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Factors influencing uptake of COVID-19 diagnostics in Sub-Saharan Africa: a rapid scoping review

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Abstract

Background

Diagnostics are critical for preventing COVID-19 transmission, enabling disease management and engagement with care. However, COVID-19 testing uptake remained low in low- and middle- income countries in Sub-Saharan Africa (SSA) during the recent pandemic, due to issues of supply, access and acceptability. Early studies conducted outside of the region provide insight into uptake of COVID-19 testing, however there has been no systematic research within the region. The aim of this scoping review is to investigate factors influencing uptake of COVID-19 testing in different settings across SSA.

Materials and methods

Inclusion criteria was any study employing qualitative or mixed methodologies, addressing uptake of COVID-19 testing conducted in SSA. MEDLINE, PubMed, Google Scholar, Web of Science, and Africa-Wide Information were searched. Thematic content analysis was conducted across all included articles until saturation was attained.

Results

In total 2994 articles were identified and fourteen reviewed. Structural, social, epidemiological, informational, and political elements affected how the public interacted with COVID-19 testing. Coverage was limited by insufficient diagnostic capabilities caused by a shortage of laboratory resources and trained personnel. False information spread through social media

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led to testing misperceptions and apprehension. Testing hesitancy was ascribed to fear of restrictive measures and the possibility of social harms if positive. Facility-based testing was physically inaccessible and perceived as lacking privacy, whereas self-testing distributed by the community removed lengthy distances and prevented stigma. Perceptions that COVID-19 was not severe and low numbers of confirmed cases in comparison to other settings undermined public urgency for testing. Low testing frequency led to low-rate assumptions, which in turn generated denial and othering narratives. Politicians' acceptance or denial of COVID-19 affected the mobilization of the health system, and their model actions—such as testing openly—promoted public confidence and involvement in interventions.

Conclusions

This review emphasizes the necessity of strong political commitments to enhancing health systems for future pandemic preparedness. Response plans should consider contextual elements that affect how people react to interventions and perceive health emergencies. Community-driven self-testing distribution could enhance the uptake of diagnostics through addressing socio-economic constraints impacting facility-delivered testing.

Introduction

Coronavirus disease (COVID-19) was declared a Public Health Emergency of International Concern by the World Health Organization (WHO) on January 30, 2020 [1,2]. Increased availability of diagnostic interventions for COVID-19 was identified as a research priority, including delivering point-of-care (POC) testing within communities [2]. The WHO recommended integrating COVID-19 testing within routine diagnostics for other respiratory illnesses including influenza and tuberculosis to increase access [3]. Following these recommendations, different diagnostic techniques, including rapid diagnostic tests (RDTs), were produced and implemented [3]. These included genome sequencing, antigen or antibody detection, and molecular testing using nucleic acids [4]. Antigen/antibody tests were recommended for pandemic monitoring since they allowed rapid, regular, and expanded testing with on-site detection and immediate management [4]. Despite this potential, COVID-19 testing was not widely adopted by the public, particularly in low- and middle-income countries (LMIC) in sub-Saharan Africa (SSA) [5].

Identification of infected individuals through diagnostics is essential for disease prevention and control but testing-related challenges have been reported worldwide [5–8]. As COVID-19 spread, demand for diagnostic tests outstripped global supply, resulting in an inequitable access [5,6]. Although high-income countries had the means to produce or purchase technologies, access was limited in the LMIC [5,6]. This has been due to political and supply-side issues, including issues of global governance and health system-related factors such as resource limitations and logistics, as well as social and community-level factors such as communication and trust in delivery agents. The spread of misinformation undermined public confidence and restricted testing uptake globally [2]. Effective political leadership was demonstrated to impact engagement in preventive measures such as a sharp increase in people's trust and willingness to test for COVID-19 when the president of Ghana tested publicly [9]. Likewise, where the political leadership was unwilling to test and dismissive of COVID-19 threat the desire to test among the general public was also correspondingly low [10].

Although studies have shed light on factors influencing public testing uptake, there has been little research in SSA specifically. User focus in SSA has been on general knowledge,

attitudes, perceptions, and practices towards COVID-19 and vaccination responses, whilst supply-side research has investigated healthcare system conditions necessary for deploying testing instruments such as RDTs [11,12].

This study formed part of the "STAR Africa, Asia, Americas COVID-19 Preparedness Project (3ACP)" funded through UNITAID, investigating COVID-19 professional use and self-testing rapid diagnostics in Nigeria, Zimbabwe, and Malawi. As part of this work, we conducted a scoping of the contextual factors influencing people's decisions regarding COVID-19 testing in various settings throughout SSA. This information would support the implementation of the main project.

Methods

Review scope

This scoping review was conducted between July and August 2023, using a methodology registered on the Open Science Framework (OSF) and available at https://osf.io. The review followed Arksey and O'Malley's framework, encompassing the formulation of the research question, identification of relevant studies, selection of studies, data charting, synthesis, and presentation of findings [13]. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework was employed to guide the paper selection process [14] (S1 Table).

Inclusion and exclusion criteria

Studies were included if they met the following criteria: peer-reviewed research investigating factors influencing the uptake of self- and provider-delivered COVID-19 testing in Sub-Saharan Africa (SSA) using qualitative methods (e.g., focus groups, interviews, ethnography, and case studies). Mixed-methods studies incorporating qualitative research alongside clinical trials were also eligible. Studies were excluded if they were quantitative research, literature reviews, or duplicates. Only studies published in English, conducted in SSA, and published between January 2020 (onset of the COVID-19 pandemic) and July 2023 were included. A detailed summary of inclusion and exclusion criteria is provided in Table 1.

Search strategy

We conducted a systematic search using Google Scholar, PubMed, Web of Science, Medline, and Africa-Wide Information databases. A combination of keywords and Boolean operators ("AND," "OR") was employed to identify relevant studies. Key terms included COVID-19, coronavirus, testing, diagnostics, behaviour, perception, cultural, sociocultural, social science,

Table 1. Inclusion and exclusion criteria.

	Exclude	Include
Publication type	Non-peer reviewed content, including preprints, was excluded	Peer reviewed studies
Study design	Quantitative surveys, clinical studies with no qualitative element.	Qualitative research (results from focus groups/ interviews), mixed-methods studies involving qualitative methodology.
Report types	Reviews, opinion pieces, letters to the editor	Primary research
Language	Non-English language	English language
Geographic area	Non-SSA countries	SSA countries
Topic	Non-COVID-19 testing, vaccine, vaccination	COVID-19 testing, COVID-19 diagnostics, and factors affecting their acceptability
Date range	Exclude studies before 2020	Studies from January 2020 to present date

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qualitative, and mixed methods. The search terms were applied individually and in combination, with filters limiting the results to primary research articles in English, conducted in SSA, and published between January 2020 and July 2023 (Table 2).

Study selection and data extraction

Studies were initially screened based on titles and abstracts. If the abstract lacked sufficient detail, the full text was reviewed using the search terms described above. A research appraisal tool developed by Hawker et al., (2002) was employed to assess the quality and relevance of eligible studies [15] (S2 Table).

Duplicates were manually identified and removed by one author during the search process. Due to the relatively small number of eligible articles, data extraction was conducted collaboratively by three authors who worked together to chart the data. This included extracting details such as author, publication year, location, study design, sample size, and key conclusions (S3 Table). The collaborative extraction process allowed real-time consensus on all data points, eliminating the need for independent extractions or discrepancy resolution.

Ethics

This investigation did not seek specific ethics approval because it analysed secondary data without involving primary data collection with human subjects. However, all the country-specific projects that it was part of received individual ethical approvals from in-country, the London School of Tropical Hygiene and Medicine, the Liverpool School of Tropical Medicine, and the WHO (S1 Text).

Data analysis

NVivo version 12 was used to import all the studies that satisfied the inclusion criteria. Codes and concepts were explored inductively and deductively. A preliminary coding framework was created and modified inductively to incorporate emerging codes. Codes were reclassified, summarised, and integrated into themes, which were later categorised into two broad groups, COVID-19 testing facilitators and COVID-19 testing barriers (Table 3).

Results

A total of 2994 studies were identified through the initial search across all databases. 2870 studies were eliminated. We screened the abstracts of 124 articles: 104 were excluded, covering topics related to COVID-19 but not directly associated with testing uptake, for example, COVID-19 vaccination, knowledge, and beliefs. Other reasons for exclusion included not focusing on the relevant disease area (HIV or tuberculosis diagnostics), while others were not conducted within SSA. We remained with 20 articles for full-text screening. Of these two were systematic reviews, three did not include qualitative approaches, and one was not conducted in SSA. A total of 14 articles remained for quality evaluation and data extraction (Fig 1).

Six studies analysed patient and stakeholder perceptions and experiences with COVID-19 testing and screening procedures [10,16–20]. The remaining eight studies explored COVID-19

Table 2. Search Query and Filters.

Query	Filters
(COVID-19 OR COVID 19 OR coronavirus) AND (test* OR screen* OR RDT OR diagnos*) AND (enabl* OR facilitat* OR motiv* OR influenc *) AND (behav* OR attitude* OR perce* OR belie*) AND (cultur* OR politic* OR socio-cult* OR econom*) AND ("social science" OR qualitative OR mixed methods)	Free full text, Journal Article, English, SSA, 2020 to present day

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Table 3. Themes and subthemes.

Theme	Subtheme	
Facilitators of COVID-19 testing	Effective political leadership	- Strong political commitment to COVID-19 containment measures - Partnerships with international and local organizations to improve testing capacity - Pro-public health advocacy by political leaders to encourage testing
	Public confidence in testing organizations	- Trust in healthcare providers, community leaders, and familiar figures - Community involvement in testing initiatives
	Novel testing modalities	- Preference for self-testing due to privacy, flexibility, and ease of access - Self-testing as a viable solution for vulnerable populations
	Public health communication	- Importance of communication in dispelling myths and building trust - Awareness campaigns to generate demand for testing
Barriers to COVID-19 testing	Health system capacity	- Lack of diagnostic tools, equipment, and testing centers - Backlogs in testing and slow sample processing
	Human resource constraints	- Shortages of skilled personnel in testing and surveillance - Increased work burden and mental exhaustion among staff
	Supply-chain issues	- Stockouts of testing kits, PPE, and other essential supplies - Budgetary constraints impacting testing and contact tracing
	Inaccessibility of testing	- Geographical barriers to testing, especially in rural areas - Limited access to self-testing kits due to central distribution
	Psycho-social and economic obstacles	- Fear and stigma associated with COVID-19 diagnosis - Economic barriers, such as loss of income due to isolation - Social repercussions and stigma surrounding COVID-19 test results
	False claims and beliefs	- Misinformation and rumors on social media undermining testing uptake - Religious and spiritual beliefs hindering testing adoption
	Political exploitation of COVID-19	- Politicization of COVID-19 testing, causing mistrust in health responses - Public reluctance to adopt testing due to political influence and misinformation

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responses generally as well as testing-related topics. Four studies reported COVID-19 self-testing [9,16–18], five used facility-based RDTs [9,19–22], two used molecular tests [23,24], one used PCR tests [18], one used imaging [25], and two did not explicitly specify the diagnostic test used [26,27]. The studies had a total of 953 participants, aged 17 to 77 (Table 4).

The uptake of diagnostic testing for COVID-19 in SSA faced significant challenges across various settings, influenced by political, structural, social, and informational factors (Fig 2).

Facilitators of COVID-19 testing

Effective political leadership

Strong political leadership was critical in determining the direction of the national COVID-19 response. Ha et al., (2022) and Yamanis et al., (2023) described that in areas where government officials viewed COVID-19 as a threat to public health, there was a strong political commitment to develop and implement disease containment measures including diagnostics. For example, in Ghana, the government gathered financial and material support to increase its diagnostic capacity through multisectoral partnerships with development partners. This allowed the country's health system to expand the number of COVID-19 testing facilities nationwide, improving access and coverage of testing services, according to one of the nation's laboratory managers:

> *"We did not have enough testing centres and PPE at the beginning of the pandemic. But, now, we have enough facilities, adequate PPE, and other consumables supported by the Ghana government, international organizations, and other donors for COVID-19 testing".* [9]

Yamanis et al., (2023) described Tanzania making a similar commitment to empowering the health system and acknowledging the existence of COVID-19 after a period of denial when the new president,

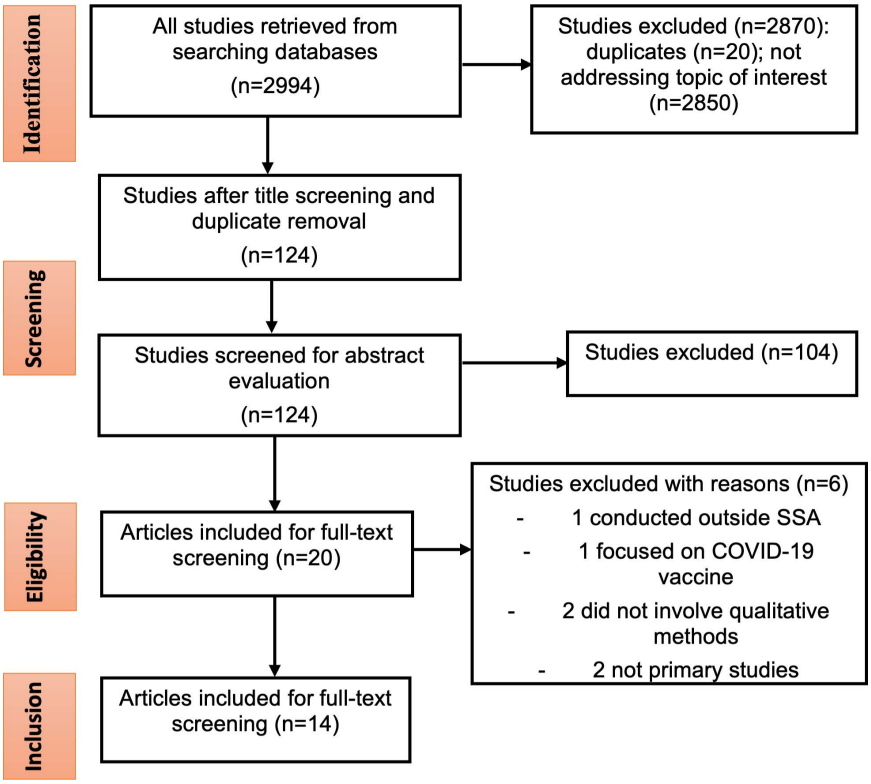

Fig 1. PRISMA flowchart of study selection process.

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Hassan, acknowledged COVID-19 as a public health emergency relying on collaboration with local and international partners to improve control measures, including promoting testing uptake.

Both Ha et al., (2022) and Yamanis et al., (2023) described the influence of government in public responses to COVID-19 services. Political leaders not only made investments in health system capacity for COVID-19 monitoring activities, but took on a pro-public health advocacy role, urging people to get tested as well as follow the rest of the controls set in place. Some government representatives underwent COVID-19 testing or vaccination in public to legitimize and encourage improved public response, motivating testing:

> *"We received lots of hope from the government and the president. Our president was really keen on tackling the pandemic […] We were highly encouraged to get tested by the president, and his leadership uplifted the motivation of getting tested".* [9].

Public confidence in organizations providing testing

Public perceptions of the organizations tasked with carrying out testing activities were central to participation. In South Africa, Brumwell et al., (2022) found that people were more inclined to test for COVID-19 if they knew and trusted the providers:

> *"I think people do trust their pastors, their healthcare workers, nurses and general practitioners, pharmacists, principles…They generally don't trust politicians. So, I wouldn't include them there. But, generally, the community leaders, non-politically aligned, I think would be people that would be trustworthy".* [18].

Table 4. Summary of included studies with key findings.

Numerical Reference	Author and Year	Country	Design & Population	Testing Modality	Testing Facilitators	Testing Barriers
28	Amoo et al., 2020	Nigeria	Mixed-method: 27 in-depth interviews with healthcare workers and 1030 participants in COVID-19 testing survey	Facility-based testing using a drive-through sampling modality (nasal and oropharyngeal) targeting COVID-19 suspects invited via social media platforms and the Nigeria Centre for Disease Control website.	Participants' understanding of COVID-19.	Nasal swabbing, was unsettling for participants; travel expenses limited participation.
23	Oleribe et al., 2021	Nigeria	Qualitative: online semi-structured interviews with 495 respondents	Facility-provided molecular and community-delivered rapid diagnostic testing	None mentioned	Shortage of test kits, incompetent medical personnel, and politicisation COVID-19.
19	Nxumalo et al., 2021	South Africa	Qualitative: 15 semi-structured interviews with primary healthcare practitioners	Facility-based provider-initiated symptomatic screening based on high body temperature. Details of diagnostic test used not described	None mentioned	Lack of PPE, fear of infection among providers, denial, mistrust of necessity
25	Lewis et al., 2021	South Africa	Qualitative: online open-ended questionnaire with 60 diagnostic radiographers	COVID-19 imaging (computed tomography) on referred patients	None mentioned	Limited testing capacity causing sample backlogs and clients' frustration at delays in processing tests results
20	Rispel et al., 2021	South Africa	Qualitative: 36 interviews with key informants (incl. policy makers, healthcare workers, advocacy groups), and document analysis	Facility-provided testing using random community-based sampling strategy	None mentioned	Limited resources, unclear guidelines, poor working conditions
17	Schmidt et al., 2020	South Africa	Qualitative: 60 interviews with community members and key informants (civil society, private sector representatives)	Door-to-door symptomatic screening and rapid diagnostic testing		Social media misinformation, mistrust of testing as an evil ploy to infect people, "othering" attitudes or seeing others as more vulnerable than self
18	Brumwell et al., 2022	South Africa	Qualitative: 52 semi-structured interviews with COVID-19 self-testing decision makers (health workers, civil society representatives, self-testing implementers	Facility-provided PCR tests, and rapid SARS-CoV-2 antigen self-testing intended for a prospective national mass testing campaign	Perceived privacy, efficiency, and convenience associated with self-testing: freedom of testing at time and place of your choice; e, shorter test results times; low risk of and social stigma	Access to facility services was hindered by long distances and high transportation expenses.
21	Asare et al., 2023	Ghana	Qualitative: 6 focus group discussions with 39 COVID-19 contact tracers	Facility-initiated screening and testing of index patients and community-level screening and sampling of contacts using RDTs	None mentioned	Inadequate testing capacity resulting in sample backlogs and processing delays impacted case management. Clients requesting the medical teams conducting the screening to disclose their political affiliation before they could take the services since they mistrusted the government with COVID-19.

(Continued)

Table 4. (Continued)

Numerical Reference	Author and Year	Country	Design & Population	Testing Modality	Testing Facilitators	Testing Barriers
9	Ha et al., 2022	Ghana	Qualitative: 20 semi-structured interviews with testing key informants incl. policymakers, implementers, frontline health workers, and community members	Mass testing through self-tests (using self-procured kits) and facility-provided tests (following a prescription or personal choice)	Better health governance through political leadership, community participation, multi-sectoral collaboration, effective resource management, and information systems.	Low-risk perceptions, comparing COVID-19 to common flu, inadequacy of material resources, uneven distribution of testing services
22	Asiimwe et al., 2021	Ghana	Qualitative: 27 semi-structured interviews with COVID-19 contact tracers, supervisors, and case contacts	Facility-initiated community-level screening and sampling involving facility-based testing as part of a national surveillance campaign.	Trained contact-tracing personnel, providing contacts with psychological support	Shortage of supplies (test kits, PPEs), poor coordination, longer test results times, fearing social stigma
26	Carlitz et al., 2021	Tanzania	Qualitative: 40 in-depth interviews with public healthcare workers, social welfare organisations, village leaders	Method of testing not confirmed.	None mentioned	Politicisation of COVID-19: country's president saying there was no COVID-19 or it was not serious, test kits had been tampered with and were unreliable, laboratories were fabricating positive test results.
27	Yamanis et al., 2023	Tanzania	Qualitative: 56 in-depth interviews with healthcare workers, social welfare organisations, village leaders	Facility-delivered screening: body temperature, heart rate, blood pressure	None mentioned	No testing facilities were available. Healthcare workers just screened suspects based on body temperature, heart rate, and blood pressure.
24	Mohammed et al., 2021	Ethiopia	Qualitative: Semi-structured interviews with COVID-19 prevention task force members, healthcare workers, community members	Door-to-door symptomatic sampling and screening implemented as part of the national community-based surveillance programme	None mentioned	The public disputing the reality of COVID-19, believing that politicians were exploiting COVID-19 to distract the public from national political issues, paying laboratory staff to fabricate test results and exaggerate the number of cases and support the political narrative that COVID-19 was present. Shortage of testing supplies.
16	Chabeda et al., 2022	Kenya	Qualitative: semi-structured interviews and focus group discussions with 50 self-testing stakeholders (providers, implementers, and advocacy groups)	Self-testing (using self-procured rapid SARS-CoV-2 antigen-detection kits accessed through private distributors)	Perceptions that self-testing was private and that it could reduce demand on public healthcare facilities.	Public facilities frequently ran out of test kits, whereas commercial test centres had better equipment but were more expensive.

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COVID-19 testing was more acceptable when spearheaded by people that community members were used to and had some form of prior association or interaction.

Novel COVID-19 testing modalities

Perspectives on self-testing were discussed in two studies by Brumwell et al., (2022) and Chabeda et al., (2022), and participants expressed a preference for self-testing over facility-based testing in both cases. Brumwell et al., (2022) claimed that this was due to testing flexibility, privacy, and confidentiality for socially excluded groups such as the homeless and drug

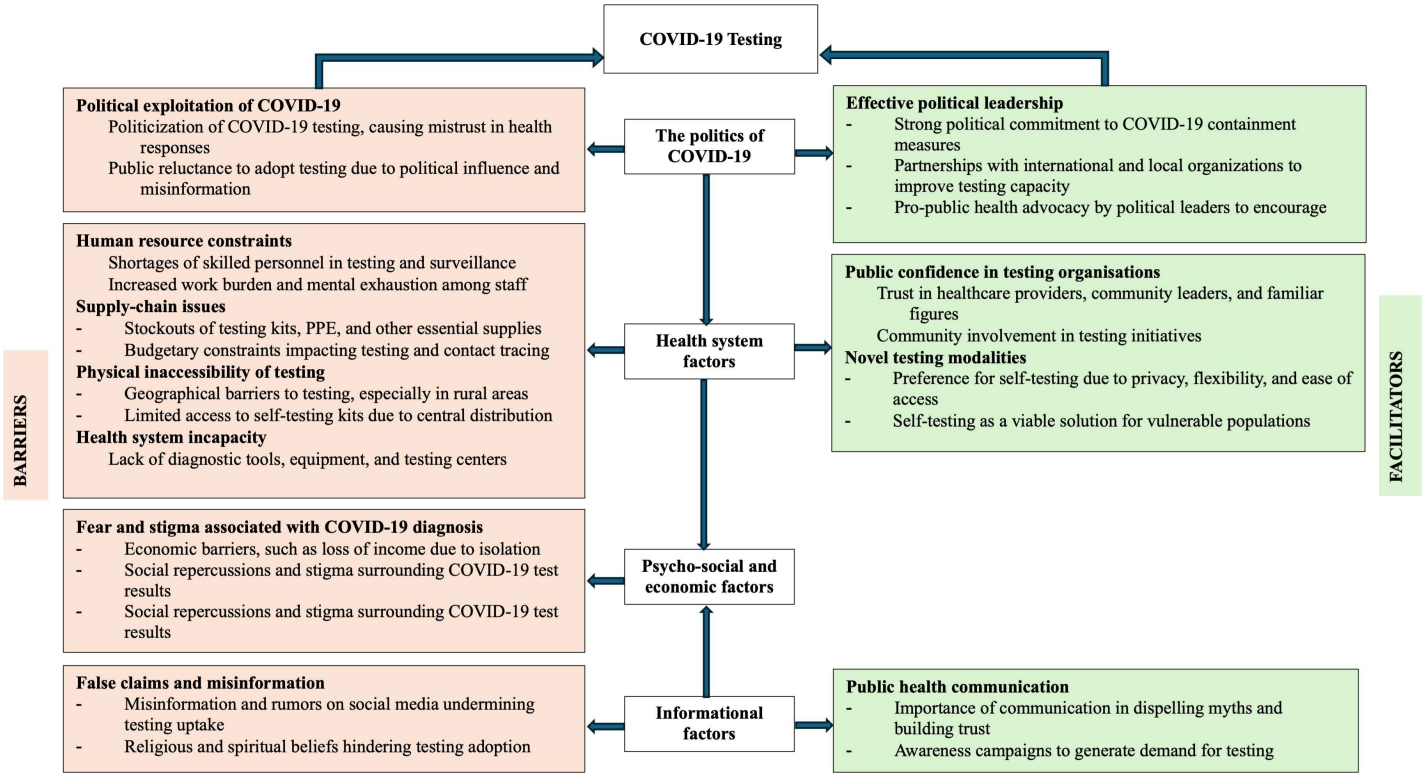

Fig 2. Graphical display of COVID-19 testing enablers and hinderers in sub-Saharan Africa.

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users, whereas facility-based testing was felt to exacerbate stigma. However, some participants in the same study raised concerns about self-testing potentially negatively impacting the public health response. They noted that it could hinder effective surveillance and contact tracing, as individuals might not report their results or follow isolation protocols. Participants in Kenya in Chabeda et al., (2022) study described decision-makers perspectives that self-testing was crucial for physically vulnerable populations such as the elderly, the sick, those with impairments, and people living in isolated locations. However, they did not interview end users of self-testing.

> *"For me one of the biggest things is: If you self-test at home, there's nobody that is recording that you are positive. And that whole thing again about 'Oh, I don't want to deal with it'. So, you know you're positive. Nobody else does. Who's going to actually monitor your contacts and ensure that you actually then do isolate and do quarantine? If you leave the responsibility solely on the patient".* [18]

Public health communication

Knowledge of COVID-19 and its risks preceded the public adoption of testing. Eight of the studies reflected the usefulness of public health communication in generating demand for testing [9,17–19,21,24,26,28]. The studies frequently ascribed the uptake of testing to ongoing public health communication, which participants said was helpful in dispelling initial pandemic myths in the communities. Asare et al., (2023) mentioned that in Ghana finding

contacts to test early in the pandemic was difficult, and awareness campaigns were seen to help communities respond more effectively:

> *"During the first wave of COVID-19, contact tracing was difficult because most people did not get enough information with regard to the disease. People who were contacts with a positive case did not understand the reason why they had to be quarantined for you to come and pick samples. You get to a contact's home and the person is already gone instead of staying in the house […] So, the first phase of COVID-19 contact tracing awas very difficult".* [21]

Barriers to COVID-19 testing

Health system capacity

Nine of the studies identified that healthcare systems in SSA lacked the diagnostic tools and equipment necessary to identify COVID-19 patients, which impacted testing availability [9,18,19,21–24,26,27]. There was common recognition that systemic underfunding of healthcare systems, pre-existent to the pandemic, translated to a lack of preparedness for COVID-19. Problems included the paucity of test kits, disinfectants, and safety equipment in laboratories. Some hospitals lacked laboratory facilities altogether. For instance, in Tanzania Yamanis et al., (2023) revealed there was no laboratory to conduct testing, medical professionals merely checked suspects' body temperatures, blood pressure, and heart rates. Inadequate laboratory readiness led to frequent backlogs in testing COVID-19 samples. Five of the studies reported protracted processing times ranging from several days [18,22,26,28] to more than a month [21] from sample collection, affecting COVID-19 public health response such as contact tracing.

> *"The testing centre is a challenge to us as a district. We have sent about 27 samples, and it is almost one and a half months now the results are not in yet. One of them was sick, but we don't know the status of that person till now. Although we have testing centres here, they are doing internal testing, so we have to send our samples to […] the capital before they are sent to the central laboratory, which delays a lot".* [21]

Human resource constraints

The availability of human capital also affected the availability of COVID-19 diagnostic testing in SSA. Four of the studies [9,20,22,23] discussed the lack of skilled medical personnel to support testing and surveillance interventions. For example, a laboratory manager in Ghana described increased work burden due to staff shortages:

> *"We have only one person at the lab who runs the test. Despite our support, he ran samples until late. I also feel too exhausted […] when testing many people. The human personnel is fewer [...}".* [9].

This shortage was also reported in South Africa and Nigeria [20,23]. Solutions suggested included retraining HIV service providers to reduce the supply-demand gap for COVID-19 testing.

Mental exhaustion and distress impacted staff capacity to respond to testing demands. Fears expressed included contracting COVID-19 through interaction with positive patients, where lack of access to personal protective equipment (PPE) and antiseptics for sanitizing surfaces was sub-optimal. Participants also felt underappreciated without support to address

these issues. Fears were exacerbated when colleagues died of COVID-19. These factors all contributed to mental exhaustion.

Supply-chain issues

Five of the studies identified supply problems that impacted the availability and distribution of COVID-19 diagnostic services [9,18,21,22,24]. Mohammed et al. 2021 drew attention to budgetary constraints that impacted the purchase of medical necessities in Ethiopia, leading to inconsistent supply and frequent stockouts of test kits. Ha et al., (2022) described similar supply challenges such as irregular provision of personal protective equipment (PPE), making it difficult for surveillance teams to effectively conduct contact tracing:

> *"When COVID-19 [] came, we [the Ghana Health Service] were not prepared, which is why we faced a lot of challenges with contact tracing in the beginning. The PPEs were not there, yet we had to work. So, if the authorities could learn their lessons, I think we will be better prepared for the future".* [9]

Accessibility of testing

Access to COVID-19 testing was geographically unevenly distributed across urban and rural settings. In one study, supply was better in urban centres than in rural ones, even when testing was supposedly available. Asare et al., (2023) in Ghana, for instance, described participants feeling that metropolitan facilities had more resources than their rural counterparts, making it simpler to receive services there. In this context, Brumwell et al., (2022) and Chabeda et al., (2022) demonstrated that self-testing could increase testing accessibility, helping to solve the issue of people failing to test because of large distances to facilities, which had an impact on both supply and demand. However, since patients had to travel to pick up the test kits, the supply was constrained by the central distribution of test kits through healthcare facilities. Participants in Brumwell et al., (2022) and Chabeda et al., (2022) believed that this posed the same challenges as facility-based testing.

> *"The barriers […] to conventional facility-based testing were diverse. The expense of COVID-19 testing […]incurred either from lost wages while waiting in queues for government testing or the cost of private testing. The cost of transportation was a barrier […] where testing facilities are geographically dispersed. RCSs feared that the same barriers to facility-based testing would apply to self-testing. Financial considerations could cause difficulty in obtaining self-testing".* [18]

Psycho-social and economic obstacles

Testing decisions were also shaped by risk perceptions and the economic and psychosocial ramifications of undergoing a test and being diagnosed with the disease. Six studies [9,17–19,22,25,26] reported prevalent pandemic-related dread among community members, worrying about contracting and developing problems. Both Asiimwe et al., (2021) and Nxumalo et al., (2021) described these worries as stemming from social media rumours claiming that foreign locations had a high death rate. Carlitz et al., (2021) described that COVID-19 fatalities were being buried as Ebola victims, stories that increased fears of the pandemic and the social repercussions of receiving a COVID-19-positive diagnosis. In Brumwell et al., (2022) South African study, participants claimed that clients who tested positive experienced stigma because neighbours thought they were spreading the disease and held them responsible for new infections or fatalities.

Relating to economic costs, the two self-testing studies by Brumwell et al., (2022) and Chabeda et al., (2022) demonstrated that testing uptake was discouraged by the negative financial consequences of being diagnosed with COVID-19 and disclosure requirements. For the majority of those who tested positive, isolation requirements meant missing work. Failure to report for duty would also result in pay loss for jobs without sick days and participants believed that people's fear of losing their income prevented them from testing and disclosing their status to prevent isolation. As mentioned earlier, transport costs incurred when accessing self-testing centrally distributed through facilities also dissuaded uptake [16,18].

> *"[…] stigma and fear were the most cited social barriers to testing. Stigma was associated with the fear of being seen testing, of a positive result, and of disclosing positive results to contacts. Fears of being separated from family, losing income, and isolation were also cited […] As with reporting self-test results, informants were unsure whether people would disclose their results to contacts, whether due to fear of stigma or being blamed for another person's illness or death".* [18]

False claims and beliefs

Nine studies reported how misinformation fuelled through social media encouraged negative perceptions of COVID-19, with a detrimental impact on demand for testing [9,17–19,21,24,26,28,29].. Mohammed et al., (2021) described a prevalent false claim that hospitals fabricated test results to increase the number of verified cases to demonstrate the reality of COVID-19.

Following the introduction of vaccination, rumours related to vaccines also impacted COVID-19 testing uptake. For example, Schmidt et al., (2020) highlighted refusal to uptake door-to-door screening and testing by medical personnel due to beliefs around vaccination in South Africa: *"Like as clinic staff we go in door-to-door, there are incidences where a house owner would refuse for us to go in, saying we don't want your vaccines because they have Corona. Then we had to explain that we are not injecting people, we are just screening and asking questions. People are really scared, because of what they heard..."* [17]

Carlitz et al., (2021); Chabeda et al., (2022) and Schmidt et al., (2020) all described spiritual beliefs and religious beliefs that prevented the public from using tests and other interventions, compounding misconceptions spreading through social media. Chabeda et al., (2022) described belief in COVID-19 as a sign of devil worship in Kenya. Schmidt et al., (2020) described how COVID-19 was seen as testament that God was angry with humanity in South Africa.

Political exploitation of COVID-19 in SSA

Seven studies demonstrated how COVID-19 testing was highly politicized [21–24,26,27]. Studies in Tanzania by both Carlitz et al., (2021) and Yamanis et al., (2023) described political figures explicitly denouncing the pandemic's existence, encouraging the public to seek herbal remedies. This, alongside the Tanzanian government's decision to remove the country's laboratory manager and end its monitoring program influenced willingness to adopt public health strategies including testing [26].

The strength of perceived association between political agendas and COVID-19, fuelled through social media contributed to public mistrust of organizations providing health responses. In Ghana, Asare et al., (2023) highlighted the relationship between political affiliation and testing engagement where the public 'screened' providers of testing according to

political views: "*Politicising the disease is a challenge to us [contact tracers]. This is because you will get to a contact's home, and they start to politicise the entire process [of contact tracing] and they begin to ask you which party you belong to*".

Discussion

The findings of this review point to several structural, political, informational, economic, testing modality, and psychosocial elements that impacted directly on both provision and uptake of COVID-19 testing across SSA. Countries were unable to increase COVID-19 screening and testing because public healthcare systems lacked adequate laboratory and diagnostic equipment. The delivery of screening and testing was also influenced by safety worries and low morale among healthcare professionals because of a lack of protective equipment and compensation for additional work burdens. Demand and supply were both heavily impacted by political leadership. When effective this promoted resource mobilization, cultivated public trust, and encouraged participation in health interventions. In contrast, when government officials made COVID-19 a political issue, this bred mistrust and discouraged engagement. Willingness to test was influenced by perceptions of the professionalism of providers. Misinformation spread through social media related to vaccinations, politics, and testing outcomes, coupled with a lack of awareness about COVID-19 in general and the belief that this was a disease from elsewhere, were factors that tended to negatively influence views toward control measures.

Public testing choices were also affected by the nature of the test, the health dangers it posed, as well as its economic and psychosocial ramifications. For instance, people favoured self-testing over facility-based testing because the former required less travel time, offered testing liberty, ensured privacy, and lessened social stigma. The latter was unaffordable due to the great distance, expensive cost, and risk of disease transmission from traffic. Healthcare workers also preferred the self-testing modality because it helped to relieve health system burdens. However, COVID-19 self-testing was not key in most of the studies as only two examined perspectives on its acceptability.

The role of political leadership in SSA aligns with trends observed in other LMICs. Strong political commitment to public health interventions, as described in Ghana and Tanzania [9,27], has also been crucial in countries like Vietnam and Rwanda, where decisive leadership enabled swift mobilization of resources and community engagement [30,31]. Public demonstrations of testing or vaccination by leaders were similarly impactful in countries like India, where high-profile figures led by example to enhance public trust [32].

Our findings are also consistent with previous research, particularly relating to the factors that promote or impede the implementation and uptake of point-of-care diagnostic interventions for pandemics in SSA, including for HIV and Ebola. For instance, several studies have demonstrated limited public engagement with facility-based HIV testing because people felt the model involved long travels and was inconvenient, lacked privacy, caused stigma and discrimination, and limited their autonomy [33,34]. Relating to supply chain issues, a systematic study on HIV diagnostics in low-and middle-income settings including SSA identified the lack of laboratory equipment as one of the key factors undermining HIV testing programmes [34]. Similarly, shortages of medical equipment and resources hampered public health efforts during the 2014 Ebola outbreak in West Africa to identify those who were infected with the virus [30,31]. Agreeing with our results, a review of HIV testing enablers and barriers in Africa showed that self-care options such as HIV self-testing granted users the freedom and convenience of testing at the place and time of choice, reduced the stigma and discrimination associated with facility-based testing, and boosted HIV testing uptake [35].

The laboratory and diagnostic challenges highlighted by this research have significant effects on country-level ability to control infectious disease outbreaks [36]. Epidemiological surveillance is also challenged when affected individuals go undetected, raising the risk of transmission, and making it more difficult to implement interventions in response to epidemics [32]. Governments may become more self-sufficient and better equipped for upcoming pandemics if domestic resource revenue is maximized under strong political leadership [34].

Strengths and limitations

The study was enhanced by the systematic searching of multiple databases to identify studies that satisfied the predefined inclusion criteria. Understanding of the variables influencing COVID-19 testing uptake was enriched through the inclusion of papers employing a variety of methodological techniques, including mixed-methods studies. Regarding limitations, restricting the inclusion of studies only to those published in English due to language barriers entailed a possibility of missing other relevant studies. The reviewed papers were written at specific time points, raising the possibility of the findings not reflecting the rapid changes in pandemic responses and how people reacted to them overtime. Primary studies addressing the research question were also scarce at the time of the review, and the few that we analysed examined COVID-19 testing largely from the viewpoints of decision-makers as opposed to actual testers. This remains a knowledge gap regarding the actual testing experiences, which would have deepened the analysis of the demand-side facilitators and barriers. To better understand uptake drivers and match testing outcomes with social contextual needs, future pandemic diagnostic testing research should prioritize end users.

Conclusions

The COVID-19 pandemic response in SSA was dynamic and testing provision and uptake changed over time. Initially, many SSA countries lacked the resources to identify all COVID-19 cases [37] and it may be likely that cases were consequently underreported [38]. Healthcare systems had received little funding and lacked the equipment and personnel needed to efficiently prepare for and conduct testing. This emphasizes the necessity of a strong political commitment to enhancing health systems for pandemic preparedness in the future. Future pandemic response plans should consider contextual elements that affect how people react to interventions and perceive health emergencies. Self-testing solutions that are distributed by the community could remove socioeconomic constraints frequently associated with facility-delivered testing and increase access to pandemic diagnostic services. To ensure proper lay use of these self-care devices and linkage to care, user-friendly instructions and community-based psychosocial support networks are crucial factors.

Supporting information

S1_Fig.tif_ Flow diagram for the research selection using PRISMA
(TIF)

S1_Table.docx_ Preferred reporting items for systematic reviews and meta-analyses framework
(DOCX)

S2_Table.docx_ Quality and relevance evaluation form
(DOCX)

S3_Table.docx_ Study selection and data extraction
(DOCX)

S1_Text.docx_ Study ethics approvals
(DOCX)

S2_Text.docx_ Nvivo coded data
(DOCX)

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