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Integrating SARS-CoV-2 rapid antigen testing in maternal, neonatal and child health, HIV, and TB clinics in Kenya and Cameroon: outcomes from the Catalysing COVID-19 Action Project

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ABSTRACT

Introduction Early diagnosis of SARS-CoV-2 infection is key to preventing severe disease and poor outcomes in vulnerable populations, such as pregnant women and people living with HIV or diagnosed with tuberculosis (TB). We assessed outcomes achieved with the integration of SARS-CoV-2 antigen-detecting rapid diagnostic testing (Ag-RDT) into maternal, neonatal and child health (MNCH); HIV and TB clinics in the Catalysing COVID-19 Action project.

Methods Screening and testing for SARS-CoV-2 per national guidelines were integrated into MNCH, HIV and TB clinics in 50 health facilities in Cameroon and Kenya. In Cameroon, screening and testing were done by existing facility staff, while in Kenya, additional community workers and laboratory staff were involved. Clients aged >2 years attending MNCH, HIV and TB clinics between May and October 2022 were included in the study. We estimated the proportion of participants screened, tested and tested positive; calculated the SARS-CoV-2 case detection rate per 1000 attendees and determined factors associated with screening, testing and positivity.

Results Overall, 528 567 attendee visits were reported in Cameroon (282 404) and Kenya (246 163), with screening for SARS-CoV-2 performed in 256 049 (48.4%), showing substantive variations between countries (62.6% in Cameroon and 32.2% in Kenya). Among the 256 049 screened, 19 013 (7.4%) were eligible for testing (9.0% in Cameroon and 3.9% in Kenya), of whom 12 934 (68.0%) were tested for SARS-CoV-2 including 9866/15 934 (61.9%) in Cameroon and 3068/3079 (96.6%) in Kenya. A total of 390 (3.0%) positive tests were identified (329/9866, 3.3%, in Cameroon and 61/3068, 2.0%, in Kenya). Country integration strategy, facility level, setting and clinic were independently associated with screening and testing.

Conclusions Integration of SARS-CoV-2 Ag-RDT in MNCH, HIV and TB clinics in both countries allowed detection of SARS-CoV-2 cases among vulnerable populations. Integration strategies should consider facility settings and additional human resources in high-volume facilities to improve screening and testing proportions.

Trial registration number NCT05498727.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ SARS-CoV-2 antigen-detecting rapid diagnostic testing is an effective and affordable tool for the early diagnosis of COVID-19 in the general population and is recommended at global and national levels to test everyone or only those eligible.

⇒ Pregnant women, people living with HIV and those diagnosed with tuberculosis (TB) are more vulnerable to SARS-CoV-2 infection than the general population, and according to a meta-analysis, they are more likely to develop severe forms of COVID-19, with pregnancy complications, long admission periods in intensified care units and death.

⇒ Integration of testing activities into the routine care of specific service delivery points in the facility is among the strategies known to improve rapid case identification of new diseases, early care and treatment provision and treatment outcomes of the most vulnerable patients.

INTRODUCTION

The SARS-CoV-2 pandemic created a major public health crisis across the world, with over 770 million confirmed cases reported as of September 2023.[1 2] With nearly seven million deaths, the case fatality rate is estimated to be 0.9% globally in the same period.[1 2] Africa reported more than 9.5 million confirmed

WHAT THIS STUDY ADDS

⇒ Integration of SARS-CoV-2 testing services, including screening, testing, referral for vaccination or provision of care and treatment, into the routine activities of maternal, neonatal and child healthMNCH, HIV, and TB clinics, is possible and was achieved through the implementation of this project.

⇒ When service integration relies only on existing staff, the screening proportions isare higher and the testing proportion is lower when compared tocompared with settings where integration relies on additional dedicated staff for screening and testing.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Policy -makers at the global and national levels may use these data to accelerate decision -making processes to bring screening and testing services closer to the most vulnerable populations, thus improving early detection and appropriate care and reducing the risk of severe forms of the disease and related mortality. Knowing that integration can be achieved regardless of the service delivery point, resource allocation and recommendations to target the most vulnerable can be taken based on the evidence provided here.

⇒ Programme implementers in Africa and other regions of the world may use these results to select the most appropriate integration strategy according to the epidemic situation and resources available.

cases and over 175 000 related deaths. In East Africa, Kenya ranked second in the number of cases with over 340 000 confirmed cases and over 5600 deaths as of September 2023.[3] In Central Africa, during the same period, Cameroon was considered an epicentre of SARS-CoV-2 transmission with over 120 000 confirmed cases and nearly 2000 deaths.[4]

In response to the rapidly spreading SARS-CoV-2 pandemic, resources were mobilised to quickly develop effective and affordable SARS-CoV-2 diagnostic tools, treatments and vaccines. Global health experts simultaneously developed policies and guidelines to limit the spread of COVID-19 through multiple measures, including limitations on travel and mass gatherings and conducted advocacy for equitable access to diagnostics, treatment and vaccines.[5–7]

In 2021, the WHO approved the use of antigen-detecting rapid diagnostic tests (Ag-RDT) as a case detection tool in symptomatic individuals and in those with high risk of infection.[8] SARS-CoV-2 testing is performed to inform symptomatic patients of their infection, provide appropriate treatment and identify infectious individuals in a population, including those without symptoms, who can then be isolated to reduce the spread of infection to others.[9] To reduce severe morbidity and unfavourable health outcomes, early identification of SARS-CoV-2 infection and appropriate care is critical for vulnerable populations, who are more likely to develop severe forms of COVID-19.[5 10 11]

It is widely recognised that SARS-CoV-2 infection has more severe impacts on pregnant women, people living with HIV (PLHIV) and those diagnosed with tuberculosis (TB).[12–17] In Africa, HIV and TB pose significant concerns due to their high prevalence. Patients living with these diseases have demonstrated a high susceptibility to developing more severe forms of COVID-19, leading to higher rates of intensive care unit (ICU) admission and mortality.[18] Pregnant women aged 15–44 years who are infected with SARS-CoV-2 have a 70% higher risk of mortality, a threefold higher risk of needing invasive ventilation and are more likely to require ICU admission and extracorporeal membrane oxygenation than non-pregnant women.[12] There is a critical need to increase access to testing and early diagnosis of SARS-CoV-2 infection in these populations to reduce viral spread and improve their health outcomes.[19]

As countries strive to enhance the overall resilience of their health systems, there has been a growing emphasis on integrated service delivery.[20] For pregnant women, PLHIV and people diagnosed with TB, integrating SARS-CoV-2 testing into their routine care during visits to maternal, neonatal and child health (MNCH), HIV and TB clinics offers important opportunities for testing. Integration of other health services into specialty clinics such as those for MNCH, HIV and TB in resource-limited settings has proven to be feasible and effective in improving quality care.[21] However, there is a lack of evidence from low-imcome/lower-middle-income countries regarding the integration of SARS-CoV-2 testing services into routine care, especially at service delivery points for more vulnerable populations.

Leveraging the experience of introducing HIV testing into MNCH and TB clinics, the Catalysing COVID-19 Action (CCA) project was implemented to increase early diagnosis and treatment of SARS-CoV-2 infection through catalytic interventions, including integration of SARS-CoV-2 testing into routine care at MNCH, HIV and TB clinics.[22] This study analysed CCA programme data to determine the outcomes of the integration of SARS-CoV-2 Ag-RDT into MNCH, HIV and TB service delivery points in two sub-Saharan African countries.

MATERIALS AND METHODS

Study design and setting

We conducted a cross-sectional analysis of data collected during the implementation of the CCA project from May to October 2022. The project integrated SARS-CoV-2 Ag-RDT into three service delivery entry points (MNCH, HIV and TB) in 50 health facilities in Cameroon and Kenya (25 in each country), selected at different levels (primary, secondary and tertiary) and geographical settings (urban, semiurban and rural). In Kenya, project sites were purposively selected by the Ministry of Health (MOH) in Kiambu County. Kiambu County in Kenya neighbours the capital city, Nairobi and was ranked second in the country in cumulative number of confirmed COVID-19 cases. The county had major gaps in COVID-19 management due to inadequate resources limiting response capacity in detecting, investigating,

contact tracing and follow-up both in the facilities and within the community. The sites within the county were selected based on the burden and reported spikes in cases of COVID-19. In Cameroon, the MOH purposively selected the project sites among the highest volume facilities with the three project clinics available in the Centre, Littoral and West regions (among the top five highest burden regions for COVID-19 in the country). The integration framework consisted of three main activities, including the provision of all materials needed to offer SARS-CoV-2 testing and treatment services, increased human resource capacity to provide these services and improved documentation of service uptake.

The SARS-CoV-2 Ag-RDT integration strategy approach differed by country. In Cameroon, based on lessons learnt from previous experiences and concertation with the project team, facilities representative and MoH, integration relied mainly on existing health facility staffs providing routine care to clinic attendees. Clinic staffs were trained to provide SARS-CoV-2 screening, pretest counselling, Ag-RDT testing, result disclosure and post-test counselling, in addition to documenting the services offered on paper-based forms and registers. In Kenya, due to the high volume of patients and the additional procedure of screening in the three clinics (MNCH, HIV and TB clinics), CHWs were engaged to support the existing staff to ensure screening was integrated in the departments. Similarly, the lab staff were engaged to ensure the integration of testing in the departments. In both countries, clinicians (doctors and senior nurses) were trained to provide care and treatment to clinic attendees who tested positive for SARS-CoV-2, per the national guidelines.

Participants and procedures

In each facility, all clinic attendees aged ≥2 years attending MNCH, HIV and TB clinics underwent SARS-CoV-2 screening and those eligible were offered testing free of charge, using SARS-CoV-2 Ag-RDT. The WHO-approved SARS-CoV-2 Ag-RDT tests, Abbott Panbio and SD Biosensor Standard Q were used for testing according to MOH guidelines. At each clinic, attendees were first screened using a tool that collected information on COVID-19 symptoms (cough, fever, runny nose, diarrhoea, headache, muscle pain, abdominal pain, loss of taste or smell, fatigue, breathing difficulty, nausea/vomiting, chest pain, joint pain and altered mental status), recent history of exposure (including contact with a person who tested positive for SARS-CoV-2), attendance at mass gathering events and travel on public transportation.[23] Those screening positive for either symptoms or exposure were offered the SARS-CoV-2 Ag-RDT following pretest counselling. Based on the results of the test, clinic attendees were either referred for SARS-CoV-2 vaccination (negative test result) or for COVID-19 care and treatment (positive test result). Clinic attendees who opted out of testing still received routine healthcare services in both countries.

Data were collected on demographics, characteristics of health facilities, symptoms of COVID-19, SARS-CoV-2 risk exposure and clinical decisions of the service provider for management of COVID-19 cases. Clinic attendees who tested positive for SARS-CoV-2 using Ag-RDT were referred to a clinician for staging of COVID-19 status and either sent home for self-isolation (if asymptomatic or showing mild symptoms) or admitted to a COVID-19 treatment unit (if showing moderate, severe or critical symptoms). Additionally, testing data on the type of sample, type of test performed and test results were captured. These data were collected by health facility staff using a paper-based form in Cameroon and via the electronic medical record system in Kenya and transferred to a deidentified research database for analysis for the time period of May–October 2022.

Statistical analysis

We used frequencies and percentages to summarise the SARS-CoV-2 screening and testing cascade, disaggregated by country. Demographic and clinical characteristics of patients were summarised using frequencies and proportions for categorical variables and means and SD or medians and IQRs for continuous variables disaggregated by clinic type (MNCH, HIV or TB).

We estimated the case detection rate as the proportion of the number of SARS-CoV-2 positive tests to the total number of clinic attendee encounters multiplied by 1000 and the associated 95% CIs. This denominator was selected to account for the entire population including those potentially missed by the screening. To account for potential variation in case detection rates between health facilities, we also estimated facility-specific case detection rates. The overall case detection rates were estimated as inverse variance-weighted averages of the facility estimates. Case detection rates were estimated and disaggregated by country and clinic.

Bivariable logistic regression analyses were performed to identify factors associated with SARS-CoV-2 screening, Ag-RDT testing and SARS-CoV-2 infection. Factors significantly associated with infection at p≤0.1 were included in multivariable logistic regression to identify factors independently associated with infection. Adjusted ORs and associated 95% CIs were used to summarise the strength and direction of the association.

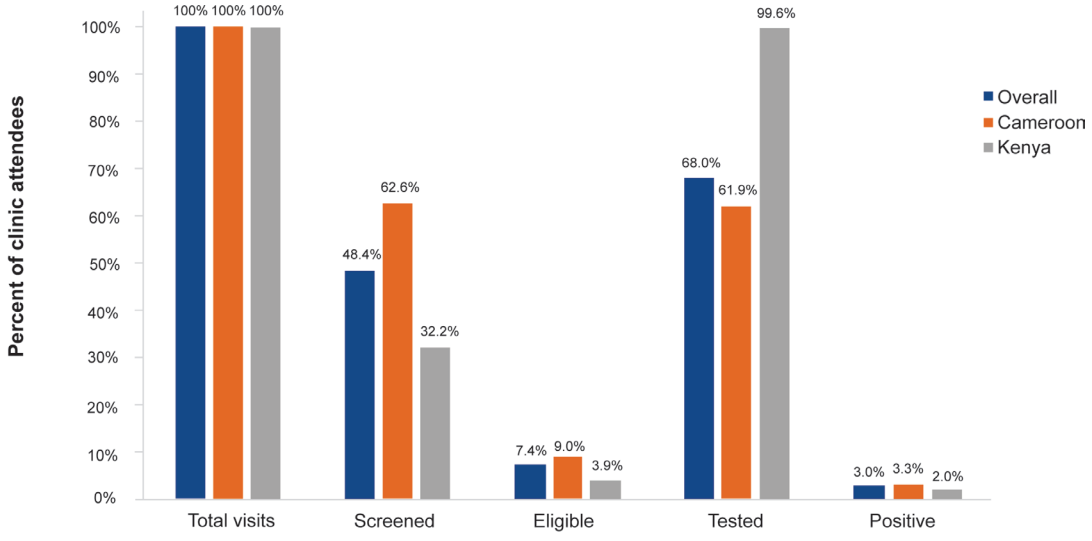
Participant and public involvement

Participants and the public were not involved in the study design, data collection, analysis, interpretation or writing of the final manuscript.

RESULTS

Integration of SARS-CoV-2 testing services in the facility clinics

Between May and October 2022, a total of 528 567 clinic attendee visits were recorded in the 50 health facilities. Of these, 256 049 (48.4%) screening events were reported, with 19 013 (7.4%) of those determined to



	Total visits	Screened	Eligible	Tested	Positive
Overall	528,567	256,049	19,013	12,934	390
Cameroon	282,404	176,712	15,934	9,866	329
Kenya	246,163	79,337	3,079	3,068	61

Figure 1 Screening and testing cascade following integration of SARS-CoV-2 antigen-detecting rapid diagnosis test in routine service delivery entry points in Cameroon and Kenya.

be eligible for SARS-CoV-2 testing (figure 1). A total of 12934 clinic attendees (68.0% of those eligible) were tested using Ag-RDTs with 390 SARS-CoV-2-positive results (3.0%). The proportion of SARS-CoV-2 screening performed were higher in Cameroon compared with Kenya (62.6% vs 32.4%); however, a higher proportion of participants identified as eligible were tested in Kenya (99.6%) compared with Cameroon (61.9%).

Characteristics of clinic attendees receiving integrated SARS-CoV-2 Ag-RDT services

A total of 256049 clinic attendees were screened, including 211334 (84.0%) females, with differences observed in sex distribution across clinics. The proportion of females in the HIV clinics (71.5%) and MNCH clinics (96.4%) was higher than the proportion of females in the TB clinics (43.2%). Table 1 shows the demographic and clinical characteristics of the participants screened, disaggregated by clinic type.

Overall, the majority of participants were in the 15–49 years age group (82.5%), and 14.3% were 50 years or above, with differences observed in age distribution across clinics. Of the 256049 participants, 176712 (69.0%) came from clinics in Cameroon, with participants in Cameroon making up a much higher proportion of the participants in HIV and TB clinics (82.6% and 71.1%, respectively). In terms of exposure and prevention factors, 5.2% of participants reported attending a mass gathering event while only 0.4% reported contact with a confirmed COVID-19 case. A higher proportion of TB clinic participants reported engagement in potentially high SARS-CoV-2 exposure environments compared with other clinic participants. Only 2981 (1.2%) clinic participants reported being fully or partially vaccinated, and 19013 (7.4%) participants reported experiencing at least one symptom of COVID-19, with cough (9,950; 3.9%) runny nose (3,980; 1.6%), headache (4,018; 1.6%) and fever within the last 3 days (3,002; 2.1%) reported as the most frequent symptoms (see online supplemental file 1).

SARS-CoV-2 testing cascade per service delivery entry points

Figure 2 displays the SARS-CoV-2 cascade by service delivery point and country. In Cameroon, screening proportions were higher in MNCH (73.7%) and TB (79.7%) clinics compared with HIV (53.2%) clinics. In Kenya, screening proportions were comparable between clinics but substantially lower than in Cameroon. Similarly, the proportion of attendees found eligible for testing was higher in Cameroon compared with Kenya across the service delivery entry points, especially MNCH (9.8% vs 3.6%) and TB (32.5% vs 8.1%) clinics. A much lower number but a higher proportion of eligible attendees were tested for SARS-CoV-2 in all the service delivery entry points in Kenya compared with Cameroon.

SARS-CoV-2 case detection rate per service delivery entry points

Overall, among 528567 attendees seen in both countries, 390 tested positive for SARS-CoV-2 Ag-RDT, giving a weighted case detection rate of 0.88 (95% CI 0.56 to 1.21) positive cases per 1000 attendees (online supplemental file 2). The case detection rate was higher in TB clinics at 4.34 (95% CI 0.46 to 8.22) cases per 1000 attendees compared with HIV clinics (0.76 cases/1000 attendees; 95% CI 0.39 to 1.12) and MNCH clinics (0.73

Table 1 Demographics, clinical and exposure factors among clinic attendees screened, disaggregated by service delivery entry point in Cameroon and Kenya

	Entry points							
	HIV clinics		MNCH clinics		TB clinics		Total	
Characteristics	N	%	N	%	N	%	N	%
	101615	100.0	145516	100.0	11938	100.0	259069	100.0
Sex								
Female	71395	71.5	135043	96.4	5115	43.2	211553	84.0
Male	28482	28.5	5007	3.6	6734	56.8	40223	16.0
Age, years								
<15	2557	2.5	4850	3.4	584	4.9	7991	3.1
15–49	66015	65.6	136293	95.0	9026	75.1	211334	82.5
≥50	31980	31.8	2314	1.6	2416	20.1	3,6710	14.3
Country								
Cameroon	83092	81.8	85075	58.5	8545	71.6	176712	68.2
Kenya	18523	18.2	60441	41.5	3393	28.4	82357	31.8
Exposure and prevention factors								
Long travel using public transportation	2572	2.6	5755	4.0	1149	9.6	9476	3.7
Attended large gathering (>50)	2307	2.3	9481	6.6	1556	12.9	13344	5.2
Visited health facility (<2 weeks)	122	0.1	1132	0.8	901	7.5	2155	0.8
Contact with a confirmed COVID-19 case	78	0.1	475	0.3	516	4.3	1069	0.4
History of vaccine*	847	0.8	1879	1.3	255	2.1	2981	1.2
Symptoms								
Presence of at least one symptom†	5580	5.5	10361	7.2	3072	25.5	19013	7.4

*At least one dose of COVID-19 vaccine.
†The symptoms include cough, fever, runny nose, diarrhoea, headache, muscle pain, abdominal pain, loss of taste or smell, fatigue, breathing difficulty, nausea/vomiting, chest pain, joint pain, altered mental status.
MNCH, maternal, neonatal and child health; TB, tuberculosis.

cases/1000 attendees; 95% CI 0.46 to 1.00). The estimated case detection rate in Cameroon was 1.26 (95% CI 0.67 to 1.75) positive cases per 1000 attendees compared with 0.55 (95% CI 0.12 to 0.86) positive cases per 1000 attendees in Kenya. SARS-CoV-2 case detection rates were consistently higher in Cameroon compared with Kenya across the service delivery entry points: 1.0 (95% CI 0.59 to 1.42) vs 0.55 (95% CI 0.01 to 0.73) in MNCH clinics, 1.0 (95% CI 0.48 to 1.53) vs 0.77 (95% CI 0.12 to 4.20) in HIV clinic and 8.01 (95% CI 0.06 to 15.96) vs 0.94 (95% CI 0.0 to 2.41) in TB clinics (online supplemental file 2).

Factors associated with SARS-CoV-2 screening, testing and positivity rate

Country integration approach, health facility setting, health facility level and entry point were independently associated with screening (table 2). Compared with Cameroon, the Kenya integration approach was associated with significantly lower odds of screening (adjusted OR (aOR) 0.12, 95% CI 0.12 to 0.13, p<0.01). Attendees in semiurban (aOR 1.71, 95% CI 1.68 to 1.74, p<0.01) and rural settings (aOR 4.47, 95% CI 4.37 to 4.60, p<0.01) were significantly more likely to be screened compared with attendees in urban settings. MNCH clinics (aOR 1.97, 95% CI 1.94 to 1.99, p<0.01) and TB clinics (aOR 1.82, 95% CI 1.77 to 1.87, p<0.01) were associated with a significantly higher odds of screening attendees compared with HIV clinics.

Similarly, the country integration approach, health facility setting, health facility level and entry point were independently associated with testing (table 3). However, the odds of testing for SARS-CoV-2 among eligible patients were over five times higher in Kenya compared with Cameroon (aOR 6.24, 95% CI 5.47 to 7.12, p<0.01). Semiurban facilities (aOR 0.65, 95% CI 0.60 to 0.71, p<0.01) and rural facilities (aOR 0.30, 95% CI 0.25 to 0.36, p<0.01) were less likely to test eligible patients for SARS-CoV-2 compared with urban facilities. Compared with primary health facilities, secondary (aOR 0.54, 95% CI 0.49 to 0.60, p<0.01) and tertiary (aOR 0.57, 95% CI 0.52 to 0.64, p<0.01) facilities were less likely to test eligible patients. MNCH clinics (aOR 0.55, 95% CI 0.52 to 0.59, p<0.01) were less likely to test eligible patients while TB clinics (aOR 4.25, 95% CI 3.73 to 4.83, p<0.01) were more likely to test eligible patients compared with HIV clinics.

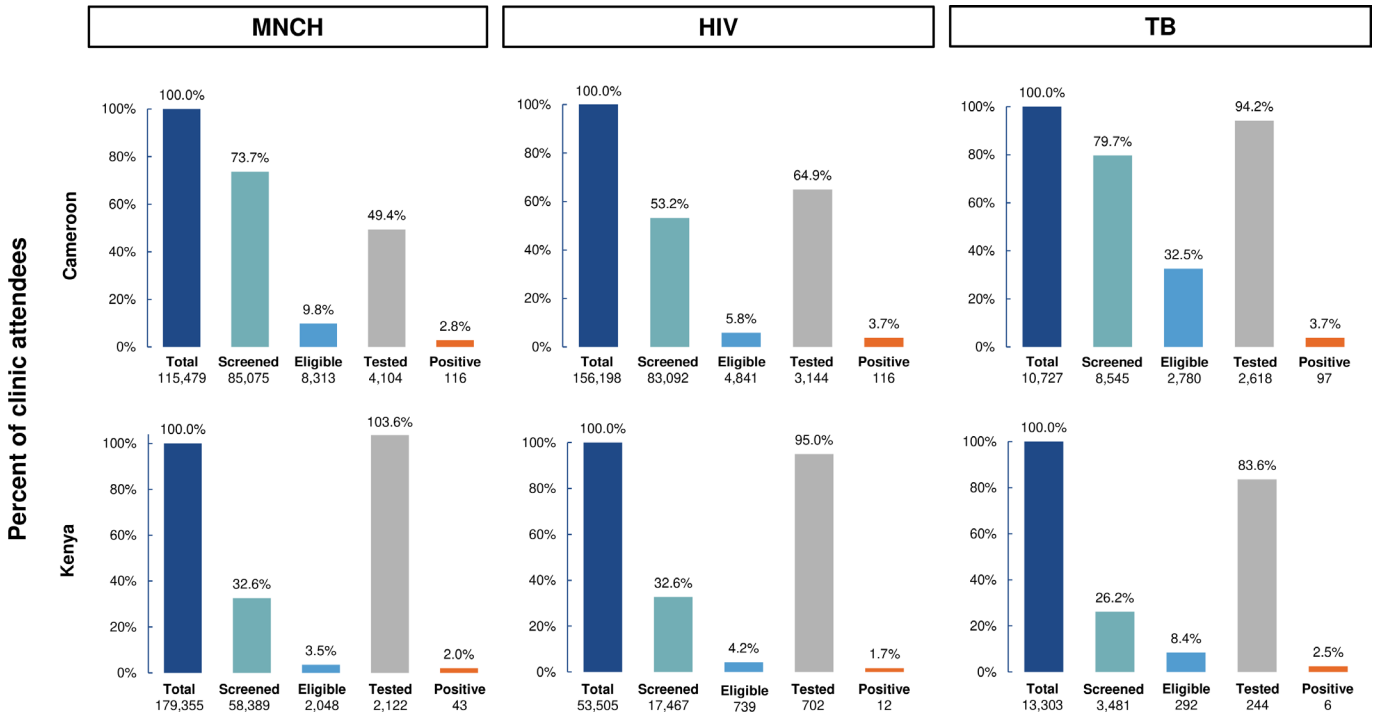


Figure 2 SARS-CoV-2 testing cascade per entry points and by country. MNCH, maternal, neonatal and child health; TB, tuberculosis.

Adjusting for attendee sex and entry point, only country implementation strategy was independently associated with SARS-CoV-2 positivity (table 4). Participants in Kenya had lower odds of testing positive for SARS-CoV-2 compared with patients in Cameroon (aOR 0.73, 95% CI 0.57 to 0.94, p<0.01).

DISCUSSION

To the best of our knowledge, this is one of the first studies assessing the integration of SARS-CoV-2 Ag-RDT into specific service delivery points such as MNCH, HIV and TB clinics. Our study showed that during the first 6 months of programme implementation, about half of clinic attendees were screened for SARS-CoV-2 signs and symptoms or potential exposure, with significant variation between countries (63% in Cameroon vs 32% in Kenya). Approximately, 1 out of 10 participants screened

Table 2 Factors associated with SARS-CoV-2 screening in Cameroon and Kenya

Characteristics	Total	Patients screened		Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
		N	(%)				
Country integration strategy							
Cameroon	282 404	176 712	63	1		1	
Kenya	246 163	79 337	32	0.271 (0.27 to 0.28)	<0.01	0.12 (0.12 to 0.13)	<0.01
Health facility setting							
Urban	340 029	176 210	51.8	1		1	
Semi urban	143 882	55 844	38.8	0.601 (0.59 to 0.61)	<0.01	1.71 (1.68 to 1.74)	<0.01
Rural	44 656	23 995	53.7	1.020 (1.01 to 1.04)	<0.01	4.47 (4.37 to 4.6)	<0.01
Health facility level							
Primary	73 891	38 904	52.6	1		1	
Secondary	230 036	121 046	52.6	1.008 (0.99 to 1.02)	0.367	1.08 (1.06 to 1.10)	<0.01
Tertiary	224 640	96 099	42.8	0.646 (0.63 to 0.65)	<0.01	1.00 (0.99 to 1.03)	0.528
Entry points							
HIV clinics	209 703	100 559	47.9	1		1	
MNCH clinics	294 834	143 464	48.6	1.10 (1.08 to 1.11)	<0.01	1.97 (1.94 to 1.99)	<0.01
TB clinics	24 030	12 026	50.0	0.96 (0.94 to 0.98)	0.004	1.82 (1.77 to 1.87)	<0.01

Table 3 Factors associated with SARS-CoV-2 testing proportions in Cameroon and Kenya

Characteristics	Total	Patients tested		Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
		N	(%)				
Country integration strategy							
Cameroon	15934	9866	61.9	1		1	
Kenya	3079	3068	99.6	2.54 (2.33 to 2.76)	<0.01	6.24 (5.47 to 7.12)	<0.01
Health facility setting							
Urban	12707	8568	67.4	1		1	
Semi urban	4950	3268	66.0	0.76 (0.71 to 0.81)	<0.01	0.65 (0.60 to 0.71)	<0.01
Rural	1356	1068	78.8	1.29 (1.15 to 1.45)	<0.01	0.30 (0.25 to 0.36)	<0.01
Health facility level							
Primary	2235	1736	77.7	1		1	
Secondary	9263	5575	60.2	0.52 (0.47 to 0.58)	<0.01	0.54 (0.49 to 0.60)	<0.01
Tertiary	7515	5623	74.8	0.83 (0.75 to 0.91)	<0.01	0.57 (0.52 to 0.64)	<0.01
Entry points							
HIV clinic	5580	3846	68.9	1		1	
MNCH clinic	10361	6226	60.1	0.66 (0.62 to 0.71)	<0.01	0.55 (0.52 to 0.59)	<0.01
TB clinic	3072	2862	93.2	4.51 (3.98 to 5.12)	<0.01	4.25 (3.73 to 4.83)	<0.01

was eligible for testing, and more than two-thirds of those eligible were finally tested, with substantial differences between countries. Screening proportions were similar across clinics while the proportion eligible and tested was higher in TB clinics compared with HIV and MNCH clinics. Country integration strategy, health facility setting, health facility level and clinic type were independently associated with being screened and with being tested while only country was independently associated with SARS-CoV-2 positivity.

The SARS-CoV-2 testing package of service includes screening, pretest counselling, sample collection, testing, result reading and documentation, providing results and post-test counselling, as well as referral for vaccination or to a clinician for disease staging, appropriate care and treatment provision.[23–25] Integrating this important package of services within the service delivery entry points for pregnant women, PLHIV and people diagnosed with TB was important to increase early identification of SARS-CoV-2 in these populations known to be more vulnerable to COVID-19.[10 23 26 27] Our results show that integrating this package of services into routine care in MNCH, HIV and TB clinics was achieved in the 50 participating health facilities, with almost half of the clinic attendees screened. Two-thirds of those eligible were tested for SARS-CoV-2 and SARS-CoV-2 positive participants were identified and referred to clinicians for care and treatment. Despite the observed gaps in the number screened and tested, the integration of the SARS-CoV-2 package of care in non-COVID-19-specific clinics and non-infectious disease clinics—during the pandemic and with very quick results—is an encouraging achievement for public health programming and epidemic response. Our results align with the available evidence showing that the integration of other health services into specialty MNCH, HIV and TB clinics is feasible and provides good results from the patient and health system perspectives.[28–34]

In addition, compared with the time it took to integrate the HIV package of services into non-HIV clinics such as MNCH and TB clinics, the integration of the SARS-CoV-2 package of service was rapidly achieved, reaching half of eligible attendees in a 6-month implementation period. Thus, in an epidemic or pandemic when specific groups are more vulnerable to disease than the general population, early integration of a preventive and curative package of services into specific service delivery entry points could be considered among the national strategies to treat and control infection.

The integration of a new package of healthcare services into clinics usually comes with challenges related to the model of integrating service delivery, which can lead to gaps in the service uptake and patient outcomes.[31 33 34] Among the challenges identified to the integration of new services, those of supply chain, human resources, referral systems, patient education, stigma, patient records, and monitoring and evaluation are the most common.[29 32 33] In our study, two major challenges were observed in the SARS-CoV-2 service coverage. The first is related to the proportion of attendees screened, which reached only half of the targeted population and ranged between 32.4% in Kenya and 62.6% in Cameroon. The second notable challenge was related to the proportion of those eligible for testing that were actually tested, which was two-thirds overall, ranging from 61.9% in Cameroon and 97.9% in Kenya. Missing half of the population targeted for screening and one-third for testing are important gaps that need to be explored to better understand and address the specific causes. Given the differences we found in country performance, we hypothesise that the integration strategy, especially the approach to human

Table 4 Factors associated with SARS-CoV-2 positivity proportion in Cameroon and Kenya

Characteristics	Total	Patients tested positive		Unadjusted OR (95% CI)	P value	Adjusted OR* (95% CI)	P value
		N	(%)				
Country integration strategy							
Cameroon	9866	329	3.33	1		1	
Kenya	3068	61	1.99	0.67 (0.55 to 0.88)	<0.01	0.73 (0.57 to 0.94)	0.014
Sex							
Female	9622	270	2.8	1		1	
Male	3126	116	3.7	1.29 (1.04 to 1.6)	0.02	1.19 (0.93 to 1.52)	0.166
Age group, years							
two to 4	183	4	2.2	1			
five to 14	269	10	3.7	0.54 (0.13 to 2.21)	0.388		
15 to 24	2745	68	2.5	0.57 (0.17 to 1.88)	0.359		
25 to 49	7397	234	3.2	0.75 (0.23 to 2.42)	0.632		
≥50	2334	74	3.2	0.76 (0.23 to 2.49)	0.655		
HIV positive							
No	9258	267	2.9	1			
Yes	3675	123	3.3	1.13 (0.91 to 1.40)	0.253		
Patient on TB treatment							
No	12 165	365	3.0	1			
Yes	768	25	3.3	1.05 (0.70 to 1.59)	0.804		
Pregnant women							
No	7207	197	2.7	1			
Yes	2552	77	3.0	0.96 (0.75 to 1.23)	0.743		
Entry point							
HIV Clinic	3846	128	3.3	1		1	
MNCH Clinic	6226	159	2.5	0.78 (0.62 to 0.97)	0.028	0.87 (0.68 to 1.10)	0.186
TB Clinic	2862	103	3.4	1.06 (0.82 to 1.37)	0.661	0.99 (0.76 to 1.30)	0.964

* Adjusting on sex and facility clinic.

resource needs, may be one of the major causes for the differences between countries. Cameroon chose not to involve new staff in the screening and testing phase while Kenya involved community healthcare workers to support the screening and documentation phase and laboratory staff to support the testing phase. These strategies led to a higher screening proportion in Cameroon but a higher testing proportion in Kenya, as well as a significant association between country implementation strategy, screening and testing, suggesting that it might be preferable to integrate the SARS-CoV-2 screening phase into the routine activity of existing staff and to involve additional lab staff for the testing phase. Moreover, the difference in the absolute number of attendees eligible for testing (higher in Cameroon compared with Kenya), and among them the proportion of those finally tested (higher in Kenya compared with Cameroon), also suggests an effect of workload on the testing, which needs to be considered. These challenges could be addressed by considering the use of SARS-CoV-2 self-test that was shown feasible and acceptable among healthcare workers and general population in high-risk populations, remote locations and also in low-resource settings.[35 36] However, the integration of SARS-CoV-2 self-test into routine health services still needs to be evaluated.

Finally, the association between being screened or being tested and facility setting, facility type or service delivery clinic suggests that many additional factors need to be considered when designing the service integration model as noted by others.[31 33 37] The facility factors such as rural location and lower level in the health pyramid reflect more the facility volume and emphasise the influence of the workload on the integration strategies and the need for alternative testing method that could increase the number of attendees tested in the clinic.

The relatively low COVID-19 case detection rates observed overall in Cameroon and Kenya in this study align with the epidemic trend of SARS-CoV-2 infection reported in each country at the time of the study but likely also reflects an underestimation of the number of cases in Africa.[1 38–40] A higher case detection rate was observed in Cameroon compared with Kenya which could be due

to the different epidemic trends in both countries and seasonal variations of local epidemic in each country, in addition to the fat that Camerron tested an absolute number more eligible people than Kenya, increasing the possibility to find positive cases. In addition, the case detection rate among TB clinic attendees was more than 4 cases per 1000 attendees, particularly in Cameroon, with 8 cases per 1000 attendees. This is consistent with previous reports suggesting that SARS-CoV-2 infection's effects on the respiratory system could activate latent TB infection given that both pathogens share the same infection site and same immune reaction processes, leading to some similarities in the pathogenesis.[14 41–44] Moreover, patients diagnosed with TB are more likely to develop severe forms of SARS-CoV-2 and to experience unfavourable outcomes.[13 14 18] It is, therefore, critical to consider high-yield service delivery entry points such as TB clinics when planning for the integration of a service delivery model.

Some limitations need to be acknowledged in this study, notably, the fact that we were not able to assess all the challenges for implementing a SARS-CoV-2 package of services in the service delivery entry points. Qualitative studies involving healthcare workers and clinic attendees will be useful to gain a deeper understanding of the facilitators and barriers to the integration of SARS-CoV-2 services into the health system. In addition, even though we selected countries among those with the highest prevalence of SARS-CoV-2 in their respective subregions in Africa, the national prevalences were relatively low at the time of the study. Thus, our results may be interpreted with caution for high prevalence periods. Despite these limitations, our study provides important data for decision-makers and programme implementers, specifically in sub-Saharan Africa, where COVID-19 vaccine coverage remains low and health systems can benefit from evidence-based implementation approaches to address future pandemics.

CONCLUSION

The integration of SARS-CoV-2 Ag-RDT in MNCH, HIV and TB clinics was feasible in both countries despite challenges with low screening proportions in Kenya and low testing proportions in Cameroon. Decentralisation of SARS-CoV-2 testing at different facility clinics has the potential to increase early detection of SARS-CoV-2 cases among vulnerable populations such as MNCH, HIV and TB clinic attendees. Moreover, integration strategies should consider health facility setting (rural vs urban) and allocation of additional human resources in high volume facilities to improve screening and testing proportions.

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