.1%	2.2%	1.96 (0.86, 4.47)
Urine tract infection	8.0%	10.1%	1.29 (0.92, 1.81)	7.6%	9.7%	1.25 (0.91, 1.74)
Group B streptococcus positive	1.7%	3.0%	1.83 (0.94, 3.57)	1.4%	2.9%	2.13 (1.07, 4.27)
Chlamydia positive	3.6%	4.5%	1.28 (0.78, 2.10)	3.9%	4.0%	1.02 (0.62, 1.67)
Antenatal hospital admission	27.6%	34.6%	1.38 (1.12, 1.71)	27.2%	35.7%	1.32 (1.13, 1.54)
Postnatal hospital admission	13.1%	8.0%	0.58 (0.42, 0.80)	12.6%	8.4%	0.67 (0.48, 0.92)
Neonatal nursery admission	26.3%	13.2%	0.43 (0.33, 0.55)	26.5%	15.1%	0.57 (0.45, 0.73)

Note: PAPPA: pregnancy-associated plasma protein A; HCG: human chorionic gonadotrophin; HIV: human immunodeficiency virus; variables adjusted in the IPTW analysis: maternal age, body-mass index, First Nations mother, education, relationship status, Socio-Economic Indexes for Areas quintiles, parity, smoking status at booking, illicit drug use, previous caesarean section, previous stillbirth, and previous preterm birth, and maternal pre-existing comorbidities (autoimmune disease, thyroid disease, haematological disease [anaemia, bleeding, clotting disorder, and leukaemia], heart disease, renal disease, liver disease, mental health illness, essential hypertension and diabetes).

Table 3: **Antenatal, birth neonatal and postnatal service use between the Birthing in Our Community group and Standard Care group among unweighted cohort and inverse probability weighted cohort.**

Cost, 2019 Australian dollars	Unweighted cohort			Inverse probability weighted cohort		
	Standard Care (n = 840) (Mean)	Birthing in Our Community (n = 796) (Mean)	Mean difference (95% CI)	Standard Care (n = 840) (Mean)	Birthing in Our Community (n = 796) (Mean)	Adjusted mean difference (95% CI)
Cost of antenatal contacts with midwife ($)	462.46	528.81	66.35 (34.03, 98.67)	453.65	535.27	81.62 (48.70, 114.54)
Cost of antenatal contacts with obstetrician ($)	58.16	59.76	1.598 (−4.70, 7.90)	57.46	59.19	1.73 (−4.55, 8.01)
Cost of antenatal contacts with other clinicians ($)	50.55	56.36	5.82 (−8.30, 19.93)	43.71	61.40	17.68 (5.73, 29.64)
Cost of postnatal contacts with midwife ($)	100.02	234.07	134.05 (123.87, 144.24)	98.64	231.95	133.31 (122.78, 143.84)
Cost of postnatal contacts with obstetrician ($)	0.092	0.058	−0.034 (−0.25, 0.18)	0.062	0.042	−0.020 (−0.17, 0.13)
Cost of postnatal contacts with other clinicians ($)	5.16	3.24	−1.91 (−5.17, 1.34)	3.70	4.20	0.49 (−2.62, 3.61)
Cost of antenatal hospitalisation ($)	1281.66	1324.18	42.52 (−243.74, 328.77)	1192.51	1373.03	180.53 (−99.78, 460.83)
Cost of postnatal hospitalisation ($)	613.27	439.16	−174.11 (−378.61, 30.38)	563.55	477.21	−86.33 (−315.53, 142.87)
Cost of ultrasound ($)	388.00	347.74	−40.27 (−87.43, 6.89)	381.53	349.02	−32.51 (−71.22, 6.21)
Cost of maternal serum genetic screen (PAPPA and HCG) test ($)	21.44	16.08	−5.36 (−7.27, −3.35)	20.88	16.83	−4.05 (−6.02, −2.08)
Cost of full blood count test ($)	34.16	40.05	5.89 (4.55, 7.24)	34.17	39.89	5.72 (4.33, 7.12)
Cost of blood group tests ($)	10.96	11.14	0.17 (0.069, 0.27)	10.99	11.14	0.15 (0.05, 0.25)
Cost of Rubella, Hepatitis B, Hepatitis C, and HIV blood test ($)	54.77	55.63	0.86 (0.34, 1.37)	55.21	55.25	0.044 (−0.46, 0.55)
Cost of blood test for syphilis serology ($)	15.28	15.53	0.25 (0.065, 0.44)	15.34	15.01	0.22 (0.04, 0.39)
Cost of treatment for syphilis serology positive ($)	20.32	12.25	−8.07 (−21.70, 5.56)	18.99	15.38	−3.97 (−18.81, 10.87)
Cost of blood test for antibody ($)	1.22	0.79	−0.43 (−0.91, 0.056)	1.23	0.84	−0.40 (−0.94, 0.14)
Cost of random blood glucose test ($)	4.61	5.00	0.39 (−0.082, 0.86)	4.51	5.00	0.50 (−0.016, 1.02)
Cost of glucose tolerance test ($)	16.13	18.15	2.02 (0.83, 3.21)	16.16	18.12	1.96 (0.71, 3.21)
Cost for insulin injections ($)	50.38	79.74	29.37 (−21.01, 79.74)	46.65	91.34	44.69 (−12.70, 102.07)
Cost of midstream urine analysis ($)	18.94	19.98	1.05 (0.60, 1.49)	19.12	20.06	0.94 (0.51, 1.37)
Cost for treating urine track infection ($)	1.86	2.34	0.48 (−0.16, 1.13)	1.79	2.25	0.46 (−0.20, 1.11)
Cost for low vaginal swab for group B streptococcus ($)	1.89	2.88	0.99 (0.16, 1.83)	1.77	2.72	0.95 (0.09, 1.81)
Cost for treating positive group B streptococcus ($)	0.27	0.48	0.22 (−0.018, 0.45)	0.22	0.47	0.25 (0.02, 0.48)
Cost for testing for Chlamydia ($)	14.73	18.28	3.86 (2.49, 5.22)	14.89	17.88	2.98 (1.53, 4.44)
Cost for treating positive chlamydia ($)	0.59	0.74	0.16 (−0.16, 0.47)	0.64	0.65	0.096 (−0.31, 0.33)
Cost for BiOC Family Support Worker antenatally-complex case with another 30 m on top of the whole visit ($)	NA	428.07	NA	NA	428.07	NA
Cost for BiOC Family Support Worker postnatal-complex case with another 30 m on top of the whole visit ($)	NA	175.19	NA	NA	175.19	NA
Cost for Social Worker support ($)	57.15	186.89	129.74 (103.98, 155.50)	57.11	195.44	138.33 (107.17, 169.49)
Cost for mental health plan ($)	413.26	476.52	63.26 (−8.98, 135.50)	417.88	488.42	70.53 (−5.63, 146.69)
Hospital birthing cost ($)	8248.30	7743.41	−504.89 (−856.21–153.58)	8176.81	7950.85	−225.96 (−570.95, 119.04)
Cost for neonates ($)	13698.77	7152.49	−6546.29 (−9092.40, −4000.17)	13531.79	7297.31	−6234.48 (−8748.55, −3720.41)

Note: PAPPA: pregnancy-associated plasma protein A; HCG: human chorionic gonadotrophin; HIV: human immunodeficiency virus; variables adjusted in the IPTW analysis: maternal age, body-mass index, First Nations mother, education, relationship status, Socio-Economic Indexes for Areas quintiles, parity, smoking status at booking, illicit drug use, previous caesarean section, previous stillbirth, and previous preterm birth, and maternal pre-existing comorbidities (autoimmune disease, thyroid disease, haematological disease [anaemia, bleeding, clotting disorder, and leukaemia], heart disease, renal disease, liver disease, mental health illness, essential hypertension and diabetes).

Table 4: **Comparisons of differences in average cost of service use per mother-baby episode between the Birthing in Our Community group and Standard Care group among unweighted cohort and inverse probability weighted cohort.**

	Unweighted cohort			Inverse probability weighted cohort		
	Standard Care (n = 840)	Birthing in Our Community (n = 796)	Incremental Difference (95% CI)	Standard Care (n = 840)	Birthing in Our Community (n = 796)	Adjusted incremental difference (95% CI)
Effectiveness						
Proportion of preterm births (%)	14.88	7.54	−7.34 (−10.37, −4.32)	14.27	8.94	−5.34 (−8.69, −1.98)
Cost (AUD, Mean)						
Antenatal cost ($)	3242.80	4450.43	1207.63 (867.02, 1548.25)	3128.05	4555.70	1427.65 (1096.05, 1759.25)
Birth cost ($)	8248.30	7743.41	−504.89 (−854.95, −154.83)	8176.81	7950.85	−225.96 (−570.95, 119.04)
Postnatal cost ($)	793.13	926.32	133.19 (−71.43, 337.81)	740.55	963.32	222.76 (−8.23, 453.75)
Neonatal cost ($)	13698.77	7152.49	−6546.29 (−9046.56, −4046.01)	13531.79	7297.31	−6234.48 (−8748.55, −3720.41)
Total cost ($)	25983.01	20272.65	−5710.36 (−8419.07, −3001.65)	25577.20	20767.18	−4810.02 (−7518.72, −2101.33)

Note: Variables adjusted in the IPTW analysis: maternal age, body-mass index, First Nations mother, education, relationship status, Socio-Economic Indexes for Areas quintiles, parity, smoking status at booking, illicit drug use, previous caesarean section, previous stillbirth, and previous preterm birth, and maternal pre-existing comorbidities (autoimmune disease, thyroid disease, haematological disease [anaemia, bleeding, clotting disorder, and leukaemia], heart disease, renal disease, liver disease, mental health illness, essential hypertension and diabetes).

Table 5: **Cost effectiveness of Birthing in Our Community service among unweighted cohort and inverse probability weighted cohort.**

(-$4672). All the sensitivity analysis results support the findings from the main analysis, which confirm the robustness of our finding that the BiOC service is cheaper and is associated with less preterm birth. The subgroup analysis for First Nations women only (Supplement Table S5) found that the BiOC service saved $5283 (95% CI -8698, −1869, p = 0.002) compared to Standard Care and the preterm birth rate decreased 6.8% (95% CI -10.4%, −3.1% p < 0.001). These results suggest we may be underestimating the impact of the intervention and that the cost effectiveness is greater for First Nations women carrying First Nations babies compared to non-First Nations women carrying First Nations babies.

Discussion

Our analysis indicates that the BiOC service is more effective and less costly than Standard Care. It significantly reduced the proportion of preterm birth from 14.3% to 8.9% and has the potential to save the government an average of $4810.02 per mother-baby pair.

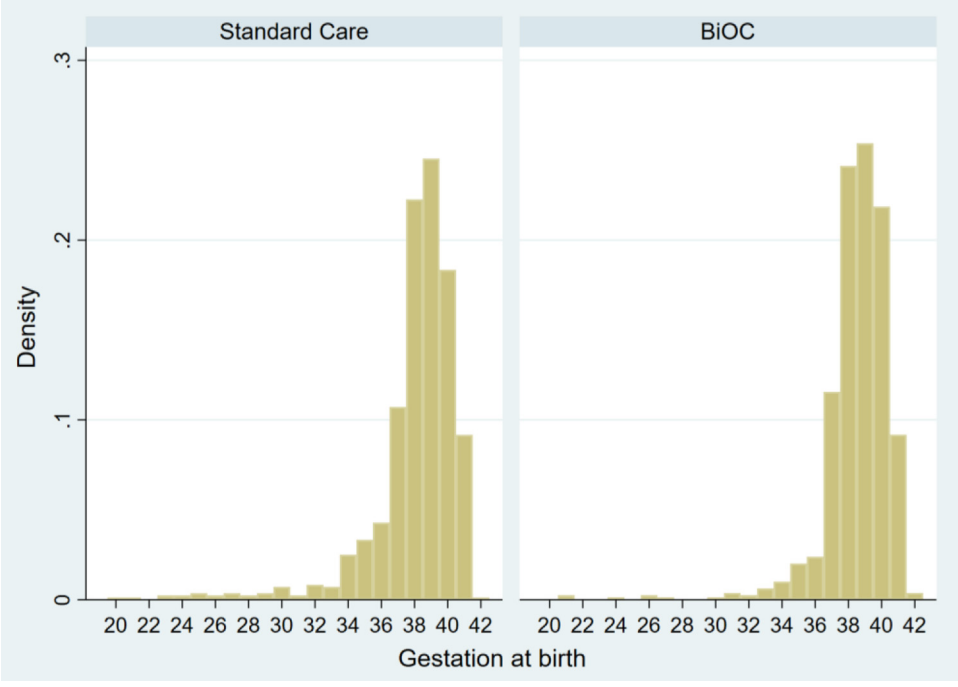

Fig. 1: **Gestation at birth by model of care: birthing in our community versus standard care cohort.**

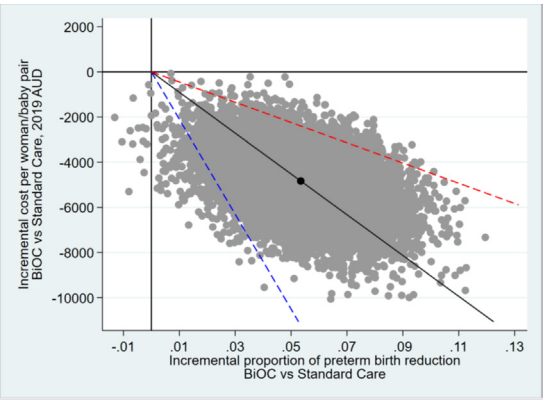

Fig. 2: **Cost-effectiveness plane of birthing on country versus standard care.**

Our sensitivity analysis showed that the cost-effectiveness results are robust to uncertainty around the key assumptions we made. To our knowledge, this is the first cost-effectiveness analysis comparing different models of care in reducing preterm births for First Nations families in Australia. Our results provide timely evidence of the cost-effectiveness of the Birthing in Our Community service and strengthen the evidence supporting the Birthing on Country policy and guidelines for the best start in life for First Nations babies.

We found that care for women in the BiOC group cost significantly more antenatally primarily, due to increased contacts with the midwife and the First Nations workforce (FSWs and drivers) which is consistent with our previous costing study for First Nations women.[20,21] This finding differs from other studies that reported a cost-saving effect of MGP care antenatally due to fewer antenatal visits.[22,23] On average, BiOC women appear to be more socially and clinically complex accessing more support from a midwife, FSW, psychologist or social worker. Issues facing First Nations families relate to housing instability, the increased needs of larger, extended families and less family income. In addition to this the intergenerational impact of colonization, and the multilayered oppressions of whiteness and gender, mean that First Nations women suffer a poorer social and emotional wellbeing including a higher rate of mental illness and distress than non-First Nations women[24] with 41% of the BiOC and 37% of the Standard Care women reporting a pre-existing mental health illness.

Total cost (AUD, Mean)	Standard Care (n = 840)	Birthing in Our Community (n = 796)	Adjusted incremental Difference (95% CI)
Main analysis			
Health system perspective ($)	25577.20	20767.18	−4810.02 (−7518.72, −2101.33)
Sensitivity analysis			
Health system perspective: transport assistance reduced 25% ($)	25533.24	20593.58	−4939.66 (−7648.36, −2230.97)
Health system perspective: transport assistance increased 25% ($)	25621.16	20940.78	−4680.38 (−7389.08, −1971.69)
Health system perspective: no extra Family Support Worker support each time for a complex case ($)	25577.20	20648.94	−4928.26 (−7635.72, −2220.81)
Health system perspective: 60 min extra Family Support Worker support each time for a complex case ($)	25577.20	20885.42	−4691.78 (−7401.85, −1981.72)
Health system perspective: social workers provide 1-h support for BiOC complex case each time and three half-hour sessions for Standard Care ($)	25548.65	20669.46	−4879.19 (−7586.45, −2171.93)
Health system perspective: social workers provide 4-h support for BiOC complex case each time and three 2-h sessions for Standard Care complex case ($)	25634.31	20962.61	−4671.69 (−7383.53, −1959.85)
Societal perspective ($)	26155.96	21320.57	−4835.39 (−7558.47, −2112.30)
Societal perspective: transport assistance reduced 25% ($)	26112.00	21146.97	−4965.03 (−7688.11, −2241.94)
Societal perspective: transport assistance increased 25% ($)	26199.92	21494.17	−4705.75 (−7428.83, −1982.66)
Societal perspective: no extra Family Support Worker support for a complex case ($)	26155.96	21202.33	−4953.63 (−7675.47, −2231.79)
Societal perspective: 60 min extra Family Support Worker support for a complex case ($)	26155.96	21438.81	−4717.15 (−7441.60, −1992.69)
Societal perspective: social workers provide 1-h support for BiOC complex case each time and three half-hour sessions for Standard Care complex case ($)	26127.41	21222.86	−4904.55 (−7626.18, −2182.92)
Societal perspective: social workers provide 4-h support for BiOC complex case each time and three 2-h sessions for Standard Care complex case ($)	26213.07	21516.01	−4697.06 (−7423.32, −1970.80)

Table 6: **Sensitivity analysis for total cost per mother-baby episode with inverse probability weighted cohort.**

We found a non-significant savings in intrapartum costs, which is consistent with findings from other studies.[25] The savings are primarily due to the BiOC women experiencing more spontaneous vaginal births, less planned caesarean sections[15] and shorter lengths of stay. In our study, the most significant savings in BiOC came from fewer admissions to the neonatal nursery largely due to less preterm births and associated complications. This finding is consistent with the Cochrane review of women receiving continuity midwifery care who had less neonatal nursery admission.[25] Other programs that reduced preterm birth also reported a cost-saving effect: screening for cervical length,[26] screening for vaginal infections during pregnancy,[27] testing for fetal fibronectin in women with threatened preterm labour,[28] and providing doula support.[29] We had hypothesised that establishing a culturally safe service would encourage women to present early in pregnancy, develop trusting relationships with care providers, disclose challenges that may lead to preterm birth (e.g. housing instability, family violence, recurrent urine infections, drug use in pregnancy) and work with team members to modify risk factors and improve maternal and infant health. Our data supports this hypothesis.

A major strength of our study is that it was based on detailed individual patient-level data from a prospective, non-randomised interventional trial, rather than decision analytic modelling, resulting in a robust estimate for the cost-effectiveness of the BiOC service through the IPTW method by controlling for a large number of baseline confounders. Our study also estimated the cost-effectiveness of BiOC from a societal perspective, the broadest perspective in health economic evaluation, by incorporating the out-of-pocket expenses and cost of productivity loss. A recent systematic review identified that more than 90% of First Nations-specific programs in Australia were not evaluated let alone evaluated for their cost-effectiveness.[30] We are aware that out-of-pocket expenses and productivity loss costs are based on a smaller proportion of the total study population. Nevertheless, our study is the first in the world to explore this cost for First Nations families. Women in our study were often socially disadvantaged and many face excessive financial difficulties in accessing mainstream services due to the high out-of-pocket expenses. The BiOC service successfully reduced two thirds of this cost by bringing the service closer to women, providing free transport, and offering food/drinks in the Hub. Despite participants not being randomized, we believe we used the best statistical analysis and balanced all the measured baseline characteristics, though hidden bias from unmeasured confounders might still remain.

In conclusion, our study demonstrated that an innovative Birthing on Country service model, known as BiOC, reduced preterm birth and cost less. The service is First Nations led, culturally responsive, popular with all stakeholders, clinically effective, and could be transferable to other settings. Dedicated funding through First Nations organisations for establishment and implementation of such services delivered significant return on investment. Such a model has the potential to address much needed reform in the Australian health system and improve birth outcomes for First Nations mothers and babies in Australia with significant cost benefits.

Contributors

YG was involved in protocol and study design, writing the successful funding proposal, conducted the analysis, interpretation of results and writing of the manuscript. She lead the analysis and completed the tables and figures. SKi was involved in developing the intervention, led the literature search, protocol development, successful funding application, study design, interpretation and writing of the manuscript. She oversaw data collection and contributed to key decisions in analysis. SH contributed to the conduct and monitoring of the study, the collection of data and writing of manuscript. ST contributed to the successful funding proposal, study design, interpretation and writing of the manuscript. SKr contributed to the protocol and study design, writing the successful funding proposal, interpretation of results and writing of the manuscript. ACh conducted literature review, contributed to the writing of the manuscript. CN was involved in developing the intervention, protocol and study design, writing the successful funding proposals, interpretation of results and writing of the manuscript. JCo, KW contributed to the delivery of the intervention, interpretation of results and writing of the manuscript. SKil, SKr, CN were involved in monitoring intervention fidelity. AC, JC and MR were involved in study design, overseeing the roll out of the intervention, study oversight and governance. CN was also involved in study oversight and governance. YR provided the Indigenous oversight of the study and was involved in protocol development, study design, writing the successful funding proposal and Indigenous methodology, contributed to key decisions in analysis, interpretation of results and writing of the manuscript. All authors approved final manuscript.

Data sharing statement

The IBUS study protocol is published and available in an open-access article. The statistical analysis plan will be made available for research purposes upon request to the corresponding author. The deidentified data supporting the conclusion of this article will be available for researchers after approval by the Birthing in Our Community Steering Committee (Brisbane, Australia).

Declaration of interests

We declare no competing interests.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.lanwpc.2023.100722.

References

1 National Indigenous Australians Agency. *Closing the Gap Report 2020*. Barton, ACT: Commonwealth of Australia, Department of the Prime Minister and Cabinet; 2020.
2 Australian Government. *Closing the Gap Report Canberra*. 2020.

3 National Aboriginal Community Controlled Health Organisation, Equity Economics. *Measuring the Gap in Health Expenditure: Aboriginal and Torres Strait Islander Australians*. 2022.
4 WHO, March of Dimes, PMNCH. *Save the Children. Born Too Soon: The Global Action Report on Preterm Birth*. Geneva: World Health Organization; 2012.
5 Lawn JE, Gravett MG, Nunes TM, Rubens CE, Stanton C, Group GR. Global report on preterm birth and stillbirth (1 of 7): definitions, description of the burden and opportunities to improve data. *BMC Pregnancy Childbirth*. 2010;10(Suppl 1):S1–S.
6 Liu L, Oza S, Hogan D, et al. Global, regional, and national causes of child mortality in 2000-13, with projections to inform post-2015 priorities: an updated systematic analysis. *Lancet*. 2015;385(9966): 430–440.
7 Australian Institute of Health and Welfare. *Australia's Mothers and Babies*. Canberra: AIHW; 2021.
8 Australian Institute of Health and Welfare. *Pregnancy and Birth Outcomes for Aboriginal and Torres Strait Islander Women 2016-2018. Cat. No. IHW 234*. Canberra: AIHW; 2021.
9 Behrman RE. *Preterm Birth Causes, Consequences, and Prevention*. Washington DC: National Academy of Sciences; 2007.
10 Mangham LJ, Petrou S, Doyle LW, Draper ES, Marlow N. The cost of preterm birth throughout childhood in England and Wales. *Pediatrics*. 2009;123(2):e312–e327.
11 Newnham JP, Schilling C, Petrou S, et al. The health and educational costs of preterm birth to 18 years of age in Australia. *Aust N Z J Obstet Gynaecol*. 2021;62(1):55–61.
12 Petrou S, Yiu HH, Kwon J. Economic consequences of preterm birth: a systematic review of the recent literature (2009-2017). *Arch Dis Child*. 2019;104(5):456–465.
13 Hickey S, Roe Y, Gao Y, et al. The indigenous birthing in an urban setting study: the IBUS study. *BMC Pregnancy Childbirth*. 2018;18(1):1–12.
14 Kildea S, Gao Y, Hickey S, et al. Reducing preterm birth amongst Aboriginal and Torres Strait Islander babies: a prospective cohort study, Brisbane, Australia. *EClinicalMedicine*. 2019;12:43–51.
15 Kildea S, Gao Y, Hickey S, et al. Effect of a Birthing on Country service redesign on maternal and neonatal health outcomes for First Nations Australians: a prospective, non-randomised, interventional trial. *Lancet Glob Health*. 2021;9(5):e651–e659.
16 Lal A, McCaffrey N, Gold L, Roder D, Buckley E. Variations in utilisation of colorectal cancer services in South Australia indicated by MBS/PBS benefits: a benefit incidence analysis. *Aust N Z J Public Health*. 2022;46(2):237–242.
17 Mitra N, Indurkhya A. A propensity score approach to estimating the cost–effectiveness of medical therapies from observational data. *Health Econ*. 2005;14(8):805–815.
18 Glick HA, Doshi JA, Sonnad SS, Polsky D. *Economic Evaluation in Clinical Trials*. 2nd ed. Oxford, UK: Oxford University Press; 2014.
19 Australian Government. *Minimum Wages Fact Sheet for Job Seekers – Effective 1 July 2019*. 2019.
20 Bar-Zeev S, Barclay L, Kruske S, Kildea S. Factors affecting the quality of antenatal care provided to remote dwelling Aboriginal women in northern Australia. *Midwifery*. 2014;30(3):289–297.
21 Gao Y, Gold L, Josif C, et al. A cost-consequences analysis of a midwifery group practice for Aboriginal mothers and infants in the top end of the Northern Territory, Australia. *Midwifery*. 2014; 30(4):447–455.
22 Homer CS, Matha DV, Jordan LG, Wills J, Davis GK. Community-based continuity of midwifery care versus standard hospital care: a cost analysis. *Aust Health Rev*. 2001;24(1):85–93.
23 Young D, Twaddle S, Lees A. The costs to the NHS of maternity care: midwife-managed vs shared. *Br J Midwifery*. 1997;5(8):465–472.
24 Walker R, Dudgeon P, Boe M. Addressing existing inequities in Indigenous mental health and wellbeing through transformative and decolonising research and practice. *Res Health Sci*. 2020;5(3):48.
25 Sandall J, Soltani H, Gates S, Shennan A, Devane D. Midwife-led continuity models versus other models of care for childbearing women. *Cochrane Database Syst Rev*. 2016;4(4):CD004667.
26 Einerson BD, Grobman WA, Miller ES. Cost-effectiveness of risk-based screening for cervical length to prevent preterm birth. *Am J Obstet Gynecol*. 2016;215(1):100.e1–100.e7.
27 Kiss H, Pichler E, Petricevic L, Husslein P. Cost effectiveness of a screen-and-treat program for asymptomatic vaginal infections in pregnancy: towards a significant reduction in the costs of prematurity. *Eur J Obstet Gynecol Reprod Biol*. 2006;127(2):198–203.
28 Parisaei M, Currie J, O'Gorman N, Morris S, David AL. Implementation of foetal fibronectin testing: admissions, maternal interventions and costs at 1 year. *J Obstet Gynaecol*. 2016;36(7): 888–892.
29 Kozhimannil KB, Hardeman RR, Alarid-Escudero F, Vogelsang CA, Blauer-Peterson C, Howell EA. Modeling the cost-effectiveness of doula care associated with reductions in preterm birth and cesarean delivery. *Birth*. 2016;43(1):20–27.
30 Doran CM, Bryant J, Langham E, Bainbridge R, Begg S, Potts B. Scope and quality of economic evaluations of Aboriginal and Torres Strait Islander health programs: a systematic review. *Aust N Z J Public Health*. 2022;46(3):361–369.