Evaluation of a Sentinel Hypertension Surveillance System in Mojo, East Shewa Zone, Oromia, Ethiopia: Insights from a Concurrently Embedded Mixed Design Study

Abiyie Demeash, Yeshiwas Ayale, Dawit Zenebe, Aman Yesuf

Submitted to: Online Journal of Public Health Informatics
on: February 20, 2025

Table of Contents

Evaluation of a Sentinel Hypertension Surveillance System in Mojo, East Shewa Zone, Oromia, Ethiopia: Insights from a Concurrently Embedded Mixed Design Study

Abiyie Demeash[1]; Yeshiwas Ayale[2]; Dawit Zenebe[3]; Aman Yesuf[4]

[1]Addis Ababa, Ethiopia St. Paul's Hospital Millennium Medical College Addis Ababa ET
[2] Teda Health Science College Gondar ET
[3] Mekelle University Mek'ele ET
[4] St. Paul's Hospital Millennium Medical College Addis Ababa ET

Corresponding Author:
Abiyie Demeash
Addis Ababa, Ethiopia
St. Paul's Hospital Millennium Medical College
Ethiopia
Addis Ababa
ET

Abstract

Background: In response to the increasing incidence and prevalence of hypertension, Ethiopia has been piloting hypertension control at the primary healthcare level in selected sentinel sites. However, no evaluation has been conducted and its success and failures has not been ascertained.

Objective: This study aimed to evaluate on whether sentinel hypertension surveillance system in Mojo City were operating efficiently and effectively

Methods: A concurrently embedded mixed design (quantitative/qualitative) study was conducted in two sentinel health centers in Mojo city, Oromia region of Ethiopia. The usefulness and nine system attributes were assessed via key informant interviews, observations and record reviews. The qualitative data were analyzed manually via thematic analysis, whereas quantitative data were analyzed via SPSS Software version 25.0.

Results: The study invited 14 key informants, and all were willing to participate in the interview. The completeness and timeliness of reports were 98% and 100%, respectively. The sensitivity, positive predictive value and representativeness were 45.3%, 92.6% and 22%, respectively. Nearly three-fourths (71.4%) of key informants perceived system as flexible, while half thought it as unstable due to factors such as inadequate training and lack of supportive supervision and feedback system. Health facilities didn't conduct routine data analysis and interpretation nor did they use for action.

Conclusions: The surveillance system in Mojo city was simple, flexible, acceptable and predictive but less sensitive, unrepresentative and unstable. There is a need for implementing routine data analysis and use for action, adequate training, and feedback system for optimizing the system's performance and to ensure its sustainability

(JMIR Preprints 20/02/2025:72909)
DOI: https://doi.org/10.2196/preprints.72909

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

✓ **Please make my preprint PDF available to anyone at any time (recommended).**
Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.
Only make the preprint title and abstract visible.
No, I do not wish to publish my submitted manuscript as a preprint.

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**

Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain v
Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in <a href="http
No. Please do not make my accepted manuscript PDF available to anyone.

Original Manuscript

Title of manuscript: Evaluation of a Sentinel Hypertension Surveillance System in Mojo, East Shewa Zone, Oromia, Ethiopia: Insights from a Concurrently Embedded Mixed Design Study

Authors: Abiyie Demelash Gashe[1]; Yeshiwas Ayale Ferede[2]; Dawit Zenebe Weldemichael[3]; Aman Yesuf Endries[4]

Author Affiliations:

[1] Ethiopian Field Epidemiology Training Program, St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia

[2] Department of Reproductive Health, Teda Health Science College, Gondar, Ethiopia

[3]Mekelle University, Department of Epidemiology, Mekelle, Ethiopia

[4]St. Paul's Hospital Millennium Medical College, Department of Epidemiology, Addis Ababa, Ethiopia

Corresponding author:

Abiyie Demelash Gashe

Email: abiyiedemelash@gmail.com

Cell phone: +251945142918

Addis Ababa, Ethiopia

Word count: Abstract (250) and main text (3972)

Abstract

Introduction: In response to the increasing incidence and prevalence of hypertension, Ethiopia has been piloting hypertension control at the primary healthcare level in selected sentinel sites. However, no evaluation has been conducted and its success and failures has not been ascertained. This study aimed to evaluate on whether sentinel hypertension surveillance system in Mojo City were operating efficiently and effectively.

Methods: A concurrently embedded mixed design (quantitative/qualitative) study was conducted in two sentinel health centers in Mojo city, Oromia region of Ethiopia. The usefulness and nine system attributes were assessed via key informant interviews, observations and record reviews. The qualitative data were analyzed manually via thematic analysis, whereas quantitative data were analyzed via SPSS Software version 25.0.

Results: The study invited 14 key informants, and all were willing to participate in the interview. The completeness and timeliness of reports were 98% and 100%, respectively. The sensitivity, positive predictive value and representativeness were 45.3%, 92.6% and 22%, respectively. Nearly three-fourths (71.4%) of key informants perceived system as flexible, while half thought it as unstable due to factors such as inadequate training and lack of supportive supervision and feedback system. Health facilities didn’t conduct routine data analysis and interpretation nor did they use for action.

Conclusion: The surveillance system in Mojo city was simple, flexible, acceptable and predictive but less sensitive, unrepresentative and unstable. There is a need for implementing routine data analysis and use for action, adequate training, and feedback system for optimizing the system's performance and to ensure its sustainability.

Keywords: Hypertension, Sentinel Surveillance, Public Health Surveillance, Noncommunicable Disease surveillance, Ethiopia

Abbreviations

BMI: Body Mass Index

BP: Blood Pressure

BSc: Bachelors of Science

DBP: Diastolic Blood Pressure

HMIS: Health Management Information System

LMICs: Low-and-middle income countries

NCD: Non-communicable Disease

PHEM: Public Health Emergency Management

PPV: Positive Predictive Value

SBP: Systolic Blood Pressure

WHO: World Health Organization

Introduction

Hypertension is the leading risk factor for cardiovascular diseases (CVDs) (1, 2). Approximately 1.28 billion adults aged 30 to 79 years have hypertension worldwide, with low-and middle-income countries (LMICs) bearing two-thirds of the global burden. Alarmingly, 46% of adults with

hypertension are unaware of their condition while only 42% received appropriate diagnosis and treatment. Furthermore, one in five hypertensive individuals have successfully controlled their blood pressure (BP) (3)

While global trends in hypertension have shown significant increases each year, the rise is disproportionately seen in LMICs especially in the African region (4, 5). By the end of 2021, the World Health Organization (WHO) of Africa exhibited the highest prevalence of hypertension (27%) compared to other regions (3). In sub-Saharan Africa (SSA), the prevalence has been reported as high as 48% (5).

Hypertension is among one of the rising non-communicable diseases (NCDs) (6-8) due to factors such as rapid urbanization, aging population as result of improved life expectancy, globalization of marketing and trade, and exposure to the social determinants of health (9, 10). The WHO estimated that the prevalence of hypertension in Ethiopia exceeds 20% and alarmingly increasing over time (11). Data from meta-analyses indicate that the prevalence of hypertension ranges from 9.3% to 30.3% in population-based studies, 7% to 37% in institution-based studies, and 13.2% to 18.8% in hospital-based studies (12). A substantial gap also exists in hypertension control in the country, with several hospital-based studies reporting BP control rates ranging from 26.4% to 52.5% (13-16).

Due to the rising incidence and prevalence of NCDs including hypertension, strengthening of the NCD surveillance system has become increasingly important. The WHO has emphasized the need for improved NCD surveillance systems to effectively tackle NCDs (17). Consequently, Ethiopia has made a significant shift in its approach to public health surveillance. For over three decades, the country implemented surveillance of epidemic-prone communicable diseases under public health emergency management system (PHEM) (18). However, country adopted its first NCD-inclusive PHEM guideline which included hypertension and diabetes mellitus by 2021 (19).

Additionally, to enhance hypertension prevention and control, the Federal Ministry of Health, in collaboration with the WHO and Resolve to Save Lives, initiated a hypertension control project at

the primary healthcare level including 74 health facilities and 200 health posts since 2019 (20). These facilities have been used as hypertension sentinel sites to facilitate early detection, timely response, and data-driven decision-making.

The target population for this surveillance system comprises adults aged 30 years and older. The major milestones of this initiative include screening 30% of the eligible population and achieving a 50% BP control. However, no evaluation has been conducted at either national or sub-national levels. Hence, evaluating this program is crucial to ascertain its success and failures, share lessons learnt, guide evidence-based decision-making, inform clinical practice and improve overall hypertension control. Therefore, this study aimed to evaluate on whether the sentinel hypertension surveillance systems in two health centers in Mojo City, Oromia region of Ethiopia are operating effectively and efficiently.

Methods

Study area

Mojo City is located in the East Shewa zone, Oromia region of Ethiopia at 74km distance from Addis Ababa, the capital city of Ethiopia. Based on Ethiopia's 2007 census data, the estimated population of Mojo City was 58,941, of which 51% were females. Adults' aged 30 years and older constitute 29% of total population. Mojo City has one primary hospital, two health centers, and two health posts. Mojo City is strategically located along the Ethio-Djibouti railway and was identified by the Ministry as one of the high NCD burden areas in the country.

Study design

This study employed a concurrently embedded a mixed-methods approach which combines both quantitative and qualitative data collection strategies at two sentinel sites in Mojo City such as Mojo and Haachaltu Gudina Health Centers, and their two administrative institutions such as the Mojo City health administration office and Oromia regional health Bearau from August 15–31, 2022. The

evaluation included the performances of these sites from September 1, 2021-July 30, 2022

Sampling procedures

We purposively included the only available two sentinel sites in Mojo City such as Mojo and Haachaltu Gudina Health Centers. Based on the phenomenon of interest, recommendations from qualitative studies, and practical considerations such as data and resource needs, 14 key informants were purposively selected based on predefined criteria's such as training, experience, education, and position they held.

We included and reviewed the central triage register of all adults ≥ 30 screened for hypertension to identify patients with the initial elevated BP. We included all actively followed hypertensive patients for BP control assessment. Also, we randomly took a convenient sample of 20 patients' records to assess data completeness and the agreement between cohort register, and surveillance reporting platforms. For sensitivity calculation, we compared the proportions of hypertensive cases captured by the surveillance system to those revealed by the survey findings. Lastly, we took all individuals having initial raised BP and later confirmed to truly have hypertension to determine positive predictive value (PPV).

Data collection procedures

We followed the Centers for Disease Control and Prevention's updated guidelines for evaluating public health surveillance systems to assess the usefulness and nine attributes of the surveillance system (21). Additionally, we adapted the standards for communicable disease surveillance and response systems evaluation to assess the core and supportive surveillance functions such as case detection, investigation and confirmation, communication and reporting, routine data analysis and interpretation, the availability of surveillance platforms, training, and supportive supervision and feedback system (22).

Data were collected using a semi-structured questionnaire through face-to-face interviews,

observations and record reviews. Simplicity, flexibility, stability, acceptability and usefulness were assessed via key informant interviews. A semi-structured interview guide was developed in English and translated into the local language, Oromifa. The interview guide was designed in a way that allowed free responses as well as choices from predefined categories, e.g., yes or no response option questions. After the informant consent was obtained from each key informant, the lead author conducted 14 face-to-face interviews. Interviews were audio recorded, notes were taken, and each interview lasted 15 to 30 minutes.

We assessed data analysis and interpretation practice, availability of surveillance guidelines and standards, supervision and feedback, and timeliness via observations. Using medical record reviews, hypertension screening and case detection, BP control, investigation and confirmation, Body Mass Index (BMI) screening, data quality, PPV, and representativeness were assessed. Both medical record reviews and observations were conducted by trained Bachelor of Science (BSc) degree nurses

Operational definitions

Usefulness: Refers the relevance of the surveillance system to detect diseases/injuries, estimate its magnitude, and assess the effects of prevention and control efforts (21)

Simplicity: Refers to the ease of the surveillance structures and the ease of operation.

Acceptability: Refers the willingness of surveillance personnel and organizations to participate in the surveillance system.

Timeliness: Reflects the speed between steps in a public health surveillance system.

Data quality: Refers completeness and validity of recorded data in the public health surveillance system.

Flexibility: Refers the ability of the surveillance system to adapt to changing information needs or operating conditions.

Representativeness*:* Refers the ability of surveillance system to describe the occurrence of health-related events over time and its distribution in the population by place and person.

Stability: Refers to the ability to collect, manage and provide data properly without failure, and the ability to be operational when needed.

Sensitivity: Refers the ability of the surveillance system accurately identify disease or condition under surveillance.

PPV: Refers to the proportion of reported cases that actually have the health-related event under surveillance (21).

Data quality control

Before the actual data collection, we discussed with key informants to ensure that the evaluation was able to address important questions and gather credible evidence. During each visit of data collection, we briefed participants on the purpose and objective of the evaluation, underscoring that it is not an individual performance evaluation. The entire data collection process was closely monitored by research supervisors and principal investigators.

Data analysis

The quantitative data were coded, cleaned, and analyzed via SPSS software version 25.0 while the qualitative data were analyzed via the following methods. First, we transcribed the audio-recorded data and carefully read the text to obtain a general sense of the content. Second, we identified condensed meaning units and developed an initial code books. Code books were designed in a way that they are flexible and devised when novel themes emerged. After the open coding, we created subcategories that merged codes with similar meanings, and subcategories were then combined to establish categories. The data were subsequently analyzed manually, narrated, and summarized via thematic analysis.

Ethical considerations

The study was approved by the Afar Public Health Institute, approval number APH/25/21. We also obtained a collaboration letter from Ethiopia’s Ministry of Health, Oromia’s Public Health Institute,

and Mojo City's Administration Health Office. Prior to commencement of interview, informed consent was obtained from the participant to ensure their understanding and agreement to the recording process. The data and all information were de-linked, de-identified, and anonymyzed for confidentiality. They were also kept in a secure file cabinet

Results

Study characteristics

The study invited 14 key informants for interviews, and all were willing to provide an interview. Of these key informants, four held master's degrees in public health, four were public health officers, and six were BSc degree nurses, of whom four were surveillance officers and two were facility heads (Table 1).

Description and operation of surveillance system

The hypertension surveillance system in the Mojo City is a multi-tiered framework involving

various healthcare providers and administrative personnel. Public health officers and BSc nurses are responsible for identifying and diagnosing hypertension, and initiating antihypertensive treatment. Health information technicians collect and report data, while the administrative staffs oversee data aggregation, analysis, and interpretation and use for action.

Based on the national clinical guidelines, surveillance system in Mojo City defines hypertension with a systolic blood pressure (SBP) of ≥ 140 mmHg and/or a diastolic blood pressure (DBP) of ≥ 90 mmHg in two consecutive visits. BP control is defined as achieving an SBP < 140 mmHg and a DBP of < 90 mmHg in two consecutive visits, with the specific targets of < 130/90 mmHg in patients having comorbidities such as diabetes, chronic kidney disease, and CVDs.

The surveillance system utilizes both electronic and paper-based reporting platforms to facilitate efficient data flow between healthcare providers and surveillance officers. The information flow follows a bottom-up approach, with data transmitted from health centers to the city health office and then to the regional health bureau (Figure 1).

Case detection

Between September 1, 2021, and July 30, 2022, a total of 3,760 adults aged 30 and older were screened for hypertension. Among those screened, 553 individuals (14.7%) were presented with raised BP, and 512 individuals (13.6%) were confirmed to have hypertension. Of the patients confirmed with hypertension, 76 (14.8%) patients were lost, while 436 (85.2%) were receiving anti-hypertensive treatment. Only 214 (49%) of patients who were on antihypertensive follow-up had achieved controlled BP.

Investigation and confirmation

A systematic approach was employed to confirm individuals with initially raised BP. Nurses and health officers oversee BP screening, and BP confirmation. All patients with raised BP were re-assessed for confirmation according to the national clinical guidelines. However, the initiation of

anti-hypertensive therapy lacked essential investigations. Specifically, only 50 (9.7%) of patients received a baseline renal panel despite this being a crucial step outlined in the national clinical guidelines. Moreover, BMI screening, another essential component of hypertension management was not systematically conducted for all patients, with only 132 (25.8%) of hypertensive patients undergoing this assessment.

Communication and reporting system

The surveillance system utilizes Health Management Information System (HMIS) framework of reporting diseases in Ethiopia. Health centers submit reports to Mojo city administration Health Office every 21st – 26th of each month. Similarly, Mojo city's administration Health Office subsequently compiled and sent to Oromia Regional Health Bureau within the same timeframe. The Oromia Regional Health Bureau further transmits reports to the Federal Ministry of Health within the same reporting schedule. This type of surveillance system was fully implemented throughout the year and maintained through both electronic and paper-based reporting system (Figure 1).

Data analysis and interpretation, action/response

Health facilities did not conduct routine data analysis, resulting in hypertension data that lacked specific information regarding time, place, and person characteristics. Additionally, there were no established action thresholds for the interpretation of data or for formulating appropriate responses.

Availability of surveillance guidelines, standards, and other resources

The surveillance system in the Mojo City ensured the continuous supply of essential surveillance forms, standards and guidelines. Both health facilities had sufficient back up store of tally sheets, intake forms, follow-up forms, referral forms, and cohort registers. However, health facilities had the shortage of appointment forms and tablets for SIMPLE App, a smart application designed for tracking patient follow-up.

Supervision, feedback, and training

Neither Ethiopia's Federal Ministry of Health nor the Oromia Regional Health Bureau provided written feedback regarding the performance of health facilities. Only 6 out of 14 key informants (42.9%) received hypertension training. Additionally, the heads of health facilities expressed concerns about inadequate training and backup staff to manage staff turnover and annual leave.

Usefulness

All 14 key informants (100%) indicated that the surveillance system was valuable, as its record-keeping capabilities documented data that highlighted the magnitude of hypertension in the area and helped them to integrate hypertension service at the community level involving community health extension workers.

One participant noted, *"I found the existing system immensely important because it helped us understand the extent of the hypertension problem in the area, evaluate our efforts in prevention and control, and improve chart keeping. I believe the lessons learned will be instrumental for further program expansion"* (Participant 5, Head of Health Care Site X)

Simplicity

All 14 key informants agreed that the current case definition was clear, easy to understand and apply, and that reporting platforms are user-friendly, requiring average completion time of 10-15 minutes. They noted that the route of information flow was clear and well delineated. They also reported that the SIMPLE-App is intuitive and required minimal/no training for data entry and updates

One participant stated *"... Without any reservation, in my view, the hypertension case definition is easy for me to understand and apply, and I am able to complete surveillance forms within a matter of 10 minutes. I am also clear with for whom to report, reporting period, and formats used for reporting"* (participant 9, surveillance officer from health care site Y)

Flexibility

Ten out of fourteen key informants (71%) thought that the current reporting form could be easily adapted to new health events, and that case definition of hypertension was flexible enough to accommodate changes. They system has previously experienced significant changes in case definition and its treatment targets, and that they did not face much difficulty in both aspects. This adjustment shifted the focus from individuals aged 18 and older to those aged 30 and older for BP screening, as well as updated BP control treatment targets of BP below 130/90 mmHg for hypertensive patients with diabetes, chronic kidney disease, and cardiovascular conditions.

One participant stated, *"I think we can modify the current case definition slightly to allow for other events. Moreover, I believe the current system can operate with varying funding sources, as it was once well established"* (Participant 3, Nurse at the Hypertension Screening Unit from Health Care Site X).

Timeliness

For all eleven months included in the evaluation, reports between each reporting units in the surveillance chain, specifically from health facilities to the Mojo City Administration Health Office, from the Mojo City Administration Health Office to the Oromia Regional Health Bureau, and from the Oromia Regional Health Bureau to the Federal Ministry of Health were submitted according to HMIS framework for reporting diseases in Ethiopia between the 21st and 26th of each month..

Data quality

Of the 20 patient medical records reviewed, 17 (85%) patient charts and follow-up forms were complete, neat, and filled in an easily understandable manner. The agreement between patient charts and cohort register was observed for all these patients. The completeness of the reports over the 11 months of review was 98%.

Acceptability

The active participation of surveillance staff in case detection, adherence to case definitions, and report completeness and timeliness demonstrated their full commitment to implementing the surveillance system. One participant expressed, *"I am very happy being the hypertension focal person at the health facility and part of this sentinel surveillance system. I am fully committed to hypertension screening and case detection, utilizing case definitions, and providing timely and complete surveillance reports"* (Participant 6, Hypertension Focal Person from Facility Y).

Representativeness

By screening 3,760 adults aged 30 and older from a corresponding target population of 17,000 inhabitants, the surveillance system reached 22% of the target population. The system identified 512 hypertensive patients, of whom 352 (69%) were reported from the Mojo Health Center, and 270 (52.9%) were females.

Stability

Half of the surveillance staff noted that restructuring during the down times of the computer system breakage did not affect the operation of surveillance system and that surveillance system was able to continue to collect, manage, and provide data properly without failure. However, the other half expressed concerns regarding the adequacy of trained backup staff and the program's dependency on a partner, citing insufficient input from local and regional governments.

One participant noted, *"There is a common practice in Ethiopia: programs supported by partners and external sources tend to be more effective, but the challenge arises when they are left to operate independently. Our system is similarly dependent on the partner; how could it continue if the partner withdraws support? I have serious concerns about its sustainability"* (Participant 2, Surveillance Officer from Administrative Institution B).

PPV and sensitivity

The BP screening and confirmation practices were taken to calculate PPV. Of the 553 patients with initially raised BP levels i.e SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg, 512 (92.6%) individuals truly had hypertension after reassessment (PPV). Similarly, to assess sensitivity, the study considered the proportion of hypertensive patients identified by the surveillance system (13.6%) compared to the survey findings (30%). Thus, the sensitivity of the surveillance system was 45.3%.

Discussion

We followed the Centers for Disease Control and Prevention's updated guidelines for evaluating public health surveillance systems to assess on whether the existing surveillance system in two sentinel health centers in Mojo City and their two administrative institutions operated effectively and efficiently.

While the surveillance system in Mojo City was fully operational throughout the year, it lacked regular supportive supervision and feedback mechanisms. There is need to institutionalize periodic evaluations enhance the system's functionality and foster a continuous improvement. Public health surveillance system should be periodically evaluated to provide scientifically sound and epidemiologically interpreted feedbacks for performance and for further its improvement (22, 23).

All surveillance staff expressed willingness to implement the system and noted that it was both useful and simple. Half perceived the surveillance system stable, while 75% thought that it was flexible; however, it was not sufficiently representative. Similarly, the performance of public health surveillance system in Dangila, Ethiopia, was found flexible and useful (24). Furthermore, a hypertension surveillance system evaluation conducted in Indonesia at two health centers and one administrative office reported an overall low stability, simplicity, acceptability, and data quality, but the researchers were unable to assess flexibility, sensitivity, representativeness, and timeliness (25). In one of the health center, PPV was 59.4% but with an overall low PPV. However, researchers relied on data collection, storage, and reporting to assess stability, rather than utilizing key informant interviews (25).

In this system, health centers collect data and report it to the Mojo City Health Office and the Oromia Regional Health Bureau. However, health facilities did not conduct routine data analysis or interpretation, nor did they use the information to inform action. Data collection necessitates analysis because the goal of surveillance is to utilize information for action, reduce morbidity and mortality, and to improve overall health (22, 23). If the collected data are not followed by regular analysis and

the application of information for action, it results in the mere consumption of resources (26).

Public health surveillance systems should operate in a manner that facilitates effective communication and dissemination of health and health-related data, enabling decision-makers at all levels to readily understand the implications of the information. Timeliness of reporting is a crucial factor for the effective communication and dissemination of health and health-related data. The report timeliness in the current surveillance system was 100%, which aligns with the Ethiopian national target of 95% (27) and the WHO target of 80% (28). Additionally, data completeness was 98%, consistent with the national target of over 95% for report completeness (27) and the WHO target of 80% (28).

The sensitivity and PPV of a surveillance system depend on the design of the case definition and its clarity among surveillance stakeholders (29). The surveillance system in Mojo City exhibited 45.3% sensitivity and a PPV of 92.6%. Our surveillance system in Mojo City is less sensitive than the hypertension surveillance system in Bogor City, Indonesia, which has a sensitivity of over 80% (30). However, the current surveillance system in Mojo City is more predictive when compared with other hypertension surveillance systems in Dangila, Ethiopia which has PPV of 11% (24) and Jombang District Health Office of the other city in Indonesia which has PPV of 59.4% (25).

Limitations of the study

The limitations of this evaluation are: First, the results may have been subject to potential social desirability bias, as surveillance stakeholders may have provided favorable responses. To mitigate this, we briefed them on the purpose and objectives of the evaluation at each visit before commencing data collection. Second, reliance on a convenience sample of 20 patients may not have provided a representative assessment of data validity. Third, this evaluation primarily relied on responses from key informant interviews rather than objective quantitative data collection, storage and reporting. Lastly, the availability of the limited data in the field led to insufficient understanding

of surveillance systems in similar contexts and a few of interpretations were made compared to surveillance systems in other country which may have structural and contextual difference with our surveillance system .

Conclusion

The sentinel hypertension surveillance system in Mojo demonstrated effective implementation throughout the year. The surveillance staff felt that it was helpful in determining the magnitude of hypertension in the area as well as for improving documentation and patient record keeping practices. It was found to be simple, flexible, acceptable, and have a higher PPV. The data quality and reporting timeliness were consistent with national and WHO surveillance standards. However, it was less sensitive, less representative and unstable.

The findings demonstrate a need for routine data analysis and interpretation, as well as a regular supportive supervision and feedback system. Efforts should also focus on community awareness creation activities to improve the surveillance's representativeness, along with staff training and capacity building to ensure its stability. Finally, if resources permit, scaling the system into a nationwide program could significantly enhance hypertension surveillance across Ethiopia.

What is already known on this topic?

- Hypertension is a leading CVDs risk factor globally, especially in LMICs including Ethiopia
- The WHO has emphasized the need for improved NCD surveillance systems to effectively monitor and manage conditions like hypertension.
- Though limited, prior hypertension surveillance system evaluations in other regions, such as Indonesia came with promising results but have documented challenges related to flexibility, sensitivity, representativeness, and timeliness

What this study adds?

- The sentinel hypertension surveillance system in Mojo City was useful, simple, flexible, and acceptable but less sensitive, less representative and unstable
- It highlighted the discrepancies in training, supervision and feedback, indicating a need for enhanced capacity-building efforts to ensure its sustainability.
- The findings suggest that the current surveillance system's structure is sound but requires routine data analysis and use for action for optimizing the system's performance

Acknowledgments

The authors would like to thank Ethiopian Field Epidemiology Training Program, Oromia Public Health Institute, Mojo City Administration Health Office, Mojo and Haachaltu Gudina health centers, health workers and data collectors.

Competing interest

We all authors declare the absence of any financial and non-financial related competing interests related to this article.

Authors' contributions

Abiyie Demelash conceived the research idea, designed and conducted the study, acquisition of data, analyzed the data, and drafted the article. Dawit Zenebe provided substantial contributions to the design of the study and drafted the article. Yeshiwas Ayale conducted an extensive manuscript review and structuring. Aman Yesuf provided substantial contributions to conception and design, or analysis and interpretation of data; and drafting the article or revising it critically for important intellectual content. All the authors have read and approved the final manuscript contributed to conception and design

References

1. Mensah GA, Roth GA, Fuster V. The global burden of cardiovascular diseases and risk factors: 2020 and beyond. Journal of the American College of Cardiology. 2019 Nov 19;74(20):2529-32.
2. Mills KT, Stefanescu A, He J. The global epidemiology of hypertension. Nature Reviews Nephrology. 2020 Apr;16(4):223-37.
3. World Health Organization (WHO). Hypertension. Key fact sheet. Available at: https://www.who.int/news-room/fact-sheets/detail/hypertension. Accessed date: August, 2021
4. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. The lancet. 2005 Jan 15;365(9455):217-23.
5. Zhou B, Carrillo-Larco RM, Danaei G, Riley LM, Paciorek CJ, Stevens GA et al. Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. The Lancet. 2021 Sep 11;398(10304):957-80.
6. Molla M. Systematic reviews of prevalence and associated factors of hypertension in Ethiopia: finding the evidence. Sci J Public Health. 2015 Jun 2;3(4):514-9.
7. Shiferaw F, Letebo M, Misganaw A, Feleke Y, Gelibo T, Getachew T et al. NCDs in Ethiopia: Disease burden, gaps in health care delivery and strategic directions. Ethiopian Journal of Health Development. 2018;32(3).
8. Misganaw A, Mariam DH, Ali A, Araya T. Epidemiology of major non-communicable diseases in Ethiopia: a systematic review. Journal of health, population, and nutrition. 2014 Mar;32(1):1.

9. Jung M, Jembere GB, Park YS, Muhwava W, Choi Y, Cho Y. The triple burden of communicable and non-communicable diseases and injuries on sex differences in life expectancy in Ethiopia. International journal for equity in health. 2021;20:1-13
10. Federal Democratic Republic of Ethiopia, Ministry of Health. National strategic action plan (NSAP) for prevention and control of noncommunicable diseases in Ethiopia, 2014-2016. https://www.iccp-portal.org/system/files/plans/ETH_B3_National%20Strategic%20Action%20Plan%20%28NSAP%29%20for%20Prevention%20and%20Control%20of%20Non-Communicable%20Diseases%20-%20Final.pdf
11. World Health Organization. Non-communicable diseases country profiles 2018.
12. Legese N, Tadiwos Y. Epidemiology of hypertension in Ethiopia: a systematic review. Integrated blood pressure control. 2020:135-43
13. Kebede B, Chelkeba L, Dessie B. Rate of blood pressure control and its determinants among adult hypertensive patients at Jimma University Medical Center, Ethiopia: Prospective cohort study. SAGE Open Medicine 2021; 9:1-10.
14. Horsa BA, Tadesse Y, Engidawork E. Assessment of hypertension control and factors associated with the control among hypertensive patients attending at Zewditu Memorial Hospital: a cross sectional study. BMC research notes. 2019;12:1-6.
15. Gebremichael GB, Berhe KK, Zemichael TM. Uncontrolled hypertension and associated factors among adult hypertensive patients in Ayder comprehensive specialized hospital, Tigray, Ethiopia, 2018. BMC cardiovascular disorders. 2019;19:1-10
16. Animut Y, Assefa AT, Lemma DG. Blood pressure control status and associated factors among adult hypertensive patients on outpatient follow-up at University of Gondar Referral Hospital, northwest Ethiopia: a retrospective follow-up study. Integrated blood pressure control. 2018:37-46.
17. WHO. Noncommunicable Disease Surveillance, Monitoring and Reporting. Surveillance of

noncommunicable diseases. Available at: https://www.who.int/teams/noncommunicable-diseases/surveillance. Accessed on 20 July 2021.

18. Ethiopian Health and Nutrition Research Institute. Public Health Emergency Management Centre. Public Health Emergency Management guidelines for Ethiopia. Addis Ababa, Ethiopia, 2012. Available at: https://www.medbox.org/document/public-health-emergency-management-guidelines-for-ethiopia-2012
19. Federal Democratic Republic of Ethiopia. Ethiopian Public Health Institute Public Health Emergency Management Center. Public Health Emergency Management Guideline for Ethiopia. Second Edition December 2022. Available at: https://eweb.ephi.gov.et/wp-content/uploads/2024/08/PHEM_Guideline_Second_Edition_2023.pdf
20. WHO regional office for Africa. Ethiopia sets to improve hypertension prevention and control at primary health care level, August 16, 2019. Available at: https://www.afro.who.int/news/ethiopia-sets-improve-hypertension-prevention-and-control-primary-health-care-level
21. Centers for Disease Control and Prevention (CDC). Updated Guidelines for Evaluating Public Health Surveillance Systems. Recommendations from the Guidelines Working Group. July 27, 2001 / 50(RR13);1-35.Available at:

https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5013a1.htm. Accessed date: July, 2021

22. WHO. Communicable disease surveillance and response systems. Guide to monitoring and evaluating. Epidemic and pandemic alert and response. WHO (2006). Available at:

https://iris.who.int/bitstream/handle/10665/69331/WHO_CDS_EPR_LYO_2006_2_eng.pdf. Accessed date; August, 2021

23. Langmuir AD. The surveillance of communicable diseases of national importance. New England Journal Medicine 1963; 268(4):182-92.
24. Alemu T, Gutema H, Legesse S, Nigussie T, Yenew Y, Gashe K. Evaluation of public health

surveillance system performance in Dangila district, Northwest Ethiopia: a concurrent embedded mixed quantitative/qualitative facility-based cross-sectional study. BMC Public Health. 2019;19:1-9.

25. Lestari D. Evaluation of monitoring hypertension case based on nine surveillance attributes in Jombang District Health Office in 2018.
26. Foege WH, Hogan RC, Newton LH. Surveillance projects for selected diseases. International journal of epidemiology. 1976;5(1):29-37.
27. The Federal Democratic Republic of Ethiopia, Ministry of Health. Health Sector Transformation Plan 2015/16–2019/20. https://www.globalfinancingfacility.org/sites/gff_new/files/Ethiopia-health-system-transformation-plan.pdf. Accessed March 21, 2021
28. World Health Organization. Technical guideline for integrated disease surveillance and response in African region. WHO regional office for Africa: third edition, March 2019. Available at https://www.afro.who.int/publications/technical-guidelines-integrated-disease-surveillance-and-response-african-region-third eight and nine. Accessed April 5, 2021
29. PennState Eberly College of science. Epidemiological research methods: case definition. https://online.stat.psu.edu/stat507/lesson/2/2.1. Accessed July 8, 2021
30. Amalia D, Kusnadi B, Bantas K. The evaluation of hypertension surveillance system based on primary health care in Bogor City, Indonesia: The 8th National Scientific Conference on Epidemiology. https://www.researchgate.net/publication/337293267_The_Evaluation_of_Hypertension_Surveillance_System_Based_on_Primary_Health_Care_in_Bogor_City_2018. Accessed June 1, 2021

Table

Table 1: Key informant characteristics: Evaluation of a sentinel hypertension surveillance system in Mojo city, Eastern Shewa, Oromia, Ethiopia, 2022

Key Informant Characteristics	Frequency	Percent

Title/Degree		
Master of Public Health (MPH)	4	28.6%
Public Health Officer	4	28.6%
Bachelors of Science degree nurses	6	42.8%
Location		
Mojo Health Center	5	35.7%
Haachaltu Gudina Health Center	5	35.7%
Mojo City Health Office	2	14.3%
Oromia Regional Health Bureau	2	14.3%
Work position		
Hypertension screening unit	2	14.3%
Hypertension focal persons	4	28.6%
Surveillance officers	4	28.6%
Data Management	2	14.3%
Facility heads	2	14.3%
Hypertension training		
Trained for hypertension	6	42.9%
Untrained for hypertension	8	57.1%
Work Experience		
Junior level (< 2 years)	2	14.3%
Intermediate level (2- < 5years)	4	28.6%
Senior level (≥ 5 years)	8	57.1%

Figure

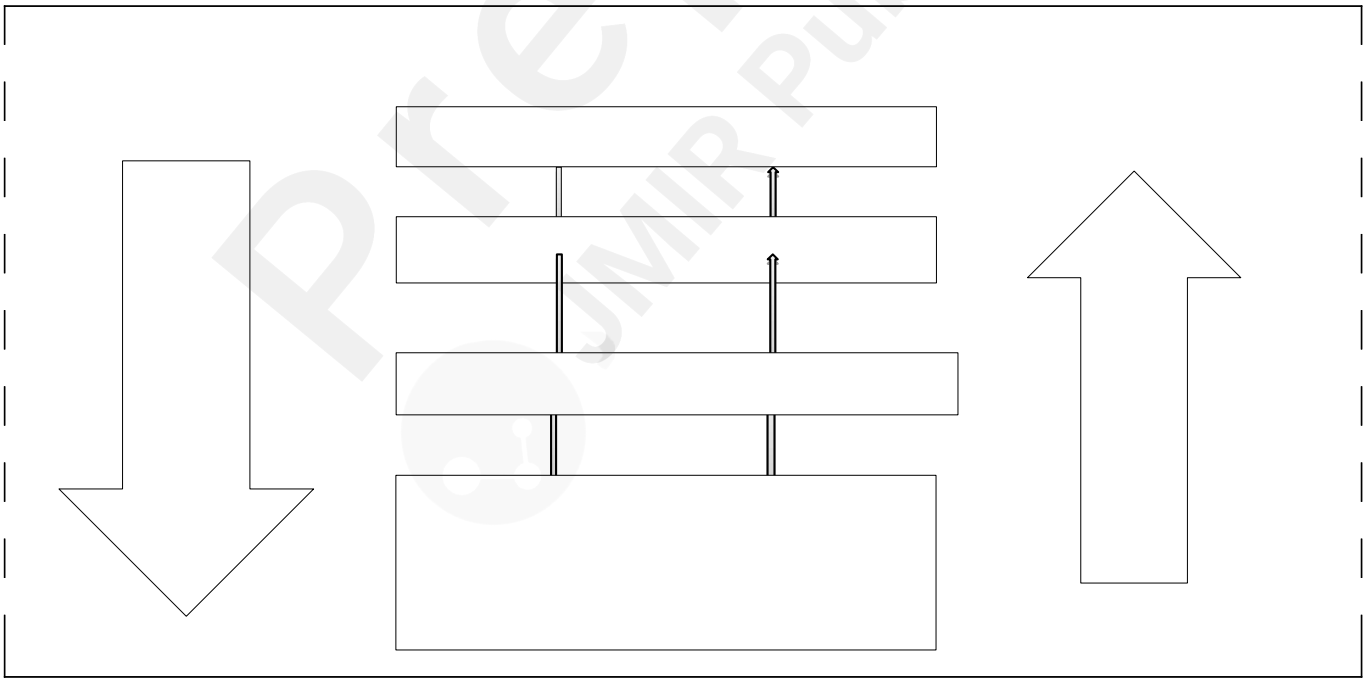

Figure 1: The information flow and reporting scheme for a sentinel hypertension surveillance system in Mojo city, Eastern Shewa, Oromia, Ethiopia, 2022

Supplementary Files