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Evaluation of the Maternal Death Surveillance and Response System in Eastern Province, Rwanda: A Cross-Sectional Surveillance System Assessment, 2021–2025

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Research Article

Keywords: maternal death surveillance, MDSR, Rwanda, surveillance evaluation, maternal health

Posted Date: August 20th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10451376/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

Maternal mortality remains a significant public health challenge in Rwanda, with most deaths considered preventable. The Maternal Death Surveillance and Response (MDSR) system was established to improve identification, review, and response to maternal deaths; however, its performance in Eastern Province has not been formally evaluated. Therefore, this study aimed to evaluate the performance and implementation of the maternal death surveillance and response system in Eastern Province, Rwanda

Methods

A descriptive cross-sectional evaluation with retrospective record review was conducted from 2021 to 2025 in six hospitals and twelve health centers of Eastern Province, 136 healthcare workers involved in the MDSR system were included using a census sampling method. Data were collected using structured questionnaires adapted from CDC surveillance evaluation guidelines, record reviews, and extraction of maternal death data from HMIS and SISCOM databases. Data were entered and analyzed using Microsoft Excel and presented using tables, frequencies, and percentages. Surveillance attributes and core functions were assessed and categorized as poor (≤ 50%), fair (51–79%), or good (≥ 80%).

Results

A total of 97 maternal deaths were reported during the study period. Maternal deaths declined from 36 cases in 2021–2022 to 13 cases in 2024–2025, representing a 64% reduction. Most deaths occurred in hospitals (72%) and communities (21%). The system performed well in data quality, case detection, data management, and analysis (all 100%), with notification at 93%. Usefulness (86%), flexibility (81%), and simplicity (80%) were rated good, while acceptability (76%), timeliness (71%), and representativeness (74%) were fair. Stability was lowest (59.8%). Response implementation was moderate (79%).

Conclusion

The MDSR system in Eastern Province is functional and demonstrates strong performance in several surveillance attributes and core functions. The reduction in maternal deaths observed during the evaluation period suggests progress in maternal health surveillance and response. However, improvements are needed in system stability, representativeness, and implementation of response actions to further strengthen system effectiveness.

Introduction

Maternal mortality refers to the death of a woman while pregnant, or within 42 days of pregnancy termination, irrespective of the duration and site of the pregnancy, from any cause related to, or aggravated by the pregnancy or its management, excluding accidental or incidental causes(1). It remains one of the most critical indicators of health system performance and social equity globally. In 2023, the World Health Organization (WHO) estimated that approximately 260,000 women died due to pregnancy- or birth-related complications, with over 90% of these deaths occurring in low- and middle-income countries(2).

Furthermore, surveys conducted in 103 low- and middle-income countries show that 85% had a national policy of maternal case review and use some form to monitor progress(3). However, many countries implement only partial surveillance-response cycles, limiting effectiveness(4, 5).

Sub-Saharan Africa bears a disproportionate share, accounting for 70% of global maternal deaths(6). The vast majority of maternal deaths are preventable through timely identification, skilled care, and coordinated health system response(2).

Evaluation of the maternal mortality surveillance system conducted in Gambia showed the surveillance system was not effective due to poor data completeness and quality. However, most of the other surveillance attributes were reported as fairly(7). In addition, evaluation of maternal surveillance and response conducted in Sierra Leone shown that the system was partially meet its objectives. Similarly, study in Ghana reported a functional system with room to improve data sharing and feedback mechanisms(8). Furthermore evaluation in Ethiopia identified deficiencies in timeliness, accuracy, and use of surveillance data for decision-making(9).

In Rwanda the maternal death audits started in 2008 and extended to Maternal Death Surveillance and Response (MDSR) following publication of National Technical Guideline with the aim of identifying all maternal deaths that happen in the either at health facility level, or at the community level and use WHO guide line for its implementation in 2014(4, 8). However, the other types of deaths like perinatal and child death were conducted without any guidelines. In 2019, a combined guideline for maternal, perinatal, and child death surveillance and response was developed with the aim of providing a systematic and standardized approach to conducting real-time death reviews, identifying causes of death, determining preventable cases, and implementing actionable recommendations to prevent future avoidable deaths(1, 10, 11).

Rwanda's has made achievements in reducing maternal mortality ratio to 105 per 100,000 live births in 2023(12). However, it still above the SDG target of 70 per 100,000, and an estimated 72% of maternal deaths are still preventable(13). Achieving this target requires not only a functioning surveillance system that counts deaths, but one that effectively analyzes causes, disseminates findings, and drives actionable improvements in care quality.

Despite progress reduction of maternal death and establishment of Rwanda's national MDSR progress, no formal evaluation of the maternal death surveillance component had been conducted in Eastern

Province, leaving facility-level performance gaps uncharacterized.

This study aimed to evaluate the performance of the maternal death surveillance and response system in Eastern Province, Rwanda, assessing its core functions, system attributes, and the epidemiological distribution of maternal deaths from 2021 to 2025, in order to identify strengths and gaps in the system, inform evidence-based improvements in maternal death surveillance and response activities, and support efforts to reduce preventable maternal deaths and improve maternal health outcomes in the province.

Methods

Study Setting

The study was conducted in Eastern Province, Rwanda, which has a population of approximately 3,563,145 and is served by 10 hospitals and 120 health centers that provide maternal services across 7 districts. Each hospital has MPCDSR Committee made by 12 members at the hospital level and 4 members at the health centers responsible for conducting Maternal death reviews(14).

The Maternal Death Surveillance and Response (MDSR) system is implemented from the central level down to the community level. When a maternal death occurs in a health facility, immediate notification is made through the Integrated Disease Surveillance and Response (IDSR) system using the standard reporting form. Members of the Maternal, Perinatal, and Child Death Surveillance and Response (MPCDSR) committee conduct a review within three days to identify avoidable causes of death and develop an action plan, which is subsequently communicated to the relevant staff. When a maternal death occurs in the community, notification is carried out by community health workers (CHWs) using a standard notification form, which is submitted to the health center. The health center then reports the case through the surveillance system. The summarized of system is described on the follow chart below (Fig. 1)

Study Design

A descriptive cross-sectional evaluation with retrospective record review and prospective data collection through interviews with staff involved in the MPDSR Committee was conducted from 2021 to 2025 in six hospitals and twelve health centers of Eastern Province, Rwanda. The CDC guideline was applied to assess the effectiveness of the surveillance system(15).

Study population

The study included all members of the Maternal, Perinatal and Child Surveillance and Response (MPDSR) committees at hospital and health center levels, comprising medical doctors, midwives, and nurses with varying experience and roles in maternal death surveillance and response system.

Demographic, attributes, and core function data were collected to provide context and ensure a representative assessment of the workforce implementing MDSR activities.

Sample size

Six hospitals were randomly selected. For each hospital, two associated health centers were purposively selected: one with a high mortality rate and the other with a low mortality rate. In addition, all 12 members of the Maternal, Perinatal, and Child Death Surveillance and Response (MPCDSR) committee from each selected hospital were included, as well as four committee members from each selected health center. Furthermore, data from piloting that involved 16 health workers were used in the final survey.

Sampling

Six hospitals were randomly selected from the ten hospitals in Eastern Province. Two health centers were purposively selected for each hospital one with a high maternal mortality rate and one with a low rate were selected resulting in a total of 12 health centers, in order to capture variation in maternal mortality burden. All MPCDSR committee members at the selected facilities were eligible to participate in the study.

Inclusion and exclusion criteria

This Study included participants who were directly involved in maternal surveillance and response system and exclude those ones who were neither consent nor involved in this surveillance system

Pilot study

A pilot study was conducted among 16 participants from one hospital and its affiliated health centres that were not included in the main study. The pilot study was undertaken to assess the clarity, relevance, and consistency of the questionnaire, and the findings were used to refine the data collection tool before the actual study.

Data Collection Instrument

A structured questionnaire was specifically designed for this study using the updated Centers for Disease Control and Prevention (CDC) Guidelines for Evaluating Public Health Surveillance Systems as the guiding framework and was administered electronically through Kobo Toolbox(5). The questionnaire collected information on participants' demographic characteristics, surveillance system attributes, and the operational performance of the maternal surveillance and response system. It was developed by the researcher solely for the purposes of this study and was not adapted from any previously published

instrument. The complete English version of the questionnaire is included as Additional file 1. In addition, document review was conducted to supplement questionnaire findings by assessing timeliness, data quality, selected components of usefulness, and the core functions of the surveillance system.

Scoring

Likert scales and binary answers were used to capture response. Performance was classified into three categories based on percentage scores: poor (≤ 50%), fair (51–79%), and good (≥ 80%). For each attribute or core function, a composite performance score was computed by taking the mean of the percentage scores of all corresponding indicators within that domain(7).

$$\textbf{\% of attributes score} = \frac{\textit{Sum of all percentage obtained from all indicators of each attributes/ core function}}{\textit{Number of indicators of each attribute}}$$

Data Analysis

Data were cleaned, and exported for analysis using Microsoft excel. Descriptive statistics were used to summarize the data, including frequencies, percentages, and trends. Surveillance system attributes and core functions were scored according to CDC guidelines. Results were presented using tables, charts, and graphs to describe the distribution of maternal deaths by person, place, and time.

Ethical Considerations

The protocol was submitted to the University of Rwanda, College of Medicine and Health Sciences, Institutional Review Board (IRB) (Ref: CMHS/IRB/755/2025) for ethical clearance. Informed consent was obtained both from the hospitals, Health centers, and members of MPCDSR who were participate in this evaluation. All personal identifiers were excluded from datasets, and digital files were stored on password-protected systems accessible only to the research team. All methods were performed in accordance with the relevant guidelines and regulations.

Results

A total of 136 healthcare workers involved in the Maternal Death Surveillance and Response (MDSR) system across the Eastern Province participated in this evaluation. The detailed socio-demographic characteristics of the respondents are summarized in Table 1 below:

Table 1
Socio-Demographic Characteristics of Study Participants (n = 136)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Female	47	34.6
	Male	89	65.4
Age (years)	20–29	24	17.6
	30–39	74	54.4
	40–49	28	20.6
	50 and above	10	7.4
Education Level	Advanced Diploma	35	25.7
	Bachelor Degree	87	64
	Post Graduate	14	10.3
Working Experience	< 1 year	5	3.7
	1–2 year	21	15.4
	> 2 years	110	80.9
Type of Health Facility	Hospital	42	30.9
	Health center	94	69.10
Role in MPCDSR	Chair Person	8	5.8
	Secretary	8	5.8
	Member	120	88.2

Epidemiology of Maternal Deaths in Eastern Province from 2021–2025 fiscal year

Overall, Burden

A total of 97 maternal deaths were recorded across Eastern Province during the four-year evaluation period. Although the number of maternal deaths was relatively low, it represents a critically important burden of maternal mortality.

The figure above illustrating the number of Maternal Deaths across six (6) healthcare facilities reveals a significant geographic and institutional variation in maternal outcomes. Rwamagana Level II Teaching Hospital (L2TH) recorded the highest number of maternal deaths (n = 21), followed closely by

Rwinkwavu District Hospital (DH) (n = 19). These figures are notably higher than those reported at Gahini DH, which recorded the lowest number of deaths (n = 9) among the listed facilities.

Place of Maternal death in eastern Province, Rwanda

Figure above shows the Hospitals accounted for the majority of maternal deaths (72%), followed by community settings (21%), health centers (7%), and none in private facilities.

Trend of Maternal Death in Eastern Province

The Fig. 5 demonstrates a significant decline in maternal deaths over four consecutive periods, decreasing from 36 deaths in 2021–2022 to 13 in 2024–2025, representing a 64% reduction. The consistent downward trend across all periods indicates sustained improvement in maternal health outcomes.

Surveillance System Attributes

Table 2
Attributes of the surveillance system in Eastern province from 2021 to 2025 fiscal year

Attribute	Indicator	Total (n)	Frequency (n)	Percentage (%)	Overall Score
Usefulness	MDSR data used for decision-making	136	109	81.0	87%
	MDSR data improved maternal health interventions	136	115	85.0	
	MDSR data shared with stakeholders	136	96	71.0	
	MDSR contributed to reducing maternal deaths	136	113	83.5	
	Facilities implementing MDSR recommendations	11	11	100.0	
	Facilities sharing MPDSR reports with staff	11	11	100.0	
Data Quality	Complete maternal death report forms	97	97	100.0	100%
	Maternal records correctly recorded in HMIS	97	97	100.0	
Timeliness	Maternal deaths reported within required timeframe	97	41	42.0	71%
	Maternal surveillance reports submitted on time	97	97	100.0	
Simplicity	System objectives easy to understand	101	94	93.1	80.1%
	Maternal death case definitions are clear	136	121	89.2	
	Reporting forms not time-consuming	42	28	66.7	
	Reporting mechanism easy to implement	35	25	71.4	
Stability	Reporting tools consistently available	136	113	83.5	59.8%
	Review meetings conducted regularly	136	89	59.0	
	Technical problems rarely affect the system	32	11	34.4	

Attribute	Indicator	Total (n)	Frequency (n)	Percentage (%)	Overall Score
	Technical support available when needed	32	20	62.5	
Flexibility	System allows modifications	33	30	90.9	80.8%
	Minimal retraining needed after changes	33	23	69.7	
	Reporting tools modified without disruption	33	27	81.8	
Acceptability	Maternal surveillance system suitable for use	136	85	63.3	73.4%
	Maternal reporting methods are applicable	136	113	83.5	
Representativeness	Data reflect all geographic areas	54	44	81.5	74.2%
	Deaths reported consistently every month	139	133	95.7	
	Private facility deaths captured in MPDSR	139	63	45.3	

The Table 2 above shows surveillance system attributes that demonstrated strong overall performance, with good scores for usefulness (87%), simplicity (80.1%), and flexibility (80.81%), and data quality (100%). Fair performance was observed in acceptability (73.38%), timeliness (71%), representativeness (74.16%), and stability (59.83%). suggesting some gaps in users' participation and data coverage. lowest stability highlighting the need for strengthening system reliability and sustainability.

Core Functions of perinatal Surveillance system

Table 3
Core Function of the Surveillance system in Eastern province from 2021 to 2025

Core Function	Indicator	Frequency (n)	Total(n)	Score (%)
Case Detection	Maternal deaths detected / all maternal deaths in registers	97	97	100%
Notification	Maternal deaths notified/detected maternal cases	90	97	93%
Data Collection & Management	Maternal deaths with complete data / total notified	90	90	100%
Analysis and Interpretation	Maternal deaths analyzed / total maternal deaths detected	97	97	100%
Response and Action	Maternal deaths with documented actions / total reviewed	38	48	79%

The Table 3 above show the core function of maternal death surveillance and response system across different variables. The system is good for Case detection (100%), notification (93%), Data collection and management (100%), and analysis and interpretation (100%). However, provision of feedback and action after analysis was fair (79%). This indicates a gap in the implementation of recommendations

Discussion

This evaluation demonstrates that the maternal death surveillance and response system in Eastern Province is functional, well-structured, and observed 64% decline in maternal deaths over four fiscal years. The system's core surveillance functions detection, notification, data management, and analysis are ranked as good which is a significant achievement in a resource-limited setting and compares favorably with evaluations from other African countries.

The progressive reduction in maternal deaths from 2021–2022 to 2024–2025 reflects the impact of sustained MDSR implementation and this aligned with Rwanda health sector strategic plan V (HSSPV) of reducing the maternal mortality ratio from 105 per 100,000 live births in 2024 to 60 per 100,000 in 2029(12). Geographic variation persists, with Rwamagana L2TH and Rwinkwavu DH accounting for 41% of all maternal deaths in the province. These facilities may have insufficient healthcare providers relative to the high patient burden with high number of delivery mothers, but their disproportionate burden warrants targeted quality improvement interventions.

The 21% of maternal deaths occurring in community settings highlights ongoing challenges in accessing/delay facility-based care. This mirrors patterns reported across sub-Saharan Africa where late referral and barriers to transport remain major contributors to avoidable maternal deaths(16).

Attributes and core function of system

The findings of this evaluation demonstrate that the Maternal Death Surveillance and Response (MDSR) system in Eastern Province, Rwanda performs substantially better across most surveillance attributes compared to similar systems in the region. In the present study, usefulness (87%), simplicity (80.1%), flexibility (80.8%), and timeliness (71%) were rated good to fair, with representativeness (74.2%) and stability (59.8%) showing moderate performance. In contrast, the evaluation conducted of the Maternal Mortality Surveillance System, The Gambia, 2022 reported lower scores across comparable attributes, including usefulness (82%), flexibility (60%), timeliness (50%), representativeness (55%), and stability (68%), with particularly poor data quality and completeness (37%). The higher performance observed in Rwanda especially in usefulness, simplicity, flexibility, and timeliness suggests a more mature and better-integrated surveillance system, likely reflecting stronger institutionalization of MDSR processes, regular committee functionality, and effective use of multiple reporting platforms. However, Rwanda's stability (59.83%) remains comparable to that reported in The Gambia (68%), indicating that system sustainability challenges, including technical constraints, are common across settings. Furthermore, while Rwanda achieved excellent data quality (100%), the markedly low data completeness reported in The Gambia highlights critical gaps in data management systems that can undermine surveillance effectiveness. Overall, these comparisons indicate that although Rwanda's MDSR system demonstrates stronger overall performance, particularly in core functional attributes, persistent challenges in stability and representativeness mirror those observed in other sub-Saharan African contexts, underscoring the need for continued system strengthening, especially in ensuring consistent operation and broader data capture across all sectors(7).

The surveillance system shows strong performance in data collection and management (100%) and case detection (100%), notification (93%), and analysis and interpretation (100%), indicating effective case identification and standardized reporting.

feedback and action (79%) remain fair, suggesting that 21% of all maternal death happened their reviewed recommendations and actions from MPCDSR committee were not communicated to the concerned stakeholders. In addition, there were no available feedback and action from national MPCDSR committee to the hospital committee found during the study. These findings are consistent with WHO and CDC reports, which highlight strong data generation but suboptimal data use in many surveillance systems. Strengthening analytical skills, feedback mechanisms, and response structures is essential to improve system effectiveness(17, 18).

Strengths and Limitations

This evaluation used multiple data sources, committee interviews, facility records, HMIS, SISCOM, enhancing triangulation and data validity. Standardized CDC surveillance evaluation criteria were applied, strengthening methodological rigor and comparability with international evaluations. Limitations include the exclusion of private facilities from the evaluation sample, potentially underestimating system gaps. Self-reported data may introduce social desirability bias. The cross-sectional design limits causal inference, and the absence of civil registration data precluded sensitivity and positive predictive value calculations.

Conclusion

The maternal death surveillance and response system in Eastern Province, Rwanda, is functional and demonstrates strong core performance. All 97 maternal deaths recorded between 2021 and 2025 were detected, 93% were formally notified, 100% were analyzed and reviewed, and there is observed 64% of reduction in maternal deaths over four years from 2021 to 2025 fiscal years. These are significant achievements that reflect Rwanda's commitment to maternal health and the effectiveness of its MDSR framework. Key areas for improvement include strengthening response and action follow-through, improving timeliness, addressing system stability challenges. Addressing these gaps will be essential for Rwanda to sustain its downward trajectory in maternal mortality and achieve its SDG target of less than 70 maternal deaths per 100,000 live births by 2030.

Declarations

Authors' contributions

BI conceived and designed the study, developed the study protocol, coordinated data collection, performed data analysis, interpreted the findings, and drafted the manuscript. KMJ contributed to study design, supervised the research process, reviewed the methodology, and critically revised the manuscript. IGIHOZO HIRWA Emmerance contributed to study design, supervised the research process, reviewed the methodology, and critically revised the manuscript. YMR and UE contributed to data analysis, interpretation of findings, and critical revision of the manuscript for important intellectual content. NJC provided technical guidance throughout the study, supervised the research activities, contributed to interpretation of findings, and critically reviewed the manuscript. NS, UV and NJ critically reviewed the manuscript and provided valuable comments and suggestions for important intellectual content. All authors read and approved the final version of the manuscript.

Ethics approval and consent to participate

Ethical approval was obtained from the University of Rwanda College of Medicine and Health Sciences Institutional Review Board (Ref: CMHS/IRB/755/2025). Written informed consent was obtained from both hospital and all participants prior to data collection. Participation was voluntary and confidentiality was maintained throughout the study.

Consent for Publication

Not applicable.

Competing Interests

The authors declare that they have no competing interests.

Funding

This study was supported by Field Epidemiology training program from University of Rwanda for data collection. The funder had no role in study design, data collection, analysis, interpretation, or manuscript preparation.

Availability of Data and Materials

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Acknowledgements

The authors express their sincere gratitude to the University of Rwanda, College of Medicine and Health Sciences, for academic guidance and technical support throughout this study. We acknowledge the Eastern Province health authorities, participating hospitals and health centers, and all members of the Maternal, Perinatal and Child Death Surveillance and Response committees who participated in this evaluation. We also thank the data collectors and supervisors for their commitment during data collection and validation.

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Figures

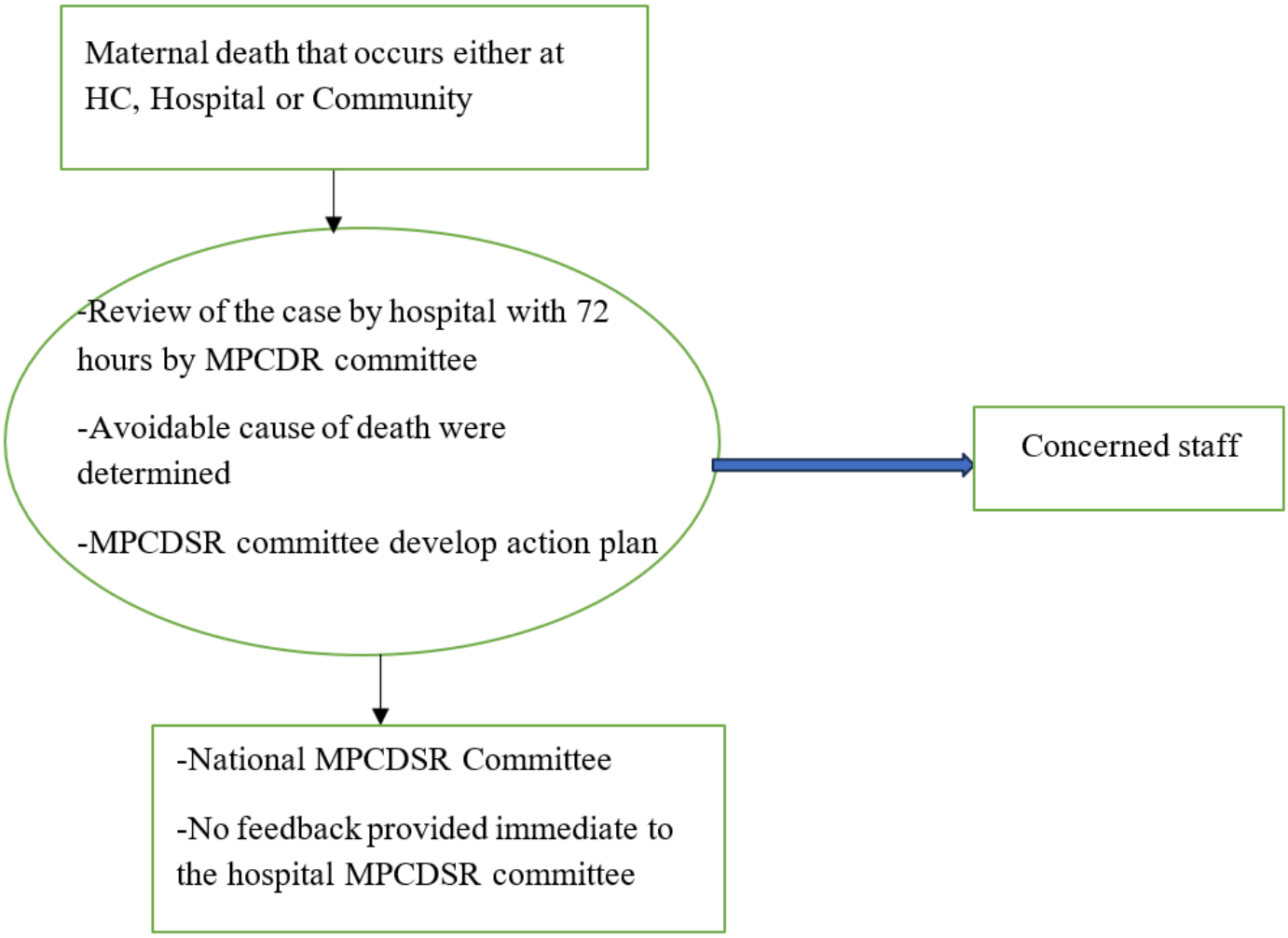

Figure 1

MDSR system in Eastern province 2021-2025

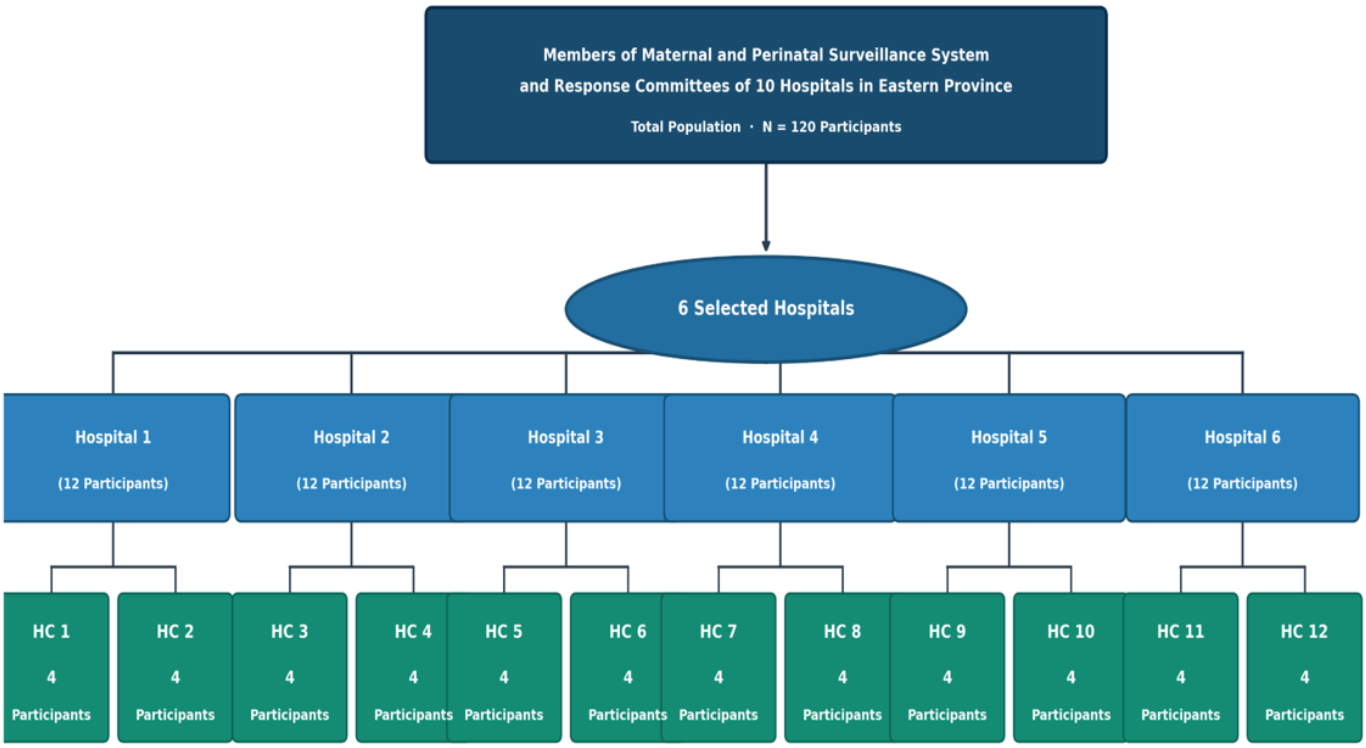

Figure 2

Sampling Procedure for MPDSR Committee Participants in Selected Health Facilities, Eastern Province, Rwanda

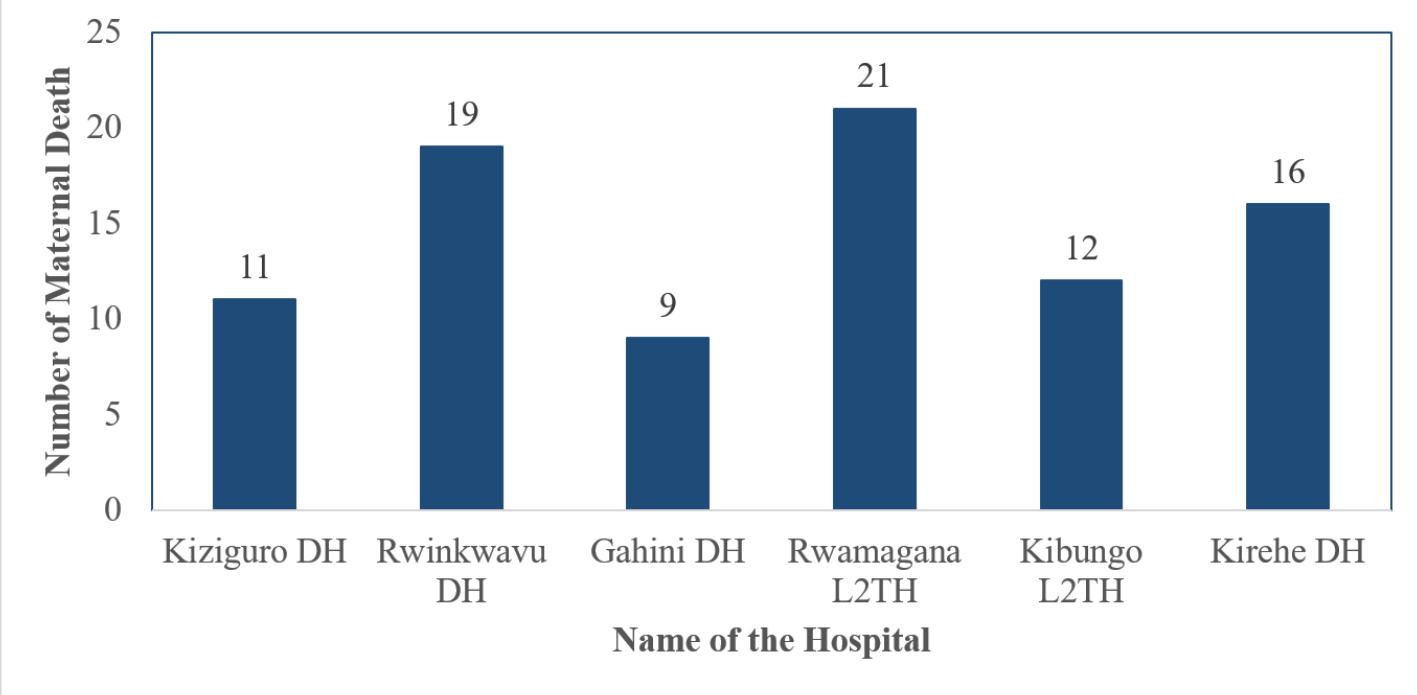

Figure 3

Distribution of maternal deaths by hospitals and their Catchment area in Eastern province from 2021 to 2025

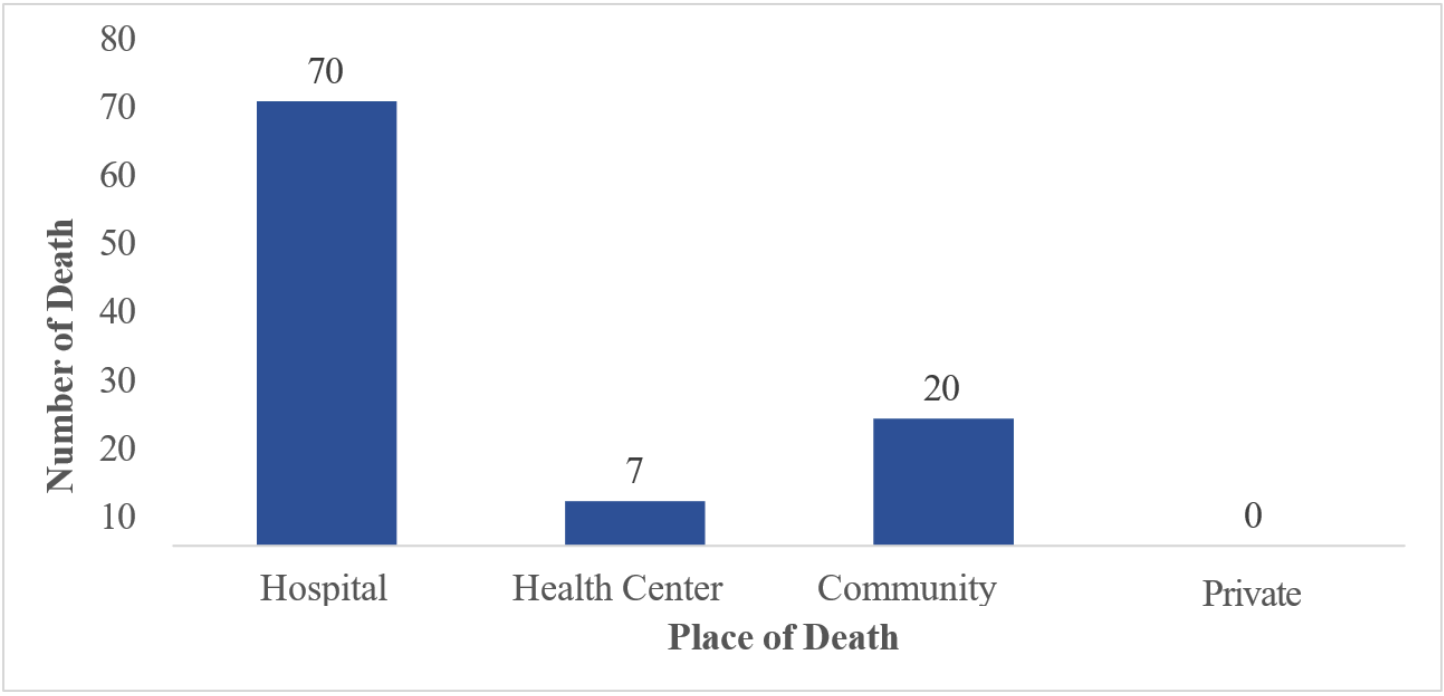

Figure 4

Distribution of Maternal Deaths by Place of Occurrence in Eastern Province, 2021–2025”

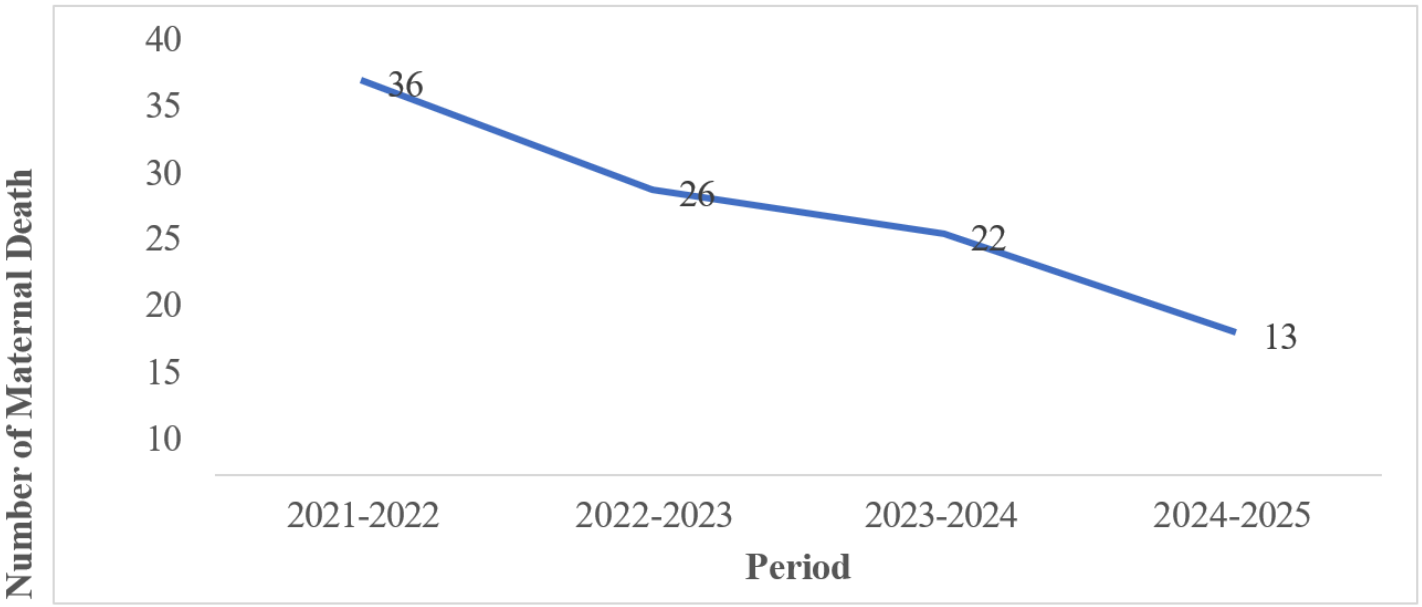

Figure 5

Trend of Maternal Death in Eastern province from 2021 to 2025 fiscal year

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- QuestionnaireforMDSR.docx