


BMJ Open Exploring changes in maternal and congenital syphilis epidemiology to identify factors contributing to increases in congenital syphilis in Florida: a two time-period observational study (2013–2014 vs 2018–2019)

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ABSTRACT

Objectives As, cases of congenital syphilis (CS) and infectious syphilis among women more than doubled in Florida and across the nation during 2013–2019, we sought to understand what may be contributing to these increases in Florida.

Design A two time-period observational study.

Setting Pregnant women with reported syphilis infections and their pregnancy outcomes (2013–2014 and 2018–2019) in Florida.

Participants 1213 pregnant women with reported syphilis infections living in Florida and 341 infants meeting the CS case definition.

Outcome measures We assessed what proportion of the increase in CS was from increases in maternal syphilis infections. We examined maternal demographics, infection characteristics and timing of diagnoses that could explain the increase in CS. Finally, we reviewed if changes in presentation or severity of CS cases occurred.

Results During 2013–2014, 83 (21%) of 404 pregnant women with syphilis delivered babies with CS. During 2018–2019, 258 (32%) of 809 pregnant women with syphilis delivered babies with CS. Comparing CS prevention rates, it was determined that 65% of the increase in CS was due to the increases in maternal syphilis infections. The proportion of maternal cases staged as primary or secondary increased over time (7%–13%) ($p<0.01$) and reports of drug use became slightly more common (6%–10%) ($p=0.02$). During 2018–2019, women delivering CS infants were more likely to be reinfected during the same pregnancy (27 (10%) vs 5 (6%) $p=0.23$) and more had negative third trimester screening tests (43 (17%) vs 7 (8%) $p=0.07$). The percentage of infants with CS who had ≥ 1 sign or symptom increased from 35% to 40%, and the combined total of stillbirths and infant deaths increased from 5 to 26.

Conclusions Recently, more pregnant women are being infected with syphilis and a higher per cent are not being treated to prevent CS. The reasons for this finding are unclear.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Study was from a high burden jurisdiction with strong surveillance data collection practices and procedures.
- ⇒ All maternal and congenital syphilis infections are investigated in Florida, regardless of stage of disease.
- ⇒ Passive data collection through surveillance may yield incomplete medical records for mother or child.
- ⇒ Some data as part of investigating these infections are self-reported and could be subject to perception biases in declaration of this information.

INTRODUCTION

Congenital syphilis (CS) is a potentially fatal infection passed from mother to child in utero. Timely identification and treatment of the infection in the mother can typically prevent CS.¹ Between 2013 and 2019, yearly reported cases of primary and secondary syphilis among all women steadily increased from 137 to 460 (236%) in Florida and from 1500 to 6493 (333%) in the USA (online supplemental figure 1). At the same time, cases of CS rapidly increased from 35 to 145 (314%) in Florida and from 362 to 1871 (417%) in the USA.^{2,3}

In 2017, in the midst of these national increases, CDC called for systems-level changes and the implementation of best practices to reduce CS infections.⁴ Identifying which pregnant women are likely to have or acquire syphilis is a challenge; one national study found that half of all pregnant women with syphilis reported no previously recognised risk factors for syphilis.⁵ Therefore, the US Preventive Services Task Force recommends screening every woman for

syphilis during pregnancy.⁶ Despite this universal first visit screening recommendation, previous research has identified challenges to preventing CS, including a lack of prenatal care, delay in treatment, inadequate therapy for patient's stage of disease and failure to detect reinfections or new infections acquired after first trimester screenings.^{7–11} Given that few groups of women have been identified as at increased risk for syphilis acquisition (eg, those with a previous STD, multiple concurrent partners, sex partners to male cases or reported drug use), CS prevention also likely requires preventing syphilis in all women.^{5 12–14}

An evaluation of CS cases in Florida and Louisiana in 2013–2014 found screening early in pregnancy and again in the third trimester along with timely treatment of pregnant women with syphilis prevented 78% of infections (regardless of treatment or prenatal care) from resulting in CS.⁷ With maternal and congenital infections rising following the previous evaluation, this current study aims to expand our understanding of CS prevention by examining the trends and specifically assessing maternal and congenital case data from two periods to identify changes among maternal infections that may have contributed to increases in CS in Florida. We explored whether the CS increase was simply due to greater numbers of pregnant women with syphilis or if there were changes in which pregnant women were diagnosed with syphilis or with the timing and adequacy of their syphilis diagnosis and treatment. Finally, we assessed differences in clinical outcomes for infants reported with CS between the two periods.

METHODS

Jurisdictional surveillance practices and dataset generation

In Florida, screening for syphilis during pregnancy is to occur at first prenatal visit, at 28–32 weeks gestational age, and in many situations at delivery.¹⁵ Syphilis and CS infections are reportable conditions required reporting by laboratories and healthcare providers in Florida.¹⁶ Most infections are initially identified through electronic laboratory reporting and investigated by local Florida Department of Health Disease Investigation Specialists (DIS). DIS conduct interviews of persons and partners infected with syphilis, collect medical records, verify or assure treatment and enter this information into Florida's sexually transmitted disease surveillance system (STDSS). All laboratory and provider reports of syphilis infections in women ≤ 45 years of age are investigated regardless of non-treponemal titre or stage of syphilis in diagnosis.

Case records of pregnant women with syphilis during two periods, 2013–2014 and 2018–2019, were extracted from the Florida STDSS along with their linked infant records. Data extracted included mother's year of reported syphilis diagnosis; age; race; Hispanic ethnicity; place of birth (US state or non-US state); reported drug use (cocaine/crack, methamphetamine, heroin, injection drug use) during pregnancy; stage of syphilis at diagnosis; and syphilis test data during pregnancy, including

test dates, results and relevant titres. Infant records contained information on CS case status; vital status at delivery; and signs, symptoms or laboratory tests indicative of CS. Women with more than one syphilitic infection reported during their pregnancy had their information condensed into one record to reflect the earliest stage of syphilis reported. Maternal and CS case criteria and staging were defined using the Council of State and Territorial Epidemiologists (CSTE) case definitions.¹⁷ Early syphilis is defined by the three stages of syphilis (primary, secondary and early non-primary non-secondary) where clinical and epidemiological evidence suggests infection occurred in the past 12 months. The remaining stage of syphilis is unknown or late duration syphilis, which include traditional late latent syphilis infections but also those without enough information to stage in one of the early syphilis stages.

Data analyses and variable categorisation

The numbers of pregnant women with syphilis and CS cases were compared across the two study periods. CS prevention rates—or the proportion of CS cases averted by timely diagnosis and appropriate treatment—were determined for each period by subtracting the CS cases from the number of pregnant women with syphilis and then dividing by the number of pregnant women with syphilis. CIs for these CS prevention estimates were determined using Wilson's Score Interval to account for uncertainties (variability) in resources dedicated to reporting, completeness of passive case reporting, changes in programme practices and other potential contributing factors. We also estimated the number of cases there would have been in 2018–2019 if the CS prevention efficacy was the same as it was in 2013–2014. Cases of syphilis among women were compared across the two periods by race/ethnicity, place of birth, age, drug use during pregnancy, stage of syphilis at diagnosis, highest reported non-treponemal test titre, trimesters when testing was performed and birth outcome. When more than one non-treponemal titre was available per pregnancy, the highest titre was used. Highest reported non-treponemal test titres were categorised into three groups: high ($\geq 1:32$), medium (1:4–1:16) and low ($\leq 1:2$).

Race and ethnicity were categorised into four groups: white, non-Hispanic; black, non-Hispanic; Hispanic or Latino; and other or unknown. Testing history was based only on syphilis test results, including negative test results, obtained via electronic laboratory reporting or medical record review. To determine the trimester in which syphilis testing occurred, sample collection dates were compared against estimated due dates (EDD) or delivery date when the EDD was not available. Screening was determined to be in the first two trimesters if the mother had reported syphilis testing in the first 27 weeks of pregnancy (≥ 91 days before EDD). Third trimester screening was defined as screening that occurred in the third trimester and in time to prevent CS (ie, reported screening after 27 weeks of pregnancy and ≥ 30 days before delivery). Syphilis

testing occurring during the 29 days before delivery was not considered screening to prevent CS.

The χ^2 test for association was used to compare proportions of maternal syphilis cases by demographic and clinical characteristics across the two periods.¹⁸ For infants with CS, the proportion of cases with each reported clinical or laboratory outcome was calculated and compared across the two periods. Infants were categorised as those having at least one physical sign of CS (as defined in the CS case definition), long bone X-rays with findings consistent with CS, abnormal cerebral spinal fluid (CSF) findings (reactive CSF-venereal disease research laboratory, elevated CSF white blood cells >0.015 WBC $\times 10^9/L$ or elevated CSF protein >120 mg/dL) or by being a syphilitic stillbirth or infant deaths (≤ 30 days after birth).¹⁶ Infant deaths consisted of those from a mother with untreated or inadequately treated syphilis at birth or among infants in treated mothers with clinical or laboratory signs consistent with CS. All statistical tests were performed using SAS Studio V.3.6.

Patient and public involvement

None.

RESULTS

Pregnant women with syphilis

During 2013–2014, there were 404 cases of syphilis during pregnancy; of these, 321 (79%; 95% CI 75% to 83%) were diagnosed and adequately treated in time to prevent CS and 83 (21%) were not or the infant had signs or symptoms consistent with CS despite adequate timely treatment, resulting in CS. During 2018–2019, the number of reported cases of syphilis during pregnancy doubled, reaching 809. Of these, 551 (68%; 95% CI 65% to 71%) were diagnosed and treated in time to prevent CS and 258 (32%) were considered CS, resulting in a tripling of CS cases over 2013–2014. If the prevention efficiency in 2018–2019 was the same as it was in 2013–2014 (79%), the 809 pregnant women with syphilis would have led to 167 cases of CS (93 fewer than the 258 that were recorded). Most (65%, 167/258) of the increase in reported CS cases can be attributed to the increase in maternal syphilis cases.

Demographics, screening and treatment factors

Comparing mothers with syphilis in the two periods, there were no major differences by race/ethnicity or age (table 1). Mothers with syphilis in 2018–2019 were slightly more likely to be born in the 50 US states (75% vs 68%), be staged as primary or secondary syphilis (13% vs 7%) and be reported with either early syphilis or high-titre syphilis of unknown or late duration (62% vs 50%) compared with mothers in 2013–2014.

There were slight increases in reported drug use among all pregnant women with syphilis (from 6% to 10%) as well as increases in reported drug use among the subset of women delivering a CS case (from 12% to 19%). Among women with syphilis during pregnancy, the drugs

reported in 2013–2014 and 2018–2019, respectively, were as follows: cocaine/crack (6% vs 9%), methamphetamine (1% vs 4%), injection drug use ($<1\%$ vs 3%) and heroin ($<1\%$ vs 2%). Mothers linked to a CS case in 2013–2014 primarily reported the use of cocaine/crack 14%. All other drug use was reported as 0% but mothers were not routinely asked about methamphetamines in 2013–2014. Mothers linked to CS cases in 2018–2019 reported using: cocaine/crack (18%), methamphetamine (8%), injection drug use (5%) and heroin (4%).

Among pregnant women with syphilis, screening was performed in time to prevent CS for 93% (375 of 404) in 2013–2014 and 91% (733 of 809) in 2018–2019 (figure 1). The remaining 7% in 2013–2014 and 9% in 2018–2019 were not screened and diagnosed more than 30 days prior to their delivery. In each period, 81% of pregnant women identified with syphilis were tested in the first two trimesters. In 2018–2019, significantly more pregnant women delivered a CS infant after testing negative at both the initial screening and the third trimester (33 (13%) vs 2 (2%)), more, in terms of case count, delivered a CS infant after testing positive in the third trimester despite testing negative in the first two trimesters (13 (5%) vs 4 (5%)) and more delivered a CS infant after testing positive in the first trimester (68 (26%) vs 16 (19%)).

The percentage of women who tested positive for syphilis early in pregnancy increased between the two periods (19%–26%) (table 2). Much of the observed increase in CS cases was due to two main factors. First, the mother was reinfected after initial treatment or experienced treatment failure (5 (6%) increased to 27 (10%) CS cases). Second, the mother was not treated for her infection (1 (1%) increased to 10 (4%) CS cases). Another change among CS cases was an increase in the percentage of women who tested negative in the third trimester but positive at delivery—a 9% overall increase from 7 to 43 CS cases. Among the 50 pregnant women in both periods who tested negative in the third trimester but positive at delivery, 22 (44%) had no history of syphilis. The remaining 56% (n=28) met the surveillance definition for a new case of syphilis but could have been treatment failure since previous diagnosis.

The two most common reasons that infants met the CS case definition during 2013–2014 were that mothers were never screened for syphilis during their pregnancy (29 CS cases; 35%) and mothers were not rescreened during the third trimester (21 CS cases; 25%) (table 2). In 2018–2019, both of these reasons increased in frequency (76 and 36 cases, respectively), but they comprised a smaller proportion of all CS cases (29% and 14%, respectively).

Infant outcomes

Among CS infants born to mothers with syphilis during pregnancy, the proportion with at least one sign or symptom of CS increased from 35% of infants in 2013–2014 to 40% of the infants in 2018–2019 (table 3). Among babies with CS born to mothers who had early or high-titre unknown duration or late syphilis, the proportions that were symptomatic

Table 1 Characteristics of maternal syphilis cases reported in Florida in 2013–2014 compared with 2018–2019

Characteristics	2013–2014			2018–2019			χ^2 *	P value*
	CS (%)	Non-CS (%)	Total	CS (%)	Non-CS (%)	Total		
Race/ethnicity								
White non-Hispanic	19 (23)	50 (16)	69 (17)	56 (22)	102 (19)	158 (20)	1.1	0.30
Black non-Hispanic	49 (59)	179 (56)	228 (56)	137 (53)	308 (56)	445 (55)	0.2	0.64
Hispanic/Latino	13 (16)	69 (21)	82 (20)	51 (20)	98 (18)	149 (18)	0.6	0.43
Other/unknown	2 (2)	23 (7)	25 (6)	14 (5)	43 (8)	57 (7)	0.3	0.58
US territory/foreign born								
Yes	22 (27)	109 (34)	131 (32)	63 (24)	136 (25)	199 (25)	8.3	<0.01
No	61 (73)	212 (66)	273 (68)	195 (76)	415 (75)	610 (75)	9.1	<0.01
Age (in years)								
14–19	9 (11)	25 (8)	36 (9)	19 (7)	67 (12)	86 (11)	0.8	0.36
20–24	31 (37)	91 (28)	122 (30)	69 (27)	150 (27)	219 (27)	1.3	0.25
25–29	19 (23)	74 (23)	93 (23)	82 (32)	153 (28)	235 (29)	5.0	0.03
30–34	16 (19)	77 (24)	93 (23)	52 (20)	113 (21)	165 (20)	1.1	0.30
35–39	5 (6)	45 (14)	50 (12)	23 (9)	55 (10)	78 (10)	2.1	0.14
40+	3 (4)	7 (2)	10 (2)	13 (5)	13 (2)	26 (3)	0.5	0.48
Average age	26.3	27.7	27.3	27.5	26.8	27.1	0.7	0.41
Drug use (cocaine/crack/heroin/meth/IDU)								
Yes	10 (12)	14 (4)	24 (6)	48 (19)	32 (6)	80 (10)	5.4	0.02
No	64 (77)	280 (87)	344 (85)	178 (69)	468 (85)	646 (80)	5.0	0.03
Unknown/refused	9 (11)	27 (8)	36 (9)	32 (12)	51 (9)	83 (10)	0.6	0.46
Max titre non-treponemal test								
High ($\geq 1:32$)	39 (47)	105 (33)	144 (36)	120 (47)	191 (35)	311 (38)	0.9	0.34
Medium (1:4–1:16)	25 (30)	102 (32)	127 (31)	96 (37)	209 (38)	305 (38)	4.6	0.03
Low ($\leq 1:2$)	19 (23)	113 (35)	132 (33)	42 (16)	151 (27)	193 (24)	10.7	<0.01
Stage of syphilis diagnosis								
Primary or secondary	5 (6)	22 (7)	27 (7)	37 (14)	69 (13)	106 (13)	11.4	<0.01
Early, non-primary non-secondary	39 (47)	88 (27)	127 (31)	117 (45)	153 (28)	270 (33)	0.5	0.50
Unknown or late duration	39 (47)	211 (66)	250 (62)	104 (40)	329 (60)	433 (54)	7.7	0.01
Early syphilis or high-titre unknown late duration	59 (71)	143 (45)	202 (50)	197 (76)	303 (55)	500 (62)	15.4	<0.01
Medium-titre or low-titre unknown late duration	24 (29)	178 (55)	202 (50)	61 (24)	248 (45)	309 (38)	15.4	<0.01
Total	83	321	404	258	551	809	–	–

*P value and χ^2 value are for the total reported maternal syphilis between the two time periods with the exception of the average age which used the t-test to compare the two means.

CS, congenital syphilis; IDU, injection drug use.

were similar in both time periods (41% in 2013–2014 and 43% in 2018–2019). The overall proportion of infants reporting at least one sign in either period among babies with CS born to mothers who had medium-titre or low-titre

unknown duration or late syphilis was 27%. CS infants born to mothers diagnosed with secondary syphilis only comprised 26 cases, although 15 (58%) reported ≥ 1 sign or symptom consistent with CS.

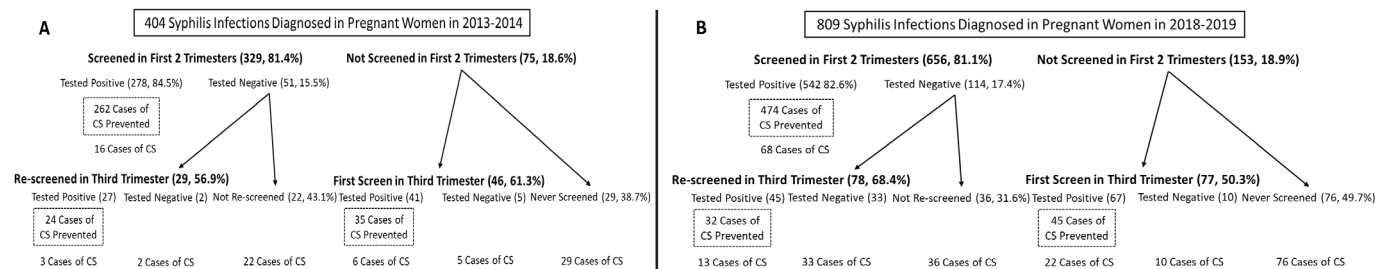


Figure 1 Timing of syphilis diagnoses in pregnant women during two time periods in Florida. (A) 2013–2014. 83 CS cases and 321 CS cases prevented (79%). (B) 2018–2019. 258 CS cases and 551 CS cases prevented (68%). CS, congenital syphilis.

The number and proportion of infants who were still-born increased between the two periods (3 (4%) to 20 (8%)) and the number of babies born alive who died within 30 days of birth increased, although the proportion remained unchanged (2 (2%) to 6 (2%)). Across both periods, 26 (84%) of the 31 stillbirths and neonatal deaths were related to mothers who were staged as having unknown duration or late syphilis. However, 22 (85%) of

26 of these mothers had high-titres ($\geq 1:32$) suggesting they were recently infected.

DISCUSSION

The increase in CS in Florida during 2013–2019 was largely (65%) due to increases in syphilis among pregnant women. As the numbers of pregnant women with

Table 2 Criteria for congenital syphilis cases in Florida, 2013–2014 versus 2018–2019

Criteria for meeting the congenital syphilis case definition	2013–2014 (%)	2018–2019 (%)	Change (%)*
Screened first two trimesters	43 (52)	150 (58)	6
Tested positive for syphilis	16 (19)	68 (26)	7
Mother was reinfected (fourfold titre increase) after initial treatment	5 (6)	27 (10)	4
Treated appropriately infant met case definition	5 (6)	17 (7)	1
Insufficient amount or inappropriate spacing of treatment for stage of disease	4 (5)	12 (5)	0
Mother not treated	1 (1)	10 (4)	4
Premature birth screened <30 days prior to delivery	1 (1)	0	-1
Treated <30 days prior to delivery	0	2 (1)	1
Tested negative for syphilis	27 (33)	82 (32)	-1
Not rescreened >30 days before delivery [†]	21 (25)	36 (14)	-9
Third trimester screen positive, treated <30 days prior to delivery	3 (4)	8 (3)	-1
Negative third trimester screen [†]	2 (2)	33 (13)	11
Third-trimester screen positive, fourfold titre increase at delivery	1 (1)	1 (<1)	-1
Mother not treated	0	2 (1)	1
Treated appropriately infant met case definition	0	2 (1)	1
Screened after the first two trimesters, but greater than 30 days prior to delivery	11 (13)	32 (12)	-1
Tested negative for syphilis	5 (6)	10 (4)	-2
Treated <30 days before delivery	3 (4)	9 (3)	-1
Treated appropriately infant met case definition	2 (2)	4 (2)	0
Mother not treated	1 (1)	4 (2)	1
Third trimester screen positive, fourfold titre increase at delivery	0	3 (1)	1
Insufficient amount or appropriate spacing of treatment for stage of disease	0	2 (1)	1
No recorded syphilis testing more than 30 days prior to delivery	29 (35)	76 (29)	-6
Total	83	258	-

*Percentage change in proportion of congenital syphilis cases for each criteria comparing 2018–2019 period against 2013–2014.
[†]P values for χ^2 test were less than $\alpha=0.05$ over the two time periods.

**Table 3** Characteristics of congenital syphilis (CS) cases

CS-related findings	Year of reported infection	
	2013–2014 (%)*	2018–2019 (%)*
Stillbirth	3 (4)	20 (8)
Infant death (≤30 days after birth)	2 (2)	6 (2)
Physical signs consistent with CS	5 (6)	25 (10)
Abnormal long bone X-rays†	8 (10)	5 (2)
Reactive CSF-VDRL	4 (5)	17 (7)
Abnormal CSF results	15 (18)	60 (23)
Total with ≥1 sign or symptom of CS	29 (35)	102 (40)

*Percentage of all reported CS cases.
†P values for χ^2 test were less than $\alpha=0.05$ over the two time periods.
CS, congenital syphilis; CSF, cerebral spinal fluid; VDRL, venereal disease research laboratory.

syphilis increased, the likelihood of diagnosing and treating infection in time to prevent CS decreased even though screening remained quite good. The likelihood that a pregnant woman with syphilis was diagnosed during the first two trimesters was nearly identical in both time periods (81% in both). Fewer cases resulting in CS in 2018–2019 (14%) compared with 2013–2014 (25%) were among those who screened negative early in pregnancy, and were not rescreened in the third trimester more than 30 days prior to delivery. This decrease in proportions may be due to increased familiarity with third trimester screening rules (28–32 weeks gestation) across Florida from 2006.¹⁶ In contrast, from 2013–2014 to 2018–2019, there were increases in reinfections during the same pregnancy and maternal infections diagnosed at delivery after a prior negative screen during pregnancy, especially those after negative third trimester screens. This could be a result of many factors including increased incidence of syphilis in women and men who have sex with women (increasing the number of infectious individuals in a community), reduced effectiveness of partner services, changes in sexual behaviour or sexual networks, or even the effects of expanded electronic laboratory reporting by providers and laboratories (compared with telephone, fax or mailed case reports), which may have increased the capacity to report infections.¹⁰ Other countries and jurisdictions have similar screening and treatment protocols to Florida, and have found similar challenges in CS prevention including: lack of or inadequate prenatal care, maternal reinfections or mother's testing positive after an initial negative syphilis test.^{19–21} Finally, these increases are not likely a result of an increase in number of live births in Florida as the number of live births only

increased 1.5% from 2013–2014 (435 099 live births) to 2018–2019 (441 518).²²

We found no important differences in age, race or Hispanic ethnicity of pregnant women with syphilis. Drug use was reported more frequently than in the past but was still relatively rare—reported by only 10% of pregnant women with syphilis. The biggest factor contributing to increasing rates of pregnant women with syphilis appears to be the increasing incidence of syphilis among women. There have been increases in the number and proportion of pregnant women with syphilis diagnosed in early stages and with higher non-treponemal titres. Additionally, the increasing proportion of cases among pregnant women born in the 50 US states suggests more had incident infections. Incident infections may have more challenges for prevention as infection may occur later in pregnancy decreasing the opportunity for detection and treatment. Incident maternal infections have long been linked to poorer birth outcomes, including stillbirth, infant death and symptomatic CS, which is supported by our study findings of increased stillbirth and signs/symptoms.²³

Nationally, 6.5% of CS ended in stillbirth or infant deaths during 1999–2013.²⁴ In our analysis, the number of stillbirths and infant deaths and the percentage of CS cases ending stillbirth or infant death increased from 6% to 10%. This may be due to chance variation or due to an increase in the per cent of pregnant women with recent infections.^{24 25} Beyond stillbirth and infant death, congenital abnormalities from CS increased from 35% to 40% across the two periods, but it is difficult to say truly how many infants had these abnormalities as not all infants had complete clinical workups and some medical records were not obtained. The presence of abnormal long bone findings decreased between the two time periods and were observed less frequently than previous reports.^{26 27} This may in part be due to the sensitivity of the case definition for CS compared with clinical review of symptomatic CS, the use of public health surveillance records instead of medical records, and not all CS infants having long bone X-rays performed.

One additional observed trend is the increase in identified drug use in pregnant women with syphilis. In this analysis, the overall drug use was higher in 2018–2019 (10%) than 2013–2014 (6%), but it was less than the percentages reported for all women with primary or secondary syphilis in the USA (16.6% for methamphetamines alone).¹⁴ This may be partially explained by the fact that our evaluation focused on pregnant women and testing positive for drugs could result in loss of custody of their child potentially lowering the risk of drug use during pregnancy. However, the counterpoint is that some individuals in our study were screened because they were pregnant which would increase detection beyond self-reported drug use. Additionally, in our study the primary drug used among pregnant women with syphilis was crack/cocaine. Some recent studies of women with syphilis have focused on methamphetamine use and not asked about crack/cocaine despite the past associations of

syphilis and crack/cocaine use.^{28 29} Our findings suggest future studies should also ask about crack/cocaine or other drugs depending on local trends.

This study has limitations inherent to the analysis of public health surveillance data. First is the use of the CSTE case definition for CS (which is intentionally highly sensitive and thus somewhat non-specific). This includes considering infant as CS cases to mothers with unknown or late duration syphilis infections not initiating or completing treatment for stage of disease more than 30 days prior to delivery, which may be less likely to transmit infection to the infant.³⁰ However, over 40% of the maternal infections resulting in CS were staged unknown or late duration and had non-treponemal test titres $\geq 1:32$ during their pregnancy suggestive of more recent infection. Second, the data are based on passive surveillance using reports from laboratories and providers to identify cases. Moreover, some of the data, particularly around drug use, is typically identified through interview of the patient (self-report) and given this involves pregnant women and their infants, there is potential bias towards not reporting drug use. Third, the increases in maternal and CS identified in this analysis may be due to other factors not assessed including but not limited to social vulnerability, educational levels, sexual health knowledge and changes in sexual behaviour.^{31 32} Finally, some cases had incomplete ascertainment of medical and case investigation records. One example is discerning screening and prenatal care practices from current surveillance records as laboratory results are required to be reported, but identifying all sources of prenatal care may be incomplete. Greater emphasis on record capture around prenatal care and syphilis screening practices could better elucidate the gaps in CS prevention. In total, the data may not be generalisable to other jurisdictions with different populations; prevention resources; and policies, practices and regulations.³³

In conclusion, our findings suggest two reasons why CS increased: (a) more women were getting syphilis and (b) we are less effective in preventing pregnant women with syphilis from having an infant with CS. There are some opportunities for decreasing CS such as improving third trimester screening, reducing the time from diagnosis to treatment and ensuring the right treatment over the right time frame for the diagnosed stage of syphilis. In 2018–2019 more women were acquiring syphilis and more were acquiring it late in pregnancy. We were unable to identify any clues that would explain why syphilis is increasing among women (other than a small increase in drug use and more incident syphilis infections among pregnant women). More work is needed to reduce syphilis among women, and to detect and treat infections during pregnancy.

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Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics statement The study was reviewed by the Florida Department of Health Institutional Review Board Office (protocol number: 2021-444). The study was determined to be exempt from review by the Institutional Review Board as it was determined to be non-research: public health practice in accordance with United States federal law 45 CFR 46.102(d).

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Data availability statement The authors do not own the data used within this study. Data are owned by the Florida Department of Health. All requests would need to be approved by the Florida Department of Health.

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