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Causes of maternal deaths in Sierra Leone from 2016 to 2019: analysis of districts' maternal death surveillance and response data

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ABSTRACT

Introduction Sierra Leone is among the top countries with the highest maternal mortality rates. Although progress has been made in reducing maternal mortality, challenges remain, including limited access to skilled care and regional disparities in accessing quality care. This paper presents the first comprehensive analysis of the burden of different causes of maternal deaths reported in the Maternal Death Surveillance and Response (MDSR) system at the district level from 2016 to 2019.

Methods The MDSR data are accessed from the Ministry of Health and Sanitation, and the secondary data analysis was done to determine the causes of maternal death in Sierra Leone. The proportions of each leading cause of maternal deaths were estimated by districts. A subgroup analysis of the selected causes of death was also performed.

Results Overall, obstetric haemorrhage was the leading cause of maternal death (39.4%), followed by hypertensive disorders (15.8%) and pregnancy-related infections (10.1%). Within obstetric haemorrhage, postpartum haemorrhage was the leading cause in each district. The burden of death due to obstetric haemorrhage slightly increased over the study period, while hypertensive disorders showed a slightly decreasing trend. Disparities were found among districts for all causes of maternal death, but no clear geographical pattern emerged. Non-obstetric complications were reported in 11.5% of cases.

Conclusion The MDSR database provides an opportunity for shared learning and can be used to improve the quality of maternal health services. To improve the accuracy and availability of data, under-reporting must be addressed, and frontline community staff must be trained to accurately capture and report death events.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Employed comprehensive national Maternal Death Surveillance and Response (MDSR) data, ensuring a wide-ranging analysis of maternal deaths in Sierra Leone.
⇒ Used district-wise segregation of data for targeted regional insights into maternal mortality trends.
⇒ Faced significant under-reporting in the MDSR system, with about 76% of deaths potentially unrecorded in 2016–2017.
⇒ The retrospective nature of the data may limit the ability to capture all relevant factors influencing maternal mortality.
⇒ Reliance on existing reports and records could introduce bias if reporting practices varied across districts.

INTRODUCTION

The United Nations estimates suggest that life expectancy at birth in Sierra Leone is 60 years.[1] It remains among the top countries having the highest maternal mortality rate, and the lifetime risk of maternal death is 1 in 52.[2] The 2019 national survey data of Sierra Leone reported the maternal mortality ratio (MMR) of 717 per 100 000 live births, and the pregnancy-related mortality ratio was 796 per 100 000 live births.[3] However, the global data on trends of MMR showed decreasing MMR trends (443 per 100 000 live births in 2020 compared with 2480 per 100 000 live births in 2000) in Sierra Leone from 2000 to 2020.[2]

Sierra Leone has made strides in improving maternal health as part of its commitment to the Sustainable Development Goals, notably through enhancing healthcare access and community education.[4] However, challenges such as limited resources and cultural barriers continue to impede further progress in this critical area.[4 5] In previous years, the government of Sierra Leone, with the support of international partners, had implemented various initiatives to improve maternal health, including strengthening the health system and increasing the access to maternal care.[4–6] The Free Healthcare Initiative and the National Reproductive, Maternal, Neonatal, Child[7] and Adolescent Health strategy are the key programmes which aimed to improve

access to quality care.[6] In terms of major health indicators, the trends of facility births in the country have made significant progress, from 25% of deliveries that took place in health facilities in 2008 to 83% in 2019.[3 5 6] This trend varies by district, for instance, in Port Loko, 61% of births occur in health facilities, while in Kenema and Pujehun, the rate is as high as 97% in 2019.[3] However, access to skilled care on the continuum of maternal care during pregnancy, intrapartum and postnatal period remains limited, and many women in rural geographies have inequalities in accessing essential obstetric services.[7] Further confirmation of this gap is indicated by the differences in caesarean section rates among Sierra Leonean districts, which remain below the safety threshold of 10% at the population level indicated by WHO.[8] These regional disparities in accessing essential quality care are grossly linked to maternal death.[9]

In 2015–2016, the Maternal Death Surveillance and Response (MDSR) system in Sierra Leone was launched,[10] which aims to identify the causes of maternal deaths and inform targeted interventions.[10 11] MDSR assigns primary death causes to maternal deaths based on clinical/medical records from hospital/facility, in most of the cases, or through verbal autopsy (VA) data in a case where clinical or medical records are not available. The data on the cause of death are then coded according to the WHO classification.[12] Indeed, in many low-income and middle-income countries, VA is often the only available method to produce mortality statistics, as deaths often occur at home.[13] Moreover, many of these countries do not have a structured and reliable system of reporting death data.[14]

The first annual report on MDSR was published by the Ministry of Health and Sanitation (MOHS) of Sierra Leone, Reproductive and Child Health Directorate and partners in 2016.[10] Although these data are part of routine reporting and dissemination at MOHS to assess the trend and cumulative causes of maternal death,[10 15] so far the analysis has not investigated the differences and patterns between districts for the different causes of death. Therefore, this paper presents the first comprehensive analysis of the burden of different causes of maternal deaths reported in the MDSR system at the district level from 2016 to 2019. In a country with the highest maternal mortality and lowest life expectancy, a detailed presentation of the data by each participating district in MDSR is crucial for global health leadership. This paper is a joint effort of work on data analysis and synthesis in partnership with the Centre for Research and Training in Disaster Medicine, Humanitarian Aid, and Global Health at Università del Piemonte Orientale and Doctors with Africa CUAMM. These three are partners in one of the projects to evaluate the countrywide impact of National Emergency Medical Services (NEMS) on maternal health services.[16] The MDSR dataset is a key component of the impact evaluation of the NEMS project, and the scope of this paper falls under the umbrella of this work.

METHODS

This is the secondary data analysis of MDSR data. Access to the dataset was given by MOHS.

MDSR system

In Sierra Leone, MDSR is implemented through a multistakeholder approach involving MOHS, healthcare providers and both national and international non-governmental organisations. The key steps involved are (1) the identification of maternal deaths through various sources; (2) notification to key programme officials and clinicians; (3) verification and investigation of each maternal death, including periodical health facility-based death audits; and (4) review and clinical determination of the cause of death.

In the context of maternal mortality surveillance, the MOHS role in the identification and reporting of maternal deaths is pivotal.[10] Recognising maternal death as a notifiable event, the MOHS implemented a surveillance and reporting system, integrating the Civil Registration and Vital Statistics, the call system as well as community engagement, to capture maternal deaths irrespective of location.[10] This system is integral to the MDSR model, a comprehensive mechanism tracking maternal deaths and identifying underlying factors for targeted intervention.[10] MOHS has endeavoured to strengthen this system, addressing challenges such as under-reporting and coordination limitations.[10] They have developed national technical guidelines to fortify MDSR, incorporating a multifaceted approach that includes training clinicians for accurate death classification, supporting midwife investigators and ensuring continuous data validation.[10] This systematic approach aims to improve the quality of care and response strategies at both facility and community levels, reflecting a committed effort to reduce maternal mortality through enhanced surveillance and response initiatives.[10]

The process of assigning the cause of death for maternal fatalities adheres to a structured and methodical approach.[12] The International Statistical Classification of Diseases and Related Health Problems, 10 (ICD-10), is used to assign causes.[10 12] The investigation into suspected maternal deaths is triggered by reports to the Reproductive and Child Health unit, leading to a systematic inquiry by a multidisciplinary team comprising district surveillance officers, district health supervisors and midwife investigators.[10] This team is tasked with confirming the nature of death and elucidating the contributory factors.[10] The WHO ICD-10 definition of maternal death is employed, which encompasses deaths occurring during pregnancy or within 42 days of termination of pregnancy, attributable to pregnancy-related causes or its management, excluding incidental causes.[10 12] Maternal deaths are categorised into direct, indirect, incidental and unclassifiable types, facilitating a better understanding of each case.[10 12]

Nearly 90% of deaths recorded in the MDSR system occurred at health facilities; therefore, the cause of death is determined during review meetings by clinicians based

on clinical symptoms, examination findings and diagnosis in the case notes.[10] VA only applies to only 10% of deaths occurring and reported at the community level. At the facility level, periodic MDSR meetings allow incident reviews by the same multidisciplinary team. A district representative is usually invited to strengthen the collaboration between peripheral, basic and comprehensive healthcare facilities. Clinical/medical records or VA is used to determine the causes, and each cause was coded for the purpose of analysis.

Analysis

The data are cleaned, coded and assessed for missingness and outliers. In case of discrepancies, MOHS is contacted to resolve these. After consulting MOHS, the dataset for analysis was locked, and the main analysis was conducted using Stata SE 17. The proportion of each leading cause of maternal death with their 95% CI was estimated by districts for the period 2016–2019. CIs were calculated using the exact binomial method, chosen for its precision in estimating intervals for proportion data. This ensures robust and reliable statistical inference and provides an understanding of the variability and potential range of the observed proportions across different districts.

The direct and indirect causes are analysed and reported according to ICD guidelines, cumulative as well as by districts. Furthermore, a subgroup analysis of selected causes of death, such as obstetric haemorrhage and other direct and indirect obstetric complications, was performed as well. The denominator represented the total number of deaths reported in each district.

Patient and public involvement

Specific for MDSR system, MOHS and stakeholders engaged with the community to report the death events in the community. However, for this paper and analysis, there was no direct involvement of the patient and the public.

RESULTS

Direct causes of maternal death

Overall, 2428 maternal deaths were recorded and coded in the MDSR system from 2016 to 2019 in all 13 districts of Sierra Leone (online supplemental table S1). Obstetric haemorrhage was the leading cause of maternal death in Sierra Leone over the study period (n=956, 39.4%, 95% CI: 37.4, 41.3), followed by hypertensive disorders in pregnancy, childbirth and puerperium (n=384, 15.8%, 95% CI:14.4, 17.3), pregnancy-related infections (n=244, 10.1%, 95% CI: 8.9, 11.3), other obstetric complications (n=200, 8.2%, 95% CI: 7.1, 9.4) and pregnancy with abortive outcomes (n=71, 2.9%, 95% CI: 2.2, 3.3) (table 1).

Within the different subgroups of obstetric haemorrhages, postpartum haemorrhage was the leading cause (n=740, 30.5%, 95% CI: 28.6, 32.3) in each district, followed by antepartum haemorrhage (n=205, 8.4%, 95% CI: 7.3, 9.6) (table 2). Furthermore, the burden of death due to obstetric haemorrhage slightly increased over the study period, from 36.6% to 41.1% (figure 1). On the other hand, there was substantial variation in the proportion of obstetric haemorrhage over the total number of deaths among the different districts, ranging between 28.2% (Kono) and 60.0% (Kailahun), even if no clear geographical pattern emerged (figure 2).

Hypertensive disorders showed a slightly decreasing trend from 17.6% to 14.6% (figure 1). Even in this case, there was a large heterogeneity among districts, with figures ranging between 2.5% (Kailahun) and 22.1% (Moyamba), without a discernible spatial arrangement (online supplemental figure S1).

The yearly trend for pregnancy-related infections decreased slightly from 13.4% to 9.3% (figure 1). These infections also showed disparities among the districts, with proportions of 6.4% (Western Area) to 17.8% (Kono), with no distinct geographical arrangement observed (online supplemental figure S2).

Finally, among the group labelled as other obstetric complications, ruptured uterus (n=89, 3.7%, 95% CI: 2.9, 3.4) and obstructed labour (n=87, 3.6%, 95% CI: 2.8, 4.4) were the leading causes (online supplemental table S2). The trends almost doubled from 5.6% to 11.3% for all other obstetric complications (figure 1); the range of variability was also visible among districts, from 5.9% (Port Loko) to 12.3% (Kambia). No spatial pattern was observed (online supplemental figure S3).

Indirect causes of maternal death

The results indicated that non-obstetric complications were reported in 11.5% of the cases (n=278, 95% CI:10.2, 12.7) as shown in table 2. The most significant contributors to these complications included severe anaemia (n=111, 4.6%, 95% CI: 3.7, 5.4), malaria (n=55, 2.3%, 95% CI: 1.7, 2.9), HIV/AIDS (n=33, 1.4%, 95% CI: 0.9, 1.9) and heart failure, cardiomyopathy or stroke (n=34, 1.4%, 95% CI: 0.9, 1.9). For further analysis, a subgroup of non-obstetric complications by district is presented in online supplemental table S3.

DISCUSSION

Findings based on the MDSR platform between 2016 and 2019 suggest that more than half of the maternal deaths in Sierra Leone are attributable to haemorrhage, hypertensive disorders and sepsis. These results are consistent with those from a recent nationally representative mortality study which used Sierra Leone Sample Registration System of births and deaths.[17] This study also reported haemorrhage as the leading cause of maternal deaths (25.0% compared with 39.4% from MDSR), followed by infections and sepsis (15.0% vs 10.1% in MDSR) and hypertensive causes (9.0% vs 15.8% in MDSR).[17] Moreover, comparing our findings with reports from the Sierra Leone National Reproductive, Maternal, Newborn, Child, and Adolescent Health Strategy 2017–2021, the leading causes of maternal death reported were obstetric haemorrhage (46.0%),

Table 1 Proportion of maternal deaths in Sierra Leone due to different causes†

Causes*															
	Pregnancy with abortive outcome		Hypertensive disorders in pregnancy, childbirth and the puerperium		Obstetric haemorrhage		Pregnancy-related infections		Other obstetric complications		Unanticipated complications of management		Non-obstetric complications		Total
Districts	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N
Western Area	16	2.9 (1.7, 4.7)	110	20.0 (16.7, 23.5)	220	40.0 (35.9, 44.2)	35	6.4 (4.5, 8.7)	34	6.2 (4.3, 8.5)	0	–	74	13.5 (10.7, 15.6)	550
Bo	7	2.9 (1.2, 5.9)	37	15.3 (11.1, 20.5)	102	42.2 (35.9, 48.6)	24	9.9 (6.5, 14.4)	19	7.9 (4.8, 12.9)	2	0.8 (0.1, 2.9)	30	12.4 (8.5, 17.2)	242
Bombali	7	4.1 (1.7, 8.2)	26	15.3 (10.2, 21.6)	55	32.4 (25.4, 39.9)	22	12.9 (8.2, 18.9)	15	8.8 (5.0, 14.1)	1	0.6 (0.01, 3.2)	27	15.9 (10.7, 22.2)	170
Bonthe	0	–	11	14.9 (7.7, 25.0)	36	48.7 (36.8, 60.5)	7	9.5 (3.9, 18.5)	6	8.1 (3.0, 16.8)	1	1.4 (0.03, 7.3)	2	2.7 (0.3,9. 4)	74
Kailahun	4	5.0 (1.3, 12.3)	2	2.5 (0.3, 8.7)	48	60.0 (48.4, 70.7)	7	8.8 (3.6, 17.2)	5	6.3 (2.0, 13.9)	0	–	10	12.5 (6.2, 21.8)	80
Kambia	1	0.7 (0.01, 3.5)	22	14.2 (9.1, 20.7)	51	32.9 (25.6, 40.9)	10	6.5 (3.1, 11.5)	19	12.3 (7.5, 18.4)	1	0.7 (0.01, 3.5)	26	16.8 (11.2, 23.6)	155
Kenema	15	6.7 (3.8, 10.7)	34	15.1 (10.7, 20.4)	73	32.4 (26.3, 38.9)	21	9.3 (5.9, 13.9)	22	9.8 (6.2, 14.4)	2	0.9 (0.1, 3.1)	36	16.0 (11.4, 21.4)	225
Koinadugu	2	1.5 (0.1, 5.1)	19	13.8 (8.4, 20.6)	57	41.3 (32.9, 49.9)	20	14.5 (9.0, 21.5)	12	8.7 (4.5, 14.6)	2	1.5 1.5 (0.1, 5.1)	16	11.6 (6.7, 18.1)	138
Kono	6	3.5 (1.2, 7.3)	25	14.4 (9.5, 20.4)	49	28.2 (21.6, 35.4)	31	17.8 (12.4, 24.3)	20	11.5 (7.1, 17.1)	0	–	26	14.9 (9.9, 21.1)	174
Moyamba	0	–	28	22.1 (15.1, 30.2)	54	42.5 (33.7, 51.6)	10	7.9 (3.8, 14.0)	10	7.9 (3.8, 14.0)	0	–	7	5.5 (2.2, 11.0)	127
Port Loko	2	1.1 (0.1, 3.8)	34	18.2 (12.9, 24.4)	88	47.1 (39.7, 54.4)	19	10.2 (6.2, 15.4)	11	5.9 (2.9, 10.2)	0	–	7	3.7 (1.5, 7.5)	187
Pujehun	7	6.0 (2.4, 12.0)	19	16.4 (10.1, 24.3)	39	33.6 (25.1, 42.9)	13	11.2 (6.1, 18.4)	12	10.3 (5.4, 17.3)	1	0.9 (0.2, 4.7)	8	6.9 (3.0, 13.1)	116
Tonkolili	4	2.1 (0.5, 5.3)	17	9.0 (5.2, 13.9)	84	44.2 (37.0, 51.5)	25	13.2 (8.6, 18.8)	15	7.9 (4.4, 12.6)	1	0.5 (0.01, 2.8)	9	4.7 (2.1, 8.8)	190
Countrywide	71	2.9 (2.2, 3.6)	384	15.8 (14.3, 17.3)	956	39.4 (37.4, 41.3)	244	10.1 (8.8, 11.3)	200	8.2 (7.1, 9.4)	11	0.5 (0.2, 0.8)	278	11.5 (10.2, 12.7)	2428

*Data on 'coincidental causes (n=1, 0.04%)' and 'unknown/undetermined causes (n=283, 11.7%)' are not included in the table and reported in online supplemental table 4.
†Data shown are the proportion of cause of death (%) with 95% CI for each district in the MDSR data.

Table 2 Subgroup analysis of obstetric haemorrhage†

Causes								
	Postpartum haemorrhage		Antepartum haemorrhage		Intrapartum haemorrhage		Obstetric haemorrhage	
Districts	N	% (95% CI)	N	N	N	% (95% CI)	N	% (95% CI)
Western Area	166	30.2 (26.6, 34.2)	53	9.6 (7.3, 12.4)	1	0.2 (0.004, 1.0)	220	40.0 (35.9, 44.2)
Bo	84	34.7 (28.7, 41.0)	17	7.0 (4.1, 11.0)	1	0.4 (0.01, 2.2)	102	42.2 (35.9, 48.6)
Bombali	45	26.5 (20.0, 33.7)	9	5.3 (2.4, 9.8)	1	0.6 (0.01, 3.3)	55	32.4 (25.4, 39.9)
Bonthe	27	36.5 (25.5, 48.4)	9	12.2 (5.7, 21.8)	0	–	36	48.7 (36.8, 60.5)
Kailahun	40	50.0 (38.6, 61.3)	8	10.0 (4.4, 18.7)	0	–	48	60.0 (48.4, 70.7)
Kambia	38	24.5 (17.9, 32.0)	13	8.4 (4.5, 13.9)	0	–	51	32.9 (25.6, 40.9)
Kenema	62	27.6 (21.8, 33.8)	11	4.9 (2.4, 8.5)	0	–	73	32.4 (26.3, 38.9)
Koinadugu	37	26.8 (19.6, 35.0)	19	13.8 (8.4, 20.6)	1	0.7 (0.01, 3.9)	57	41.3 (32.9, 49.9)
Kono	38	21.8 (15.9, 28.7)	10	5.7 (2.7, 10.3)	1	0.6 (0.1, 3.1)	49	28.2 (21.6, 35.4)
Moyamba	40	31.5 (23.5, 40.3)	13	10.2 (5.5, 16.8)	1	0.8 (0.1, 4.3)	54	42.5 (33.7, 51.6)
Port Loko	73	39.0 (32.0, 46.4)	14	7.5 (4.1, 12.2)	1	0.5 (0.1, 2.9)	88	47.1 (39.7, 54.4)
Pujehun	32	27.6 (19.6, 36.6)	6	5.2 (1.9, 10.9)	1	0.9 (0.02, 4.7)	39	33.6 (25.1, 42.9)
Tonkolili	58	30.5 (24.0, 37.6)	23	12.1 (7.8, 17.6)	3	1.6 (0.3, 4.5)	84	44.2 (37.0, 51.5)
Countrywide	740	30.5 (28.6, 32.3)	205	8.4 (7.3, 9.6)	11	0.5 (0.2, 0.8)	956	39.4 (35.9, 44.2)

†Data shown are the proportion of cause of death (%) with 95% CI for each district.

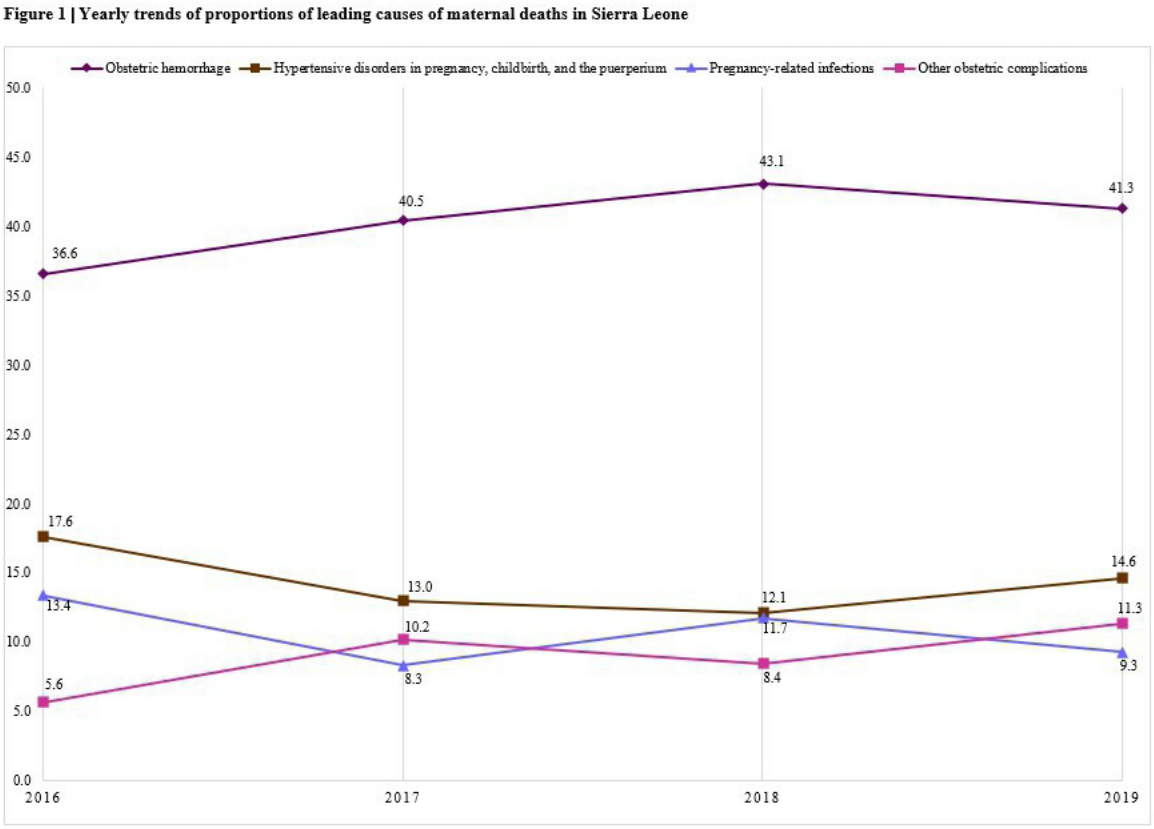

Figure 1 Yearly trends of proportions of leading causes of maternal deaths in Sierra Leone.

hypertension (22.0%), obstructed labour (21.0%) and sepsis (11.0%).[18] The regional comparison of our findings suggests that in the West African countries, obstetric haemorrhage is also the leading cause of deaths (31.4%), followed by hypertension (22.7%), non-obstetric causes (14.1%) and infections (10.3%).[19] Likewise, data from sub-Saharan Africa on maternal deaths suggest a similar pattern. A WHO systematic analysis revealed obstetric haemorrhage (24.5%), hypertension (16.0%), obstructed labour (2.1%) and sepsis (10.3%).[20]

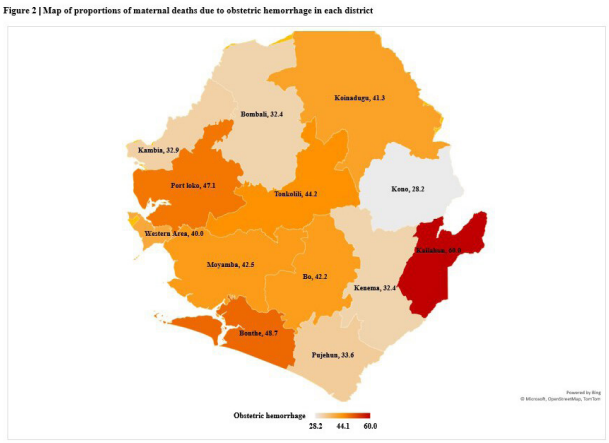

Figure 2 Map of proportions of maternal deaths due to obstetric haemorrhage in each district.

A time-trend analysis of the major causes of maternal death failed to reveal any major patterns. A potential explanation could be that the observation period was relatively short to detect a temporal trend in maternal mortality at the population level.[21] The extent of the changes to be measured depends on numerous factors, such as the frequency with which the data are collected, the accuracy of the data and the magnitude of the changes to be measured.[21] Data spanning at least 5 years are recommended to detect trends in maternal mortality.[22] Even in high-mortality settings, maternal mortality is a relatively rare event; therefore, data accuracy is particularly relevant.[22] Thus, in addition to the quantity of data, it is crucial to ensure data quality and consider any changes in data collection methods or definitions that occur during the observation period. Additionally, despite the heterogeneity in the burden of the specific causes of death, no clear geographical pattern emerged. The reason for this may be associated with the fact that the total number of deaths reported in MDSR may vary from district to district, and the validity of how the MDSR team assigns the cause of death in each district could differ due to the field-related challenges.

This study presented comprehensive findings on causes of maternal deaths using the national dataset of MDSR Sierra Leone segregated by districts. This is crucial for policymakers, decision-makers and programme implementers to understand the targeted interventions. However, it should be noted that the MDSR platform has the major constraint of under-reporting deaths in the system. Approximately 76% of deaths were not recorded by this system in 2016 and 2017 due to several challenges in reporting.[10] This is a well-known limitation of systems like MDRS, which have been documented to have under-reporting rates ranging between 58 and 76 in other settings.[23–25] Nonetheless, such systems remain integral in developing countries to evaluate the performance of health systems and population-level issues. A similar evaluation of the cause as well as an in-depth analysis of these maternal deaths by districts could help policymaker and programme implementers to track the maternal health indicators.[26]

The introduction of monitoring and evaluation (M&E) mechanisms, together with the efforts to tackle reporting challenges within the community, limited organisational capacity and motivation, and difficulties in implementing the programme in the field, can substantially improve the performance of MDSR.[26 27] Moreover, a differential under-reporting rate among the specific causes of death seems unlikely. Thus, an analysis based on relative numbers (proportions over the total number of deaths) rather than absolute numbers should be less sensitive to this limitation.

Finally, the quality of assigning the cause of death using clinical/medical records as well as VA data may have affected the results in specific districts. However, the percentage of VA is low because of the lack of data on maternal death from the community. Therefore, the MDSR system in Sierra Leone has a great opportunity to strengthen the community reporting system within MDSR.

CONCLUSION

To reduce maternal mortality in Sierra Leone, there is a pressing need for more robust strategies in districts with a high burden of top preventable causes. There is an enormous opportunity for shared learning from the MDSR database, which can be used by different stakeholders to provide better-quality services to high-risk women. Although this platform and data have limitations, they can still be used to advance health policies, programmes and innovations aimed at reducing maternal deaths. This can be accomplished by applying the knowledge obtained from these findings. The issue of under-reporting must be addressed to improve the availability and quality of data on maternal deaths and their causes. Capacity building and motivating frontline staff to capture the death event across different scenarios are crucial for improving mortality estimation at the district level. Effective M&E within the MDSR system will be ensured by strengthening the synergy between the national, district, facility and community levels to improve the reporting system and assess the impact of the improvement strategies. Furthermore, longitudinal data on maternal deaths and causes will ensure time-trend analysis of the causes of maternal mortality and design targeted interventions in different districts.

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