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Evidence of Accessibility and Utility of Point of Care Diagnostics as an Integral Part of Prevention of Mother to Child Transmission Services: Systematic Scoping Review Protocol

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Title: Evidence of Accessibility and Utility of Point of Care Diagnostics as an Integral Part of Prevention of Mother to Child Transmission Services: Systematic Scoping Review Protocol

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ABSTRACT

Introduction: Point-of-care (POC) diagnostics have been shown to help improve healthcare access in resource-limited settings. However, the implementation of POC diagnostics services for prevention of mother to child transmission (PMTCT) in resource-limited settings is not well known. We propose to conduct a systematic scoping review to map the evidence on POC diagnostics services for PMTCT.

Methods and Analysis: The study will be guided by a scoping review framework proposed by Arksey and O'Malley and will include a quality assessment. A comprehensive electronic literature search will be performed in the following databases: EBSCOhost, PubMed, Google scholar and Science Direct. Reference lists of included articles will be hand searched. Primary research articles published in peer-reviewed journals and grey articles that address our question will be included in the study. At least one reviewer will conduct title screening and two independent reviewers will perform abstract and full article screening in parallel. The same process shall be employed to extract data from studies meeting the eligibility criteria. All data from the included studies will be analyzed by thematic content analysis using NVIVO software, version 11.

Discussion: We anticipate finding broad overview of studies on point-of-care diagnostics for PMTCT programmes. The results will allow us to identify potential gaps on the subject and will guide future research.

PROSPERO registration number: CRD42017056267.

Strengths and limitations:

- There will be no language limitation for the literature that will be included in this study

- The study findings will be helpful in achieving the SDG3 and to reach the 90% target of viral suppression
- Studies published prior to 2013 will not be included in the study

Ethics and Dissemination: Ethical approval is not applicable to this study. The study findings will be published in a peer-reviewed journal and presented at conferences related to syphilis, HIV, PMTCT and POC diagnostics.

Keywords: Women; Point of care diagnostics; HIV; syphilis; Prevention of mother-to-child transmission

INTRODUCTION

Pediatric HIV and syphilis infection among pregnant women remain a public health problem despite advances in biomedical research. By the end of 2015, UNAIDS estimated that 150 000 children became newly infected with HIV and 1.8million children were living with the infection [1]. Most of these (110 000) newly infected children live in Sub-Sahara and they have been infected through mother-to-child of HIV transmission [2]. Over the last two decades, there has been growing health advances including the global plan to eliminate MTCT of HIV by 90% and reduce HIV-related maternal deaths by 50% [3], as well as the global strategies for dual elimination of MTCT of HIV and syphilis[4]. Countries such as Uganda, South Africa and Burundi have made substantial progress towards achieving the targets of reducing HIV vertical transmission by 90% [5]. Syphilis in pregnancy is associated with an increased risk of HIV transmission [6]. Therefore, the World Health Organization has recommended strategies such as rapid syphilis and HIV screening for pregnant women in antenatal care (ANC) clinics [4,7]. These strategies have been found to be effective in preventing MTCT of syphilis and HIV [8]. Additionally, an intensive effort to scale up prevention of mother-to-child transmission (PMTCT) programs and integration of antiretroviral therapy (ART) within the program has yielded significant results by reducing new HIV infections among children by 60% between 2009 and 2015 [9]. However, this is below the marked target of 90% [3] and an indication that more work needs to be done.

Despite tremendous achievements made by PMTCT [10-13], these programs in poor countries are still faced with challenges including inadequate laboratory infrastructure, inefficient health systems, poor access to laboratory facilities and patient loss to follow up [14,15]. To address the problem of access to laboratory, UNAIDS and its partners launched a diagnostic access initiative which focuses on the need to develop new affordable diagnostic tools that can increase access to prevention, treatment,

and care programs [16]. In response to this initiative, there have been an increase in development of point-of-care (POC) diagnostics for use in settings with limited access to laboratory to target infectious diseases[17]. It has been reported that the use of POC diagnostics for bacterial pneumonia, syphilis, tuberculosis and malaria infections could prevent more than 1.2 million deaths from HIV/AIDS and its co-infections per year in low-and-middle-income countries [18].

The expansion of PMTCT including the "test and treat" strategies will require increased access to POC testing (POCT) to ensure coverage and impact public health. The potential impact of POC diagnostics have been shown on some global programs including HIV and syphilis [19]. However, little is known regarding the level of accessibility and utility of POC diagnostics for PMTCT in resource-limited settings. "Accessibility" and "utility" are some of the factors affecting effective implementation of POC diagnostics [20]. We define "accessibility" as the availability or presence of a test in each health facility as opposed to how closer the test is in terms of distance to be accessed to achieve the greatest impact. "Utility" is defined as the level or a measure of uptake of a given test given that, its access has improved to achieve the desired outcome. The aim of this study is to map the evidence of point-of care-diagnostics for PMTCT services. It is anticipated that the results of this study will help identify research gaps and guide future research.

METHODS AND ANALYSIS

The study design for this study is systematic scoping review. The study will be guided by Arksey and O'Malley scoping review framework and will include quality assessment [21]. The study title was registered under PROSPERO international prospective register for systematic reviews with registration number: CRD42017056267 and can be accessed via the link below: https://www.crd.york.ac.uk/prospero/display_record.asp?ID=CRD42017056267

Scoping review framework

The scoping review methodological framework proposed by Arksey and O'Malley has been used to guide the development of our protocol [22]. The framework outlines the following five stages: (1) Identify the research question (2) Identify relevant studies, (3) Study selection (4) chart the data (5) collate, summarize and report the results.

(1) Identify the research question:

The following research question will be addressed in our systematic scoping review:

The main research question is: What is the evidence of point-of-care (POC) diagnostics on PMTCT for HIV and syphilis?

Specific research questions are as follows:

- What is the effect of POC diagnostics on preventing MTCT of HIV?
- What effect does POC diagnostics for syphilis have in preventing MTCT of syphilis?
- What effect does POC diagnostics have on child survival and reduced infant mortality?
- What effect does POC diagnostics have on linking patients to care?
- What effect does POC diagnostics have to facilitate access to HIV and syphilis treatment?

The eligibility of the question was framed based upon the PICO (Population, Intervention, Comparison and Outcomes) model described in Table 1 **below:**

(2) Identifying relevant studies

The search will include both published and unpublished (grey literature) primary studies as well as systematic reviews. We will search electronic database for articles published in English, French, Portuguese and Spanish language between 2013 and 2017. Reference list of key articles will be hand searched for additional studies. The electronic search will involve the following databases:

EBSCOhost, PubMed, Google scholar and Science Direct. Other sources of literature will include presentations from conferences and publications on organizational websites such as World Health Organization and UNAIDS. The search key terms will include a combination of pregnant and breast-feeding women and point-of-care testing and PMTCT or timely results or access to ART or reduced patient loss to follow up. Our search will use Boolean terms (AND, OR) to separate the keywords and Medical Subject Headings (MeSH) terms will also be utilized during the search. Researchers will keep record of the number of publications retrieved and the search date after each session (see **Table 2)**.

Inclusion criteria:

Studies will be included based on the following criteria:

- Studies that show evidence on pregnant and breast-feeding women;
- Studies that include HIV point-of-care diagnostics;
- Studies that include syphilis point-of-care diagnostics;
- Studies that show PMTCT as the main outcome;
- Studies that show access to HIV and syphilis treatment;
- Studies that report on linkage to care;
- Studies that report on reduced infant mortality;
- Studies published in English, French, Portuguese and Spanish between 2013 and 2017; and
- Primary studies using qualitative and quantitative study designs.

Exclusion criteria:

The following will be used as the exclusion criteria:

- Studies that do not include pregnant and breast-feeding women;

- Studies that do not include point of care diagnostics and PMTCT;
- Studies published before January 2011;and
- Narrative reviews.

(3) Study selection

This will be conducted in stages: Title and abstract screening followed by full article screening. One reviewer will perform title screening with guidance from the study eligibility criteria and export the search results to endnote software version X7, where an endnote library will be created. Studies that do not meet the eligibility criteria and duplicates will be excluded. The endnote library will be shared among the reviewers. Two other independent reviewers will screen abstract and full article, consecutively. All discrepancies from results of abstract and full article screening will be discussed and resolved by the third reviewer. The study selection results will be presented in a modified PRISMA flowchart [23].

(4) Charting:

A data-charting form to record key information found from the included studies, will be developed. The extracted data will include the following sections as outlined:

- Author(s)
- Date of publication
- Study design
- Aims/purpose
- Study population (from 12 weeks gestation period up to 6months breast feeding)
- Methodology
- Intervention type
- Outcomes

- Key findings and conclusions that relate to this systematic scoping review research question

(5) Collating, summarizing and reporting the results:

We will conduct a narrative description of the search results followed by a PRISMA flowchart [24]. Data will be analyzed using content thematic analysis aided by NVIVO, version 11. A narrative summary of the charted results in relation to the objective and question will be presented.

QUALITY ASSESSMENT:

The Mixed Methods Appraisal Tool (MMAT) version 11 will be used to assess the quality of the studies that will be included in our search [25]. To get the overall score of included studies, we will divide the number of criteria that each study will meet by the total number of criteria according to the study design and calculate it as a percentage.

DISCUSSION

This systematic scoping review is part of the larger study on evaluation of accessibility of point of care diagnostics for prevention of mother-to-child HIV transmission (PMTCT) in resource-constrained settings. The review will map existing evidence on point-of-care diagnostics in PMTCT. We will describe factors related to their implementation and their usefulness in PMTCT. High HIV prevalence countries such as Malawi, Zambia and Kenya have adopted WHO treatment guidelines option B+ for PMTCT [14,26]. This "universal test and treat" prevention approach requires access to rapid HIV testing and immediate or early initiation of ART. To ensure success of this strategy to prevent HIV transmission, barriers that affect access to HIV testing need to be understood. POC diagnostics are being recommended and implemented in low-income and high HIV prevalence settings where access to laboratory is limited. In addition, POC tests for syphilis have been adopted and implemented in many countries including Zambia [27]. However, the factors affecting their

successful implementation have not been examined. The review could answer on what is known and unknown on the research question.

We will exclude studies based on our exclusion criteria because we are only focusing on women who attend ANC services as our population. We will also limit our search from 2013 to 2017 because we consider these to be the most recent published articles. Narrative reviews may be subjective and therefore will be excluded. We anticipate finding relevant literature on studies that have been conducted in on POC diagnostics of PMTCT for HIV and syphilis. Our study findings will help inform POC diagnostics programs implementers and policy makers on ensuring efficient implementation of POC diagnostics services for PMTCT, particularly in countries that have high prevalence of HIV and syphilis infections. This will therefore aid countries in achieving the SDG3 goals which highlights the need to prevent MTCT [28] and to reach the UNAIDS 90% target of viral suppression to further prevent chances of viral transmission [29].

CONCLUSION

The findings of our systematic scoping review will yield information that will be useful to POC implementers to design POC programs that can effectively improve care and prevention programs such as PMTCT in resource limited settings. The study is important to achieve the sustainable development goal 3 (SDG3) that draws attention to eliminate MTCT and to reach the 90% target of viral suppression.

LIST OF ABBREVIATIONS

PMTCT - Prevention of mother-to-child of HIV transmission.

POC-Point-of-care

HIV-Human Immunodeficiency Virus

AIDS-Acquired Immunodeficiency Syndrome

ART-Antiretroviral Therapy

WHO-World Health organization

UNAIDS- The Joint United Nations Programme on HIV/AIDS

LIMCs-Low income-middle countries

DECLARATIONS

Ethics approval clearance (Not applicable)

Consent for publication (Not applicable)

Availability of data and material: The data that will be produced in this study will be included in the published systematic scoping review article and will be made available as part of the supplementary material of the systematic scoping review.

Competing interests: We declare that we have no competing interests.

Funding: This research study was funded by the University of KwaZulu-Natal College of Health Sciences PhD Scholarship.

Authors' contributions: The study was conceptualized by JK under the supervision of TM-T and LH. Contributions towards developing the background and planned output of the research as well as

the design of the study were made by JK, TPM-T and LH. TPM-T contributed to developing methods relating to the review and synthesis of data including the sifting and data extraction process. The manuscript was prepared by JK, TPM-T and LH reviewed it. All authors (JK, TPM-T and LH) contributed to the reviewed draft version of the manuscript and approved the final version.

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Table 1. A PICO Framework to determine eligibility of the review question.

Population **(P)**	Pregnant and breast feeding women,
Intervention **(I)**	Point of care diagnostics for HIV and syphilis
Comparison **(C)**	Absence of POC diagnostics
Outcomes **(O)**	Primary outcome: PMTCT Secondary outcomes: HIV infection; Syphilis infection; access to treatment; Linkage to care; Linkage to treatment; Reduced infant mortality;

Table 2. Search record

Date	Keywords	Search Engine	Number of publications retrieved

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item	Page number
ADMINISTRATIVE INFORMATION			
Title:		**Evidence of Accessibility and Utility of Point of Care Diagnostics as an Integral Part of Prevention of Mother to Child Transmission Services: Systematic Scoping Review Protocol**	1
Identification	1a	Identify the report as a protocol of a systematic review	1
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	N/A
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	2
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	1
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	N/A
Support:			
Sources	5a	Indicate sources of financial or other support for the review	11
Sponsor	5b	Provide name for the review funder and/or sponsor	11
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	11
INTRODUCTION			
Rationale	6	Describe the rationale for the review in the context of what is already known	5-6
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	6
METHODS			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	6-7
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	7

Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	7
Study records:			
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	9
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	8
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	8
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	7
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	6
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	N/A
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	N/A
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)	N/A
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	N/A
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	9
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	N/A
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	9

*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

From: Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.

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ABSTRACT

Introduction: Point-of-care (POC) testing has been shown to help improve healthcare access in resource-limited settings. However, there is paucity of evidence on accessibility of POC testing for prevention of mother to child transmission (PMTCT) in resource-limited settings. We propose to conduct a systematic scoping review to map the evidence on POC testing services for PMTCT.

Methods and Analysis: A scoping review framework, proposed by Arksey and O'Malley, will guide the study. A comprehensive literature search will be performed in the following electronic databases: PubMed, Science Direct, Cochrane Central, Google scholar and databases within EBSCOhost (Medline and CINAHL). The primary research articles published in peer-reviewed journals and grey articles addressing our question will be included. One reviewer will conduct title screening and the results will be exported to endnote library. Two independent reviewers will perform abstract, then full article screening in parallel. The same process shall be employed to extract data from eligible studies. Data analysis will involve a narrative summary of included studies and thematic content analysis aided by NVIVO software, version 11. The Mixed Methods Assessment (MMAT) tool will be used to assess the quality of studies that will be included.

Ethics and Dissemination: Ethical approval is not applicable to this study. The study findings will be published in a peer-reviewed journal and presented at conferences related to syphilis, HIV, PMTCT, Bacterial infections and POC diagnostics.

PROSPERO registration number: CRD42017056267.

Strengths and limitations:

- The study findings will provide evidence which with will be helpful in achieving the Sustainable Development Goals 3 (SDG3) and the 90-90-90 UNAIDS target.
- The review has no language limitation.

- There will be a search date limitation for the literature that will be included in this study as a result, some relevant information could be missed.

Keywords: Women; Point-of-care testing; Infants; PMTCT.

INTRODUCTION

Pediatric HIV and syphilis infection among pregnant women remain a public health problem despite advances in biomedical research. By the end of 2015, UNAIDS estimated that 150 000 children became newly infected with HIV [1]. More than two thirds of these newly infected children live in Sub Saharan Africa and they have been infected through mother-to-child HIV transmission [2].

Over the last two decades, there has been growing health advances including the global plan to eliminate mother-to-child transmission (MTCT) of HIV by 90% and reduce HIV-related maternal deaths by 50% [3], as well as the global strategies for dual elimination of MTCT of HIV and syphilis[4]. Countries such as Uganda, South Africa and Burundi have made substantial progress towards achieving the targets of reducing HIV vertical transmission by 90% [5]. Syphilis in pregnancy is associated with an increased risk of HIV transmission [6]. Therefore, the World Health Organization (WHO) has recommended strategies such as rapid syphilis and HIV screening for pregnant women in antenatal care (ANC) clinics[4,7]. These strategies have been found to be effective in preventing MTCT of syphilis and HIV[8]. Additionally, an intensive effort to scale up prevention of mother-to-child transmission (PMTCT) programs and integration of antiretroviral therapy (ART) within the program has yielded significant results by reducing new HIV infections among children by 60% between 2009 and 2015[9]. However, this is below the marked target of 90% [3] and an indication that more work needs to be done. In addition to the above, malaria and Group B streptococci (GBS) infections are also associated with morbidity and mortality for both mothers and infants[10-12]. Vertical transmission of malaria is associated with increased infant susceptibility to malaria infection and other infections whereas GBS infection increases risk of bacterial pneumonia in infants [13 14].

Despite tremendous achievements made by PMTCT [15-18], these services in poor countries are still faced with challenges including inadequate laboratory infrastructure, inefficient health systems, poor access to laboratory facilities and patient loss to follow up [19,20]. To address the problem of access to diagnostic laboratory services, UNAIDS and its partners launched a diagnostic access initiative

which focuses on the need to develop new affordable diagnostic tools that can increase access to prevention, treatment, and care programs [21]. In response to this initiative, there has been an increase in development of point-of-care (POC) diagnostics for use in settings with limited access to laboratory services to target infectious diseases[22]. It has been reported that the use of POC diagnostics for bacterial pneumonia, syphilis, and tuberculosis and malaria infections could prevent more than 1.2 million deaths from HIV/AIDS and co-infections per year in low-and-middle-income countries[23].

The expansion of PMTCT including the "test and treat" strategies will require increased access to POC testing to ensure coverage and impact on public health. The PMTCT cascade which has evolved overtime is a series of steps that starts with HIV screening and diagnosis of pregnant women, initiation of ART for HIV positive pregnant women and their exposed infants. This is followed by HIV diagnosis in infants and ART initiation for those that are infected[9,24]. Continued linkage to HIV care for HIV positive women and infants is needed during post-partum period.

POC testing is essential for routine screening of pregnant women for HIV and syphilis in ANC clinics[7]. Throughout the PMTCT cascade, POC testing is important, as a prerequisite for entry into care as well as in monitoring of HIV infected mothers that are on treatment to reduce onward transmission[7,25]. POC testing fits into the infant HIV continuum of care by facilitating early diagnosis, enrollment into care and reducing loss to follow up to ensure chances of child survival [26]. POC testing is also useful in detecting asymptomatic malaria and GBS infections, which can be transmitted vertically during gestational period[13,27,28].

The potential impact of POC testing have been shown on some global programs including HIV and syphilis [29]. However, little is known regarding the level of accessibility and utility of POC testing for PMTCT in resource-limited settings. "Accessibility" and "utility" are some of the factors affecting effective implementation of POC testing [26 30]. We define "accessibility" as the availability or the presence of a POC test in each health facility as opposed to how closer the test is in terms of distance to be accessed to achieve the greatest impact. "Utility" is defined as the level or a measure of uptake

of a given POC test given that, its access has improved to achieve the desired outcome. Universal access to quality essential health care services has been emphasised as one of the essential components to fulfil the sustainable development goal number three (SDG3), whose target is to ensure health and promote the well-being for all people at all ages [31]. The aim of this review is to map the evidence on accessibility of point-of care testing for PMTCT. It is anticipated that the results of this study will help identify research gaps and guide future research.

METHODS AND ANALYSIS

The study design for this study is a scoping review. The study will be guided by Arksey and O'Malley scoping review framework and will include a quality assessment[32]. The study title was registered under PROSPERO international prospective register for systematic reviews with registration number: CRD42017056267 and can be accessed via the link below: https://www.crd.york.ac.uk/prospero/display_record.asp?ID=CRD42017056267

Scoping review framework

The scoping review methodological framework proposed by Arksey and O'Malley has been used to guide the development of our protocol [33]. The framework outlines the following five stages: (1) Identify the research question (2) Identify relevant studies, (3) Study selection (4) chart the data (5) collate, summarize and report the results.

(1) Identify the research question:

The main research question that will be addressed in this review is: What is the evidence of accessibility of POC testing on PMTCT?

Specific research questions are as follows:

- What is the evidence of POC testing for preventing HIV vertical transmission?
- What is the evidence of POC testing on preventing syphilis vertical transmission?

- What is the evidence of POC testing on preventing malaria and bacterial vertical transmission?
- What is the evidence of POC testing on child survival and infant mortality?
- What is the evidence of POC testing and linking mothers and infants to care?
- What is the evidence of POC testing on facilitating access treatment?
- What is the evidence of POC testing on facilitating access ART?

The eligibility of the question was framed based upon the PICO: Population of interest, Intervention: showing POC tests of interest, Comparison: studies that do not have POC testing and Outcomes: the included studies that will have PMTCT related outcomes as described in Table 1.

Table 1. A PICO Framework to determine eligibility of the review question.

Population **(P)**	Pregnant and breast feeding women Infants
Intervention **(I)**	Point of care test for: • HIV • CD4 • Viral Load • Early Infant Diagnostic tests (EID) • Syphilis • Malaria • Group B streptococci
Comparison **(C)**	Absence of POC diagnostics
Outcomes **(O)**	Primary outcome: Prevention of Mother-to-Child Transmission (PMTCT)

	Secondary outcomes: HIV infection; Syphilis infection; malaria, bacterial pneumonia; access to ART; access to HIV and syphilis treatment; Linkage to care as defined by WHO; Infant mortality; patient loss to follow up, timely results

(2) Identifying relevant studies

The search will include both published and unpublished (grey literature) primary studies as well as systematic reviews. There will be no language restriction. We will search for primary research articles published between 2013 and 2017. The electronic search will involve the following databases: PubMed, Science Direct, Cochrane Central, Google scholar and databases within EBSCOhost (Medline and CINAHL). Reference lists of key articles will be hand searched for additional studies. Other sources of literature will include presentations from conferences and publications on organizational websites such as WHO and UNAIDS. The search key terms will include a combination of pregnant and breast-feeding women, infant, Point of care testing and PMTCT or timely results or access to HIV and syphilis treatment or linkage to care as defined by WHO (a confirmation of HIV positive diagnosis and the first HIV clinic visit)[34] or access to ART or infant mortality or reduced patient loss to follow up. Our search will use Boolean terms (AND, OR) to separate the keywords and Medical Subject Headings (MeSH) terms will also be utilized during the search. Researchers will keep record of the number of publications retrieved and the search date after each session. The draft literature search for PubMed and Google scholar is provided in Table 2.

Table 2. Search record

Search Date	Keywords	Search Engine	Number of publications retrieved	Search Terms
12/08/2017	Pregnant and	PubMed	974	((((((pregnant and breast feeding

	breast feeding women, Infants, Point of care diagnostics, prevention of mother to child transmission, access to treatment, access to ART			women)) AND infants) AND Point of care diagnostics) AND prevention of mother to child transmission) AND access to treatment) OR access to ART
15/08/2017	Pregnant and breast feeding women and Infants, Point of care testing, prevention of mother to child transmission.	Google Scholar	470	pregnant and breast feeding women and infants prevention OR of OR mother OR to OR child OR transmission " point of care testing"

Inclusion criteria:

Studies will be included based on the following criteria:

- Studies that show evidence on pregnant and breast-feeding women
- Studies that include mother-infant pair or infant as a population
- Studies that include point-of-care testing related to HIV, syphilis, malaria and GBS
- Studies that show PMTCT as the main outcome
- Studies that report on HIV, syphilis, malaria and bacterial pneumonia infections

- Studies that show access to HIV and syphilis treatment
- Studies that show access to ART
- Studies that report on linkage to care
- Studies that report on infant mortality
- Studies that report on loss to follow up
- Studies published between 2013 and 2017
- Primary studies using qualitative and quantitative (randomized, non-randomized and observational) and mixed method study designs.
- Studies that were conducted in high, low-and-middle income countries

Exclusion criteria:

The following will be used as the exclusion criteria:

- Studies that do not include pregnant and breast-feeding women or infants as a population
- Studies that do not include point-of-care testing related to HIV, syphilis, malaria and GBS infections
- Studies that do not show PMTCT as the main outcome
- Studies that do not report on HIV, syphilis, malaria and bacterial pneumonia infections
- Studies that do not report on linkage to care or treatment
- Studies that do not report on infant mortality
- Studies that do not report on loss to follow up
- All Narrative reviews

(3) Study selection

This will be conducted in stages: Title, abstract, followed by full article screening. One reviewer will perform title screening using the inclusion criteria. The search results will be exported to endnote software version X7, where an endnote library will be created. The use of endnote will be useful to manage all citations. Studies that do not meet the inclusion criteria and duplicates will be excluded.

The endnote library will be shared with another independent reviewer for abstract screening. Two independent reviewers will conduct abstract screening, concurrently. All discrepancies from the results of abstract screening will be discussed and resolved by the third reviewer. Two independent reviewers will then carry out full article screening and all disagreements with the results will also be tackled through discussions and consultation with a third reviewer for consensus. The study selection results of various databases will be presented in a modified PRISMA flowchart [35].

(4) Charting:

A data-charting form to record key information found from the included studies will be developed. The extracted data will include the following sections:

- Author(s)
- Date of publication
- Study design
- Aims/purpose
- Study population (from 12 weeks gestation period up to 6months breast feeding)
- Methodology
- Intervention type
- Outcomes
- Key findings and conclusions that relate to this systematic scoping review research question

(5) Collating, summarizing and reporting the results:

Collating and summarizing means analysis of the data. This process involves providing a narrative summary of all the included studies. Content thematic analysis will be performed which involves identifying of themes in relation to the objectives of the study. Emerging themes will also be included. Thematic content analysis will be aided by NVIVO, version 11.

QUALITY ASSESSMENT:

The Mixed Methods Appraisal Tool (MMAT) version 11 will be used to assess the methodological quality of the studies that will be included in our search [36]. The advantage of using the MMAT for our review is that it allows reviewers to assess the methodological quality of all the qualitative, quantitative, and mixed methods research studies that will be included in this scoping review. The overall score of the included studies will be calculated as a percentage, by dividing the number of the criteria that each study will meet by the total number of criteria according to the study design.

DISCUSSION

This scoping review is part of the larger study on evaluation of accessibility of POC testing for prevention of mother-to-child HIV transmission (PMTCT) services in resource-constrained settings. The review will map evidence on existing literature on point-of-care diagnostics for PMTCT. There has been an increase in the development of POC diagnostics in the past five years[37] and therefore, we will search for literature published between 2013 and 2017 because we hope to obtain the most recent information. The findings of the scoping review will generate important information that will be useful to WHO and its partners that advocate for universal access to healthcare and in resolving healthcare challenges in settings with poor access to diagnostics services. The proposed study will thus contribute to healthcare systems strengthening in developing countries. It will also help review the gap in knowledge on this topic and influence direction for future research. The study intends to build and contribute to a body of literature on diagnostics research, which can improve maternal health.

We anticipate finding relevant literature on studies that have been conducted on POC testing for PMTCT. Our study findings will help inform POC diagnostics program implementers and policy makers on ensuring efficient implementation of POC testing services and future scale up of POC technologies. This will therefore aid countries in achieving the SDG3 goals which highlights the need to prevent MTCT [31] and to reach the UNAIDS 90% target of people knowing their HIV status and prevent chances of viral transmission [38].

CONCLUSION

The findings of our systematic scoping review will provide evidence that will be useful to POC diagnostic implementers to design POC testing programs that can effectively improve PMTCT services globally.

ETHICS AND DISSEMINATION

The protocol does not require ethical approval because it does not include human subjects. The results will be disseminated through publication in a peer-reviewed journal and presentations at conferences related to syphilis, HIV, PMTCT, malaria, Bacterial infections and POC diagnostics.

LIST OF ABBREVIATIONS

AIDS-Acquired Immunodeficiency Syndrome

ART-Antiretroviral Therapy

HIV-Human Immunodeficiency Virus

INFANT- An infant as defined by WHO is a child younger than one year of age

LIMCs-Low income-middle countries

MTCT - Mother-to-child of transmission.

PMTCT - Prevention of mother-to-child of transmission.

POC-Point-of-care

SDG3- Sustainable Development Goal 3

UNAIDS-The Joint United Nations Programme on HIV/AIDS

WHO-World Health organization

DECLARATIONS

Ethics approval clearance (Not applicable)

Consent for publication (Not applicable)

Availability of data and material: The data that will be obtained in this study will be included in the published systematic scoping review article.

Competing interests: We declare that we have no competing interests.

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Authors' contributions: The study was conceptualized by JK under the supervision of TM-T. Contributions towards developing the background and planned output of the research as well as the design of the study were made by JK, TPM-T and LH. TPM-T contributed to developing of methods relating to the review and analysis and data extraction process. The manuscript was prepared by JK, TPM-T and LH reviewed it. All authors (JK, TPM-T and LH) contributed to the reviewed draft version of the manuscript and approved the final version.

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PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item	Page number
ADMINISTRATIVE INFORMATION			
Title:		**Evidence of Accessibility and Utility of Point of Care Diagnostics as an Integral Part of Prevention of Mother to Child Transmission Services: Systematic Scoping Review Protocol**	1
Identification	1a	Identify the report as a protocol of a systematic review	1
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	N/A
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	2
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	12
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	N/A
Support:			
Sources	5a	Indicate sources of financial or other support for the review	14
Sponsor	5b	Provide name for the review funder and/or sponsor	14
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	14
INTRODUCTION			
Rationale	6	Describe the rationale for the review in the context of what is already known	6
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	6-7
METHODS			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review	7
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	8

Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	8-9
Study records:			
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	11
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	10-11
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	11
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	7-8
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	7-8
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	N/A
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	N/A
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ)	N/A
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	N/A
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	11
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	N/A
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	12

*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

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