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ORIGINAL ARTICLE

Preventing early births in a regional tertiary maternity unit: Evaluating preterm and early term birth rates before and after implementation of the Preterm Birth Prevention Initiative in the Australian Capital Territory

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Background: A multifaceted preterm birth (PTB) prevention initiative was launched in the Australian Capital Territory (ACT) in 2019. The aim of this initiative was to safely lower the rate of early births across the ACT and the surrounding areas in New South Wales. Modelled on the Western Australian PTB Prevention Initiative, the program included new clinical guidelines and a new PTB prevention clinic at the main tertiary hospital.

Aim: To evaluate the initiative and its effects on preterm and early term birth rates at the main tertiary hospital after 16 months of implementation.

Materials and Methods: A before and after intervention study was conducted. Rates of preterm and early term birth before (previous five years) and after 16 months of implementation of the ACT PTB Prevention Initiative were evaluated.

Results: At the main tertiary hospital in The Canberra Hospital, the rate of PTB was significantly reduced by 10% after 16 months of implementation of the initiative. Rates of PTB were lower than any of the preceding five years and resulted in 45 averted or delayed PTBs. The number of planned early term births with no medical indication was significantly reduced by 34.5% and resulted in 77 averted or delayed early term births.

Conclusions: The multifaceted PTB Prevention Initiative safely lowered the rates of early birth in the ACT context. These results highlight the importance of prioritising early birth prevention, education, research and expanding the initiative nationwide.

KEYWORDS

preterm, early term, prevention initiative, early births

INTRODUCTION

Preterm birth (PTB), defined as birth before 37 completed weeks of pregnancy, is associated with a range of adverse outcomes.[1–4] PTB is considered one of the most significant causes of perinatal morbidity and mortality worldwide.[5–7] In 2018, 8.7% of Australian babies were born preterm, an increase from 8.2% ten years ago.[8]

There is growing evidence showing a proportion of spontaneous PTBs can be prevented.[9,10] There is evidence demonstrating the efficacy of particular strategies used in both isolation and combination for the prevention of spontaneous PTB including cervical cerclage,[11] vaginal progesterone pessary supplementation[12] and mid-trimester ultrasound of the cervix.[13] Reducing these births can result in significant health, social and economic impacts for families and significant economic benefits for health services.[14,15]

The importance of preventing early term births is also emerging. Research suggests that there can be adverse short and long-term health effects for those born early term (37–38 + 6 weeks) compared to late term (39 weeks onwards), especially for neonatal admissions, respiratory distress and neurodevelopment.[16,17] Data show that planned early term births are increasing across Australia and the beneficial effects of lengthening pregnancy are not often emphasised in clinical practice.[8,18]

A team in Western Australia (WA) implemented a comprehensive state-wide PTB prevention initiative in 2014 called 'The Whole Nine Months'. They incorporated a range of interventions aimed at reducing early births (PTBs and early term births). One year after implementation of the initiative there was a significant 7.6% reduction in singleton PTBs state-wide.[2]

Following WA's success, The Canberra Hospital in the Australian Capital Territory (ACT) introduced the ACT PTB Prevention Initiative in 2019. The aim was to safely lower the rate of early births, following the WA model. The objective of this study was to evaluate the ACT PTB Prevention Initiative and its effects on PTBs and early term births at the main tertiary hospital and to assess whether the initiative achieved similar results.

MATERIALS AND METHODS

The study was approved by the ACT Health Human Research Ethics Committee (reference number 2019/ETH12446; approved 17 July 2019). The intervention was the PTB Prevention Initiative and the main outcomes measured were rates of PTB and early term birth before and after implementation of the initiative.

Initially, a guideline on the prevention and management of early birth was developed with different pathways to follow for low, medium and high-risk women. A three-month outreach education program and dissemination of the new clinical guidelines took place with sonographers, obstetricians, midwives and general practitioners across the ACT and surrounding New South Wales (NSW) areas. The initiative was officially launched on 28 February 2019 and received philanthropic support to establish the service and ministerial endorsement. After the launch, further multidisciplinary education sessions were organised throughout the ACT and hospitals in the southern NSW regions.

The key interventions in the new clinical guidelines included the following.

- Universal screening of cervical length (CL) at all routine 18–20 week fetal anomaly ultrasound scans. Transabdominal ultrasound recommended for low-risk women and transvaginal ultrasound were recommended if the cervix measured less than 35 mm or for women at high risk of PTB.
- Prescription of vaginal progesterone pessary for women who have a shortened cervix (≤25 mm) on transvaginal ultrasound between 16–24 weeks to continue until 36 weeks gestation.
- Prescription of vaginal progesterone pessary for all women with a history of spontaneous PTB (24–34 weeks) or spontaneous loss (16–24 weeks) to be used from 16 to 36 weeks gestation.
- Consideration of cervical cerclage for CL < 10 mm.
- Avoidance of early planned birth unless medically indicated.
- Implementation of a structured smoking cessation program.
- Implementation of a dedicated multidisciplinary preterm birth prevention clinic with maternal-fetal medicine specialists, ultrasound imaging facilities for CL measurements and midwifery services.

The new PTB prevention clinic was established within the Fetal Medicine Unit (FMU) at The Canberra Hospital, the sole tertiary centre for referral of high-risk pregnancies for the ACT and surrounding NSW areas. Local hospital policies and referral processes assist in the initiative capturing the majority of women with an increased risk of PTB. Referrals were triaged as a priority. Continuity of care was offered to all women.

A pre- and post-intervention study was conducted to examine the association between the PTB Prevention Initiative and preterm and early term birth rates. Planned early term births with no medical indication were of particular interest. Planned births included all births that were not spontaneous. No medical indication included all planned births that did not include a medical reason as per hospital guidelines. Our analysis included women who gave birth at The Canberra Hospital in the pre-intervention period from 1 January 2014 to 31 December 2018 and the post-intervention period from 1 January 2019 to 30 April 2020. Inclusion criteria included women who had a singleton birth between 20–38 + 6 weeks gestation within the study period. Rates of PTB, early term birth and stillbirths above 20 weeks gestation before (2014–2018) and after 16 months of implementation of the initiative were evaluated. Women who had a termination of pregnancy above 20 weeks of gestation were excluded from the data set. Rates of early birth were assessed using run charts of bimonthly preterm and early term rates from 2014-2020. The post-intervention period of 16 months was chosen to include one year of operation of the clinic as well as the period of outreach education.

Data were collected from the Central Birth Outcome System electronic medical record. This system collects all births from 20 weeks of pregnancy at The Canberra Hospital. Retrospective collection of existing records occurred for both the pre-intervention and post-intervention groups. All data were de-identified and the study did not require patient involvement. Discrete data were reported as numbers and percentages and compared using χ^2 tests. A *P*-value of 0.05 was considered significant.

RESULTS

The number of singleton births in the pre-intervention period was 17 355 and the number of singleton births in the post-intervention

period was 4592. The demographics of the pre- and post-intervention populations are shown in Table 1. There was a statistically significant increase in percentage of advanced maternal age (AMA) defined as age > 40 (4.05% vs 3.02% P = 0.005) and in Class III obesity, defined as body mass index (BMI) > 40kg/m^2 (5.5% vs 4.34% P = 0.008). There was a statistically significant reduction in smoking rates (7.14% vs 6.11% P = 0.014).

The trends for preterm and early term births including planned births with no medical indication are shown in Figure 1. Table 2 demonstrates the differences between pre- and post-intervention with respect to preterm and early term births.

The rate of PTBs (20–36 weeks) within the post-intervention period was 8.75% which was significantly lower than the preceding five years with an average of 9.74 % (odds ratio (OR) 0.88, 95% CI 0.79–0.99, P = 0.05). This resulted in a 10% reduction in rates of PTB. When the rates of PTB were separated into grouped gestational ages there was a significant reduction in the 20–23 + 6 weeks gestation group, (OR 0.63, 95% CI 0.41–0.97, P = 0.03), a non-significant reduction for the 24–27 + 6 week gestation group (OR 0.84, 95% CI 0.57–1.25, P = 0.40), a significant reduction for the 28–31 + 6 weeks gestational group (OR 0.73, 95% CI 0.54–1.00, P = 0.05) and a non-significant increase for the 32–36 weeks gestational group (OR 1.00, 95% CI 0.86–1.17, P = 0.92).

The rate of early term births (37–38 + 6 weeks) within the post-intervention period was 25.78% which was a significant increase in births compared to the preceding five years with an average of 23.95% (OR 1.10, 95% CI 1.02–1.18, P = 0.009). When further analysed, there was a significant reduction in planned early term births with no medical indication (OR 0.73, 95% CI 0.61–0.87, P = 0.0001) which equated to a 34% reduction.

Table 3 displays the estimated number of PTBs and planned early term births with no medical indication averted or delayed post-intervention. The estimated number of averted or delayed PTBs based on the 10% reduction was 45 and the estimated number of planned early term births with no medical indication that were averted or delayed based on the 34% reduction was 77.

DISCUSSION

The introduction of the multifaceted PTB Prevention Initiative was associated with a significant 10% reduction in the overall rate of PTB compared to the average for the previous five years at the tertiary referral hospital in the ACT. These findings were consistent with the successful results from the WA experience.[2,19] Once PTBs were separated into grouped gestational ages the greatest reductions in preterm birth were observed in the 20–23 + 6 and 28–31 + 6 gestation age groups. The run chart data show that the majority of the effect appears to have occurred soon after the implementation of the initiative in early 2019, most likely due to increased awareness and momentum highlighting the need for sustained outreach education.

Rates of planned early term births with no medical indication were significantly reduced by 34.5% and this was sustained over the whole year of the post-intervention period. This highlights the success of the hospital's policy encouraging judicious decision making for early term births and the receptiveness by staff to change. We have included early term births in this analysis as we believe interventions aimed at reducing early term birth rates should be considered alongside PTB prevention strategies due to the emerging research on the adverse effects of the early term birth. We hypothesise that the overall increase in early term births is due to a delay in PTB, shifting the distribution curve to the right. A concern in delaying birth is the risk of stillbirth; however, there was no difference in rates of stillbirth over the study period.

This study focused on the effect of early birth in singleton pregnancies for two main reasons. We aimed to offer consistency in the literature by assessing singleton births similar to the WA study. We are also aware the mechanism for PTB in singletons and

TABLE 1 Maternal characteristics for pre- and post-intervention project at The Canberra Hospital

Demographic	Pre-intervention N = 17 355	Post-intervention N = 4592	P-value
Age (years) mean / SD	30.7 / 5.13	31.1 / 5.06	0.002
Age > 40 n / % / χ^2	524 / 3.02 / 12.30	185 / 4.05 / 12.30	0.005
BMI (kg/m^2) mean / SD	25.6 / 6.45	26.1 / 6.89	<0.001
BMI > 40 kg/m^2 n / % / χ^2	753 / 4.34 / 11.17	252 / 5.50 / 11.17	0.008
Aboriginal Torres Strait Islander n / % / χ^2	755 / 4.35 / 0.003	199 / 4.33 / 0.003	0.95
Smoking n / % / χ^2	1239 / 7.14 / 5.97	280 / 6.11 / 5.97	0.014
Smoking > 10/day n / % / χ^2	150 / 0.87 / 2.35	29 / 0.64 / 2.35	0.11

BMI, body mass index

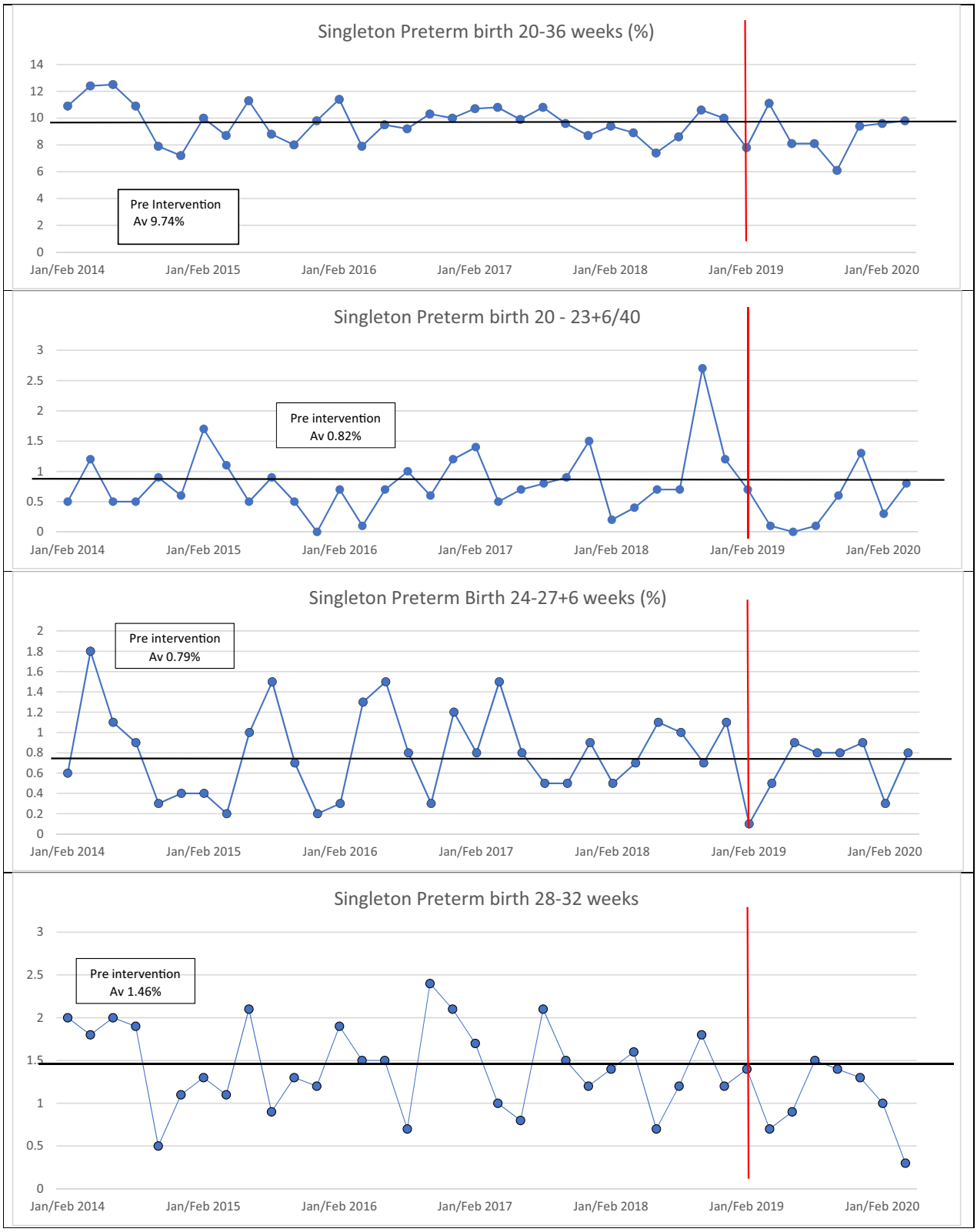

FIGURE 1 Rates of preterm birth and early term birth (run charts) by year and gestation at The Canberra Hospital.

multiples may vary and the majority of the interventions in this initiative were focused on singleton pregnancies.

The success of the initiative was multifactorial. Firstly, the study was conducted in a well-resourced country, with a universal healthcare system. This allowed for the key interventions to be implemented with minimal issues around dissemination of information, access or health care costs. Cost of progesterone pessaries are subsidised by The Canberra Hospital to minimise barriers

FIGURE 1 Rates of preterm birth and early term birth (run charts) by year and gestation at The Canberra Hospital.

to use as it was recognised that the higher cost of this medication could result in reduced uptake.[20] Providing access to cervical surveillance via the FMU for all women at high risk of PTB also promotes equity and a standard of care for all high-risk women. The establishment of a dedicated preterm birth prevention clinic provided a consistent central point for information, education and

TABLE 2 Comparison of preterm birth and early term birth pre- and post-intervention project by gestation at The Canberra Hospital

	Pre-intervention *N* = 17 355		Post-intervention *N* = 4592				
Gestational age, weeks	***n***	**%**	***n***	**%**	**Odds ratio**	**95% CI**	***P*-value**
20–36	1691	9.74	402	8.75	0.88	0.79–0.99	0.04
20–23 + 6	143	0.82	24	0.52	0.63	0.41–0.97	0.03
24–27 + 6	138	0.79	31	0.67	0.84	0.57–1.25	0.40
28–31 + 6	255	1.46	50	1.08	0.73	0.54–1.00	0.05
32–36	777	4.47	207	4.50	1.00	0.86–1.17	0.92
37–38 + 6	4156	23.95	1184	25.78	1.10	1.02–1.18	0.009
37–38 + 6 Planned with non-medical indication	783	18.84	146	12.33	0.69	0.58–0.83	0.0001

Rates of stillbirth after 20 weeks were a non-significant reduction in 1.2% pre-intervention vs 0.95% post-intervention ($P = 0.12$).

TABLE 3 Estimated number of averted/delayed preterm births 24–36 weeks and planned births 37–38 + 6 weeks with no medical indication (NMI)

	20–36 weeks			37–38 + 6 weeks planned with NMI	
Total births	***n***	**%**	**Birthed 37–38 + 6 weeks**	***n***	**%**
Pre-intervention *N* = 17 355	1691	9.74	Pre-intervention *n* = 4156	783	18.84
Post-intervention *N* = 4592			Post-intervention *n* = 1184		
Expected	447	9.74	Expected	223	18.84
Observed	402	8.75	Observed	146	12.33
Births averted/delayed	45	10.0		77	34.5

referrals. The Canberra Hospital is the sole tertiary level referral centre for high-risk cases for the ACT and southern NSW surrounding areas and this assisted in identifying and offering interventions for all women at risk of PTB. The benefits of continuity of care especially for reducing PTB[21] were recognised and all women were offered continuity in pregnancy. Additional staff training was undertaken in nicotine addiction and smoking cessation to support the implementation of a structured smoking cessation program. Outreach education played a key role in the initiative's success. A widespread education program that included tertiary and regional hospitals in the ACT and southern NSW that refers to The Canberra Hospital was conducted. Widespread education occurred with sonographers which helped embed cervical screening at morphology scans into routine practice.

The data for the birthing outcomes were sourced from a highly reliable perinatal database, meaning our results are likely to be accurate which strengthens the study's results. A before and after study was the best study design for our research purpose. We wanted to evaluate an intervention by assessing trends over time across a population. We did not identify any extraneous variables that may have influenced the rates of early births during the study period. The use of aspirin for the prevention of pre-eclampsia and the associated effects on PTB rates may be thought to impact the study's findings; however, during the study period, there was no change in the hospital policies or guidelines in the use of aspirin, nor was there widespread education or change in this area.

There has been evidence leaning toward a reduction in spontaneous preterm birth during the COVID-19 pandemic.[22] It is unlikely that this would be a significant confounding factor in this study. The main effects that may contribute to a reduction of preterm birth in a COVID-19 era relate to periods of increased isolation, social distancing and increased vigilance on hand hygiene and these measures were only put in place for approximately one of the 16 months in the post-intervention period.

The significant difference in patient population has also increased the strength of this study. We were able to demonstrate a reduction in early births despite our post-intervention population having a higher rate of AMA and BMI > 40 kg/m^2 which are known risk factors for PTB.[23,24]

We acknowledge the known limitations to before and after intervention studies. We have not included data from other public and private hospitals. The Canberra Hospital is the sole tertiary level hospital for high-risk women for ACT and southern NSW surrounds so we are confident that most high-risk cases were referred to The Canberra Hospital; however, including trends from other hospitals would strengthen the results. In addition,

the study did not include mid-trimester losses prior to 20 weeks as the Birth Outcomes System at The Canberra Hospital does not record births prior to this period. We did not include births beyond 39 weeks. This information may be useful when analysing PTB trends and patterns and would further strengthen the study's results. A further limitation is that there is minimal data on the rates of the various key interventions in the pre-intervention period due to the nature of the hospital's data collection system. Progesterone pessary supplementation and cerclage were used by specialists in the hospital; however, it was administered in an ad hoc manner prior to the PTB Prevention Initiative with different specialists prescribing different protocols. This study would be strengthened if we could clearly compare rates of each key intervention in the two time periods.

The economic impact of averted or delayed early births is an important aspect that is outside the scope of this study but would be the basis of valuable follow up research. With resource-rich and expensive neonatal intensive care bed spaces costing in excess of $1000 per day to run,[25] the reduction of these bed numbers would have significant fiscal benefits.

Early birth is not inevitable. Gestational age at birth can be a key determinant for an individual's health and wellbeing throughout life.[26] Our findings are consistent with those from WA and we propose that the study may assist in implementation of similar initiatives across Australia. The overall significant results for reduction of PTBs and early term births indicate a multifaceted PTB prevention initiative can lower the rates of early birth. These results highlight the importance of prioritising PTB prevention, education, research and expanding the initiative nationwide.

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