

Impact of the Ebola outbreak on health systems and population health in Sierra Leone

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ABSTRACT

Background The current Ebola outbreak has proved devastating to vulnerable populations in West Africa. Health needs assessments were conducted in two districts of Sierra Leone to identify and quantify the impact of the outbreak on population health and health systems.

Methods Mixed qualitative and quantitative methods were employed including interviews, focus groups, and interrogation and analysis of data from health facilities, district health records and burial teams. *T*-tests were performed to compare periods before and during the outbreak.

Results A breakdown in relations between the health system and communities was demonstrated leading to marked and significant reductions in utilization of health facilities including: paediatric all-cause and malaria admissions, maternity admissions and attendance in the community. High avoidable all-cause mortality was identified (3.4 times higher than normally registered for the period, 42% deaths in children <5 years, 2% attributed to Ebola). Negative impacts on the health workforce, health system leadership and governance, and disruption of health programmes and systems were demonstrated. Reductions in vaccination coverage and a rise in teenage pregnancy were noted.

Conclusions The findings indicate a public health emergency as a legacy of the Ebola outbreak. Sustained commitment of the international community is required to support health system re-building.

Keywords communicable diseases, morbidity and mortality, public health

Background

The current outbreak of Ebola virus disease (EVD or Ebola) has proved devastating to the populations of West African countries such as Sierra Leone, Guinea and Liberia, who already experienced among the highest infant and maternal mortality rates worldwide. The outbreak has led to considerable morbidity and mortality with 27 443 clinically compatible cases of Ebola and 11 220 deaths reported almost certainly gross underestimates.¹ To date 874 healthcare workers (HCWs) have become infected and 509 have died.¹ Resources have been prioritized to Ebola outbreak response activities. Furthermore, it is apparent that there has been a breakdown in trust in healthcare systems which were patently unprepared for the Ebola outbreak and unable to respond to the needs of

patients. This situation has led to reported under-utilization of available health services.^{2–4}

The Ebola outbreak has been diminishing for several months; however, transmission continues in the three countries at the time of writing.

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Doctors of the World and Medicos del Mundo have been operating in Sierra Leone for over a decade and during the Ebola outbreak have supported the Ebola response by running an Ebola Treatment Centre and Holding Centres and performing outreach activities. In order to determine the impact of the Ebola outbreak on the health system, identify priority population health needs and to inform strategy in the transition from Ebola response to a programme of health system strengthening, situation analyses and health needs assessments were conducted for two districts. Assessment relevant to describing the impact of the Ebola outbreak is described here. The findings indicate a public health emergency occurring in Sierra Leone.

Methods

Field work for the assessments was undertaken in Moyamba district (population ~373 000) in the Southern Region and in Koinadugu district (population ~398 000) in the Northern Region during the months of February and May 2015, respectively.

Mixed qualitative and quantitative methods were employed.

Over 60 interviews were conducted in total across both districts with participants including: key local stakeholders [such as District Health Management Teams (DHMT), members of Ebola response teams; civil and traditional authority figures], HCWs, community workers, social mobilizers, patients and members of non-governmental organizations (NGOs). Six focus groups were also conducted with: community members, a women's group, mothers with children attending a child health clinic, social mobilizers and town council members. Thematic analysis was performed to identify common themes.

In Moyamba, a sample of 15 health facilities was selected for assessment during which attendance data were retrieved from facility registers (this sample was purposively selected in partnership with the DHMT in order to achieve representativeness as much as practical in terms of: geography, health facility type, and condition and resources of the facility). Data recorded by safe burial teams operating in the Ebola response in Moyamba was obtained and interrogated to estimate Ebola-related and all-cause mortality. Interrogation and analysis of routine health information held at district level in both districts was also performed.

Paired *t*-tests were performed to compare the mean difference in monthly and period attendance counts between years. An independent group *t*-test was performed to compare mean vaccination coverage between 6 month periods considered pre- and peri-Ebola outbreak. All statistical tests were

performed and confidence intervals for estimates generated using STATA.⁵

Results/findings

Findings included: an evident loss of trust in the health system, reduced utilization of services, high avoidable all-cause mortality, adverse impacts on the health workforce and health system leadership and governance, and disruption of essential health programmes and systems with consequences for population health. These are described in turn.

Impact of the Ebola outbreak on relations between communities and the health system

The following major themes were identified from interviews and focus groups.

People let down by the health system

A recurring theme derived from almost all interviews including those with HCWs themselves was that people felt that they had been let down by a health system that they perceive could and should have done more. 'The community frowned at us' (Community Health Officer). 'People were disappointed in the health system' 'Nurses will ignore the people for fear of being infected' (Senior member of District Ebola Response Centre). 'The health care system cannot address the needs and problems of the people. . . . [people think:] "if there is no cure what is the point?"' (Paramount Chief).

Fear and loss of trust in the health system and the Ebola response

Fear of Ebola was evident. Ebola was frequently associated with health facilities. Furthermore, it was apparent that many people blame the health system for the outbreak. 'They suggested we created Ebola . . . the rumour is the health facilities are giving people Ebola' (Maternal Child Health Aide). Focus group participants stated they stopped having their children immunized for fear of the 'needles injecting Ebola' and had believed the weighing scales would give their children Ebola. Focus group participants claimed that rumours in their communities had created a societal pressure to refrain from bringing children to the clinics. Social mobilizers reported that most communities did not now trust health workers particularly those involved in the Ebola response. It was widely perceived that regaining trust would require sustained engagement with communities and although success was not guaranteed, it could be achieved: 'People are highly traumatised' (Social Mobilizer). 'We are talking, talking with the community . . . some they come back . . . this will take a long time' (Community

Health Officer). ‘If we involve the community it will go a long way’ (Nurse).

Impact of the Ebola outbreak on utilization of health services

The factors above were universally perceived to have resulted in people and communities disengaging with health services. Interrogation of attendance register data revealed marked reductions in health facility utilization. Figure 1 illustrates the difference in attendance to Community Health Centres located in four Chiefdoms in Moyamba between equivalent 4 month periods pre- and peri-Ebola outbreak.

Community health centre attendance in Lower Banta Chiefdom was significantly reduced with a mean of 679 attendances per month (95% CI: 330–1028) during a 4-month period (October 2013–January 2014) pre-Ebola compared with 187 attendances per month (95% CI: 95–278) during the equivalent 4-month period peri-Ebola outbreak, $P = 0.025$. Significant reductions were also noted in Ribbi Chiefdom with the mean monthly attendance of 338 (95% CI: 323–353) pre-Ebola compared with 164 (95% CI: 131–197) peri-Ebola, $P < 0.001$. A non-significant reduction was noted in Kori Chiefdom, and in Kagboro Chiefdom, attendance was largely unchanged. It is notable that the populations of Lower Banta and Ribbi Chiefdoms were most affected by the Ebola outbreak (up to mid-February 2015, there had been 33 and 58 confirmed Ebola cases in these Chiefdoms, respectively), Kori less so (20 confirmed cases during the same period), while Kagboro Chiefdom was one of the least Ebola affected Chiefdoms in the district (9 cases). A similar pattern was noted in Koinadugu district with the most marked reductions in attendances in Nieni, the most Ebola affected Chiefdom.

As health facilities are mostly accessed by women and children, the reductions in health facility attendances were reflective of marked reductions in their attendance. In Lower Banta

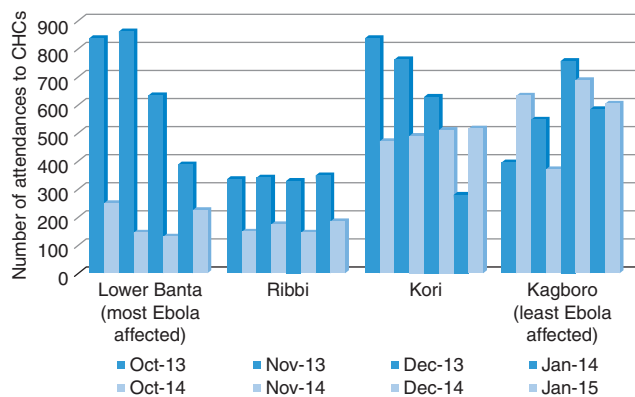


Fig. 1 Attendances at Chiefdom Community Health Centres in equivalent 4-month periods (pre- and post-Ebola outbreak).

among women aged ≥ 15 years, there were 324 women attending the Community Health Centre in November 2013 for urgent, routine and antenatal care compared with just *one person* in November 2014. Deliveries in health facilities were reduced particularly in the most Ebola affected areas, for example, in Ribbi Community Health Centre, the estimated mean number of monthly deliveries during the period of August–December 2013 was 24.2 (95% CI: 19.2–29.2) compared with 13.8 (95% CI: 8.0–19.6) peri-Ebola outbreak, $P = 0.017$.

Marked reductions were also noted in hospital attendance and admissions during the outbreak compared with the equivalent period the year before; in particular, there were significantly lower numbers of: women admitted during labour, urgent paediatric hospital admissions including children hospitalized with malaria and outpatient consultations (Table 1).

Meanwhile, attendance of children under 5 years of age to community health facilities (for all causes) in Moyamba was notably lower compared with the previous year with a mean of 12 222 (95% CI: 11 100.45–13 343.55) attendances per month for June–December 2013 and 9208 (95% CI: 6820.48–11 595.52) attendances per month for June–December 2014, $P = 0.02$.

Mortality during the Ebola outbreak

Safe burial teams operate across the country with the aim of promptly and hygienically burying all deaths occurring in the district and diagnosing Ebola post-mortem by collecting and submitting viral swabs for PCR. In a 5.5-month period

Table 1 Moyamba government hospital admissions and consultations August–December 2013 and 2014

	August–December 2013: mean number per month (95% CI)	August–December 2014: mean number per month (95% CI)	P-value
Maternity admissions	46.4 (38.3–54.5)	25.8 (17.3–34.3)	0.01
Paediatric admissions (urgent/non-elective)	44.0 (29.7–58.3)	11.0 (5.6–16.4)	0.001
Paediatric malaria admissions	26.2 (23.4–29.0)	5.2 (2.1–8.3)	<0.001
General outpatient consultations	152.2 (80.4–224.0)	66 (43.0–89.0)	0.03

(1 November 2014–15 April 2015), burial teams recorded 1874 deaths in Moyamba (for which age was recorded in 1861 cases) of which 496 (27%) were under the age of 1 year, 786 (42%) were under the age of 5 years and 1282 (69%) were aged under 50 years of age. Ebola was confirmed post-mortem in 38 (2.0%) cases during this period. The number of deaths reported per week is shown below; there was an apparent rising trend over the period under study (Fig. 2).

The number of deaths recorded by the burial teams was over 3.4 times greater than the average number of deaths registered during the same period (November to mid-April) from the previous 4 years (mean 556 of deaths for years 2010–13).

Impact of Ebola on the health workforce

The following themes were identified.

Direct losses

In Sierra Leone, 304 HCWs are reported to have been infected with Ebola (~28% of the total HCW workforce of ~1100) and 221 (72%) of these died. Twenty-five HCWs in Moyamba and 8 in Koinadugu died between October 2014 and March 2015 (26% of the country total during the period) according to the Ministry of Health and Sanitation and Unicef (data unpublished). Both districts were severely understaffed pre-outbreak with Moyamba having two clinically practicing doctors and Koinadugu just one (a combined doctor to

population ratio of ~0.04 per 10 000), there were just 12 midwives working in Moyamba and 20 in Koinadugu (combined midwife to population ratio of ~0.4 per 10 000), so it was perceived that any losses could be ill afforded.

Diversion of resources to the Ebola response

Almost all members of District Health Management Teams (DHMT) were engaged in key roles in the Ebola response. It was their perception that they had therefore largely been unable to provide the level of leadership, supervision and support for the health system that is their usual mandate. HCWs attributed this as a major contributing factor in exacerbating feelings of isolation, worsening already low morale and reducing their motivation. The result was universally felt to be diminished productivity and effectiveness of HCWs.

Many trained HCWs (~30 in each district) were working in Ebola treatment and care centres. Of most concern to DHMT members, however, was the ‘uncertainty’ surrounding the volunteer Community Health Worker (CHW) workforce (~1000 in each district pre-Ebola), considered the ‘bedrock’ of the healthcare system. Many were recruited to Ebola-related activities; however, it was perceived that more had become disenfranchised by observing others being recruited and paid for performing Ebola-related activities, leading several members of DMHTs to suggest that ‘<50% of CHWs remain working’.

Impact of the Ebola outbreak on essential health programmes and systems and population health

The following themes were identified.

Disruption of vertical programmes

EPI programmes in both districts had been affected mainly due to widespread disengagement of people with health services but also a reduction in the outreach services provided by HCWs in the community. Interrogation of routinely collected data revealed marked reduction in coverage in Koinadugu (Fig. 3) (vaccination data from Moyamba were considered too unreliable for comparison).

The mean number of children receiving all recommended childhood vaccinations before the age of 1 year per month during months January–June 2014 (before the outbreak was generally perceived to have taken hold in the district) was 1152.5 (95% CI: 1066.2–1238.8) compared with 507.7 (448.0–567.4), $P < 0.0001$ in the final 6 months of the year (peri-outbreak).

All major health programmes had been adversely affected according to DHMT leads, most notably TB, HIV, malaria and nutrition programmes. Community TB DOTS services

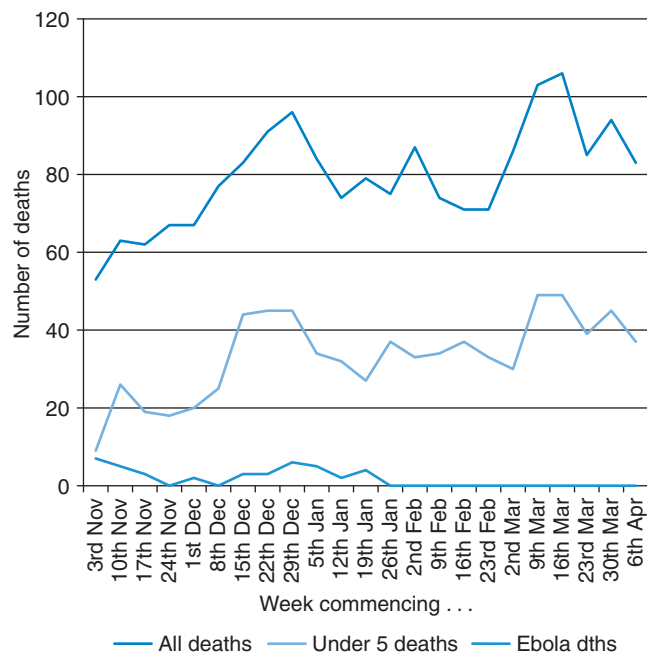


Fig. 2 Weekly deaths in Moyamba weeks commencing 3 November 2014 to 6 April 2015.

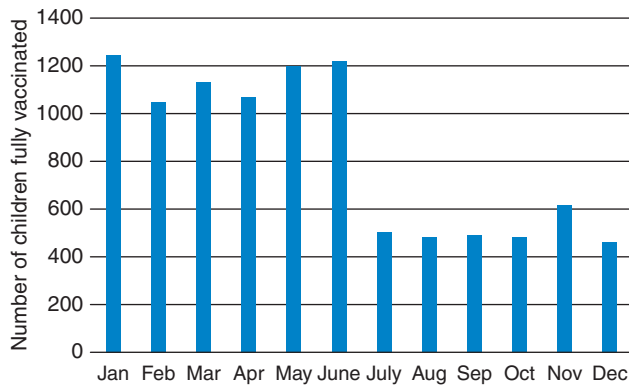


Fig. 3 Number of children aged <1 years 'fully vaccinated' by month in Koinadugu, 2014.

were no longer functioning in either district in view of the absence of CHWs and reduced provision of supervision and support. Stock outs of HIV drugs had been a particular issue in Moyamba. In both districts, DHMT members reported increased disengagement of HIV and TB patients from services following the start of the outbreak and reduced community outreach services for malaria prevention and control. The supplementary nutrition programme had been suspended indefinitely from June 2014 following the advent of the outbreak.

Weakened essential systems

Basic communication systems for both districts were reported to have deteriorated when compared with before the outbreak and it was observed that in Koinadugu district (where there is only ~20–30% mobile telephone network coverage), the VHF radio system and the district switchboard system were non-functional and the latter unmanned for several weeks. Thus, HCWs in the community had no mechanism to call upon an emergency ambulance let alone engage in routine communications. Similarly, in Moyamba, a previously functioning closed user group telephone system had not been funded since the outbreak. Thus, core disease surveillance systems (reliant on passive reporting from health facilities) were almost entirely non-functional in both districts.

Wider impact of the Ebola outbreak

Many adverse social consequences were reported, however, in particular it was widely perceived that since schools had closed sexual activity particularly involving young girls and older men had increased. This was evidenced by the findings of increase in teenage pregnancy in Moyamba in 2014 compared with 2013 with a mean of 137.6 (95% CI 96.4–178.9) teenage pregnancies recorded per Chiefdom in 2013 and mean of 173.1 (117.1–229.2) in 2014, $P = 0.03$.

Discussion

Main findings of this study

This study indicates a current public health emergency as a legacy of the Ebola outbreak. The existence of a breakdown in trust between communities and the health system has been demonstrated, and its impact evidenced by widespread disengagement with the health system apparently in proportion to the scale of the Ebola outbreak in the locality. There are obvious potential adverse health consequences of lack of presentation to health facilities in particular relating to children with malaria and women in labour. This study provides evidence of high avoidable mortality on a much greater scale than has previously been reported for the area studied.

The impact of the outbreak on an already compromised health system has been demonstrated; particularly the diversion of resources and attention towards Ebola activities and resulting reduced provision of leadership, support and governance to the health system. Disruption to vertical programmes, activities and essential systems has been highlighted. Urgent population health needs are evident, in particular reduction in vaccination coverage coupled with reduced surveillance capacity indicates high risk of outbreaks of vaccine-preventable infectious disease.

What is already known on this topic

Unicef reported reductions in utilization of peripheral health facilities from May to September 2014 with 10% reduction in fourth antenatal care attendance and 16% reduction in births reported for Moyamba.² Modelled estimates suggest the Ebola outbreak will be responsible for around 8000 additional deaths in children under 5 years and 300 additional maternal deaths.^{2,4}

What this study adds

This study indicates that reduced health system utilization has been sustained, and that even within districts, there is marked variation between localities. This study provides real evidence of high avoidable mortality during the outbreak. The mixed qualitative and quantitative methodology employed in this study has allowed a comprehensive snapshot of the impact of the Ebola outbreak on the health system beyond lack of utilization and demonstrates wider health and social consequences. The findings of this study indicate that sustained engagement between communities and the healthcare system is necessary in order to rebuild relations and reverse the emergency situation. The study findings add to a body of evidence highlighting wider social, ethical, political and legal issues which may inform the international response to public health emergencies in the future.

Limitations of this study

This study was conducted in two districts located in different regions of Sierra Leone. The districts are considered representative of the majority of the country outside of the Western Area Urban District in their health system structure and function and are similar in terms of available population demographics and for many baseline health indicators.⁶ However, the Ebola outbreak did not affect the country uniformly and Moyamba and Koinadugu were two of the less severely Ebola affected districts. In more Ebola affected districts, population health and health system impacts might be more pronounced.

Mortality data presented are an underestimate of the true burden. 'Safe burial' practice is unpopular with people given the departure from culture and tradition and potential consequences of post-mortem Ebola diagnosis (including quarantine of the household, stigma, heavy disinfection). While traditional burial practice is currently outlawed, it is understood that some burials take place in secret and that reporting of deaths is suboptimal. The apparent increase in weekly mortality might represent variability in reporting practices. Comparison with registered deaths in previous years is compromised as death ascertainment methods are different and routine registration of death is perceived to be suboptimal.

Given that schools were closed in the latter 6 months and pregnancy is generally diagnosed by clinical signs, the apparent 25% increase in teenage pregnancy is likely to be a marked underestimate.

Limited health and health system data are collected routinely at district level and it was not practical to provide quantitative evidence for some themes identified.

Conclusion

Our study describes the devastating wider impact of the Ebola epidemic on health systems, public health programmes and the catastrophic consequences for the health of the population in Sierra Leone. The attention of the international community is rapidly moving from West Africa to newer health emergencies at a time when resources and support are urgently

required to strengthen public health systems. While the global threat of Ebola is disappearing, the destructive legacy of the epidemic is becoming more apparent. Opportunities for intervention through the transition of the assets of the Ebola response should be taken, not least the utilization of well-resourced social mobilization (community engagement) teams. Sustained commitment of the international community and meaningful collaboration between organizations is critical to support health system re-building and to begin to reverse the current public health emergency.

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References

- 1 World Health Organisation Ebola situation report—1st July 2015. <http://apps.who.int/ebola/current-situation/ebola-situation-report-1-july-2015> (7 July 2015, date last accessed).
- 2 UNICEF and Ministry of Health and Sanitation. *Sierra Leone Health Facilities Survey 2014: Assessing the Impact of the EVD Outbreak on Sierra Leone's Health System*. Freetown: Government of Sierra Leone Ministry of Health and Sanitation, 2014.
- 3 Assessment Capacities Project (ACAPS). *Thematic Note: Health Service Utilisation in Sierra Leone*. Geneva, 2015.
- 4 UNFPA. *Rapid Assessment of Ebola Impact on Reproductive Health Services and Service Seeking Behaviour in Sierra Leone*. Freetown: UNFPA, 2015.
- 5 StataCorp. *Stata Statistical Software: Release 13*. College Station, TX: StataCorp LP, 2013.
- 6 Statistics Sierra Leone and Ministry of Health and Sanitation. *Demographic and Health Survey 2013*. Freetown: Government of Sierra Leone Ministry of Health and Sanitation, 2014.