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*Review*

# Scoping Review of the Models for Case-Based Health Programs in Africa

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**Abstract**

The review was aimed at exploring models across Africa that could best help Lesotho succeed in its efforts to establish a case-based surveillance (CBS) system for their HIV program. Research involved looking through several sources and databases including EBSCOHOST, Google Scholar, Science Direct and PubMed. The insights of suitable models were from the following Africa countries: South Africa, Kenya, Guinea, Tanzania, Ghana, Mozambique and Zambia. The researched models focused on infectious diseases such as measles, HIVand COVID-19. The key takeaway is that setting up electronic medical records systems (EMRs) is critical as a first step for any effective CBS. Also, using unique identifiers, establishing clear data governance policies and building strong infrastructure is a necessity in making CBS work. For a successful establishment of CBS, Lesotho should adopt these strategies that can be sustainable, improve disease tracking, response and ultimately health outcomes for Basotho.

**Keywords:** HIV and surveillance; case-based surveillance; patient-level health systems; infectious diseases surveillance; Africa

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## 1. Introduction

The purpose of this scoping review is to identify existing models for case-based surveillance health programs that are available in Africa. The review will aid in informing the development of a case-based surveillance (CBS) of HIV for implementation in Lesotho. Case-based surveillance system is critical in public health, it provides an understanding of diseases and how they spread and eventually helps determine appropriate interventions to control outbreaks (CDC, 2024).

Globally, HIV continues to be a public health concern with approximately 39.9 million people living with HIV (PLHIV) at the end of 2023 (WHO, 2024). Out of all PLHIV, about 5% constitutes children 0-14 years while the remaining 95% accounted for adults 15 and above years. Of all WHO regions, Africa accounts for the highest proportion; 65% of PLHIV globally followed by South-East Asian region and region of the Americas each attributing 10% of PLHIV (WHO, 2024).

Additionally, HIV prevalence varies significantly by country, especially in Africa. The top five countries with a high HIV prevalence in the world in 2023 are Eswatini at 27.5%, Lesotho 20.5%, Botswana 19.7%, South Africa 16.6% and Mozambique 11.8% (World Population Review, 2025). Although the countries experience high HIV rates, the Antiretroviral treatment (ART) has significantly improved the lives of many and has resulted in reduced new infections (World Population Review, 2025).

### *1.1. Global Interventions for a Successful HIV CBS*

As countries continue to manage HIV, there are many interventions put in place including the use of technology for easier programming. The Department of Affairs (VA) in North America attests to health data being more manageable with the use of technology for activities such as Veterans Aging Cohort Study Index (VACS Index) which has helped in predicting all-cause mortality, cause specific mortality and other health outcomes specifically for PLHIV (Mason, 2017).

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For the HIV population monitoring, WHO has recommended establishment of CBS which is not only useful for retaining individual-level data for everyone diagnosed with HIV but also for linkage between systems using unique identification number (UID) and retaining data gathered from multiple sources (Harklerode et al, 2017).

With that said, the importance of the UID for a successful CBS cannot be over-emphasized. Thailand is a good example of a country that uses UID based on social insurance. This number is used to link pivotal databases in the country for effective patient management (JMIR, 2018). Benefits of the said system include improved turnaround time of laboratory results and facilitation of reimbursements where necessary. However, the system only caters for nationals and excludes migrants in Thailand (JMIR, 2018).

In 2016, France developed a mandatory surveillance system called SurCeGIDD covering sexually transmitted infections (STI) clinics called CeGIDDs. The system was using individual data aimed at guiding STI prevention programs and policies at national and sub-national levels (Ngangro NN, et al., 2022). The system did not only cover the prevalence of STIs but other key elements such as socioeconomic determinants that helped guide the development of policies and evaluation of service delivery. Prior to the use of SurCeGIDD, case detection was low, but the use of the system resulted in improved records from 2,414 in 2017 to 382,890 in 2018 (Ngangro NN, et al., 2022).

There are also notable successes in Africa of a successful surveillance system. Botswana has implemented a system that uses national unique identification and insurance number to access health HIV services including HIV and other social services. This system enables easy access and linkages to HIV and other health services across health facilities within the country (JMIR, 2018).

### *1.2. Challenges of Existing Health Systems for HIV Program in Africa*

Despite the successes of CBS especially in developed countries, Africa continues to encounter challenges hindering smooth implementation. A cross-sectional study on the performance of COVID-19 case-based surveillance system in the Federal Capital Territory (FCT), Nigeria conducted by Umeozuru CM, et al. highlighted some challenges as inadequate resources such as transport for response activities, data for internet which is for the system's functionality, non-harmonization of the treatment protocol and high dependence on donor support which limits long term sustainability to mention but a few (Umeozuru CM et al., 2022).

Additionally, a situational assessment of data systems conducted in Tanzania, South Africa and Kenya highlighted a few challenges of existing health systems particularly for the HIV program. In Tanzania, one of the challenges is the unavailability of UID which limits linkage to care after diagnosis (Harklerode et al, 2017). Also, the country experienced infrastructure difficulties. "Various information technology issues were observed, including smaller facilities not having computers, inconsistent connectivity and power outages, and a lack of interoperability between the patient monitoring systems (PMS) and other data systems at the health facility" (Harklerode et al, 2017). Thus, for the successful implementation of CBS, the country must address the highlighted challenges and strengthen data quality while also enforcing adherence to and optimal use of standard operational procedures (SOPs).

Regarding South Africa, Harklerode et al. revealed that the country has implemented a national PMS which collects individual-level data at facility level although it is not available nationwide. Unlike Tanzania, South Africa uses a national identity number as the UID although not assigned to about 105 of non-citizens residing in the country. However, the country is developing a health patient registration system which will incorporate every patient seeking health services (Harklerode et al, 2017). Notwithstanding, South Africa was challenged by staff shortages and over-populated health facilities resulting in non-adherence to SOPs thereby limiting data completeness and quality.

Lastly in Kenya, the assessment revealed that there were several data systems from which individual-level data for HIV CBS could be obtained. However, many facilities still use paper-based systems and EMR is only used at facilities with patients greater than 500. "Existing infrastructure presents challenges to capturing and storing individual-level data electronically. All visited facilities

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reported having experienced periodic power outages, and only larger facilities reported having backup generators" (Harklerode et al, 2017). Regarding the use of UID, patients are assigned a unique number at facility level which is included in the PMS but cannot be transferred across facilities and this limits the accuracy of data matching and de-duplication process (Harklerode et al, 2017).

Lastly, due to a high burden of HIV and other infectious diseases in Africa, a well-functioning CBS is important for successful programming. A systematic review conducted by Ayanore et al., revealed that surveillance systems cannot only improve clinical care and patients' outcomes but can also help improve health systems preparedness for public health threats (Ayanore et al., 2019). Thus, it is critical for African countries to have a stable CBS which will routinely and systematically monitor HIV patients from the time of diagnosis and throughout their clinical care. The summary of the scoping review will include a description of studies; types of models or systems used and lastly challenges and successes.

### *1.3. Aim and Objectives*

The aim of the study was to review existing models for the case-based health programs in Africa to inform the development and implementation of case-based surveillance of HIV in Lesotho. This was achieved by the following objectives:

1) To identify and describe the existing models for case-based health programs in Africa.
2) To determine successes and challenges to implementation of these models in Africa.
3) To assess the needs for development and implementation of a case-based surveillance and to recommend a model that could be relevant for Lesotho.
4) To identify any gaps in the models that could be considered when developing a case-based surveillance for HIV in an African setting.

## 2. Materials and Methods

### *2.1. The Study Design*

The study used a scoping review and followed a descriptive study design. Documents were reviewed using Preferred reporting Items for Systematic Reviews and Meta-analysis (PRISMA) for scoping reviews style, a guideline for reporting systematic reviews (Page et al., 2021).

### *2.2. The Database Search*

There were several databases that were used to search for articles, and these included EBSCOHOST, Science Direct and PubMed to mention but a few. The following key words were used to search for documents: HIV and surveillance, case-based surveillance, patients-level health systems, infectious diseases surveillance and Africa. For this paper, many articles were reviewed but not all of them were selected for inclusion. The inclusion criterion focused on articles related to implementation of case-based surveillance for infectious diseases not older than 10 years (2014-2024), documents written in English, and both quantitative and qualitative studies to assess the differences and results when implementing CBS.

There were two (2) reviewers involved in screening articles and full text reviews. Selection bias was minimized by ensuring that reviewers screened articles independently and consensus was reached where there were disagreements. The selection and screening of articles was done through Rayyan (https://rayyan.qcri.org), a tool useful for both literature and systematic reviews. Out of 537 publications searched, 329 were duplicates and were therefore excluded. Total articles screened were 208 and about 182 were further excluded because of irreverence and outdated as per inclusion criterion of 10 years. There were 43 articles left as included. The 34 articles that were excluded were due to insufficient information, some were focusing on the progress of diseases, not the system and two (2) full articles could not be accessed. Finally, nine (9) were included and analyzed.

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*2.3. Inclusion of Data Sources*

The PRISMA method for scoping reviews was used to select articles to be included and excluded. The graphic or flow diagram below illustrates the articles that were identified, screened, identified as eligible, those included or excluded.

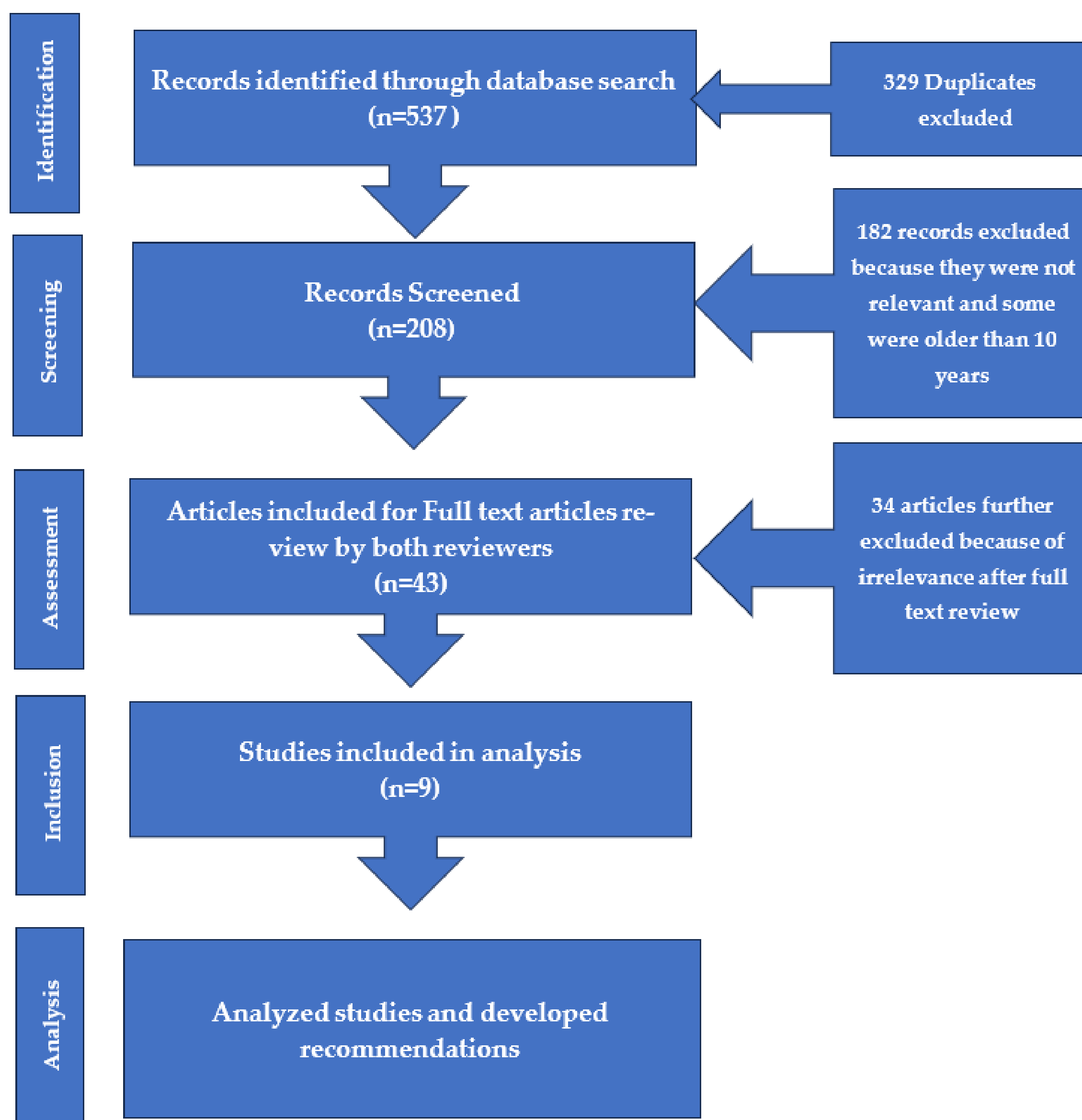


**Figure 1.** Selection of studies as per PRISMA approach.

*2.4. Data Extraction*

Data extraction from the articles was based on specified characteristics such as country, region, HIV prevalence, other prevalent infectious diseases, availability of CBS, barriers, enablers, and results of implementing CBS.

*2.5. Data Analysis*

In-depth analysis of articles related to the case-based surveillance was applied. The researcher aimed to assess the year and time it took to implement the CBS, the approaches and models used. For critical appraisal of individual sources of evidence, a tool aimed at measuring the quality of the article was developed where a score ranged from 0 to 10 with 7 and higher being good quality, 4 to 6 as

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moderate and 0 to 3 as low quality. Out of 43 full articles reviewed, (9) scored good, (15) scored moderate and lastly (19) scored low quality. A decision was made to include all the nine articles scored as good. The included articles demonstrated high relevance to CBS, excellent comparison and robust methods. Also, there was strong emphasis on digital architecture description and assessment, clear CBS operational models and strong data quality assessment relevant to CBS system strengthening. On the other hand, the articles scored moderate and low quality were as a result of low CBS specificity, moderate depths on CBS functionality and some were just not focused on CBS technical model.

## 3. Results

This section will discuss the description of the studies, types of models and systems and lastly challenges and successes.

### *3.1. Description of the Studies*

This section provides a summary of the description of the studies highlighting the number of studies reviewed, the study designs and study settings. The focus was on countries in the African region although countries outside of Africa were included to assess the global situation pertaining to CBS (Table 1). Some countries were included in more than one publication. Of the countries selected, all were in Africa; majority were Southern Africa (four (4)), two (2) in Eastern Africa, one (1) in Western Africa and two (2) in Africa but not specified regions. The individual countries mostly focused on South Africa and Zimbabwe in the Southern African region, Rwanda, Tanzania and Kenya in the Eastern region and Western Cape is represented by Guinea. Other countries outside of Africa were Asia and the Caribbean. There were several methodological approaches used by the studies and these were mixed methods for three (3) studies, one (1) case study, one (1) conceptual Framework, one (1) survey using REDCap, one (1) descriptive cross-sectional study, one (1) combination of in-depth interview and site visit and one (1) combination of desk review, stakeholder meetings and site visits. There were no randomized controlled trials included the common approaches were cross-sectional and case studies.

**Table 1.** Description of the studies.

| Author(s) | Article Type and Title | Population/health program | Study Design/Methods | Country/Region |
|---|---|---|---|---|
| **Mabona et al. 2024** | Evaluation of the malaria case surveillance system in KwaZulu-Natal Province, South Africa, 2022: a focus on DHIS2 | Malaria surveillance system | A mixed-methods cross-sectional study design | South Africa/Southern Africa |
| **Sherr et al. 2017** | Manuscript: Measuring health systems strength and its impact: experience from the Africa Health Initiative. | General population | Conceptual evaluative framework using World Health Organization's health systems building block framework | African Health Initiative countries/multi-country |
| **Ohuabunwa EC, Sun J, Jean Jubanyik K,** | Electronic Medical Records in low to middle income countries: The case of | Trauma cases | Case study evaluating the ability and completeness of the EMR at Khayelitsha hospital to capture all | South Africa/Southern Africa |

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| **Wallis LA., 2015** | Khayelitsha Hospital, South Africa. | | emergencies classified as trauma. | |
| **Harklerode R, Schwarcz S, Hargreaves J, Boulle A, Todd J, Xueref S, Rice B., 2017** | Manuscript: Public Health and Surveillance. Feasibility of Establishing HIV Case-Based Surveillance to Measure Progress Along the Health Sector Cascade: Situational Assessments in Tanzania, South Africa, and Kenya. | HIV Population | A desk review of relevant materials on HIV surveillance and program monitoring, stakeholder meetings, and site visit | -Tanzania and Kenya/East Africa -South Africa/Southern Africa |
| **Holmes JR, Dinh T, Farach N, et al., 2019** | Manuscript: Morbidity and Mortality Weekly Report Status of HIV Case-Based Surveillance Implementation — 39 U.S. PEPFAR-Supported Countries, May–July 2019. | - HIV population -HIV CBS | A survey using Research Electronic Data Capture (REDCap) an electronic data management tool hosted at CDC and distributed to each PEPFAR-supported CDC country or regional office | 39 PEPFAR supported countries, with majority in Sub-Saharan Africa |
| **Nyashadzashe Cosmas Makova et al., 2022** | Evaluation of the measles case-based surveillance system in Kwekwe city, 2017-2020: descriptive cross-sectional study | -General population -Measles CBS | Descriptive cross-sectional study using CDC surveillance guidelines | Zimbabwe/Southern Africa |
| **Collins D, Rhea S, Diallo BI, Bah MB, Yattara F, Keleba RG, et al. (2020)** | Surveillance system assessment in Guinea: Training needed to strengthen data quality and analysis, 2016 | -General Population - Case and community-based surveillance for: cholera, meningococcal meningitis, measles, and yellow fever | -In-depth interviews with key informants and site visits | Guinea/West Africa |
| **Govender et al., 2023** | Progress towards unique patient identification and case-based surveillance within the Southern African | -HIV population -CBS with a unique patient identification (UPI) | Mixed methods landscape analysis of UPI and CBS implementation | Southern African Development Community (SADC) countries |

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| | development community | | | |
| **Oluoch et al., 2023** | Implementation of an HIV Case Based Surveillance Using Standards-Based Health Information Exchange in Rwanda | -HIV population -CBS for HIV implementation | Quasi experimental, mixed methods | Rwanda/East Africa |

### *3.2. Types of Models/Systems*

Of the articles reviewed, four (4) focused purely on HIV case-based surveillance while the other five (5) focused on other diseases or public health care (PHC). Eight (8) out of nine (9) articles revealed government ownership of systems for respective countries while one (1) article had no mention of specific ownership. Regarding funding of the systems, 78% (7/9) were externally funded while the remaining 22% (2/9) were internally funded by the Government or there was no mention of the donors. The U.S. Government through PEPFAR appeared to be the main funder for most of the studies. Malaria surveillance system was also discussed for South Africa and measles was discussed for Zimbabwe and Guinea. Another country in West Africa (Guinea) covered Ebola surveillance but also focused on cholera, meningococcal meningitis, measles, and yellow fever. Majority of the publications were owned by academic institutions and very few by donor funded implementing partners (Table 2).

**Table 2.** Models of CBS in Africa.

| Author | Disease Focus | Source of Funding | Countries | Model/System/Owner |
|---|---|---|---|---|
| **Mabona et al. 2024** | Malaria | Internal: National Department of Health; no external donors mentioned | South Africa | -Evaluation: Malaria case surveillance system: DHIS2<br>-The systems in this article are DHIS2 which is used as central data management systems and malaria case surveillance flow system which supports tracking case classifications and ensures timely reporting of cases.<br>-Data is collected by health care workers at facility level into Malaria surveillance system and then integrated into DHIS2 either manually or automatically.<br>-Both systems are owned by the government of South Africa although managed by other partners.<br>-The four critical components of a surveillance system are data quality, timeliness, simplicity, and acceptability<br>-A effective surveillance system is critical in evaluating the plans to achieve elimination<br>-Although data quality was generally accepted, timeliness of reporting cases within 24 hours remained a challenge<br>-For optimum use and acceptability of the systems, giving |

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| | | | | feedback to lower surveillance levels is crucial |
| **Sherr et al. 2017** | This article is not disease based but focused on population health with focus on child mortality | External: Doris Duke Charitable Foundation funded this study | Ghana, Mozambique, Rwanda, Tanzania, and Zambia | -Evaluation framework to measure health systems strength<br>-Assessing association between health systems measures and health outcomes.<br>-Six WHO core blocks measured were service delivery, Health workforce, information systems, medical products, vaccines and technologies, health financing and leadership and guidance.<br>-There were some attributes of health systems that could not be evaluated and these include trust, resilience, quality, and leadership.<br>-The six WHO health systems are limited in measuring validity, sensitivity and comprehensive metrics of health systems.<br>-Effective evaluation of health systems strength requires sophisticated evaluation methods, indicators in context and understanding how various systems work. |
| **Ohuabunwa EC, Sun J, Jean Jubanyik K, Wallis LA., 2015** | This study focuses on trauma cases | External: The study was externally funded by Down's Fellowship and Yale School of Medicine but the donors of the system are not mentioned. | South Africa | -Electronic Medical Records system.<br>-The assessment at KH was used as a proxy which would reflect nationwide estimates of about 40% of emergency center visits.<br>-KH is using both Enterprise Content Management (ECM) and EMR. The systems were deployed in 2012 and are owned by the government although they are controlled by JAC Computer services because they are proprietary systems. Patient's data is collected at the hospital through EMR, ECM and the file.<br>-For a successful electronic medical record system, funding must be secured for adequate training and supervision of users and other necessary resources<br>-Adequate records system is a pillar of the health facility without which it is prone to collapsing |
| **Harklerode R, Schwarcz S, Hargreaves J, Boulle A, Todd J, Xueref S, Rice B., 2017** | Focused on HIV | External: The article was externally funded by Bill and Melinda Gates Foundation, WHO and Global Fund | Tanzania, South Africa, and Kenya. | -Situational Assessment: Case-base surveillance<br>-All systems are owned by the government<br>-In Tanzania, data is collected at individual-level from point of entry into care on approximately |

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| | | to Fight AIDS, Tuberculosis, and Malaria but the systems are public or government owned. | | two-thirds of people on ART. In SA, the system collects individual-level data at the facility and then reported to the national level including names and other personal identifiable factors. In Kenya, EMRs are used for facilities with patients greater than 500. Individual-level data are captured in the EMR, and aggregate data is reported to the central data warehouse on quarterly basis.<br>-The systems though funded externally are owned by the government in respective countries.<br>-All the three countries do not have policies for HIV reporting, data security and confidentiality. The only policy in SA is for vital registration data and Kenya has some policy for infectious diseases but not specific to HIV.<br>-In Tanzania and Kenya, de-duplication of patients' data is done using clinical identifier while SA uses an algorithm<br>-All the three countries reported internet challenges in the rural areas.<br>-Tanzania thought of interoperability as unnecessary because the PMS database is national. SA on the other hand uses Tier.Net which is also a national system therefore limiting interoperability issues. Kenya has 4 EMRs that are not interoperable and data in each system has not been evaluated. |
| **Holmes JR, Dinh T, Farach N, et al., 2019** | The disease focus in this article was HIV | External: The study was funded by the United States Government through CDC/PEPFAR program | Angola, Botswana, Brazil, Cambodia, Côte d'Ivoire, Democratic Republic of the Congo, Dominican Republic, El Salvador, Eswatini, Ethiopia, Ghana, Guatemala, Guyana, Haiti, Honduras, | -CBS implementation assessment<br>-Of the 20 countries implementing CBS, all collect date of HIV diagnosis and 85% collect sentinel event survey data and 50% of these countries use the UID to link and de-duplicate patients' data.<br>-Countries already implementing CBS and those planning to implement have funding, mostly from PEPFAR and they have dedicated human resource for the systems.<br>-Of the 39 countries assessed, 20 had already implemented CBS, 15 were planning to 4 were not planning to implement<br>-Challenges reported especially in Sub-Saharan Africa included lack |

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| | | | Jamaica, Kenya, Laos, Lesotho, Mali, Malawi, Mozambique, Namibia, Nicaragua, Nigeria, Panama, Papua New Guinea, Rwanda, Senegal, South Africa, South Sudan, Tanzania, Thailand, Trinidad and Tobago, Uganda, Ukraine, Vietnam, Zambia, and Zimbabwe | of UID limiting data linkage across systems and lack of national policies and data security standards.<br>-The 4 countries that were not planning to implement CBS indicated lack of funding and dedicated human resources as major barriers. |
| **Nyashadzashe Cosmas Makova et al., 2022** | Measles | Internal: This is a public health surveillance and there is no mention of external donors. | Zimbabwe | -Descriptive cross-sectional assessment using CDC guidelines for surveillance system evaluation. The measles CBS in Zimbabwe is a government owned system integrated with other vaccine preventable diseases such as acute flaccid paralysis.<br>-Data for all suspected cases of measles is routinely collected at all levels of health delivery using measles case surveillance form.<br>-Data from primary health facilities is sent to the district, then to the province and finally to the national level.<br>- This system is owned by the local Department of Health<br>-The evaluation revealed that although most users confirmed that the CBS was simple, it lacked stability, acceptability and sensitivity.<br>-Lack of training was shown as one of problems for underperformance of measles CBS.<br>-Also, lack of relevant staff for the system hindered its optimum use.<br>-Engagement of relevant stakeholders such as private sector |

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| | | | | and the community is key for the success of the system. |
| **Collins D, Rhea S, Diallo BI, Bah MB, Yattara F, Keleba RG, et al. (2020)** | The assessment focused on four (4) diseases namely: cholera, meningococcal meningitis, measles and yellow fever | External: The study was funded by the US Government through CDC but is a government owned public health surveillance system. | Guinea | -Surveillance system assessment using CDC's guidelines for surveillance system evaluation.<br>-This is a government owned system supported by international partners.<br>-The assessment was focused on focused on the surveillance system's operations, resources, and attributes particularly simplicity and data quality)<br>-At health center level, the surveillance system is paper-based while at prefectural and central levels, it is computer spreadsheet-based.<br>-The Ministry of Health surveillance protocol required immediate and routine weekly reporting at health and prefectural levels and then reported at central by telephone.<br>-This is a public health system owned by the government in Guinea<br>-The assessment revealed that the system in Boffa was simple but had limitations in documentation and data analysis.<br>-The Ebola outbreak in 2014-2016 revealed Guinea's weak health systems and surveillance gaps hindering proper detection and swift response to emerging disease outbreaks.<br>-The system's sensitivity was determined as low as no cases or the 4 diseases were identified during the assessment period although data suggested existence of cases<br>-For a successful surveillance system, the country needs to improve capacity building for the users, improve infrastructure such as electricity and enhance feedback mechanisms to encourage data analysis and use. |
| **Govender et al., 2023** | The assessment focuses on HIV although there is mention of hypertension, diabetes, and TB. | External: The assessment was funded though PEPFAR and there is strong emphasis strong US support to health information systems. | Botswana, Eswatini, Lesotho, Mozambique, Namibia, South Africa, | - landscape analysis of unique patient identification (UPI) and CBS implementation within selected SADC countries<br>-The commonly collected identifiers are patient name, date of birth, government ID, phone numbers and facility file number. |

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| | | | Zambia and Zimbabwe | -The system is owned by the government through Ministry of Health in all the countries respectively.<br>-UPI implementation is limited by paper-based systems and lack of integration between health information systems.<br>-Many countries still rely on paper-based systems and fragmented electronic systems that are not integrated.<br>-Common CBS barriers include limited financial resources, lack of capacity building for staff, limited systems interoperability, data security and lack of confidentiality for patients' information.<br>-Most SADC countries are in the early to middle stages of developing patient-centered, case-based surveillance systems using UPIs. |
| **Oluoch et al., 2023** | Disease focus is HIV | External: The HIV CBS in Rwanda is particularly PEPFAR funded | Rwanda | -Conducted an assessment of health information exchange ecosystem focusing on open-sources and standards supporting generation of complete data sets needed for HIV CBS in Rwanda.<br>-The systems are owned by the government but financially supported by PEPFAR.<br>-Data collection is done at health center level and collects patient -level data.<br>-The study revealed that using open sources such as HL7 FHIR is effective and enables interoperability of systems in low-resource settings.<br>-In the absence of national ID as UID, the study demonstrated that UID can be done with client registry linking it with demographic data and multiple identifiers to enable linkage and matching across different systems. |

### *3.3. Challenges and Successes*

The section discusses a summary of successes and challenges of the CBS systems in Africa that were reviewed.

#### 3.3.1. Successes

- Many African countries are responding to the WHO's call of advocating for a person-centered approach of reporting through case-based surveillance as part of HIV patient monitoring guidelines.

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- System's sensitivity was highlighted as critical in most studies to ensure that there is proper and early detection of public health threats.
- The use of fingerprints and national ID by some countries are steps in the right direction giving hope to uniquely identify patients.
- Some countries have developed health information systems that are interoperable which allow for secure data sharing and use which results in better care for patients and eliminates duplication.
- Although many countries have highlighted inadequate and lack of funding for CBS, a decision to use open sources can bring some stability and continued maintenance of the systems in low-resource settings.
- A study conducted in Rwanda proved a successful data exchange between multiple systems including EMR, Lab Information System (LIS), CR and DHIS2 tracker demonstrating a 100% match when generating a dataset for the HIV CBS.
- This research highlighted the CBS implementation gaps which could help Lesotho to avoid when implementing CBS.

3.3.2. Challenges

- Many countries are still struggling with finding the right UID for linking patients to the health services and tracking them in the long-term.
- Many countries still do not have relevant policies that help ensure data security and confidentiality of patient's information.
- Infrastructure continues to be one of the major components hindering successful implementation of CBS especially in rural areas.
- The use of both paper and electronics continues in many countries with paper-based systems being preferred because of lack of training and dedicated staff for electronic systems. The EMR case study done in Cape Town, South Africa, by Ohuabunwa et al. confirmed that there is resistance from the clinicians to use full EMR and some hospitals have opted to maintain paper-based systems.

## 4. Discussion

This paper is discussing the different models and systems used in different countries to assess robust case-based health systems for a stable health system and to determine which ones may be appropriate in a low-income country setting like Lesotho. This research revealed that countries are investing in surveillance systems, especially for infectious diseases, although they are hampered by issues such as inadequate infrastructure and resources, lack of relevant policies, concerns about data security and confidentiality, insufficient capacity and training for staff, data quality, lack of UID and in some cases sensitivity of the systems. Literature review by Mabona et al. confirms sensitivity as a challenge with only 61% of malaria cases notified within 24 hours in KwaZulu-Natal (Mabona et al., 2024) thereby delaying prompt response for emergencies and outbreaks control. This is unsatisfactory as per WHO's recommendations that cases of notifiable diseases including malaria should be reported within 24 hours of diagnosis to allow for timely intervention (WHO, 2015).

Several countries struggle with implementation of UID which is critical for tracking and linking patients within and across health facilities (Govender et al, 2023). The absence of UID also affects data quality and promotes duplication thereby showing a false picture of the prevailing situation. Some countries like South Africa are opting for an algorithm to cater for non-citizens as well instead of using a national ID only (Harklerode et al, 2017). Although use of national ID poses as a challenge for many countries, a study conducted in Rwanda demonstrated that UID can be implemented within the client registry and be linked with demographic data and other multiple identifiers which can enable matching across systems even during internet outages (Oluoch T. et al., 2023). In this study, there was a 100% match between source systems when generating a database for routine HIV CBS; few initial errors were resolved.

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There are many factors that contribute to an effective health system such as health financing, health information, health workforce, medical products, leadership and governance. However, a study conducted by Sherr et.al. in five sub-Saharan African countries (Ghana, Mozambique, Rwanda, Tanzania and Zambia) reveals that leadership and governance remained behind and this impedes optimal functioning of the health systems (Sherr et al., 2017).

The use of CBS is imperative for the entire clinical cascade from HIV diagnosis, initiation into antiretroviral therapy (ART), monitoring of disease progression or improvement and finally death (Harklerode et al, 2017). A study conducted in Tanzania, Kenya and South Africa in 2015 which focused on the feasibility of implementing CBS revealed some of the critical elements for CBS including availability of UID which is critical for linking clients' data within and across health facilities (Harklerode et al, 2017).

For countries to have a well-functioning case-based system, establishing an electronic medical record system (EMRs) is one of the first critical steps (Jayatilleke, 2020). In Africa, establishing EMRs is due to increasing infectious diseases that result in death, especially HIV and TB (Ohuabunwa EC, Sun J, Jean Jubanyik K, Wallis LA., 2015). Thus, Lesotho is in a right track since it is one of the countries that have started on developing the national EMR systems according to a World Health Organization (WHO) survey (Ohuabunwa EC, Sun J, Jean Jubanyik K, Wallis LA., 2015). Moreover, the cost of establishing these systems must be a reasonable one, especially for low-income countries. Ohuabunwa et at., 2025 suggests that open-source systems are ideal as they allow the users to configure them to fit their intended purpose and do not require licensing and software upgrades cost as opposed to expensive propriety systems which may be suitable for wealthier countries.

Although open sources may ensure sustainability, the assessed articles revealed heavy reliance on external funding for establishment and maintenance of the systems. Of the nine (9) articles assessed, only two (2) were internally funded by the government while the all the remaining seven (7) were externally funded particularly by the U.S. Government. Thus, there is need for countries to allocate specific budgets for their health information systems, strengthen local expertise, leverage on domestic resources to cater for HIS and to gradually absorb externally supported system to the local government budget.

Furthermore, regardless of challenges encountered by countries implementing CBS, there is notable progress in Africa. An assessment conducted by CDC in the 46 U.S. President's Emergency Plan for AIDS Relief (PEPFAR) supported countries to identify enablers and barriers to implementing CBS revealed that "among the 39 (85%) countries that responded, 20 (51%) have implemented CBS, 15 (38%) were planning implementation, and four (10%) had no plans for implementation" (Holmes JR, Dinh T, Farach N, et al., 2019) . Some of the barriers highlighted by the countries included lack of policies or guidance on CBS, lack of UID and unavailability of data security standards to mention but a few (Holmes JR, Dinh T, Farach N, et al., 2019).

## 5. Conclusions

The aim of the study was to review existing models for the case-based health programs in Africa to inform the development and implementation of case-based surveillance of HIV in Lesotho. This research revealed that several African countries have case-based surveillance systems for different health programs such as HIV, Malaria, Ebola and measles to mention but a few. Common CBS barriers include limited financial resources, lack of capacity building for staff, lack of relevant policies, limited systems interoperability, data security and lack of confidentiality for patients' information. For the successful implementation of CBS, countries need to invest in infrastructure, ensure availability of policies, use of open sources, provide capacity building for relevant staff and prioritize use of UID for the ability to track individual patients across health services over time. Until governments cease to rely on donors for HIS support, sustainability and ownership will continue to be hampered.

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## Abbreviations

The following abbreviations are used in this manuscript:

| **Acronym** | **Definition** |
|---|---|
| CBS | Case-Based Surveillance |
| EMRs | Electronic Medical Records |
| PLHIV | People Living with HIV |
| ART | Antiretroviral Treatment |
| UID | Unique Identification Number |
| WHO | World Health Organization |
| PEPFAR | President's Emergency Plan for AIDS Relief |
| LIS | Laboratory Information System |
| CR | Client Registry |
| DHIS2 | District Health Information System 2 |
| REDCap | Research Electronic Data Capture |
| ECM | Enterprise Content Management |
| PMS | Patient Monitoring System |
| HL7 FHIR | Health Level Seven Fast Healthcare Interoperability Resources |
| SOPs | Standard Operating Procedures |
| SADC | Southern African Development Community |
| GPA | Global Program on AIDS |
| CDC | Centers for Disease Control and Prevention |
| EBSCOHOST | A research database platform |
| PRISMA | Preferred Reporting Items for Systematic Reviews and Meta-Analyses |
| COVID-19 | Coronavirus Disease 2019 |
| STI | Sexually Transmitted Infection |
| ECM | Enterprise Content Management (also listed above) |
| N/A | Not Applicable |

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