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RESEARCH

Bottlenecks in the implementation of essential screening tests in antenatal care: Syphilis, HIV, and anemia testing in rural Tanzania and Uganda



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ABSTRACT

Objective: To identify and compare implementation bottlenecks for effective coverage of screening for syphilis, HIV, and anemia in antenatal care in rural Tanzania and Uganda; and explore the underlying determinants and perceived solutions to overcome these bottlenecks. **Methods:** In this multiple case study, we analyzed data collected as part of the Expanded Quality Management Using Information Power (EQUIP) project between November 2011 and April 2014. Indicators from household interviews (n = 4415 mothers) and health facility surveys (n = 122) were linked to estimate coverage in stages of implementation between which bottlenecks can be identified. Key informant interviews (n = 15) were conducted to explore underlying determinants and analyzed using a framework approach. **Results:** Large differences in implementation were found within and between countries. Availability and effective coverage was significantly lower for all tests in Uganda compared with Tanzania. Syphilis screening had the lowest availability and effective coverage in both countries. The main implementation bottleneck was poor availability of tests and equipment. Key informant interviews validated these findings and perceived solutions included the need for improved procurement at the central level. **Conclusion:** Our findings reinforce essential screening as a missed opportunity, caused by a lack of integration of funding and support for comprehensive antenatal care programs.

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1. Background

Screening for syphilis, HIV, and anemia is an essential element of antenatal care (ANC) and its importance remains uncontested [1,2]. Almost two-thirds of adverse outcomes in newborns could be prevented through effective screening followed by treatment and/or prophylaxis for

mothers infected with syphilis and/or HIV, respectively [3,4]. Anemia is a frequent indirect cause of maternal mortality [5]. Despite the emphasis on screening in the focused ANC strategy launched by WHO in the early 2000s, coverage of screening for syphilis, HIV, and anemia remains low in many settings [6].

In Tanzania and Uganda, both countries with a high maternal and newborn mortality, screening for adverse conditions in pregnancy has long been included in national policies [7]. Before the arrival of rapid point-of-care tests for syphilis in 2005, storage and the time needed to perform the rapid plasma regain test constituted major barriers to implementation [8]. Since 2010, rapid point-of-care tests for syphilis have been available in both Tanzania and Uganda [9]. Testing for HIV during pregnancy became an integral part of ANC for prevention of mother-to-child transmission (PMTCT) in the early 2000s and is

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routinely available in most facilities offering ANC. In contrast, screening for anemia is largely restricted to facilities with laboratory services [10].

In both countries, maternal health policies aim to provide user-friendly integrated services, whilst achieving results and providing value for money [11]. Comparing the coverage of screening tests represents an opportunity to monitor the implementation of such policies [12]. However, studies on integrated care have primarily examined single aspects such as the acceptability of offering several tests during the same visit [13] or of dual testing [14]. Such studies evaluate the feasibility of integration at the point of service delivery but not the effectiveness of integrated services within a health system [15].

Herein, the implementation bottlenecks for effective coverage of syphilis, HIV, and anemia screening in rural Tanzania and Uganda are identified and compared utilizing a novel approach linking data from households and health facilities to estimate population coverage in stages of implementation and key informant interviews to explore underlying determinants and potential solutions to the identified bottlenecks.

2. Methods

2.1. Study design and setting

This multiple case study [16] was nested within the Expanded Quality management Using Information Power (EQUIP) project, a district-wide collaborative quality improvement intervention for maternal and newborn care implemented between 2011 and 2014 in rural south-eastern Tanzania (Tandahimba district) and eastern Uganda (Mayuge district) [17,18]. One of the many areas of improvement focused on increasing consistent syphilis screening during ANC.

The study regions have high maternal and newborn mortality, with 6% and 8% of adult women being HIV positive in Tanzania and Uganda,

respectively [19,20]. Population-based syphilis prevalence in adult women is 2% in Uganda, whereas sentinel surveys in pregnant women show a syphilis prevalence of 4% in Tanzania [19,20].

2.2. Data collection

As part of EQUIP, surveys of households and health facilities were implemented to generate data for quality improvement and project evaluation [18]. These surveys were also conducted in adjacent non-intervention districts (Newala, Tanzania; and Namayingo, Uganda).

The household survey was a continuous cluster sample survey implemented between November 2011 and April 2014 where, each month, 10 household clusters were selected with a probability proportional to the population size of each district. Within each cluster, 30 households were sampled using simple random sampling. Interviews were held with all resident women of reproductive age (13–49 years; n = 27 957), applying a special module for those with a recent live birth; mean age was 30 years (interquartile range 30–39) and 63% were married. Questions included utilization of health services during pregnancy and delivery, type of care received, and perceptions of quality. During analysis, participants were limited to women with a live birth in the 12 months prior to the survey (n = 4415).

The health facility survey was a census of all 122 health facilities, repeated six times at four-month intervals during the study period. A checklist was used to assess facility readiness in terms of availability of drugs and equipment and interviews were conducted with the in-charge regarding the provision of routine care [18].

Fifteen purposively sampled key informants were interviewed in February 2014 in Tandahimba, Tanzania, and in November 2014 in Mayuge, Uganda. Three key informants at the district level were interviewed in each country. At the health facility level, six interviews

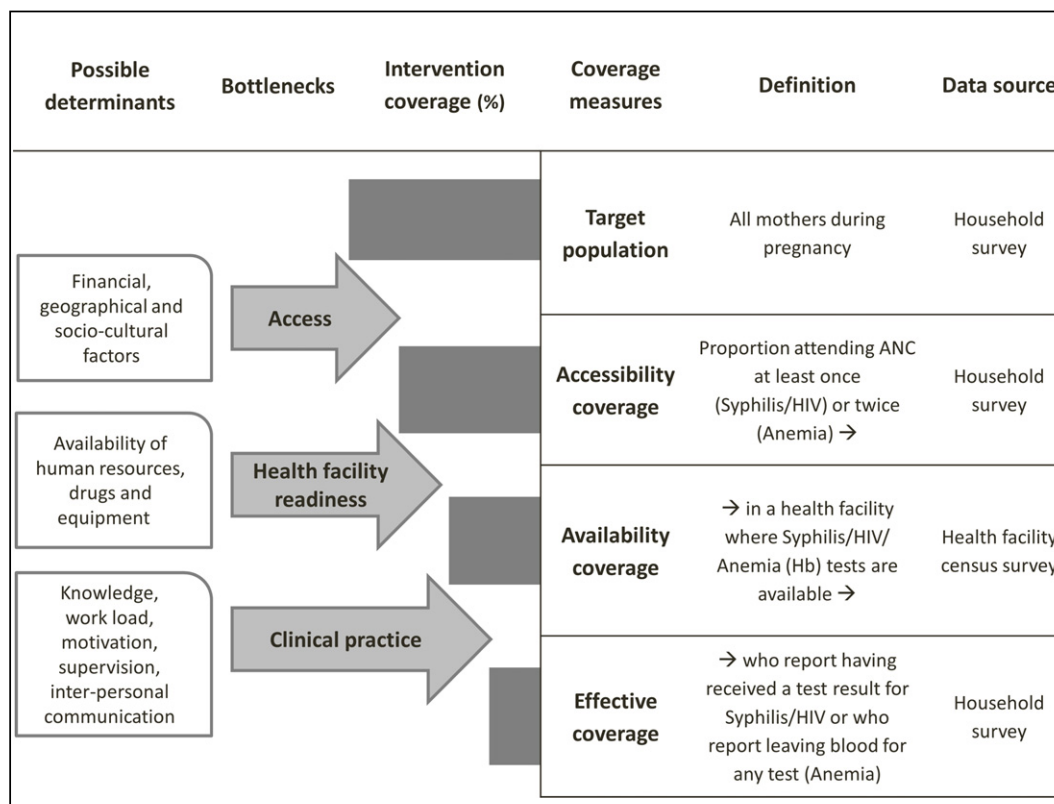


Fig. 1. Implementation pathway for essential screening tests during antenatal care (ANC). Adapted from Baker et al. [22]. Coverage measures with their definitions are outlined. Arrows in the definition column represent the conditionality of the stages in the pathway. Attritions in coverage, the bottlenecks causing these, and their possible determinants are illustrated.

Table 1
EQUIP survey sample sizes.

	Tanzania (n)	Uganda (n)	Total (n)
Households interviewed	14 215	13 125	27 340
Women of reproductive age (13–49 years) interviewed	13 239	14 718	27 957
Women with a live birth in the past 12 months	1422	2933	4415
Number of health facilities surveyed (6 time points)	63	59	122

were conducted in Tanzania and three in Uganda. In Tanzania, these interviews were part of a larger qualitative study exploring bottlenecks in the district health service and health workers were sampled to represent different facility levels (hospital, health center, or dispensary). In Uganda, the interviews were conducted for the purpose of this study and were sampled to represent two health facility levels (health center II and III). All interviews were recorded. Transcription was verbatim in all but three cases where summary notes were made and illustrative quotes captured verbatim.

2.3. Bottleneck analysis

An adapted Tanahashi model [21], the implementation pathway, was used as suggested by Baker et al. [22]. This model allows for estimating coverage in conditional stages of implementation between which bottlenecks can be identified (Fig. 1). The stages of this pathway include (1) accessibility coverage; (2) availability coverage; and (3) effective coverage.

The target population was defined as all pregnant women. Accessibility to screening was estimated using ANC attendance (at least once for syphilis and HIV and at least twice for anemia). Availability coverage was conditional on mothers having attended ANC at a clinic where the tests were available. This was estimated by linking data on ANC attendance from the household survey with data on test availability from the household census. This analysis was stratified so that the proportion of mothers attending a dispensary, health center, or hospital for ANC was multiplied by the proportion of dispensaries, health centers, or hospitals with the screening test in stock. Stratified results were summarized to form an overall availability coverage for each screening test.

Effective coverage was conditional on mothers having attended ANC in a health facility where the screening tests were available and who reported having had the test. In the case of anemia, no specific indicator was available and mothers' reports of having had blood drawn for any test were used as a proxy indicator (Fig. 1).

Bottlenecks along the implementation pathway were measured as absolute attrition in coverage from one stage to the next and were given the overall labels: access (attrition from target population to accessibility coverage); health facility readiness (attrition from accessibility to availability coverage); and clinical practice (attrition from availability to effective coverage) (Fig. 1). STATA 12 (StataCorp, College Station, TX, USA) was used for the analysis. Stratification and multiplicative analysis to construct the coverage measures was performed in Excel (Microsoft; Redmond, WA, USA).

2.4. Qualitative framework analysis

Key informant interviews were analyzed using framework analysis [23]. The analysis stages included: (1) familiarization with data; (2) developing pre-determined key themes to be explored; (3) indexing interview data under relevant themes while noting down any emergent new themes in the data; and (4) summarizing and reducing data in an Excel spreadsheet.

2.5. Ethical considerations

The study was granted ethical clearance from the National Institute of Medical Research in Tanzania and from Makerere University, College of Health Sciences, School of Public Health, Higher Degrees Research and Ethics Committee in Uganda through the EQUIP project.

3. Results

3.1. Overview

Data from 4415 women with a live birth in the 12 months prior to the household survey and from six repeated censuses of 122 health facilities was analyzed (Table 1). Availability of screening tests at each health facility census is displayed in Fig. 2.

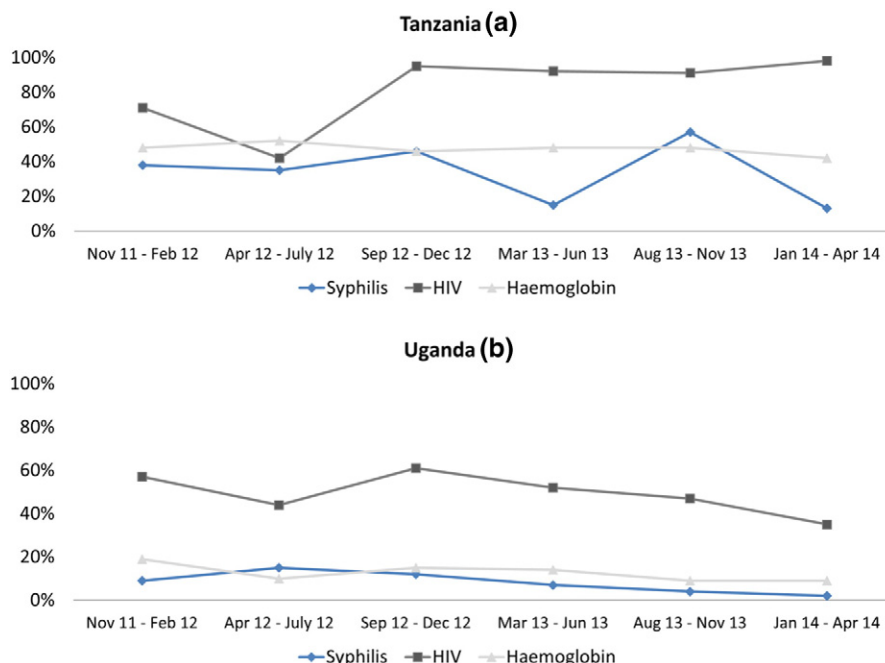


Fig. 2. Proportion of health facilities with availability of screening tests at different time points in Tanzania (a) and Uganda (b).

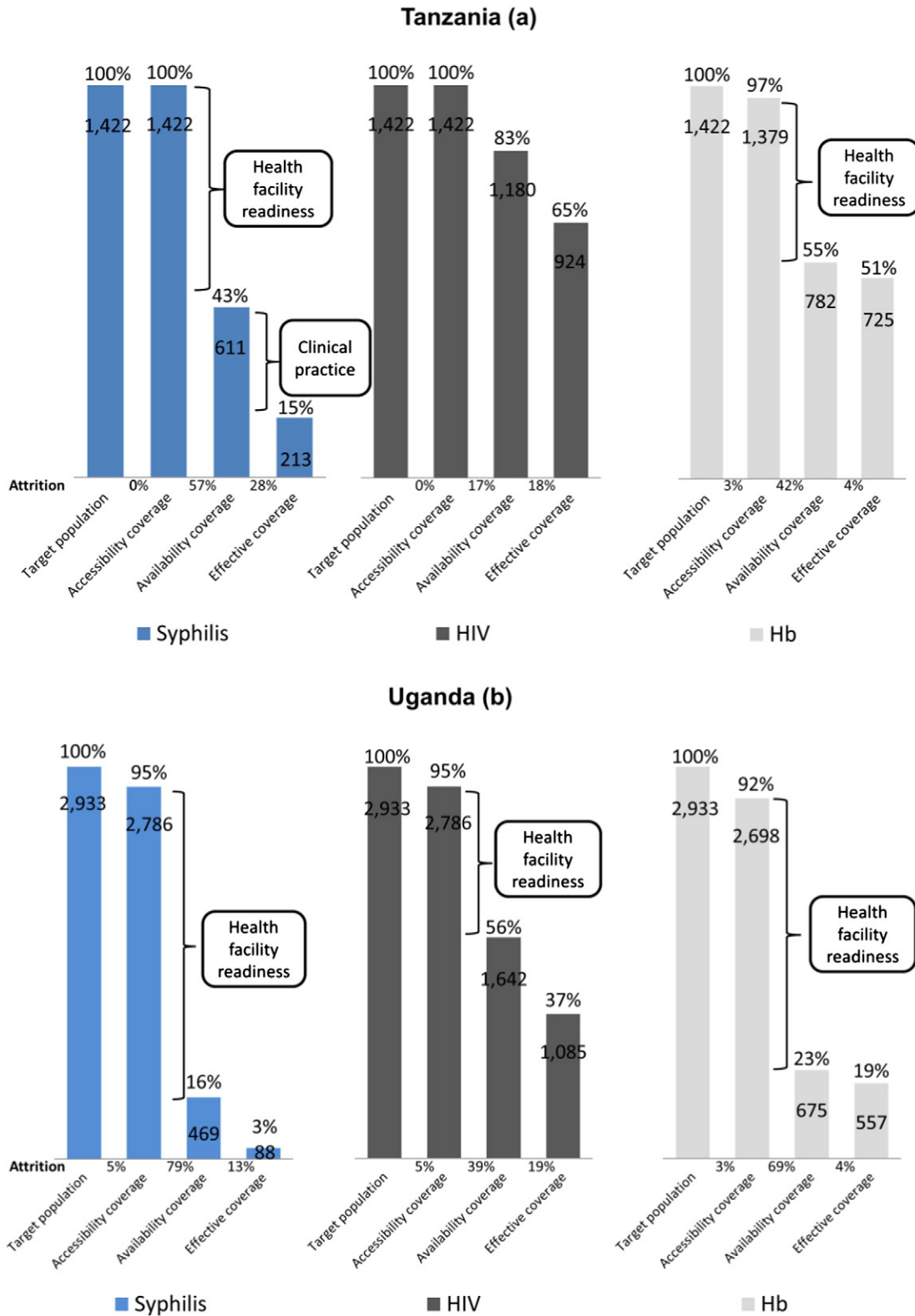


Fig. 3. Implementation pathway for screening of syphilis, HIV, and anemia (Hb) in Tanzania (a) and Uganda (b). Coverage for each stage of implementation is indicated at the top of the bars. Main bottlenecks causing attrition in coverage are indicated in text boxes with attrition in percent indicated below in between bars.

3.2. Bottleneck analyses

In Tanzania, effective coverage of screening tests was estimated at 15% (213/1422) for syphilis, 65% (924/1422) for HIV, and 51% (725/1422) for anemia (Fig. 3a). For all three tests, accessibility coverage was universal or near-universal. The largest bottleneck was poor health

facility readiness, i.e. test shortages, causing an attrition of 57% (811/1422) for syphilis screening and 42% (597/1422) for anemia screening. For HIV screening, test shortages only caused an attrition in coverage of 17%. Clinical practice represented a second large bottleneck, causing an attrition of 28% for syphilis screening and of 18% for HIV testing. For anemia, there was minimal attrition from availability to effective coverage.

Table 2
Main themes and subthemes from qualitative framework analysis.

Themes	Subthemes	Tanzania	Uganda	Tanzania	Uganda	Tanzania	Uganda
		Syphilis		HIV		Hemoglobin	
Availability		Low	Low	High	Moderate	Low	Low
Determinants of availability and effective coverage	Supply chain	<ul style="list-style-type: none"> • Stock-out in MSD • No buffer stock kept at district level • Expired tests • Lack of coordination in MSD • Delay in ordering from health facilities 	<ul style="list-style-type: none"> • Irregular supply from NMS • Ordering from health facilities via district not satisfactory 	<ul style="list-style-type: none"> • Procurement of HIV tests priority in MSD 	<ul style="list-style-type: none"> • Regular supply of test kits from NMS • Previous buffer of test kits stopped • Ordering from health facilities via district not satisfactory 	<ul style="list-style-type: none"> • Stock-out in MSD 	<ul style="list-style-type: none"> • Irregular supply from NMS • Ordering from health facilities via district not satisfactory
	Financing and implementation support	<ul style="list-style-type: none"> • No external support • Budget tied to MSD 	<ul style="list-style-type: none"> • No external support • Few health facilities with laboratory 	<ul style="list-style-type: none"> • External support • PMTCT in all health facilities 	<ul style="list-style-type: none"> • External support • Few health facilities with laboratory 	<ul style="list-style-type: none"> • Limited external support • Budget tied to MSD • Few health facilities with Hemocue 	<ul style="list-style-type: none"> • No external support • Few facilities with laboratory
	ANC clinical practice			<ul style="list-style-type: none"> • Heavy work load • Lack of health worker knowledge • Long waiting • Mothers arrive late • Mothers refuse testing • Mothers not tested 		<ul style="list-style-type: none"> • Heavy work load • Health workers motivated to test • Long waiting • Mothers arrive late • Mothers refuse testing • Mothers not tested 	<ul style="list-style-type: none"> • Mothers not tested
Importance of testing/consequences of low availability		<ul style="list-style-type: none"> • Mothers not tested • Clinical assessment • Counselling undermined 					
Solutions to overcome low availability and effective coverage	Supply chain	<ul style="list-style-type: none"> • Improved feed-back on stock-outs from MSD 	<ul style="list-style-type: none"> • Increase size of test kits • Order directly from health facilities • Improve planning and communication 		<ul style="list-style-type: none"> • Increase size of test kits • Order directly from health facilities • Improve planning and communication 		<ul style="list-style-type: none"> • Increase size of test kits • Order directly from health facilities • Improve planning and communication
	Financing and implementation support	<ul style="list-style-type: none"> • External support • Integrate screening programs • Use alternative funds to procure tests outside of MSD 	<ul style="list-style-type: none"> • External support • Roll-out to more health center levels • Increase number of health workers for ANC 		<ul style="list-style-type: none"> • External support • Roll-out to more health center levels • Increase number of health workers for ANC 	<ul style="list-style-type: none"> • External support • Equip all health facilities with Hemocue 	<ul style="list-style-type: none"> • External support • Roll-out to more health center levels • Increase number of health workers for ANC
	ANC clinical practice	<ul style="list-style-type: none"> • Request tests from nearby facilities • Delay testing • Refer to other health facility 	<ul style="list-style-type: none"> • Increase health workers' knowledge • Increase mothers' knowledge of reason for testing 		<ul style="list-style-type: none"> • Increase health workers' knowledge • Increase mothers' knowledge of reason for testing 	<ul style="list-style-type: none"> • Refer to other health facilities 	<ul style="list-style-type: none"> • Increase health workers' knowledge • Increase mothers' knowledge of reason for testing

Abbreviations: ANC, antenatal care; MSD, Medical Stores Department; NMS, National Medical Stores; PMTCT, prevention of mother-to-child transmission.

In Uganda, effective coverage of the screening tests was estimated at 3% (88/2933) for syphilis, 37% (1085/2933) for HIV, and 19% (557) for anemia (Fig. 3b). Accessibility coverage was 95% (2786/2933) for syphilis and HIV and 92% (2698/2933) for anemia screening. The largest bottleneck was health facility readiness, causing a large attrition for both syphilis and anemia of 79% and 69%, respectively, as well as a substantial attrition (39%) from accessibility to availability coverage of HIV screening. Clinical practice caused minor attrition from availability to effective coverage of syphilis and HIV screening (13% and 19%, respectively) and even less for anemia screening (4%).

3.3. Overview qualitative framework analysis

The overarching themes, sub-themes, and categories explored in the framework analysis are outlined in Table 2, with the main findings elaborated below.

3.3.1. Availability of tests

In Tanzania, informants confirmed the low availability of tests and equipment to screen for syphilis and anemia while the availability of HIV tests was not perceived as a problem. In Uganda, availability was expressed as a problem for all three screening tests, although less so for HIV.

"We have run out of syphilis tests but we have those for HIV." (Nurse, Dispensary, Tanzania)

"HIV test would be okay because all the mothers who come are all tested and testing tubes are abundantly available." (Member of District Health Management Team, Uganda)

3.3.2. Determinants of availability and effective coverage

In Tanzania, the main reason for low availability of syphilis tests and hemoglobin test cuvettes was perceived to be stockouts in the Medical Stores Department (MSD). No external partner provided the district with support for syphilis screening and, as the district's budget is tied to the MSD, procurement from alternative sources during stockouts is difficult.

"Money can be there but if the items are not there [at MSD] we don't get [them] but we can't get our money back." (Member of Council Health Management Team (CHMT), Tanzania)

Procurement of HIV tests was perceived to be given priority by the MSD over other tests and external partners provided test kits in parallel with the MSD. Anemia screening had received some support from the Elizabeth Glaser Pediatric AIDS Foundation through its PMTCT program.

In Uganda, health facilities submit their orders through the district rather than directly to the National Medical Stores (NMS); this was perceived to result in suboptimal procurement.

"We do monthly reporting but I don't think they [the district management] follow them [...] in the end, they don't supply us with the kits." (Health worker, Health center III, Uganda)

The implementation of either syphilis or anemia screening in Uganda was not supported by external partners, while this was the case for HIV. However, the Ministry of Health had recently stopped the parallel procurement of HIV test kits by external partners in an effort to improve coordination.

In Tanzania, no key informants discussed the role of clinical practice in ANC as a determinant. In Uganda, the heavy workload was perceived to be a factor in the inconsistent performance of screening despite tests being available. Mothers were perceived to have poor knowledge of reasons for syphilis and anemia screening and to avoid the laboratory if waiting times were long.

"When you delay them [mothers] here [at ANC], they end up not doing some tests." (Health worker, Health center III, Uganda)

In Uganda, there was also a perception of insufficient knowledge among health workers on the importance of screening for syphilis and anemia. For HIV screening, on the other hand, the motivation to test was perceived to be higher due to the knowledge of PMTCT and a personal need for infection control measures at the time of delivery.

3.3.3. Consequences of low test availability

In both countries, the obvious consequence of low test availability was that mothers were not being screened. In Tanzania, health workers expressed reverting to clinical examination to assess signs of syphilis and to refer suspicious cases for testing. The shortage of tests was also perceived to undermine counselling of mothers on the importance of testing.

"Even if you tell the mother [about syphilis], it doesn't help because the tool for testing syphilis is not available." (Nurse, Health center, Tanzania)

3.3.4. Solutions to overcome low test availability

In Tanzania, the district suggested improved reporting from the MSD during syphilis tests stockouts. Support from external partners for syphilis screening and improved integration of support for ANC was also expressed as a key solution.

"If these [external partners] could support us [...] and not focus only on HIV, HIV [testing] is not a problem." (Member of CHMT, Tanzania)

Another strategy occasionally employed by the district in Tanzania was to use cost sharing funds, i.e. patient fees, to procure syphilis tests from private pharmacies when the MSD was out of stock. Mothers were sometimes referred to test in other facilities or tests were requested from nearby districts.

"We normally request either from Newala or Masasi [nearby districts], we normally share whatever we have." (Nurse, District hospital, Tanzania)

In Uganda, the perceived key solutions to increase screening coverage included further external support, extending testing to more health center levels, and recruiting additional health workers for ANC. The possibility of health facilities placing orders directly to the NMS was also perceived as important.

"If they can allow us [health facilities] to make requisitions [to the NMS] by ourselves, it will help us." (Health worker, Health center III, Uganda)

4. Discussion

Effective coverage of essential screening for pregnant mothers remains low in Tanzania and Uganda, with the highest effective coverage achieved for HIV in Tanzania (65%) and the lowest for syphilis in Uganda (3%). The main bottleneck identified in both countries was the shortage of tests and equipment. Overall, the availability of tests was higher in Tanzania than in Uganda. The availability of HIV tests was significantly higher than that for syphilis and anemia in both settings. Perceptions of the underlying determinants included lack of integration of support for different aspects of ANC and central level procurement problems.

The estimates of test availability are close to those from recent national surveys in both countries [24,25]. For syphilis and HIV screening, the results are also similar to the WHO estimates of 44%

and 15% of pregnant women being tested for syphilis and 86% and 63% being tested for HIV in Tanzania and Uganda, respectively [26]. To our knowledge, international estimates for anemia screening are not available.

Key informants in both countries expressed difficulties in ensuring a regular supply of syphilis testing kits, pointing to procurement problems at the central level. This was also the experience from the EQUIP study, where quality improvement teams in health facilities did not identify any solutions to overcoming the low availability of syphilis tests. This was different for other improvement areas where, for example, the availability of oxytocin was ensured through consistent ordering routines. In both Tanzania and Uganda, screening tests for syphilis and HIV are partly funded by external partners, while logistics is integrated into the national procurement and supply system. In Tanzania, external partners occasionally procure test kits from outside the MSD, but this is mainly limited to HIV tests. In Uganda, a similar system has recently been reformed with the aim to improve coordination. While donor-driven procurement is not desirable, district stakeholders and health providers see it as a potential solution.

The large differences in availability between the screening tests reflect the strength of international support. PMTCT is high on the agenda and financially supported through the Global Fund. The Eliminating Congenital Syphilis initiative, led by WHO, is less known and supported [27], and apparently poorly funded, despite the strong evidence base [3,28].

There is currently a strong consensus regarding the importance of integrating health services and creating synergies to meet the health needs of populations [29], as reflected in national policies. In Tanzania, external partners support implementation of PMTCT within a framework which states that “testing for HIV is an integral part of ANC and should be accompanied with all other necessary tests such as syphilis, hemoglobin and others” [30]. The present study, however, suggests that such policies do not necessarily lead to the provision of integrated services unless financing and support are comprehensive rather than selective.

4.1. Limitations

The present analysis did not include indicators of adequate treatment as a result of screening. There was no access to such detailed data; further, it would have complicated the comparative nature of the analysis since treatments and endpoints differ. Definitions for the stages of coverage along the implementation pathway were based on simplifying assumptions. While early screening is important to ensure the largest impact, the timing of the first ANC visit was not included [31]. The validity of mothers' reports is a generic problem for any survey [32]; estimates of effective coverage could therefore have been underestimated, although we believe that if screening and counselling have been effective, mothers will remember. Indicators were not individually linked between mothers and the particular health facilities they attended; this could result in false low coverage estimates as availability may be higher at the actual facility attended. Additionally, stakeholder interviews at the national or regional levels could not be included in this study although these could have provided further explanation for testing material shortages within the national drug distribution systems. Finally, while the study was conducted in typical rural districts in Tanzania and Uganda [17], we believe that these results are generalizable to both countries.

5. Conclusions and policy recommendations

The low effective coverage and large differences in availability of tests for essential screening indicated herein reflect missed opportunities with severe health implications for mothers and newborns in rural East Africa. A focus on developing mechanisms for joint financing and support for screening as part of care bundles for mothers and

newborns is required. Such a strategy may avoid the opportunity costs of targeting a few priority conditions while leaving other essential aspects of care underfunded.

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Conflict of interest

The authors declare that they have no conflicts of interest.

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