Electronic Reporting of Integrated Disease Surveillance and Response: Lessons Learned from Northeast, Nigeria, 2019.

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Abstract

Background: Electronic reporting of integrated disease surveillance and response (eIDSR) was implemented in two states in North-East Nigeria as an innovative strategy to improve disease reporting. Its objectives were to improve the timeliness and completeness of IDSR reporting by health facilities, prompt identification of public health events, timely information sharing, and public health action. We evaluated the project to determine whether it met its set objectives.

Method: We conducted a cross-sectional study to assess and document the lessons learned from the project. We reviewed the performance of the Local Government Areas (LGAs) on rumors identification and reporting of IDSR data on the eIDSR and the traditional system using a checklist. Respondents were interviewed online on the relevance; efficiency; sustainability; project progress and effectiveness; effectiveness of management; and potential impact and scalability of the strategy using structured questionnaires. Quantitative data were analyzed and presented as proportions using an MS Excel spreadsheet. Qualitative data was cleaned, converted into an MS Excel database, and analyzed using Epi Info version 7.2 to obtain frequencies. Responses were also presented as direct quotes or word clouds.

Results: The number of health facilities reporting IDSR increased from 103 to 228 (117%) before and after implementation of the eIDSR respectively. The completeness of IDSR reports in the last six months before the evaluation was ≥ 85%. Of the 201 rumors identified and verified, 161 (80%) were from the eIDSR pilot sites. The majority of the stakeholders interviewed believed that eIDSR met its predetermined objectives for public health surveillance. The benefits of eIDSR included timely reporting and response to alerts and disease outbreaks, improved completeness, and timeliness of reporting, and supportive supervision to the operational levels. The strategy helped the stakeholders to appreciate their roles in public health surveillance.

Conclusion: The eIDSR increased the number of health facilities reporting IDSR, enabled early identification, reporting, and verification of alerts, improved completeness of reports, and supportive supervision on staff at the operational levels. It was well accepted by the stakeholder as a system that made reporting easy with the potential to improve the public health surveillance system in Nigeria.

Background

Disease surveillance remains the cornerstone to overcome health threats affecting humans and their environments globally. It is the core attention of global health security. A functioning surveillance system is required to promptly detect and report outbreaks of diseases and conditions with the potential of public health impact [1, 2]. An efficient surveillance system is also required to monitor and measure the impact of public health interventions. This in turn depends on a robust information system with reliable and timely data collection, collation, analysis, interpretation, and transmission of the information for action.

The Integrated Disease Surveillance and Response (IDSR) is the adopted strategy for public health surveillance in Nigeria as with other members' states in the African sub-region of the World Health Organization (WHO) [3]. IDSR provides a rational basis for decision-making and implementation of public health interventions that are efficacious in responding to priority diseases and events. The strategy was adopted in Nigeria since 2001 to improve the ability of local government areas (LGAs) to detect and respond to outbreaks of diseases, conditions, and events that cause high levels of death, illness, and disabilities [4]. It operates at the three levels of governance in the country (National, state, and LGA levels). The health facility (primary, secondary, or tertiary) is the basic operational unit for IDSR. It is the primary point for the generation of surveillance data with the health facility register being the source document. The data from each health facility is collated by the LGA Disease Surveillance and Notification Officer (LGA DSNO) for submission to the State Epidemiologist. The reports from each state are transmitted to the Nigeria Centre for Disease Control (NCDC). The process relies on manually extracting the data from a paper-based source at the health facility and transmission to the LGA DSNO. Although the IDSR strategy had been implemented in Nigeria for about two decades [5], the delays in detection of diseases such as Lassa fever, measles, cerebrospinal meningitis and Yellow fever leading to outbreaks in the country [6–10] indicate problems with the traditional way of implementing the strategy [11, 12].

The information technology (IT) has contributed significantly to shaping the 21st -century world. IT is increasingly becoming available in the health care industry including public health surveillance system where communication plays the central role. The speed of transmission of the information is one of the important qualities of the surveillance system to limits the mortality, morbidity, and disabilities caused by the outbreak of any disease [13–15]. The IT can facilitate early detection of infectious disease outbreaks and tracking of public health intervention [16, 17]. The routine public health surveillance systems can leverage on the system in the form of electronic IDSR reporting (eIDSR) to collect, report, and respond to public health threats in the country [18]. The electronic reporting by-passes the manual collation of the data improves the quality and reliability of the surveillance data and increases the speed of transmission of the information. Some innovative methods using information technology to improve reporting of diseases and outbreaks in the country include the mobile Strengthening Emergency and Response System (mSERS) and the Surveillance Outbreak Response Management and Analysis System (SORMAS). mSERS supports electronic transmission of the weekly data from the LGA DSNO to the state, SORMAS facilitates automatic notification of outbreaks in real-time by the LGA DSNOs to the higher levels [15, 19]. These innovative approaches still depend on manual transmission of the IDSR data from the health facilities to the LGA DSNOs. Consequently, there is a need for a system that will boost the performance of disease surveillance and response particularly with early reporting from the health facilities level. The eIDSR captures data from the point of generation at the health facility level. The idea was conceived as part of the revitalization of disease surveillance and response system in the country. Its main goal was to strengthen the disease surveillance system for early detection and real-time reporting enabling prompt responses to the outbreak of diseases including rumor verification and reporting.

The objectives were to:

- build capacity of health facility personnel, the LGA, and State on detection, reporting, and responses to outbreaks of diseases and public health events in the country
- build the capacity of the LGA and state DSNOs, the state Epidemiologists and national staff on the coordination roles for disease surveillance and management of the surveillance data including the provision of supportive supervision to the lower levels
- improve on the quality of the surveillance data for evidence-based decision making.
- ensure real-time data reporting from the health facility for prompt action

The project was implemented in 10 LGAs from two states in North-East Nigeria. The implementation had a two-phased approach; the first phase was to strengthen the IDSR reporting system at all levels in the selected states. These included the provision of standard case definitions of the priority diseases under surveillance in the country, IDSR reporting tools, and training of the State, LGA and health facility surveillance focal persons on the reporting system. This is based on the premise that introducing a new concept or innovation in a weak system would be worthless. An eIDSR can only function in a system where the traditional IDSR system is already working.

The second phase was the introduction of the eIDSR in the selected health facilities. A total of 54 health facilities from ten LGAs drawn from two states were selected for the initial implementation. The selection criteria were; location of the health facilities, participation in IDSR reporting, availability of mobile network, accessibility, and security challenges. An application was developed for the eIDSR by a team of specialists on an electronic application for the Auto-visual AFP detection and response (AVADAR) system in the polio eradication initiative. The immediate notification, weekly, monthly reporting form, and supervision checklist were converted into electronic format. A task team was formed to develop a blueprint and coordinate the implementation of the eIDSR. The members of the task team were also trained on the application which was subsequently field-tested by the task team. Surveillance focal persons and the officers in charge of the selected health facilities were trained on the use of mobile phones to collect and report IDSR data. A total of 108 staff from the piloting health facilities were recruited and trained for the study. A supervision plan was developed for eIDSR. The supervisors from State and LGA visited the health facilities at least once a week, while the supervisor from the federal level visited at least once a quarter using the supervision checklists. The supervision process included a written summary of findings, deliberations, and solutions from the health facilities. The states produced weekly situation reports and conducted monthly meetings at the state level. There was a quarterly meeting at the national level with all key stakeholders to review the progress of implementation, address challenges, and proffer solutions.

We evaluated the initial implementation of the eIDSR to determine whether the project met its predetermined objectives for improving timeliness and completeness of IDSR reporting, prompt identification of public health events, timely information sharing, and use of the system by the key players in disease surveillance in the piloting facilities and LGAs for actions.

Methods

Study design

We conducted a cross-sectional study to assess and document the lessons learned from the initial implementation of the eIDSR. We reviewed the performance of the LGAs on reporting of IDSR data including rumors identification by the eIDSR and the traditional system using a checklist. The respondents were the surveillance focal persons, clinicians working in the health facilities implementing the eIDSR, State Epidemiologists in the two states, the State Disease Surveillance and Notification Officers (SDNOs), and LGA DSNOs. The respondents were interviewed using structured questionnaires sent to their mobile phones used in the eIDSR reporting. The questionnaires were adapted from a set of tools for the evaluation of public surveillance systems. Separate tools were developed for respondents at the health facilities and the stakeholders at the LGA and state levels [20, 21].

Study setting

Nigeria has a federal system of government made up of 36 states and a Federal Capital Territory (FCT) with 774 constitutionally recognized local government areas. Yobe and Adamawa states, our study areas are located in the northeastern part of the country. They have an estimated population of 5.5 million people extrapolated from the 2006 national census [22]. The evaluation was conducted in 54 health facilities from 10 LGAs involved in the eIDSR project.

Data collection

We conducted a desk review of the performance of the LGAs on the reporting of IDSR data. The review included assessing the number of health facilities reporting IDSR before and after the introduction of the eIDSR; the number of rumors identified by the eIDSR system compared to the traditional system; timelines and completeness of weekly IDSR reporting from health facilities implementing eIDSR compared to the traditional system using checklists. The health facility surveillance focal persons and other stakeholders involved in surveillance activities at LGAs and states were interviewed online using structured questionnaires. They were interviewed on the following six core theme for evaluation of a surveillance system:

(a). **The relevance of the strategy**: questions were asked on the extent to which the activities designed and implemented were suited to the priorities and realities of the Nigerian context

(b). **Project Progress and Effectiveness**: To explore the extent to which the program has adequately achieved its intended outputs and objectives such as prompt identification of public health threats, facilitation of electronic data collection, validation and real-time analysis of data, provisions of a platform for efficient information management and timely information sharing with stakeholders and generation of accurate weekly aggregate line list of cases.

(c). **Sustainability**: assessed the ability of supported activities and functions to continue after the program ends

(d). **Effectiveness of Management Arrangements**: Explored the extent to which the project brings together relevant stakeholders to achieve project objectives

(e) **Potential Impact and Scalability**: the likelihood and extent to which the project will contribute to longer-term improvements in the electronic disease early warning system and scale up to the remaining health facilities in the two states in Nigeria.

Data analysis

Quantitative data from the desk review were entered into an MS Excel spreadsheet, analyzed, and presented as proportions. Data from the online evaluation was cleaned, converted into an MS Excel database, and analyzed using Epi Info version 7.2 to obtain frequencies. Qualitative data were presented as direct quotes or word clouds.

Ethical considerations

We obtained ethical clearance for the study from the National Health Research Ethics Committee of Nigeria (NHREC) in the Department of Planning Research and Statistic of the Federal Ministry of Health Nigeria. Informed written consent was also obtained from all respondents involved in the study.

Results

The number of health facilities reporting IDSR in the 10 LGAs increased from 103 to 228 (117%) before and after implementation of eIDSR respectively. The completeness of IDSR reports in the six months following the implementation was ≥ 85% in the health facilities with eIDSR compared to ≤ 65% in the remaining health facilities in the LGAs (Fig. 1). Also of the 201 rumors identified and verified in the 6 months before the evaluation, 161 (80%) were from health facilities with eIDSR. Fifty-two health facilities were involved in the piloted eIDSR, of which 45 (87%) participated in the evaluation. Forty (89%) were public, and 5(11%) were private health facilities. A total of 45 staff at the health facilities and 21 stakeholders at the LGA levels responded to the online questionnaire. The respondents at the health facilities were 23 (51%) surveillance focal persons, 13 (29%) officers in charge of the health facilities, 7 (16%) Assistant DSNOs, and 2 (4%) Local government area facilitators (LGAFs). Furthermore, of the 21 stakeholders, 11 (52%) were DSNOs, 5(24%) were WHO local government facilitators (WHO LGAF), 3 (14%) were WHO Cluster coordinators, and 2 (10%) were AVADAR coordinators.

The respondents reported benefits for surveillance using eIDSR to include timely reporting and prompt response to alert and outbreaks of diseases. The majority of the stakeholders believed that eIDSR met the requirement of public health surveillance. Similarly, all the respondents in the pilot health facilities had received supportive supervision (Tables 1 and 2). Deductions from the respondents were as follows;

Table 1
eIDSR surveillance attributes from stakeholders' viewpoint (n = 21)

Attributes	Frequency Yes (%)
Do users find eIDSR useful?	20 (95.2)
Do users find eIDSR simple to use?	20 (95.2)
Is eIDSR a cost-effective option for Nigeria surveillance system	20 (95.2)
Do users find eIDSR acceptable?	18 (85.7)
Is eIDSR sensitive to identify public health problems at the health facility level?	21 (100)
Is eIDSR representative of all public health problems at the health facility level?	18 (85.7)
Does eIDSR provide timely notifications?	21 (100)
Is eIDSR stable (or reliable)?	18 (85.7)
Does eIDSR provide quality data for decision-making?	20 (95.2)
Is eIDSR flexible (can other diseases be reported through it)?	19 (90.5)

Table 2
View of respondents on the design and implementation of eIDSR

Theme	Queries	Yes (%)	No (%)	Total
The relevance of the eIDSR	eIDSR designed according to Nigerian Context	45 (100)	0 (0)	45
	Staff trained before implementation of eIDSR	44 (98)	1 (2)	45
	Staff received supportive supervision during implementation of eIDSR	42 (93)	3 (7)	45
	eIDSR suitable for health facilities reporting	20 (95)	1 (5)	21
Project progress and effectiveness	Alert detected in the last three months by the system	25 (56)	20 (44)	45
	The time lag of two hours or less between detection and reporting of alerts	28 (62)	17 (38)	45
	eIDSR data analyzed at the local levels	7 (33)	14 (67)	21
	eIDSR used for action at the health facility levels	44 (98)	1 (2)	45
	Implementation of eIDSR added burden to the work of the staff	19 (42)	26 (58)	45
	eIDSR is a cost-effective option for public health surveillance in Nigeria	20 (95)	1 (5)	21
Efficiency	eIDSR reflects the efforts staff put into the surveillance system	16 (76)	5 (24)	21
	The system will contribute to e-surveillance in the long term	21 (100)	0 (0)	21

- eIDSR has demonstrated need and feasibility for an electronic solution for event-based and possibly indicator-based surveillance and response in Nigeria, which is the basis for eSurveillance.
- It was easy to use at the health facility level
- eIDSR provided regular data updates to higher levels.
- eIDSR was capable of sending alerts within 2 hours of detection and had been used to send alerts from health facilities in several instances over the past 3 months.
- eIDSR was found to be useful at all levels, particularly in providing timely alerts of public health conditions
- eIDSR had demonstrated the importance of mobile technology in event-based reporting (Table 3).

Table 3
Some direct quotes from respondents on the design and implementation of the eIDSR

Theme	Comments/quotes from respondents
DSNO/State epidemiologists views on the extent to which eIDSR achieved its objectives	It improves the knowledge gap of health workers, through training, supervision, and on-the-job training.
	Immediate notifications and actions were taken on diseases and conditions of public health concerns at the grassroots level.
	It improved the disease surveillance system, increase the flow of data, and improve early detection and investigation of diseases and conditions of public health concerns.
Surveillance focal person views on the major achievements of eIDSR in Nigeria	It helped in the instant notification of cases that led to the investigation and appropriate public health interventions. More so, it brought line managers closer to surveillance happening at the peripheral level.
	The major achievements included the illustration of how mobile technology can be used to report alerts of IDSR cases, data collection can occur at facilities and be readily available at all level and dashboards for the ministry of health
	It can be used to show data in real-time, and alerts can be generated to inform leadership potential disease outbreaks.
DSNO/State epidemiologists views on the ability to roll out eIDSR	It helps in reduction in the printing of data tools
	It reduces the cost of paper or written materials to do the job.
	Surveillance data will be easily accessed with eIDSR than the traditional method of reporting. Data reported through the traditional system can be altered along the channel of reporting due to manual compilation
Surveillance focal person views on how using eIDSR have benefited their state and Nigeria	It has contributed a lot in identifying and reporting priority diseases and other conditions of public health concern to the responsible authorities, for prompt intervention
	eIDSR contributed to public health surveillance and response in the community
	It makes it easier to report priority diseases timely and completely for prompt action
DSNO/State epidemiologists view on the output of eIDSR relative to the effort put in it	It improved timely reporting and eliminate missing reports
	It keeps the LGA and state informed about immediately reportable diseases
	The system prompted me to verify cases from sources before sending them to a higher level for action
	The system helped me to participate more actively in surveillance activities in my LGA
How eIDSR could contribute to public health surveillance in Nigeria	It helped to improved reporting and response.

Theme	Comments/quotes from respondents
	eIDSR has made reporting easier. Therefore, in the future, it will contribute greatly to surveillance such that diseases will be reported immediately for action.
	It will help the country report on time outbreaks and other conditions of public health concerns in the communities. It also helped prompt detection of cases that came from the community.

The word cloud analysis revealed the perceived central role of the health facility staff in the design of the eIDSR in Nigeria to be reporting of diseases to a higher level (Figs. 2).

Discussion

The evaluation of the initial implementation of the eIDSR revealed that the strategy contributed significantly to improving the operation of disease surveillance and response in the states. The major contributions were on a numerical increase in health facilities involved in reporting and the key performance indicators for IDSR. The numerical increase might have been due to refreshers training that included the key surveillance officers in the LGAs. This is important as one of the cardinal consideration in setting up an innovative system, in this case, an electronic reporting of the IDSR was to first strengthen the existing traditional system. Furthermore, the numerical increase in the health facilities reporting IDSR could have been due to the responsiveness of the key surveillance officers at the LGAs with more regular supportive supervision to the health facilities.

A system can only function well if the core and support functions are in place. These support functions included training, provision of case definitions, reporting tools, and android phones might have contributed to the improvement in the reporting. Experiences shared from Uganda among participants at a focus group discussion showed that training on IDSR at the operational levels led to the improvement in the completeness and timeliness of reporting, case detection, and data analysis [23, 24]. Timeliness and completeness are two critical complementary performance indicators of the IDSR strategy. Timely reporting of diseases especially communicable diseases is crucial to initiate public health actions to prevent transmission leading to large outbreaks. In the traditional method using the paper-based reporting, reports are delayed because it depends on the physical transmission of the report from the health facility to the LGA. Electronic reporting increased the speed of transmission of the report from the health facilities to the DSNOs at the LGA and state levels [25]. This is supported by the finding of Rebecca Wurtz and Bruce J. Cameron on electronic laboratory reporting (ELR). In their report, ELR increased the speed of completeness of the reporting [26, 27]. Completeness of reporting in our context is not diseased specific or case enumeration, [28] but is based on the number of health facilities sending IDSR reports to the next level within agreed deadlines [4, 29]. Putting the timeliness and completeness together, the generation of information products for decision making to limit mortality and morbidity from any unexpected health event depends on the speed of detection, reporting, and completeness of the data. Our pilot project revealed an increase in these key performance indicators of the IDSR. The finding from our

pilot is corroborated by Randriamiarana R et al. from Madagascar [30], they noted that short message services (SMS) improved the completeness and quality of IDSR data. Although the electronic system of reporting such as the mobile Strengthening Emergency and Response System (mSERS) and the Surveillance Outbreak Response Management and Analysis System (SORMAS) are operational in the country [31], both systems are stationed at the LGA levels and depend on the paper-based reporting from health facility level leading to delays in reporting. The electronic reporting system stationed at the operational levels (health facilities) hastened the speed of reporting and by-passed manual collation at the LGA thereby improving the quality of the data. The result also revealed that the electronic transmission of data from the health facilities improved the detection, reporting, and verification of alerts which is one of the major life-saving precursors of public health surveillance and a key consideration of the global health security whose hope is to detect and contain potential health events at the source.

Although there is a paucity of information on the electronic IDSR because it is newly introduced in the country, the views of our respondents have revealed that the system was good and improved their work. That viewpoint assertion seems to be at variance with the findings of Soto G et al [32]. In an evaluation of a four-year implementation of an electronic disease surveillance system in a resource-limited setting, the challenges reported by the authors included personnel issues, resources, issues relating to the data collection and operation of the system, and central coordination. Personal benefits from the use of the phones must have contributed to the observed variance. In our pilot, the surveillance focal persons were at liberty to use phones for private communications and other social activities. Additionally, the personal benefits could have been motivating factors for the users to ensure the phones remained functional at all times.

The results of our pilot showed that there was an improvement in the level of supportive supervision to the operational level. The use of ODK for the supervision might have contributed because with the system each site visited were recorded and transmitted real-time to the higher levels. The importance of supervision cannot be overemphasized. It is the basic element for the improvement of work performance of staff through watching, directing, and guiding what the individual is doing or how a task should be done. The ultimate aim of supervision is to sustain good quality services, identify problems, decide what has caused the problem, and develop feasible solutions. The additional training the supervisors received might have contributed to improving their work performance and commitment.

The evaluation approach had some limitations. All the respondents were participants in the pilot and could have views that were influenced by their role in the program. There may have been a natural bias to focus on program successes, although the team tried to tease out other critical points to the questions. We also envisage recall bias as one of the major limitations because the evaluation questions required the respondents to have adequate recall of events that occurred in the past but we tried to triangulate sources of information to limit its effect.

Conclusion

The evaluation of the eIDSR project in the two states has revealed that the system had a positive impact on the key performance indicators for IDSR, improved supportive supervision on the staff at the operational levels including data transmission, and information sharing. The innovation was well accepted by the stakeholders and viewed by the frontline surveillance officers and health workers as a system that made reporting in public surveillance easy. The innovation if well harnessed will bring a paradigm shift in public health surveillance in Nigeria

List Of Abbreviations

DSNO: Disease surveillance and notification officer

eIDSR: Electronic Integrated Disease Surveillance and Response

ELR: Electronic Laboratory Reporting

FCT: Federal capital territory

IDSR: Integrated disease surveillance and response

ICT: Information communication technology

IT: Information technology

LGA: Local government area

LGA DSNO: Local government disease surveillance and notification officer

LGAF: Local government facilitators

mSERS: mobile Strengthening Emergency and Response System (mSERS)

NCDC: Nigeria center for disease control

ODK: Open Data Kit

SORMAS: Surveillance Outbreak Response Management and Analysis System

SMS: Short Message Services

SDSNO: State disease surveillance and notification officer

WHO: World health organization

Declarations

Ethical approval

Ethical approval for the evaluation was obtained from the National Health Research Ethics Committee of Nigeria (NHREC) in the Department of Planning Research and Statistic of the federal ministry of health Nigeria, reference number NHREC/01/01/2007-03/03/2020

Consent for publication

Not applicable in this survey

Availability of data and materials

The dataset used and analyzed during this study are available from the corresponding author on reasonable request

Competing interest

The authors declare that they have no competing interest

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None

Authors contributions

PN Conception, design, and writing of protocol for the evaluation, acquisition of data, analysis, and interpretation of data, and critical review of the manuscript. LMI Design, acquisition of data, analysis, interpretation of the evaluation data and wrote the manuscript. JSP Acquisition of data and literature review. IO, MS, AK, EI, OO, CI, OO, DRO, SGT, FB and WKM, Literature review, and review of the manuscripts. CLPL and WA Critical review and approved the final manuscript.

All the authors have read and approved the final version of the manuscript

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Figures

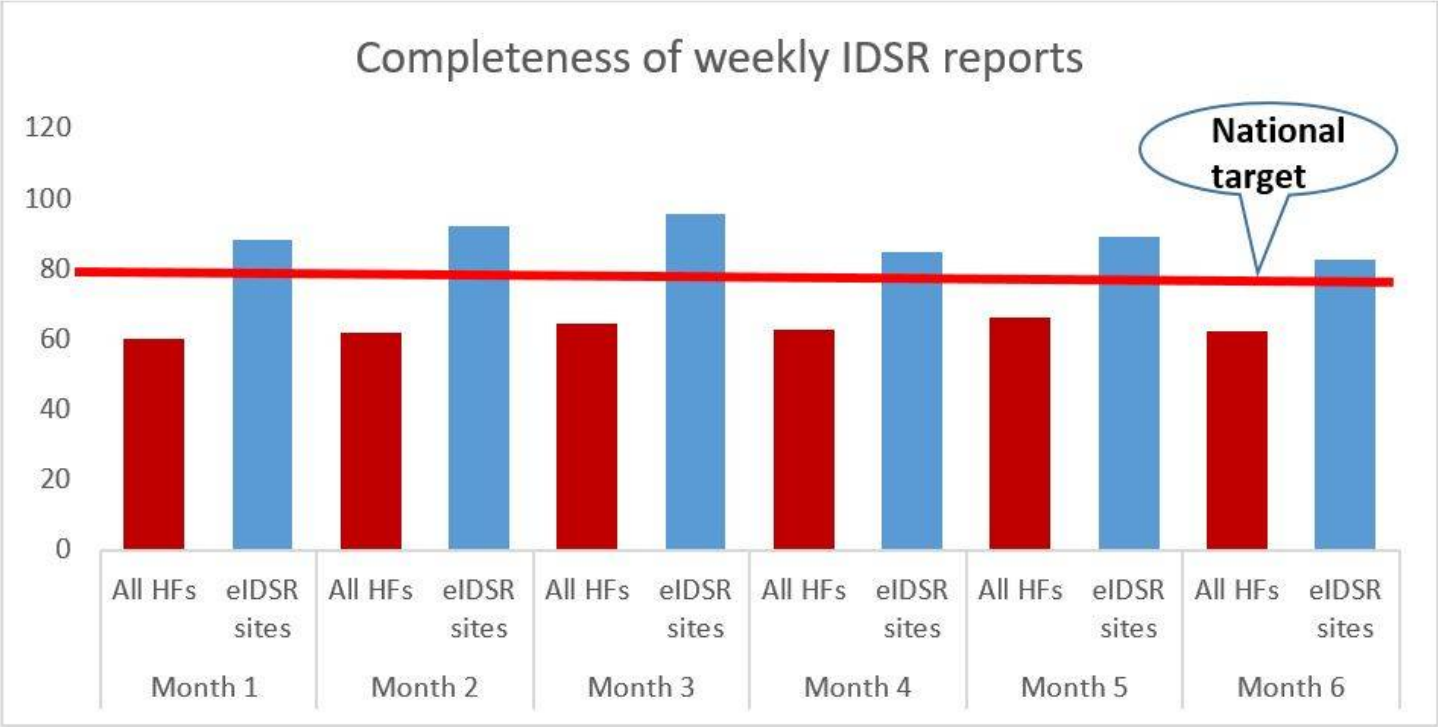

Figure 1

Completeness of weekly IDSR reporting in all and health facilities with eIDSR

Figure 2

Word cloud of the health facility respondents' view of their role in eIDSR

Supplementary Files

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- QuestionairesforstakeholdersatLGAandstatelevels.pdf
- Questionairesforrespondentsathealthfacility.pdf