

Structure, functions, Performance and Gaps of Event-Based Surveillance (EBS) in Sudan, 2021: A Cross-Sectional Review

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Abstract

Background

Event-based surveillance (EBS) is an essential component of Early Warning Alert and Response (EWAR) as per the International Health Regulations (IHR), 2005. EBS was established in Sudan in 2016 as a complementary system for Indicator-based surveillance (IBS). This review will provide an overview of the current EBS structure, functions and performance in Sudan and identify the gaps and ways forward.

Methods

The review followed the WHO/EMRO guidelines and tools. Structured discussions, observation and review of records and guidelines were done at national and state levels. Community volunteers were interviewed through phone calls. Directors of Health Emergency and Epidemic Control, surveillance officers and focal persons for EBS at the state level were also interviewed. The quantitative data was analysed using SPSS, and the qualitative data were analysed using a thematic analysis, paying particular attention to the health system level allowing for an exploration of how and why experiences differ across levels. Written and verbal consents were obtained from all participants as appropriate.

Results

Sudan has a functioning EBS; however, there is an underestimation of its contribution and importance at the national and states levels. The link between the national level and states is ad hoc or is driven by the need for reports. While community event-based surveillance (CEBS) is functioning, EBS from health facilities and from non-health sectors is not currently active. The integration of EBS into overall surveillance was not addressed, and the pathway from detection to action is not clear. The use of electronic databases and platforms is generally limited. Factors that would improve performance include training, the presence of a trained focal person at state level, and regular follow-up from the national level. Factors such as staff turnover, income in relation to expenses and not having a high training degree (Diploma or MSc) were noticed as inhibiting factors.

Conclusion

The review recommended revisiting the surveillance structure at national and state levels to put EBS as an essential component and to update guidelines and standard operation procedures SOPs to foster the integration between EBS components and the overall surveillance system. The need for strengthening the link with states, capacity building and re-addressing the training modalities was highlighted.

Background

Surveillance is the process of a continuous and systematic collection, analysis, interpretation and dissemination and the use of this data for action (1). Surveillance systems vary in tools, scope, goals, and characteristics, and what is considered important in one country could be less important in another (2). Therefore, when structuring a system, careful balancing should be done to ensure system flexibility. The aim as stated by Shahab, must be “adapt not adopt” (3). With emerging and re-emerging of diseases and with an international enforcement on the countries driven by the international health regulations; communicable disease surveillance has been widely adopted in recent years in developing countries (4, 5) and is becoming a cornerstone in control of diseases and events. Communicable disease surveillance consists of core and supportive activities. The core activities include case detection, registration, laboratory confirmation, data reporting, data analysis, feedback, and epidemic preparedness and response. The supportive activities include coordination, supervision, training, and mobilization of resources (6).

The communicable disease surveillance (indicator-based surveillance- IBS) in Sudan is sentinel-based and it can be classified as passive surveillance that shifts into partially active during epidemics or outbreaks (7). For the passive surveillance, 30% (1918/ 6393) of public health facilities report on a weekly basis. During epidemics (e.g. COVID-19) or when the risk of occurrence is high, the Surveillance and Information Department (SID) at national level expands the system to cover all the health facilities and asks for daily reporting even if there are no cases (zero reporting). The Federal Ministry of Health (FMOH) adopted this system for COVID-19; but as there is no system to track facilities who report zero cases, its usefulness was uncertain. A study assessing surveillance activities and functions conducted in Khartoum state in 2010 concluded that, despite good knowledge and data reporting, there was poor data analysis, preparedness, feedback to reporting facilities, documentation, and system updates (8). The national surveillance system was also found to be not representative, as it did not include the private, military, and teaching hospitals and facilities.

Event-base surveillance (EBS), defined as the “*Organized collection, monitoring, assessment and interpretation of mainly unstructured ad hoc information regarding health events or risks, which may represent an acute risk to human health,*” came into attention following the revision of the International Health Regulations (IHR) (2005) as the IHR expands usual infectious disease notification to include surveillance of public health events from various origins. Furthermore, the IHR urges countries “*...to strengthen and develop both routine, or indicator-based, surveillance and event-based surveillance*” (9, 10). EBS is highly needed where coverage with indicator-based surveillance is limited, and lessons learned from the Ebola outbreak in West Africa and its associated challenges highlight this as an urgent issue (11). In 2014, WHO developed a guide for the implementation of early warning system with focus on EBS (12).

In Sudan, EBS was established in 2016 with guidelines and SOPs for implementation. This was followed by training of EBS focal persons at state level and the training in some states extended to the community level as part of community event-based surveillance (CEBS). EBS is currently considered an important support activity for the Surveillance and Information Department at Health Emergency and Epidemic

Control (HEEC) General Directorate, and it also provides support to the Emergency Operation Centre (EOC) for decision making. The need for an assessment of supporting and core functions of EBS in Sudan was raised by the HEEC Director in order to learn from the current practice and for further development of the EBS system. This review provides an overview of the current EBS structure, functions and performance in Sudan and identifies the gaps and ways forward.

Methodology

Study design and area

A cross-sectional study using mixed quantitative and qualitative methods was conducted during the period from March - April, 2021. The study reviews the situation at the national level and at 6 states (out of the 18 states in Sudan) selected based on their vulnerability to epidemics considering the socioeconomic, demographic, housing and hygiene, epidemiological, and health system status. Each state represents a region of Sudan (Figure 1).

Data collection and sampling

The study followed WHO/EMRO guidelines and tools to assess the establishment and implementation of EBS in Sudan (13). HEEC directors, surveillance officers and focal persons for EBS, CEBS, point of entry (POE) and Incidence Tracking System (ITS) at states level were interviewed using a self-administered questionnaire disseminated through email. Seven focus group discussions (FGD) were arranged at national level and at each state. The participants included the focal persons of EBS, CEBS, POE and for ITS at visited states, in addition to stakeholders and other partners.

At least five frontline volunteers were randomly selected from a list of those who are currently involved with CBS/EBS/POE and interviewed via phone. The EBS structure and supporting functions at national and selected states were reviewed using forms developed by WHO/EMRO (13) "*EMR Country Landscape Assessment: Integrated Disease Surveillance with a Focus on Event-Based Surveillance*". The form was completed through group discussion and observation of annual plans, HEEC structure, and reports (weekly, monthly and event-based reports). To assess the performance of EBS, a score sheet was developed to compile findings from the interview, review of records, and observation by the team members. Each assessment team was asked to score the performance of visited states in 21 items covering aspects related to detection, reporting, verification, risk assessment, perception, planning, implementation and monitoring of EBS at states level. The maximum score for each item is 10 marks.

Data analysis

Statistical Package for Social science (SPSS version 23) was used to analyse quantitative data. Percentages were used to describe the data where appropriate. Data was presented using frequency tables. Qualitative data was organized in themes and analysed using a thematic analysis, paying

particular attention to the health system level allowing for an exploration of how and why experiences differ across levels.

Results

Structure and supportive activities for EBS

At the national level, surveillance, through the SID, is part of the HEEC General Directorate. The overall structure of the SID at national level consists of 4 sub-directorates with a unit called “Supportive Activities” (Figure 2). The EBS components (Partner-based surveillance-PEBS, CEBS, HEBS, POE, hotline and media scanning-HMS) are under the Supportive Activities unit with a focal person for each and a coordinator for all EBS activities. There was no written job description to show the roles and responsibilities of the EBS coordinator and focal persons, but there were SOPs for each project including responsibilities at different levels. At the state level a very simple structure was adopted (Figure 3) where IBS and EBS are under the umbrella of the Surveillance Unit with 1-3 persons responsible for the work. Overall, states give less attention to EBS as compared to IBS, and EBS at the state level is equivalent to CEBS. In fact, very few EBS trained focal persons remained at states indicating high turnover due to political instability and low salary.

The surveillance and epidemic control arrangements and activities are governed by the Sudan Constitution and by the National Public Health Law, 2008 in addition to IHR, 2005. The establishment of HEEC General Directorate at states levels (and hence surveillance and Information department) was guided by a letter from the Undersecretary of Health (Federal MOH) in 2014. No law, regulation or decree is designed for EBS separately, nor is there an enforcement mechanism in place to accelerate the implementation of EBS. The government contribution was limited to meet the salaries for surveillance officers and to cover the free telephone network (with paid internet). This reflects low institutional and political commitment to the system since its establishment.

Apart from regularly scheduled coordination meetings between implementers (Federal and States MoH) and stakeholders during an epidemic or health emergencies, there was no outlined mechanism for regular coordination at national and state levels regarding EBS implementation. There was no technical working group of key implementers or broader coordination committee of partners to manage coordination at the national level. However, the Emergency Operation Centre (EOC) daily meeting (during times of public health crises) involves partners (WHO, UNICEF, Non-health sectors) and implementation bodies, and it is the forum that reviews the surveillance data and the response activities. No formal link between national and states apart from expecting immediate reports for the detected signals/ events in addition to monthly reports. Ad hoc phone calls were sometimes arranged by the national level particularly when there are rumours or notification needs triage and/ or verification at state level.

The national level has developed and availed soft and printed format guidelines and SOPs for EBS (PEBS, CEBS and POE) to direct the implementation at states level. The guidelines identified the priority events and signals, defined the role and responsibilities of each level, and stated clearly the information

flow. While some states currently use the SOPs and guidelines and reported to have shortage of supply of SOPs and guidelines, others did not know it existed.

In 2016-17, the national level trained states' EBS focal persons together with 18-22 partners at each state. Partners at state level include governmental sectors (animal, agriculture, police, climate and meteorology, education, public mass media), civil societies, UN agencies, international NGOs, and big development schemes. These partners differed from state to state. Furthermore, all focal persons for CEBS at states level were trained in 2018 to be trainers at their state's "TOT- Training of Trainers". No formal refreshment training and no regular follow-up or supportive supervision for focal persons was provided. The exact need of personnel for EBS and the target for training was not clear at both national and states levels.

EBS has its own reporting format and data flow which was partially integrated at national and states levels. At the national level, the weekly meetings foster the information sharing and coordination between the different projects as per the current structure of SID; in these meetings, both EBS and IBS reports are presented and discussed and the final decision about the disease/ event under discussion make use of both sources of data. The EBS monthly report compiled all the signals/ events from different states and submitted separately to the Head of the Department.

EBS core functions

The FMOH developed signals to be detected by the EBS. The CEBS for instance is expected to detect and report unusual, unexpected signals with particular emphasis on acute respiratory symptoms, haemorrhagic fever, acute diarrhoea, jaundice, acute neurological symptoms, guinea worm, floods, draught, displacement, conflicts, and death among animals. The CEBS was based on trained community volunteers. Each group of volunteers assigned identified one person to be the coordinator. When the community volunteers detected a signal, she/ he reported either to volunteer coordinator or directly to the locality level using telephone calls, direct contact, or through another person. The contribution of partners (including other governmental sectors like animal sector) was limited to the detection of signals and reporting it to state health authorities. On some occasions, partners (e.g. animal sector) report to its relevant authority at the national level and this authority informed the national health authority. No system to capture rumours, official or media reports about unusual or unexpected events apart from phone calls from individuals to the emergency call centres (ECC) at national and state levels (using the emergency numbers). With the exception of Gedarif state (out of 6 states visited), there were no official rumours logbooks or databases for the registration of suspected public health events from informal sources, making the follow-up of signals after detection very difficult. Efforts were ongoing to enhance follow-up based on the OSM (Online Signal Module). Some volunteers and focal persons used a notebook for registration, but it was not standardized to an official format. There are no weekly or monthly reports required from volunteers. Volunteers were expected to report when there is a signal; "*no report means zero signals!!*" as stated by one surveillance officer in a state.

States report immediately when there is a signal or event. By the end of the month, states compile all reported signals and events and send to Federal MOH using a structured format which covers the what,

where, when, who, and how of the signal or event. The focal points for EBS and CEBS at the national level would compile the reports from all states and issue their monthly reports. The contents of these reports are discussed as part of “Surveillance and Information Department” and “HEEC General Directorate” formal meetings. Few states showed a monthly EBS or CEBS reports but there are separate reports for each event. There was no attempt to use database for signals/ events reporting at state level.

Once the locality surveillance officer received a notification from a community volunteer or another source, they informed the state and started arrangements for **triage, verification, and risk assessment**, if needed. This process depends on the locality resources and, in most cases, is completed jointly with the state team. The team sends a written report to the Director General of Health at the state, and if the event represents a public health event of concern, the director informs the Federal MOH. The state conducts verification, risk assessment, and response, which is carried out by trained rapid response teams (RRTs). The training process of RRTs was accelerated by the COVID-19 pandemic (Figure 4).

Performance of state EBS: After visiting the states and analysing the data using mixed quantitative and qualitative methods, the assessment teams gave a score for each state. In 14 out of the 21 items, the overall score was high. However, the assessment teams have concerns about the presence of a structured collaboration with partners: on most occasions there was no collaboration, or it was weak. Moreover, in 2 states there was no EBS unit or focal persons. Most states did not have a written organogram or define roles and responsibilities for EBS staff. Although the current personnel were trained in surveillance and in EBS, the trained personnel were not sure about their capability to do the assigned work. Free access to the internet was limited and supportive supervision from the state to localities and to frontline personnel was lagging (See Table 1 in the appendix).

The above mentioned findings were confirmed by the data obtained from 53 surveillance officers working at the state level. Around 60% of respondents reported to have a list of signals with standard definition. More than 75% of respondents stated there was a presence of a community-based system to capture unusual, unexpected or new event. Ninety percent of the information captured was through the call centre, volunteers or health care workers.

All respondents reported detecting signals/ events in the last year. Over two-thirds of the respondents stated having personal notes in which they recorded information about signals such as date, time, place, source of information, initial cause, description of the signal/ event, and number of cases/ deaths occurred as a result. Less attention was given to have a unique serial number to signal/ event (37.7%). The other important finding was that states were inadequate in the following areas: database development (54.7%), electronic system (39.6%), list of experts (47.2%) and public health laboratory (35.8%). A total of 33 (62.3%) respondents knew the recommended time for verification, but more than that stated having risk analysis team (67.9%) and conducted risk analysis (86.8%) using Federal MOH or WHO tools. Unfortunately, only 30 candidates analysed the last risk. Generally, limited numbers of respondents (41.5%) attempted to analyse paper-based EBS and IBS data at state level as shown in Table 1.

Respondents also reported their self-assessment related to detection, reporting, verification, risk assessment, perception, planning, implementation and monitoring of EBS at states level (Figure 5). Many of them stated that states have a list of signals/ events for immediate notification (84.9%) and knew the time for notification (77.4%). The lower level notified to higher level immediately or within 24 hours using the telephone in most of the cases. Likewise, states reported to a higher level immediately. States reported signals and events immediately; however, limited number of states reported on weekly or monthly basis, and the telephone is the preferred tool. States have a report for each event, they keep a copy for the sent reports, and they shared the report with the non-health sector and NGOs. Sending or receiving feedback report was not identified by reviewers as a common practice. The response to an event and to an emergency, in general, looks good as perceived by the respondents. The findings related to supporting activities for EBS and surveillance were encouraging. More than 80% of respondents stated having plans for surveillance and response, coordination committees with partners, supported telephone calls, guidelines for CBES, and have integrated EBS into broader surveillance. Respondents have concerns about meeting with partners, buffer stock, and guidelines for overall surveillance for response. Few candidates reported having free access to internet, HEEC being established in the state based on law or decree, or an EBS team.

Table 1
 Detection, registration, verification and risk analysis of signals and events (n=53)

Variables	Frequency	%
Ever detect a signal/ event at state level	45	84.9
State with a register for signals/events	38	71.7
Event has a unique serial number	20	37.7
Event notification date and time documented	40	75.5
Initial cause of the event registered	33	62.3
There is a description for the event	36	67.9
Cases and deaths reported	40	75.5
Event place stated	41	77.4
Event source of information stated	38	71.7
State has databases	29	54.7
State has e-system	21	39.6
Respondents know verification time	33	62.3
State has a list of experts	25	47.2
State has a Public Health Lab	19	35.8
State analyses data on regular basis	22	41.5
State has risk analysis team	36	67.9
State conduct risk analysis for the detected signals/ events	46	86.8
State use MOH or WHO tool for risk analysis	44	83.0
Last risk analysed	30	56.6

EBS at state level as perceived by the community volunteers

Following the TOT training in 2018, states, through support from the Federal MOH and other partners, identified target areas and trained community volunteers. States keep records of the volunteers which includes telephone numbers. During the visits to five states, the assessment teams) randomly selected 5 – 7 volunteers from the list and communicated with them by phone. Surprisingly, almost all attempts succeeded. Out of 26 volunteers, 13 were female. The mean (SD) age was 37.9 (11.1) years ranging between 23 to 62 years. Fourteen have basic education and 10 have university/ above university education. Eighteen designated themselves as community volunteers and 4 as health care providers. The majority (21 respondents) were involved with CEBS for 2 years or less, and 5 of them were involved in such work for more than 5 years. Twenty-two of them were trained and knew what their role was, and

almost all knew what needed to be reported. Eighteen of the respondents had reported an event before. Most of the reported events could be classified as biological (diseases) and a few were social (displacement). The events came to the attention of the volunteers during engagement in social gathering, personal contact and observation. Volunteers used phones to notify to the higher level. The majority of respondents at the community level identified no hindrances apart from communication network problems. Only 11 respondents reported having notification forms, and 10 had a register for events. Of those ten, only 4 registered the last event they had. One third of them received occasional feedback from the lower level. What is outstanding is that 20 were satisfied with CBS and 22 were willing to continue. The volunteers' suggestions to improve the project include support to phone calls, training and supplies such as notification forms and registers.

Discussion

This mixed qualitative and quantitative cross-sectional review aimed at exploring the EBS implementation and providing insight to existing infrastructure, program gaps, rationale behind the current system, and program improvements. EBS was established at the national and states levels with some variation in supportive and core functions, performance of EBS as perceived by the assessment teams, state surveillance staff perception about EBS, and community volunteers' performance and perception about EBS.

EBS and IBS are complementary and essential components of the national surveillance system (14). This was not the case in Sudan; EBS at the national level is placed under the supportive activities unit of IBS, a situation that underestimates its usefulness and importance to an extent. Comparatively, EBS is equivalent to CEBS in some states. Factors contributing to the disproportionate weight given to IBS verses EBS are the weak links between the national EBS focal person and states and the long-time gap since the last training. A lack of understanding is considered one of the reasons for sub-optimal implementation of EBS capacities at states level as establishing an optimally functioning EBS system requires involvement of communities, health facilities, and partners (15). Despite this fact, the situation in Sudan indicates that EBS is partially integrated in the existing system, and this is the case in low- and middle-income countries where a review showed that all EBS systems were integrated into existing routine surveillance systems and pre-existing response structures to some extent (16). However, potential EBS partners are not yet contributing to EBS in Sudan although they showed clear willingness to support the efforts of establishing the system. The One Health Approach- recently initiated at the national level in Sudan- can be used as a platform to enable capturing of events from human, animal, environmental, and other relevant sources (17, 18). However, to move ahead with EBS system in any country depends on the country's ability to review and adapt existing surveillance structures and to involve communities and partners (15). Although electronic surveillance and internet-based systems proved their role in augmenting the traditional surveillance, particularly in detection, tracking and reporting of emerging infections (19), they have limited use for surveillance purpose in Sudan. Attempts to maximize the benefits from signals module are ongoing at national level and there is a plan to expand to states.

There was an uncertainty in the pathway between signal detection and action; this weakens the system, leading to delayed verification, risk assessment and response and hence lowers its performance. The other point to be mentioned here is that states report when there is a signal or event immediately, and they stated that they compiled all reported signals and events and send to Federal MOH as a monthly report. In the visited states, the assessment team found reports on each signal and event but few states showed a monthly EBS reports. This is potentially the cause of concern about the limited contribution of EBS to the general surveillance. Experience from the pilot project in Vietnam showed that presence of structured data and reports were valuable for the MOH to understand the function of the EBS program and the success and challenges of implementing EBS (20).

The EBS performance of the 6 visited states as scored by the assessment team revealed an overall higher score in many assessed items but states lagging behind and having concerns about presence of structured collaboration with partners and communities, presence of written organogram, roles and responsibilities, low capacity, limited access to internet and lack of supportive supervision. The lack of documented SOPs was recognized as a potentially compromiser to quality and consistency of practice in EBS and that implementation of SOPs, and continuous quality improvement processes are highly needed (21). As well, case detection can be very much improved through increased staff training and community engagement (22). The EBS in Sudan could make use of the lessons learned from Vietnam EBS project which showed the value of supportive supervision, monitoring and evaluation to build sustainable system and to identify barriers to effective implementation (23).

The surveillance staff at states levels reported to have a list of signals with standard definition, trained community volunteers, they knew the recommended time for verification and all respondents reported detecting signals/ events in the last year and have conducted risk analysis. All the above mentioned items were included in the EBS SOPs and guidelines, 2016. However, a comprehensive and updated EBS guideline is highly needed. This indicates presence of a functioning CEBS system at states level with some limitations; a situation typical to what reported about surveillance before in Khartoum State, the capital of Sudan (11).

The community volunteers were nominated by their communities, a factor that ensures the success of CEBS and increases the community's acceptance, participation and trust (18). Most of the community volunteers are satisfied with their tasks and are willing to continue. This is an ideal facilitating factor for the system and provides a better opportunity for sustainable CEBS. Other factors associated with better performance include regular training and supportive supervision from the national level. A study in Sierra Leone reported that training, guidelines and follow-up from supervisors, together with seeing results and having a role in helping their communities, were the main motivating factors (24). The staff turnover and the gap between income and expenses were the biggest challenges that compromise the sustainability of the system. However, these compromisers can be mitigated by development of better mechanisms to publicize the role of volunteers, and improvement of recognition and appreciation schemes (25).

The assessment revealed that the strong points of EBS in Sudan included the presence of a functioning IBS, a trained and committed national team, strong guidelines and SOPs, dedicated volunteers, regular monthly reports, and functioning media scanning at the national level. The weakest points in the system were poor link between national and states level, disintegration of EBS components at national and state level, limited utilization of E-Systems at state level, under appreciation for the surveillance structure at national and state level, and a lack of strategic vision. Still there are opportunities for the development of resilient EBS system, and this is reflected in the partners' willingness to participate and to support implementation. All these efforts could be compromised by high staff turnover, particularly at localities and states and by COVID-19 pandemic. These findings highlighted the need for an EBS strategy, updated guidelines and training manuals.

Limitations

The study was not able to assess the quality of EBS and its contribution in early detection and response as there was no registry for signals and events at state or national level or the information recorded were not complete. The small sample of the interviewed community volunteers showed their willingness and a satisfaction with their contribution to EBS, but it is not enough to conclude about the effectiveness of community volunteers. Further study needed to reflect the experience of CEBS.

Conclusions And Policy Implication

There are efforts to improve EBS within Sudan as reflected by the national assignment of an EBS coordinator, development of guidelines and SOPs, and the training of EBS focal persons at states. This, however, is challenged by the underestimation of the EBS role by the national level and the misperception of it as an activity instead of a system. The pathway from "detection of signals/ events" to "data for action" is not clear and affects the timely use of data, delayed response, delayed integration and affects the overall performance. The link between the national level and states is unstructured and driven by the need for reports. Despite the efforts to train states' staff and frontline personnel, high staff turnover at state and localities due to political instability and low salary is still a big problem. Partners EBS in not functioning (the only exception is animal sector) in all states; however, there are partners willing to participate and support. Electronic databases are ignored and not used or even unknown especially by states. There is feedback coming from the national level to the states but not from the later to the localities and sentinel sites. Training, presence of trained staff and regular follow up are supporting factors, while staff turnover is the biggest challenge.

The study highlighted very important points that have implications of EBS policy. The FMOH needs to develop an EBS strategy, comprehensive guidelines and training manuals. Moreover, the ministry has to revise the list of signals/events, reporting format and recording procedures as well as to have in place a clear role and responsibilities of EBS actors.

Abbreviations

CEBS	community event-based surveillance
COVID-19	Corona Virus Disease 2019
EBS	Event-based surveillance
ECC	emergency call centres
EOC	Emergency Operation Centre
EWAR	Early Warning Alert and Response
FGD	Focus Group Discussions
FMOH	Federal Ministry of Health
HEEC	Health Emergency and Epidemic Control
HMS	Hotline and Media Scanning
IBS	Indicator-based surveillance
IHR	International Health Regulations
ITS	Incidence Tracking System
MoH	Ministry of Health
NGOs	Non-Governmental Organization
OSM	Online Signal Module
PEBS	Partner-Based Surveillance
POE	Point of Entry
SID	Surveillance and Information Department
SOP	Standard Operation Procedures
SPSS	Statistical Package for Social Science
UN	United Nation
WHO/EMRO	World Health Organization/ East Mediterranean Office

Declarations

Ethics approval and consent to participate

The ethical approval for this review was provided by the national research ethical committee at Federal Ministry of Health. Written informed consents were obtained from all participants as appropriate.

Consent for publication

Not applicable

Competing interests

All authors declared they have no conflict of interest

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Availability of Data

All data is available at the surveillance and Information Directorate (SID) at Sudan Federal Ministry of Health.

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EMM, AIA, SAM, MAE, OEM, IMI, HFF conceptualized the idea and outlined the theme to be discussed. AAB and RI, AMA, MMO, TAM, MAA, and SGE approved the idea and contributed with additional inputs. SAM, AIA and EMM analysed the data and wrote the draft. BAAM, MH, MS and AA revised the draft and

modified the layout, suggestion additional points, and enriched the discussion. All authors reviewed the draft and the modified versions and approved the submitted version.

References

1. World Health Organization. Early detection, assessment and response to acute public health events: implementation of early warning and response with a focus on event-based surveillance: interim version. World Health Organization; 2014.
2. Drewe JA, Hoinville LJ, Cook AJ, Floyd T, Stärk KD. Evaluation of animal and public health surveillance systems: a systematic review. *Epidemiology Infection*. 2012 Apr;140(4):575–90.
3. Shahab S. Finding value in the evaluation of public health syndromic surveillance systems from a policy perspective. Finding value in the evaluation of public health syndromic surveillance systems from a policy perspective. Alberta, Canada: Alberta Health Services. 2009:1-24.
4. Abat C, Chaudet H, Rolain JM, Colson P, Raoult D. Traditional and syndromic surveillance of infectious diseases and pathogens. *International Journal of Infectious Diseases*. 2016 Jul 1;48:22–8.
5. Al-Said SS. The Health Information System in Sudan: the Disease and outbreaks Surveillance System at the National Level and the State Capital: A Descriptive Study (Master's thesis).
6. Calba C, Goutard FL, Hoinville L, Hendriks P, Lindberg A, Saegerman C, Peyre M. Surveillance systems evaluation: a systematic review of the existing approaches. *BMC Public Health*. 2015 Dec;15(1):1–3.
7. Nsubuga P, Eseko N, Tadesse W, Ndayimirije N, Stella C, McNabb S. Structure and performance of infectious disease surveillance and response, United Republic of Tanzania, 1998. *Bull World Health Organ*. 2002;80:196–203.
8. Sahal N, Reintjes R, Eltayeb EM, Aro AR. Feasibility of implementing recommendations to improve communicable diseases surveillance—a modified Delphi study. *Afr Health Sci*. 2011;11:93–9.
9. WHO. International Health Regulations. (2005), 2nd ed. Geneva: World Health Organization; 2008 http://whqlibdoc.who.int/publications/2008/9789241580410_eng.pdf.
10. WHO. Protocol for Assessing National Surveillance and Response Capacities for the IHR. (2005). Geneva. WHO; 2010. (WHO/HSE/IHR/2010.7; http://www.who.int/ihr/publications/who_hse_ihr_201007_en.pdf?ua=1).
11. Sahal N, Reintjes R, Eltayeb EM, Aro AR. Assessment of core activities and supportive functions for the communicable diseases surveillance system in Khartoum state, Sudan, 2005-2007. *EMHJ-Eastern Mediterranean Health Journal*, 16 (12), 1204-1210, 2010. 2010.
12. WHO. Early detection, assessment and response to acute public health events: Implementation of Early Warning and Response with a focus on Event-Based Surveillance (Interim Version). WHO/HSE/GCR/LYO: Geneva, WHO; 2014. /2014.4.
13. WHO/EMRO. Manual for the assessment of the public health surveillance system with a focus on Early Warning And Response(EWAR) and Event-Based-Surveillance (EBS). Draft 3. (October 2016)

(unpublished document).

14. WHO/WPR. A guide to establishing event-based surveillance. WHO 2008. ISBN 978 92 9061 321 3.
15. Balajee SA, Salyer SJ, Greene-Cramer B, Sadek M, Mounts AW. The practice of event-based surveillance: concept and methods. *Global Security: Health, Science and Policy*. 2021 Jan 1;6(1):1-9.
16. Kuehne A, Keating P, Polonsky J, et al. Event-based surveillance at health facility and community level in low-income and middle-income countries: a systematic review. *BMJ Global Health* 2019; 4:e001878. doi:10.1136/ bmjgh-2019-001878.
17. Center for Diseases Control and Prevention, One Health Basics. 2021, accessed from <https://www.cdc.gov/onehealth/basics/index.html>.
18. Africa CDC. Africa CDC Framework for Event-based Surveillance. Interim version; Nov 2018.
19. Milinovich GJ, Williams GM, Clements AC, Hu W. Internet-based surveillance systems for monitoring emerging infectious diseases. *The Lancet infectious diseases*. 2014 Feb 1;14(2):160-8.
20. Clara A, et al. Developing monitoring and evaluation tools for event-based surveillance: experience from Vietnam. *Globalization Health*. 2020;16:38. <https://doi.org/10.1186/s12992-020-00567-2>.
21. Beebejaun K, et al. Evaluation of Event-Based Surveillance, Nigeria. *Emerging Infectious Diseases* www.cdc.gov/eid Vol. 27, No. 3, March 2021. DOI: <https://doi.org/10.3201/eid2703.200141>.
22. Ratnayake R, et al. Assessment of Community Event-Based Surveillance for Ebola Virus Disease, Sierra Leone, 2015. *Emerging Infectious Diseases*; Vol. 22, No. 8, August 2016. DOI: <http://dx.doi.org/10.3201/eid2208.160205>.
23. Clara A, et al. Factors Influencing Community Event-based Surveillance: Lessons Learned from Pilot Implementation in Vietnam. *Health Security* Volume 16, Supplement 1, 2018 DOI: 10.1089/hs.2018.0066.
24. Larsen TM, Mburu CB, Kongelf A, Tingberg T, Sannoh F. (2017) Red Cross volunteers' experience with a mobile community event-based surveillance (CEBS) system in Sierra Leone during-and after the Ebola outbreak- A qualitative study. *Health Prim Car* 1: DOI:10.15761/HPC.1000114.
25. Jigssa HA, Desta BF, Tilahun HA, McCutcheon J, Berman P. Factors contributing to motivation of volunteer community health workers in Ethiopia: the case of four woredas (districts) in Oromia and Tigray regions. *Human Resources for Health* (2018) 16:57 <https://doi.org/10.1186/s12960-018-0319-3>.

Figures

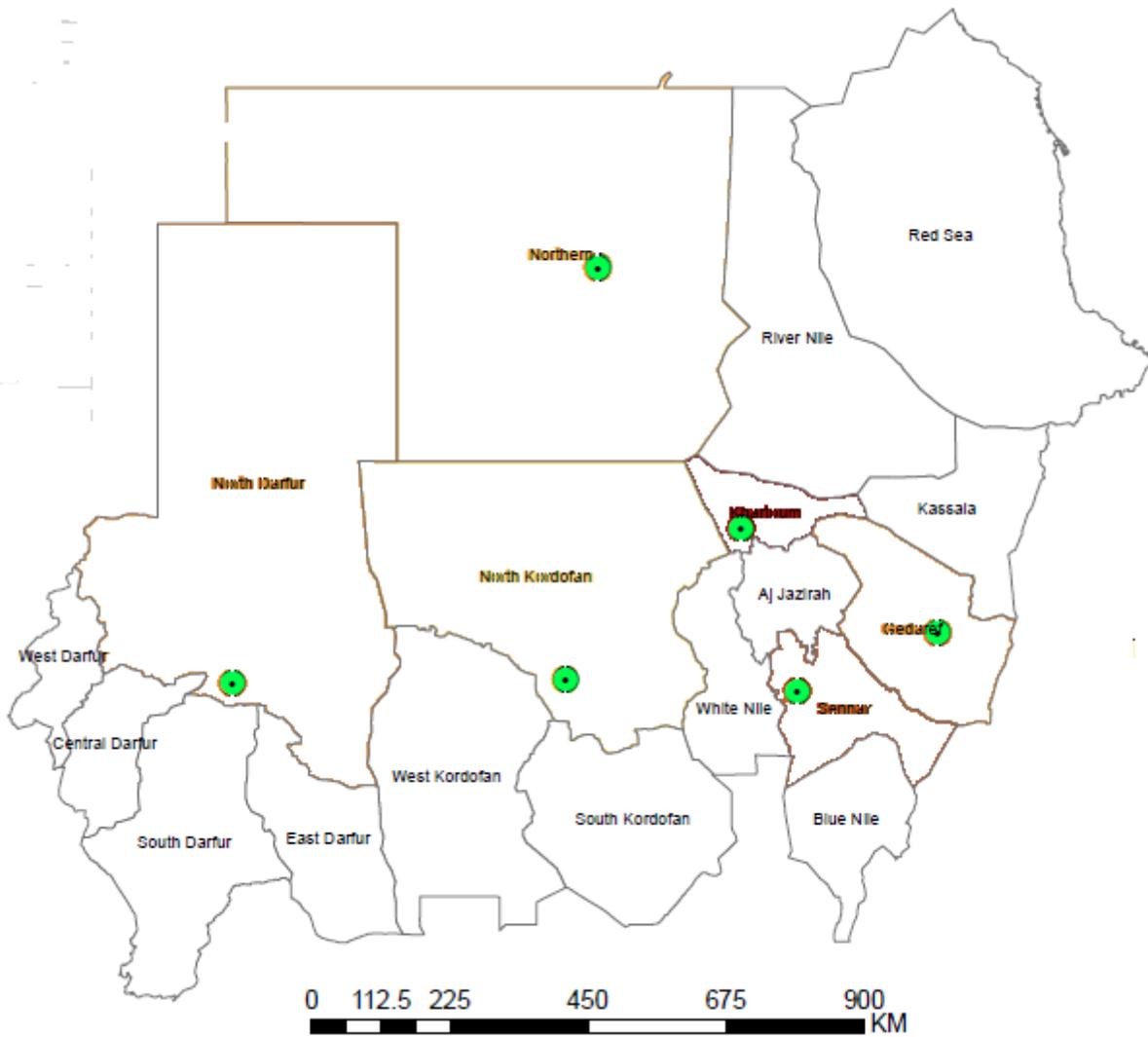


Figure 1

Sudan map showing the capital of the six visited states (green circle indicates the state capital)

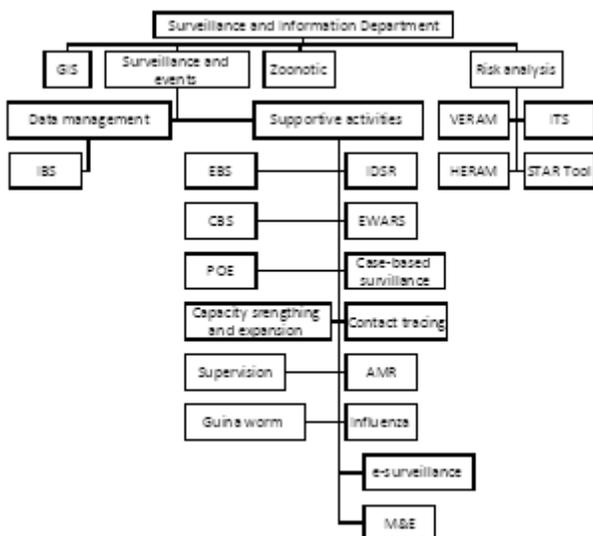


Figure 2

The structure of SID at national level

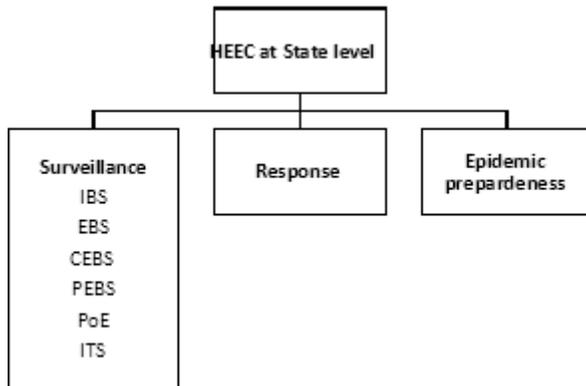


Figure 3

The structure of HEEC at state level

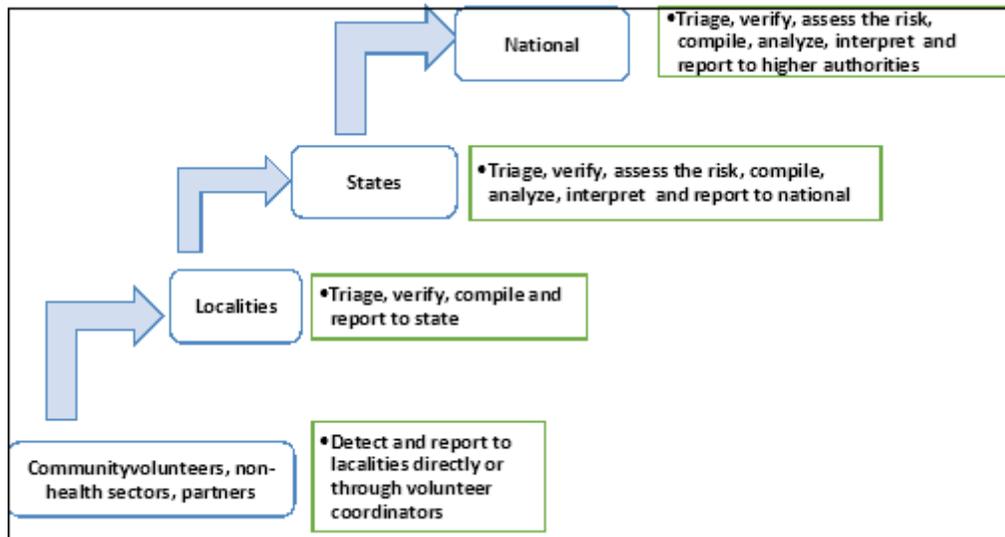


Figure 4

Role of each level and the information flow in EBS

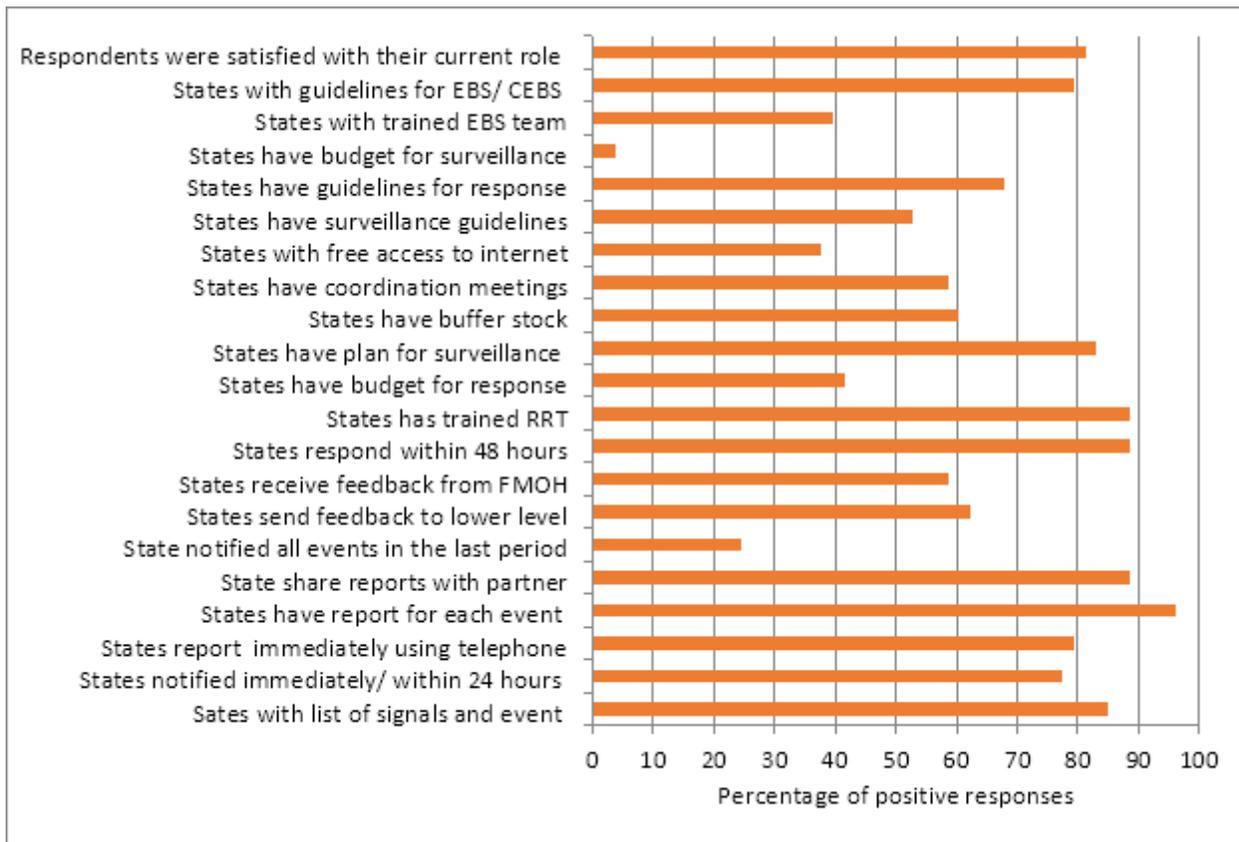


Figure 5

Respondents reported self-assessment related to detection, reporting, verification, risk assessment, perception, planning, satisfaction related to EBS at states level

Supplementary Files

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