

**SORT IT SUPPLEMENT: POST-EBOLA RECOVERY IN WEST AFRICA****Effects of the 2014 Ebola outbreak on antenatal care and delivery outcomes in Liberia: a nationwide analysis**F. Q. Shannon II,¹ E. Horace-Kwemi,¹ R. Najjemba,² P. Owiti,^{3,4} J. Edwards,^{5,6} K. Shringarpure,⁷ P. Bhat,⁸ F. N. Kateh¹<http://dx.doi.org/10.5588/pha.16.0099>**Setting:** All health facilities, public and private, in Liberia, West Africa.**Objectives:** To determine access to antenatal care (ANC), deliveries and their outcomes before, during and after the 2014–2015 Ebola outbreak.**Design:** This was a descriptive cross-sectional study.**Result:** During the Ebola outbreak in Liberia, overall monthly reporting from health facilities plunged by 43%. Access to ANC declined by 50% and reported deliveries fell by one third during the outbreak. Reported deliveries by skilled attendants and Caesarian section declined by respectively 32% and 60%. Facility-based deliveries dropped by 35% and reported community deliveries fell by 47%. There was an overall decline in reported stillbirths, maternal and neonatal deaths, by 50%, during the outbreak. ANC, reported deliveries and related outcomes returned to pre-outbreak levels within one year following the outbreak.**Conclusion:** The Liberian health system was considerably weakened during the Ebola outbreak and had difficulties providing basic maternal health services. In the light of the major reporting gaps during the Ebola period, and the reduced use of health facilities for maternal care, these findings highlight the need for measures to avoid such disruptions during future outbreaks.

The 2014 Ebola virus disease (EVD) outbreak was the largest in history, starting in Guinea in December 2013 and then spreading to Liberia and Sierra Leone. The outbreak spread to Liberia, one of the hardest hit countries, in March 2014, and peaked in September 2014, resulting in 10678 cases and 4810 deaths. The Liberian health care system, which had been steadily expanding, was virtually crippled,^{1,2} with 372 health workers becoming infected and 184 subsequently dying secondary to EVD as of 8 April 2015.³

The maternal health care indicators had been improving in Liberia before the EVD outbreak. From 2007 to 2013, national facility-based deliveries had increased from 38% to 56% and the fourth antenatal care (ANC) visit rates from 37% to 78%.⁴ However, overall maternal health indicators remained poor, with the maternal mortality ratio remaining at 1072 per 100000 live births.⁵

During the Ebola outbreak, there was a perceived compromise in maternal health care services for the following reasons: health workers following the EVD 'no

touch' policy, the scarce supply of personal protection equipment,^{6,7} the community perceptions of a higher risk of contracting EVD at health care facilities⁸ and a general lack of trust in government services.⁹ Furthermore, health care workers who feared being infected with EVD while providing care abandoned health facilities, which in most cases were already understaffed.⁹

Access to ANC links a pregnant woman to the formal health system, where pregnancy-related health risks can be identified and managed. The World Health Organization (WHO) recommends that all pregnant women have at least four ANC visits during the span of their pregnancy.^{10,11} It is projected that an increase in ANC visits increases the opportunity for mothers to seek safer deliveries in a health facility and/or assistance by a skilled birth attendant, which benefits both the mother and the infant.

Although maternal health care packages such as ANC and intrapartum care can greatly reduce the risk of maternal death, pregnant women and children were at the highest risk of death from EVD.¹ The Ebola outbreak challenged health care service delivery, particularly for the mother and child. During the outbreak, Liberia recorded one of the highest maternal mortality ratios, second only to Sierra Leone.¹ Since the outbreak, there has been no comprehensive nationwide review of the effects of EVD on the use of ANC services and delivery outcomes. The insight gathered from this study could help bridge the knowledge gap regarding the impact of EVD on maternal health care services. The findings could also guide the post-Ebola recovery process and strategic planning for future outbreak responses in Liberia and similar contexts elsewhere.

The present study aimed to determine the effects of the Ebola outbreak on maternal health services and delivery outcomes in Liberia. Specifically, the key maternal and child health care indicators assessed were 1) first and fourth (or more) ANC visits, 2) normal delivery by skilled and unskilled staff at a facility and outside a facility, 3) delivery by Caesarian section (C-section), and 4) proportion of different delivery outcomes (reported live births, maternal deaths, still births and neonatal deaths) before, during and after the outbreak.

METHODS**Study design**

This was a descriptive cross-sectional study using routinely reported programme data.

AFFILIATIONS

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- 2 Makerere University College of Health Sciences, Kampala, Uganda
- 3 Academic Model Providing Access to Healthcare (AMPATH), Eldoret, Kenya
- 4 International Union Against Tuberculosis and Lung Disease, Paris, France
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SETTING

General setting

Liberia (population approximately 4 million), a country situated in West Africa, bordered by Guinea on the north, Ivory Coast on the east and Sierra Leone on the west, is divided into 15 political subdivisions known as counties. More than 50% of the population is aged <35 years.¹² As of September 2015, there were 91 health districts and 727 health facilities in Liberia. Health services are provided in urban and rural areas; services in rural areas are mainly primary health care facilities.

Liberia maternal health programme and services

The Family Health Division (FHD) is situated within the Ministry of Health (MoH) in the Department of Health Services. It is responsible for setting standards, developing guidelines and policies, and planning, coordinating and monitoring activities related to maternal and child health. The FHD works with counties, health facilities and communities to ensure the implementation of reproductive health services. The maternal and child health (MCH) care services provided at health facilities include ANC, delivery, emergency obstetric and neonatal care, and postnatal care.¹² Health promotion messages are delivered using mass media such as radio during community outreaches to target pregnant women and mothers in communities to use the MCH services. Pregnant women are encouraged to visit the health facility for routine check-ups. The national maternal health services conform to the WHO guidelines on basic MCH services and recommend at least four ANC visits. Routine weekly maternal health services are offered in most counties, and most pregnant women access three to four ANCs.¹³ ANC and delivery records in the health facility are logged in the ANC and delivery ledgers, respectively. Trained traditional midwives and/or general community health volunteers report community deliveries to the health facilities, and these are subsequently captured in the national database.

Study population

The study population included all women seeking ANC at health facilities, all institutional and community deliveries and all newborns across Liberia before (July–December 2013), during (July–December 2014) and after (July–December 2015) the EVD outbreak.

Data variables

The data variables for the study included the first ANC (ANC1) visit, four (ANC4) or more ANC visits, institutional deliveries, normal deliveries by both unskilled and skilled staff, reported community deliveries (i.e., deliveries outside a facility), deliveries by C-section, and birth outcomes (live births, still births, maternal deaths and neonatal deaths). Data on these variables were reported on a routine monthly basis over the study period.

Data analysis

Data were extracted from the District Health Information System, version 2 (DHIS, Oslo, Norway) data plat-

form and exported to MS Excel (Microsoft, Redmond, WA, USA). Data were analysed using EpiData Analysis software, version 2.2.2.182 (EpiData Association, Odense, Denmark). The results for the maternal health service variables under study were analysed for all beneficiaries of maternity services and compared between the different years by county using the χ^2 test, relative risk and risk ratios, as appropriate. The level of significance was set at <5%.

Ethics approval

Ethics approval for the study was obtained from the University of Liberia Pacific Institute for Research and Evaluation Institutional Review Board, Monrovia, Liberia, and the Ethics Advisory Group of the International Union Against Tuberculosis and Lung Disease, Paris, France. As aggregate data were used for this study, informed consent from patients was not required.

RESULTS

Reporting gaps

Of the expected number of deliveries projected for 2014 ($n = 172\,244$), only 42% were reported compared to 53% (91678/173579) in 2013 and 47% (85374/180945) in 2015. Furthermore, ANC1 and ANC4 (or more) reporting fell by respectively 14% and 9% in 2014 compared to 2013.

Trend of access to antenatal care

The trends in ANC1 and ANC4 (or more) visits during the study period are illustrated in Figure 1. There were severe decreases in the numbers of pregnant women who accessed either ANC1 or ANC4 during compared with before the EVD outbreak. Reported ANC visits during the outbreak were almost half of the baseline (pre-EVD) mean monthly numbers of 12894 and 9501 for ANC1 and ANC4. There was a gradual revitalisation of the use of ANC services in the post-EVD period.

Trends in total institutional and community deliveries

Figure 2 depicts trends in total deliveries reported during the study period. The number of reported deliveries declined drastically during the EVD outbreak compared with pre-EVD. During the outbreak, reported deliveries represented only two thirds of the baseline (before the outbreak) mean monthly deliveries ($n = 8144$). In the post-Ebola period, the reported number of deliveries largely returned to the pre-EVD level. Table 1 gives a comprehensive summary of reported deliveries, comparing different time periods. The reduction in the proportion of reported institutional deliveries during EVD was respectively 32%, 76% and 60% for deliveries by skilled attendants, unskilled attendants and C-section when compared to the pre-EVD period. Although there was a 47% reduction in the number of reported deliveries outside facilities during EVD as compared with the pre-Ebola outbreak period, all types of deliveries largely returned to pre-EVD levels after the outbreak.

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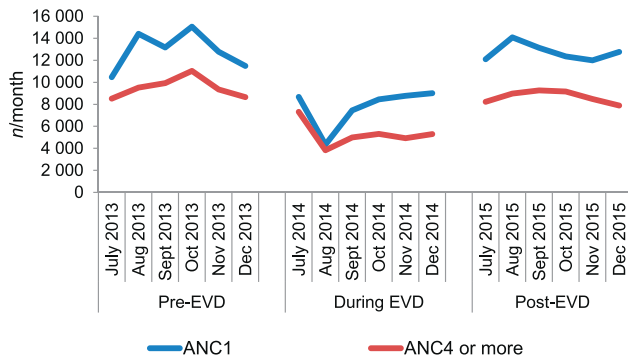


FIGURE 1 Trends in pregnant women accessing antenatal care at health facilities before, during and after the Ebola outbreak, Liberia, 2013–2015.* *Pre-EVD = July–December 2013; during EVD = July–December 2014; post-EVD = July–December 2015. EVD = Ebola virus disease; ANC = antenatal care.

Delivery outcome indicators

Delivery outcomes and neonatal deaths are shown in Figure 3. While trends showed an overall decline in reported stillbirths and maternal and neonatal deaths by over half during the EVD period, reported numbers of all of these indicators in the post-EVD period returned to pre-outbreak levels. We therefore decided to compare the second half of the 3 years under review because it was during the second half of 2014 that EVD reached its peak and health services shut down completely in most parts of the country. We feel our analysis would not have been representative of the overall objective of the study if we had included the 12 months of all 3 years. Table 2 shows the comparison of birth outcome and neonatal death indicators before, during and after the EVD outbreak. The numbers of recorded maternal deaths, stillbirths and neonatal deaths declined during the Ebola outbreak; the differences were statistically significant.

DISCUSSION

To our knowledge, this is the first study to examine the effect of the Ebola outbreak on MCH services from a national perspective in West Africa. There were several important findings. The study showed a substantial gap in reported access to ANCs and deliveries. There was a severe decline in institutional deliveries performed; this was especially marked in C-sections and deliveries by skilled attendants during the outbreak period. The monthly reports submitted by health facilities dropped substantially during

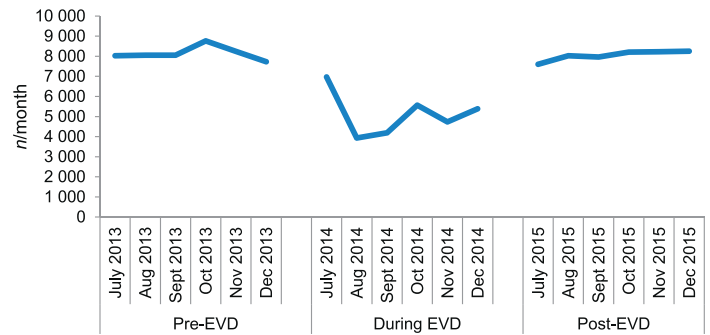


FIGURE 2 Trends in total deliveries reported by health facilities and community health workers before, during and after the Ebola outbreak, Liberia, 2013–2015.* *Pre-EVD = July–December 2013; during EVD = July–December 2014; post-EVD = July–December 2015. EVD = Ebola virus disease.

the outbreak. This resulted in a significant reduction in stillbirths and maternal and neonatal deaths reported compared to the existing suboptimal pre-Ebola reporting of these indicators. Maternal health services largely returned to pre-Ebola levels during the corresponding months of the year after the outbreak ended.

One of the key strengths of this study is the inclusion of all health facilities, both private and public, in the country; it is thus representative of the national situation. The conduct and reporting of this study also adhered to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines and sound ethical principles.^{14,15} Nevertheless, the study had some weaknesses. As with any routine programme data, errors at source of collection could not be ruled out. As countywide monthly aggregate data were used, interdependent linked characteristics could not be reported.

There was an unprecedented decline in all indicators of maternal health care during the Ebola outbreak, partly due to the major reporting gaps that occurred during this period. The downward trend of MCH indicators during the Ebola outbreak could also be attributed to low utilisation of services due to poor health-seeking behaviour, as well as the closure of most health facilities during the outbreak. The latter is in agreement with a study conducted in rural Liberia on the effect of the Ebola outbreak on facility-based delivery, where the authors reported an 80% reduction in service deliveries in counties where most of the health facilities were closed.¹⁶ Low service utilisation was also reported in a study conducted in neighbouring Guinea, where hospital records

TABLE 1 Comparison of mean monthly reported deliveries before, during and after the EVD outbreak, Liberia, 2013–2015

Type of delivery	Pre-EVD* mean <i>n</i>	During EVD* mean <i>n</i>	Difference† <i>n</i> (%)	During EVD* mean <i>n</i>	Post-EVD* mean <i>n</i>	Difference† <i>n</i> (%)
Institutional						
Skilled attendant‡	6468	4367	–2101 (–32)	4367	6618	2251 (52)
Unskilled attendant§	183	44	–139 (–76)	44	226	182 (41)
C-section	472	191	–281 (–60)	191	433	242 (13)
Outside facility	927	496	–432 (–47)	496	702	206 (42)

*Pre-EVD = July–December 2013; during EVD = July–December 2014; post-EVD = July–December 2015.

†Differences calculated by subtracting the numbers in the preceding period from the numbers in the following period.

‡Normal deliveries conducted in institutions by skilled attendants, including doctors.

§Normal deliveries conducted in institutions by unskilled attendants.

EVD = Ebola virus disease; C-section = Caesarian section.

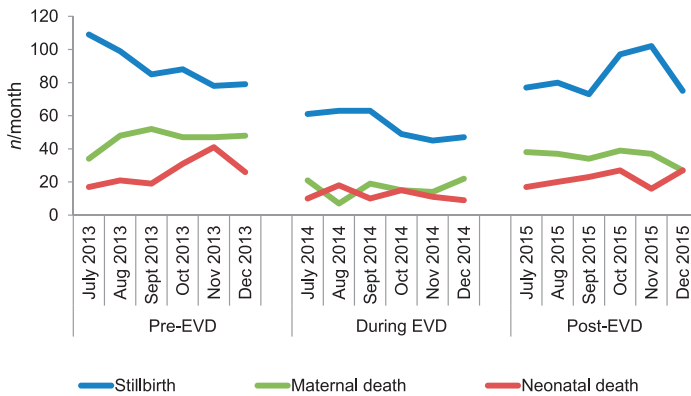


FIGURE 3 Trends in reported maternal and child health outcomes before, during and after the Ebola outbreak, Liberia, 2013–2015.* *Pre-EVD = July–December 2013; during EVD = July–December 2014; post-EVD = July–December 2015. EVD = Ebola virus disease.

showed a reduction in the utilisation of maternal health services.¹⁷

While the above may explain the decline in utilisation of ANC services, the high numbers of ANC1 visits and deliveries before the Ebola outbreak and the low numbers during the Ebola outbreak indicate reporting issues with the deliveries and consequently the outcomes, i.e., stillbirths and maternal and neonatal deaths. The closure of health facilities¹⁶ during the outbreak likely resulted in increases in home deliveries, which remained largely unreported. Furthermore, while institutional deliveries were reported immediately, the reporting system in the country depends entirely on postnatal care (PNC) visits to report home deliveries.

Missed PNC visits would therefore obviously lead to a failure to notify home deliveries, stillbirths and neonatal and maternal deaths if these occurred at home. This is in line with the suboptimal baseline data on indicators for stillbirths and maternal and neonatal deaths available in the national DHIS-2 database used in the present study (almost one third lower than pre-Ebola) compared to the 2013 National Annual Report and the 2013 Liberian Demographic and Health Survey.¹² Coupled with the generalised perception of the underutilisation of the health services, as discussed above, this might have further undermined PNC visits during the Ebola period and resulted in the under-reporting of home deliveries, stillbirths, and maternal and neonatal deaths observed during the Ebola outbreak.

The decline in institutional deliveries might be due to the general fear of contracting Ebola if delivering at a health facility, coupled with the strict ‘no touch’ policy implemented, the scarce supply of personal protective equipment and the repurposing of health workers.⁶ The decline in C-sections was likely also due to these factors and to the invasive nature of the procedure, which was generally avoided during the outbreak. Overall, the return of maternal health services to normal after the outbreak was reassuring.

The study has three important policy implications. First, the reporting system needs to be strengthened to avoid gaps in reporting, which prevents planning for resources and contingent measures during such outbreaks. Measures to improve reporting include more active reporting at community level and real-time online reporting by community health workers, similar to measures taken in Malawi.¹⁸ Strengthening the reporting system is important in planning for resources and arrangements to reduce maternal and child mortality, and to improve mother and child

TABLE 2 Reported maternal and child health outcome indicators before, during and after the EVD outbreak, Liberia, 2013–2015

A) Stillbirths vs. total births				
Period	Stillbirths		Total births	
	<i>n</i>	Rate*	<i>n</i>	RR (95%CI)
Pre-EVD†	538	11	48 864	Reference
During EVD†	328	11	30 781	0.61 (0.53–0.70)
Post-EVD†	504	10	48 260	0.60 (0.53–0.68)

B) Total deliveries vs. maternal deaths				
Period	Maternal deaths		Total deliveries	
	<i>n</i>	Rate‡	<i>n</i>	RR (95%CI)
Pre-EVD†	155	317	48 64	Reference
During EVD†	73	237	30 781	0.75 (0.57–0.98)
Post-EVD†	130	269	48 260	0.85 (0.67–1.07)

C) Total live births vs. neonatal deaths				
Period	Neonatal deaths		Total live births	
	<i>n</i>	Rate§	<i>n</i>	RR (95%CI)
Pre-EVD†	276	6	48 326	Reference
During EVD†	98	3	30 453	0.56 (0.45–0.71)
Post-EVD†	212	4	47 756	0.78 (0.65–0.93)

* Number of stillbirths/1 000 live births.

† Pre-EVD = July–December 2013; during EVD = July–December 2014; post-EVD = July–December 2015.

‡ Number of maternal deaths/100 000 live births.

§ Number of neonatal deaths/1 000 live births.

EVD = Ebola virus disease; RR = relative risk; CI = confidence interval.

care services and overall management of the services during any such future outbreaks.

Second, there is a need to improve institutional deliveries. This includes more advocacy, communication and social mobilisation in increasing institutional deliveries, empowering and incentivising mothers to have better access to care, implementing the lessons learnt from Uganda, India and elsewhere.^{19,20} Promotion of delivery by skilled birth attendants is especially important to reduce the generally high rates of maternal mortality and stillbirths in the country.

Finally, pre-emptive measures should be put in place to handle any such outbreaks in future. These include meticulous planning of resources and contingent measures, including training in infection prevention and control for all health care workers, promotion of safe practices in health facilities, and the development and implementation of strict standard operating procedures for institutions.²¹

In conclusion, our study confirms the fragility of Liberia's health system in providing adequate maternal health services during the Ebola outbreak. While there were major reporting gaps during the Ebola period, the utilisation of health facilities for maternal health remained low. These findings highlight the need for pre-emptive measures to avoid such disruptions in services during any future Ebola outbreaks in Liberia and similar contexts.

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Contexte : Toutes les structures de santé, publiques et privées, au Liberia, Afrique de l'Ouest.

Objectif : Déterminer l'accès aux consultations prénatales (ANC), aux accouchements assistés et à leurs résultats avant, pendant et après l'épidémie d'Ebola de 2014 à 2015.

Schéma : Étude descriptive transversale.

Résultat : Pendant l'épidémie d'Ebola au Liberia, l'ensemble des rapports mensuels des structures de santé a plongé de 43%. L'accès aux ANC a chuté de 50% et les accouchements déclarés ont diminué d'un tiers pendant la flambée. Les accouchements assistés par du personnel compétent et les césariennes ont décliné de 32% et de 60%, respectivement. Les accouchements en milieu médical ont

chuté de 35% et les accouchements déclarés en communauté ont dégringolé de 47%. Il y a eu un déclin général dans les déclarations de mortalité, de décès maternels et néonataux de 50% pendant la flambée. Les ANC, les accouchements déclarés et leurs résultats ont été restaurés au niveau d'avant la flambée dans l'année qui a suivi l'épidémie.

Conclusion : La fourniture de soins de santé maternels de base a été significativement fragilisée pendant l'épidémie d'Ebola. Dans le sillage des graves lacunes des rapports pendant la période d'Ebola et de la faible utilisation des structures de santé pour les soins maternels, ces résultats appellent des mesures visant à éviter de telles perturbations pendant les flambées à venir.

Marco de referencia: Todos los establecimientos de atención de salud del sector público y el sector privado de Liberia, en África occidental.

Objetivos: Analizar el acceso a la atención prenatal (ANC), los partos y los desenlaces obstétricos antes de la epidemia de fiebre hemorrágica del Ébola, durante el brote y después del mismo del 2014 al 2015.

Método: Fue este un estudio transversal descriptivo.

Resultado: Durante el brote epidémico del Ébola en Liberia se observó una drástica disminución de 43% del índice general de presentación de informes mensuales. El acceso a la ANC disminuyó un 50% y los partos notificados se redujeron un tercio durante la epidemia. Los partos atendidos por personal competente notificados disminuyeron un 32% y las cesáreas un 60%. Los partos institucionales

se redujeron un 35% y los partos notificados en la comunidad un 47%. Durante la epidemia se observó una disminución global de 50% en la notificación de mortinatos, muerte materna y muerte neonatal. La ANC, los partos notificados y los desenlaces obstétricos recuperaron los niveles anteriores a la epidemia durante el primer año que siguió al brote.

Conclusión: Durante la epidemia del Ébola se puso de manifiesto una fragilidad notable del sistema de salud en materia de prestación de los servicios básicos de salud materna en Liberia. Al revelar deficiencias mayores durante el brote epidémico del Ébola y una escasa utilización de los servicios obstétricos de los establecimientos de salud, los resultados del presente estudio exigen la adopción de medidas con el fin de evitar las perturbaciones durante epidemias futuras.