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Barriers and facilitators to HIV and syphilis rapid diagnostic testing in antenatal care settings in low-income and middle-income countries: a systematic review

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ABSTRACT

Background Testing and treatment during pregnancy is a well-established and cost-effective prevention strategy, which relies largely on use of rapid diagnostic tests (RDTs). Yet, in many low-income and-middle-income countries, the uptake of RDTs is suboptimal. A qualitative meta-synthesis was conducted to identify the barriers and enablers to use of HIV and syphilis RDTs among pregnant women in low-income and middle-income countries.

Methods This review was conducted using PRISMA guidelines. Eligible studies included peer-reviewed publications, which used qualitative methods to explore HIV and syphilis RDT in antenatal care clinics in low-income and middle-income countries. Studies focusing on perspectives of pregnant women, healthcare workers and/or stakeholders were included. We used an inductive approach informed by a modified socioecological model to synthesise the data.

Results 62 manuscripts met the eligibility criteria. For pregnant women, initial acceptance of the RDT and continuation in antenatal care depends on the perception that engaging in testing will be a beneficial experience for their baby and themselves, often influenced by the provision of services that are gender-sensitive, confidential, respectful, flexible and considers their well-being into the future. Local sociocultural beliefs about pregnancy and diseases, awareness of diseases and gender roles in society also influenced RDT acceptability among pregnant women. For healthcare workers, the ability to provide high-quality RDT care required ongoing training, accurate and easy to use tests, support from supervisors and communities, sufficient resources and staffing to provide services, and reliable salary. At the stakeholder level, well-developed guidelines and health system infrastructures were imperative to the delivery of RDT in antenatal clinics.

Conclusion Our findings highlight clear gaps to the provision of sustainable and culturally acceptable maternal HIV and/or syphilis screening using RDTs. In addition, greater attention needs to be paid to community stakeholders in promoting the uptake of RDT in antenatal clinics.

PROSPERO registration number CRD42018112190.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ There exist international and national guidelines and targets for the prevention and elimination of mother to child transmission of HIV and syphilis.

⇒ Rapid diagnostic testing during pregnancy has been shown to be an effective strategy for identification of cases, but little is understood about the acceptability of, and barriers and enablers to, rapid diagnostic HIV/syphilis testing in antenatal care settings.

WHAT THIS STUDY ADDS

⇒ Informed by a modified socioecological model, this paper describes patient, provider and stakeholder perspectives relevant to implementation of rapid diagnostic HIV/syphilis testing across four levels of influence: intrapersonal, interpersonal, organisational and contextual.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This systematic review identifies the barriers and enablers to programme implementation (provider level) and uptake (patient level), which can inform national policies and agenda setting for achieving national and global targets for preventing and elimination mother to child transmission of HIV and syphilis.

INTRODUCTION

Mother-to-child transmission of HIV and syphilis contribute significantly to the global burden of perinatal morbidity and mortality, especially in low-income and middle-income countries (LMICs).[1] Untreated HIV in pregnancy will lead to mother-to-child transmission in 25% of babies, and for syphilis nearly half, which in turn lead to adverse neonatal outcomes, such as stillbirth, neonatal death, preterm birth, major malformation and even death.[2–4] The WHO and other global health

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organisations have recognised elimination of mother-to-child transmission of HIV and syphilis (EMTCT) as a public health priority.[5] In 2016, WHO pledged to work together with its member states to achieve the goal of zero new HIV infections in infants and the elimination of congenital syphilis as a public threat by 2030.[6 7] In 2022, a number of countries, including Cuba, Thailand, Belarus and Malaysia, have achieved validation of EMTCT of HIV and syphilis.[8 9] Despite the success of EMTCT in these countries, progress has been slow in other regions, particularly for the African Region where the highest burden of the two infections persists. For example, the coverage of prevention of mother-to-child transmission (PMTCT) of the HIV programme in the Middle East and North Africa was only 41% in 2020 compared with the 87% global average.[10]

Testing is the main approach for prevention of HIV and syphilis mother-to-child transmission. One of the key factors which has enabled programmes to scale up HIV and syphilis testing coverage is significant advances in rapid diagnostic tests (RDTs) for the detection of antibodies. These tests are accurate, cheap and easy to use, and can be performed to a high degree of accuracy by health service staff with minimal training.[11] A particular benefit of RDTs in LMICs is that they can provide test results at the point-of-care or near point-of-care, enabling prompt and effective treatment.[11 12] However, when introducing a new RDT test into a healthcare facility, comprehensive strategies are usually needed to integrate new diagnostic tools into routine practice and maximise uptake by healthcare providers (implementors) and patients (end users).[13] Although HIV and syphilis RDTs have been recommended for use globally, critical barriers to implementation and uptake remain.[14 15] Gaining knowledge on which factors affect the implementation and uptake of RDT is important. There is a need to answer the questions of why the use of RDT for antenatal care is accepted (or not) by pregnant women in different contexts; why implementers are willing (or not) to initiate RDT for antenatal care and how could stakeholders better support RDT for antenatal care scale-up.[16] It is therefore important to identify the barriers and facilitators to implementataionation of HIV and syphilis RDT during antenatal care across these perspectives to inform strategies for the scale up of HIV and syphilis RDT in LMICs.

Previously published reviews have shown adequate diagnostic accuracy of HIV/syphilis RDTs, and that use of such technology is feasible within antenatal settings, particularly in LMICs.[17–22] However, an accurate and RDT could be integrated into service delivery, but factors that influence diagnostic test use might prevent pregnant women from accessing the testing service.

Qualitative research allows for reflecting the interplay between factors at multiple levels, such as those which influence HIV/syphilis RDT implementation in individual, interpersonal, organisational and contextual levels.[23] By using findings from qualitative studies, we can develop context-specific strategies to ensure successful implementation of HIV/syphilis RDT necessary in PMTCT efforts. This study aims to synthesise and appraise the qualitative evaluations of multilevel facilitators and barriers, which influence the implementation of HIV and syphilis RDT during antenatal care from the perspectives of pregnant women, healthcare workers and stakeholders/policy makers. It is anticipated these findings will inform strategies for the scale up of HIV and syphilis RDT in LMICs.

METHOD

Inclusion criteria

This systematic review thematically analysed qualitative research, which was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement[24] (online supplemental table 1). Studies were eligible for inclusion if they reported on data which used qualitative methods for data collection (eg, observation, focus group discussion, in-depth interview or any other narrative data collection methods) and analysis (eg, grounded theory, thematic analysis, content analysis); as well as studies that reported perceptions about, and experiences of, using RDT for HIV or syphilis among pregnant women; and were published in English in a peer-reviewed journal. Studies were included if participants fit within one of three participant groups: patients (ie, pregnant women); healthcare workers (including doctors, nurses, midwives, community counsellors and other healthcare workers responsible for providing healthcare to pregnant women for HIV and syphilis testing) and other stakeholders. For this review, stakeholders were defined as anyone who may influence RDT uptake at a provider–patient or policy level, such as health facility managers, policy makers, community organisations and community members. Mixed-method studies were included if qualitative data was presented in the results sections in line with the focus of this systematic review. We excluded studies that used only quantitative methods or studies that used qualitative methods to collect data but analysed that data using proportion or semiquantified presentation, or did not present analysis of the qualitative data.

Search strategy

The search strategy included Medical Subject Headings (MeSH) and, where necessary, free text headings using a catalogue of terms and variations of these terms which included infectious diseases (ie, HIV and syphilis), testing, qualitative and pregnant women. This search strategy was developed with an experienced librarian at the University of New South Wales, Sydney and discussed with team members. We searched the following six databases: Medline, Web of Science, Embase, Emcare, CINAHL and Global Health. Searches were limited to studies published between January 1998 and March 2021, to reflect the timeline of when RDT technologies were first integrated into WHO guidelines (1998). The full search strategy is available in online supplemental table 2.

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Screening strategy

All publications located during database searches were downloaded into EndNote V.X8 (reference software, Clarivate Analytics, V.7.8, 2018). The process of selecting an eligible record included three stages. In the first stage, duplicate titles were removed and the abstracts were independently assessed against the eligibility criteria by two reviewers (YZ and HC). Kappa analysis revealed almost perfect agreement (kappa score=0.85).[25] Publications were excluded in this early stage if the study did not meet one or more of the inclusion criteria. In the second stage, full texts of all remaining papers were screened by two reviewers independently. Finally, any discrepancies from the full-text screening were resolved by the adjudication of group discussion among team members. Where needed, the authors have contacted the study authors or searched the relevant national guidelines for clarification.

Data extraction, analysis and management

Two types of data were extracted: (1) primary data sources (direct quotes from participants as presented within publications) and (2) secondary data source (interpretation of data by publication authors mainly from the results sections). For each study that met the inclusion criteria, we extracted information related to study characteristics using an excel spreadsheet, including lead author's name, year of publication, country of study, study setting (urban/rural, type of healthcare facility), participant group (pregnant women, healthcare worker and stakeholders), research collection methods, theoretical framework and findings. We undertook data extraction and analysis simultaneously for each study, starting with the earliest study. To code the primary and secondary data, YZ read the publication line by line and coded the relevant text from the study findings. Sections of coding were checked by an experienced qualitative researcher (LL) to ensure consistency in coding. Then, codes were organised and inductively analysed into related descriptive themes; the analytical themes were generated to answer the review questions.[26] The thematic synthesis approach, a commonly used qualitative method in the health field,[27] was used to analyse and synthesise the included articles. The developed thematic themes were found to be well fitted with the four levels of the modified socialecological model (SEM): interpersonal, intrapersonal, organisational and contextual.[28] Contextual covers both the cultural norms relevant to the descripted topic and other broader issues of the funding and governance environments in which antenatal clinics (ANCs) operate. The SEM lens presents the health construct broadly and considers that health behaviour is affected by interactions across the multiple levels.[29]

The quality of each included study was assessed using the Critical Appraisal Skills Programme quality assessment tool for qualitative studies,[30] a tool which has been extensively used in previous qualitative systematic reviews.[31 32] Two reviewers (YZ and HC) appraised the quality of each included study; appraisal results were discussed with a third author (LL) to reach consensus. In addition, the confidence in review findings was assessed using the Evidence from Reviews of Qualitative Research (CERQual) approach.[33] The CERQual approach provides a mechanism for evaluating qualitative synthesis through a process of examining relevance, coherence and adequacy of each finding.[33]

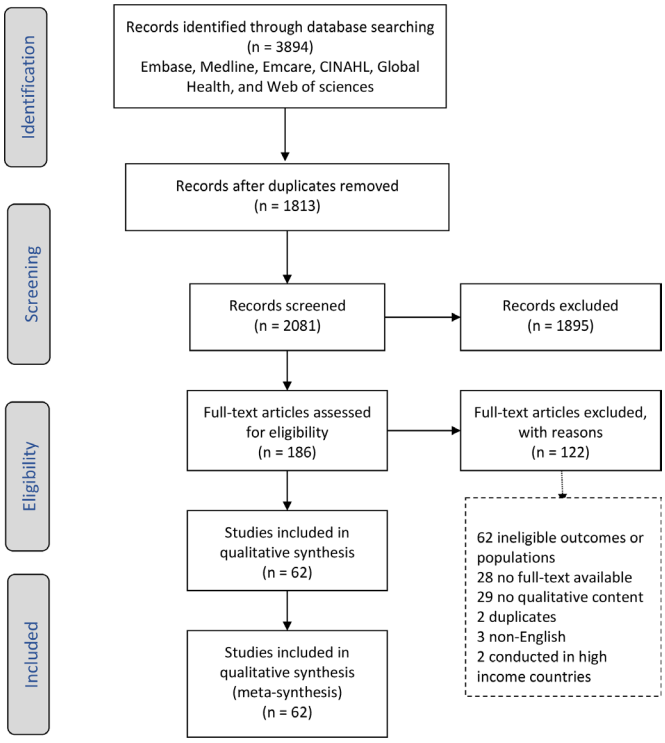

Figure 1 Study flow diagram.

RESULTS

Included studies

The initial search yielded 3894 results, of which 62 studies were included within this systematic review (figure 1). In this initial screening, we aimed to include all studies on HIV and syphilis RDTs at ANCs, regardless of the economic status of the country. However, only two studies from high-income countries (HICs) were found that met the review eligibility criteria. The potential factors that influence the implementation of HIV/syphilis RDT services during pregnancy may be highly different in HICs and LMICs. To ensure the findings are meaningful and transferable to similar context, we refined our focus to include only studies from LMICs in this synthesis. The characteristics of included studies are presented in table 1 and online supplemental table 3. Included studies were published between January 2007 and March 2021. The majority of studies (53 of 62) were conducted in Africa. Out of the 62 included studies, 18 utilised a mixed-methods approach, incorporating both qualitative and quantitative methods. In total, 47 studies included qualitative data from pregnant women, 40 from healthcare workers and 23 from other stakeholders. In terms of

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Table 1 Study characters

	Study characters (N=62)
Region	
Africa	53
Asia & Pacific	7
Europe	1
America	1
Year of study publication	1998–2021
Study method	
In-depth Interview	33
Focus group discussion	7
Mixed method	18
Service delivery level [1]	
Community	8
Clinic	32
Hospital	32
Number of target diseases	
HIV	54
Syphilis	4
Both	4
Target participants*	
Pregnant women	51
Health providers	40
Stakeholders	23

Stakeholder: including were defined as anyone who may influence rapid testing uptake, such as, health facility managers, local or international collaborator and policy makers.
*Aggregate data are presented.

'other stakeholders', we found 7 studies explored governmental stakeholder perspectives, involving policy makers, district managers and hospital managers; 13 reported on program-related stakeholders; 4 included local community organisations or community members. The majority of studies (54, 87%) explored perceptions or experiences of using HIV RDTs, four studies (6%) focused on syphilis RDTs and four studies explored both (6%).

In alignment with the modified SEM, our summary of findings are presented across the different levels of influence: intrapersonal, interpersonal, organisational and contextual (table 2).[28] Table 3 summarises the review findings and the confidence rating for each finding, with the summary of quality assessments described in table 4.

Intrapersonal factors

Many studies identified individual-level factors that influenced pregnant women's acceptability of using HIV/syphilis RDTs. Three subdomains arose from the findings of this review including: information; fears, beliefs, motivation and experience; and characteristics of individuals.

Information

Multiple studies identified information was an important factor to uptake and deliver HIV/syphilis RDT at ANCs.[34–46] Providing adequate information about natural history of infection and testing can be used for empowering pregnant women in the testing decision process.[36–43] Compared with their knowledge of HIV and its testing, pregnant women tended to be less informed of the potential for neonatal complications resulting from untreated syphilis.[36] In addition, several papers highlighted the need for initiating testing services and introducing knowledge of diseases prior to pregnancy, for example, early enough to ensure the information could usefully inform decision-making.[41 45 47 48] For example, women from Botswana reported: 'ANCs are the only place for obtaining information about the benefit of HIV and syphilis testing from health professionals'. A study from Uganda called for wider dissemination of public health information and testing services to foster HIV/syphilis RDT use throughout a women's life course, and not just during pregnancy.[34]

Most healthcare workers knew how to perform HIV testing but remained unclear on the testing policy (eg, universal testing/testing frequency required). Interviews with healthcare workers revealed a disconnection between the guideline recommendations and its interpretation. For example, healthcare workers from Indonesia thought their local 'policy recommended HIV testing to pregnant women at risk, such as pregnant women with tattoo or whose husband work as driver'.[49]

Fear, beliefs, motivation and experience

Fear was noted as a critical barrier to initial acceptance of HIV/syphilis RDT at ANCs or not returning to the ANC for testing at all.[35 36 41–43 49–61] This anxiety predominantly manifested as fear of a positive result. Pregnant women were worried that a positive HIV result would grossly impact on their health, including imminent mortality,[58 59] as well as concerns of stigma and social discrimination, or abandonment by their male partners if a positive HIV or syphilis result was returned.[35 41–43 49–57] Pregnant women also mentioned shame regarding having a syphilis test, and a positive result was often seen as an indicator of promiscuity.[41 54] In rural areas where there is often less anonymity, an HIV/syphilis test in the ANC could potentially create feelings of shame and embarrassment if the pregnant women is concerned others will know she has accessed testing. The belief that HIV testing provided an opportunity to secure their baby's safety motivated some pregnant women to overcome the social fears of testing.[34 53 57 62 63] As a participant from Malawi explained, 'I didn't have fear to test because I wanted to protect my baby'.[48] Beliefs regarding the risk of illness from a disease were also important. Syphilis was often perceived by pregnant women as a less significant disease (compared with HIV) with minimal negative outcomes on women and their babies' health.[36]

In terms of healthcare workers, the findings evidenced they preferred not to use syphilis RDTs as they were unaware of the possibility of syphilis infection. For example, a study in Burkina Faso showed that healthcare workers tended to have limited awareness of the high

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Table 2 Individual, interpersonal, organisational, contextual levels of barriers, facilitators and recommendations to implementation

Socioecological model	Themes	Barriers	Facilitators	Recommendations
Contextual	Sociocultural norms	▶ Misleading by traditional beliefs ▶ Gender inequality		Incorporate gender-sensitive interventions to promote couples testing—examples include targeting men through community members, male peers and male-friendly ANCs
	Policy factors	▶ Programme target are baby-centred and mandatory ▶ Lack of screening and management guidelines ▶ Limited programme coverage (eg, lack of involvement of private health facilities)	High political will	To deliver person-centred care to enhance women's right across HIV/syphilis RDT services for pregnant women.
Organisational	Resources	▶ Understaffing ▶ Absence of clinic supplies, including RDTs ▶ Inadequate financial support (eg, salary)	▶ Job security ▶ Adequate financial support	▶ Provision of a full two-way feedback loop and creation of a culture of openness among stakeholders ▶ Strengthen monitoring and supervision ▶ Sufficient transport infrastructure ▶ Clear procurement systems ▶ Accurate budgets ▶ Adequate training on stock and supply management
	Training	Inadequate comprehensive training in HIV/syphilis RDTs	Having access to routine training	Providing informative training sessions which are interactive, flexible, comprehensive and incorporate previous experience of other colleagues
Intrapersonal	Influence of health provider's attitude	Lack of respect toward pregnant women (eg, neglected, threatened)	Good interaction and communication between healthcare workers and pregnant women	
	Support	Lack of support from partner, family and friends	▶ Receiving support from partner, family, peers, healthcare workers, and communities ▶ Peer support from other healthcare workers ▶ Effective supervision and mentoring from practice managers	
Interpersonal	Information	▶ Lack of knowledge about infections and testing ▶ Lack of information about HIV/syphilis epidemiology and testing policy	High awareness about infections and testing	▶ Initiating testing services and introducing knowledge of diseases prior to pregnancy ▶ Providing information and testing for women before pregnancy
	Fear, beliefs motivation, and experience	▶ Fear and shame regarding having a positive result; ▶ Low risk perception of infections; ▶ Low level of trust on RDTs ▶ Lack of confidence of performing test	▶ Belief that RDTs could deliver a better service and provide- effective testing ▶ Recognise the benefit of RDTS as easy to use, accurate, convenient and time saving tool	▶ Comprehensive training in HIV/syphilis RDTs ▶ Competence of implementing RDTs increases with use
	Characteristics of pregnant women	▶ Financial hardship (eg, refugees, unemployed) ▶ Young age mothers who faced with social discrimination of pregnancy at their age		Psychosocial support and peer support to encourage pregnant women to attned ANCs and access HIV/syphilis testing

ANCs, antenatal clinics; RDTs, rapid diagnostic tests.

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Table 3 Summary of quality and confidence of included studies

Review finding		Relevant paper	Confidence in the evidence	Explanation of confidence in the evidence assessment
Intrapersonal factor				
Information	Lack of information about syphilis or, other STIs before testing, lack of information about STIs epidemiology	34–46	High confidence	Very likely to be a factor in a variety of settings
Fear, belief, motivation and experience	Fear and shame: fear of a positive result; shame of having a test	35 41–43 50–61	Moderate confidence	'Fear of positive result' is a strong factor. A bit of concerns about the adequacy of data on the subtheme of 'shame of taking the test'.
	Belief and motivation: HIV/syphilis test is good for the baby; syphilis and other STI were minimally significant compared with HIV	34 53 57 62 63	Moderate confidence	A bit of concerns about the adequacy of data
	Experience help to relief the anxiety of performing test	54 57 64–67		
Characterstics of the patient	Financial statue: the direct and indirect cost of service acted as a barrier for pregnant women engagement with maternal HIV/STIs testing services	36 37 41 42 51 57 64 67 69–72	Moderate confidence	High conference data. A bit of concern about the adequacy of data.
	Age: a low proportion of adolescent and young mothers had fully utilised HIV services	42 59 63	Low confidence	High concerns about the adequacy of data and coherence
Interpersonal factors				
Healthcare worker's attitude	Positive attitude: helpful, kind, open to being asked questions, and being who could be trusted; negative attitude: impatient, uncaring or rude; women felt be neglected, threatened, or exposed to physical or verbal abused; health worker justified their action as compensation for dealing with high patient workload	37 40 42 51 57–59 61 62 69 71–76	High confidence	High coherence and adequacy data. Very likely to be a factor in a variety of settings
Support	Support from friends, familys, and male partners has a significant positive impact on women's decision-making process	35 39 42 44 50 51 56 58 62 65 69 73 78–80 83	Moderate confidence	A bit of concern about the adequacy of data on 'support from friends or family.'
Organisational factors				
Resources	Availability of material resources; availability of human resources; availability of funding	34 36 39 47 53 55 57 63 65–67 72 73 78 81–86	Moderate confidence	High coherence and adequacy data. A bit of concern about relevance. Likely to be relevant in African LMICs.
Training and supervision	Informative training session: being interactive, flexible, comprehensive and enriching based on the previous experience; peer trainings or support groups are effective to supplement the regular training session	36 39 41 47 53 57 65–67 78 79 81 82 89	High confidence	A bit of concern about relevance and adequacy data on peer training or support groups
Contextual factors				

Continued

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Table 3 Continued

Review finding		Relevant paper	Confidence in the evidence	Explanation of confidence in the evidence assessment
Sociocultural norms	Traditional generally inhibit testing; gender roles and gender norms of women in society performed as a key factor that influencing women's acceptance of HIV/STI testings	35 36 39 41 46 51 57 63 69 70 75 80 92–96	Moderate confidence	A bit of concern about coherence and relevance.Likely to be relevant in a specific rural area
Policy factors	Biomedical model: Programme targets still focused on the clinical target; Programme coverage need to extend to private health facilities; Importance to have comprehensive and standard guidelines	34 37 48 49 55 62 63 68 71 73 74 78 80–83 95 97 98	Moderate confidence	A bit of concerns about coherence and relevance, particularly for the subtheme of 'programme coverage.'

LMICs, low-incoome and middle-income countries; STIs, sexually transmitted infections.

Table 4 Quality of included studies

Reporting quality criteria		Studies meeting reporting quality criteria	No of studies (%)
Aim	A clear statement of the aims of the research	34–38 40–45 48 50–76 78–82 84 86 88–90 92–98	56 (90)
Methods	Explains reasons for choice of qualitative methods	34–38 40–45 47 48 50–76 78–82 84–86 88–90 92–98	58 (94)
	Research design is appropriate to address the aim of research	34–38 40–45 48 50–55 57–76 78–82 84 85 88 89 92 94–98	53 (85)
	Describe the recruitment strategy	35–38 41 42 44 47 48 51 55–59 63 67 68 70–76 79 82 89 92–97	34 (55)
	Describe the data collection strategy	34 35 37–42 44 47 48 51–53 56–59 62–64 67–74 76 78 79 82 85 88 89 92–98	44 (71)
	Describe the relationship between research and participants	40 42 59 61 71 74 82 84 88 89 92–94 97	14 (22)
	Consider the ethical issues in the study	34–42 44 48 51 53 55 57–59 61 63–72 74 76 78–82 84–86 88–90 92–95 97 98	47 (76)
Results	Provide sufficiently rigorous data analysis	34–42 44 47 48 52 55 57–64 66–82 84–86 88–90 92–96 98	51 (81)
Discussion	Provide a clear statement of finding	34–38 41–44 47 48 51 53–57 59–61 63 65–76 78 81 82 84–86 88 89 92–98	48 (77)
Refelction	Discuss the value of the research	34–38 41–45 47 48 50 51 53–76 78–82 84–86 88–90 92–98	56 (90)

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prevalence of syphilis in the district where they worked.[34] Healthcare workers' motivations of providing quality RDT services not only relies on the 'value' of the diseases, but also depends on whether they believe there are benefits of using RDTs to prevent MTCT.[64–66] Belief in accuracy of test results was another factor inhibiting implementation of RDT by healthcare providers in some settings. For example, healthcare workers in the Solomon Islands were found to hold a low level of trust in the results of RDTs due to their previous experiences with low specificity malaria tests, which had a negative influence on their confidence in the roll-out for syphilis RDTs.[64] Conversely, healthcare workers in Zambia expressed confidence that RDTs could enable better service delivery through providing effective testing, which resulted in a high willingness to take part in roll-out of testing nationally.[66]

Healthcare workers commonly described the benefits of HIV/syphilis RDTs as easy to use, convenient and time saving compared with standard laboratory testing.[54 57 64–67] Some healthcare workers reported their initial anxiety and worries in collecting adequate samples, waiting for test results and interpreting results.[57 64] But the anxiety gradually disappeared after a few attempts as healthcare workers became more familiar with implementation of RDTs.[65] For pregnant women, previous experience of pregnancy helped them learn about HIV/syphilis RDTs making the testing experience less stressful during subsequent pregnancies.[34 68]

Characteristics of pregnant women

Twelve studies reported that the economic status of pregnant women acted as a significant barrier for engagement with HIV/syphilis RDT at ANCs.[36 37 41 42 51 57 64 67 69–72] Testing fees,[36 37 51] ANC service fees,[51 69] transportation costs to and from clinics/hospitals,[37 42 51 57 64 72] informal payments to healthcare providers and other out of pocket costs[70 71] were all reported as reasons affecting uptake of HIV/syphilis RDTs in ANCs. It is difficult for women faced with financial hardship, such as migrants, refugees and those who are underunemployed, to prioritise preventative healthcare and treatment. In addition, three studies[42 59 63] found that younger mothers tend to refuse or drop out of HIV/syphilis RDT testing services to avoid the social discrimination of pregnancy at their age. A study in Uganda emphasised the need for psychosocial support and peer support to encourage this subgroup of pregnant women to access MTCT services. Personal characteristics of health workers and other stakeholders were not available.

Domain 2: interpersonal factors

Interpersonal factors explored the influence of social networks on pregnant women and health workers' acceptability of HIV/syphilis RDTs.

Influence of health providers' attitude

More than a quarter of eligible studies identified that healthcare providers' attitudes were a key factor influencing pregnant women's initial acceptance of HIV/syphilis RDT and continuation in antenatal care.[37 40 42 51 57–59 61 62 69 71–76] Pregnant women were more likely to accept an RDT and attend the health service throughout their pregnancy when they perceived healthcare workers to be helpful, kind, open to being asked questions, and someone who could be trusted.[51 61 62 71 73 76 77] In these situations, pregnant women tended to establish a bond with healthcare workers quickly, which promoted adherence to antenatal care throughout their pregnancy. Five studies indicated a power dynamic at ANCs between pregnant women and healthcare workers. In these studies, pregnant women reported feeling neglected, threatened and/or exposed to physical or verbal abuse by healthcare workers.[40 59 71 73 74]

Support

For pregnant women, support from friends, family and predominantly male partners, was consistently found to be a facilitating factor[35 39 42 44 50 51 56 58 62 65 69 73 78–80] to testing. For example, eight studies highlighted the positive impact that support from male partners had on a woman's willingness to undertake an RDT for HIV/ syphilis.[44 50 51 58 62 69 70 80] These findings are reiterated in the contextual section below (domain 4), occurring most strongly in societies where women were often socially and financially dependent on their male partners. Women also reported they felt encouraged and motivated to have an RDT after hearing about the testing experiences of others and discussing their concerns with other women who have been tested, or with lay counsellors, peer educators and local religious groups.[42 51 60 65]

For healthcare workers, several studies found that peer support of other healthcare workers were a source of support for implementing HIV/syphilis RDTs.[41 47 53 79 81] Practice managers were also found to play a role in providing technical and emotional support for healthcare workers.[57 65 66 81–83] Confidence in healthcare worker competence to perform and interpret the test result correctly is an important facilitative factor as well. Effective supervision and sufficient mentoring from practice managers help to stimulate confidence among healthcare workers.

Domain 3: organisational factor (health worker, stakeholders)

The third domain presents a number of organisational factors that affect RDT service provision, including resources and training.

Resources

Eighteen studies from seven countries in Africa highlighted that availability of resources was a critical factor influencing implementation of HIV/ syphilis RDTs for pregnant women, including material resources, human resources, infrastructure and

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financial resources.[34 36 39 47 53 55 57 63 65 67 72 73 78 81 82 84–86] The absence of clinic supplies was reported as occurring frequently, ranging from lasting several days to 4 months.[39 47 53 57 63 65 78 81 82 84 85] When structural inputs required for testing were absent, pregnant women were only provided counselling and were referred for HIV testing to a later date.[34] Several causes for underresourcing of HIV/syphilis RDT supplies were identified, namely: lack of clear communication channels,[36 67 82 86] poor monitoring and supervision, insufficient transport infrastructure,[85] complex procurement systems,[36 63] inaccurate budgets or delays in disbursement of funding,[57 63 72] withdrawal of specific test kits from the market,[85] and lack of training on stock and supply management.[82]

In addition to inadequate supply of RDTs' equipment, infrastructure and constraints on human resources also impacted the HIV/syphilis RDT delivery at ANCs. Fourteen studies highlighted workforce shortage as a critical challenge to integrating HIV and syphilis RDT in ANC services.[39 47 49 53 55 57 72 78 81–85 87 88] Understaffing in healthcare facilities led to staff burn-out, forcing many ANCs to set up strict restrictions on appointment times, thereby effecting the flexibility and quality of healthcare service delivery in LMICs.[37 47 49 53 57 58 60 72 75 83] As a result, counselling sessions would often be condensed.[57] Together, these challenges imposed on privacy and confidentiality, resulting in additional barriers to HIV/syphilis RDT in many ANCs.[39 46 47 53 63 72 81 85 88]

Lastly, six studies reported there was inadequate funding available for employees' salaries.[43 53 63 64 67 78 82 84 86] Job security, financial support or skill training programmes were perceived as motivators for healthcare providers in some cases.[43 53 63 64 67 78 82 84 86]

Training

Inadequate comprehensive routine training in HIV/syphilis RDTs was perceived as a barrier. Generally, healthcare workers described HIV/syphilis RDTs as quick to learn and easy to use.[54 57 64–67] But, studies also highlighted the importance of doing routine training to maintain and refresh healthcare workers' knowledge and upskill new staff.[36 39 41 47 53 57 65–67 78 79 81 82 89 90] Training sessions that were viewed as informative and worthwhile frequently shared common characteristics, such as being interactive, flexible and comprehensive. Healthcare worker confidence was reportedly further reinforced by the concordant results between RDTs and laboratory tests.[91]

Domain 4: contextual factors

In alignment with the modified SEM, the last domain relates to the characteristics of the setting that are unique to the local community. We categorised the contextual factors into two subdomains: sociocultural norms and political factors.

Sociocultural norms

About a quarter of included studies (n=15) described sociocultural norms, such as traditional beliefs, gender roles and gender norms, as key factors influencing pregnant women's acceptability of HIV/syphilis RDT at ANCs.[35 36 39 41 51 57 63 69 70 75 80 92–96] Five studies reported that traditional beliefs regarding pregnancy can prevent women from seeking care at ANCs.[35 39 57 63 92] Specifically, in locations where the biomedical healthcare model of pregnancy was not culturally appropriate, pregnant women preferred seeking care from traditional health practitioners rather than going to ANCs.[39 63] In other contexts, pregnant women, particularly those who were older, perceived pregnancy as a normal health/life status with no reason to attend antenatal visits. There were a variety of supernatural fears relating to pregnancy disclosure in the first 3 months of pregnancy.[35 63]

Furthermore, eight studies in this review reported gender roles and gender norms to be associated with HIV/syphilis RDT at ANCs.[36 41 44 46 51 69 74 92] In patriarchal-dominated cultures, women reportedly often sought partner or spousal approval and guidance in the decision process of HIV/syphilis testing, as one pregnant woman reported, 'I agree with whatever my husband has said. It has to do with our culture'.[95] In these settings, pregnant women were often financially dependent on their spouses and were expected to be subordinate to their husbands. A case study from Indonesia reported healthcare workers had denied the request from pregnant women of HIV testing if their husbands refused to give permission.[46] Intentional and unintentional breaches of pregnant women confidentiality to their husband or family members were also more likely to occur in these settings.[41 46 93 96] We found six studies that included male partners in the study design in an effort to enhance women's acceptability of testing.[69 70 75 80 94 95] However, among these, three studies failed to recognise the influence of gender inequality issues within the local setting.[70 80 94] Accordingly, pregnant women were made accountable, and some felt forced, to recruit their partners for HIV testing[70 80 94]; a scenario that is counter to cultural norms within male-dominant societies. A study in Uganda emphasised that it is crucial to incorporate gender-sensitive interventions into couples testing—examples include encouraging men through community members, male peers and male-friendly ANCs.[70]

Policy factors

Guidelines, policy frameworks, programme targets, programme coverage and political context were identified as factors influencing the implementation of HIV/syphilis RDT programmes for pregnant women.[34 37 48 49 55 62 63 68 71 73 74 78 80–82 95 97 98] Programmatic targets were identified as influencing the implementation of HIV/syphilis RDT in ANCs by affecting service provision.[34 37 68 74 80] For example, the primary focus of preventing mother to child HIV/syphilis transmission programme in ANCs is to prevent transmission to babies and hence assist in reaching targets around reducing new infections.[34] Furthermore, in these instances, testing services tended to be baby-centred and mandatory but

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were sometimes found to neglect the human rights of women.[34 37 46 55 62 68 71 73 74 80 97] For example, HIV testing was a prerequisite for pregnant women to access other services at health facilities in several rural settings,[62 73 80 97] 'If she does not get tested, it means she will not access antenatal services'.[73] In addition, both women and healthcare workers echoed the importance of having comprehensive and standard guidelines and programme targets for HIV and syphilis RDT at ANCs.[95 98] Half of syphilis studies reported a lack of screening and management guidelines and referral protocols for syphilis, including when to offer syphilis RDTs, how to perform and interpret test results, who is responsible, as well as how to care for or refer syphilis cases identified at ANCs.[49 82 98] In these instances, a lack of management guidelines meant ambiguous responsibility, poor coordination and lack of information flow at all levels which may influence the healthcare worker's motivation to address challenges and consequently negatively impact implementation of syphilis screening at ANCs.[49 98] Furthermore, one of the studies from South Africa indicated that not only the existence of a protocol, but also the awareness of the protocol, was important to ensure provision of quality care to pregnant women.[83]

In addition, this review found that political will and engagement both play a significant role in health promotion and shaping countries' policy preferences and the sustained implementation of HIV/syphilis RDT at ANCs.[43 49 67 78] Stakeholders from Uganda emphasised that a high political will to change traditional lab-based tests to RDTs must be combined with effective health systems amid scale-up efforts of a new health intervention.[78] A study from Indonesia showed that political will may also have been negatively affected by the stigma and discrimination attached to HIV/syphilis in the society.[49] Likewise, programme coverage was discussed in three studies.[74 81 82] Two of these studies included private healthcare facilities and found that HIV/syphilis RDT services were limited for pregnant women accessing these facilities. Healthcare workers in Ghana reported that the national syphilis RDT programme failed to reach many women in rural settings who attend private maternity homes that are not covered by the national programme.[82]

Quality of studies included

The result of the appraisal is summarised in table 4. Of the 62 studies included in the review, most studies reported the aim(s) of the study (90%), justified the research method(s) (94%) and described the study design (85%). Of the methods employed with each study, over half included detailed data recruitment (55%) and collection (71%) strategies. Only 22% of studies clearly described the relationship of researcher/s to participants.

DISCUSSION

Our review identified various factors across the four levels of the modified SEM (ie, intrapersonal, interpersonal, organisational and contextual) that heavily influence the implementation of HIV/ syphilis RDT services during pregnancy in LMICs. The acceptability and feasibility of implementing maternal HIV/syphilis RDT varied by context, such as rural and urban settings, or related to cultural and social influences. These findings identify the complex nature of integrating RDTs into ANCs through a multifaceted perspective.

For pregnant women, the acceptance of HIV/syphilis RDTs in pregnancy depends on a belief that doing so will benefit them and their babies. Perceptions of acceptability can be supported by providing adequate information and quality care. Most of the studies reporting on pregnant women indicated HIV and syphilis-related services (including testing and counselling) were only available at their ANCs. The findings suggest that providing information and testing for women before pregnancy may improve knowledge and awareness and in turn women's engagement in future testing services. Women viewed good quality care as encompassing accessible care with flexible appointments, effective referral systems and culturally sensitive care with healthcare workers who are caring, compassionate and trustworthy. In addition, how pregnant women engage with HIV and syphilis RDT at ANCs are affected by their traditional beliefs about pregnancy, social norms for HIV and syphilis testing, and gender roles. Despite specific barriers for pregnant adolescent and young women being widely reported, and that these women are less likely to test for HIV than the older ones,[99 100] it was surprising that only 5% of studies (3 of 62) explored the utilisation of HIV/syphilis RDTs by pregnant adolescents and young women. This limited set of studies showed that a low proportion of young pregnant women had fully used HIV services, which suggests studies are urgently needed to give closer consideration to addressing the unique needs of these women.

For healthcare workers, there was a myriad of factors which effected the use of HIV/ syphilis RDTs, including self-efficacy (ie, their perception of the value of tests and their capacity of conducting tests), their previous experience of using RDTs, and their motivation to perform the tests. To address these barriers, ANCs require adequate staffing, rooms and resources for testing services at the clinic, as well as adequate training for healthcare workers for implementation of RDTs and counselling strategies. Healthcare workers also need effective guidelines, retraining/upskilling, regular supervisory support and community support to do deliver quality care inclusive of HIV/syphilis RDT. Readily available testing resources will facilitate healthcare workers to provide adequate and equitable care. However, there is a clear gap in research about the personal attributes of healthcare workers essential for service provision. Previous studies on antenatal care in other fields, such as mental health, have explored the roles of gender, education level, empathy and respectfulness of healthcare providers, with findings suggesting these characteristics are influential in healthcare workers' ability to carry out their duties[101 102]

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and delivery of person-centred care.[101] There is need for future research that supports healthcare workers to deliver and enhance person-centred care across HIV/syphilis RDT services for pregnant women at ANCs.

Organisational-level challenges included supply-related issues, technological challenges and processing problems. Constrained resources coupled with low health system capacity hinder the provision of quality HIV/syphilis RDT services for pregnant women. Besides the existing structural limitations, many of the identified organisational-level challenges could be partially addressed with sufficient communication across different levels. Provision of a full two-way feedback loop and creation of a culture of openness among stakeholders is particularly essential in the implementation of effective and sustainable HIV/syphilis RDT programmes.[103 104] In addition, our review identified that one of the main challenges to providing quality HIV/syphilis RDT services for pregnant women relates to having a sufficient (and proficient) healthcare workforce to deliver services. Other studies of maternity care have shown that community health workers can ease the burden of practice-based healthcare workers and have been found to be acceptable healthcare providers among pregnant women.[105] However, few studies mentioned the relevance of optimising design and performance of community health worker initiatives, such as how to provide training to community health workers or how to provide a stable financial package to support and employ such workers. The WHO (2018) identified 15 recommendations for training, service and programme implementation for improving community health workers' involvement.[106] Future research is needed to follow WHO guidelines and provide evidence for community health worker contribution to maternal HIV/syphilis RDTs development.

Programme design requires ongoing collaboration with a variety of stakeholders at multiple levels, including policy-making and administrative levels, and local 'downstream' implementation actors (eg, services and community members).[107] In response to the question posed at the beginning of the paper, the findings also highlight the need to understand the interconnectedness between the different levels of modified SEM for improving the future HIV/syphilis RDT implementation at ANC settings. Our findings showed significant gaps in providing high-quality, equitable and women-centred care, reflected by poor interpersonal interaction and failures to recognise the role of the cultural, social and ethnic contexts within the local setting. For example, although the gender hierarchy was mentioned in various studies, gender-sensitive practice is an underexplored topic and rarely included in HIV/syphilis RDT programme implementation. Healthcare workers were found to persuade or coerce pregnant women to bring their partner to the clinic for couples testing, which can be inappropriate in some cultures, and inhibits the woman's right to get tested without her partner.[107 108]

This review has implications for clinical management and policy relating to delivery of high-quality HIV and syphilis RDTs at ANCs in LMICs. First, access to HIV and syphilis information and testing should be made available to women prior to pregnancy. The national and regional health bureaus should design culturally appropriate health messages for young women in cooperation with local women's groups. Second, RDT services implemented at ANCs should be efficient, timely and equitable. To foster efficient service delivery, health managers and stakeholders should develop efficient communication pathways between the health service and health institutions to ensure timely provision of resources required for RDT at the clinic level. To support feedback, clinic managers should develop strategies for timely identification of healthcare provider training needs and procurement of goods. At last, stakeholders should adopt policies and guidelines which support health system infrastructures to enhance the implementation of syphilis RDTs, including resource allocation. Overall, strategies for implementing women-centred HIV and syphilis RDT service at ANCs need multisectoral input and extensive community engagement to work together to make a difference on a large scale.

There are a few gaps that need to be addressed in future research. It should be noted that most stakeholder studies in this review were government stakeholders and program-related stakeholders. Future research is needed to explore ground level community engagement efforts to increase RDTs. Furthermore, only a small minority of papers within this review investigated the experiences of offering and delivering syphilis RDTs during pregnancy. The findings evidenced individual-level factors that both pregnant women and healthcare workers perceived syphilis as a less significant concern than HIV. This evidences a need to implement effective change for greater uptake of syphilis RDT, as well as delivery of these tests, public health messaging needs to be targeted at both the implementer (healthcare worker) and end-user (pregnant women) levels. It is important to note that all studies, except one study, on syphilis testing included in our review were conducted in African settings, which might limit the generalisability of these findings to other settings. In addition, top-down initiatives should include integration of policymakers to influence relevant policy change required to enhance HIV/syphilis RDT availability and resourcing.[109 110]

CONCLUSION

In conclusion, this review contributes to RDT implementation research by identifying multiple factors across four levels of the health system which influence the uptake and delivery of HIV and syphilis RDT at ANCs. Several barriers and facilitators to HIV/syphilis RDT at ANCs were identified within this review. Specifically, gender-sensitive, confidential and flexible maternal HIV and/or syphilis screening services were well received by pregnant women

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when provided by respectful healthcare workers. Healthcare workers were able to deliver this level of care when they received adequate support from supervisors, sufficient resources to deliver services, adequate salary and comprehensive routine training to conduct RDT. To enable these facilitative pathways, gaps must be addressed with all key stakeholders involved and refocused toward a broad socioecological approach. The findings also indicate that organisational challenges will need to be addressed with greater investment in the healthcare workforce to maintain system readiness and operator reliability. The findings of our study can provide researchers, decision-makers and health professionals with a global picture of the difficulties and opportunities that they may face when implementing HIV and syphilis RDT in antenatal care settings. Finally, our review's findings suggest the need for more extensive research on community stakeholder engagement for maternal HIV and/or syphilis RDTs.

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Supplementary Table 1: PRISMA Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	4-5
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	6
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	2
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5-6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5-6, Appendix
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6, Figure 1
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6-7
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6-7
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A

Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	7, Table 2 Figure 2
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	7, Table 3
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	7, Figure 1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	7-8, Appendix
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	15, Table 2 &3
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	N/A
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	N/A
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	15-18
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	18
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	18
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	18

Supplementary Table 2: Keywords for systematic review search strategy

The search strategy will include MeSH headings and, where necessary, free text headings using a catalogue of terms and variations of these terms, including:

Terms for exposure	**MESH "Syphilis"** Non-MESH: Treponema pallidum OR T. pallidum OR pallidum **MESH"HIV"** Non-MESH: Human immunodeficiency virus (es), AIDS, Acquired immune deficiency syndrome, HTLV III, human T-cell lymphotropic virus type III, HUMAN T-lymphotropic Virus type III, LAV-HTLV-III
	AND
Terms for Method	**MESH: "Qualitative research"** **MESH: "Interview"** Non-MESH: Narration OR Focus group(s) OR participant observations OR discourse analysis OR mixed method(s) OR semi-structured(s) OR in-depth OR observation OR focus group OR qualitative OR ethnographic OR fieldwork OR discrete choice experiment (DCE)
	AND
Terms of Intervention	**MESH: "Rapid diagnostic Test"** **"Point-of-care Test"** Non-MESH: point-of-care OR POC test*OR POC testing OR POCT OR Rapid diagnostic test*OR rapid test*OR onsite test*OR same-day test* OR near patient OR rapid adj6 test*OR rapid assay*OR bedside test OR testing OR screening OR test OR screening
	AND
Terms of Study population	**MESH: " Pregnant women"** Non- MESH: Pregnancy OR Pregnant woman OR ANC OR antenatal

Supplementary table 3: Characteristics of included studies

First author	Year	Country	Diseases	Participants	Sample size	Type of service provided Place
Kebaabetswe	2007	Botswana	HIV	PW, HW,	21 PW, 10	ANC
Biribonwonha	2007	Uganda	HIV	HW	15 HW	Hospital
Varge	2008	South Africa	HIV	PW	24 PW, 9 HW	Hospital
Bwirire	2008	Uganda	HIV	PW, HW	16 PW, not available HW	Hospital
Mbonye	2010	Uganda	HIV	PW, SH	25 PW, not available SH	ANC
Malema	2010	South Africa	HIV	HW	15 HW	Hospital
Medley	2010	Uganda	HIV	HW, SH	27 HW, 3 SH	Mixed
Groves	2010	South Africa	HIV	PW	25 PW	ANC
Angotti	2011	South Africa	HIV	PW,SH	40 PW, 15 SH	Hospital
Moges	2011	Ethiopia	HIV	PW, HW	32 PW, 5 HW	ANC
Sprague	2011	South Africa	HIV	PW,HW,SH	83 PW, 70 HW,30 SH	Hospital
Falnes	2011	Tanzania	HIV	PW, HW	53 PW, 11 HW	ANC, VCT
Balcha	2011	Ethiopia	HIV	SH	3 SH	ANC
Fanta	2012	Ethiopia	HIV	PW	48 PW	Hospital, ANC
Larsson	2012	Uganda	HIV	PW	18 PW	ANC
Hardon	2012	Sub-saharan	HIV	PW, HW	63 PW, 35 HW	ANC
Laher	2012	South Africa	HIV	PW	45 PW	ANC
Musheke	2013	Zambia	HIV	PW, HW,	10 PW, 7HW	ANC
Musheke	2013	Kenya	HIV	PW	40 PW	ANC
Rujumba	2013	Uganda	HIV	PW, HW	30 PW, 6 HW	ANC, Hospital
Crozier	2013	Thailand	HIV	PW, HW	38 PW, 26 HW	Hospital
Triipathi	2013	Ukraine	HIV	PW, HW	75 PW. 25 HW	ANC
Vernooij	2013	Thailand	HIV	HW, SH	6 HW, 6 SH	Community
Hamela	2013	Malawi	HIV	PW	10 PW	Hospital
Kendall	2014	Mexico	HIV	PW	55 PW	HIV clinic
Schechter	2014	Côte d'Ivoire	HIV	PW, HW	73 PW, 14	ANC
Gourlay	2014	Tanzania	HIV	PW, HW	21 PW, 9 HW	Government
Bocoym	2014	Burkina Faso	Syphilis	PW, HW,	35 PW, 32	Primary health
Madhivanan	2014	India	HIV	PW	14 PW	Hospital
Onono	2015	Kenya	HIV	PW	33 PW	Government health
Ansbro	2015	Zambia	Syphilis	HW	40 HW	Hospital, community
An	2015	Tanzania	HIV	PW, HW	196 PW, 57	Government health
An	2015	Tanzania	HIV	HW	57 HW	ANC
Balira	2015	Tanzania	HIV,	SH	Not provide	ANC
Gidey	2015	Ethiopia	HIV	PW	18 PW	Not addressed

Asiyanbola	2016	Nigeria	HIV	PW	40 PW	Hospital
Ahumuza	2016	Uganda	HIV	PW, HW,	89 PW, 10	Hospital
Rogers	2016	Kenya	HIV	HW	13 HW	Not addressed
Nnko	2016	Tanzania	Syphilis	PW	31 PW	Mixed
Ehiri	2016	Nigeria	HIV	PW	45 PW	Community based setting (church)
Doherty	2017	Uganda	HIV	HW, SH	75 HW, 82	Community
Maddox	2017	Malawi	HIV,	HW, SH	6 HW, 19 SH	Hospital
Vieira	2017	Sub-Saharan Arican	HIV	PW, HW	27 PW, 24 HW	ANC
Bocoum	2017	Burkina Faso	Syphilis	HW	12 HW	Primary health
Mitiku	2017	Ethiopia	HIV	PW, HW	28 PW, 4 HW	Public facility
Tamir	2018	India	HIV	PW	24 PW	Not provided
Thomsom	2018	Kenya	HIV	PW, HW,SH	121 PW, 13 HW	Large clinics
Mustapha	2018	Uganda	HIV	PW, HW	20 PW, 9HW	Hospital
Haruna	2018	Tanzania	HIV	PW	17 PW	Hospital
Badriah	2018	Indonisia	HIV	PW,HW,SH	14 PW, 3SH	Hospital, community
Mark	2018	Solomon	Sphilis	HW	20 HW	Hospital
Dassah	2018	Ghana	Sphilis	SH	15 SH	Hospital
Sibanda	2018	Zimbabwean	HIV	PW	21 PW	ANC
Young	2019	Kenya	HIV,	PW	147 PW	ANC
Lubega	2013	Uganda	HIV	PW	132 PW	ANC
Dirisu	2020	Nigeria	HIV	SH	12 SH	Community and hospital
Mukose	2019	Uganda	HIV	HW, SH	34 HW, 20 SH	Hospital
Phiri	2019	Malawi	HIV	HW	34 HW	Hospital
Oshosen	2020	Tanzania	HIV	PW	24 PW	Clinic
Najmah	2020	Indonesia	HIV	PW,HW,SH	18 PW, 26 HW, 21 SH	Not addressed
Baker	2020	Indonesia	HIV, Syphilis	SH	25 HW, 15 SH	Community
Paulse	2020	South Africa	HIV	PW	Not avaialble	Clinic