International Journal of Infectious Diseases 159 (2025) 107993

Contents lists available at ScienceDirect

International Journal of Infectious Diseases

journal homepage: www.elsevier.com/locate/ijid

Impact of the dual rapid diagnostic test for HIV and syphilis among pregnant women: a before and after health center-based study in Central Uganda (2018-2019)

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ARTICLE INFO

Article history:
Received 30 March 2025
Revised 16 July 2025
Accepted 18 July 2025

Keywords:
Syphilis
Antenatal care
Rapid diagnostic test (RDT)
Adverse birth outcomes
Congenital syphilis

ABSTRACT

Objectives: Systematic testing of antenatal clinic attendees using dual HIV and syphilis rapid diagnostic tests (RDT) can improve syphilis screening and reduce mother-to-child transmission. We assessed the effect of the dual HIV/syphilis RDT on syphilis care and adverse birth outcomes (ABOs), including congenital syphilis (CS) in Central Uganda.

Methods: Eleven antenatal clinics were selected from Kalungu and Masaka districts. First-visit records were extracted on syphilis testing, positivity and treatment over two 9-month periods, pre- and post-introduction, with a 3-month buffer. Syphilis cascade indicators were calculated for the two periods. The World Health Organization CS Estimation Tool evaluated impact on CS cases and ABOs.

Results: A total of 6011 records were extracted, 2660 pre-test introduction and 3351 post-introduction. Syphilis testing increased from 49.1% pre-test to 84.0% post-introduction, an increased testing rate ratio of 1.71 (95% confidence interval 1.64-1.78). Treatment coverage modestly increased post-introduction (rate ratio = 1.19, 0.94-1.50), resulting in an absolute rate difference of 31.4% (20.5-41.6%, P <0.001). This resulted in a modeled 41% decline in CS cases and 39% decline in ABOs.

Conclusions: This is the first demonstration of the impact of dual HIV/syphilis RDT in routine antenatal clinics in Uganda, which could reduce CS and ABOs.

Introduction

Syphilis, caused by the spirochaete *Treponema pallidum* subspecies *pallidum,* if untreated during pregnancy can be vertically transmitted to the fetus, known as congenital syphilis (CS), and can result in adverse birth outcomes (ABOs) such as fetal loss or stillbirth, neonatal death, prematurity, or low birthweight [1]. To reach the goal of global elimination of mother-to-child transmission, the World Health Organization (WHO) has indicators of 95% coverage for first antenatal care visit (ANC1), 95% syphilis testing of antenatal care (ANC) attenders, and treatment of 95% of seropositive women using long acting benzathine penicillin G (BPG) [2,3]. These targets aim to achieve the impact indicator of 50 or fewer cases of CS per 100,000 live births, using the WHO case surveillance definition of a live birth or fetal death at less than 20 weeks of gestation or less than 500 grams (including stillbirth) born to a woman with positive syphilis serology and without adequate treatment [2–4]. Globally, CS is the second leading cause of infectious stillbirth [5], with an estimated global incidence rate of 523 per 100,000 livebirths in 2022, an increase from 425 per 100,000 livebirths in 2020 [6].

Despite the development of treponemal rapid diagnostic tests (RDTs) for syphilis and their implementation in antenatal settings, rates of syphilis testing in pregnant women at ANC1 have remained lower than those for HIV [7]. Previous studies have shown that challenges to effective syphilis program implementation include ensuring adequate supplies of test kits, which are hindered by service delivery weaknesses [8,9]. The advent of dual HIV and syphilis RDTs has been shown to be cost-effective compared with separate HIV and syphilis tests and offers to close the gap between

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https://doi.org/10.1016/j.ijid.2025.107993

HIV and syphilis testing coverage [9–12]. In addition, to improve antenatal screening coverage for syphilis, a study in sub-Saharan Africa confirmed that dual HIV/syphilis RDTs can be effectively incorporated into antenatal testing algorithms to enhance efforts towards elimination of mother-to-child transmission of these infections [13]. In Uganda, advances have been made towards elimination of vertical HIV transmission with routine ANC1 testing data indicating >95% of pregnant women were tested for HIV, but only 43% for syphilis in 2017 [14,15]. Serosurveillance between June and September 2015 among 2500 mothers at delivery and their newborns from the postnatal ward of Mbarara Regional Hospital, found active syphilis, with a *Treponema pallidum* agglutination assay (TPHA, detecting treponemal infection exposure) test and a rapid plasma reagin (RPR, detecting active syphilis, with greater than 1:8 titer) test, prevalence at 4.1% with newborn RPR prevalence estimated at 3.8% [16]. The Uganda Ministry of Health (MOH) released the *Consolidated Guidelines for the Prevention and Treatment of HIV and AIDS* in September 2018, which recommended using the WHO pre-qualified SD-Bioline HIV/Syphilis Duo (Abbott Diagnostics Korea Incorporated) as the combined test for HIV and syphilis (treponemal) antibodies in antenatal clinics [17,18]. The dual HIV/syphilis RDTs were rolled out nationwide in all MOH antenatal department health centers between September 2018 and January 2019.

Although past research has examined syphilis RDT implementation in Uganda [19], this study aimed to examine the impact of the dual HIV/syphilis RDT implementation on testing, treatment, and adequate treatment coverage (care cascade) in real life and modeled its effect on rates of CS and syphilis-related ABOs.

Methods

Study settings

To compare pre- and post-RDT introduction testing and adequate treatment coverage, we conducted a retrospective observational health center-based review of ANC registers from different levels of health centers in Kalungu and Masaka districts in Central Uganda. Kalungu is a rural agricultural district, whereas Masaka borders Lake Victoria, which is made up of fishing and roadside communities. Within each district, we stratified antenatal services by service level (Supplementary Figure 1). The study aimed to sample two antenatal services from the eligible health centers at the parish (level II), sub-district (level III), and district (level IV) levels in each district (S1/Supplementary Methods).

To be eligible for inclusion, antenatal clinics needed an attendance record for both study periods (see below) of at least 100 new ANC1 registrations over a 12-month period or an average of 10 new registrations per month over 18 months. In total, 11 health centers were included in the analysis: six in Masaka and five in Kalungu, where only one level IV was eligible for inclusion (S1/Supplementary Methods).

Study procedures

The introduction of dual HIV/syphilis RDT in Central Uganda started in September 2018 through January 2019. Antenatal attendance records were reviewed for all clinics for the 9-month period before the introduction of the dual test (period 1: January-October 2018) and the 9-month period post-test introduction (period 2: January-October 2019), separated by a 3-month buffer period (no data collection) allowing for adoption of the new test (Supplementary Figure 2). Prior to test introduction, Uganda MOH guidelines recommended syphilis screening either with the use of a TPHA test or RPR (though without titration) test depending on service level [20].

At each health center, data were extracted from the Uganda Health Management Information System attendance records stored in physical register books, and included antenatal attendance numbers, documented syphilis testing, positivity, and treatment received. Attendees' inclusion criteria for analysis were limited to ANC1 attendances with a visit date documented within period 1 or 2, with records missing visit dates dropped for analysis.

Data was collected by trained researchers into tablets that were linked to a protected server, retrospectively from September to November 2019 at all eligible health center antenatal departments. Extracted register data included ANC registration number, visit number, testing for syphilis at visit, documented test results, and, if positive, any corresponding treatment. Data were anonymized by study numbers instead of patients' names and combined with the antenatal department number as a unique identifier.

Data were entered onto password-protected Android tablets using Open Data Kit (San Diego, California) data collection instrument, with daily quality assurance cross-checks conducted on 5% of the data collected.

An audit of each health center was conducted at the end of period 2 to measure availability of the dual HIV/syphilis test, RPR test, and BPG stock. We defined "adequate in-stock" for the dual test and RPR as enough for 20 patients in 1 month and BPG as the quantity to treat 10 patients per month according to the 2016 Uganda MOH treatment guidelines [21].

Syphilis testing and treatment cascade analysis

The primary study outcomes were estimation of the change in testing coverage, test positivity, treatment coverage, and adequate treatment coverage, i.e. the discrete indicators used by the WHO to measure the progress of syphilis elimination and collectively known as the syphilis care cascade, during ANC1 visits between the two study periods [2,4]. Testing coverage for maternal syphilis was defined as the proportion of attendees who received syphilis testing, and test positivity was the proportion of tested women who were given a positive result. Treatment coverage was the proportion of positive cases receiving at least one dose of BPG, whereas adequate treatment coverage was determined by the product of testing coverage and treatment coverage.

Statistical methods

We calculated rates of testing coverage, test positivity, treatment coverage, and adequate treatment coverage between study periods, stratified by district and health center level. Rate ratios were generated for testing coverage, test positivity, and treatment coverage, whereas absolute rate differences were used for the analysis of adequate treatment coverage. To compare study periods, we used chi-square tests or Fisher's exact test (when the expected frequencies were lower than 5) to test the null hypothesis of no change in coverage.

Testing coverage, test positivity, treatment coverage, and adequate treatment coverage were all expressed per 100 and presented as percentages (%) or as rates with 95% confidence intervals based on the Wilson score interval.

Sample size calculation required obtaining data from 2000 ANC1 registrations in each of period 1 and 2 to detect a minimum 1.4-fold (80% power) to 1.5-fold (90% power) increase in adequate treatment coverage between period 1 and period 2, assuming a baseline coverage of 50%.

Estimating the impact on CS and syphilis-related ABO

From collected data on testing coverage, test positivity, and treatment coverage, the number of CS and ABO cases over each

Table 1
Results of first antenatal care visit testing, positivity, treatment, cure, CS and syphilis-related ABO results and rates from period 1 (9 months pre-introduction of dual HIV/syphilis rapid diagnostic test) compared with period 2 (9 months post-introduction) overall in two districts of Central Uganda.

		Total (Health Centers = 11)					
		Period 1		Period 2		Period 2 / Period 1	
Indicator		n	Rate %[a] (95% CI)	n	Rate %[a] (95% CI)	Rate ratio (95% CI)	*P*-value
Testing	Tested (1)	1307	49.14	2816	84.03	1.71	<0.001
	Attendees (2)	2660	(47.24-51.04)	3351	(82.76-85.24)	(1.64-1.78)	
Positivity	Positive (1)	55	4.21	113	4.10	0.95	0.833
	Tested (2)	1307	(3.25-5.44)	2816	(3.35-4.80)	(0.70-1.31)	
Treatment	Treated (1)	34	61.82	83	73.45	1.19	0.174
	Positive (2)	55	(48.61-73.48)	113	(64.64-80.72)	(0.94-1.50)	
Adequate treatment[b]			30.37		61.72	31.35	<0.001
			(22.96-37.50)		(53.49-68.81)	(20.46-41.60)	
Estimated CS[c]	CS cases	59	2109.40	44	1248.58	0.59	0.010
	Births	2797	(1638.87-2711.31)	3524	(931.42-1671.92)	(0.40-0.87)	
Estimated ABO[c]	ABO cases	31	1108·33	24	681.04	0.61	0.093
	Births	2797	(781.91-1568.87)	3524	(458.09-1011.41)	(0.36-1.04)	

ABO, adverse birth outcome; CI, confidence interval; CS, congenital syphilis.
[a] Rate calculated as: numerator row value (1) divided by denominator row value (2) for the corresponding indicator, rate per 100
[b] Adequate treatment calculated as: product of testing rate x treatment rate; absolute rate difference shown rather than a rate ratio
[c] Rate calculated as: numerator row value (n) divided by denominator row value (N) for the corresponding indicator, rate per 100,000.

study period was calculated using the WHO Congenital Syphilis Estimation Tool (S1/Supplementary Methods) [22–24].

To estimate the number of CS and syphilis-related ABOs cases averted after the test introduction in Uganda nationally, we used the observed 9-month care cascade data applied to the respective annual 2018 (taken as population pre-intervention) and 2019 (post-intervention) live births numbers for Uganda (as reported from the United Nations Population Division) to calculate the total number of CS and syphilis-related ABOs cases in each period [24,25].

Ethics

Ethical approval was obtained from the Institutional Review Board of the Uganda Virus Research Institute (UVRI) (Number: GC/127/19/06/725) and the Uganda National Council for Science and Technology (UNCST) (Number: HS2620), with regulatory permission obtained from District Health Officers.

Results

Of the 6011 eligible total ANC1 attendee records in both districts, 2660 were obtained from period 1 and 3351 from period 2; a further 1396 records straddling both periods were not eligible for study inclusion due to missing antenatal visit dates and were excluded from analysis. Records missing antenatal visit dates were mostly from health center level III (1383, 99.1%), with levels II and IV contributing seven (0.5%) and six (0.4%), respectively.

Syphilis cascade indicators

Table 1 presents the syphilis cascade indicators overall for the two study periods, Table 2 presents the indicators by health center level, and Supplementary Table 1 presents the indicators by district. Figure 1 shows the change in absolute numbers and rates of testing and treatment by period and by health center level.

Syphilis testing

Syphilis testing coverage showed an overall 1.71-fold increase (95% confidence interval: 1.64-1.78) from 49.1% (47.2-51.0%) pre-test introduction (period 1) to 84.3% (82.8-85.2%) post-test introduction (period 2) (Table 1). Increased testing numbers were observed in all strata, both by district and by health center level in period 2 compared with period 1. By health center level, there was significant increased coverage of 6.99-fold (5.47-8.94) for level II, 2.45-fold (2.17-2.76) for level III, and 1.22-fold (1.19-1.26) for level IV (Table 2). In both districts, testing coverage significantly increased between the two periods (Kalungu: rate ratio = 1.51, 1.42-1.60; Masaka: rate ratio = 1.88, 1.77-1.99) (Supplementary Table 1).

Audits were conducted in all health centers during period 2, except for one level III health center in Masaka. Of the 10 centers visited at the time of the audit, 9/10 had adequate RDT in stock, whereas 5/10 had adequate RPR in stock.

Syphilis test positivity

In period 1, a total of 55 (4.2%) women tested positive (by TPHA or RPR), and in period 2, a total of 113 (4.1%) tested positive by RDT (Table 1). Overall, test positivity decreased slightly between the study periods (rate ratio = 0.95, 0.70-1.31). By health center level, there was a 66% decrease (rate ratio = 0.34, 0.14-0.79) in test positivity in level II, but an over 100% increase for level III (rate ratio = 2.1, 0.66-6.77), whereas in level IV, test positivity remained similar over time (rate ratio = 1.00, 0.69-1.47) (Table 2). Test positivity changed in opposite directions in the districts, with no significant difference by study period (Supplementary Table 1).

Syphilis treatment

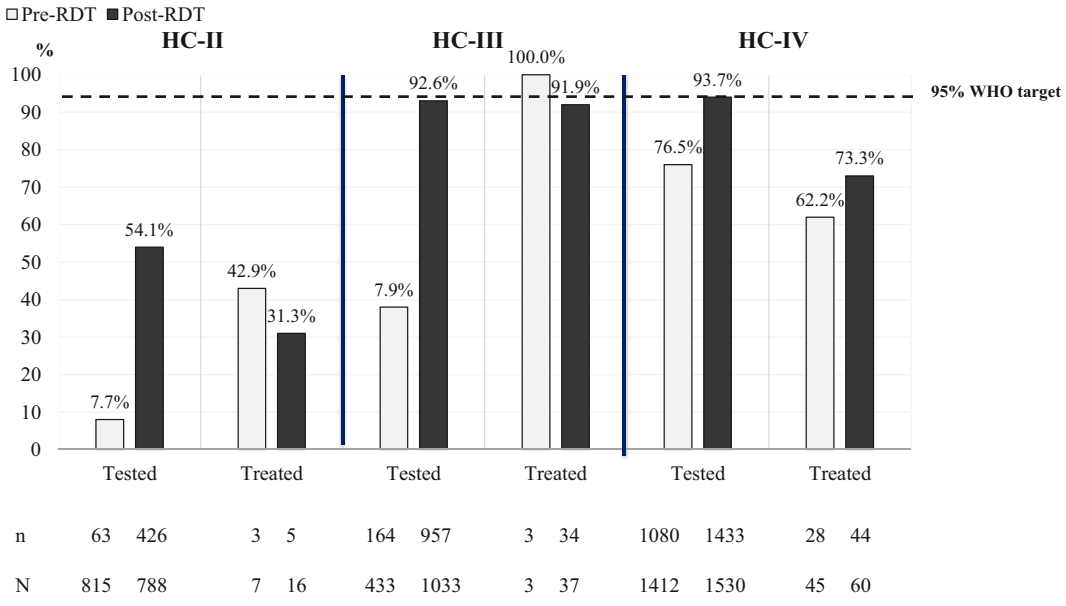
Documented treatment of positive cases increased modestly (overall rate ratio = 1.19, 0.94-1.50) (Table 1), similarly in both districts (Supplementary Table 1). By health center level, non-significant decreases were observed between the periods in treatment coverage in both level II (rate ratio = 0.73, 0.24-2.24) and level III (rate ratio = 0.92, 0.84-1.01), whereas non-significant increases in treatment coverage were observed in level IV (rate ratio = 1.18, 0.90-1.55) (Table 2).

During audit visits, , 4/10 health centers did not have adequate in-stock BPG for the next month, including three in four at level II and one in four at level III.

Syphilis adequate treatment

Overall, the coverage of adequately treated syphilis cases more than doubled from 30.4% (23.0-37.5%) in period 1 to 61.7% (53.5-68.8%) in period 2, an absolute difference of 31.4% (20.5-41.6%, P <0.001) (Table 1), which was similar in both districts (Supplementary Table 1).

The absolute difference in adequate treatment coverage improved at all levels of service delivery: level II (13.6%, 3.1-28.8%, P = 0.011), level III (47.3%, 32.9-71.3%, P <0.001), and level IV (21.1%, 4.3-36.8%, P = 0.014) (Table 2).



Numerators (n) are for the women tested or treated in the relevant column
Denominators (N) for Tested are for the women presenting at ANC visit 1; and for Treated are for the women found positive by the syphilis test

Figure 1. Test and treat cascade indicators for maternal syphilis screening in Central Uganda, by period (pre- and post-RDT introduction) and HC level.
HC, health center; RDT, rapid diagnostic test.

Impact of dual HIV/syphilis test on CS and other syphilis-related ABO

The WHO Congenital Syphilis Estimation Tool indicated an overall 41% reduction (rate ratio = 0.59, 0.40-0.87) in CS cases, from 2109.4 (1638.9-2711.3) in period 1 to 1248.6 (931.4-1671.9) in period 2 (Table 1). Syphilis-related ABO cases showed a 39% reduction (rate ratio = 0.61, 0.36-1.04) in between the study periods, from 1108.3 (781.9-1568.9) in period 1 to 681.0 (458.1-1011.4) (Table 1). The CS rate ratio was significantly reduced for level II (rate ratio = 0.31, 0.19-0.52), but increased non-significantly for level III (rate ratio = 1.47, 0.49-4.43), and decreased non-significantly for level IV (rate ratio = 0.66, 0.36-1.21) (Supplementary Table 2).

Similarly, estimated syphilis-related ABOs decreased significantly only at level II (rate ratio = 0.31, 0.15-0.64) (Supplementary Table 2). There was a differential impact by district: the district with lower pre-test introduction syphilis positivity had the largest decrease in CS rates (Kalungu: seropositivity 3.7%, CS rate ratio = 0.34, 0.16-0.72; Masaka: seropositivity 4.7%, CS rate ratio = 0.74, 0.47-1.16) (Supplementary Table 3).

When findings were extrapolated to national level using birth outcomes in 2018 and 2019, if testing had increased 1.71 times with the test rollout, and treatment had increased 1.19 times, and keeping syphilis test-positivity rates found in Southwest Uganda, it was estimated the intervention could have prevented a total of 13,858 (13,499-14,137) CS cases and 6664 (6196-7131) ABOs cases when comparing 2019 (using period 2 results) to 2018 (using period 1 results) (Supplementary Table 3). This would equate to averting 2157 (1913-2401) infants with clinical CS, 574 (402-746) premature births or low birthweights, 2703 (2401-3005) stillbirths, and 1140 (940-1340) neonatal deaths in 2019 (Supplementary Table 3).

Discussion

This study shows that, following the introduction of dual HIV/syphilis RDT in Central Uganda, syphilis testing coverage increased to 84% (a 71% relative increase) and adequate syphilis treatment coverage to 62% (a doubling rate). These effects were observed in both districts with different background test-positivity rate differences, and at all health center levels, albeit with different magnitude. The positive effect of RDT introduction on testing was the highest (seven-fold increase) where syphilis testing was previously low (i.e., level II health centers). Consequently, the estimated impact for CS and syphilis-related ABOs was potentially large with estimated reductions of 41% and 39%, respectively, thus, potentially paving the way towards elimination of CS in Uganda, if these efforts were sustained and applied nationally.

The study results are consistent with a study of dual HIV/syphilis RDT introduction in China, which similarly compared pre- and post-implementation at ANC1 and observed an increase in testing from 76-90% post-test [26]. Although primary outcomes evaluated testing rates before and after the test, we noticed a more modest increase in treatment rates, which has been shown in other low-resource settings [27]. As reported by Althabe *et al.* [28] in the Democratic Republic of Congo and Zambia, interventions targeting both testing and treatment may face challenges improving treatment rates even when testing improves. In our study, treatment improvements were limited potentially by BPG stockouts, particularly at level II centers, and possibly by insufficient recording. Testing without ensuring treatment capacity fundamentally limits a screening program's effectiveness. At the time of our health center audit, Uganda MOH 2016 recommendations were that BPG be available in levels II to IV health centers, although injectable drugs are not generally administered at peripheral antenatal clinics without a clinician available [21]. The findings underscore the importance of not only ensuring provision of supplies but also providing adequate training and supervision to frontline health workers operating ANC services. They confirm that improved syphilis screening is only useful for reducing CS and ABOs if patients testing positive (and their partners) are then treated [29].

Although a number of studies have reported a strong positive impact of the introduction of treponemal test on testing and treat-

Table 2
Results of first antenatal care visit testing, positivity, treatment, cure results and rates from period 1 (9 months pre-introduction of dual HIV/syphilis rapid diagnostic test) compared with period 2 (9 months post-introduction) by health center level.

		II (Health centers = 4)					III (Health centers = 4)					IV (Health centers = 3)				
		Period 1		Period 2		Period 2 / Period 1	Period 1		Period 2		Period 2 / Period 1	Period 1		Period 2		Period 2 / Period 1
		n	Rate %[a] (95% CI)	n	Rate %[a] (95% CI)	Rate ratio (95% CI) *P*-value	n	Rate %[a] (95% CI)	n	Rate %[a] (95% CI)	Rate ratio (95% CI) *P*-value	n	Rate %[a] (95% CI)	n	Rate %[a] (95% CI)	Rate ratio (95% CI) *P*-value
Indicator																
Testing	Tested (1)	63	7.73	426	54.06	6.99 <0.001	164	37.88	957	92.64	2.45 <0.001	1080	76.49	1433	93.66	1.22 <0.001
	Attendees (2)	815	(6.09-9.77)	788	(50.57-57.51)	(5.47-8.94)	433	(33.43-42.53)	1033	(90.89-94.08)	(2.17-2.76)	1412	(74.21-78.63)	1530	(92.33-94.78)	(1.19-1.26)
Positivity	Positive (1)	7	11.11	16	3.76	0.34 0.019	3	1.83	37	3.87	2.1 0.284	45	4.17	60	4.19	1.00 1.000
	Tested (2)	63	(5.49-21.20)	426	(2.32-6.01)	(0.14-0.79)	164	(0.62-5.24)	957	(2.82-5.28)	(0.66-6.77)	1080	(3.13-5.53)	1433	(3.27-5.35)	(0.69-1.47)
Treatment	Treated (1)	3	42.86	5	31.25	0.73 0.657	3	100.00	34	91.89	0.92 1.000	28	62.22	44	73.33	1.18 0.317
	Positive (2)	7	(15.82-74.95)	16	(14.16-55.60)	(0.24-2.24)	3	(43.85-100.00)	37	(78.70-97.20)	(0.84-1.01)	45	(47.63-74.89)	60	(60.99-82.87)	(0.90-1.55)
Adequate treatment[b]			3.31		16.89	13.58 0.011		37.88		85.13	47.26 <0.001		47.59		68.68	21.09 0.014
			(0.96-7.32)		(7.16-31.97)	(3.06-28.84)		(14.66-42.53)		(71.53-91.45)	(32.88-71.32)		(35.34-58.88)		(56.31-78.54)	(4.34-36.81)

CI, confidence interval.
[a] Rate calculated as: numerator row value (1) divided by denominator row value (2) for the corresponding indicator, rate per 100
[b] Adequate treatment calculated as: product of testing rate x treatment rate; absolute rate difference shown rather than a rate ratio.

ment rates, few have directly measured impact on CS and other related birth outcomes, most being modeling studies [27]. Similarly, our use of the WHO Congenital Syphilis Estimation Tool shows that the test intervention could significantly reduce the number of CS cases to help meet the WHO elimination target of less than 50 CS cases per 100,000 live births. The model indicated an estimated 41% decrease in CS cases in period 2 to a rate of 1248.6 (931.4-1671.9) per 100,000 live births, which is comparable to the, yet unacceptably high, average in the WHO African region (estimate of 1119 per 100,000 live births in 2016) [23]. These findings indicate that, while Uganda is falling short of meeting elimination targets, proper dual HIV/syphilis RDT implementation with increased treatment rate could make a large impact in reducing CS cases nationally. To maximize the benefits of improved testing, treatment rates must be enhanced by addressing drug supply chain challenges, particularly BPG shortages, strengthening provider training on syphilis treatment protocols, and clarifying prescribing authority at different levels of the health care system to ensure providers can initiate treatment upon positive results.

This study had a number of limitations. First, although our sampling tried to be representative with two centers in each stratum, one district (Kalungu) only had one level IV health center for sampling, possibly skewing some of the comparisons. Furthermore, the exclusion of nearly 19% of records because of incomplete information may have affected our results, which is unfortunately a frequent situation when using real-world data. Study periods were also limited to the 9 months before and after test introduction and may not be indicative of the rate changes that could be sustained or improved with time. Similarly, there was no study control group to determine if any temporal variables had impacted between period 1 and 2 results, nor were confounding variables such as HIV status or gestational age being measured. Second, the use of different tests between periods makes direct comparisons of test positivity between the periods difficult to interpret, as the tests have different characteristics and detect syphilis at different stages of infection. Real prevalence of syphilis could not be determined in this study because we did not directly collect and test samples from pregnant women, and we relied on clinic results being "correct," in the absence of a national quality assurance program. Third, we were unable to link pregnant women's data in the ANC registers to their entries with Delivery Ward register's birth data to document their linked pregnancy outcomes and thus could not directly measure the incidence of CS and syphilis-related ABOs. Instead, we used the WHO Congenital Syphilis Estimation Tool, which may over- or under-estimate true incidence depending on underlying assumptions (e.g., about testing accuracy) [4]. Although this validated tool provides standardized estimates, future studies with linked mother-infant outcomes would provide stronger evidence of real-world effectiveness. Furthermore, as our study was conducted as a two-district health center pilot with the typical structure of Uganda's health system (levels II-IV), extending to estimate the impact nationally may also have resulted in overestimates of the test's impact given the higher rates of syphilis in Central Uganda compared with national surveys [14]. Fourth, although the participating 11 health centers ensured representation in the study sample from all of level II, III, and IV of the health care system, calculations of the testing and treatment rate ratios were not weighted to reflect the relative frequencies of births taking place at each level in the country. Only a minority of births take place at higher-level facilities, and the study may therefore have oversampled ANC attendees at higher health center levels, thereby potentially underestimating the true impact of the test introduction in the country because the testing rate ratio was less pronounced in health centers level III and IV.

The study's main strength is its empirical analysis of real-world data in a representative sample of government health centers in

Uganda, with a relatively large sample size allowing an accurate assessment of the impact of the dual HIV/syphilis RDT rollout on the syphilis cascade, combined with the use of the recommended WHO Congenital Syphilis Estimation Tool to estimate impact on CS and ABOs [4].

In conclusion, the dual HIV/syphilis RDT introduction in Central Uganda significantly increased syphilis testing and adequate treatment rates, contributing to an estimated considerable decrease in CS and ABOs rates within a short period. Since our study, the tests are part of the standard of care, with continued funding for the supply by the MOH. This supply may be supported by the fact that in 2021, the Clinton Health Access Initiative, along with other partners, provided support for access to dual HIV/syphilis RDT at US $0.95 in low- and middle-income countries [30]. Programmatic best practice suggests that periodic diagnostic availability and service provision assessments should be conducted to monitor a diagnostic test intervention effectiveness at multiple time points [31,32]. We encourage future research to indeed monitor the ongoing testing, positivity, and treatment rates in Central Uganda using our data as a baseline to evaluate the intervention over time. The importance of these findings is encouraging for tracking the progress of CS elimination targets in Uganda.

Funding

Funding was supplied by Medical Research Council (MRC) United Kingdom, United Kingdom HIV Epidemiology and Interventions Programme, 2016-2023 (grant number MC_UU_000_27/3), and the London School of Hygiene & Tropical Medicine Students' Fund. The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Ethics approval

Uganda Virus Research Institute (UVRI) REC Approval Number: GC/127/19/06/725 and Uganda National Council for Science and Technology (UNCST) No. HS2620 on July 15, 2019.

Authors contributions

Conception and design: UB, LH, CHH, PM; Execution: LH; Analysis: PO; Interpretation of findings and reporting: UB, LH, AA, PM; All authors have read and agreed to the publication of this manuscript.

Declaration of competing interest

The authors have no competing interests or disclosures.

Acknowledgments

Study authors would like to acknowledge the efforts of Dr. Billy Mayanja (field supervisor), the MRC/UVRI & LSHTM in Uganda Unit field workers, Mr. Allan Buyinza and Ms. Damalie Keirembo; and heads and staff of health centers, and District MOH staff for their support.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijid.2025.107993.

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