

Examination of a prenatal syphilis screening program, Alberta, Canada: 2010–2011

Sabrina S. Plitt, PhD,¹ Mariam Osman, MPH,² Vanita Sahni, MSc,² Bonita E. Lee, MD, MSc,³ Carmen Charlton, PhD,⁴ Kimberley Simmonds, PhD²

ABSTRACT

OBJECTIVES: In 2009, due to increasing congenital syphilis rates, prenatal syphilis tests (PST) at both mid-gestation and delivery were added to first trimester prenatal screening in the province of Alberta. We sought to determine the proportion of mothers who had all three recommended PSTs during this period and to identify factors associated with incomplete PST.

METHODS: A cohort of all pregnancies resulting in a live or stillborn infant in Alberta for 2010 and 2011 was developed from Vital Statistics and linked with prenatal screening data to determine the number and timing of PSTs for pregnant women. The proportion of women who had PSTs at the three recommended time points in pregnancy and associated correlates were identified using basic statistics and logistic regressions.

RESULTS: Of 99,609 pregnancies, 20.7% had all three PSTs at the recommended time points. Overall, 98.5% (98,162) had at least one PST, 1.5% only had PST at delivery and 1.5% had no PST performed. Independent risk factors for not having the three recommended PSTs included First Nations status (adjusted odds ratio [AOR]: 1.78 [95% CI: 1.62–1.96]), rural remote residence (AOR 3.61 [95% CI: 3.10–4.20]) and sole use of a midwife for prenatal care (AOR 13.70 [95% CI: 9.20–20.39]).

CONCLUSIONS: Nearly all pregnant women in Alberta received a PST at least once during their pregnancy, however far fewer received PSTs at the recommended time points. Interventions that target those who are less likely to be prenatally screened may help to ensure that pregnant women get early and appropriate care for syphilis during pregnancy.

KEY WORDS: Prenatal diagnosis; syphilis; prenatal care; Canada

La traduction du résumé se trouve à la fin de l'article.

Can J Public Health 2016;107(3):e285–e290
doi: 10.17269/CJPH.107.5320

Early identification and treatment of syphilis infections in pregnancy is crucial to the prevention of transmission of infection from women to their unborn infants. Untreated syphilis infections in pregnant women or acquired infections during pregnancy can result in stillbirth, preterm birth, congenital abnormalities or neonatal disease. Transmission typically occurs transplacentally but can also occur at the time of delivery through contact with vaginal lesions. Although any stage of untreated syphilis infections can result in vertical transmission of infection, the risk of transmission is highest (i.e., 70%–100%) with primary or secondary syphilis infection.^{1,2}

Universal prenatal syphilis screening is recommended as one facet in the strategy for the elimination of congenital syphilis,³ however there is limited literature on maternal characteristics associated with poor compliance with prenatal syphilis testing. Studies have shown that lack or late initiation of prenatal care,^{4–8} single marital status,⁵ tobacco, alcohol or drug use,^{4,5,8} and rural residence⁴ are associated with congenital syphilis infections and may represent factors associated with barriers to prenatal screening.

In 2007, a syphilis outbreak was declared in the Canadian province of Alberta. The provincial infectious syphilis rate increased from 0.6/100,000 in 2000 to 6.4/100,000 in 2006 with 28 congenital syphilis cases (stillborn and live births) diagnosed between 2006 and 2011.⁹ These perinatal transmissions took place

despite a Provincial Prenatal Screening Program, implemented in 2002, whereby all pregnant women seeking prenatal care are tested for syphilis and four other infectious disease markers (hepatitis B, HIV, rubella and varicella) at their first prenatal visit.¹⁰ When the outbreak was declared in 2007, many of the mothers of infants with congenital syphilis had limited or no prenatal care or screening.^{6,7} However the mother of at least one congenital syphilis case had tested negative at her first trimester screen but acquired syphilis infection later in pregnancy from a believed-to-be monogamous relationship.¹¹ In response to the syphilis outbreak and rise in congenital syphilis cases, a prenatal syphilis rescreening program was recommended by Alberta Health and was implemented in the spring of 2009. In addition to first trimester syphilis screening, it was recommended that all pregnant women be rescreened for syphilis at 24–28 weeks gestation to coincide with their glucose tolerance test and again at labour and delivery.¹² The

Author Affiliations

1. Centre for Communicable Diseases and Infection Control, Public Health Agency of Canada, Ottawa, ON
2. Alberta Health, Edmonton, AB
3. Department of Pediatrics, University of Alberta, Edmonton, AB
4. Alberta Health Services, Edmonton, AB

Correspondence: Kimberley Simmonds, PhD, Epidemiology and Surveillance Team, Alberta Health, 23rd Floor, ATB Place, 10025 Jasper Avenue, Edmonton, AB T5J 1S6, Tel: 780-422-1940, E-mail: kimberley.simmonds@gov.ab.ca

Conflict of Interest: None to declare.

addition of the mid-gestation syphilis screen was to provide another opportunity to identify infection missed by the first trimester screen so that timely treatment could be given during pregnancy to possibly prevent vertical transmission, while rescreening at delivery served to detect new cases acquired in the third trimester to allow for appropriate clinical treatment and follow-up of the mother and infant.¹³ Detailed information about the syphilis outbreak and the new rescreening policies were widely circulated to health care personnel who provided prenatal and/or perinatal care in the province, including general practitioners, family physicians, obstetricians and midwives as well as targeting hospitals and health care centres that provide obstetric care in the province.

Here we report the proportion of women delivering babies in 2010 and 2011 who had first trimester prenatal syphilis screening and rescreening performed at both the recommended mid-gestation and delivery time points. Using a cohort of all mothers delivering babies during the period of the syphilis rescreening program, we describe the maternal demographic and prenatal care characteristics associated with i) receipt of prenatal syphilis testing (PST) at the three recommended time points, and ii) receipt of PST only at the time of delivery or no receipt of PST throughout pregnancy or at delivery.

METHODS

A birth cohort of live and stillborn infants in Alberta between January 1, 2010 and December 31, 2011 was obtained from the Alberta Vital Statistics Registry. This cohort was deterministically linked through their unique personal health number (PHN) to individual-level data from a number of provincial databases, including: Alberta Health Care Insurance Plan (AHCIP), Notice of Birth (NOB), Supplemental Enhanced Service Event (SESE – physician claims), and the Alberta Provincial Laboratory for Public Health. First Nations status was defined as anyone ever having registered with AHCIP as either status First Nations or Inuit, two of the indigenous population groups in Canada. The NOB form is completed by health care staff at the time of birth and has a mandatory section that was the source of the information on birth attendant (physician, midwife), maternal age, marital status, and postal code, and a non-mandatory section that provided information such as smoking and alcohol use during pregnancy. Prenatal care provided by a physician was captured through the SESE – physician claims database. Prenatal care was defined as having at least one visit where the physician billed for prenatal care (procedure code: 03.03B) or if there was a midwife as the birth attendant (assuming that the midwife involved would have provided prenatal care during the pregnancy). The location of residence variable (urban, rural, remote rural, and metro) was determined through standard Alberta Health methodology whereby an individual's postal code of residence is used to determine geographic boundaries, population densities, and time to travel to a variety of health services. Income quintile was determined using postal code and was based on the average income of the census dissemination area in which the mother was living at the time of delivery. Income groupings were ranked separately by urban/rural geographical location and then pooled together to determine overall income quintile to reduce bias from the differing income profiles of rural and urban areas.

The Alberta Provincial Prenatal Screening Program is a centralized screening program whereby all pregnant women are tested for selected communicable diseases, including syphilis, at their first prenatal visit.¹¹ All testing is performed by the Provincial Laboratory for Public Health (ProvLab). Two separate prenatal requisitions are being employed for the initial syphilis screen and rescreen requests respectively.

Since September 2007, syphilis screening at ProvLab is performed using a Syphilis enzyme immunoassay (EIA) (Architect Syphilis TP Microparticles, Abbott Laboratories, Illinois, USA). Positive samples are tested by quantitative RPR titers (Macro-Vue™ RPR kit, Becton Dickinson Microbiology Systems, Ontario, Canada) to assist with disease staging. Samples submitted from patients with no history of confirmed syphilis serology are also tested with a confirmatory immunoassay, INNO-LIA (INNO-LIA Syphilis, Innogenetics NV, Ghent, Belgium). A positive INNO-LIA is defined as 2 or more bands $\geq 1+$ for TpN47, TpN15, TpN17 or TmpA antigen, while an indeterminate result is reported if only one syphilis antigen line is 1+ or higher. Physicians are asked to submit a follow-up specimen for indeterminate INNO-LIA results if clinically indicated to rule out a recent infection.

The number and timing of PSTs were analyzed for all pregnancies. Screening in the first trimester was defined as any test prior to 13 weeks gestation, mid-gestation screening was defined as any screening from 24–28 weeks and screening at delivery was defined as a PST within 72 hours of delivery. The birth of multiple infants was analyzed as one pregnancy event. Those with all three recommended rescreenings were compared to the rest of the cohort of mothers delivering babies during this time period. Comparisons were performed using chi-square tests for categorical variables and Mann–Whitney tests for continuous variables. Maternal age and number of prenatal care visits were collected as continuous variables but were analyzed as categorical variables based on clinically relevant standard cut-points. Secondary analysis examined women who had no PST throughout their pregnancy or at delivery and those women who only had PST at the time of delivery as compared to all other women who had at least one PST prior to delivery. Multivariable logistic regression was used to identify variables independently associated with the three recommended PSTs among those women giving birth in Alberta. Any variable associated with the outcome at a p -value < 0.10 in univariate analyses was assessed in the multivariable model, however only those variables that remained significant ($p < 0.05$) were included in the final model.

All analyses were conducted using SAS 9.3 (SAS Institute, Cary, NC).

Ethics approval was received by the Health Research Ethics Board at the University of Alberta, Edmonton.

RESULTS

There were 99,609 pregnancies resulting in a live or stillborn infant between January 1, 2010 and December 31, 2011 in Alberta. Of these pregnancies, 98.5% (98,162) had at least one PST and of these, 1.5% (1,492) had their only PST at the time of delivery (Table 1). Overall, 65.7% (65,448) of pregnancies had PST performed during the first 12 weeks of pregnancy, 50.1% (49,885) had a mid-gestation rescreening test and 57.4% (57,142) had a rescreening test at the time of labour and delivery. Overall,

Table 1. Timing of recommended prenatal syphilis testing (PST) in Alberta, 2010–2011, *N* = 99,609

	Number (%) of women tested	
	<i>n</i>	(%)
At least one PST during pregnancy (regardless of timing)	98,162	(98.5)
First trimester PST performed only	10,555	(10.6)
First trimester PST plus mid-gestation PST performed only	13,824	(13.9)
Mid-gestation PST performed only	5764	(5.8)
First trimester PST and delivery PST performed only	12,876	(12.9)
Delivery PST performed only	1492	(1.5)
First trimester PST performed	65,448	(65.7)
Mid-gestation PST performed	49,885	(50.1)
Delivery screen PST performed	57,142	(57.4)
Three recommended PSTs performed: first trimester, mid-gestation and at delivery	20,624	(20.7)

Note: First trimester screen is defined as screening taking place at 1–12 weeks of gestation. Mid-gestation screen is defined as screening taking place at 24–28 weeks of gestation as per Alberta rescreening recommendations. Delivery is defined as ± 3 days around the date of delivery.

20.7% (20,624) had all three screening tests performed at the recommended time points. Approximately one third (36.1%) of women had three or more tests performed at any time during their pregnancy. There was only a slightly higher proportion of women who had all three recommended tests done in 2011 than in 2010 (21.1% vs. 20.3%, *p* = 0.001).

We compared women who had completed the three recommended PSTs to all other women giving birth in the province. The women with three recommended PSTs were more likely to be older (median age: 30 years [IQR: 26.5–33.5] vs. 29 years [25–33, *p* < 0.0001]). They were also less likely to have First Nations status (3.1% vs. 8.2%, *p* < 0.0001) and to be not married (24.0% vs. 31.1%, *p* < 0.0001) (Table 2). Women with recommended screening were more likely to be in higher income quintiles (*p* < 0.001) and to live in metropolitan areas (75.4% vs. 61.4%, *p* < 0.0001) than women without the recommended screenings. Women with the recommended PSTs were less likely to smoke or drink during pregnancy (11.3% vs. 17.2%, *p* < 0.0001 and 3.2% vs. 4.7%, *p* < 0.0001 respectively). Women with all recommended PSTs were more likely to have received prenatal care (99.4% vs. 96.3%, *p* < 0.0001), more likely to have started physician care in the first trimester (75.8% vs. 60.5%, *p* < 0.0001), and less likely to seek midwifery care (0.4% vs. 3.3%, *p* < 0.0001).

Multivariable analysis showed independent risk factors for not having the three recommended screenings were First Nations status (adjusted odds ratio [AOR]: 1.78 [95% CI: 1.62–1.96]), not being married (AOR: 1.09 [95% CI: 1.04–1.13]) and smoking during pregnancy (AOR: 1.23 [95% CI: 1.16–1.30]) (Table 3). Living in non-metropolitan areas was associated with not completing recommended screenings, with rural remote residence having the highest association (AOR: 3.61 [95% CI: 3.10–4.20]). In addition, the three lowest income quintiles were significantly associated with not having the recommended screenings (AOR: 1.17 [95% CI: 1.11–1.24]; AOR: 1.17 [95% CI: 1.11–1.23]; AOR: 1.14 [95% CI: 1.08–1.21] for income Q1–Q3 respectively). Compared to those with only physician prenatal care, those with no prenatal care had

an AOR of 5.58 (95% CI: 4.61–6.74). Likewise, compared to physician prenatal care only, having both physician and midwifery care or midwifery care alone were associated with an increased likelihood of not having the recommended screenings during pregnancy (AOR 3.29 [95% CI: 2.51–4.30] and 13.70 [9.20–20.39] respectively).

Information on alcohol and smoking during pregnancy was missing for 13.5% and 14.6% of women respectively. Pregnancies missing (vs. not missing) these data were more likely to: have no prenatal care; have a midwife-attended birth; and live in an urban location; but both groups were similar in terms of age, income quintile and First Nations status. Separate logistic models without the inclusion of the smoking and alcohol variables were run. There was no significant difference in the effect size or significance values for the results, except for the midwifery care category. The AOR for only midwifery care as compared to physician prenatal care only was increased to 19.6 (95% CI: 13.6–28.3) in the model without smoking from 13.7 (95% CI: 9.2–20.4) in the model with smoking.

We also examined women who had no PST documented (*n* = 1,447) together with those who had their first and only PST at the time of delivery (*n* = 1,492) and compared them to women with any PST testing prior to delivery (*n* = 96,670). Women with no or late testing were more likely to: be younger (median age: 28 years [IQR: 24–32] vs. 29 years [IQR: 25 years vs. 33], *p* < 0.0001); have First Nations status (15.9% vs. 6.9%, *p* < 0.0001); not be married (47.6% vs. 29.1%, *p* < 0.0001); be in the lowest income quintile (26.6% vs. 21.0%, *p* < 0.0001); and report smoking or drinking alcohol during pregnancy (31.9% vs. 15.5%, *p* < 0.0001 and 10.1% vs. 4.2%, *p* < 0.0001 respectively) (data not shown). They were also more likely to have no prenatal care (39.2% vs. 2.0%, *p* < 0.0001) or to seek midwifery care (4.1% vs. 2.6%, *p* < 0.0001), and among those who sought physician prenatal care, women who had no or late testing were less likely to start physician care in the first trimester (37.8% vs. 64.3%, *p* < 0.0001).

Women who had their first PST at the time of delivery were more likely to: have First Nations status (18.6% vs. 13.1%, *p* < 0.0001); not be married (51.1% vs. 43.9%, *p* < 0.0001); live in an urban area (19.6% vs. 9.9%, *p* < 0.0001); and start prenatal care in the last trimester (23.1% vs. 14.1%, *p* < 0.0001) compared to those who had no documentation of a PST.

Midwife use was associated strongly with having no PST; 4.4% of women who used midwives did not have any PST, while only one woman with a midwife had her sole PST screening at the time of delivery (*p* < 0.0001). Of the 1,724 pregnancies with only midwifery care, 5.7% did not have any PST, this compared to 0.8% of women seeking prenatal care without a midwife. The midwife patient population represents 14.3% of all women who had prenatal care and never received a PST. We also compared midwife patients to women who did not use a midwife; women who used midwives in our cohort were older (median age 31 years [IQR: 25–37] vs. 29 years [IQR: 21–37], *p* < 0.0001), and were less likely to be First Nations (3.3% vs. 7.3%, *p* < 0.0001), to have single marital status (14.5% vs. 30%, *p* < 0.0001) and to be in the lowest income quintile (12.1% vs. 21.3%, *p* < 0.0001).

Furthermore, we examined women moving to Alberta while pregnant to assess the effect of migration on the potential for misclassification of prenatal care or PST status. Twenty-three (0.7%)

Table 2. Characteristics of women receiving the three recommended PSTs* during pregnancy and those women not receiving the recommended testing in Alberta, 2010–2011

	Received all recommended PSTs				p-value†
	Yes		No		
	n	(%)	n	(%)	
Year	20,624	(20.7%)	78,985	(79.3%)	0.001
2010	10,085	(48.9%)	39,617	(50.2%)	
2011	10,539	(51.1%)	39,368	(49.8%)	
Age (years)					<0.0001
<20	478	(2.3%)	3658	(4.6%)	
20–29	9620	(46.6%)	38,509	(48.8%)	
30–39	9971	(48.3%)	34,538	(43.7%)	
40+	555	(2.7%)	2280	(2.9%)	
First Nations	630	(3.1%)	6507	(8.2%)	<0.0001
Not married	4954	(24.0%)	24,639	(31.1%)	<0.0001
Income quintile					<0.0001
Q1 (lowest)	3671	(17.8%)	17,109	(21.7%)	
Q2	3272	(15.9%)	13,909	(17.6%)	
Q3	3620	(17.6%)	13,415	(17.0%)	
Q4	4395	(21.3%)	15,266	(19.3%)	
Q5 (highest)	5599	(27.1%)	18,149	(23.0%)	
Residence					<0.0001
Remote rural	218	(1.1%)	3110	(3.9%)	
Rural	2149	(10.4%)	16,614	(21.0%)	
Urban	2713	(13.2%)	10,710	(13.6%)	
Metro	15,543	(75.4%)	48,506	(61.4%)	
Smoking during pregnancy	2082	(11.3%)	11,619	(17.2%)	<0.0001
Alcohol during pregnancy	584	(3.2%)	3156	(4.7%)	<0.0001
Had prenatal care	20,495	(99.4%)	76,020	(96.3%)	<0.0001
Type of prenatal care‡					
Any physician prenatal care	20,466	(99.2%)	74,325	(94.1%)	<0.0001
Any midwifery care	91	(0.4%)	2588	(3.3%)	<0.0001
Midwifery care only	29	(0.1%)	1695	(2.1%)	<0.0001
Total number of physician prenatal visits§					<0.0001
0	129	(0.6%)	2965	(3.9%)	
1–6	1114	(5.4%)	13,956	(18.3%)	
7–13	16,489	(80.3%)	53,289	(69.8%)	
14+	2801	(13.6%)	6187	(8.1%)	
Timing of first physician prenatal visit§					<0.0001
Trimester 1	15,471	(75.8%)	44,400	(60.5%)	
Trimester 2	4746	(23.3%)	24,004	(32.7%)	
Trimester 3	187	(0.9%)	5028	(6.8%)	

Note: Variable data are missing as follows: not married (0.1%), income quintile (0.6%), residence (0.03%), smoking (13.6%) and alcohol use (14.6%).

* The recommended PST protocol included one PST in the first trimester, a second PST at 24–28 weeks and a third at the time of labour and delivery.

† The p-value was calculated using chi-square tests.

‡ The categories are not mutually exclusive.

§ Does not include data for those women who sought midwifery care.

of the women who were classified as having received no prenatal care migrated to Alberta during their pregnancy. Of these 23 women, all had at least one PST recorded in Alberta during their pregnancies, except for 3 women who had PST recorded at delivery only and 1 who had no PST recorded.

DISCUSSION

The vast majority (98.5%) of pregnant women in Alberta received at least one PST during their pregnancy, however only 20.7% of pregnant women had the three recommended PSTs during pregnancy. This low uptake of all three recommended PSTs was seen despite an ongoing syphilis outbreak that was publicized in the media and bulletins being sent to health care professionals to inform them of the changes to prenatal syphilis testing.

We sought to determine factors associated with not having the recommended PST during pregnancy, as most of the congenital syphilis cases in Alberta were diagnosed in infants born to women who had little or no prenatal care.^{6,7} In our study, factors associated with not having the recommended prenatal syphilis

testing included First Nations status, single marital status, non-metropolitan residence, lower income quintiles, midwifery care, and late or no prenatal care. Similar risk factors were identified for women who were not screened at all or only at delivery. Lack or late initiation of prenatal care has been associated with lack of prenatal syphilis screening in other studies.^{8,14} Other correlates, such as rural residence and single marital status have previously been associated with congenital syphilis transmission.^{4,5} In 2007, Singh et al. reported on nine congenital babies born in 2005 and 2006 in Alberta, where two thirds of mothers were First Nations and half did not obtain prenatal care before onset of labour.⁷

During the period of this prenatal screening evaluation (2010–2011), seven mothers gave birth to babies with congenital syphilis and none had a PST in the first trimester. Four of these mothers started prenatal care in their second trimester, one in the third trimester and two had no prenatal care, as determined by our study methods. Because these cases presented later in gestation, it is possible that congenital syphilis could have been prevented if appropriate interventions had been given earlier in the pregnancy.

Table 3. Adjusted odds ratios (AORs) of not receiving the three recommended PSTs* during pregnancy in Alberta, 2010–2011

	Adjusted odds ratio (AOR)	95% confidence interval
Age (years)		
<20	1.34	1.20–1.50
20–29	1.00	
30–39	1.00	0.97–1.04
40+	1.25	1.12–1.38
First Nations	1.78	1.62–1.96
Not married	1.09	1.04–1.13
Residence		
Remote rural	3.61	3.10–4.20
Rural	2.28	2.16–2.40
Urban	1.22	1.16–1.28
Metro	1.00	
Smoking during pregnancy	1.23	1.16–1.30
Income quintile		
Q1 (lowest)	1.17	1.11–1.24
Q2	1.17	1.11–1.23
Q3	1.14	1.08–1.21
Q4	1.00	0.96–1.06
Q5 (highest)	1.00	
Type of prenatal care		
No prenatal care	5.58	4.61–6.74
Physician prenatal care only	1.00	
Physician and midwifery care	3.29	2.51–4.30
Midwifery care only	13.70	9.20–20.39

Note: Variable data are missing as follows: not married (0.1%), income quintile (0.6%), residence (0.03%), smoking (13.6%) and alcohol use (14.6%).
 * The recommended PST protocol included one PST in the first trimester, a second PST at 24–28 weeks and a third at the time of labour and delivery.

From a public health perspective, identification of and support for high-risk groups who do not receive early and adequate prenatal care is paramount.

Due to the lower uptake of mid-gestation syphilis rescreening, combined with the limited utility for the diagnosis of new syphilis infections with mid-gestation screening, Alberta Health decided in January 2012 to no longer recommend mid-gestation syphilis screening for all pregnant women.¹⁵ Screening for syphilis during the first trimester and again at delivery continue to be recommended in Alberta for all pregnant women, with the understanding that more PSTs are indicated during pregnancies for women with significant risk factors for infection. The Canadian Guidelines on Sexually Transmitted Infections recommend that prenatal screening be performed in the first trimester, at mid-gestation (i.e., 28–32 weeks) and again at delivery among pregnant women who are at high risk of acquisition of syphilis, or in areas that are experiencing heterosexual syphilis outbreaks.¹³ The guidelines emphasize that universal syphilis screening of pregnant women should continue to be standard of care in most Canadian jurisdictions.¹³

Our study identified midwife-attended birth as a risk factor for not having any PST. Previous Canadian studies have also reported midwife use being associated with lower prenatal HIV testing rates.^{16,17} This may be due to women who choose midwifery care having alternative beliefs regarding health care interventions, as evidenced by recent literature showing decreased vaccination rates and neonatal vitamin K prophylaxis among children born to women who sought midwife care.^{18,19} This trend might also be due to midwifery’s principles of encouraging informed choice for

independent decision making.^{20,21} Women using midwives in our cohort were older, and less likely to be First Nations, single and in the lowest income quintile than women not using midwives. The only statistically significant difference between the midwifery patients who did and did not have a PST was that those who also saw a physician for prenatal care in the first or second trimester were more likely to be tested (97.9% vs. 94.3%, $p < 0.0001$). It is possible that these midwifery patients deemed themselves, or the midwives deemed their patients to be, at low risk for syphilis infection and therefore prenatal syphilis screening was not felt to be warranted. None of the babies born in Alberta with congenital syphilis during this study time period had a midwife-attended birth.

This population-based program evaluation with linkage to multiple population-based databases and registries provides a complete picture of provincial PST. Study limitations included the fact that pregnant women tested via routine syphilis testing instead of the Provincial Prenatal Screening Program would not have been identified through our study methodology. Thus the small number of the women classified as having received no PST might be overestimated. In addition, there is the potential for misclassification of prenatal care. Prenatal care might not be fully captured if it was not billed as such by the physician (e.g., family physician billing for a routine visit), or if care was delivered by a non-physician (e.g., nurse-practitioner). In addition, midwifery prenatal care during pregnancy would not have been captured if the infant was delivered by a physician as this variable was determined by attendant at birth. These factors may explain the 64.9% of 3,094 women classified as having no prenatal care but who actually had a PST prior to labour and delivery. If prenatal screening was performed outside of Alberta, these data would not have been captured by our study methods, however an examination of migrant women identified as having no prenatal care in our study indicated all, except one, had a PST in the province.

CONCLUSIONS

In 2010–2011, nearly all pregnant women in Alberta received PST at least once during their pregnancy, however far fewer women received all three recommended screenings. Policies and interventions that target those who are less likely to be screened are important to ensure that pregnant women get early prenatal care and appropriate testing to protect the health of their infants.

REFERENCES

1. Fiumara NJ, Fleming WL, Downing JG, Good FL. The incidence of prenatal syphilis at the Boston City Hospital. *N Engl J Med* 1952;247:48–52. PMID: 14941281. doi: 10.1056/NEJM195207102470203.
2. Finelli L, Berman SM, Koumans EH, Levine WC. Congenital syphilis. *Bull World Health Organ* 1998;76(Suppl 2):126–28. PMID: 10063689.
3. World Health Organization, Department of Reproductive Health and Research. The Global Elimination of Congenital Syphilis: Rationale and Strategy for Action, 2007. Available at: <http://www.who.int/reproductivehealth/publications/rtis/9789241595858/en/> (Accessed May 5, 2016).
4. Mobley JA, McKeown RE, Jackson KL, Sy F, Parham JS, Brenner ER. Risk factors for congenital syphilis in infants of women with syphilis in South Carolina. *Am J Public Health* 1998;88(4):597–602. PMID: 9551001. doi: 10.2105/AJPH.88.4.597.
5. Desenclos JC, Scaggs M, Wroten JE. Characteristics of mothers of live infants with congenital syphilis in Florida, 1987–1989. *Am J Epidemiol* 1992; 136(6):657–61. PMID: 1442732.

6. Caddy S, Lee B, Sutherland K, Robinson J, Plitt S, Read R, Singh AE. Pregnancy and neonatal outcomes of women with reactive syphilis serology in Alberta, 2002–2006. *J Obstet Gynaecol Can* 2011;33:453–59. PMID: 21639965.
7. Singh AE, Sutherland K, Lee BE, Robinson JL, Wong T. Resurgence of early congenital syphilis in Alberta. *CMAJ* 2007;177(1):33–36. PMID: 17606936.
8. Warner L, Rochat RW, Fichtner RR, Stoll BJ, Nathan L, Toomey KE. Missed opportunities for congenital syphilis prevention in an urban southeastern hospital. *Sex Transm Dis* 2001;28(2):92–98. PMID: 11234792.
9. Alberta Health. Interactive Health Data Application. Available at: http://www.ahw.gov.ab.ca/IHDA_Retrieval/selectSubCategoryParameters.do (Accessed April 14, 2015).
10. Alberta Prenatal Screening Program for Selected Communicable Diseases. June 2006. Available at: <http://www.health.alberta.ca/documents/Prenatal-Screening-Program-July-2007.pdf> (Accessed February 16, 2015).
11. Lee MC, Robinson JL, Lee BE, Singh A. An infant with seizures, rash, and hepatosplenomegaly. *Clin Infect Dis* 2008;46:451–52, 472–73. PMID: 18181743. doi: 10.1086/525533.
12. Alberta Perinatal Health Program. Alberta Perinatal Connection, 2009. Available at: <http://www.aphp.ca/pdf/Syphilis%20edition%20July%2022%5B1%5D.pdf> (Accessed September 15, 2015).
13. Public Health Agency of Canada. *Canadian Guidelines on Sexually Transmitted Infections*, 2013 ed. Ottawa, ON: Her Majesty the Queen in Right of Canada, 2013. Available at: <http://www.phac-aspc.gc.ca/std-mts/sti-its/cgsti-ldcits/index-eng.php> (Accessed December 10, 2014).
14. Schrag SJ, Arnold KE, Mohle-Boetani JC, Lynfield R, Zell ER, Stefonek K, et al. Prenatal screening for infectious diseases and opportunities for prevention. *Obstet Gynecol* 2003;102(4):753–60.
15. Alberta Health Services. *ProvLab Laboratory Bulletin. Discontinuation of Second Trimester Syphilis Screening on Pregnant Women*, 2012. Available at: http://www.provlab.ab.ca/LabBulletin2012/wf_lb_prenatal_syphilis_testing.pdf (Accessed April 17, 2016).
16. Wang F, Larke B, Gabos S, Hanrahan A, Schopflocher D. Potential factors that may affect the acceptance of routine prenatal HIV testing. *Can J Public Health* 2005;96(1):60–64. PMID: 15682699.
17. Guenter D, Kaczorowski J, Carroll J, Sellors J. Prenatal HIV tests: Routine testing or informed choice? *Can Fam Physician* 2003;49:1334–40. PMID: 14594102.
18. Bell CA, Simmonds KA, MacDonald SE. Exploring the heterogeneity among partially vaccinated children in a population-based cohort. *Vaccine* 2015; 33(36):4572–78. PMID: 26187259. doi: 10.1016/j.vaccine.2015.07.004.
19. Sahni V, Lai FY, MacDonald SE. Neonatal vitamin K refusal and nonimmunization. *Pediatrics* 2014;134(3):497–503. PMID: 25136042. doi: 10.1542/peds.2014-1092.
20. Midwife Philosophy. Alberta Association of Midwives. Available at: <http://www.alberta-midwives.com/what-is-a-midwife/midwifery-philosophy/> (Accessed April 30, 2015).
21. Dube E, Vivion M, Valderrama A, Sauvageau C. Knowledge and attitudes toward vaccination among midwives in Quebec. *Sante Publique* 2013; 25(1):35–43. PMID: 23705333.

Received: October 13, 2015

Accepted: May 15, 2016

RÉSUMÉ

OBJECTIFS : En 2009, la hausse des taux de syphilis congénitale a poussé la province de l'Alberta à ajouter aux dépistages systématiques du premier trimestre des tests prénatals pour la syphilis (TPS) au milieu de la grossesse et à l'accouchement. Nous avons cherché à déterminer la proportion des mères ayant subi les trois TPS recommandés durant la grossesse et l'accouchement et à cerner les facteurs associés aux TPS incomplets.

MÉTHODE : À l'aide des statistiques de l'état civil, nous avons créé une cohorte de toutes les grossesses ayant donné lieu à un enfant vivant ou mort-né en Alberta en 2010 et en 2011 et nous l'avons liée aux données de dépistage prénatal afin de déterminer le nombre et le moment des TPS administrés aux femmes enceintes. La proportion des femmes ayant subi des TPS aux trois points recommandés durant leur grossesse, et les corrélats associés, ont été déterminés à l'aide de statistiques élémentaires et de régressions logistiques.

RÉSULTATS : Sur 99 609 grossesses, 20,7 % de femmes avaient subi les trois TPS aux points recommandés dans le temps. Dans l'ensemble, 98,5 % des femmes enceintes (98 162) avaient subi au moins un TPS, 1,5 % n'avaient subi qu'un TPS à l'accouchement et 1,5 % n'en avaient subi aucun. Les facteurs de risque indépendants pour n'avoir pas subi les trois TPS recommandés étaient le statut de membre d'une Première Nation (rapport de cotes ajusté [RCa] : 1,78 [IC de 95 % : 1,62–1,96]), le fait de résider en région rurale éloignée (RCa 3,61 [IC de 95 % : 3,10–4,20]) et le recours exclusif à une sage-femme pour les soins prénatals (RCa 13,70 [IC de 95 % : 9,20–20,39]).

CONCLUSIONS : Presque toutes les femmes enceintes en Alberta ont subi un TPS au moins une fois durant leur grossesse, mais elles sont beaucoup moins nombreuses à avoir subi les TPS aux points recommandés dans le temps. Des interventions ciblant les femmes moins susceptibles de subir un dépistage prénatal pourraient contribuer à faire en sorte que les femmes enceintes reçoivent des soins précoces et appropriés pour la syphilis durant la grossesse.

MOTS CLÉS : diagnostic prénatal; syphilis; soins prénatals; Canada