Reducing preterm birth by a statewide multifaceted program: an implementation study

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BACKGROUND: A comprehensive preterm birth prevention program was introduced in the state of Western Australia encompassing new clinical guidelines, an outreach program for health care practitioners, a public health program for women and their families based on print and social media, and a new clinic at the state's sole tertiary level perinatal center for referral of those pregnant women at highest risk. The initiative had the single aim of safely lowering the rate of preterm birth.

OBJECTIVE: The objective of the study was to evaluate the outcomes of the initiative on the rates of preterm birth both statewide and in the single tertiary level perinatal referral center.

STUDY DESIGN: This was a prospective population-based cohort study of perinatal outcomes before and after 1 full year of implementation of the preterm birth prevention program.

RESULTS: In the state overall, the rate of singleton preterm birth was reduced by 7.6% and was lower than in any of the preceding 6 years. This reduction amounted to 196 cases relative to the year before the introduction of the initiative and the effect extended from the 28–31 week gestational age group onward. Within the tertiary level center, the rate of preterm birth in 2015 was also significantly lower than in the preceding years.

CONCLUSION: A comprehensive and multifaceted preterm birth prevention program aimed at both health care practitioners and the general public, operating within the environment of a government-funded universal health care system can significantly lower the rate of early birth. Further research is now required to increase the effect and to determine the relative contributions of each of the interventions.

Key words: implementation, population-based study, preterm birth, prevention

Preterm birth (PTB) is the single most important cause of perinatal mortality and morbidly in the developed world.[1] Recent advances have expanded our knowledge of how some cases of preterm birth may be prevented,[1-4] but effective implementation of new clinical strategies across an entire population remains a challenge.

The barriers to effective implementation of evidence-based clinical strategies are manyfold. Preterm birth is the final common pathway of multiple medical, obstetric, and social problems.[3] For different societies and their health care systems, each will require an individualised approach, and analyzing and monitoring the effectiveness of these approaches will be a vital component of implementation strategies.

In societies such as Australia, access to health care is relatively available because of the nation's government-funded universal health care system. Inequities do exist, but the population and its media in general are highly receptive to health care messages, and the relative affluence of the society enables the widespread implementation of new clinical strategies. In particular, ultrasound imaging services are well developed, and health care outcomes are computerized with effective data linkage between the various government-funded databases.

Western Australia in particular is ideally suited for the evaluation of new population-based programs. There is a single tertiary level perinatal referral center for the entire state with computerized and linked data collection and monitoring systems.

The Western Australian Preterm Birth Prevention Initiative had the single goal of safely lowering the rate of preterm birth across the state. There were 3 components: an outreach program providing on-site education about new clinical guidelines to health care professionals throughout the state, a public health campaign based on print and social media for women and their families (thewholeninemonths.com.au), and a new dedicated PTB prevention clinic at the major hospital for referral of cases at highest risk.[5,6]

The purpose of this study was to analyze the effects of implementation of this program on preterm birth rates in Western Australia as a whole, and in the tertiary level center, before and after the first full year of operation.

Material and Methods

The study was approved by the Women and Newborn Health Service Human Research Ethics Committee (reference number 2016027EW; approved March 1, 2016).

The initiative was officially announced on Nov. 17, 2014, but the new clinical guidelines had been released unofficially in May 2014, resulting in partial introduction of the program during 2014 and full enactment during 2015.

There were 3 components. First was a statewide outreach program informing health care practitioners throughout the state of the new clinical guidelines. This process began with the mailing of more than 2400 information booklets accompanied by a personal letter from the

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Chair of the Initiative (J.P.N.) to all medical practitioners and health care centers in the state involved in perinatal care. Formal lectures and workshops were given at all available conferences and seminars in the state in the fields of obstetrics, midwifery, and obstetric sonography.

In addition, 2 hour evening multidisciplinary workshops were conducted in hospitals throughout metropolitan and rural regions, providing education by lectures and interactive sessions for practitioners in their own workplaces. This outreach team consisted of 2 obstetricians (J.P.N., S.M.), a chief sonographer (M.K.P.) and 2 senior midwives. In 2015, more than 500 health care practitioners attended these workshops, and the outreach team traveled more than 13,000 km, ensuring that, as far as was possible, the health care practitioners in all regions had access to the new information and training.

Second was a public health campaign aiming to influence the behavior of the 34,000 women who give birth each year in the state. This program involved the distribution of 16 page magazines within the state's major daily newspaper written for the general population and outlining the ways in which the risk of PTB may be identified and avoided. A total of 160,000 of these magazines were distributed in February 2015. There was also an active social media campaign involving several community partners. The social media component of the initiative was known as thewholeninemonths, which is its registered trademark.

Third was a new PTB prevention clinic at the major hospital as the clinical center point of the initiative. The clinic was staffed by obstetricians with a special interest in the field, a clinical psychologist, and specialist midwives and sonographers with dedicated scanning rooms. The clinic developed management plans and referred women back to their usual health care provider when the risk of early preterm birth had passed.

The principal clinical strategies are shown in Table 1. These clinical strategies were aimed solely at singleton pregnancies with no new strategies adopted for multiple pregnancies.

Data were from the Western Australian midwives' notification system. This system records all births within Western Australia that occurred from 20 pregnancy weeks onward using information recorded by the attending midwife. Birth notifications were initially reported either electronically or in hard copy and had quality assurance processes to validate the outcomes. Pregnancy records held in the midwives' notification system are linked for validation with the Hospital Morbidity Data System and birth registration records. Data included gestational age at birth, live born, or stillborn, aggregated in gestational age groups. In addition to aggregated data, exact gestational information was also available for the tertiary level center.

Gestational age−specific preterm birth incidence and stillbirth rates per 1000 births were used to summarize the data for each year. PTB rates and the percentage reduction observed in 2015 were calculated as [reduction = (year 2015)/year] relative to each year between 2009 and 2014 and in which a negative reduction represents an increase in 2015 incidence. Comparisons of the birth and stillbirth incidence densities relative to those observed in 2015 used Poisson regression analysis and SAS statistical software (proc genmod) (version 9.3; SAS Institute Inc, Cary, NC).[7] Values of $P < .05$ were considered statistically significant.

The rates of PTB were also investigated using run charts of bimonthly PTB rates in 2013, 2014, and 2015 to assess the patterns of improvement.[8] Changes with time were assessed using the rules of probability to detect runs, shift, and trends.

The numbers of averted/delayed singleton preterm births in 2015 when compared with 2013 and 2014 were estimated using the PTB rate reduction in that year and accounting for the differences in distribution of births between tertiary and nontertiary care and stratified by gestational age groups. The expected mean reductions were calculated by subtracting the number of births in 2015 from births in 2013 or 2014, with their 95% confidence interval estimated using normal approximation to Poisson distribution.

Results

Table 2 shows the number of births from singleton and multiple pregnancies between the years 2009 and 2015 in Western Australia for the state's single tertiary-level referral center, nontertiary centers, and the state overall. Across this period, the total number of births in the state increased progressively from 30,293 in 2009 to 34,427 in 2015.

The annual rates of PTB from singleton pregnancies are shown in Table 3, and the trends in 2013−2015 are shown in Figures 1 and 2. Within the tertiary center, the rate of PTB in 2015 was 17.1%, which was significantly lower than in the preceding 4 years ($P < .001$ compared with 2014 and 2013, $P = .002$ compared with 2012, and $P = .022$ compared with 2011) (Table 3 and Figure 1A). In the years prior to the introduction of the initiative, the rate of PTB had a trend to increase with a maximum rate of 21.4% in 2013. The actual reduction in the rate of PTB in 2015 compared with the preceding 2 years was 20.3% when compared with 2013 and 15.0% when compared with 2014, which was the year in which the initiative had been partially introduced.

In the 32−36 week gestational age group in the tertiary center, the PTB rate in 2015 of 11.5% was significantly lower than in the preceding 4 years ($P = .002$ compared with 2014, $P < .001$ compared with 2013, $P = .003$ compared with 2012, and $P = .019$ compared with 2011). The PTB rates in 2015 in the 20−27 and 28−31 week ages were also lower than in the preceding years, although the differences did not reach statistical significance (Table 3).

In nontertiary care there was an increase in PTB rates over the years 2014−2015, representing the planned expansion of several secondary-level hospitals during this time (Table 3 and Figure 1B). However, in the state overall, the rate of singleton PTB in 2015 was 6.9%, which was lower than in any of the

TABLE 1
The key interventions included in the new clinical guidelines within the Western Australian Preterm Birth Prevention Initiative

1. Measurement of cervix length to be included in all midpregnancy morphology scans, conducted routinely at 18–20 weeks' gestation.[2,9,10,19] In those cases in which the cervix can be imaged clearly on a transabdominal scan, a closed length from internal to external os of ≥35 mm is adequate. In all other cases transvaginal scanning with an empty bladder is required at which a closed cervix length measured by this route of ≤25 mm is considered shortened.[20]
2. Natural vaginal progesterone 200 mg pessary to be prescribed nightly for any case in which the cervix has been found on ultrasound imaging to be shortened between 16 and 24 weeks' gestation.[9] Treatment is to continue until 36 weeks' gestation.
3. In cases in which the cervix length is <10 mm on transvaginal imaging, management can include cervical cerclage, vaginal progesterone, or both.[21]
4. Natural vaginal progesterone 200 mg pessaries to be prescribed for all cases in which there is a history of spontaneous preterm birth (with or without preterm prelabour rupture of membranes) between 20 and 34 weeks' gestation and to be used each night from 16 to 36 weeks' gestation.[22]
5. No pregnancy is to be ended prior to ≥38 weeks' gestation unless there is a medical or obstetric justification.[2,23]
6. Women who smoke should be identified and offered counseling though one of the well-established Quitline services offered through the Western Australian Department of Health.[2,24,25]
7. A new dedicated and multidisciplinary Preterm Birth Prevention Clinic established at the tertiary-level center for referral of high risk cases.[6] Typically, a management plan is developed and the woman referred back to her referring practitioner when the high risk period is concluded. Maternal-fetal medicine specialists, ultrasound imaging facilities for cervix length measurement, and mental health care and midwifery services are available within the clinic.

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preceding 6 years, with the reduction being statistically significant when compared with 2012 and 2013 when the rates were 7.4% and 7.5%, respectively (Table 3 and Figure 2). This reduction in 2015 when compared with 2013, which was the year preceding the initiative, represents an overall decrease in the statewide singleton PTB rate of 7.6% since the implementation of the program.

Table 4 displays the estimated number of PTBs averted in 2015 compared with the preceding 2 years. The mean number of averted preterm births in the tertiary center was 201 relative to 2014 and 297 relative to 2013. The incidence of PTB in 2015 in nontertiary care increased by 123 from 2014 and by 101 from 2013 because of the development of secondary hospitals handling more high-risk cases. As a result, the statewide reduction in PTBs was less than observed within the tertiary level center and amounted to 78 relative to 2014 births and 196 relative to 2013 births.

Within the gestation age group 20–27 weeks, there was no significant effect on rates either in the tertiary or nontertiary hospitals or statewide (Figures 1, A and B, and 2). However, in the analysis of the estimated expected number of averted PTBs in 2015, the calculated reduction in preterm infants in this age group exceeded 20.

Figure 3 displays run charts for births at the tertiary level center for each week within the term gestational age period. There was an upward shift in births in the categories of 37 and 39 weeks. The magnitude of this effect for the increased births in the 39 week group was $P < .001$

TABLE 2
Number of births in Western Australia between 2009 and 2015

		All	Nontertiary	Tertiary	
Pregnancies	Year	n	n	n	All births, %
Singleton	2009	30,293	24,820	5473	18.1
	2010	30,416	24,847	5569	18.3
	2011	31,287	25,820	5467	17.5
	2012	32,926	27,208	5718	17.4
	2013	33,457	27,944	5513	16.5
	2014	34,214	28,679	5535	16.2
	2015	34,427	29,052	5375	15.6
	All	227,020	188,370	38,650	17.0
Multiple	2009	914	601	313	34.2
	2010	841	518	323	38.4
	2011	905	559	346	38.2
	2012	936	608	328	35.0
	2013	946	584	362	38.3
	2014	1034	666	368	35.6
	2015	931	586	345	37.1
	All	6507	4122	2385	36.7

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when compared with 2013 and $P = .003$ when compared with 2014. The statewide data for this analysis are not available.

The dedicated PTB prevention clinic commenced Nov. 14, 2014. Until the end of 2015, a total of 154 women had attended the clinic and 92 pregnancies were concluded in that time. The median number of visits was 3 (range, 1–8), with the median gestational age at the first visit of 13.6 weeks (range, 9.3–26.3). Women with histories of early PTBs (67.4%, n = 62 of 92), recurrent pregnancy losses (26.1%, n = 24 of 62), a history of stillbirths or neonatal deaths (40.2%, n = 37 of 92), autoimmune conditions (10.9%, n = 10 of 92), uterine anomalies (6.5%, n = 6 of 92), placental risk factors (9.8%, n = 9 of 62), and/or a history of cone biopsies or other ablative procedures of the cervix (14.1%, n = 13 of 92) were referred. Thirty-nine women (42.4%) were treated with vaginal progesterone and 25 women (27.2%) by cervical cerclage, 24 women (26.1%) had medical interventions, and 25 women (27.2%) required mental health intervention. Excluding 8 pregnancy losses, 57 of 84 women delivered at term (67.9%).

Table 5 shows the rates of stillbirth across the 6 years for singleton pregnancies statewide and stratified by tertiary care. The average statewide stillbirth rate in 2015 in singleton births was 6.6 per 1000. This rate in 2015 was no different from the rate in any of the preceding years except for 2011 when the rate was 7.8 per 1000 ($P = .007$). In nontertiary care the higher rate in 2011 was also observed when compared with 2015 ($P = .009$). However, overall, the stillbirth rate in the tertiary center was unchanged in 2015 when compared with the preceding years ($P = .943$). There was also no change in the stillbirth rate within the term or near-term gestational age groups (data not shown).

TABLE 3
Rates of preterm birth in singleton pregnancies stratified by gestational age and obstetric care

GA, wks	20–27		28–31		32–36		<37	
Year	n	%	n	%	n	%	n	%
Tertiary								
2009	196	3.6	162	3.0	738	13.5[a]	1096	20.0[b]
2010	192	3.4	150	2.7	697	12.5	1039	18.7
2011	184	3.4	139	2.5	713	13.0[a]	1036	19.0[a]
2012	182	3.2	169	3.0	772	13.5[a]	1123	19.6[a]
2013	180	3.3	159	2.9	843	15.3[b]	1182	21.4[b]
2014	194	3.5	169	3.1[c]	750	13.6[a]	1113	20.1[b]
2015	168	3.1	134	2.5	617	11.5	919	17.1
Nontertiary								
2009	38	0.2	37	0.1	945	3.8[b]	1020	4.1[b]
2010	36	0.1	23	0.1	1083	4.4[a]	1142	4.6[a]
2011	47	0.2	28	0.1	1091	4.2[b]	1166	4.5[a]
2012	47	0.2	28	0.1	1239	4.6	1314	4.8
2013	49	0.2	30	0.1	1251	4.5	1330	4.8
2014	45	0.2	25	0.1	1269	4.4[a]	1339	4.7
2015	43	0.1	39	0.1	1388	4.8	1470	5.1
All								
2009	234	0.8[a]	199	0.7[a]	1683	5.6	2116	7.0
2010	228	0.7[a]	173	0.6	1780	5.9	2181	7.2
2011	231	0.7	167	0.5	1804	5.8	2202	7.0
2012	229	0.7	197	0.6	2011	6.1	2437	7.4[a]
2013	229	0.7	189	0.6	2094	6.3[a]	2512	7.5[a]
2014	239	0.7	194	0.6	2019	5.9	2452	7.2
2015	211	0.6	173	0.5	2005	5.8	2389	6.9

[a] $P < .05$, statistically significant differences from rates in 2015; [b] $P < .001$, statistically significant differences from rates in 2015; [c] $P < .10$, statistically significant differences from rates in 2015.

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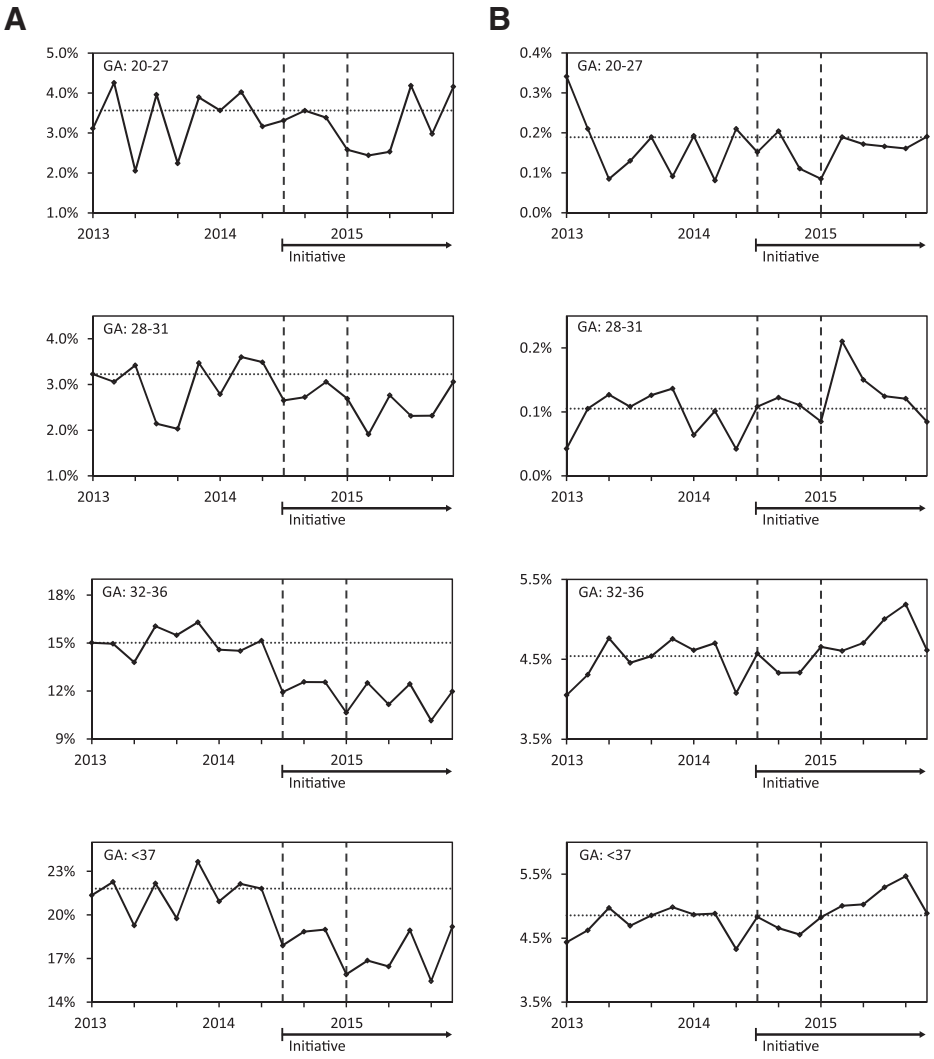
Comment

The implementation of a statewide PTB prevention program in Western Australia was followed by a significant reduction in the rates of singleton preterm birth both in the tertiary-level center and the state overall. There had been a trend to an increased rate of early birth in the preceding years, peaking in 2013. After introduction of the initiative, in part during 2014 and fully during 2015, the rate statewide incrementally decreased and in 2015 was lower than in any of the preceding 6 years.

The effect appeared to be greatest at the tertiary center, with the reduction in 2015 being 20.3% when compared with 2013 and 15% when compared with 2014. Detailed data on gestational age at birth were available for the tertiary-level center and indicated the reduction in births before 37 weeks was followed by a significant increase in the 39 week age group and a trend to an increase in the 37 week group. This reduction in PTB rates in the tertiary center appeared to result from a combination of both an initiative-driven decrease and a trend to more early births being conducted in secondary-level centers as part of a planned expansion in this growing state.

The statewide reduction in PTB rates included the 28–31, 32–36, and <37 week gestational age groups. Within the 20–27 week gestational age group, there

FIGURE 1
Preterm birth rates between 2013 and 2015 in tertiary and non-tertiary centers



Run charts of PTB rates in singleton pregnancies between 2013 and 2015 in the tertiary center **(A)** and the nontertiary centers **(B)**. The *horizontal dotted lines* indicate the median bimonthly rates of birth within each GA from January 2013 to June 2014. Using the definition of a shift as 6 consecutive rates below the baseline median, introduction of the initiative was followed by a downward shift in PTBs in the tertiary center within gestational age groups 28—31, 32—36 and <37 weeks. In the nontertiary centers, there were increasing trends in PTBs overall and in the gestational groups 32—36 weeks in 2015, most likely reflecting changing referral patterns at that time.

GA, gestational age group; *PTB*, preterm birth.

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was not a significant effect, but the calculation of the estimated reduction showed a trend toward a clinically significant decrease.

Calculation of the number of preterm births averted during the initiative also showed a greater number averted in the tertiary center than in the state overall. At least in part, this effect may have resulted from the fact that the initiative was operated out of the tertiary center in which awareness would have been greatest. Within the tertiary center, the estimated number of preterm births averted in 2015 was 201 relative to 2014 and 297 relative to 2013. In the state overall, the estimated number of PTBs averted in 2015 was 78 relative to 2014 and 196 relative to 2013.

Data available at this time do not allow an analysis of the PTB phenotypes that may have been prevented. The effect, however, appeared to occur rapidly after first introduction of the initiative in middle to late 2014 and included the gestational age groups from 28—31 weeks onward. These observations may suggest that the beneficial effects resulted from a combination of at least several of the interventions that were applied, with rapid effects from strategies to prevent nonmedically indicated late PTB and more delayed

effects from treatments such as progesterone.

One concern with delaying gestational age at birth is the risk of stillbirth. During the time of the initiative, there was no sign to suggest a change in stillbirth rates, either in the tertiary center or state overall. The relatively high rates of stillbirth in the major center reflect the referral of the most high-risk cases in this environment, including cases in which the fetus had died and the woman transferred for delivery and specialized care by the perinatal loss team. Nevertheless, even though the early signs for this initiative are reassuring, close attention will be given to rates of perinatal mortality and morbidity in the coming years when all clinical pregnancy outcome data are available.

The design of a preterm birth prevention program needs to be specific for that particular health care environment. Western Australia is geographically a large state, with a land area approximately one third the size of the United States but with a total population of 2.6 million people. The majority live in or near Perth, which is the capital city, with the remainder spread across large distances. In general, the population is relatively affluent with government-funded universal health care, a high level of health awareness, and well-established government-funded air and road transport systems to the major city when advanced health care is required.

Prenatal ultrasound imaging is well developed and readily available throughout the state. As a result, this health care environment was ideal for choosing the introduction of routine cervix length measurement at the time of all midpregnancy scans as a key component of the initiative.

Finding a shortened cervix in midpregnancy by ultrasound imaging is a strong predictor of preterm birth, and a prescription of vaginal progesterone therapy in such cases can be expected to reduce the risk of early birth by approximately 40%.[9-12] The Western Australia Preterm Birth Prevention Initiative strongly promoted the measurement of cervix length at all midpregnancy scans and empowered both primary and specialist-level medical practitioners to provide the necessary progesterone treatment. This strategy was coupled with education to ensure the imaging practitioners were providing best-practice examinations.

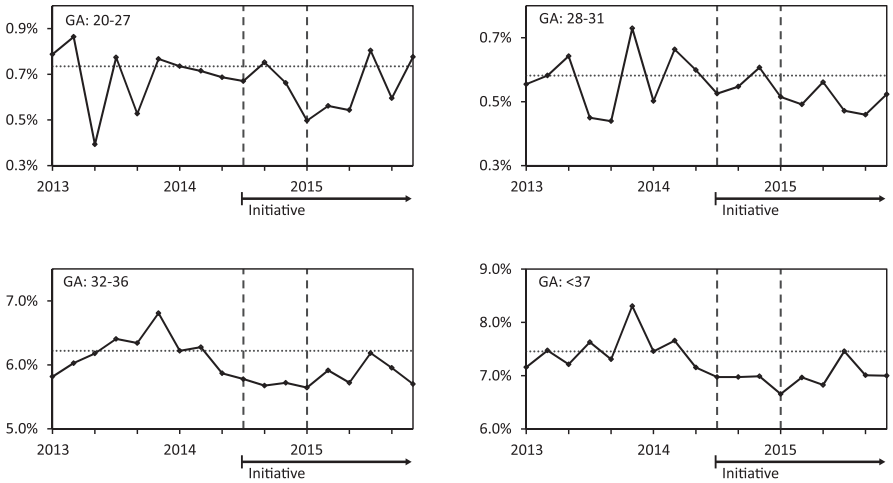
Influencing practitioners' behavior to prevent nonmedically indicated preterm birth and early elective deliveries is a significant challenge. Great leadership has been shown in this field within the United States in which the March of Dimes, together with partner organizations, initiated quality improvement programs that have successfully decreased the rate of elective scheduled early deliveries.[13]

The best approach to achieve such success is likely to vary among the many alternative health care systems. The Hospital Corporation of America in a program involving 27 hospitals observed that a hard stop policy including prohibition was more effective than just physician education backed up by peer review.[14] The Western Australia Preterm Birth Prevention Initiative chose an alternative strategy based on education of not only the specialist physicians but also the primary care medical practitioners, midwives, and imaging professionals together with the women and their families through a print and social media campaign. At least within the tertiary center, there was an effective increase in term births after the introduction of the initiative, but detailed analysis of the relative contribution of delaying elective delivery to this outcome will require additional study.

Whereas the relatively small numbers in the very preterm gestational age groups limit the statistical power when evaluating effects within these groups, the confidence intervals are suggestive of positive effects. Ongoing study into the future will also provide insights into the effects of the initiative on individual pregnancy phenotypes.

Preterm birth rates across the world vary greatly and are not static. Some of the lowest rates are observed in Northern Europe and Japan, with the highest rates in Africa and Cyprus.[1] China does not keep national statistics, but there is evidence their rate is low and increases in Chinese women when they move into Western environments.[15,16] Since 1980, the United States has experienced an increasing

FIGURE 2
Preterm rates between 2013 and 2015 in Western Australia



Run charts of PTB rates in singleton pregnancies between 2013 and 2015 including all births across the entire state of Western Australia. The *horizontal lines* indicate the median bimonthly rates of birth within each gestational age group from January 2013 to June 2014. Introduction of the initiative was followed by a downward shift in PTB rates within GAs 28–31, 32–36, and <37 weeks.

GA, gestational age group; *PTB*, preterm birth.

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TABLE 4
The estimated expected number of averted/delayed singleton preterm births in 2015 and their 95% CI, estimated using the rate reduction from 2013 and 2014

	Gestational age at delivery, wks			
Year	20–27	28–31	32–36	<37
Tertiary (n = 5375)				
2015, observed	168	134	617	919
95% CI	(144.4–195.4)	(113.1–158.8)	(570.3–667.6)	(861.6–980.4)
2014, estimated	195.2	170.1	754.7	1119.9
95% CI	(169.6–224.7)	(146.3–197.7)	(703.4–811.5)	(1057.1–1188.5)
2013, estimated	185.2	163.6	867.4	1216.3
95% CI	(160.0–214.4)	(140.1–191.1)	(810.6–928.1)	(1148.7–1287.7)
Reduction in 2015				
2014, average	27.2	36.1	137.7	200.9
95% CI	(−10.2 to 64.6)	(1.9–70.3)	(65.1–210.3)	(112.4–289.4)
2013, average	17.2	29.6	250.4	297.3
95% CI	(−19.6 to 54.0)	(−4.2 to 63.4)	(174.9–325.9)	(206.7–387.9)
Nontertiary (n = 29,052)				
2015, observed	43	39	1388	1470
95% CI	(31.9–58.0)	(28.5–53.4)	(1316.9–1463.1)	(1396.8–1547.0)
2014, estimated	45.3	25.2	1276.9	1347.3
95% CI	(33.8–60.7)	(17.0–37.2)	(1208.6–1349.1)	(1285.6–1431.1)
2013, estimated	50.4	30.9	1287.3	1368.6
95% CI	(38.1–66.7)	(21.6–44.1)	(1217.7–1360.6)	(1296.8–1444.0)
Reduction/increase in 2015				
2014, average	2.3	−13.8	−111.1	−122.7
95% CI	(−16.1 to 20.7)	(−29.5 to 1.9)	(−212.3 to −9.9)	(−226.7 to −8.7)
2013, average	7.4	−8.1	−100.1	−101.4
95% CI	(−11.5 to 26.3)	(−24.5 to 8.3)	(−201.5 to 1.3)	(−205.8 to 3.0)
All (n = 34,427)				
2015, observed	211	173	2005	2389
95% CI	(184.4–241.5)	(149.0–200.8)	(1919.0–2094.5)	(2295.2–2486.7)
2014, estimated	240.5	195.2	2031.6	2467.3
95% CI	(211.9 73.0)	(169.6–224.7)	(1944.8–2122.1)	(2371.7–2566.9)
2013, estimated	235.6	194.5	2154.7	2584.8
95% CI	(207.0–268.2)	(168.6–224.3)	(2064.2–2249.1)	(2485.6–2688.1)
Reduction in 2015				
2014, average	29.5	22.2	26.6	78.3
95% CI	(−12.1 to 71.1)	(−15.4 to 59.8)	(−97.9 to 151.1)	(−58.0 to 214.9)
2013, average	24.6	21.5	149.7	195.8
95% CI	(−16.8 to 66.0)	(−16.1 to 59.1)	(23.2–276.1)	(57.6–334.0)

Negative reduction corresponds to an increase in 2015.

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rate of preterm birth reaching 12.8% in 2006.[1,13,17] In the 7 years that followed, the rate progressively decreased to 11.4% in 2013. Many factors are thought to have contributed to this decline. Demographic changes during this time period have included a reduction in the teenage pregnancy rate and fewer high-order multiple births.[18]

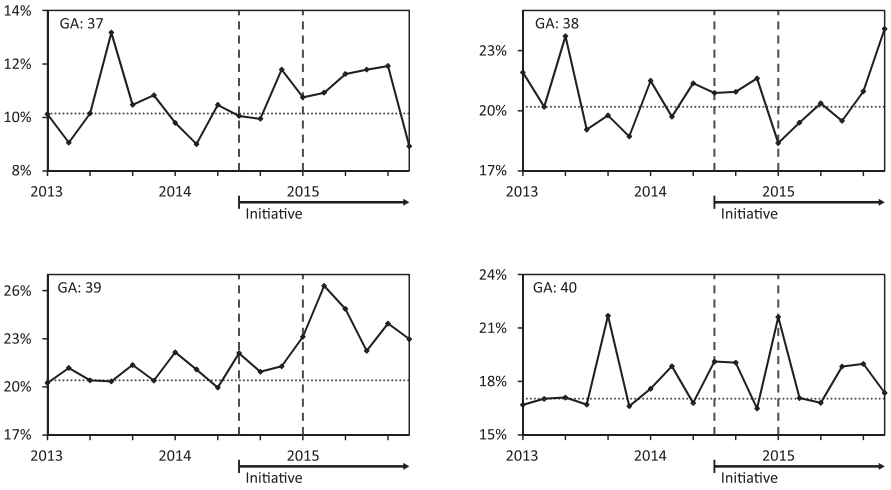
The policies to reduce the number of nonmedically indicated elective deliveries were of value, and there have been undoubted contributions from tobacco control programs as well as the use of progesterone treatment. Within the United States, health inequity has been a risk factor for PTB that has been tackled recently by the introduction of programs aiming to improve access to maternity care and education. A community program badged as Healthy Babies Are Worth the Wait in Kentucky improved preterm birth rates when compared with surrounding states by targeting underserved communities and incorporating many modifiable risk factors including the use of group antenatal care.[13]

PTB rates in the United States are expected to be reduced even further in the coming years by changing the method by which gestational age is calculated from use of the last menstrual period to ultrasound estimate, beginning with the release of the 2014 birth year data.[13] In contrast to the American situation, the strategies chosen for the Western Australian PTB Prevention Initiative were tailored for a different environment in which government-funded universal health care is widely available, and the population and the media were already very receptive to health care messages.

In conclusion, this study has shown that statewide introduction of a comprehensive and multifaceted PTB Prevention Initiative based on an outreach program for health care practitioners across the many disciplines involved in pregnancy care, coupled with a print and social media campaign for women and their families together with a new dedicated clinic at the major center, was associated with a significant reduction in the rate of PTB. The effect extended from the 28–31 week gestational age group onward and was not accompanied by any change in the rate of stillbirth.

Further study will be required to delineate the relative contributions of the various components of the program, although the major effort has been directed at cervix length measurement at the time of all midpregnancy ultrasound scans, prescription of vaginal progesterone therapy, avoidance of nonmedically indicated early deliveries, and a dedicated clinic in the major center. Within a developed nation such as Australia, prevention of PTB is likely to require a whole-of-health system and whole-of-community approach, as has been the basis of this initiative. ■

FIGURE 3
Preterm birth rates between 2013 and 2015 in the tertiary center



The *horizontal dotted lines* indicate the median bimonthly rates of birth within each GA from January 2013 to June 2014. Introduction of the initiative was followed by upward shifts in births in the 37 and 39 week groups.

GA, gestational age week; *PTB*, preterm birth.

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TABLE 5
Stillbirths in singleton pregnancies between 2009 and 2015

	All	Nontertiary	Tertiary	All	Nontertiary	Tertiary
Year	n	n	n	Rate per 1000	Rate per 1000	Rate per 1000
2009	213	73	140	7.0	2.9	25.6
2010	200	74	126	6.6	3.0	22.6
2011	245	108	137	7.8[a]	4.2[a]	25.1
2012	215	78	137	6.5	2.9	24.0
2013	188	63	125	5.6	2.3	22.7
2014	217	84	133	6.3	2.9	24.0
2015	209	83	126	6.1	2.9	23.4
All	1487	563	924	6.6	3.0	23.9

[a] Statistically significant differences from rates in 2015 when $P < .05$.

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References

1. Chang HH, Larson J, Blencowe H, et al. Preventing preterm births: analysis of trends and potential reductions with interventions in 39 countries with very high human development index. Lancet 2013;381:223-34.

2. Newnham JP, Dickinson JE, Hart RJ, Pennell CE, Arrese CA, Keelan JA. Strategies to prevent preterm birth. Front Immunol 2014;5:584.

3. Romero R, Dey SK, Fisher SJ. Preterm labor: one syndrome, many causes. Science 2014;345:760-5.

4. Lackritz EM, Wilson CB, Guttmacher AE, et al. A solution pathway for preterm birth: accelerating a priority research agenda. Lancet Glob Health 2013;1:e328-30.

5. Sharp AN, Alfirevic Z. Provision and practice of specialist preterm labour clinics: a UK survey of practice. BJOG 2014;121:417-21.

6. Whitworth M, Quenby S, Cockerill RO, Dowswell T. Specialised antenatal clinics for women with a pregnancy at high risk of preterm birth (excluding multiple pregnancy) to improve maternal and infant outcomes. Cochrane Database Syst Rev 2011:CD006760.

7. Stokes ME, Davis CS, Koch GG. Categorical data analysis using SAS, 2nd ed. Cary (NC): SAS Institute Inc; 2000.

8. Perla RJ, Provost LP, Murray SK. The run chart: a simple analytical tool for learning from variation in healthcare processes. BMJ Quat Saf 2011;20:46-51.

9. Romero R, Nicolaides K, Conde-Agudelo A, et al. Vaginal progesterone in women with an asymptomatic sonographic short cervix in the midtrimester decreases preterm delivery and neonatal morbidity: a systematic review and metaanalysis of individual patient data. Am J Obstet Gynecol 2012;206:124.e1-19.

10. Son M, Grobman WA, Ayala NK, Miller ES. A universal mid-trimester transvaginal cervical length screening program and its associated reduced preterm birth rate. Am J Obstet Gynecol 2016;214:365.e1-5.

11. Temming LA, Durst JK, Tuuli MG, et al. Universal cervical length screening: implementation and outcomes. Am J Obstet Gynecol 2016;214:523.e1-8.

12. Einerson BD, Grobman WA, Miller ES. Cost-effectiveness of risk-based screening for cervical length to prevent preterm birth. Am J Obstet Gynecol 2016;215:100.e1-7.

13. McCabe ER, Carrino GE, Russell RB, Howse JL. Fighting for the next generation: US prematurity in 2030. Pediatrics 2014;134:1193-9.

14. Clark SL, Frye DR, Meyers JA, et al. Reduction in elective delivery at <39 weeks of gestation: comparative effectiveness of 3 approaches to change and the impact on neonatal intensive care admission and stillbirth. Am J Obstet Gynecol 2010;203:449.e1-6.

15. Newnham JP, Sahota DS, Zhang CY, et al. Preterm birth rates in Chinese women in China, Hong Kong and Australia—the price of Westernisation. Aust N Z J Obstet Gynaecol 2011;51:426-31.

16. Payne MS, Feng Z, Li S, et al. Second trimester amniotic fluid cytokine concentrations, Ureaplasma sp. colonisation status and sexual activity as predictors of preterm birth in Chinese and Australian women. BMC Pregnancy Childbirth 2014;14:340.

17. Spong CY. Defining "term" pregnancy: recommendations from the Defining "Term" Pregnancy Workgroup. JAMA 2013;309:2445-6.

18. Schoen CN, Tabbah S, Iams JD, Caughey AB, Berghella V. Why the United States preterm birth rate is declining. Am J Obstet Gynecol 2015;213:175-80.

19. Hughes K, Kane SC, Araujo Junior E, Da Silva Costa F, Sheehan PM. Cervical length as a predictor for spontaneous preterm birth in high-risk singleton pregnancy: current knowledge. Ultrasound Obstet Gynecol 2016;48:7-15.

20. Society for Maternal-Fetal Medicine, McIntosh J, Feltovich H, Berghella V, Manuck T. The role of routine cervical length screening in selected high- and low-risk women for preterm birth prevention. Am J Obstet Gynecol 2016;215:B2-7.

21. Alfirevic Z, Stampalija T, Roberts D, Jorgensen AL. Cervical stitch (cerclage) for preventing preterm birth in singleton pregnancy. Cochrane Database Syst Rev 2012;4:CD008991.

22. Dodd JM, Jones L, Flenady V, Cincotta R, Crowther CA. Prenatal administration of progesterone for preventing preterm birth in women considered to be at risk of preterm birth. Cochrane Database Syst Rev 2013;7:CD004947.

23. Tita AT, Landon MB, Spong CY, et al. Timing of elective repeat cesarean delivery at term and neonatal outcomes. N Engl J Med 2009;360:111-20.

24. Shah NR, Bracken MB. A systematic review and meta-analysis of prospective studies on the association between maternal cigarette smoking and preterm delivery. Am J Obstet Gynecol 2000;182:465-72.

25. Ion R, Bernal AL. Smoking and preterm birth. Reprod Sci 2015;22:918-26.

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