ISSN: 3065-5102
Research Article
Journal of Sexual Health and AIDS Research

Evaluation of the HIV Case-Based Surveillance System in Dire Dawa City Administration, Ethiopia. A Descriptive Cross-Sectional Study

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Submitted: 03 July 2025 **Accepted:** 09 July 2025 **Published:** 15 July 2025

https://doi.org/10.63620/MKJSHAR.2025.

Citation: *Hagos, F., Kassahun, A., & Hailu, E., & Sisay, A. (2025). Evaluation of the HIV Case-Based Surveillance System in Dire Dawa City Administration, Ethiopia. A Descriptive Cross-Sectional Study. Jour of Sexu Heal and AIDS Res, 2(3), 01-10.*

Abstract

Background: *Ethiopia started the Human Immunodeficiency Virus (HIV) Case-Based Surveillance (CBS) system along with Research Electronic Data Capture (REDCap) in June 2021. From January to June 2022, only five out of 14 CBS implementing health facilities in Dire Dawa City, Ethiopia, reported 35 newly diagnosed HIV patients through the REDCap Database compared to 314 in the District Health Information System (DHIS-2). This study aimed to evaluate the case-based surveillance system, its usefulness, and reasons for under-reporting in Dire Dawa City, Ethiopia.*

Methods: *We used a descriptive cross-sectional study design. We customized the data collection tools from the Centers for Disease Control and Prevention (CDC), a guideline for evaluating public health surveillance systems. Questionnaires were administered to 36 healthcare workers involved in supporting CBS. Completed HIV CBS case reporting forms were also assessed for completeness. EPI Info software was used for data entry and analysis. Descriptive statistics, such as frequencies and proportions, were used to describe the findings.*

Results: *Interviews were successfully conducted with 34 health workers. The lack of CBS reporting guidelines for healthcare facilities was 22 (61%). Limited coordination between technical staff and health facilities 19(53%) and limited competency in REDCap 23(64%) were also observed. CBS data timeliness, completeness, and validity were 89%, 87%, and 99% respectively, in the REDCap. There is a lack of standard operating procedures during system interruption. The overall health facility representativeness was 368 of 757 (49%). Acceptability was 100%, mainly due to reduced paperwork and the ability to generate simple reports.*

Conclusion and Recommendations: *The HIV case-based surveillance system was timely and acceptable. However, its representativeness was poor owing to limited competency in the REDCap. We recommend that health workers receive further training for case-based HIV surveillance.*

Keywords: HIV, REDCap, Case-Based Surveillance, Surveillance Evaluation, Dire Dawa, Ethiopia.

Acronyms/Abbreviations

CBS: Case-Based Surveillance
CDC: Centers for Disease Control and Prevention
COVID-19: Coronavirus Disease
CRF: Case Report Form
CSA: Central Statistical Agency
CPAC: CBS Publication Advisory Committee
DHIS-2: District Health Information System
EFY: Ethiopian Fiscal Year
EPHI: Ethiopian Public Health Institute
FCH: Family and Child Health unit
HF: Health Facility

HIV: Human Immunodeficiency Virus
HTS: HIV Testing Services
VMMC: Voluntary Male Medical Circumcision unit
REDCap: Research Electronic Data Capture
RHB: Regional Health Bureau
WHO: World Health Organization
ZHD: Zonal Health Department
IRB: Institutional Review Board

Introduction

The U.S. Department of Health released the HIV National Strategic Plan in January 2021, aiming to reduce new HIV infections by 90% by 2030, which was replaced by the National HIV/AIDS Strategy in December 2021 [1].

Ethiopia has made significant progress toward universal coverage of HIV diagnosis, treatment, and viral suppression in people living with HIV. For instance, in the past two decades, Ethiopia has been successful in reducing the HIV prevalence rate from 3.3% in 2000 to 0.9% in 2017 and in decreasing AIDS-related deaths from 83,000 deaths in 2000 to 15,600 in 2017 [2].

However, existing HIV/AIDS information systems have several limitations. For instance, it does not distinguish whether the diagnosis of a new HIV case is due to an increase in HIV transmission or increased testing coverage for undiagnosed infections, lacks a real-time data reporting system, or does not track individual-level data. Strengthening national HIV/AIDS strategic information systems through longitudinal and individual-level data is the World Health Organization's recommendation to its member states to better understand subnational epidemics and guide more focused interventions [3]. Ethiopia initiated the implementation of HIV case reporting and recency testing surveillance in June 2019 based on the technical guidelines of the Ministry of Health (EPHI) technica0l guideline. The system has the following major activities, currently rolled out in more than 400 high-volume HIV public and private health facilities and community drop-in centers [1].

The objective of the evaluation of the HIV Case-Based Surveillance System study aimed to evaluate the case-based surveillance system, its usefulness, and reasons for under-reporting in Dire Dawa City, Ethiopia. The CBS system also aims to monitor and describe epidemiological patterns in newly diagnosed HIV cases based on demographics, behavior, method of transmission, and time after HIV infection. Furthermore, the system intends to track and report trends in clinical state (WHO stage, initial CD4 count, and other opportunistic infections) at the time of diagnosis. The United States Centers for Disease Control and Prevention (CDC) emphasizes the need for routine evaluation of disease surveillance systems within a district, region, or nation [4]. The functionality of the surveillance system was determined through a surveillance system evaluation. Hence, the evaluation of a surveillance system is vital for identifying gaps in the system and ensuring improvement in the quality, efficiency, and usefulness of the system.

Flow of Data in the HIV CBS System in Ethiopia

At the health facility level, HIV case reports are generated at the point of service delivery, such as the hospital outpatient department or inpatient department, Family and Child Health unit (FCH), and Voluntary Male Medical Circumcision unit (VMMC). At health facilities that use REDCap, all surveillance data elements are recorded on a single HIV case report form (CRF). The data from this case report form were then transferred to the REDCap system using an on-site computer device. Data from both the e-first and e-last clinic-based REDCap databases were merged into the national shared health record component through web-based applications with secure internet connectivity. A command to deduplicate all health records across clinics by applying software using demographic variables. Deduplicated and anonymized individual health records were transmitted to the national server in the EPHI database from the shared health record component [5] (Figure 1). Fourteen health facilities in the Dire Dawa city administration in eastern Ethiopia implemented CBS using the REDCap database in 2019 as part of efforts to reduce inefficiencies associated with paper data collection and reporting. At these facilities, patient-level data for all newly diagnosed HIV patients collected through CBS forms were entered and reported through REDCap to the national server. Reported figures should tally with the monthly aggregate number of newly diagnosed HIV patients reported through the DHIS2 system, which is collated from the HIV monthly return forms at the health facility level, where the primary data source is HIV Testing Services (HTS) registers. This study aimed to evaluate the case-based surveillance system, its usefulness, and reasons for under-reporting in Dire Dawa City, Ethiopia. [6]. The region was selected purposively from nine regional states and two town administrations based on the prevalence of HIV in the city administration and the absence of previous case-based surveillance system evaluations of HIV.

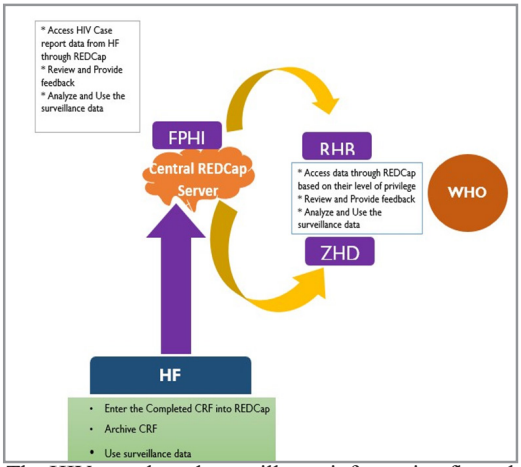

Figure 1: The HIV case-based surveillance information flow chart in Ethiopia

Methodology

Study Design

The study design used for this research was a descriptive cross-sectional approach aligned with the updated guidelines provided by the CDC for evaluating public health surveillance systems. In addition to quantitative analysis, qualitative methods were integral to this study. Qualitative techniques, including interviews, observations, and document reviews, were used to gain a comprehensive understanding of the nuances and contextual factors influencing the effectiveness of the surveillance systems under investigation. These qualitative methodologies enriched the analysis by providing insights into stakeholders' perspectives, operational challenges, and potential areas for improvement within the public health surveillance framework [7].

Study Setting

Based on 2012 (EFY) figures from the Central Statistical Agency (CSA) of Ethiopia, it has an estimated total population of 506,639 consisting of 185,377 males and 184,264 females [8]. A total of 32.2% of the population is estimated to be rural inhabitants, while 67.5% are urban dwellers [9]. All health facilities offered HIV testing and counseling services; however, HIV CBS implemented health facilities were 14 at the time of the study [7]. We included in this study all 14 health facilities that had implemented HIV CBS. These were Sabiyan Primary Hospital, Dil Chora Hospital, Yemaryam Work General Hospital, Art General Hospital, Bilal Hospital, Goro Health Center, Gende Kore Health Center, Legehare Health Center, Gendegerada Health Center, Dechatu Health Center, Addis Ketema Health Center, Diredawa Health Center, FGA Health Clinic, and Melka Jebdu Health Centers.

Study Population

We interviewed healthcare workers involved in the HIV CBS system and HIV testing and counseling services as primary respondents. The Regional Health Bureau HIV CBS focal persons, health facility level focal persons, nurses in charge, REDCap data clerks in facilities, and provincial health information officers were interviewed as key informants. The study participants were RHBs, Woreda health offices, and health facilities (hospitals and health centers) found in the city administration.

Sample Size Determination

To assess the completeness of HIV CBS forms, we calculated a minimum sample size of 80 HIV CBS reporting forms using Dobson's formula for calculating the sample size for a single population proportion:

n = (Zα/ 2)2 (p) (1− p))

c2

where:

Z = Z statistic value i.e. 1.96 for a 95% confidence interval;

p = proportion of HIV CBS reporting forms with 76% completeness;

c = 10% precision.

Assume that the completeness of HIV CBS reporting forms is 76% complete and given a 95% confidence interval, 10% level of precision and 14% nonresponse rate.

n = (1.96)2 (p) (1− p)) n = (1.96)2 (0.76) (1-0.76) = 70*14%= 80

c2 (0.1)2

Sampling Techniques

Sampling of Primary Participants

All of the health workers who were engaged in HIV testing and counseling, as well as data entry, were found to be on duty at the health facilities over the course of the study. In addition, we enrolled participants from the RHBs.

Sampling of HIV Case-Based Surveillance Forms

We used the random sample formula in Microsoft Excel "=RAND ()" to sample seven forms from each health facility included in the study. We created a line list of all identified reporting forms in an Excel spreadsheet using the monthly sequential number obtained from the HIV testing services (HTS) register. We sampled 80 paper-based HIV CBS forms for the period between November 1, 2022, and October 30, 2022.

Data Collection

We used interviewer-administered questionnaires to collect the demographic characteristics of healthcare workers participating in the study and information on the reasons for underreporting of newly diagnosed HIV patients in the REDCap system from healthcare workers and key informants, as well as to assess system attributes. Using standardized formats, we extracted secondary data from the surveillance reports.

Health Worker Knowledge of the HIV CBS System with Recency Testing

We used interviewer-administered questionnaires to assess health workers' knowledge of the HIV CBS system with recency testing using the following variables: ability to accurately define a case, ability to describe the purpose of the HIV CBS system, ability to state what information is collected from a case in the HIV CBS system, ability to accurately state which sentinel events are reportable, and ability to describe the steps taken after an HIV case is diagnosed. We used a 5-point Likert scale to assess health worker knowledge levels [10]. Health workers who answered less than or equal to two questions correctly out of five were classified as having poor knowledge levels, and those who scored three out of five were classified as having fair knowledge levels. Participants who answered four or above four questions correctly were classified as having good knowledge levels.

Evaluation of HIV CBS System Attributes

Say something about SS attributes before going to the list!

Representativeness

Representativeness measures the degree to which the CBS system captures all cases and sentinel events and the degree to which cases in the surveillance system are representative of all cases in the population. We assessed representativeness by examining the proportion of HIV cases reported in the REDCap system compared to those recorded in the DHIS-2 using monthly reports. We measured representativeness as the: 1) proportion of healthcare facilities in the city administration (private or public) that submit case reports to the national system and 2) proportion of HIV cases diagnosed in a quarter that were reported in the DHIS-2 and CBS systems.

Timeliness

This is the time between the date of HIV diagnosis and its entry into the REDCap. All CRFs should be ready and entered within specified time frame within 15 days, having been checked, and

verified. The percentage of timely reporting facilities in a given area shows which institutions report on time. We determined timeliness by assessing the lag time between diagnosis and entering the case report in the CBS system.

Data Quality

The data quality reflects the completeness and validity of the data recorded in the HIV CBS system. Completeness describes the proportion of case reports that contain essential variables. We assessed the completeness of the HIV CBS system by calculating the proportion of case reports that had all completed case-defining variables. The "unknown" or "blank" responses to items on the case report forms were deemed incomplete if applicable to the HIV case. We also assessed the data quality by the number of training, supervision, and data quality assurance reviews conducted. Validity describes the degree to which the CBS data "makes sense" or whether the data fall within the range of possible or expected values. We assessed validity using birth year, which should be four digits between 1900 and 2022.

Simplicity

Simplicity refers to the ease of operation, structure, and integration of incidence and routine HIV surveillance. We assessed the simplicity of the HIV CBS system with recency testing using the proportion of health workers who found completing paper-based and electronic forms to be easy and not time-consuming (average time taken to complete these forms) and staff training requirements.

We assessed the surveillance system using the following criteria: the ability to log into the system, creation of an HIV electronic health record, retrieval of a client's electronic health record, editing or updating an electronic health record, deleting an electronic health record, and generating a report.

Acceptability

Acceptability reflects the willingness of healthcare workers to participate in case-based HIV surveillance. We assessed acceptability through interviews with health workers. We calculated the proportion of healthcare workers willing to continue participating in the system and relied on data from it. We objectively assessed the acceptability of the HIV CBS system using completeness, quality of data, timeliness, availability of meeting minutes, and feedback reports.

Flexibility

A flexible surveillance system can adapt to changing information needs or operating conditions with minimal additional time, personnel, or allocated funds. We assessed the flexibility of the HIV CBS system by observing how the system responded to new information and technology requirements such as COVID -19, and conflicts, man-made, and natural disasters.

Stability

Stability refers to the reliability and availability of an HIV-case-based surveillance system. We assessed the stability of the surveillance system by ascertaining the presence of dedicated staff for HIV CBS activities and the level of interruption of the system due to inadequate human resources, REDCap system downtime due to electricity outages, availability of case report forms, and dedicated computers to enter case reports using a checklist.

Usefulness

We assessed the usefulness of the HIV case-based surveillance system by asking respondents if the collected data were analyzed, the data used, and any reports or graphs generated from the data. The respondents were also asked about the public health actions carried out or made based on the findings from the data collected by the surveillance system. We also assessed the availability of minutes of meetings held on the surveillance system and any actions taken to validate its usefulness.

Data Analysis

We used Epi Info TM version 7.2.4 for data entry and analysis. Descriptive statistics were used to analyze the quantitative data and are presented as medians, interquartile ranges, frequencies, and proportions. A 5-point Likert scale was used to rate the respondents' knowledge.

Results

Demographic Characteristics of the Respondents

We interviewed 34 healthcare workers, the majority of whom were female (22/34, 65%), and diploma nurses (13/34, 38%). The median age of the study participants was 29.5 years ([interquartile range [IQR] =10), and the median years of service was 4 years (IQR=8). The authorities responsible for the 14 CBS implementing health facilities were as follows: government, mission, and private [9, 11, 2].

Table 1: Demographic characteristics of health workers involved in HIV CBS activities at REDCap implementing facilities in Dire Dawa, 2022.

Variable	Categories	Frequency n = 34	Percentage
Sex	Female	22	65
Male	12	35	
Designation	Nurse (diploma)	13	38
Nurse (Degree)	9	26	
Health Officer (HO)	6	18	
Data entry clerks	6	18	
Age group (years)	20 – 24	15	44
25 - 29	11	32	

30 – 34	5	15	
35 - 39	3	9	

The major reasons reported by health workers for underreporting newly diagnosed HIV-positive cases through the REDCap database were work overload/under-staffed 25/34 (73.5%), high staff turnover 22/34 (64.7%), and inadequate REDCap database competence 17/34 (50%). Limited coordination between units: 14/34 (41%); absence of feedback from higher levels: 11/34 (30%); and use of parallel systems: 9/34 (26%).

Table 2: Reasons for underreporting of newly diagnosed HIV cases through the REDCap database at health facilities in Dire Dawa, 2022.

Reason for underreporting	Frequency n = 34	Percentage
Work overload/short staffed	25	73
High staff turnover	22	65
Inadequate REDCap database competence	17	50
Limited coordination between units	14	41
No feedback from higher levels	11	32
Electricity power outages	10	29
Use of parallel systems for reporting cases	9	26
No reporting guidelines	8	22
Poorly designed interface	6	18
Too many data sources required to fill the form	5	15
Poor network connectivity	2	6

Health Worker Knowledge about the HIV Case-Based Surveillance System in Dire Dawa, 2022

Of the 34 health workers assessed for awareness and understanding of the HIV CBS system, 31 (91%) were able to accurately define an HIV-positive case, while 28 (82%) were able to describe the objectives of the HIV CBS system. A total of 33/34 (97%) knew which information was collected for HIV case reporting, and 33/34 (97%) were able to accurately state reportable sentinel events. Actions taken after an HIV-positive case was diagnosed were accurately described by 31/34 (91%) healthcare workers. Using a 5-point Likert scale, 28/34 (82%) healthcare workers had good knowledge, 4/34 (12%) had fair knowledge, and 2/34 (6%) had poor knowledge of the HIV CBS system.

Table 3: Health worker knowledge levels of the HIV case-based surveillance system at CBS implementing facilities in Dire Dawa, 2022.

Variable	Frequency n = 34	Percentage
Health workers who knew at least two (≥2/3) definitions of an HIV case	31	91
Health workers who knew at least two (≥2/4) objectives of the HIV CBS system	28	82
Health workers who knew at least eight (≥8/16) patients		
variables collected on an HIV case	33	97
Health workers who knew at least four (≥4/8) reportable sentinel events	33	97
Health workers who knew at least 2 (≥2/4) actions to be taken		
when an HIV case has been identified	31	91

Overall health worker knowledge levels of the HIV CBS system		
Good (4 - 5 correct)	28	82
Fair (3 correct)	4	12
Poor (1 - 2 correct)	2	6

The HIV CBS System Attributes at CBS Implementing Facilities in Dire Dawa

Representativeness

Compared to the DHIS-2 system, 3/156 (2%) of HIV cases were reported through the CBS system from July to August 2019, which increased to 169/233 (72%) by April-June 2022. Overall, the representation was 44%. Three private facilities reported cases through the HIV CBS system; however, 31/36 (86%) of the healthcare workers reported that there were governmental organizations that performed community testing as well as outreach activities (FGA) clinics that reported HIV cases to the facilities through the HIV CBS system.

Data Quality

Eighty CRFs were assessed, and the overall completeness was 84%. Data completeness ranged from as high as 95% for client identifier information and 88% for facility information to as low as 44% for the assessment of WHO clinical staging at diagnosis. Validity was 95% of the assessed 80 CRFs after the patients' age was verified by comparing the age of the patient with the calculated age based on the date of birth. Thirty-four healthcare workers (94%) reported that they had received a supervisory visit at a higher level. The median reported number of supervisory visits was four (IQR, 4).

Table 4: Data quality of the HIV case-based surveillance system at facilities in Dire Dawa, 2022.

Variable (%)	Frequency N = 80	Percentage	Completeness
Section A: Client identifier Information	80	100	95
Section B: Facility information	78	97	88
Section C: Index testing	75	94	85
Section D: Client Demographic information	79	99	89
Rapid test for HIV recent infection (client aged			
15 years and above)	75	94	81
ART initiation	77	96	89
Assessment of WHO clinical staging at notification	27	34	44
Validity	79	99	
Supervisory visits from higher levels	Median 3 Q1 = 2		Q3 =6

Timeliness

Of the 34 health workers interviewed, 31 (91%) still used both the notification systems. At facilities using both paper-based and electronic systems, of out 23/25 (92%) healthcare workers entered the HIV CBS forms daily. Data transmission from the facility- to national-level was automatic (real time) once entered as reported by 31/34 (91%) of the healthcare workers.

Table 5: Timeliness, simplicity, flexibility, acceptability and usefulness of the HIV CBS system at CBS implementing facilities in Dire Dawa, 2022.

Variable	Frequency	Percentage
Timeliness of the HIV CBS system		
Still using both CBS forms & DHIS-2	31	91
Time period taken for entry of paper-based HIV CBS forms into the REDCap database (n = 25)		
Daily	23	92
Weekly	1	4
Monthly	1	4
Timely transmission of CBS data from the facility to the national level		

Yes	32	94
No	2	6
Simplicity of the CBS system		
Access the REDCap database	6	100
Generate a report	32	89
Edit or update data on the REDCap	29	80
Median time taken to complete HIV CBS case report form Median 10 min (Q1=7) (Q3=14)		
Acceptability of the CBS system		
Health workers who reported a case in the CBS system	34	100
Health workers who completed an HIV CBS case		
Reporting form (CRF)	33	97
Health workers willing to participate in the system	31	91
Health workers able to do data analysis and use	28	82
Flexibility of the HIV CBS system		
Ease of integration with the DHIS2/ PHEM system	33	97
Ease of sharing CBS data through the PHEM reporting system	32	94
Ease of integrating new information requirements	30	88
More staff required to operate the system	28	82
Usefulness of the HIV CBS system		
Held meeting on CBS as an agenda in regular meeting	31	86
Data analysis performed at the facility level	23	68
Public health action taken	21	62
Trend line from HIV CBS data	20	59
Availability of minutes	18	53
Risk behaviors identified for hotspot areas	18	53

Simplicity

Of the 34 health workers interviewed, 32 (94%) reported that HIV-CBS forms were not difficult to complete. The median time taken to complete one form was 10 min (IQR, 7-14) compared to 20 min (IQR, 8.5 - 29.5) when completing a case reporting form in the DHIS-2 system. The use of the REDCap database ranged from 34/34 (100%) data clerks who were able to access the REDCap to 29/34 (85%) being able to edit or update an electronic health record.

Acceptability

All 36 (100%) healthcare workers reported their willingness to continue participating in the HIV CBS system and had previously reported a case, while 33/36 (92%) reported that they were part of a team that analyzed and utilized HIV CBS data.

Flexibility

Health workers mentioned that CBS is easy to integrate with the DHIS-2 system 33/34 (97%), while sharing HIV CBS data through the PHEM reporting system 32/34 (94%) mentioned that systems included DHIS-2 and an electronic Patient Monitoring System (EPMS). However, the integration of new information required 30/36(83%). More staff members were required to operate the system (28 /34, 82%).

Stability

Healthcare workers dedicated to HIV CBS activities constituted 27/36 (75%) respondents. Of the 14 facilities assessed, seven did not have a generator, two had nonfunctioning generators and needed repairs, and two health facilities did not have solar power, which affected the operation of the CBS system. We found that these challenges were associated with fuel shortages for the generators. Eight facilities did not have WHO clinical staging of HIV disease guidelines.

Usefulness of the HIV CBS System

The majority of healthcare workers, 31/34 (86%), reported that either MDT or RRT met and discussed HIV CBS data as an

agenda while 23/34 (68%) reported that data were analyzed and utilized at the facility level. The number of public health actions taken after the analysis report was 21/34 (62%). Data were also used to identify new infection hotspots for community interventions 30/34 (83%) (Table 5).

Discussion

We evaluated the HIV CBS system to assess whether the objectives of the system were being met, its usefulness, the extent of underreporting, and the reasons for underreporting of newly diagnosed patients in the REDCap database. We found that the major reason for underreporting HIV cases through the REDCap database was due to work overload. Health workers in facilities other than ART were not willing to complete the CRF, while the health workers in ART were not confident in finishing forms at the time within their institutions, resulting in underreporting of cases. Educating health workers on reporting requirements reduces their perception of HIV case reporting as burdensome. Other reasons for under reporting of HIV cases through the REDCap database included high staff turnover and inadequate REDCap database competence of feedback from central levels as reasons for poor performance of the system [8].

Stability

The role of feedback cannot be overemphasized in coordinating surveillance activities, increasing awareness, or reinforcing the importance of participating in the HIV CBS system. The system was not stable, as electric power outages and software upgrades affected the system in some facilities. Seven facilities lacked functional generators for power backup, and facilities with functional generators faced fuel shortages. Our findings were consistent with those that found that some of the challenges in the HIV CBS system were electricity outages and a lack of supplies to operate the system [12,13]. An extensive backup plan was not in place, as the HIV CBS forms that could be used as backup paper-based records were not available at the four facilities. We found that the overall representativeness of the HIV-CBS system was poor.

Representativeness

The availability of electronic mobile devices to health workers after 2020 facilitated the backdated entry of HIV-CBS forms, which resulted in improved representativeness by the end of 2020. These findings are in conflict with those of Gortakowski et al. (2010), who found that the system accurately represented the HIV epidemic in New York City [14].

Only three private facilities participated in the system. However, the distribution of community self-testing kits by partner agencies facilitated the inclusion of individuals irrespective of age, sex, and locality. This was consistent with the findings of Okeafor et al. in Nigeria, who found that representativeness was limited by the non-inclusion of private health facilities [15].

Timeliness

We found that the timeliness of the HIV CBS system was 92%, as HIV CBS forms were entered daily by the majority of healthcare workers, and there was real-time automatic transmission of data to the national level. This is consistent with the findings of Ezeudu et al. (2016), who also found the system to be timely in Enugu State, Nigeria [16].

Completeness

Data quality was measured using completeness and validity. We found that the data quality of the HIV CBS system is good. Completeness was high for client identifier information; however, it was low for the WHO clinical staging. These findings are consistent with those of Naqibullah et al., 2020 who found that demographic variables had a high level of completeness, but the completeness of clinical variables (screening, diagnosis, and treatment) was lower in Afghanistan [17].

An evaluation of the United States HIV/AIDS surveillance system by Ngugi et al, 2019 concluded that data quality was low because it was not granular enough to differentiate complex transmission risks that result from cultural and ethnic diversity [18].

Usefulness

This reinforces the importance of HIV CBS, as these shortcomings in data quality affect the usefulness of data for programming. We found that HIV CBS to be simple when using the HIV CBS forms. However, the notification of HIV cases through the CBS system was not simple,as the majority of healthcare workers could only log in and create a REDCap, which ultimately required more time than when using the paper-based HIV CBS form. Several gaps were observed in terms of the retrieval and editing of patient records, generation of reports, and analysis of results.

This is consistent with the findings of Sukums et al. (2014), who concluded that given the low levels of computer knowledge among rural health workers in Africa, it is important to provide adequate training and support to ensure the successful uptake of electronic systems in primary health facilities in Burkina Faso, Ghana, and Tanzania.

Training ensures that users are competent and comfortable with the use of the new CBS system, and reassessment status should be ascertained to evaluate the training gaps. The system was found to be flexible consistent with findings by Okeafor et al. who found the HIV CBS system to be flexible in Rivers State, Nigeria [14].

The HIV CBS system could also be integrated with several reporting systems; however, the use of parallel HIV reporting systems, including paper-based systems (HIV CBS forms and registers), electronic patient monitoring systems (EPMSs), and DHIS-2 systems, results in the duplication of tasks. This is consistent with the findings of Ogungbemi et al. (2012), who found that the use of multiple unlinked HIV databases to capture program monitoring data results in duplication of effort and poor resource use.

Acceptability

We found that the HIV CBS system was acceptable, as all healthcare workers expressed willingness to continue participating in the system because it presented opportunities for reduced paperwork, secure storage of records, and simple report generation. Our findings are consistent with those of Okeafor et al., 2017 where an evaluation of the HIV CBS system in Rivers State, Nigeria revealed that all stakeholders were willing to continue to participate in the surveillance system [15].

The majority of the healthcare workers had good knowledge of the HIV CBS system. This may be because health workers play a central role in HIV interventions, which enhances their knowledge of the HIV CBS system. Data were analyzed at the facility level, and the majority of healthcare workers found the system useful for their daily operations. Data from the HIV CBS system was used to identify hotspots for targeted interventions, to identify risky behavior for communication strategies, drugs, and HIV test kit supply management, and to identify challenges. This is consistent with Nsubuga et al., 2020 who found that the system was utilized at the facility level to analyze client data and enable staff to accurately order the exact number of antiretroviral drugs for their clients [14].

Public health actions included health education, community outreach, awareness campaigns, enhanced contact tracing, HIV testing, and the distribution of condoms. However, there is no record of how the surveillance system was used to evaluate the success of the reported public health interventions.

Limitation of the Study

The data quality of the HIV CBS system was assessed by interviewing healthcare workers, as there was no documentation of training, support, and supervision visits, which could have introduced some recall and social desirability bias.

Conclusions

We concluded that the overall knowledge levels of health workers regarding the HIV CBS system were satisfactory. The HIV case-based surveillance system with recency testing performed well in terms of timeliness, flexibility, and acceptability with high data quality; however, representativeness, stability, and simplicity were not satisfactory. The reasons for underreporting of HIV cases through the CBS system are mainly work overload, high staff turnover, inadequate REDCap database competence and limited feedback from higher levels.

There were no SOPs for backup operations during system interruptions, and health workers required further training on the use of the CBS system. The system was useful because the information was used to manage stocks and identify hotspots of new infections.

Recommendations

To the health facility

We also recommend the distribution of WHO clinical staging guidelines for HIV, the servicing of generators for backup electricity, and the installation of solar power.

To the Regional Health Bureau

We recommend on-the-job refresher training on the CBS system for healthcare workers and data entry clerks to address identified training gaps as well as data analysis training.

Support and supervision visits at higher levels, and technical staff are critical.

Acknowledgments

We are thankful to the Ethiopian Public Health Institute HIV/TB directorate. Many thanks go to the health workers in Dire Dawa city administration and health facilities for their cooperation and participation in successfully completing this study. We would like to thank Dr. Getinet Abera (Senior Public Health Specialist – Surveillance, CDC Ethiopia) and Mr. Jeleta Bulti (HIV team lead, HIV and TB research directorate, EPHI) for his encouragement and guidance. We also appreciate all PHEM personnel for their willingness and cooperation in giving us the data on the surveillance system.

Funding

The research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ethical Considerations

Ethical clearance was obtained from the Ethiopian Public Health Institute (EPHI) CBS Publication Advisory Committee (CPAC) and the EPHI Institutional Review Board (IRB). The letter of support was obtained from the EPHI HIV/TB Directorate and Dire Dawa City Health Bureau and 14 HIV CBS implemented health facilities. Written informed consent was obtained from all study participants to ensure their voluntary participation and confidentiality. Participants' anonymity was maintained throughout the study by not using their names or addresses. Additionally, COVID-19 infection prevention and control practices were observed during the interviews to prioritize participant safety. To uphold data confidentiality and security, the research team adhered to the national CBS confidentiality agreement by signing it before accessing any data.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

Fitsum Hagos, the corresponding authors, was the major contributor to preparing the manuscript. Fitsum Hagos, Eyob Hailu & Aklesiya Kassahun supported the analysis and interpretation of the data and revised the manuscript critically for important intellectual contents. Additionally, it contributed substantially to the design of the study and critical revision of the final approval of the manuscript to be published. Eyob Hailu & Aklesiya Kassahun contributed a lot to the conception, revision, and approval of the final version of the manuscript. All the authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors have approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not applicable.

Approval on guidelines and regulations during the Study

During all phases, all methods carried out in the study were per-

formed in accordance with the relevant guidelines and regulations.

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