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SARS-CoV-2 case detection using community event-based surveillance system—February–September 2020: lessons learned from Senegal

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ABSTRACT

The COVID-19 pandemic necessitated the rapid development and implementation of effective surveillance systems to detect and respond to the outbreak in Senegal. In this documentation, we describe the design and implementation of the Community Event-Based Surveillance (CEBS) system in Senegal to strengthen the existing Integrated Disease Surveillance and Response system. The CEBS system used a hotline and toll-free number to collect and triage COVID-19-related calls from the community. Data from the CEBS system were integrated with the national system for further investigation and laboratory testing. From February to September 2020, a total of 10 760 calls were received by the CEBS system, with 10 751 calls related to COVID-19. The majority of calls came from the Dakar region, which was the epicentre of the outbreak in Senegal. Of the COVID-19 calls, 50.2% were validated and referred to health districts for further investigation, and 25% of validated calls were laboratory-confirmed cases of SARS-CoV-2. The implementation of the CEBS system allowed for timely detection and response to potential COVID-19 cases, contributing to the overall surveillance efforts in the country. Lessons learned from this experience include the importance of decentralised CEBS, population sensitisation on hotlines and toll-free usage, and the potential role of Community Health Workers in triaging alerts that needs further analysis. This experience highlights the contribution of a CEBS system in Senegal and provides insights into the design and operation of such a system. The findings can inform other countries in strengthening their surveillance systems and response strategies.

SUMMARY BOX

⇒ Forging sustainable strategies to maintain population awareness and hotline usage in event-based surveillance (EBS) during low notification periods.
⇒ The EBS comes to complement the indicators-based surveillance to ensure more effective early diseases and public health treats detection.
⇒ Our study shows that linkage of alert systems to national system is key to tracking and monitoring of COVID-19 cases.
⇒ Additionally, communication channels for promotion of the use of alert systems needs to expand beyond urban areas.

INTRODUCTION

The novel COVID-19 caused by the SARS-CoV-2 spread out worldwide from China and was declared a pandemic by the WHO on 11 March 2020.[1] By 29 July 2020, at least 188 countries were affected, with more than 16 500 000 laboratory-confirmed cases and 600 000 deaths worldwide.[2] While Egypt confirmed the first case in Africa on 14 February 2020,[3] Senegal registered its first case on 2 March 2020.[4]

Rapid response to an outbreak is critical to mitigating disease spread, especially for a disease with high epidemic potential such as COVID-19. Because the rapid response is closely linked to early detection, the International Health Regulations (IHR) recommends that countries develop a functional detection and rapid response system.[5] According to WHO, an effective early warning and rapid response system should include indicator-based surveillance (IBS) and event-based surveillance (EBS) as two major pillars.[6]

In Senegal, as with 43 of 46 other African countries, IBS is run through the Integrated Disease Surveillance and Response (IDSR) system.[7] The IBS component of IDSR system has been implemented locally since 2008 at health structures level, and start from 2016, it was extended to community level targeting 8 diseases (cholera, yellow fever, meningitis, measles, acute flaccid paralysis, bloody diarrhoea and haemorrhagic fever) with a community level case definition for each.

Currently in Senegal, the IBS includes 16 diseases or events reported weekly, with an average of over 90%[8] reporting completeness using District Health Information Software (DHIS2). The IBS is well established with data transmission from health posts at the subdistrict level up to the national level.

To further strengthen IDSR in Senegal, it was necessary to reinforce detection, especially during a pandemic, by use of an EBS system. Senegal had no established EBS system which is a more sensitive and faster approach for public health event detection at an early stage and proper case management in order to mitigate disease spreading.[9] Despite the IHR recommendation in 2005 and the first EBS system generic guide developed by WHO in 2014,[6] Senegal had EBS established for an early detection at the end of 2019.

The concept of EBS is relatively recent and is defined as: 'the organised collection, monitoring, assessment and interpretation of mainly unstructured ad hoc data regarding health events or risks, which may represent an acute risk to human health…'.[6] The unstructured aspect of the definition allows for rapid detection of any public health event at all levels within and out of the human health system. Thus, according to the CDC Africa EBS framework, EBS can be implemented in communities, health facilities or at the national level through hotlines and media scanning.[10]

EBS systems have been implemented and evaluated in countries such as Vietnam, Sierra Leone and Kenya with satisfactory results.[11–13] Recent EBS system efforts in Africa show data collection of media monitoring using internet-based epidemic intelligence platforms such as the Hazard Detection and Risk Assessment System and Epidemic Intelligence from Open Sources.[14] We found no publication documenting EBS implementation using hotlines in countries within the WHO Regional Office for Africa in response to the current COVID-19 pandemic.

In this paper, we describe the system design and implementation of a community EBS (CEBS) system in Senegal and lessons learnt.

We conducted a cross-sectional descriptive analysis of COVID-19 response data collected from a CEBS system in 14 regions of Senegal from February to September 2020. The COVID-19 suspected case definition used in Senegal at the time was—a person with severe acute respiratory infection (fever and cough with need of hospitalisation), without other aetiology fully explaining the clinical profile, and travel history or residency in China in 14 days prior to symptoms onset.[15]

EBS SYSTEM DESIGN AND EVALUATION

Prior to the pandemic in April 2018, Senegal designed and developed a CEBS system with several preparatory workshops to develop and validate its rollout. The usage of an alert system at the national level was identified as the first part of the CEBS system design and implementation, followed by linkage to the national system at the health district. Implementation of the CEBS system became effective as a result of the COVID-19 pandemic, which accelerated and modified the initial design. Initially, only standard phone numbers through major network providers in Senegal were available to contact the alert system. After 9 April 2020, a toll-free number 1919 was made available for the alert system and was promoted using various communication channels, including TV, radios and posters. All calls to the standard phone numbers were also automatically redirected to the toll-free number. Callers are community members who need information on COVID-19, who are symptomatic or who have been in contact with a COVID-19 laboratory confirmed case. The flow chart of the alert system and its linkage to the national system are shown in figure 1. Briefly, the national system consisted of laboratory confirmed data on COVID-19 positive cases tested by reverse transcription PCR.

The alert system was managed by Ministry of Health (MoH) staff in addition to volunteers supporting the surge capacity need. The alert system was open for calls 7 days a week and 24 hours a day and nationwide. No language translation system was in place, staff managing calls spoke both French and Wolof. According to the 2019 health and demographic survey, Wolof is spoken by approximately 40% of the population interviewed during the survey.[16] Trained data clerks triage COVID-19 calls received from individuals within the community to the next stage for verification by validators. The COVID-19 suspected case definition used in Senegal serves as a guide to characterising a COVID-19 call and includes individuals self-reporting COVID-19 symptoms, travel history outside Senegal 14 days prior to symptom onset or a positive SARS-CoV-2 test. The data clerks document the COVID-19 specific data and also capture demographic data from the callers using the platform made available to them for this purpose.

On receipt of the COVID-19 call data, the validators who are all medical staff (doctors, dentists, pharmacists and nurses) reach out to individuals potentially suspected for COVID-19 within 24 hours to verify and confirm the triaged information. Calls that meet the COVID-19 suspected case definition at the time are categorised as validated calls. Calls that do not meet the definition are categorised as not validated calls. Validated calls are then referred to respective health districts based on caller residence/address information for further investigation (trigger transmission). Not validated calls are not sent for further investigation; however, symptomatic caller can seek medical care in health structures directly.

We abstracted data collected in the CEBS system (the alert system and the national system) a month before and up to 6 months after the first laboratory SARS-CoV-2 confirmed case in Senegal on 2 March 2020. Within the alert system, we abstracted data on call origin, residence information and call status (validated or non-validated). From the national system, we abstracted data on the calls referred from the alert system specifically

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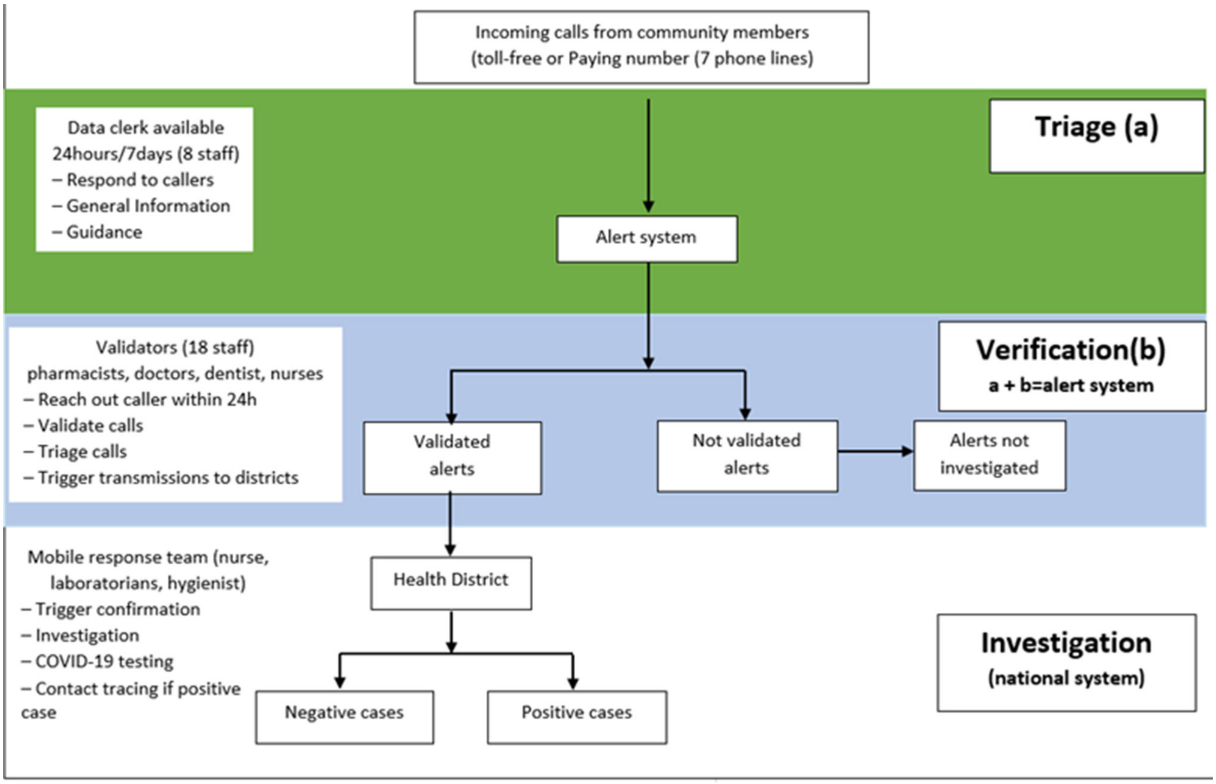

Figure 1 Flow diagram depicting the linkage between the alert system and the national system in Senegal, 2020.

the corresponding laboratory results (positive) of the callers. Unique identifiers were created in each dataset using individual data (first 3 letters of family name, first 3 letters of surname, age, sex and health district location) before dataset anonymisation and sharing with the analysis team. This approach was critical to linking laboratory-confirmed cases from the alert system. All the relevant data were extracted from the two systems and imported into Excel for analysis.

Descriptive analysis was performed on all received calls by region and laboratory-confirmed cases. Missing and duplicative data were excluded from the analysis.

We obtained written permission from the Senegalese MoH, Department of Prevention, to abstract and use data from the alert system and the national system. No local ethical committee approval was required for secondary surveillance data analysis. This activity was reviewed by US Centers for Disease Control and Prevention (CDC) and was conducted consistent with applicable federal law and CDC policy (see, for example, 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. 241(d); 5 U.S.C. 552a; 44U11.S.C. 3501031 et seq).

During February–September 2020, a total of 10760 calls from all 14 regions were received by the alert system (figure 2)—an average of 307 calls per week. Of the 10760 calls, our analysis focused on 10 751 COVID-19 calls—9 calls were missing information (n=8) or not COVID-19 related (n=1). Calls were notified on persons between

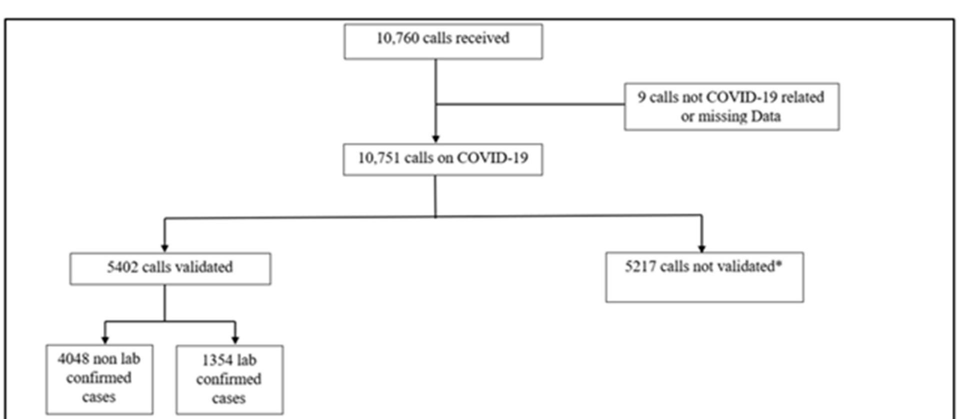

Figure 2 Flow diagram of COVID-19 calls from 14 regions in Senegal, February–September 2020. *Not validated included invalidated and not classified.

the ages of 5 years and 39 years with a male-to-female sex ratio of 1:7. The most frequently reported symptoms were cough 43% (4268/9878), headache 30.7% (3196/10 413) and fever (2879/9899).

Of all the COVID-19 calls received by the alert system, 84.8% (9117/10 751) were from the Dakar region and 7.4% (801/10 751) from the Thies region, the two regions with the highest population estimates for 2020 (table 1).[17] Of the COVID-19 calls, 50.2% (5402/10 751) were validated and sent to the health district for further investigation. Among the validated calls from the alert system, Dakar region had the highest number of validated calls (87.9%, 4748/5402) followed by Thies region (6.5%, 354/5402). Of the validated calls 5402/10 751 from the alert system that were sent to the health district, only 1354/5402 (25%) were positive cases of SARS-CoV-2 (table 1). The highest number of positive SARS-CoV-2 cases was reported from the Dakar region (85%%, 1152/1354), followed by the Thies region (8%, 104/1354).

After the first laboratory-confirmed case during week 10 (March 2020), the volume of COVID-19 calls to the alert system increased (figure 3). During week 10, the alert system received only 10 COVID-19 calls compared with week 27 with the highest number of calls (n=689). As SARS-CoV-2 transmission became established, as defined by the high number of laboratory-confirmed cases during weeks 20–24 (June 2020), the number of COVID-19 calls to the alert system eventually tapered off during week 28 (July 2020) and stabilised for a few weeks.

LESSONS LEARNT

Transforming EBS implementation at a national scale: the vitality of a decentralised system

Implementation of the alert system of the CEBS system in Senegal showed the usefulness of a hotline in the prevention efforts during a pandemic and contributed to strengthening the country's surveillance system and COVID-19 response. The findings showed that over 90% of calls received were COVID-19 related—a reflection of the community concerns and questions about COVID-19 in Senegal at the time. Additionally, at the time, most of the calls came from the Dakar region, which was the COVID-19 outbreak epicentre in Senegal. This region also served as the hub for official media communication, likely resulting in greater awareness among the population. A wider population sensitisation on hotlines and toll-free usage could have affected the usage of the alert system in the Dakar region. Strategies to reach a majority of the population should be considered in the future for other regions and in accordance with rates of transmission in the respective regions. The calls received were proportional to the population of the respective regions with over 80% of the calls from the highly populated Dakar region, which had 23% of the country's population and a density of 7010 inhabitants/square kilometres. This finding aligns with research on the role of population density in the spread of COVID-19 and transmission risk in areas with higher population density[18–20]; however, earlier research found no association between population density and COVID-19 transmission.[21]

Table 1 Laboratory confirmed cases from validated calls by the alert system in the 14 regions, Senegal, February–September 2020

		Incoming calls		Validated calls sent to district		Lab confirmed (positive cases)	
Region	**Population***	**n**	**%**	**n**	**%**	**n**	**%**
Dakar	3 835 011	9117	84.7	4748	87.9	1152	85.1
Diourbel	1 859 503	315	2.9	120	2.2	43	3.2
Fatick	900 800	40	0.4	7	0.1	2	0.1
Kaffrine	728 951	33	0.3	8	0.1	5	0.4
Kaolack	1 191 577	112	1.0	30	0.5	8	0.6
Kedougou	190 509	7	0.1	2	0.03	1	0.1
Kolda	822 003	31	0.3	17	0.3	4	0.3
Louga	1 061 612	62	0.6	23	0.4	5	0.4
Matam	732 863	21	0.2	6	0.1	2	0.1
Saint Louis	1 091 735	114	1.1	46	0.8	15	1.1
Sedhiou	572 101	12	0.1	4	0.1	1	0.1
Tambacounda	872 155	23	0.2	10	0.2	5	0.4
Thies	2 162 833	801	7.4	354	6.5	104	7.7
Ziguinchor	683 955	67	0.6	26	0.5	7	0.5
Missing	–	1	–	–	–	–	–
All regions	**16 705 608**	**10 751**	**100**	**5402**	**100**	**1354**	**100**

*Population estimates for Senegal 2020.

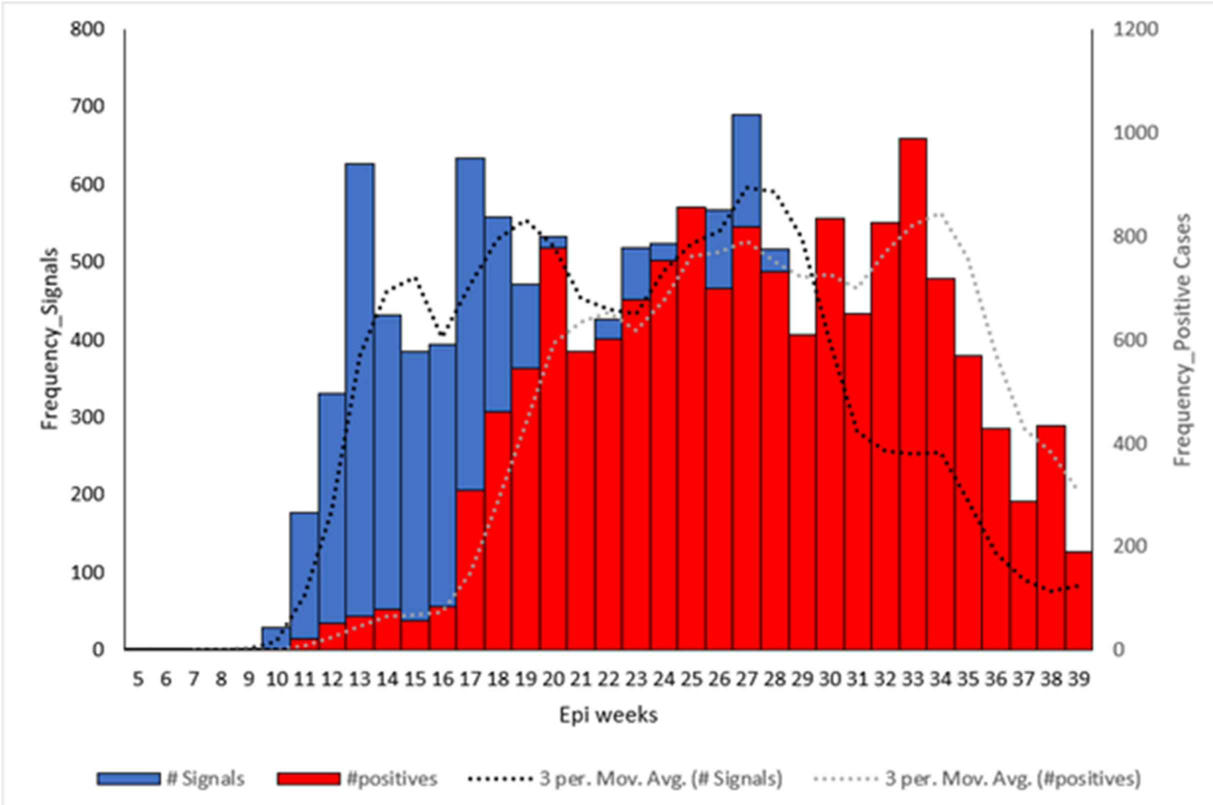

Figure 3 Signals and laboratory-confirmed positive SARS-CoV-2 cases in Senegal, February–September 2020 (weeks 5–39). #Signals = number of COVID-19 calls to the alert system. #positives = number of laboratory-confirmed positive cases of SARS-CoV-2 as reported by the health district and linked to callers in the alert system. Mov. Avg = moving average.

Strengthening EBS from noise to public health events: Community Health Workers (CHWs) and key informants

As with any alert system, the calls received were either valid or not valid. During the implementation of the alert system, only half the calls received were validated and sent forward to the district for further investigation. The validated proportion of calls (50%) was lower than the 83% of alerts validated in a community-based surveillance (CBS) study implemented in Niger at the same timeline.[22] Unlike the alert system in Senegal, the Niger study was a CBS using trained Community Health Workers (CHWs) whose involvement may have led to a more specific and less noisy system. Indeed, trained CHWs are more likely to triage alerts at their level, using the community case definition, before transmission of the information to the next level. Additionally, instead of using key informants as suggested by Balajee and colleagues,[9] to reduce noise, our hotlines and toll-free event-based system was opened to the general population. Even though CHWs have been heavily involved in the pandemic response, particularly in low and middle income countries where they are well established,[23] their role and responsibilities, as well as the level of disease risk exposure countries want to put them on, as non-medical and volunteered staff, must be reconsidered . In other words, opening the hotline to the general population for EBS may be safer, faster and cheaper, but a formal cost-effectiveness study should be considered for a better documentation.

Enhancing EBS integration with the laboratory system: tracking validated signals across all surveillance levels

The absence of a link between the existing alert system and the national system resulted in difficulty tracking calls investigated and tested by the health districts. Data provided from the national dataset included only information on positive laboratory-confirmed cases of SARS-CoV-2. Consequently, we were unable to decipher if the validated calls (75%) that were not positive cases were either negative cases or if individual callers chose not to get tested. Of note is that during project implementation, individuals had the option to get COVID-19 testing at home or close to their place of residence. However, stigma was reported associated with testing for SARS-CoV-2, which may have deterred community members from seeking testing. Stigma has been identified as a barrier to health seeking from the community and health personnel[24 25] and in some cases, can serve as a barrier to testing. Future efforts should consider incorporating testing in a manner that avoids stigmatisation of individuals, for example, testing in locations other than the community of residence.

EBS during high notification volume period: ensuring effective hotline usage during low attention periods

A review of the COVID-19 calls showed gradual alignment with the number of COVID-19 cases reported. After the first laboratory-confirmed case during week

11, we observed an increasing trend in the number of calls to the alert system. Possible reasons for the increase include anxiety and stress related to COVID-19 among the population as the public was learning more about the disease. In 2020, a meta-analysis conducted with data from different countries showed the rate of anxiety varying from 6% to 51% in the general population during the COVID-19 pandemic, with frequent exposure to COVID-19 social media/news identified as the leading cause of anxiety and stress symptoms.[26] Another study found that the highest prevalence of anxiety due to COVID-19 in the general population was in Africa (62%).[27] The trend in calls received was maintained with an average of 396 calls per week up to week 27, eventually tapering off, possibly due to the low case fatality rate of COVID-19 in the country and awareness of COVID-19. Based on our observations, the majority of calls we received were from men. However, it is crucial to note that this does not necessarily indicate that men are more susceptible to anxiety. Instead, it likely reflects the fact that a higher number of COVID-19 confirmed cases were reported among male patients in Africa.[28–31]

The findings from this project should be interpreted with the following limitations. First, the calls documented in the alert system were self-reported, and individuals may have over-reported or under-reported the COVID-19 symptoms experienced and/or travel history. Second, the project focused only on callers to the alert system, limiting the findings' generalisability. Furthermore, because this project was conducted in early 2020, near the beginning of the COVID-19 pandemic in Senegal, the results are not generalisable to the current context as relates to SARS-CoV-2 testing. Third, during the early stages of the alert system implementation, calls for the alert system were documented on paper. After 9 April 2020, calls were documented electronically. As a result, some of the data may have been incomplete or missing, resulting in our inability to process the caller's information. Fourth, a toll-free number was made available during project implementation and could have impacted the number of calls received. Lastly, the absence of the use of similar unique identifiers by the two systems made it difficult to link data, which may have potentially led to a loss of information.

CONCLUSION

Disease outbreaks provide opportunities to assess a detection system's effectiveness and added value. COVID-19 accelerated CEBS system implementation in Senegal not only reinforced disease detection with an early warning system, but also provided lessons that can be shared with other countries. Implementation of the CEBS in Senegal contributed to the identification of positive cases of SARS-CoV-2. The system, however, was not without operational challenges, such as missing data, incomplete information and lack of system. These challenges can guide improvements and facilitate implementation success in existing or new CEBS systems implemented during a pandemic in Senegal and elsewhere.

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Competing interests None declared.

Ethics approval Data use for the manuscript was collected as part of COVID-19 surveillance reinforcement for early warning system establishment. Therefore, no individual consent was required.

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