Enhancing functionality and scaling up of the electronic Integrated Diseases Surveillance and Response system in Uganda, 2020-2023: Description of the journey, challenges, and lessons learned

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Abstract

Background: In 2017, Uganda implemented an electronic Integrated Disease Surveillance and Response System (eIDSR) to improve data completeness and reporting timelines. However, the eIDSR system had limited functionality and was implemented on a small scale. The Ministry of Health (MOH), with support from the Infectious Disease Institute (IDI) and Health Information Systems Program Uganda (HISP-Uganda), upgraded the system functionality and scaled up its implementation.

Objective: We describe the upgrade of the eIDSR system, its rollout, and its effect on disease surveillance in Uganda.

Methods: We used the human-centered iterative process to upgrade eIDSR. The eIDSR rollout followed a consultative workshop to create awareness of the system among stakeholders. A curriculum was developed, and a national training of trainers (TOT) was conducted. These trainers cascaded the training to the District Health Teams (DHTs), who later cascaded the training to health workers. The training adopted an on-site training approach, where a group of national or district trainers would train new users at their desks.

Results: The eIDSR system was upgraded to the DHIS2 2.35 platform, featuring faster reading and writing tracker data, handling over 100 concurrent users, and enhanced case-based surveillance features on Android and web platforms. From October 2020 to September 2022, eIDSR was rolled out in 68% (100/146) districts. Additionally, the system permitted prompt reporting of signals of epidemic-prone diseases.

Conclusions: Improving the functionality and the expanded geographical scope of the eIDSR system enhanced disease surveillance. Stakeholder commitment and leveraging existing structures will be needed to scale up eIDSR.

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Abstract

Introduction: In 2017, Uganda implemented an electronic Integrated Disease Surveillance and Response System (eIDSR) to improve data completeness and reporting timelines. However, the

eIDSR_system had limited functionality and was implemented on a small scale. The Ministry of Health (MOH), with support from the Infectious Disease Institute (IDI) and Health Information Systems Program Uganda (HISP-Uganda), upgraded the system functionality and scaled up its implementation. We describe the upgrade of the eIDSR system, its rollout, and its effect on disease surveillance in Uganda.

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Keywords: Electronic Integrated Disease Surveillance; Response (eIDSR); Uganda; training of trainers

Introduction

Uganda is highly vulnerable to public health emergencies due to its proximity to the ecologically diverse and biologically rich tropical Congo Basin, recurrent epidemic-prone outbreaks and refugee inflow [1]. Before 2000, surveillance systems could not adequately detect outbreaks for early

intervention [2].

Uganda embraced the integrated disease surveillance and response (IDSR) technical guidelines in 2000 [4]. However, IDSR system was largely been paper-based. Reports from health facilities were transmitted physically from health facilities to the district by the district surveillance focal persons. This manual process led to delayed data transmission and response [4]. The delays in detecting and reporting diseases resulted in outbreaks in the country, highlighting the limitations of the conventional approach to implementing the IDSR strategy. The world health organization (WHO) joint external evaluation (JEE) conducted in 2017 highlighted weaknesses in human health surveillance systems and inadequate electronic interoperability with laboratory and animal health data [5]. In 2017, MOH approved the implementation of the electronic integrated disease surveillance and response (eIDSR) system to strengthen disease surveillance in the country [3].

The electronic Integrated Disease Surveillance and Response system

Electronic Integrated Disease Surveillance and Response is the electronic component of IDSR and was developed and customized on the district health information software-2 (DHIS2). Unlike the conventional paper-based system used in health facilities, which requires data to be re-entered electronically at the district level, the eIDSR facilitates the instantaneous reporting of notifiable diseases through its SMS, Android, and web platforms [7]. The android platform had an offline mode functionality that allowed case-based notification and registration. The SMS platform facilitated immediate notification through a toll-free code currently utilized by the Uganda MOH. The application could also save data offline and automatically submit it as soon as a connection was available [8]. Despite these functionalities, there was a need to upgrade and add new features and functionalities to enhance the system's capabilities. These included advanced reporting tools, data visualization features, and integration with other health information systems.

In October 2020, the infectious diseases institute (IDI), in collaboration with MOH and the health information systems program uganda (HISP-Uganda), upgraded the functionalities and scaled the

eIDSR to 77/146 districts. We describe upgrading eIDSR functionalities and expanding its implementation to additional districts to enhance public health surveillance, enable early detection of diseases, and strengthen the healthcare system in Uganda.

Methods

Coordination

The MOH, through its integrated epidemiology, surveillance, and public health emergencies (IES&PHE) department, coordinated the implementation of eIDSR. User requirements were gathered through the technical partner, HISP Uganda, with the goal of transforming the requirements for the system into an operational system. A technical team from HISP Uganda upgraded the system's functionalities. National surveillance stakeholder engagement meetings were also convened with stakeholders, including MOH and ministry of agriculture, animal industry and fisheries (MAAIF), implementing partners, and regional and district surveillance officers to discuss the performance of the eIDSR system and coordinate and harmonize the rollout of eIDSR.

Training

An eIDSR curriculum was developed to facilitate the training of a cohort of national trainers of trainers (TOT). The three-day training focused on alert notification, case notification, registration, and reporting using SMS, Android, and Web platforms. The training curriculum also covered the fundamentals of surveillance, such as event-based and indicator-based surveillance, as well as priority diseases and events for immediate reporting. The rollout model adopted the MOH-recommended approach, where training was cascaded from the national to the lower levels (Fig.1).

At the national level, national training of trainers was conducted to establish a cohort of national trainers to cascade training to the regional level. This training targeted epidemiologists, health information analysts, laboratory, clinical, monitoring & evaluation specialists from MOH and implementing partners. At the regional level, the national trainers oriented the district health teams (DHTs) on eIDSR. The district health team comprised biostatisticians and HMIS focal persons,

district surveillance focal persons, district laboratory focal persons, district veterinary officers, and health sub-district surveillance focal persons.

At the district level, regional trainers trained clinicians, nurses, laboratory and health information assistants, and facility-based community-based health workers (VHTs) at the facilities. Health workers were selected from high-volume facilities, regional and district hospitals, and health centers III(provide a broader range of services including outpatient and inpatient care, basic laboratory services, maternity services, and minor surgeries), IV (provide comprehensive care to larger areas with emergency obstetric care, basic surgeries, laboratory services, and treatment for common diseases). District surveillance focal persons in the districts that were trained were given tablets, monthly airtime, and internet data to support case registration and reporting of priority diseases. The trainers subsequently provided post-training mentorship and support supervision to sub-national health teams through mentorship to ensure that skills gained during the training were sustained.

Results

System Upgrade and Stakeholder Engagement for eIDSR Enhancement

In 2020, HISP Uganda developers improved the eIDSR system to the DHIS2 2.35 platform version following the user requirements gathering process. Improvements included the development of an additional 19 electronic case investigation forms for priority diseases, including rabies, anthrax, severe acute respiratory illnesses/influenza-like illnesses like COVID-19, and cholera. More data variables were included on the digitized forms to capture case investigation details, exposure and travel history, symptoms, underlying conditions, and hospitalization. The laboratory requests and results module were improved to capture laboratory requests for tests to be conducted on the specimen collected for each case. Variables captured include the identification, place, and time (date) of sample collection and the reference laboratory and final laboratory results. The case outcome module was improved to capture the final investigation and health outcome details of the case. The specimen tracking module was developed to link an existing system that facilitated

tracking specimens across the laboratory hubs and laboratories until the completion of the case investigation. The module was developed to send an automated notification to the reference laboratory, and the national disease surveillance team via email and SMS.

Additional upgrades to the system included enhanced data management and analytics capabilities that included the design of highly customizable forms to track individual-level data to facilitate case-based surveillance with data validation functionality for data quality assurance. Data analysis upgrades included robust charting capabilities to include epi curves to facilitate epidemiological data analysis. The upgrade included geographic information systems (GIS) analysis using thematic mapping allowing overlay of population, climate, and other layers using the Maps app and supporting geolocation of individual cases. In a bid to enhance situational awareness, a smart web-enabled television at the national level was procured to facilitate access to international news outlets and facilitate data visualization from eIDSR.

The eIDSR System Adoption and Utilization

During the two years of implementation (October 2020 and September 2021), eIDSR was scaled up to 68% (100/146) of districts and cities (Figure 2). Thirty national trainers and 191 of the targeted 200 district-level mentors were trained. The district mentors subsequently trained and mentored 2,409 of 3,295 targeted facility-level healthcare workers from 536 health facilities. The project also trained another cohort of national-level surveillance officers and field epidemiologists from the public health emergency operations center (PHEOC) on system navigation, data extraction, analysis, and use for action.

Since its rollout, eIDSR has continued to be an important data source for disease surveillance to facilitate the detection and reporting of public health events countrywide. Several events were detected through eIDSR from SMS messages sent from the community between 2020 and 2022 (Table 1).

Table 1. Outbreaks detected by eIDSR 2020 – 2022, Uganda

	Disease outbreaks or events	Districts that notified	Date

		through eIDSR	
1	Anthrax	Madi-Okollo	2022
2	Undiagnosed deaths	Kyotera	2021
3	Rift Valley fever	Kagadi	2020
4	Anthrax	Bududa & Manafwa	2022
5	Crimean Congo hemorrhagic fever	Kagadi	2020
6	Undiagnosed illness (skin rash)	Pakwach	2020
7	Rabies	West Nile region: Arua, Adjumani, Moyo, Yumbe	2020-2021
8	Suspected VHF: Rift Valley	Moyo, Obongi, Terego, Madi Okollo, Yumbe	2020-2021
9	Anthrax	Arua, Madi-Okollo	2021-2022

Challenges in implementing eIDSR

The eIDSR system in Uganda faces several challenges that could threaten the system's sustainability. These include insufficient technology infrastructure, including reliable internet connectivity and computer hardware, which can hinder the effective deployment and use of eIDSR. Ensuring the accuracy and completeness of data entered into the eIDSR system can be challenging, as it relies on timely reporting from healthcare facilities, which may vary in their capacity to collect and transmit data accurately. Healthcare workers often face heavy workloads, and the additional burden of data entry and reporting through eIDSR can be challenging without appropriate incentives and support. Ongoing maintenance, troubleshooting, and user support for the eIDSR system are essential but may face resource constraints.

Opportunities

Several opportunities can be harnessed to advance the implementation of eIDSR, such as leadership and commitment from the MOH. This would bolster future implementation efforts and ensure long-term sustainability. The eIDSR offers robust functionality to facilitate the detection and reporting of disease outbreaks. The pivotal role played by the MOH throughout the implementation process, coupled with the active involvement of district health team trainers creates a strong possibility of the government taking ownership of eIDSR implementation, independent of external project support.

Discussion

We successfully upgraded the eIDSR system functionality and scaled to more than half of the districts in the country within two years of implementation. We also established a cohort of surveillance staff at national and subnational levels who could train health workers across all levels of health care. The implementation of eIDSR was one of the key priority actions in real-time surveillance to address gaps that were recommended from the last WHO JEE conducted in 2017.

The WHO IDSR framework, which strongly emphasizes the necessity for electronic surveillance tools to allow a wide range of crucial surveillance functions, served as a guide for improving the functionality of the eIDSR system. These functions encompass alert notification, case investigation and registration, data quality assurance, real-time reporting, and monitoring and evaluation [9]. The expanded goal of enhancing the national electronic surveillance system has the potential to benefit significantly from the enhanced functionality of eIDSR. This broader system intends to seamlessly integrate laboratory tests, notification processes, emergency responses, and reporting mechanisms with IBS, EBS, and case-based surveillance data across the human health sector. Notably, eIDSR adheres to open standards and was carefully created on the DHIS2 platform, enabling smooth interchange and connectivity with other software applications and data sources. This strategic alignment puts Uganda on a trajectory for developing interoperability with numerous electronic surveillance systems across multiple industries, in addition to laboratory systems.

A crucial element of the successful rollout of the eIDSR system was the establishment of the curriculum and training of health personnel. Learning is improved by creating a thorough curriculum that incorporates on-site mentoring improvement [12],[13]. It was crucial to have onsite supervision and experienced national trainers with knowledge of eIDSR, public health, and disease monitoring. Maintaining competency requires regular monitoring and evaluation, which includes refresher training. Documenting training records maintains accountability. Sustainability is promoted by incorporating eIDSR training into already-existing healthcare training programs, and community

involvement increases understanding of the system's significance and the responsibilities that healthcare professionals play in disease monitoring, ultimately improving public health outcomes.

The commitment of MOH and existing administrative structures provided an opportunity to implement eIDSR. For example, the division of health information in MOH is mandated to coordinate initiatives to digitize the health infrastructure [15]. The department of IES&PHE must coordinate surveillance and response to public health emergencies coordinated regional disease surveillance initiatives. However, several factors observed during the implementation of eIDSR could threaten the sustainability of the system; these include workforce challenges such as weak information and communication technology (ICT) infrastructure at the district and health facility level; and insufficient funding at the district to conduct surveillance activities. Additionally, Uganda does not have in place an interoperable and inter-connected electronic reporting for animal health; laboratory data cannot be linked through an interoperable inter-connected electronic system; data utilization is lacking as we wait for outbreaks to act rather than use available data to predict specific disease outbreaks and analysis also remains a challenge.

There are potential limitations to this project. First, the analysis was not intended to be a formal review of the eIDSR platform; we did not assess how the system performed. Thus, additional research is needed to examine to what extent the intervention contributed to improved reporting rates. Secondly, this project did not train village health teams (VHTs) due to inadequate funding. Our project did not give phones and tablets to health workers; therefore, we cannot make definitive claims about the effect of implementing eIDSR on improving case reporting rates.

Conclusions

Improving the functionality and expanding the geographical scope of the eIDSR system enhanced disease surveillance. The improved functionality has strengthened healthcare systems in detecting public health events more efficiently. The wider geographical reach signifies a successful initial scale-up. To ensure the sustained success and scale of the eIDSR system, future programs should

facilitate stakeholder commitment and leverage existing structures. Engaging internal and external stakeholders is crucial for securing long-term support, commitment, and endorsement at the national and sub-national levels.

Acknowledgments

Conflicts of interest

The authors declare that they have no competing interests. The findings and conclusions in this report are those of the author (s) and do not necessarily represent the official position of their institutions

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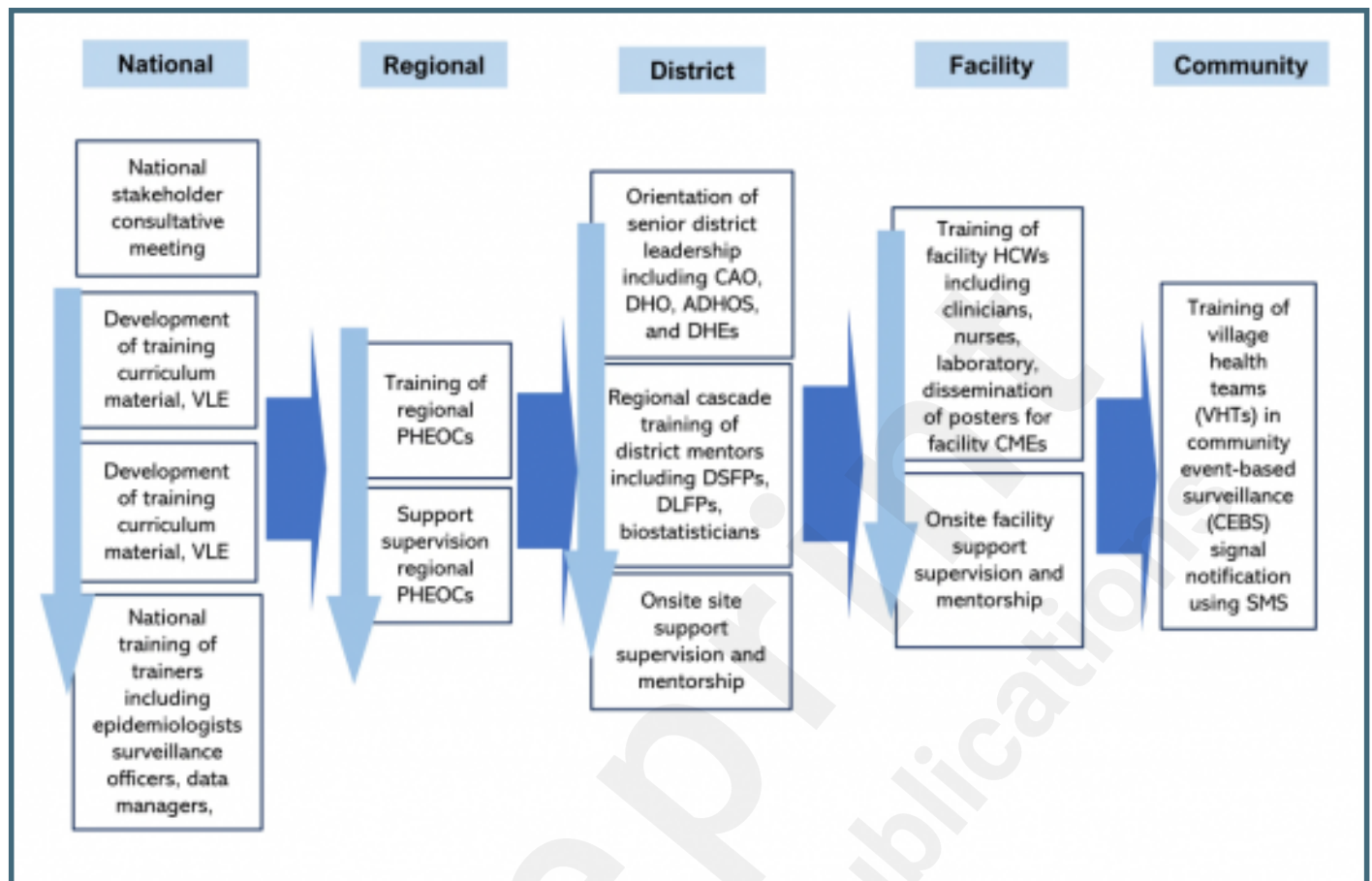15. Ministry of Health. Health Information & Digital Health Strategic Plan.

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Supplementary Files

Figures

eIDSR Implementation Approach, Uganda 2020-2022.

Coverage of electronic integrated diseases surveillance and response system (eIDSR) Phase 1 and Phase 2 training, Uganda 2020-2022.