

"For this one, let me take the risk": why surgical staff continued to perform caesarean sections during the 2014–2016 Ebola epidemic in Sierra Leone

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ABSTRACT

Introduction Routine health service provision decreased during the 2014–2016 Ebola virus disease (EVD) outbreak in Sierra Leone, while caesarean section (CS) rates at public hospitals did not. It is unknown what made staff provide CS despite the risks of contracting EVD. This study explores Sierra Leonean health worker perspectives of why they continued to provide CS.

Methods This qualitative study documents the experiences of 15 CS providers who worked during the EVD outbreak. We interviewed surgical and non-surgical CS providers who worked at public hospitals that either increased or decreased CS volumes during the outbreak. Hospitals in all four administrative areas of Sierra Leone were included. Semistructured interviews averaged 97 min and healthcare experience 21 years. Transcripts were analysed by modified framework analysis in the NVivo V.11.4.1 software.

Results We identified two themes that may explain why providers performed CS despite EVD risks: (1) clinical adaptability and (2) overcoming the moral dilemmas. CS providers reported being overworked and exposed to infection hazards. However, they developed clinical workarounds to the lack of surgical materials, protective equipment and standard operating procedures until the broader international response introduced formal personal protective equipment and infection prevention and control practices. CS providers reported that dutifulness and sense of responsibility for one's community increased during EVD, which helped them justify taking the risk of being infected. Although most surgical activities were reduced to minimise staff exposure to EVD, staff at public hospitals tended to prioritise performing CS surgery for women with acute obstetric complications.

Conclusion This study found that CS surgery during EVD in Sierra Leone may be explained by remarkable decisions by individual CS providers at public hospitals. They adapted practically to material limitations exacerbated by the outbreak and overcame the moral dilemmas of performing CS despite the risk of being infected with EVD.

INTRODUCTION

The 2013–2016 Ebola virus disease (EVD) outbreak in Liberia, Guinea and Sierra Leone constituted a prolonged public health

Key questions

What is already known?

- The 2013–2016 Ebola outbreak disrupted routine health services in West Africa, but one study reported that Sierra Leonean public hospitals remarkably continued to perform caesarean section surgery despite the outbreak.

What are the new findings?

- Caesarean section surgery continued in Sierra Leone as individual providers at public hospitals were intrinsically motivated to continue to perform surgery despite being aware of the infection risks and stigmatisation of working with healthcare during the Ebola virus disease outbreak.
- In addition, providers demonstrated resourcefulness by adapting practically to the resource limitations, increased workloads and infection risks exacerbated by the outbreak.

What do the new findings imply?

- Ebola is a recurring health system hazard that constitutes significant threats to healthcare staff.
- Clear policies must be in place to ensure their protection especially for the surgical workforce.
- Failure to better support caesarean section providers might reduce the health system's ability to provide essential life-saving surgery in times of need and expose the surgical workforce to significant danger.

emergency that infected almost 30 000 and claimed over 11 000 lives.¹ The most high-risk group to contract EVD was health workers.² In addition, the EVD outbreak disrupted non-EVD healthcare services due to fear and reduced provision of health services.^{2–5} More recent outbreaks of EVD in the Democratic Republic of the Congo and plague in Madagascar have also disrupted routine health services significantly.^{6–8} This highlights the need for health systems to be resilient and withstand shock in order to manage excess

burden of disease caused by the epidemic, in addition to maintaining routine health services.⁹

The health system of Sierra Leone, badly damaged by the 1991–2002 Civil War, consists of public, private and private not-for-profit sectors. It faced multiple barriers to effective health service delivery before the EVD outbreak affected the country in early 2014. The health workforce is unevenly distributed between rural and urban areas, and there is a shortage of specialised healthcare staff.¹⁰ Maternal (1 360 per 100 000 live births) and under-5 (110.5 per 1 000 live births) mortality rates in Sierra Leone are among the highest globally.^{11 12}

Caesarean section (CS) is an essential health service that potentially saves lives when performed for the right indication. The WHO proposes that 10% of women attempting to deliver will require a CS.¹³ Before the EVD outbreak, CS was the most common major surgery performed in Sierra Leone.^{14 15} In 2012, the CS rate was 2.1%.¹⁶ The high unmet need can be attributed to a number of barriers, such as lack of finances, staff, equipment and healthcare infrastructure.^{14 17–21}

Despite these challenges, a study found that public hospitals in Sierra Leone unexpectedly maintained or even increased CS volumes during the EVD outbreak.²² While most studies focus on the negative impact of healthcare provision following the EVD outbreak, there is a need to increase the knowledge about successful examples of resilience.²³

In line with recent calls to understand the ‘recurrent failings’ of interventions in humanitarian crises and develop surgical guidelines for EVD,^{7 24 25} we explore factors that influenced the continuation of CS provision at public hospitals during the 2014–2016 EVD outbreak in Sierra Leone, from the perspective of CS providers.

METHODS

CS in Sierra Leone

Approximately 60 public and private health facilities at the district, regional and national levels regularly perform surgery in Sierra Leone.²⁶ Women who experience birth

complications at peripheral health units are routinely referred to these facilities for consultation (CS, repair of ruptured uterus and hysterectomy). Most of those health facilities are first-level hospitals, typically staffed by a medical officer or clinical assistants known as surgical assistant community health officers (SACHOs), both with basic surgical training, who perform emergency obstetric surgery such as CS alongside general surgical procedures. Referral hospitals are located in larger urban areas, offering a wider range of specialised services and employ more surgical staff.²⁶ We define *CS provider* as any health worker involved in CS surgery or CS-associated hospital care before and after delivery, irrespective of level of training.

The Free Health Care Initiative was introduced by the Ministry of Health and Sanitation (MoHS) in 2010 to guarantee free healthcare for children under 5 years and pregnant and lactating women.^{27–29} However, with fewer than three surgical care providers per 100 000 people in 2012—which is 10 times lower than recommended—Sierra Leone’s capacity to increase CS volumes has remained low.^{10 30} Most operations, including CS, were performed by non-specialised medical officers, and most surgical care providers were based in the capital, Freetown.^{14 19 26}

Study design

This study is based on qualitative, semistructured interviews with surgical care providers. The COnsolidated criteria for REporting Qualitative (COREQ) research tool has directed the reporting.³¹ Five public hospitals were purposively sampled from Sierra Leone’s four geographical areas. Hospital selection was guided by facility-level data on CS volumes from a prior study.³² Three hospitals, whose weekly CS volumes increased by ≥15% compared with a nationwide baseline survey performed prior to the EVD outbreak, were selected for inclusion (table 1). To allow cross-validation, two hospitals whose volumes decreased by at least 15% were also included.

Table 1 Change in average weekly volume of CS at the five study hospitals, before EVD compared with during EVD

Hospital level	Average number of CS weekly, 2014 before EVD	Average number of CS weekly, 2014–2015 during EVD peak	Change in average number of CS weekly, during vs before EVD peak	Change in weekly normal delivery volume, during vs before EVD peak (before, after)	Changes in CS rates, during vs before EVD peak (%)
Regional referral	2.1	4.7	2.6	–4.1 (32.9, 28.8)	46.9 (38.1)
Regional referral	2.7	3.9	1.2	–3.3 (14.7, 11.4)	34.0 (18.1)
National referral	25.6	30.3	4.7	–2.7 (67.3, 64.6)	16.5 (6.5)
District level	2.0	1.0	–1.0	–7.7 (12.0, 4.2)	18.6 (28.3)
District level	3.7	1.1	–2.5	–6.9 (13.0, 6.0)	24.7 (16.7)

EVD peak: peak period of EVD in Sierra Leone, defined as week 21, 2014, to week 20, 2015.

Numbers originally published in aggregate form by Brolin Ribacke *et al*³²

CS, caesarean section; EVD, Ebola virus disease.

The interviewer was a Swedish male medical student (GD), trained and ongoingly coached by experienced researchers in qualitative methods. The interviewer had no relation to the participants. The research was guided by the team members with extensive field and policy experience from surgery and EVD in Sierra Leone, and applied qualitative methods in resource-scarce settings.

Participant selection

Participant inclusion criteria were ≥ 6 months of work experience related to emergency obstetrics and obstetric surgery during the EVD outbreak (defined as week 21 of 2014 to week 20 of 2015). Surgically skilled providers were healthcare workers with surgical operating skills: specialised surgeons, non-specialised medical officers and SACHOs.³³ Malterud's theory on information power guided the sample size estimation.³⁴

CapaCare is a non-governmental organisation that offers surgical training nationwide in Sierra Leone and had studied hospital function during EVD.³⁵ Staff from CapaCare introduced the researchers to a suitable physician or other senior staff (medical superintendent or head nurse) at the selected hospitals. Participants were identified to reflect a broad variety of professions involved with performing CS. To secure a multidisciplinary sample, we purposively identified and invited surgeons, medical officers, midwives, surgical and anaesthesia nurses, and SACHOs to be interviewed on arrival to each hospital. We interviewed at least one physician and two other cadres per hospital. Apart from the medical officer or medical superintendents interviewed, participants were

sequentially recruited following advice from those interviewed (snowball sampling).

Interviews were conducted in English between September and November 2016. A total of 16 participants were invited, of whom 15 were interviewed, at five public hospitals from September to November 2016 (table 2). One medical officer declined because of time constraints. Their healthcare experience averaged 21 (range 7–36) years, and the interview durations averaged 97 (range 74–130) min. All but one participant worked in the same hospital at the time of the interview as during the outbreak.

Interview guide

To serve the aim of the study, an interview guide was developed using the WHO's six building blocks of health systems and a resilience framework by Kruk *et al* (online supplementary file 1).^{9, 36} Interviews started with open-ended questions on the routine function of surgery at participants' hospitals, continued with questions on the changes in patient flow, and ended with questions regarding changes in clinical practice and surgical system functions during the outbreak. A pilot interview was conducted with a SACHO in Freetown to ground the interview guide in the context. Interview locations were chosen to the comfort of participants and included offices, quiet corridors at hospitals and private clinics. Interviews were recorded and transcribed verbatim by GD, while one interview was transcribed by an assistant and later checked for content by GD. Field observations by GD and AvD from 14 public and private hospitals

Table 2 Participant characteristics

ID	Profession	Surgical	Facility performance	Time at facility in the EVD outbreak	Experience (years)	Age (years)	Interview (min)
1	Midwife	No	High	Full period	31	69	97
2	Scrub nurse	Yes	High	Full period	30	56	104
3	Midwife	No	High	Full period	16	45	96
4	Midwife	No	High	Full period	10	48	98
5	Specialised physician	Yes	High	Full period	32	56	130
6	Midwife	No	Low	Full period	27	50	82
7	Medical officer	Yes	Low	Middle to end	8	37	106
8	SACHO	Yes	High	Full period	30	52	120
9	Medical officer	Yes	High	Full period	7	36	84
10	Anaesthetist nurse	Yes	High	Full period	21	50	95
11	Scrub nurse	Yes	Low	Full period	20	40	90
12	Midwife	No	Low	Full period	15	43	74
13	Medical officer	Yes	High	Middle to end	36	60	106
14	Anaesthetist nurse	Yes	Low	Full period	7	38	82
15	Scrub nurse	Yes	Low	Full period	10	45	87

Information about the profession, period worked at the given health facility during the EVD crisis, experience from healthcare, age and the length of the interview.

EVD, Ebola virus disease; SACHO, surgical assistant community health officer.

provided contextual insight into surgical team composition, operating room capacity and hospital infrastructure at the district, regional and national referral levels.

Data analysis

Transcripts were imported to the qualitative software NVivo V.11.4.1 (QSR International) and read for immersion into data. Framework analysis was used to initially code transcripts into the predetermined categories made up of the WHO building blocks.³⁷ In a second step, the content was revisited and thematically coded to capture the specific changes that occurred during the outbreak. Thematic coding included identification of meaning units, combination of meaning units into broader categories and horizontal analysis of categories to identify overarching main themes. We then developed themes that capture how CS volumes at public hospitals continued during and despite EVD, in the perception and lived experience of surgical care providers. Data trustworthiness was safeguarded using a frequently revisited codebook and cross-checking of identified categories by GD, HMA and JVS until thematic consensus occurred. When available, raw quantitative data were used to triangulate statements from participants, for example, concerning increased or decreased healthcare utilisation. Whenever a transcription’s meaning was unclear, the original audio file was revisited.

Patient and public involvement

The research was conducted without patient involvement. Participant feedback from the pilot interview aided the development of the interview guide. Other participants were not invited to comment on study design nor the final manuscript.

RESULTS

Two overarching themes were developed from the interviews with the Sierra Leonean CS providers. The subthemes of the main themes below are presented in table 3.

Participants highlighted that CS volumes relied on the ability to adapt to both exacerbated and new barriers to CS provision. First, they reported a high degree of internal motivation among CS providers to overcome the moral dilemmas posed by the outbreak, such as being overworked in a hazardous hospital environment. The main motivators were their medical duty and loyalty to the communities. Second, there had to be pervasive clinical adaptability of individual CS providers in order to adjust to the clinical challenges, altered healthcare-seeking behaviour, arrival of international actors and intensified resource scarcity. Meaning unit analysis and categorisation according to the WHO building blocks are found in the online supplementary material 2.

Pre-EVD constraints to surgery and safety

The participants reported that pre-existing barriers to effective surgical care before EVD continued to impede surgical volume during the outbreak. Specialised surgeons were described as deficient long before EVD, and most operations were performed by medical officers. Three of the included hospitals had only one medical officer and one SACHO, while two hospitals also had a specialised surgeon. Hospital administrators procured supplies, but coordination with clinical need was described as limited before the outbreak. Protective materials were scarce and safety precautions were seldom adhered to despite awareness of nosocomial infections.

Table 3 Main themes and key findings

Themes	Overcoming moral dilemmas			Adapting to clinical challenges			
	EVD triggered heightened dutifulness	Increased dependence on the surgical team	Prioritising maternal health	Improved safety precautions	Changes in healthcare utilisation and referral patterns	International actors essential	Pre-EVD constraints to surgery and safety
Subcategories	With medical training comes great pride and responsibility. Outbreak fostered loyalty to the communities served.	Staff deaths. Staff overworked amidst dangers. Little absenteeism. Need for surgically skilled individual.	Obstetric emergencies prioritised highly. Elective surgery ceased.	Controlled slowing down of surgery. Improved early to overcome hazards. Reinforced by the arrival of IPC and PPE. Symptomatic similarities with EVD a barrier.	More obstructed labours due to delayed presentation. Patients shunted from closed private facilities. Public campaigns (sensitisations). Ambulances redirected to obstetric emergencies.	Broader EVD containment facilitated surgery. Provided EVD diagnostics, technical support and protective gear.	Barriers to surgery before the outbreak. Few surgical specialists. Broken supply chains and coordination. Lack of operative protection.

Underlying results sorted by WHO building block categories: see online supplementary material 2 for full category tables. Exploratory analysis of findings in the six predefined categories yielded results pertaining to the importance of the functioning surgical team, heightened dutifulness, maternal health priorities, safety precautions, referral and care utilisation patterns, and the role of international actors. EVD, Ebola virus disease; IPC, infection prevention and control; PPE, personal protective equipment.

This I will confess. In our nursing schools, they do teach us universal precaution, that's how to put on your gloves, your apron maybe. /.../ But before the outbreak of Ebola we really did not practice the universal precautions. (ID 3, Midwife)

Increased dependence on the surgical team

Most participants highlighted that clinically active, surgically skilled practitioners were essential to maintain CS provision during EVD. Participants felt pressured to work harder during the outbreak because colleagues had died of EVD. Absenteeism from work initially increased due to fear of infection. In addition, staff were reallocated to work at EVD treatment units. Especially in the first half of the outbreak, medical officers and SACHOs in particular were overworked and without human and material support from the MoHS. Despite this they stayed.

There were times when I didn't even have time to go to my house. I would take three, four days [of] work here. /.../ Because the number of cases that was coming was overwhelming. You keep working until night, and there are cases still to do. /.../ There were nights [when] we would get ten caesarean sections. I would stand throughout the night performing. (ID 8, SACHO)

We found no difference in perceived workload between surgical staff at high-performing and low-performing public hospitals. The essential role of the broader surgical team to keep theatres open and active was acknowledged by most participants. Surgical staff reportedly faced little absenteeism compared with other cadres at the hospital. Scrub nurses, anaesthesia nurses and midwives continued to show up for work and prepare patients for CS, sterilise equipment, and oversee admissions and discharge of CS patients.

The theatre staff were exceptional. The theatre staff were exceptional. /.../ Should we have very [many] emergencies, it's just a matter of making calls to those whom we believe should be working in the theatre, they did come. (ID 13, Medical officer)

Participants at low-performing hospitals argued that CS services ceased because the hospital's surgically skilled practitioners either died or were promoted and thus unable to operate. One public hospital failed to provide surgery for several months following the death of a medical officer. Participants at hospitals in adjacent districts sometimes increased patient volumes when the neighbouring hospital stopped to operate.

There was no doctor by then. So, there was a break in chain. All cases for surgery, [a district hospital] referred them to Freetown or to Port Loko. In November, December, January. Three good months. No surgery. (ID 12, Midwife)

EVD triggered heightened dutifulness

Surgical care providers of all cadres cited a heightened sense of duty as the main reason for going to work during EVD. While initial absenteeism was acknowledged, it was emphasised that staff were motivated by professional

pride, and that this made them continue despite the direct risks, contextual stresses, fears and uncertainties. Some participants argued that their medical training played a unique role. A couple of participants invoked notions of the Civil War to describe their determination.

Some will go to the warfront to fight. Some will die, but we still stayed. If I stop, who will do my job? (ID 6, Midwife)

According to staff, the outbreak fostered a sense of common responsibility for one's community. The notion of social duty, as one dimension of professional pride, was strong across surgical cadres and was important to overcome traditional barriers to service provision, including extreme work burden and unpaid salaries.

We are working directly for our people. /.../ The community where I am working here, most of them are *my* people. /.../ So even if I don't want to work because I'm not being paid, I am prompted to work because the others will just come, 'doctor, that is our cousin, this lady there, this is our other relatives this is an uncle' or whatever. These are the things: it is not actually money, but it's just that we are working in a place where we are surrounded by our own people. (ID 13, Medical officer)

Simultaneously, all participants experienced significant pressure from communities and families to stop operating because of the personal risks. To carry on their duty, staff occasionally lied to their families and communities.

Back home I told my family 'I don't do surgeries, I don't wear PPE [Personal Protective Equipment]', while I was actually doing surgeries. (ID 7, Medical officer)

Prioritising maternal health

Participants highlighted that the urgent nature of complicated pregnancies made emergency CS the highest surgical priority. Several participants noted an increase in pregnancy complications requiring CS. This is supported by quantitative data demonstrating that normal delivery rates decreased by 4%–65% at the study sites (table 1). Because of limited surgical capacity during the outbreak, several providers said they had to carefully prioritise which surgical cases to operate and which could wait. Obstetric emergencies risked the lives of both the unborn foetus and the mother. Many participants said they justified the risks of operating by the fact that waiting for rapid EVD test results before operating would have potentially devastating implications.

Definitely she will even die if [we postponed surgery] all that time. So, I will take the risk. I will say 'no, for this one, let me just take the risk'. Especially for the ruptured uteruses. (ID 8, SACHO)

The lack of protective gear in the early phases of the outbreak made the operations stressful. Participants recalled cancelling elective surgery in favour of emergencies. They mentioned that elective surgery was postponed during the outbreak. They did not specify exactly when this prioritisation began.

Improvised safety precautions

Participants often highlighted the need for improvised safety measures. They noted that provision of surgery was purposefully slowed down early in the outbreak because of the risks and low-quality infection prevention and control (IPC) measures. However, as tested protective equipment was brought by foreign actors, surgical efforts were resumed.

[F]irst, they stopped operation, that was the first. Because, one, material was not enough until when the British came /.../, then the dressing, usually /.../ we just [went with] any outfit we want to a patient, but now we don't go to a patient without using apron. (ID 1, Midwife)

It was observed that protective strategies evolved with time to minimise the everyday risks. Staff undertook 'no-touch' policies and used double gynaecology gloves and rubber boots in theatre. Women with unclear EVD status were isolated until EVD was ruled out, despite the risks for the pregnant women and the foetus. Some participants said they decreased the EVD risks by operating quicker, although some hospitals were said to slow operations down in order to minimise adverse events such as pricking oneself.

At that time, we did not know if a patient was Ebola positive, because they needed to be tested, and at that time the test result maybe comes five days later, prior to surgery. So, we need to wait for the result to come or we take our risks and treat the patient. Very, very, very dangerous risk. (ID 5, Specialised physician)

Some participants mentioned that women sometimes died while waiting to be screened for EVD. Participants did not believe that staff withheld CS surgery until the last moment. Instead, CS indications reportedly remained constant in relation to healthcare utilisation. Participants indicated that CS outcomes worsened due to the unavailability of rapid EVD tests early in the outbreak.

The [EVD test] results were slow to come in. It might take days. So, by the time they come in the patient is in the triage system and would be very, very more sick [sic] and hopeless. And later we lost most of the patients. (ID 9, Medical officer)

Other clinical compromises resulted from pre-existing resource shortages. For example, the surgical practitioners had to use absorbable instead of non-absorbable sutures. Surgical and labour ward nurses reduced blood pressure monitoring and basic clinical services such as blood sample testing due to lack of basic protective equipment.

Changes in healthcare utilisation and referral patterns

Many participants suggested that CS volume increased because more pregnant women than before EVD sought care for birth complications at public hospitals. Routine maternal health services reportedly ceased during the outbreak. Participants believed that failures to detect

maternal complications early resulted in higher need for emergency obstetric surgery.

[We were] doing very, very bad obstetric cases. A lot of ruptured uteruses, more than thirty to thirty-five percent of the indications by that time, for the obstetric interventions, were ruptured uterus. Simply because, initially even the patients and relatives knowing [that] this patient needs hospital care for delivery, but they also lack confidence of coming to the hospital. So, they will stay home and try. So that has been their first line. And when they [attempted] very wrong and crude manipulations, they end[ed] up in hospital with ruptured uterus. You see. So, there were a lot of bad obstetric cases. (ID 9, Medical officer)

Participants believed most private hospitals ceased performing CS during the outbreak, driving pregnant women to public hospitals. Some participants experienced increased patient influxes when a nearby maternal clinic was converted into an EVD treatment unit. Healthcare utilisation was helped by information campaigns known as public sensitisations, which neutralised rumours about hospitals and healthcare workers spreading EVD. It was also suggested that the referral system improved as the international response brought more ambulances and improved communication between health facilities in the end of the outbreak. This improvement to the referral system may have increased CS volumes at public hospitals.

International actors essential

Participants often noted that their capacity to perform surgery increased when international actors started providing direct hospital support, towards the peak of the outbreak. Actors ranging from non-governmental organisations and WHO agencies facilitated the implementation of IPC, personal protective equipment (PPE), sterilisation equipment and diagnostics. They also brought materials for the theatre, including sutures, gloves, and occasionally advanced equipment such as suction and anaesthesia machines.

During the Ebola, /.../ we started having supplies from different NGOs, yes, the Ministry of Health was supplying. Other NGOs, and other partners were supplying. So, we start having enough supplies. (ID 12, Midwife)

The rapid EVD test in particular was praised for contributing to reduced preoperative delays and increased CS volumes.

Initially it took so long and we were taking more risks. But later we were lucky, they came with rapid test kits. And that actually helps to deliver the uptake of surgery. (ID 8, SA-CHO)

Safety precautions embraced during the outbreak were reportedly retained after the outbreak. They ranged from routine handwashing at the ward and the use of examination gloves, to wearing PPE for routine surgery.

Before the Ebola, I was saying frankly that we were so careless. /.../ That's why most of us were involved in this crisis.

Because /.../ we are taught all those [safety precautions], but /.../ we deviated from all those things. But after the Ebola, we are conscious. (ID 6, Midwife)

DISCUSSION

This study aimed to explore why government hospitals in Sierra Leone continued performing CS during the EVD outbreak, from the perspective of the healthcare professional on the front line. We found that CS provision depended on the internal motivation of the healthcare staff and their adaptability to the pervasive clinical challenges during the outbreak.

Overcoming moral dilemmas

The reported risk-taking by individual CS providers during the EVD outbreak was a striking finding. Staff were aware of the risks; many had colleagues or relatives who died from EVD. Although interviewees acknowledged the widespread fear and stigmatisation, their accounts reveal a strong sense of responsibility and heightened dutifulness for the community. They were also motivated by the urgency of obstetric emergencies, the development of safe standard operating procedures and the strong identification with their professional obligations.

These findings reflect previously reported sources of motivations during EVD: professional duty, religion and responsibility for one's community.^{38–40} Similar motivations have been reported in other studies by rural midwives, who also continued to offer basic maternity services during the EVD outbreak.^{38–39} In addition, community health officers bridged primary healthcare efforts to the formal health systems, partly thanks to internal motivation but also because of their customary high standing in the community.⁴⁰ These narratives challenge the literature on staff morale in emergencies. Previously, concern for self and family has been suggested to outweigh professional duties during disasters, the so called 'disaster dilemma'.⁴¹ In comparison, it is remarkable that at least one of our study participants even lied to the family about performing surgery. These intrinsic motivations might explain the remarkable productivity demonstrated by surgical care providers in Sierra Leone during EVD.²²

Although late, the international EVD response facilitated surgery at a stage when individual adaptations and improvisation could not further increase CS rates. Staff reported that the scale-up of the global response with rapid EVD tests, protocols, materials and IPC helped to maintain CS services.^{42–44}

Although financial motivations were not specifically assessed in this study, previous experience and reports from Sierra Leone indicate that the lack of regular salary payment and shortage of financial incentives caused significant problems, even riots and strikes among healthcare providers.^{45–46}

Adapting to clinical challenges

This study also found that CS providers adapted stepwise to the obstacles posed by the EVD outbreak. Individual

efforts were central to CS provision, as surgical champions had to work around pre-existing challenges, such as the shortages of protective gear, safety procedures and surgically skilled providers. CS providers minimised touching, reduced operation durations, isolated suspected EVD cases and postponed elective surgery, thereby minimising potential EVD exposure while allowing some degree of surgical activity.

These remarkable findings echo those of the literature from low- and middle-income countries. Staff in low-resourced contexts are often forced to adapt to and navigate resource scarcity and heavy workloads.^{47–48} This might explain why some of the coping strategies at public hospitals during EVD seemed to evolve with time as bottom-up developments, rather than sudden top-down policies.^{7–9} Although some coping strategies precluded non-CS surgery and reduced the completeness of perioperative care processes, they ultimately protected the surgical workforce and contributed to the resilience displayed by CS surgery. In contrast, one particularly EVD-exposed hospital lost 25% of its surgeons early in the outbreak and subsequently reduced surgical volume by 97%.⁴

Maternal and child health tend to be underprioritised in humanitarian crises, and the transmission of EVD via fluids posed significant risks for staff in fluid-rich obstetric surgery.⁵⁰ Yet we noted that surgical staff overtly prioritised emergency obstetric patients during the outbreak. Our study did not elucidate whether this priority resulted from formal or informal decision making. But it suggests that the urgency of CS and sense of empathy for women with life-threatening birth complications imposed this priority on staff.⁴⁰ In addition, ambulances meant for EVD patients were rerouted to transport women with birth complications to public hospitals.⁵¹ This suggests that while a resourceful workforce can compensate to some extent for failed hospital functions, higher level coordination of healthcare functions such as patient logistics is needed.

Study limitations

Hospital case fatality data were not available for the study period. Jones *et al*.⁵² estimated that maternal mortality ratio and stillbirth rates across all districts increased 34% and 24%, respectively.

The results of our study may have been influenced by a selection bias, as staff who died from EVD or left since the outbreak were not interviewed. There might have been a profession bias towards nurses and midwives since fewer physicians were included. This might have limited our understanding of the managerial perspective, as physicians often have leadership roles at Sierra Leonean hospitals and therefore unique insights into hospital function. Administrators might also have knowledge of specific facets of hospital functioning but were excluded due to our focus on lived clinical experiences. Recall bias was reduced by a carefully structured interview guide and by conducting interviews close to the end of the outbreak.

Hierarchy, trust and power dynamics between providers and managers might have limited the reported criticisms to CS provision. We also acknowledge that there might be a performative aspect of recall when people portray themselves in a positive light after overcoming tough challenges. However, participants recognised that women died when the surgical and anti-EVD practices failed, indicating that performative recall was low. The interviewer characteristics might have affected interviewees to hold back on details they did not believe lived up to European standards but could also have established an open interview relationship.

The multinational impact of the 2013–2016 EVD outbreak was unique in scope, but we believe that the key implications of this study might be transferrable to other types of outbreaks. For instance, WHO has acted with greater urgency to contain outbreaks of EVD in Congo (2017), Zika in Brazil (2015) and plague in Madagascar (2017), possibly informed by lessons learnt from the EVD outbreak in West Africa.^{6 53–55} High-income settings can also be exposed to outbreaks and might face similar challenges to CS or surgical provision. For example, a Taiwanese study suggests that the need for emergency surgery persisted whereas that for elective surgery decreased following the 2002–2003 severe acute respiratory syndrome outbreak.⁵⁶ However, our findings might not apply to the trauma-heavy surgical need resulting from natural disasters and armed conflict.^{53 57}

The study was conducted to high information power, across five dimensions defined by Malterud *et al.*³⁴ The research question was narrowly focused at CS at public hospitals. We applied a dense selection of participants (specific sampling), an extensive interview guide (theory basis) and explored staff narratives in great depth (quality of dialogue). After visits to five hospitals, the development of CS provision following the EVD outbreak was clear, and the interprofessional interactions had been described at a level of detail deemed sufficient.

Policy implications

Drawing lessons from CS provision in Sierra Leone might help improve routine health services in future epidemics. This study found that when international ‘leadership, solidarity, and systems’ failed during EVD, local CS providers were punching above their weight.⁵⁸ Human resources are at the core of a resilient health system, and policymakers need to consider that staff have different motivations and fears. Health ministries can prepare for future shocks by ensuring that the health system understands these motivations, because EVD, Lassa fever, and plague resurface cyclically in low-resourced settings.^{6–8 59} Top-down initiatives can harness the bottom-up resourcefulness displayed by staff during EVD. For instance, policymakers can support staff with PPE, EVD vaccines, rapid EVD tests, surgical materials and equipment, payment of salaries, and protection against burn-out.⁷ Sterilisation and waste management will further improve the safety of CS surgical providers, who have been nicknamed ‘the

unprotected workforce’ in Sierra Leone.²⁰ Leadership training for key health workers will improve hospital management and local stewardship in future outbreaks.

These functions should be at the core of health systems prospectively and not be delayed until epidemics manifest. Without such measures, health systems risk repeating the ‘recurrent failings’ of health interventions during crises and will not be able to ensure service delivery in neither epidemics nor times of relative calm.²⁴

Conducting research in public health emergencies is complex. Ethical issues arise from allocating scarce resources on data collection during a crisis as well as retrospectively researching a disaster overcome. More transparent and continuous reporting by aid agencies have been suggested feasible solutions.^{22 60} Evaluations might run the risk of lending too little agency to the frontline workers involved in the EVD response. Policymakers should make sure to interpret the assessment of local healthcare performance against the backdrop of the broader health system failures and pre-existing standards.²⁴ Individual interviews in the local setting can position and situate performance assessments to the contextual challenges of providing routine healthcare during disasters. Inevitably, this must include the voices of local frontline workers, supplemented by evaluations from international agencies and researchers.

CONCLUSION

Our interviews found that the continued CS provision during the EVD outbreak in Sierra Leone depended on individual providers. Public hospitals relied on resourceful and motivated individual surgical champions that prioritised obstetric emergencies. A resilient health system may withstand shocks such as an EVD outbreak for a short period if it has local healthcare heroes that are willing to take risks. However, individuals cannot compensate for health system shortcomings without support. Such support must be prepared and ready to be implemented and include protection of and support for healthworkers at significant risk. This might both improve routine healthcare provision and build health systems resilience against the shocks of future epidemics.

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interview guide was designed by GD, HM-A and JVS. Data analysis was conducted primarily by GD, HM-A, AvD and JVS throughout the study. All authors have revised the manuscript and cleared it for publication. All authors take responsibility for the content and ensure accuracy for the manuscript in full.

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