Stockholm Evaluation Unit

OCB EBOLA REVIEW

Part 1: Medico-operational

[March 2016]

This publication was produced as part of a broader review on OCB's response to the Ebola emergency. It was prepared independently by **Marie-Pierre Allie, Robert Colebunders, Veronique de Clerck and Javier Gabaldon**.

DISCLAIMER

The authors' views expressed in this publication do not necessarily reflect the views of **Médecins sans Frontières** or the **Stockholm Evaluation Unit**.

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Front Cover Photo by Fernando Calero/MSF:

Musu Kennedy, Ebola Survivor

Musu was admitted to the Ebola Treatment Centre ELWA3 on November 10, where laboratory tests confirmed that she was Ebola-positive. She recovered, testing negative for the first time 13 days after her arrival at ELWA3. But instead of going home, she chose to remain in the centre to care for Siah Borbor, an 11-year-old girl who had lost both her parents. Siah was declared Ebola-free on 24 November, the same day that her little sister passed away. Her aunt and her little sister came to pick her up and bring her home.

Musu contracted the virus through helping sick people in her church, where she is the President of the Youth Club. No other members of her family got infected.

ACRONYMS

ALIMA	Alliance for International Medical Action
CFR	Case fatality rate
CHW	Community Health Worker
CT	Cycle Threshold (for Ebola diagnostic test results)
ETC	Ebola Treatment Centre
EVD	Ebola Virus Disease
FHF	Filovirus Haemorrhagic Fever
GSK	GlaxoSmithKline
GRC	Gondama Referral Centre
HCW	Healthcare Worker(s)
HQ	Headquarters (at MSF)
HP	Health Promotion
IFRC	International Federation of the Red Cross and Red Crescent Societies
IPC	Infection Prevention and Control
IV	IntraVenous
MoH	Ministry of Health
MOU	Memorandum of Understanding
MSF	Médecins Sans Frontières
MTA	Material Transfer Agreement
NGO	Non-Governmental Organisation
OC	Operational Centre
OCA	Operational Centre Amsterdam
OCB	Operational Centre Brussels
OCBA	Operational Centre Barcelona
OCG	Operational Centre Geneva
OCP	Operational Centre Paris
PPE	Personal Protective Equipment
UNICEF	United Nations Children's Fund
VHF	Viral Haemorrhagic Fever
WHO	World Health Organisation

1. EXECUTIVE SUMMARY

This review provides a dynamic picture of the OCB Ebola intervention over the period between 1 March 2014 and 31 March 2015. It also presents a critical analysis of the operational and medical choices made and identifies lessons for improving future responses to Ebola or other large-scale epidemics.

For months, the epidemic spread faster than the international community's response. MSF was instrumental in sounding the alarm in March 2014 and intervened immediately, increasing its response and capacities in accordance with the outbreak and stretching the organisation to its limits. Today, OCB is considered a reference point as a medical and humanitarian organisation, with major legitimacy in the Ebola response.

Classical Ebola response strategies quickly showed their limits in this context. The intervention strategy oscillated between a total assumption of the response, addressing all six pillars of an Ebola response, (the approach taken at the beginning and end of the outbreak) and a central focus on the ETC at the outbreak's peak.

MSF-OCB was the first, the main and the most experienced provider of Ebola Virus Disease (EVD) care and did so for close to 4000 confirmed patients (as of the end of March 2015). Protection of MSF staff was the top priority, resulting in the establishment and implementation of excellent biosafety guidelines.

The level of patient care varied among Ebola Treatment Centres (ETCs) and fluctuated over the course of the outbreak, depending on the number of patients, beds and healthcare workers (HCW). At the peak of the outbreak there were periods when not all suspected cases could be admitted to the ETC, and instead some were sent home or had to wait outside the ETC. The worst such period was in ELWA 3 at the end of August 2014. The overall mortality rate in MSF ETCs was on average 51% in 2014.

Psychosocial care was provided from the onset of the response to staff, family members, patients and survivors by a team of trained HCW. Counselling was upon referral or self-referral, and counsellors also did rounds among the teams to proactively identify issues. Though not implemented systematically from the onset, families were supported through phone contact and allowed to bring gifts, and a grief team was established to counsel family members whose loved one(s) had died. Peer care established itself in many ETCs: Due to the limited time nurses could spend inside the ETC's high-risk zone, less sick patients often started taking care of the severely ill. These caretaking patients functioned as a lifeline for others, providing hope, care and dignity in a stressful environment.

Knowledge transfer was a key factor for scaling up the response capacity, both internally and externally. By collaborating and for the first time providing training to non-MSF actors, OCB enabled other organisations to respond. Due to internal delays, the well-known "first reponder course" only fully started in September.

This review identified **clear differences in Health Promotion (HP) outcomes, depending on the level of investment made.** Activities within communities demonstrated several weaknesses in strategic design, timely implementation, and monitoring and evaluation. While HP was part of the work at ETCs from the onset, outreach and community activities were not consistently rolled out; in some locations it took several weeks after ETCs opened for the latter to become operational. While this is largely explained by HR constraints, it also partly reflects the lower overall priority given to HP within MSF, the delay in availability of comprehensive HP guidance documents, and missing links to establishing effective communication with communities. MSF's decision to train other actors on HP had far-reaching, positive implications: in addition to improved relations among actors on the ground, these trainings resulted in better harmonisation of messages across the different actors, and in helping training participants become agents of change.

The approach of proactive community/survivor engagement was empowering, and restored dignity to patients and communities. However, use of MSF anthropological assessments was initiated too late in

the intervention. In addition, more timely analysis of these assessments, and sharing of results with the field, could have supported response teams in adapting their approaches and tools earlier in the outbreak.

OCB was engaged in outreach (alert, response, contact tracing) to varying degrees and with differences in approaches over time, and among and within countries. Except at the beginning in Guéckédou or Télimélé there were often no teams dedicated specifically to outreach activities, which were therefore conducted in such settings only when staff had extra time available, especially during phases when teams were overwhelmed. During the review period contact tracing was being done mostly by other actors (MoH, WHO). MSF has been critical of the way in which contact tracing was performed, but many interviewees recognised that it was an impossible task in many locations, given the large numbers of cases and transmission chains.

The distribution of protection/disinfection kits in Monrovia was an innovative initiative in an overwhelming situation. These kits gave people means to protect themselves if a family member became ill, and allowed them to disinfect their homes to cut the risk of transmission.

Non-Ebola health care during the epidemic was disastrous. In Liberia and Sierra Leone, patients in need of hospitalisation were left moving from one medical structure to another after being refused attention. Implementation of Infection Prevention and Control (IPC) programmes in non-MSF health facilities showed strategic weaknesses. Though IPC guidelines were very clear, MSF failed generally to effectively implement these programmes at the onset, because of the priority given to patient management at ETCs.

Epidemiological surveillance during this outbreak was poor for periods of up to several months. Epidemiologists were deployed to each location where MSF was present, but they were poorly coordinated and their analyses were rarely used to redefine strategy. There was no standardised way to collect data from ETCs. This led each centre to set up and modify its own system based on the views of the particular epidemiologist or data manager on the ground. Additionally, the compilation and analyses of data, mainly from ETCs, was carried out late. Only in October was an epidemiologist appointed to the Ebola Task Force.

Staff at ETCs tested and implemented numerous innovations and good practices in terms of organisation of care, equipment, data transfer from the high-risk zone, and care for survivors. However there was also a reluctance to test innovative approaches to care during the peak of the epidemic. The large-scale distribution of malaria treatment by OCP and OCBA as well as the mass distribution of protection/disinfection kits in Monrovia are other new types of interventions that should be evaluated.

There was little proactive planning for operational research, but overall scientific output has been high. This was largely thanks to the initiative and involvement of returning field volunteers. The lack of standardised data collection hampered operational research. Publication of certain clinical findings and lessons learnt was slow, and research results will therefore be useful mainly for future outbreaks. The options of experimental treatment and vaccination were explored only after the outbreak's escalation in July/August. Thereafter OCB participated in clinical research on new products, including trials of 3 therapeutic experimental products and a new vaccine as well as a feasibility study for a better, easier-to-use diagnostic tool (GeneXpert). Involvement in clinical research on such a scale during an emergency was new for MSF.

Lack of the right numbers and/or types of HR is cited repeatedly throughout the report as a major constraint on the intervention. Management of national and international HR was also part of the Ebola review process and is the subject of a separate report, hence not addressed in detail here.

Following this outbreak, OCB should capitalise on the many lessons learnt during this intervention, finalise the draft guidelines developed during the epidemic, and improve tools for data collection and analysis. It will be also important to define how MSF wants to collaborate with other organisations in the areas of training, mentoring, and coaching during future medical emergencies. Furthermore, evaluators

recommend that MSF should develop more research capacity within the organisation, should establish a research think tank for clinical and operational research, and should improve collaborations with selected outside research institutions/experts, including by making further investment in building capacity of African staff.

2. BACKGROUND

OCB's response to the Ebola outbreak in Western Africa was complex and challenging. Inevitably, questions have arisen as to whether the choices made were timely and optimal. For this reason the OCB management commissioned an extensive, multi-sectoral review of the intervention, focusing on the time period from 1 March 2014 to 31 March 2015.

This report on medico-operational issues identifies examples of good and bad practice throughout the OCB response. It identifies lessons learned and draws recommendations that can improve guidelines and strategies for future response. In several places it refers to the other reports of the OCB Ebola review.

These other sub-reviews cover human resource management, water and sanitation, supply, logistics, communications and advocacy, and governance. A review of treatment centre design and construction was included in the OCB review process, but was commissioned by OCA and looked at all MSF Ebola treatment centers.

A separate summary report highlights main findings from each of the full review's reports. All reports are available on http://evaluation.msf.org.

2.A Introduction

On 23 March 2014, Ebola Virus Disease (EVD) was identified in Guinea. From there it spread rapidly in the West African region, which was unfamiliar with the disease; before long it was present in the neighbouring countries of Liberia and Sierra Leone and had given rise to the first large urban outbreaks of Ebola.

MSF Operational Centre Brussels (OCB) responded to this epidemic, taking on responsibilities beyond what it viewed as its mandate, due to the delayed response of others in the medical and humanitarian community—both the World Health Organisation (WHO) and regional governments initially denied the gravity of the challenges this outbreak presented. OCB also faced the difficulty of dealing with a disease about which little was known: there were no effective drugs or vaccines, and more questions than answers on key issues such as risk factors, persistence, and relapse.

2.B Description of the outbreak

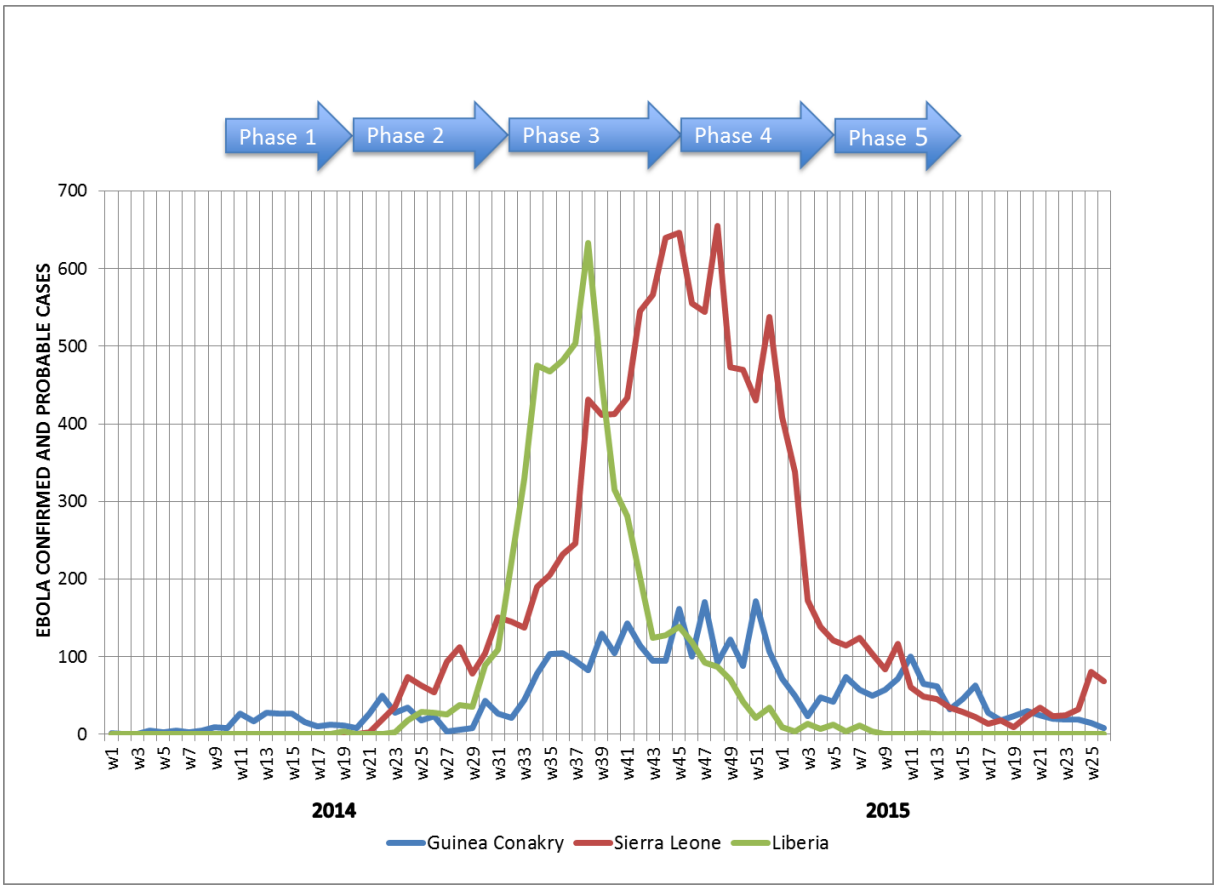
In December 2013 an Ebola outbreak emerged in the south of Guinea, where Ebola had never been seen before. A three-month delay between the first patient and recognition of the outbreak by health authorities allowed the virus to spread to the capital city of Conakry and to neighbouring Liberia and Sierra Leone. Initially MSF was alone in providing aid to contain the virus, efforts that proved unsuccessful despite some positive signs at the end of April. In subsequent months the outbreak spread throughout all three countries, and by August 2014 had become the largest Ebola epidemic in history. In late 2014 it showed the first signs of subsiding.

During preliminary discussions between the evaluation team and decision-makers at OCB, it was agreed to define the intervention between March 2014 and March 2015 as divided into five phases. These phases are indicated in Fig. 1 (below) and defined as follows:

Phase 1 (March—April 2014): Declaration of the outbreak in Guinea. Although the outbreak was characterised as unprecedented, until the beginning of May there was hope that it could be controlled—even though at the same time some key actors within MSF continued to raise alarms.

Phase 2 (May—July 2014): EVD spread to neighbouring countries and case numbers increased. The absence of a response from other actors obliged MSF to continue and expand its intervention.

Fig 1. New probable and confirmed cases per week, by country (January 2014- June 2015) (*Source: WHO*)



Phase 3 (August—October): The number of cases increased dramatically in all three countries, with a very sharp peak in Monrovia. MSF urgently called on other actors to intervene, while limitations in capacity forced OCB to prioritise selected aspects of the 6-pillar intervention. Based on a humanitarian perspective, OCB decided to focus on isolation and care. However, even within this narrowed intervention, in some places the overwhelming number of patients relative to staff meant that priority had to be given to providing only a reduced package of care.

Phase 4 (November 2014—February 2015): More actors were on the ground, enabling OCB to diversify its activities and re-introduce more flexible approaches.

Phase 5 (February—March 2015): The outbreak was still ongoing but an organised response was present. The improved conditions on the ground made it possible for OCB to evaluate innovations within its response and to conduct research on possible Ebola treatments.

2.C Objectives of this review

The first aim of this review is to provide a dynamic picture of OCB's intervention over the five epidemic phases from 1 March 2014, when MSF's response began, through 31 March 2015. This overview includes a critical analysis of the intervention and the operational and medical choices made, and of the appropriateness and effectiveness of the different strategies chosen. The second aim is to identify lessons learnt, based on these assessments and on evidence gathered during the intervention, and to

capitalise on them by formulating recommendations about good practices for future Ebola epidemic response initiatives led by OCB.

The review is limited to interventions under the direct operational management of OCB in Liberia, Sierra Leone and Guinea.

Following are the key issues addressed in this medico-operational review, as delineated in the Terms of Reference (ToR) drawn up prior to this evaluation. A full description of the ToR is contained in the original documents, which are available on the MSF evaluation website.[1]

- Investigate the effectiveness of the OCB Ebola intervention in the following areas:
    a. Patient care[2]
        i. Clinical care (triage, diagnosis, treatment, nutrition support, psychosocial support, survivor care, caretaker support, laboratory activities, level and organisation of care, palliative care)
        ii. Paramedical care
        iii. Operational support activities (flow, organisation, etc.)
    b. Infection control within the Ebola Treatment Centre (ETC)
        i. Personal Protective Equipment (PPE)
        ii. Safety procedures
    c. Health Promotion (HP)
        i. Was HP an integral part of the intervention in the ETC? In the community?
        ii. Were the strategies and methods used adapted to each setting and time period? Were they timely, appropriate, and effective?
    d. Outreach (alert, response at community level, contact tracing)
        i. What role did MSF play in these activities?
        ii. Should this role have been larger?
    e. Surveillance & epidemiological follow-up
        i. Data availability and reliability
        ii. Use of these data as a decision-making tool
    f. Non-Ebola care (infection control)
    g. What were the gaps in baseline protocols? How were these gaps filled and protocols adapted over time?
    h. What innovative approaches were introduced?
- Identify operational research initiatives and missed opportunities
- How was the research agenda defined? What mechanisms will be used to integrate the research outcomes into future Ebola response strategies?
- Evaluate the participation of MSF in treatment trials

[1] For ToR see http://evaluation.msf.org/ocb-ebola-critical-review-work-page-1

[2] Two different terms were used to designate Ebola care structures: Ebola Management Centre and Ebola Treatment Centre. We use the term ETC throughout this report.

- Were the different operational approaches balanced in terms of availability of resources and adaptation to the different scenarios in the different places?
- What was the relative priority given to the different pillars of the intervention? Were they equally timely? How were they prioritised?
- How did the OCB response link to that of other actors? What role did OCB play in Ebola response coordination in the different countries and locations?
- Was the operational management adapted to the scale and complexity of the crisis? (Feedback on this question is provided in the governance review report.)

Analysis of the evaluation team's findings takes into account the phase of the epidemic (onset, epidemiological peak, declining trend) and the different settings (urban/rural) in the three countries.

Section 3 of this report describes the methodologies used for this review and discusses their limitations. Findings and analysis of the issues listed above are presented in Section 4. Finally, Sections 5 and 6 consider and respond constructively to questions such as:

- What could have been done better?
- What alternative choices were available and what, if anything, prevented OCB from choosing these alternatives?

3. EVALUATION METHODOLOGY & LIMITATIONS

Although this review covers only the time span from March 2014 to March 2015, certain events occurring after that period were taken into consideration since they were consequences of earlier research and reflection.

3.A Methodology

- Desk review using a newly created database (Knowliah) to collect and identify relevant documents and emails
- Field visits to Guinea, Liberia, Sierra Leone
- Group discussions with MSF national staff
- Interviews (N=215) with the most relevant internal and external actors in this response, including MSF people at different levels of the organisation; national staff; representatives of key institutions; national authorities; staff from non-governmental organisations (NGOs), UN agencies and the US Centers for Disease Control and Prevention (CDC); affected populations; and Ebola survivors and their families
- Online survey sent in September 2015 to all MSF Ebola field staff with an active e-mail address (N =777). The overall response rate was 33%. The survey was designed in several parts. The first part solicited feedback on human resource issues, including training and stress management. Other parts directed respondents to specific questions depending on their area of work, asking appropriate subgroups about issues such as their experience using MSF guidelines and their views on the quality of care indicators used and on MSFs overall performance in the field. Response rates to these more targeted questions were variable: 51% for emergency coordinators, 43% for epidemiologists, 30% for WatSan staff and 25% for medical staff.
- Coordination meetings among consultants and discussions on transversal issues

3.B Limitations

The timing of this evaluation, particularly the field visit (which occurred only after most ETCs had been dismantled), was a limiting factor in information collection, despite the huge volume of written material. This is because the MSF teams and partners were not present at some sites during field visits or had moved on to other projects, and because it was no longer possible to observe the projects in action.

In Guinea, the later interventions the review team visited (Nongo, Mboke, etc.) reflected an evolved response that incorporated recent Ebola experience and implemented improved strategies and successful innovations.

It was often not possible to obtain precise dates for events described during personal interviews, or to place these events into the chronology of the five phases of the outbreak (defined above and in Fig. 1). This information gap reflected the high turnover of HR in different projects and the enormous stress experienced by staff during their missions.

4. FINDINGS

4.A Timeline of the OCB response

The volume, magnitude and duration of the intervention, its extension into 3 countries, and the different pillars of the response, make it challenging to select a limited number of key milestones. In Fig. 2 we attempt to present the most significant events for facilitating an understanding of the response and the choices made (and their evolution over time), with a focus on milestones that had the greatest operational impact.

4.B MSF strategy

MSF's general (traditional) strategy to control an Ebola outbreak3 is organised in six pillars, which must put in place comprehensively and concurrently. The pillars are:

1. Isolation and supportive medical care for patients, including psychosocial support for patients/families;
2. Safe burial activities (in Ebola Treatment Centres and in the community);
3. Awareness/Health Promotion (HP)
4. Alerts and surveillance in the community (case finding and analysis of active transmission chains)
5. Contact tracing
6. Access to health care for non-Ebola patients, including infection control in health facilities and protection of health workers

During previous outbreaks, all of which were small and localised, MSF was able to implement all six pillars, in collaboration with others actors on the ground, usually including the affected country's Ministry of Health (MoH), the World Health Organisation (WHO), US Centers for Disease Control (CDC), Red Cross, etc.

Within the MSF movement, OCB's experience and knowledge of Viral Haemorrhagic Fever (VHF) led them to assume a leading role in the response and to guide health authorities. During the first half of the epidemic this role in coordination, which provided support for the establishment of national Task Forces in affected countries, was backed at headquarters level.[4] However, it was discontinued at the end of 2014 because headquarters did not consider it to be part of MSF's mandate, and because other actors and specialists who began arriving in late 2014 could take on this function.[5]

4.B.1 Guinea

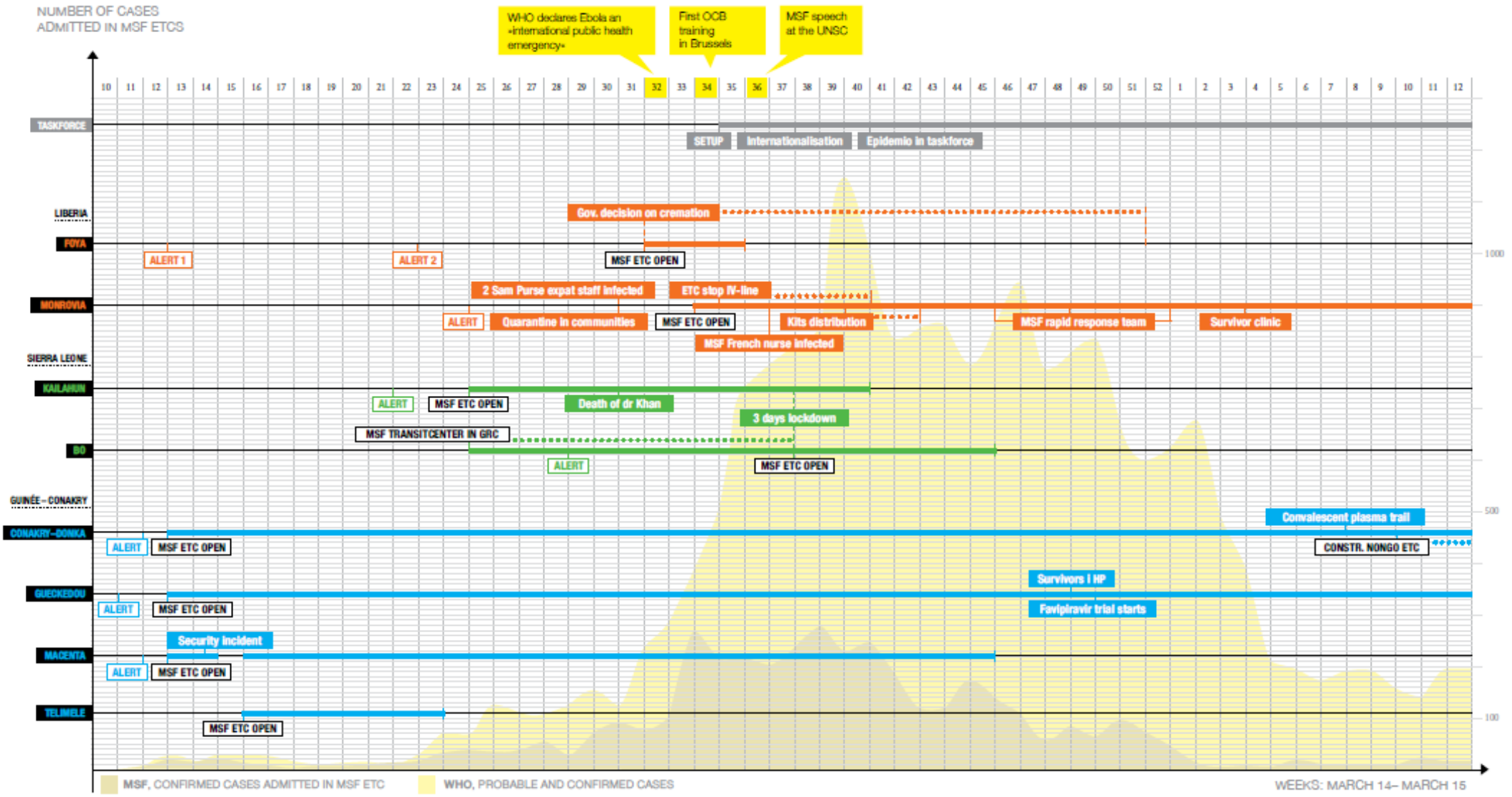
After several weeks of delay following the identification and diagnosis of EVD, MSF became part of the alert and confirmation of the outbreak in Guéckédou, and at the same time deployed response teams. The response was a joint intervention between OCB and Operational Centre Geneva (OCG) and was put under the lead of OCB, given their Ebola expertise.

[3] Sterk, Esther. "Filovirus haemorrhagic fever guideline (draft)." Médecins Sans Frontières, 2008

[4] During an August 2014 visit to the field, the OCB Operational Director and the MSF International President confirmed this interest in being involved at the national coordination and high strategic levels, going beyond an E-coordinator role if possible. In October 2014 the Task Force recommended distancing MSF from the coordination bodies. The break took place in January 2015.

[5] Comments from the former Head of the Task Force.

Fig 2. OCB Ebola Response Timeline

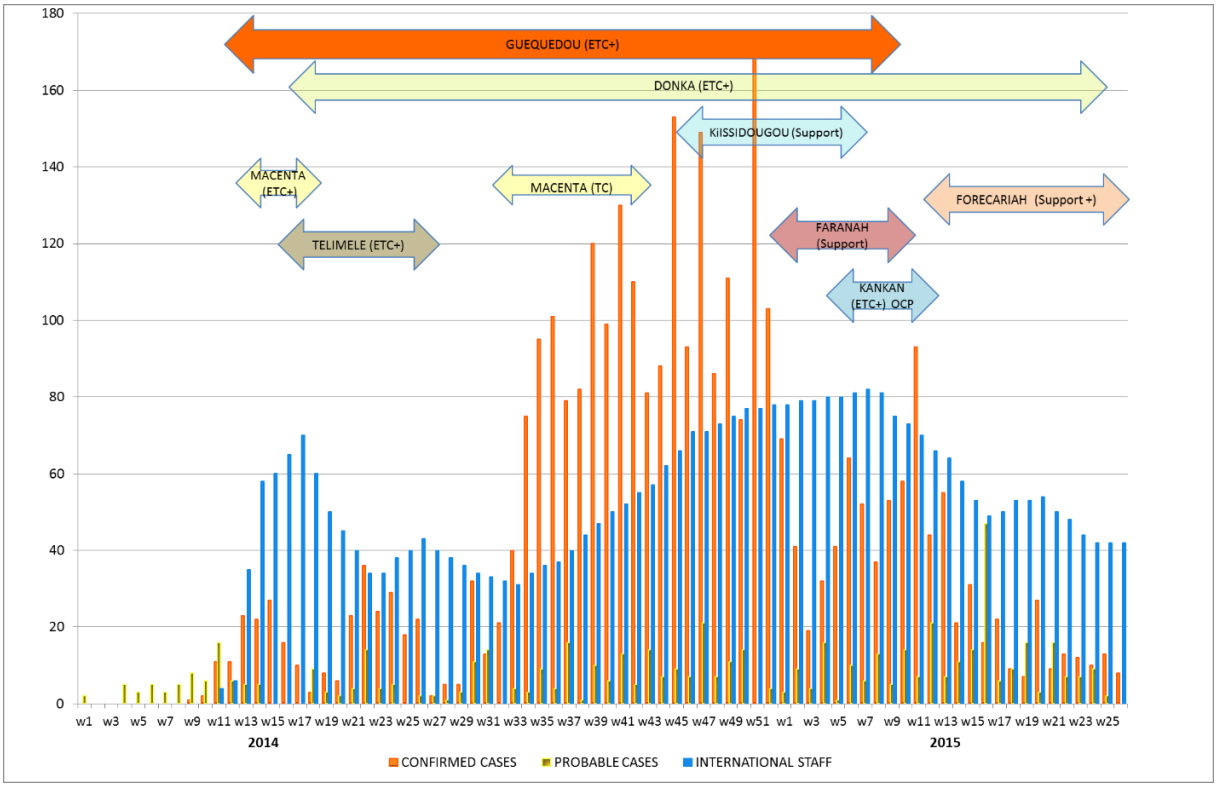


In this first stage, despite recognising the exceptional character of the outbreak (e.g., involvement of both rural and urban sites; cross-border issues; newness of disease to the region),[6] MSF's response in Guéckédou followed the 2008 MSF Ebola guidelines[7] as closely as possible.

At the same time MSF opened a transit centre in Macenta, although it had to be closed several weeks later for security reasons. At that time activities related to mobilisation and health promotion could not be implemented, since too few specialised human resources needed for this work were available. In Conakry, the intervention was therefore limited to setting up ETC on the site of the Donka Hospital, which also helped with triage and infection control in the hospital itself. The ETC was complemented by community-based work, including social mobilisation and health promotion activities, under the responsibility of the MoH, WHO, CDC and UNICEF.

Given OCB's limited capacity, the presence of other agencies, and the lower number of transmission chains at that time in Conakry compared to Guéckédou, first priority was given to the ETC activities, followed by community work, outreach etc. when capacity was available. During the second phase of the response, by which time the epidemic was raging, OCB strategy and its implementation were driven by the past experience of its staff in traditional responses and on the technical resources (staff, medical and lab equipment) available. This left OCB without strategic

Fig 3. MSF Ebola Response in Guinea (2014-2015)



[6] "Guinée: Mobilisation contre une épidémie d'Ebola sans précédent [Communiqué de presse]." Conakry - Brussels - Geneva: Médecins Sans Frontières, 31 March 2014.

[7] Sterk, Esther. "Filovirus haemorrhagic fever guideline (draft)." Médecins Sans Frontières, 2008.

options other than reactive response and gap-filling, and unable to anticipate or prepare for how the outbreak might evolve. (See Annex IV Figs. A, B and C illustrations of the response in terms of international staff numbers over the course of the outbreak.)

However, OCB was able to adapt its response by implementing smaller, more decentralised and comprehensive interventions—first in Télimélé in April (Phase 1), again starting late in 2014 during Phase 4 (working collaboratively with MoH in Faranah and Kisidougou), and again in supporting other organisations, for example the Alliance for International Medical Action (ALIMA) and the French Red Cross, that began arriving in October.

During Phases 4 and 5, after the closure of the Guéckédou ETC and excluding Donka, MSF handed over some ETCs, allowing them to focus more on outreach, community-level activities, capitalisation and research.

4.B.2 Liberia

As soon as the first cases appeared in Liberia (22 March 2014), OCB sent a small team to support the MoH in both Foya (Lofa) and Monrovia.[8] This team helped in both places to set up a comprehensive response (ETC, safe burial, contact surveillance and training). At the end of April, once it was clear that there were no more cases, the MSF team returned to Guéckédou.

MSF intervened again at the end of May, when new cases coming from Sierra Leone were identified. But it was a more limited intervention: the comprehensive, integrated six-pillar strategy was not considered feasible due to the high number of infected people and locations, and to OCB's commitments in other countries where Ebola had spread.

During the next two months MSF witnessed an alarming deterioration of the situation and urgently called for international mobilisation. On the ground the strategy was to support other responders (the NGO Samaritan's Purse and the Liberian MoH), enabling them to run the ETCs so that MSF could get involved in activities such as contact tracing. However, at the end of July, two Samaritan's Purse international medical personnel became infected, leading the organisation to suspend its activities in Liberia.

With the situation continuing to deteriorate MSF reversed the decision to limit its intervention, and in August began to significantly scale up its response. In agreement with the MoH, MSF assumed full responsibility of Foya and Monrovia (ELWA 3) ETCs.

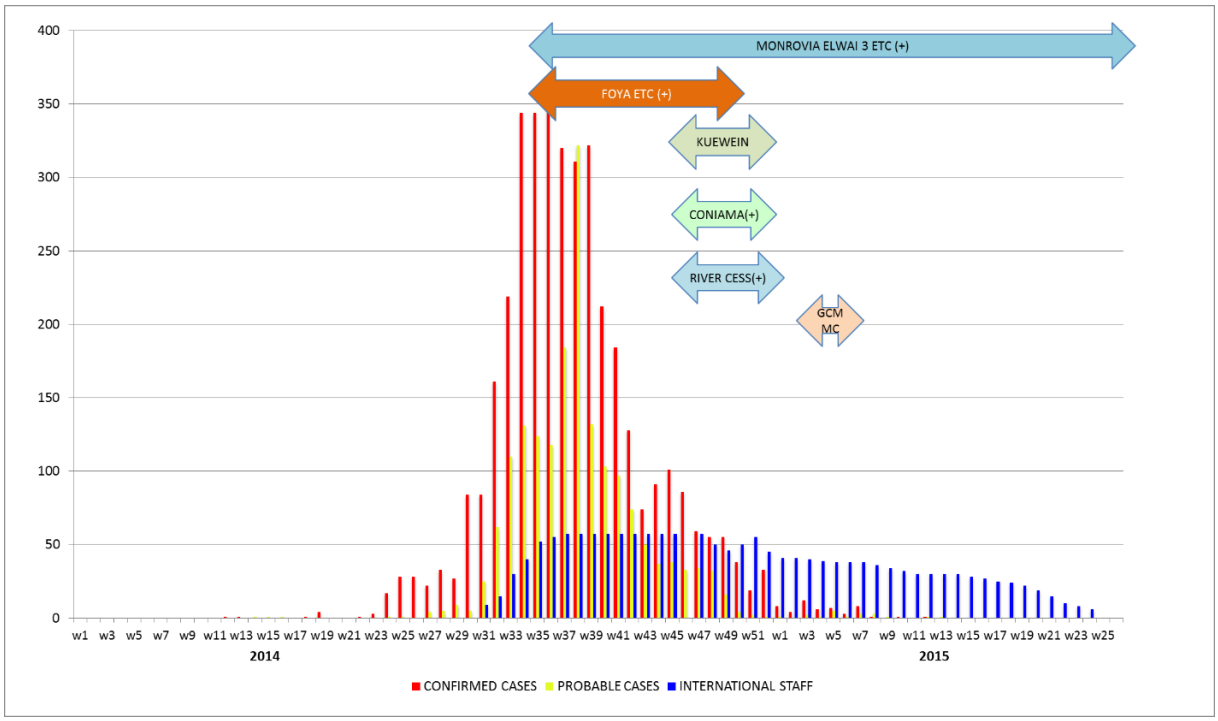
The Foya project was handed over to OCG at the end of August.

In Monrovia, the initial focus was on increasing capacity to isolate patients. Over time the intervention grew to encompass three components: an ETC; community mobilisation and HP activities (see sections 4.E and 4.F); and mass distribution of protection/disinfection kits (see sections 4.E.5 and 4.I) to highly vulnerable groups (health workers, contacts families, etc.) and specific communities (see below).

Only in October/November 2014, with other actors responding, was OCB able to revamp its response and focus on other pillars, such as surveillance and contact tracing. Another shift in the response was geographic: as Monrovia experienced a significant reduction in case numbers, new hotspots continued to emerge elsewhere the country (without the necessary response). OCB adapted by scaling down in ELWA 3 and deploying to these new hotspots.

[8] Interview with an MOH staff person, Liberia

Fig 4. MSF Ebola Response in Liberia (2014-2015)



4.B.3 Sierra Leone

Prior to the outbreak OCB was present in Sierra Leone with a regular project in Bo. When the Ebola alert was raised in Guinea, suspicions were high that infection had already spread over the border. The MSF team on the ground in Sierra Leone made repeated, unsuccessful requests to the health authorities for information. The Ebola response was put under the responsibility of the Kenema Hospital (which had a ward specialised in Lassa fever) and Metabiota, a US company also involved in Lassa research, in association with the University of Tulane.

The first cases in Sierra Leone were declared on 26 May, although the outbreak may have already been evolving undetected for several weeks, despite the surveillance that was supposed to be in place. Kailahun District was initially the epicentre of the country's outbreak, and at that point MSF was able to intervene by opening a 60-bed ETC on 27 May and initiating outreach and HP activities. Surveillance and contact tracing were carried out by Metabiota.[9] From the start MSF worked with the local government task force (the Ebola Response Committee). The full package of activities was set up only gradually due to a lack of experienced people to hire, heavy workload in the ETC, and a re-assessment and heightening of biosafety measures following news of a staff infection at another facility. Contact tracing became possible for the MSF team starting only in October, when the caseload in the ETC had decreased and OCA took over the project from OCB.

Prior to the turnover, OCB gave support to Kenema Hospital, for example by setting up a better temporary isolation ward, redesigning patient flow, training workers, and providing supplies. But OCB opted not to take charge, given that its limited capacity at the time (in July) left it unable to manage the deteriorating situation.

The outbreak spread in the rest of the country, but the absence of ETCs in western Sierra Leone and

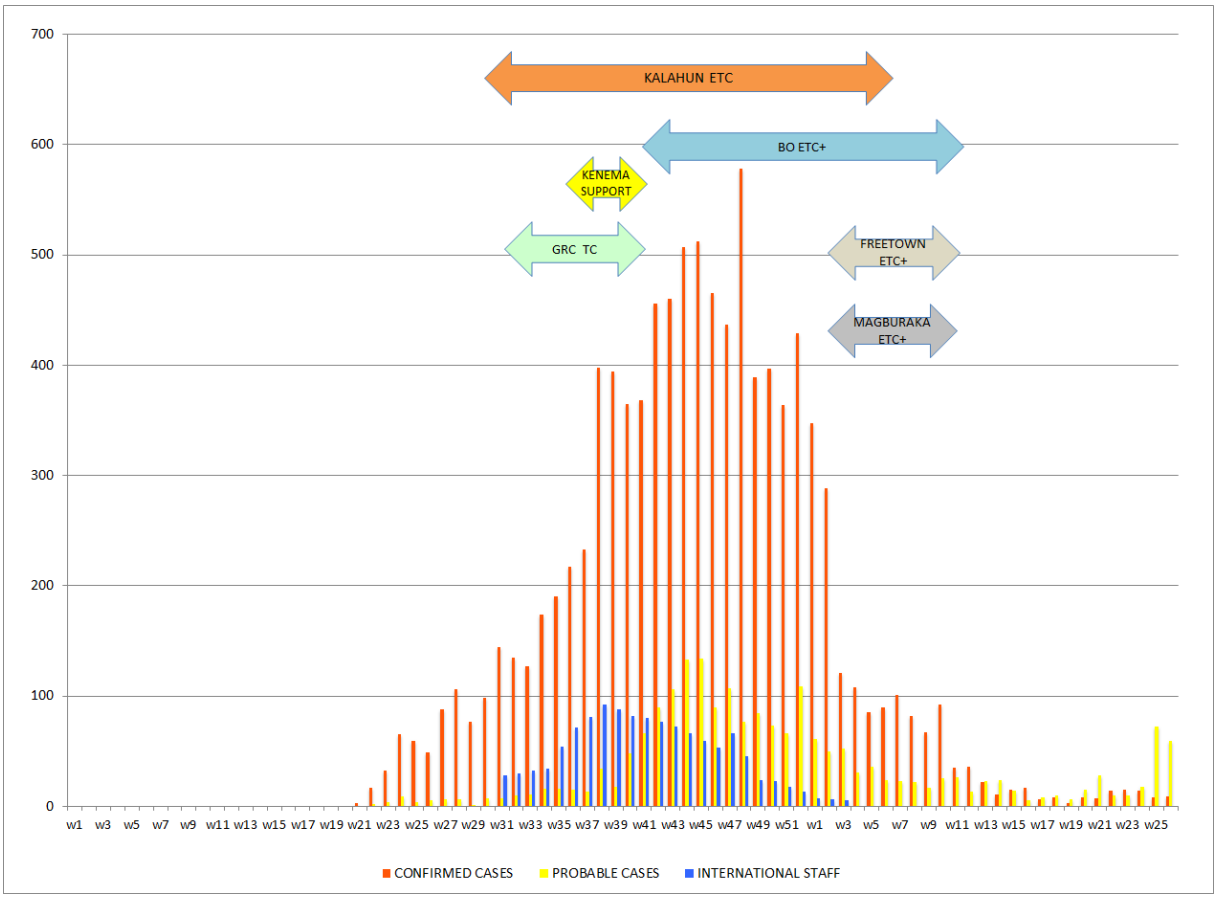
[9] Interview the Head of emergency unit, OCB

the high number of new cases meant that significant numbers of patients from elsewhere were transferred to Kailahun. This influx contributed to the Kailahun ETC's overload in August/September.

The Kailahun Ebola Project was handed over to Operational Centre Amsterdam (OCA) on 10 October after four weeks of preparation.

In Bo, an Ebola transit centre was set up in the Gondoma Referral Centre (GRC), where MSF ran a regular project prior to the outbreak. In September a new ETC opened in the town of Bo, a decision that seems to have stemmed more from pressure from the team in GRC than from epidemiological considerations (the outbreak was rapidly moving westward). The Bo ETC was handed over to OCA in November 2014. During this period, the activities that had pre-existed Ebola in GRC were suspended—obstetric care closed in August and paediatric activities in October, depriving the local population of essential services. This action reflected both the belief among international staff that the working conditions were not safe enough and the dramatic drop in utilisation rates for paediatric services.

Fig 5. MSF Ebola Response in Sierra Leone (2014-2015)



4.B.4 Evolution of strategy over time

Here we describe and assess the strategies used during each of the 5 phases of the outbreak (defined earlier in section 2B and Fig. 1).

OCB aimed to adapt its intervention strategy to the different contexts (rural, urban, etc.) as much as possible. Strategies varied between taking on the total response (i.e., addressing all the pillars) at the beginning of the intervention (Phase I) and focusing on the ETC at other times, especially at the peak

of the outbreak.

Initially the team held out hope that the outbreak could be controlled by the end of April, despite initial warning signs to the contrary, such as the unprecedented geographic spread and number of cases, lack of regional coordination, highly mobile populations in the three countries, transmission in urban areas, poor infrastructure throughout the region, and weak healthcare systems. Without a clear overview of what was happening in Sierra Leone (exacerbated by the government's refusal to allow an MSF exploratory assessment and by possible hidden cases until late May), these hopes were unrealistic. However, nothing more was done at that time to prepare for a potential resurgence of the outbreak.

The response during Phase I focused mainly on the triangle of Guéckédou (Guinée Forestière) – Kailahun – Lofa (Foya). It did not anticipate how the outbreak might evolve, due to a lack of experienced human resources and of a more strategic vision.

During Phase 2 and Phase 3, when the epidemic was raging and resources were severely limited (in terms of experienced HR and capacity of other actors), OCB strategy appears as one of gap-filling. It included support for other organisations to intervene in ETCs, which MSF still considered the central activity. Until July, OCB's request to other MSF sections was to provide HR in support, rather than a push for other OCs to intervene on their own.

During Phase 3 of the outbreak, described by some OCB staff as "the apocalypse," needs for intervention increased but the MSF response had to be restricted due to limited availability of experienced staff. ETC activities were then prioritised.

Training activities, together with support by experienced MSF staff, permitted handover of the management of some ETCs, not only to others MSF OCs but also to other organisations such as Samaritan's Purse (in July) and subsequently to the International Federation of the Red Cross and Red Crescent Societies (IFRC).

At the beginning of September, questions were raised at different levels of the MSF movement about the strategies employed by OCB: could the outbreak be better controlled with other strategies, such as a more decentralised strategy, or possibly use of isolation packages for home-based care?

Developing ETC services closer to the outbreak's epicenter was a challenge. At the Kailahun ETC, one in three admitted cases originated outside Kailahun district because of limited access to ETCs in the country. This complicated contact tracing, safe burial and disinfection measures.[10] It also led to many dead bodies (and potential contaminations) in the ambulances, and to patients arriving in very bad condition. There was no good model for spreading out Ebola treatment services in a safe and effective way. Overall, OCB was not able to develop ETC services closer to the epicentre of the epidemic in time, and there were no other actors to do so.

Alternatives put forward by CDC, WHO and national governments did not convince OCB. CDC was at one point (in October in Sierra Leone) promoting a basic form of home-based care: families would receive basic protective gear and information on how to deal with sick family member(s). This idea was not further developed, since implementation would require a high number of trained staff. However, the model of Community Care Centres (CCC), promoted by WHO and the UK Department for International Development (DFID), was implemented. The idea behind this model was that the community identifies an area in the village for isolate patients and providing basic care, theoretically under the supervision of trained health staff who conduct regular checks and provide the necessary materials.

OCB was opposed to the establishment of CCCs, because these centres raised many questions in

[10] Dallatomasina, S, et al. "Ebola outbreak in rural West Africa: epidemiology, clinical features and outcomes." *Tropical Medicine & International Health*, 2015; 20(4): 448-454

terms of quality of care and as potential hubs for further EVD transmission. In Sierra Leone, different types of decentralised structures were put in place: transit centres referred suspected cases without confirmatory laboratory testing, while holding centres held patients until testing had confirmed their Ebola-positive status. In Sierra Leone, holding centres and CCCs were increasingly called Amplification Centres (ACs). Government officials admitted by the end of November that, of the estimated 1400 beds in holding centres and CCCs, "a significant part" were in "such bad condition that they should be shut down."

Heated discussions took place between MSF and WHO/CDC on the subject of CCCs, with OCB remaining opposed. WHO/CDC pursued the strategy nevertheless, with limited success, for many reasons: delays, lack of flexibility, etc. OCB maintained its view that there were no feasible alternative strategies that would be consistent with MSF principles.

In Sierra Leone, the national quarantine policy caused considerable friction between OCB and the national authorities. Quarantine was used in many locations in Liberia as well. In both countries, these quarantines were enforced by the military, which raised tensions with populations. Taking a position on quarantine was a dilemma for MSF. Given the needs in quarantine sites, MSF could have had a great impact in supporting people living under quarantine. But, to do this well, staff and supervision capacity were needed. The scarcity of these human resources partly explains OCB's decision not to intervene in these settings. At the same time OCB was putting forward strong arguments against quarantine, which they saw as precluding them from intervening. More flexibility in their approach could have allowed MSF to defend its principles and at the same time provide needed support and even innovation, including contact tracing, early detection of suspects, distribution of protection/disinfection kits, etc.[11]

Proposals and requests from other OCs for adaptations to the response set were not acted on.[12] These included re-assessing the strategic decision-making process, the necessity for MSF to step back and look at the "big picture," and the need to harvest high-quality reflections and contributions on critical issues such as advocacy and alternative and/or complementary medico-operational strategies.[13]

During Phase 4, slowing of the Ebola outbreak in Liberia finally allowed MSF to implement more flexible strategies that addressed key priorities. These included early outbreak detection, assessment of community response, and immediate isolation of potential Ebola cases through a coordinated response that included rapid deployment of staff and materials. Starting in November 2014, MSF also implemented more reactive approaches to quickly tackle new alerts in different locations—first in Liberia and later in Guinea. In Liberia, the caseload in Monrovia was sufficiently reduced by November for OCB to propose and launch a rapid response team.[14] The first deployments of this team were to River Cess and Grand Bassa Districts.[15]

Other changes also began to take hold as case numbers declined. In addition to isolation and care for patients, other essential activities such as surveillance, contact tracing, HP, and safe burial started to be integrated into the response in more systematic ways. And patient care itself improved, both in terms of having ample numbers of beds, but also in intensification of patient care. This included, for example, the use of biochemistry to individualise fluid management, and the creation of more family- and visitor-friendly ETCs. Finally, it was mainly during the two last phases (Phase 4 and 5) that

[11] Crestani, Rosa. *Visit report Libera, Sierra Leone, October 2014*. Médecins Sans Frontières, 2014

[12] "RIOD Meeting Geneva 1st October 2014." RIOD. Geneva: Médecins Sans Frontières, 2014.

[13] Zachariah, Rony. "Ebola in Sierra Leone, an epidemiological overview of the outbreak at district level, Kailahun and Bo districts." MSF OCB, October 2014

[14] "Proposal for an MSF Rapid response Team in River Cess County, Liberia [Internal Porposal]." Médecins Sans Frontières, 10 November 2014

[15] "Rapid Response in River Cess and Grand Bassa [PowerPoint]." Médecins Sans Frontières, 9 December 2014.

MSF engaged in clinical trials in its ETCs.

4.C Timeliness of the response

4.C.1 Speed of identifying the epidemic and the response reactivity

It took three months from the first case until the epidemic was identified and declared. The first Ebola index case[16] was identified retrospectively as having occurred in December 2013 in the Meliandou, Guinée Forestière region: Emile Ouamouno, a two-year-old boy, died on 6 December, 4 days after he started exhibiting fever, black stool and vomiting. Subsequently, three other members of Emile's family died. It is believed that the Ebola virus then spread to the villages of Dandou Pombo and Dawa, both in Guéckédou, by the midwife who tended to the sick family. From Dawa village, the virus spread to Guéckédou Baladou District and Guéckédou Farako District, and on to Macenta and Kissidougou. These 49 total deaths—and probably many others—remained unexplained (and unrelated to Ebola) until 23 March 2014, when laboratory confirmation was obtained and Guinea's MoH officially declared that an epidemic was underway. In January 2014, the MoH and OCG had sent a team for an epidemiological investigation, without any conclusive result.[17] The non-identification of the disease at that early time allowed it to spread in the region (the triangle of Guinée Forestière, Lofa, and Kailahun).

On 16 March 2014, following identification by the Guinean MoH of the suspected VHF among medical staff in Guéckédou and Macenta, OCG and OCB responded very rapidly. The delay between the first cases and the declaration of the outbreak, similar to those observed in previous outbreaks but associated here with conditions that facilitated rapid spread, as described earlier (see section 2B and 4B4), translated into difficulties in anticipating the outbreak's subsequent spread. Many people interviewed stated that MSF was always running after the outbreak, one step behind.

4.C.2 Monrovia

After helping the Liberian MoH set up the response in March-April, OCB teams returned to Guéckédou, as there were no further cases. Starting at the end of June 2014, MSF resumed its support for the Liberian MoH, when new cases appeared and increased in number. Given the level of MSF resources already engaged in Guinea and Sierra Leone, the decision was to limit the scope of the response in Liberia and not to establish an MSF ETC.[18] Instead, the plan was to provide support to Samaritan's Purse, enabling them to assume management of the ETC for Monrovia, while MSF would provide management support for contact tracing to ensure that all contacts were followed up. MSF was also supporting the MoH outbreak coordination, with an MSF emergency coordinator assisting the MoH outbreak management in coordination meetings. The objective was not only to represent MSF activities at the coordination level, but also to assist the outbreak operations coordinator and the chief medical officer in their management.

Despite calls for help from the team of authorities on the ground,[19,20] MSF decided in July not to intervene in Monrovia due to lack of means. However, this decision was reversed at the beginning

[16] Primary case, or patient zero, is the initial patient in the population and result of an epidemiological investigation.
[17] Akpodiete, Claudette. "Rapport mini Expo à Meliandou pour les cas de sévère diarrhée [Report]." Médecins Sans Frontières, 28 January 2014
[18] Sprecher, Armand. "Assessment of Ebola Outbreak Control – Montserrado County, Liberia, 2014." MSF - OCB, July 2014.
[19] Mail HOM Liberia to emergency desk 03/07/2015
[20] Mail MSF Doctor to OCB board member 28/07/2015

of August when the situation had become absolutely catastrophic.[21,22] OCB's intervention launched at this late stage of the outbreak led them to concentrate mainly on ETCs, and to limit their involvement in outbreak control measures.[23]

4.C.3 Sierra Leone

The MSF intervention in Sierra Leone did not start until June, when cases had already spread, mostly in the Kailahun district. MSF's earlier attempts to get information on cases and to respond actively were rejected by the government. The MSF team on the ground raised alarms in the national Task Force meeting but was accused by the MoH of exaggerating.[24]

Kenema Hospital, which had long-term experience managing Lassa fever cases, was made the designated ETC by the MoH. Simultaneously, Bo hospital (run by the MOH) was receiving Ebola-suspected patients under poor conditions of infection and prevention control (IPC). Field interviews reported that there was a disconnect between MSF field in GRC (a regular MSF project in Bo) and capital coordination, and several proposals for opening an MSF ETC were refused.[25] In parallel, Kailahun, located near the country's only ETC (in Kenema Hospital), was receiving many cases from Bo[26] and other districts. Soon after (in July-August), both Kenema and Bo hospitals suffered a heavy toll of staff deaths. In August, the decision was made to set up an ETC in Bo, which took six weeks to open due to delays in building the structure. Some respondents considered these decisions as a strategic error. For them, the decision to open Bo ETC should have been made earlier. Others think that by the time this decision was made, priority for a new ETC should have been given to other districts westward.

4.D Patient care

4.D.1 Treatment/management guidelines/protocols

At the start of the epidemic, the main guidelines used were from MSF 2008.[27] These were appropriate to ensure an acceptable standard of patient care but were not detailed enough in many areas, particularly with respect to the administration of IV fluids, monitoring electrolytes, nutritional support, palliative care, pregnancy, paediatrics, classification of patients according to their care needs, triage of patients, follow-up of survivors, non-Ebola care, and infection control.[28] The main problem in developing improved guidelines was the limited knowledge on EVD management. Key knowledge gaps included: pathophysiology of EVD, optimal symptomatic and anti-viral treatment, optimal PPE, and duration of infectivity.

Initially, discharge guidelines were based on clinical grounds (3 days without symptoms) supported by laboratory results.[29] Because of high staff turnover and lack of experienced medical staff on ground, these criteria were sometimes modified at field level, so that patients were discharged earlier, or later. This situation was then corrected, with the exception of Kailahun when—due to lack of enough beds—a decision was made to discharge patients who showed no symptoms and had a

[21] Interview with Operational Director
[22] Mail HOM Liberia to emergency desk 13/08/2015
[23] Interview Emergency coordinator Liberia
[24] Interview Assistant MedCo, Sierra Leone
[25] Interviews field staff
[26] Interview Kailahun staff, interviews international staff
[27] Sterk, Esther. "Filovirus haemorrhagic fever guideline (draft)." Médecins Sans Frontières, 2008.
[28] *Interviews with international staff* (2015).
[29] *Ibid.*

cycle threshold (CT) value above 36.

One problem with using the 2008 guidelines in the West African outbreak was that they were not designed for such heavy caseloads.[30] For example, gate and triage guidelines were not suitable for the extreme situation in August-September at ELWA 3 in Monrovia, when patients had to be turned away due to lack of capacity.[31]

Over the course of the epidemic more detailed guidelines were developed and made available.[32] In August, a first draft paper on managing pregnant and lactating women was released. Updates based on field feedback and new information[33] were provided in October, November and December, as were separate documents on the planning and organisation of delivery at ETC level. A recommendation was formulated to systematically offer termination of pregnancy to all pregnant women and to systematically perform a pregnancy test for all convalescent women at discharge.[34]

Beginning in early September, HQ conducted a thorough revision of the protocols for paediatric patients, involving multiple rounds of feedback from field staff.[35] The reason for this revision was a concern that regimens and/or dosages in the standard clinical protocols were not adapted to children. Dosages were initially based only on estimated weight for age, since weight was not being measured directly. Often, children simply received half doses of the drugs provided to adults. The new paediatric protocol was adopted in ELWA 3 in November, and in Bo in December.[36] To directly measure the weight of all children under 15 years old using a mechanical scale, the weight of an adult in PPE was subtracted from the weight of the adult with the child in his/her arms. The Ebola equipment/drug kit was revised to include specific paediatric equipment along with drugs that were previously not part of the kit, such as paediatric formulations of certain drugs (e.g., ciprofloxacin and paracetamol syrup), paediatric perfusion sets, disposable graduated medicine cups, and infant formula.

Nutritional protocols[37] were slated to be further updated based on feedback from the field. However, the protocols were never formally taken up in the missions. Indeed, nutritional support was managed *ad hoc* in the different missions. Draft guidelines about potassium supplementation were circulated in January 2015.[38] Adaptations of protocols were made in response to changes in the operational environment.

Initially, family members were not given access to all ETCs.[39] Since case fatality rates (CFRs) were so high early in the outbreak, ETCs were initially perceived by the population as centres where people went to die. To change this belief, family members were invited to visit the inside of the ETC (wearing full PPE). A film was made to show people how ETCs functioned. HP teams, often including EVD

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[30] *Ibid.*

[31] *Ibid*.

[32] Filovirus Haemorrhagic Fevers Field Manual [Draft].” 2015. https://www.evernote.com/pub/agsprecher/FilovirusFieldManual (accessed December 8, 2015).

[33] Akerlund, E, J Prescott, and L Tampellini. “Shedding of Ebola Virus in an Asymptomatic Pregnant Woman.” *N Engl J Med*, 2015;372(25): 2467-2469 ; Baggi, F, et al. “Management of pregnant women infected with Ebola virus in a treatment centre in Guinea, June 2014.” *Euro Surveill*, 2014;19(49) and Black, BO, S Caluwaerts, and J Achar. “Ebola viral disease and pregnancy.” *Obstet Med*, 2015;8(3): 108-113.

[34] Black, BO, S Caluwaerts, and J Achar. “Ebola viral disease and pregnancy.” *Obstet Med*, 2015;8(3): 108-113.

[35] Zuniga, I. *Pediatric care in Ebola Treatment centres, Draft version November 2014.* 2015.

[36] *Ibid.*

[37] Vijvers, M, and NAPDVC. *Nutritional protocol for patients infected with Ebola Virus Disease, .* MSF OCB/OCG - ICRC, 2015.

[38] Petrucci, R. *Potassium (KCL) supplementation, Draft January 2015.* MSF OCG, 2015.
Pols, Thomas. “Ebola outbreak 2014: a struggle between medicine and policy, Fletcher School of law and policy.” 2015.

[39] *Interviews with international staff* (2015).

survivors, explained the functioning of the ETC during outreach activities.[40] Different strategies (visitor's area, phone in high-risk zone) were devised to facilitate communication between family members and patients in the high-risk zone.[41]

In Guinea, healthcare workers (HCW) complained that some guidelines were not available in French. This complicated interactions with national staff.[42]

4.D.2 24-hour care

MSF established a system of 24h care at ETCs. Day and night, several patient rounds were organised in the high-risk zone, including for blood sampling, providing food and drinks, and hygienic care, and for doctors to plan medical care and administer treatment. Rounds were always performed by two people working together, plus one sprayer in the room. International doctors generally performed two patient rounds of one hour each per day. In general, their total time spent in the high-risk zone was about 3 hours per day,[43] as reported in the online survey conducted among field staff (see section 3.A).

MSF clinical care included:

1. Symptomatic care;
2. Supportive care, mainly rehydration;
3. Presumptive care for potential co-infections (antibiotics and anti-malarial drugs);
4. Nutritional support (vitamins and therapeutic foods); and
5. Psychosocial counselling.[44]

While the overall system and treatment strategies were similar at all ETCs, the level of care differed among ETCs and fluctuated over time[45] as teams adapted to the number of patients, beds and HCW. When ETCs were overwhelmed with patients, only very low levels of care were provided.[46]

In Conakry, where there was no shortage of medical staff, patient care was provided by four teams of doctors, four teams of nurses and four teams of hygienists.[47] In contrast, in Sierra Leone and Liberia, very few local doctors were available to work at ETCs. In these latter settings, patients did not always have access to a doctor or a nurse between rounds.[48] In our survey, more than half of respondents reported that patients were able to contact a doctor or nurse "most of the time," and more than a third said they were "always" able.[49]

Overall there was a lack of paediatric expertise in the ETCs. Very few paediatricians or paediatric nurses worked in the ETCs, and those that did were involved in both adult and paediatric care. Care for children may have benefited from more human resources with paediatric skills.

In ELWA 3 at the end of August, not all suspected EVD cases could be admitted to the ETC, and

[40] *Interviews with national staffs* (2015).
[41] *Interviews with international staff* (2015) and Van Den berg, R. *Clinical care in the West Ebola Outbreak.* 2015.
[42] *Interviews with national staffs* (2015).
[43] *Interviews with international staff* (2015).
[44] Sterk, Esther. "Filovirus haemorrhagic fever guideline 2008." Médecins Sans Frontières, 2008.
[45] *Interviews with international staff* (2015).
[46] *Interviews with international staff* (2015).
[47] *Group discussions among health care workers at Nongo* (2015).
[48] *Interviews with international staff* (2015).
[49] MSF. "Survey for MSF Staff in SurveyMonkey." SurveyMonkey, 2015.

consequently some patients were sent home or had to wait outside the ETC.[50] During the worst period of bed shortages the ETC was only able to admit a few patients during a 30-minute period each morning, with others dying on the gravel outside the ETC gate.[51] In October, the ETC in Donka also experienced a brief period when they had to refuse some patients.[52] Nearly 40% of the participants in our survey reported that at some point the ETC where they worked was unable to admit all suspected EVD patients.[53]

Later on, experience gained and lessons learned led to changes in the set-up and care at ETCs. At one of the later ETCs established in Nongo, Conakry, patients could be observed continuously through Plexiglas, and in August 2015 electronic monitoring of blood pressure, heart and respiratory rate, and oxygen saturation was installed to allow patient monitoring from outside the high-risk zone.[54] (Although this example is outside the review period, we consider it worth mentioning.)

4.D.3 Protection of staff

MSF developed a system to provide care for EVD patients while offering maximal protection of staff. Protection of MSF staff was the priority.[55,56] Therefore, invasive procedures were avoided unless absolutely necessary. Initially, there was a safety problem during the triage of patients during periods when ETCs were overwhelmed with patients, because the two-metre distance was not always respected.[57] After the first MSF international staff member became infected in September at ELWA 3, regular biosecurity checks were performed by an expert at each MSF site every 3-4 weeks. The issue of staff infections is discussed in detail in the separate HR report of this review.

4.D.4 Level of care

The level of EVD patient care fluctuated over time, as mentioned above (section 4.D.2). A low point occurred in Monrovia with the overwhelming caseload in August—October 2014 at ELWA 3, and which resulted in the suspension of certain activities. While the number of admitted cases overall never exceeded the number of available beds, limitations in the number of staff available led to the strategic decision to invest in isolation capacity and to adapt the level of care to the high workload.[58] This adaptation mainly involved a switch from individualised care to standardised or packaged care, and a restriction or complete suspension of IV treatment.[59] During the most acute period (mid-August to mid-September), the ETC was unable to provide even oral rehydration solution to all patients. Staff struggled to get dead bodies out of the tents in a timely manner and to give water to patients waiting outside the centre in cars or on the gravel.[60] Beginning in October, which brought the beginning of the epidemic's decline in Monrovia along with increased bed capacity in ELWA 3 and the opening of other ETCs in Monrovia, a sharp decrease of admissions was observed; thereafter, ELWA 3 was never full.

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[50] *Interviews with international staff* (2015).
[51] *Ibid.*
[52] Van Den berg, R. *Clinical care in the West Ebola Outbreak.* 2015.
[53] MSF. "Survey for MSF Staff in SurveyMonkey." SurveyMonkey, 2015.
[54] Colebunders, Bob. *Personal observations.* 2015.
[55] *Interviews with international staff* (2015).
[56] *Interviews with HQ Staff* (2015).
[57] *Interviews with international staff* (2015).
[58] Van Den berg, R. *Clinical care in the West Ebola Outbreak.* 2015.
[59] *Ibid.*
[60] Chertow DS, Kleine C, Edwards JK, Scaini R, Giuliani R, Sprecher A. "Ebola virus disease in West Africa--clinical manifestations and management." *N Engl J Med* , 2014;371(22): 2054-2057.

By the end of December ELWA 3 was scaled down to 60 beds. However, despite the decrease in patient numbers, restoration of a higher level of care was slow.[61] This was explained by the trauma and stress among staff, resulting from the infection of an international staff member during the earlier overwhelming period. Several doctors working at ELWA 3 during this time[62] found it difficult to cope with not being able to provide better care.

In the two months after the Bo ETC was opened (September/October), it was also not able to consistently provide supportive care.[63]

Treatment strategies in ETCs changed frequently, often depending on the person in charge at a given moment—a situation exacerbated by the high staff turnover and the limitations on time that could be spent in the MSF-type PPE (one hour per round; 2-3 rounds per day), which meant that a relatively large number of staff was needed at an ETC in order to provide an acceptable level of quality of care.

55% of international doctors and nurses who participated in our online survey (section 3.A) considered the level of care acceptable, 45% considered the level too low, and none felt the level was too high.[64]

MSF, in contrast to certain other organisations (such as the French armed forces), did not establish ETCs with a higher standard of care, e.g., to provide care for EVD-infected national healthcare workers or to conduct clinical trials. However, MSF had an agreement with certain other ETCs where a higher level of care could be provided for local MSF staff members in case they became infected, e.g., with the ETC for Caregivers in Conakry, set up by the French armed forces and the Monrovia Medical Unit, a US-sponsored ETC.[65]

4.D.5 Administering IV fluids and other supportive treatment

Treatment of patients with EVD in Europe and the USA suggests that optimal supportive treatment may decrease mortality.[66] Optimal treatment encompasses aggressive parenteral fluid replacement based on careful monitoring of the fluid balance and correction of electrolytes, and in some patients additional interventions such as renal replacement therapy, mechanical ventilation, parenteral nutrition and use of vasopressors.

OCB considers IV fluids to be an essential component of EVD treatment,[67] and recognised the importance of their use in this epidemic. However, as mentioned previously (section 4.D.4), during periods when ETCs were overwhelmed by patients (such as in Donka, Foya in weeks 31-32 and ELWA 3, Monrovia, in September), very little or no IV fluid was given. Moreover, when bed capacity increased at ELWA 3, IV fluid therapy was re-introduced only very slowly.[68] In addition, no IV fluids were administered in the initial phase of most OCB ETCs during the reviewed period.[69]

In most ETCs, IV fluids were mainly given to patients with dehydration and shock. In other centres,

[61] *Interviews with international staff* (2015).
[62] *Ibid.*
[63] *Ibid.*
[64] MSF. "Survey for MSF Staff in SurveyMonkey." SurveyMonkey, 2015.
[65] *Interviews with non-MSF Ebola experts* (2015).
[66] Wolf, Timo, Gerit Kann, Stephan Becker, and Hans-Reinhardt Brodt. "Severe Ebola virus disease with vascular leakage and multiorgan failure: treatment of a patient in intensive care." *The Lancet*, 11-17 April 2015; 385 (9976): 1428-1435.
[67] Sterk, Esther. "Filovirus haemorrhagic fever guideline (draft) 2008." Médecins Sans Frontières, 2008.
[68] *Interviews with international staff* (2015).
[69] *Ibid.*

they were rarely given to patients who still were able to drink,[70,71] even those who were vomiting or had diarrhoea. In contrast, in Kailah during August, the practice was to place IV lines earlier, to avoid having to do so when the patient was already in poor condition.[72]

In March-April 2014 at the Donka ETC in Conakry, 76% of patients received IV fluids, although administration was often intermittent.[73] Of the MSF doctors and nurses who participated in our online survey, 85.7% reported that generally 1-3L/day was administered[13]; 40.5% (a subset of the first group) reported 1-2L/day; and only 5% reported that they had been able to administer more than 3L/day. In terms of the regularity and timing of IV fluid administration, 5 participants (10%, all from ELWA 3) reported that no IV fluid was given during their time at the ETC; 23% said that IV fluids were administered intermittently during patient rounds; 31% said that IV fluids were administered continuously; and 35% reported that IV fluids were not given during the night,[74] due to lack of sufficient light to place an IV line safely[75] [76]and of capacity to maintain them at certain ETCs. In some ETCs during certain periods, no IV fluid was given to children. Nasogastric tube feeds were initially discouraged in the paediatric guidelines due to concerns that the child would pull out the tube and that fluid might splash on staff when placing or especially removing the tube. However, in retrospect, it was felt by several MSF staff that nasogastric tube feeds with proper guidance may have been helpful for some children, especially young infants, for whom control of IV infusion volumes is particularly difficult.

For biochemical monitoring the I-stat was used initially but then abandoned due to the heavy workload and technical problems; it was re-introduced only much later. Even then, there was little knowledge among staff of how to interpret the results.[77,78] Without this monitoring, doctors were often reluctant to administer too much IV fluid, particularly in patients with oedema and in children.[79]

One of the main reasons reported for not using an IV line or administering fluids continuously was that confused and agitated EVD patients might pull out IV lines, which results in bleeding.[80,81] Moreover, it may be that providing only a limited amount of IV fluid in severely ill patients with EDV, without being able to monitor electrolytes, has little impact on survival. The limited data available on this issue from Foya in the period before week 34, when very little IV fluid was administered, compared with the time after week 34 (when IV fluid was given to more patients) showed no significant differences in patient survival, according to a retrospective analysis (see Figs. 6 and 7).[82] Doctors working at ELWA 3 observed (no evidence) that the clinical outcome for hypovolemic patients who were not in shock could be improved by anti-emetics, anti-diarrhoeal treatment and oral rehydration only (i.e., no IV fluids).[83]

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[70] *Ibid.*
[71] *Group discussions among health care workers at Nongo* (2015).
[72] Van Den Berg. *Op. cit.*
[73] Bah, EI, MC Lamah, and T Fletcher. "Clinical presentation of patients with Ebola virus disease in Conakry, Guinea." *N Engl J Med*, 2015;372(1): 40-47.
[74] MSF. "Survey for MSF Staff in SurveyMonkey." SurveyMonkey, 2015.
[75] *Interviews with international staff* (2015).
[76] *Group discussions among health care workers at Nongo* (2015).
[77] *Interviews with international staff* (2015).
[78] *Group discussions among health care workers at Nongo* (2015).
[79] *Interviews with international staff* (2015).
[80] *Interviews with international staff* (2015).
[81] *Interviews with HQ Staff* (2015).
[82] Grandesso, F. "MSF Epi-bulletin Ebola Epidemic in West Africa Week 51." 8 January 2015.
[83] Chertow DS, Kleine C, Edwards JK, Scaini R, Giuliani R, Sprecher A. "Ebola virus disease in West Africa--clinical manifestations and management." *N Engl J Med* , 2014;371(22): 2054-2057.

In all ETCs, oral rehydration solution (ORS) was very frequently given to EVD patients. Antibiotic treatment was also frequently given, but types of antibiotics differed among ETCs and over time. Most but not all patients received anti-malarial treatment (see Table 2, example of Foya). Morphine seems to have been rarely given, because of acceptance issues with national medical staff.

Fig 6. Number of patients at the Foya ECT who received IV fluids (April-October 2014)[84]

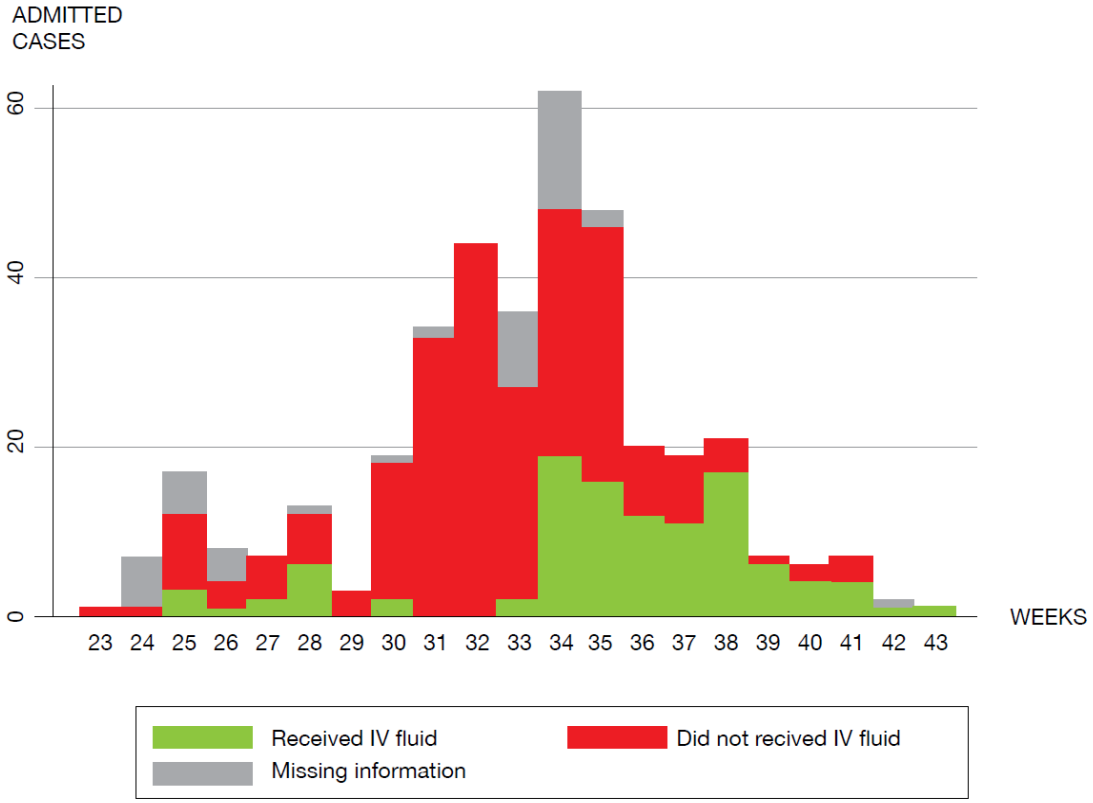


Fig 7. Survival time of patients at the Foya ETC before week 34 (when few patients received IV fluid) and after (when more patients received IV fluids)[85]

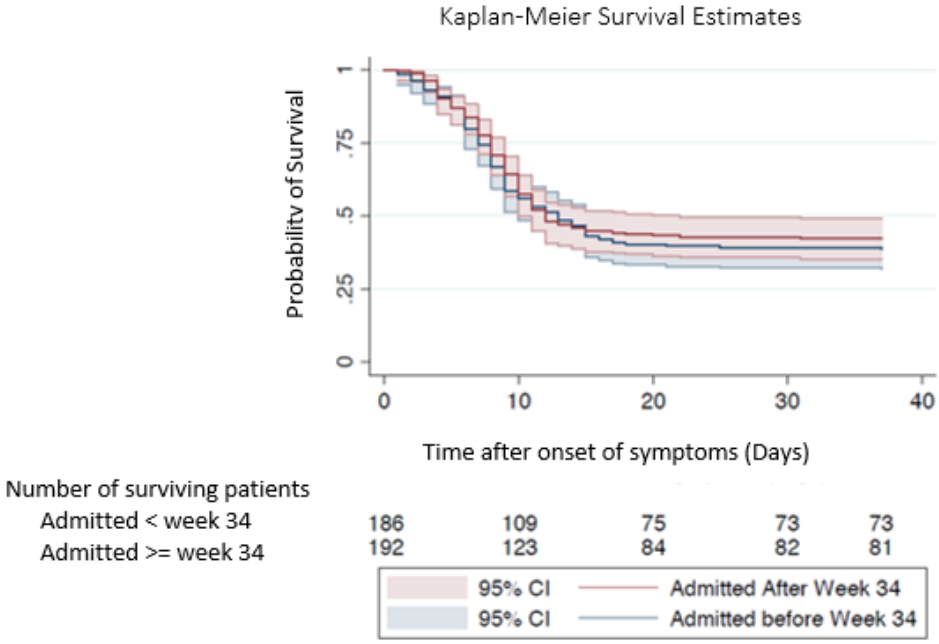


Table 1. Treatment provided at the ETC in Foya, Liberia[86] (April—October 2014)

Supportive care	Received	Not received	Unknown
ORS	264	64	56
IV fluid	107	221	56
Antibiotic	317	11	56
Antimalarial	265	63	56
Morphine	4	324	56
Diazepam	24	305	55

A last point about IV use relates to safety, which led to some reluctance to administer IV fluids in patients still able to drink.[87] One concern was that if an MSF staff member became infected while inserting or checking an IV line, it could lead to closure of the ETC, or could discourage other HCW from involvement in caring for Ebola patients, whether with MSF or other organisations.[88] In past Ebola outbreaks, administering IV fluids was linked to an increased risk of EVD infection in HCW. During the 2001 Gulu (Uganda) Ebola outbreak, 32 HCW became infected (two-thirds of whom died); the rate of occupational EVD was 8.6 per 1 000 days of admission in Lacor Hospital, where 79% of the patients received IV fluids, compared to 2.8 per 1 000 days of admission in Gulu Hospital, where 21% of the patients received IV fluids.[89] During the West African epidemic only six needle stick injuries were reported by MSF staff, one of which was by a nurse during medical procedures.[90]

4.D.6 Monitoring and documentation of clinical symptoms and vital signs

Monitoring and documentation of clinical symptoms and vital signs was generally poor at MSF ETCs, even during clinical trials.[91,92,93] Blood pressure and pulse were not monitored at ELWA 3 during the peak period when it was overwhelmed with patients.[94] In all ETCs, respiratory rate was rarely monitored and the fluid balance/urine output was never monitored.[95,96] Furthermore, the treatment received by patients was not well documented.

4.D.7 Evaluation of the quality of care; case fatality rates at MSF ETCs

Evaluating the quality of care provided by the MSF ETCs is difficult. Theoretically one approach would be to compare case fatality rates (CFR) at MSF ETCs with those at ETCs run by other organisations and those from previous EVD outbreaks. However, reported CFRs are difficult to interpret for several reasons, a chief one being that they depend on the patient population admitted to the ETC. Because

[84] Grandesso, F. "MSF Epi-bulletin Ebola Epidemic in West Africa Week 51." 8 January 2015.
[85] *Ibid.*
[86] Grandesso, F. "MSF Epi-bulletin Ebola Epidemic in West Africa Week 51." 8 January 2015.
[87] *Interviews with international staff* (2015).
[88] *Interviews with HQ Staff* (2015).
[89] Bell, M. Report by M. Bell, CDC [unpublished]. CDC, n.d.
[90] *Interviews with HQ Staff* (2015).
[91] *Interviews with international staff* (2015).
[92] *Group discussions among health care workers at Nongo* (2015).
[93] *Interviews with HQ Staff* (2015).
[94] *Interviews with international staff* (2015).
[95] *Ibid.*
[96] *Group discussions among health care workers at Nongo (2015).*

the Ebola epidemic was so widespread in West Africa, patients often had to travel long distances to be admitted to an ETC, and the very sick often died before arriving.

To illustrate this point: the Bo ETC had a comparatively low CFR (40%). However, it admitted only patients with laboratory-confirmed EVD, and it is likely that the delays introduced by testing meant that the sickest patients never made it to this ETC. Consistent with this observation, when patients who died in other health facilities and in the community were included, the CFR in the Bo district in September 2014—January 2015 was 66%.[97] Another example comes from the Kailahun ETC, where the CFR between June and October 2015 was 51%. Mortality rates were lower in those who travelled >100km and in those with a longer interval between onset of symptoms and admission to the ETC, findings which also support suggestions that the very sick never reached the ETC.[98]

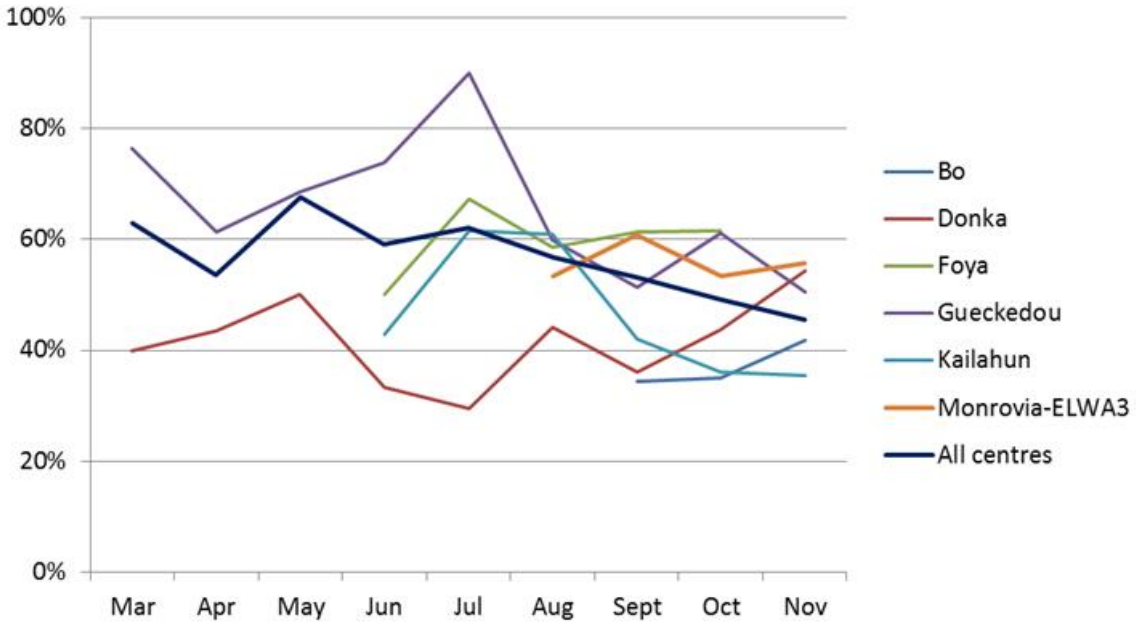
Furthermore, it is not easily feasible to compare the severity of disease in admitted patients across ETCs, since the best parameter for doing so is patient viral load. Yet the test used to measure viral load (cycle threshold, or CT value) is both indirect and somewhat variable among labs, so that quantitative results from ETCs using different labs cannot be directly compared.

Another complicating factor in interpreting CFRs or using them as a metric to assess quality of care is their variation over time. Figure 8 shows the fluctuation in CFRs in MSF ETCs over time and across ETCs. Differences were more pronounced in the beginning of the epidemic, for example

[97] Crowe SJ, Maenner MJ, Kuah S, Erickson BR, Coffee M, Knust B, Klena J, Foday J, Hertz D, Hermans V, Achar J, Caleo GM, Van Herp M, Albariño CG, Amman B, Basile AJ, Bearden S, Belser JA, Bergeron E, Blau D, Brault AC, Campbell S, Flint M, Gibbons A, Goodman C, McMullan L, Paddock C, Russell B, Salzer JS, Sanchez A, Sealy T, Wang D, Saffa G, Turay A, Nichol ST, Towner JS. "Prognostic Indicators for Ebola Patient Survival". Emerg Infect Dis. 2016 Feb;22(2):217-23250

[98] Fitzpatrick G, Vogt F, Moi Gbabai OB, Decroo T, Keane M, De Clerck H, Grolla A, Brechard R, Stinson K, Van Herp M. "The Contribution of Ebola Viral Load at Admission and Other Patient Characteristics to Mortality in a Médecins Sans Frontières Ebola Case Management Centre, Kailahun, Sierra Leone, June-October 2014." J Infect Dis. 2015 Dec 1;212(11):1752-8

Fig 8. Case fatality rates among admitted and confirmed Ebola cases in MSF ETCs, by month of admission (2014)



between Guinea, with CFRs of 60—80% in Guéckédou compared with 40—50% in Donka (Conakry). In October–November CFRs in all MSF ETCs fluctuated between 40 and 60%. During the Kikwit EVD outbreak in 1995 when very little supportive treatment was offered except at the end of the epidemic, case fatality was 80%.[99]

Case fatality rates in ETCs run by other organisations also varied widely. For example, early in the epidemic the Kenema governmental hospital in Sierra Leone had a CFR of 74%, while late in the epidemic the UK-supported ETC in Kerry Town, Sierra Leone had a CFR of 37%. The latter ETC admitted only patients with confirmed EVD; as observed in Bo, this approach presumably lowered the CFR. Turning to EVD patients treated in European or US intensive care units, the combined CFR for all 27 such patients was 18.5%.[100] Again, it is difficult to compare this CFR with those observed in African ETCs, since people transferred to Europe or the US were young previously healthy while African patients with EVD included young children and older individuals (with worse prognosis) and patients with nutritional/immunological deficits and potential co-infections.

Within the framework of this review, and in the absence of more detailed information about the characteristics of the patients admitted to the ETCs (and of a validated quantitative viral load test), and with very limited data about the type of supportive treatment provided to each patient, it was not possible to determine which supportive treatment strategies had a beneficial effect on survival. For example, Télimélé, where only a relatively basic supportive care was provided, a CFR of only 38% was observed.

[99] Bwaka, MA, et al. "Ebola hemorrhagic fever in Kikwit, Democratic Republic of the Congo: clinical observations in 103 patients." The Journal of Infectious Deseases, 1999; 179: S1-S7.
[100] Uyeki, TM, et al. "Clinical Management of Ebola Virus Disease in the United States and Europe." New Eng J Med 2016: 374;636-646.

4.D.8 Avoiding nosocomial transmission of EVD in ETCs

It is unclear how much nosocomial transmission of EVD may have occurred among suspects at ETCs, but the risk was often present. Patients with suspected EVD were sometimes gathered in one tent for testing, where symptomatic patients of unknown Ebola status were kept together for hours or days. In certain tents for suspected EVD patients there was just one metre between beds.[101] A good initiative at some ETCs was to isolate patients of unknown Ebola status who had diarrhoea and vomiting. Patients were also separated according to their predicted likelihood of being Ebola-positive, based on their clinical symptoms and any recent exposure to an Ebola patient.

However, it is not possible to reliably identify (and therefore isolate) all patients with EVD infection within a group of suspects. EVD case definitions based on history of fever and risk factors for EVD exposure do not have sufficient sensitivity to identify all cases.[102,103] Therefore, to avoid nosocomial transmission, it is important to obtain EVD test results rapidly. This was not always the case at MSF ETCs. Moreover, a negative EVD test result must be repeated if the patient has had symptoms for fewer than three days. The GeneXpert EVD test therefore offers advantages, because a positive result can be obtained in less than 2 hours and the test is more sensitive than the PCR-based test.[104] However, GeneXpert became available only at the end of the epidemic, and was used for the first time in the field by MSF at the laboratory in Conakry.[105] While waiting for the EVD test results, patients should ideally be accommodated in single patient compartments, as was the case for the later ETCs built by MSF (e.g., Prince of Wales in Freetown). Alternatively, a simplified separation into liquid-producing and non-liquid-producing patients should be evaluated, as was done in certain ETCs. It is also crucial to improve the initial triage step on whether or not to admit a patient to the ETC.

It is very likely that EVD transmission occurred in ambulances and taxis bringing patients to the ETCs. Transporting patients with ambulances was initially done by MSF Guéckédou, Télimélé and Macenta but was abandoned due to the lack of trained HCW. EVD patients had to travel long distances because MSF, together with all other partners involved in the control of the epidemic, had not been able to establish a decentralised system of care (e.g., with rapidly movable ETCs) for treating EVD patients closer to home. In Sierra Leone, ambulances frequently arrived with large numbers of suspected patients cramped together, while in Kailahun (where MSF was not involved in transporting patients), ambulances sometimes arrived at the ETC with several dead bodies alongside patients of unknown EVD status.[106] If these new arrivals tested negative, they were sent home.[107]

These EVD-negative patients were generally not followed up as contacts after they left the centres. However, sometimes patients diagnosed as EVD-negative based on a PCR test result later returned to the ETC and were found to be infected. It is possible that some of them were already infected when they were first hospitalised but tested PCR-negative because their viral load had not yet reached the threshold of detection by the PCR diagnostic test. Alternatively, patients could have become infected after returning to their family. It is important to know whether some of them became infected through contact with EVD cases during their hospitalisation while waiting for their

[101] Mbow, FF. "Ebola treatment centres were far from perfect." BMJ , 2015;350: 2787.
[102] Lado, M, et al. "Clinical features of patients isolated for suspected Ebola virus disease at Connaught Hospital, Freetown, Sierra Leone: a retrospective cohort study." The lancet Infectious Diseases, 2015; 15(9): 1024-1033.
[103] Zachariah, Rony. "Ebola in Sierra Leone, an epidemiological overview of the outbreak at district level, Kailahun and Bo districts." MSF OCB, October 2014.
[104] Van den Bergh, R et al. "Feasibility of Xpert Ebola Assay in Medecins Sans Frontieres Program, Guinea." Emerg Infect Dis 2016; 22(2): 210-216.
[105] *Interviews with HQ Staff* (2015).
[106] *Interviews with international staff* (2015).
[107] *Interviews with international staff* (2015).

EVD test result. In Kailahun, 16 of these readmissions were investigated.[108] Fifteen were readmitted within 21 days, and 9 were EVD-positive. All these readmitted patients had had contact with an Ebola case in the community within the previous 21 days, indicating that the infection was likely acquired outside the ETC; however, nosocomial transmission could not be excluded.

Sick patients diagnosed as EVD-negative at the ETC were transferred to other health facilities, but time was often lost in securing appropriate treatment for them. This was particular problematic at ETCs situated far from health facilities where appropriate care for the EVD-negative patient could be provided. It is also unclear how many patients ever received such care in the referral facility. Data on the outcome of the EVD-negative patients discharged from ETCs were not available.

4.D.9 Nursing and hygienic care

From the onset, there was a clear strategy for paramedical care—one that was adapted in a timely manner, well implemented and followed up, innovative and mostly effective. A team of nurses assisted by hygienists provided good hygienic care. In the online survey conducted for this review (see section 3.A), three quarters of respondents reported that patients were assisted with showering, more than 80% reported that patients were washed in bed, and nearly half reported that daily clean linen was provided.[109] However, due to biosafety measures, continuous monitoring and care by health staff was problematic. Unaccompanied young children or those accompanied by caretakers who were too sick to care for them could not maintain adequate hydration unless another patient stepped in to help them.

4.D.10 Psychosocial care

Psychosocial care was provided from the onset to staff, family members, patients and survivors by a team of trained HCW. Many staff, including those working outside the ETC, consulted this service on a regular basis.[110] Many local staff reported suffering strong stigmatisation from their own families and communities, and the onsite psychosocial support was seen as effective in reducing stress and fear.[111] Stigma forced some staff to leave their family; others kept their ETC work secret from their family for months.[112] ELWA 3 staff reported that the psychosocial services underwent several adaptations to improve quality.

Counselling was initiated upon referral or self-referral, and counsellors also did rounds among the teams to proactively identify issues. Workshops were organised where staff could invite family members to discuss infection, protection, demonstrate PPE, and hear testimonies of survivors.[113] These workshops were considered powerful and effective. For ELWA 3 patients, there were three daily rounds delivering psychosocial support. An increase in size of the counselling team meant that staff could spend more quality time with patients.[114]

For children, games and activities were made available. Though not implemented from the onset, families were supported through phone contact and allowed to bring gifts, and a grief team was

[108] Fitzpatrick, G, et al. "The Contribution of Ebola Viral Load at Admission and Other Patient Characteristics to Mortality in a Medecins Sans Frontieres Ebola Case Management Centre, Kailahun, Sierra Leone." *The Journal of Infectious Diseases*, 22 May 2015.
[109] MSF. "Survey for MSF Staff in SurveyMonkey." SurveyMonkey, 2015.
[110] *Interviews with national staffs* (2015).
[111] *Ibid.*
[112] ELWA Staff. "Focus group discussion." 2015.
[113] Viscus, Athena. "Handover report, ELWA 3, MH responsible." Monrovia: MSF, 2015.
[114] "Handover reports Mental health responsible, ELWA 3." MSF, 2015.

established to counsel family members whose loved ones had died. They also issued photos and certificates for discharge and deaths.[115] 'Cured' certificates were issued at one stage. At an earlier stage 'negative test' certificates were issued but then discontinued after they were found to be misused when people became sick later on.[116]

Beginning soon after the peak of the epidemic, survivors suffering from stigma and exclusion upon discharge were accompanied home for community education and a facilitated reintegration. Survivors were also recruited in the ETC as basic care providers for other patients, especially unaccompanied children. One outstanding issue in this regard was to what degree they needed PPE; different protocols were applied at different ETCs. In addition, some concerns were raised to whether this peer-to-peer support would aid or burden the mental health of a survivor who had already undergone severe trauma.[117]

HP teams provided information to patients, family and staff.[118] Survivors assisted in providing care for children, including feeding and playing with them. At the Nongo ETC, in August 2015 survivors interviewed for this review reported that some children did not want to leave the ETC because they liked the setting so much.[119]

Appropriate food provision in the ETC was considered essential for the physical and psychological wellbeing of patients, and an important determinant of whether sick people in the community would agree to seek care in an ETC.[120] Food and nutritional supplements were provided for patients by specialised teams of nurses in all ETCs. However, initially in ELWA 3, food provided by the ETC was not accepted by the local community.[121] "The [ETC staff's] refusal to permit meals made at home" was not considered appropriate, and it dissuaded people from going to an ETC.[38] In certain ETCs and at certain times, personal requests for food were fulfilled.[3,11] It was suggested by survivors that this "saved patient's lives."[38]

To evaluate the quality of care at ETCs, it is important to speak with patients. Survivors generally were very thankful for the care they received. However, they also reported several problems. For them, 'dignity' was essential. Liberian survivors who were interviewed reported that at the epidemic's peak in ELWA 3:

> *"Some dead bodies were not taken away for up to 12 hours."*
> *"We were all packed together."*
> *"We should not see bodies like this."*
> *"Some of us died of fear."*
> *"We, Liberians, can deal with anything, but seeing bodies piled up like charcoal is too much."*

Avoiding being confronted with severely ill patients and dead bodies as much as possible was considered essential for patients and their psychological wellbeing.[122]

ETCs provided little privacy. ELWA 3 survivors proposed separating patients based not only on clinical severity but also on gender. They stressed that consideration of cultural sensitivities was essential to increase acceptance of ETC care. Providing food and IV fluid was seen as important for convincing people to be admitted to an ETC. Moreover, "maintaining family contact was felt to be more

[115] Venables, E. "Atomic bomb, Monrovia-Liberia." December 2014.
[116] *Interview HQ Mental Health* (2015).
[117] *Ibid.*
[118] Reference: Health Promotion Chapter
[119] *Interviews with national staff* (2015).
[120] Venables, E. "Atomic bomb, Monrovia-Liberia." December 2014.
[121] *Survivor focus group discussions* (2015).
[122] *Ibid.*

important than an IV line to reduce mortality."[123]

Later in the epidemic in most ETCs, systems were put in place that allowed patients to remain in contact with family members by phone and, when they were able to walk, to meet and greet their relatives across a fence that kept a 2-metre distance between them.[124,125]

To further evaluate the quality of care, families who lost a loved one should ideally also be interviewed. However, this has not been done so far, as it is still considered too delicate.[126]

Strategies were developed to reduce PPE time where possible, so that more time could be given to bedridden or unconscious patients. In Guéckédou, a limit of two patient rounds a day was temporarily implemented but found insufficient.[127] Clinicians were also initially found to be too involved in nursing care; separate nursing and clinician rounds were therefore implemented in December in Guéckédou.[128]

Initially at triage, patients were received in full PPE, but this was abandoned so as to personalise care providers and reduce patients' fear at admission. However, an MSF staff infection at the Bo ETC was suspected to have occurred at triage; this led to triage workers wearing full PPE again, upgrading protection, and respecting a 2-metre distance.[129]

Peer care established itself in many of the ETCs. Since nurses could not always be present in the high-risk zone, less sick patients helped take care of the severely ill. They functioned as a lifeline, providing hope, care and dignity in a stressful environment.[130]

4.D.11 Support for survivors

Psychosocial teams visited survivors at their homes, and when home visits were not possible they communicated via telephone.[131,132] They also conducted counselling sessions and performed psychosocial assessments using a standardised questionnaire. Based on the recovered patient's condition and healing progress, some received more than one visit.

Medical care for survivors was not provided early in the outbreak[133]—the first MSF clinic for survivors was opened on 28 January 2015 in Monrovia, initially located outside ELWA 3 and then (as of April 2015) in the MSF paediatric hospital in Monrovia. Its services included a thorough history and physical examination using a medical assessment form, and provision of medical treatment. Patients with eye problems were referred to either a local ophthalmologist or a team of international ophthalmologists who visited Monrovia in April 2015.

4.D.12 Constraints to providing optimal care

Several constraints impeded OCB teams from providing optimal care, in particular during the height of the epidemic. Depending on location and period of the outbreak, these included: the large number

[123] *Interviews with Ebola survivors* (2015).
[124] *Interviews with international staff* (2015).
[125] *Group discussions among health care workers at Nongo* (2015).
[126] *Interviews with international staff* (2015).
[127] Decroo, Tom. "Field visit report Guinea." 2015.
[128] *Interviews with international staff* (2015).
[129] *Ibid.*
[130] *Ibid.*
[131] *Interviews with national staffs* (2015).
[132] *Interview Counsellor ELWA 3* (2015).
[133] *Interviews with international staff* (2015).

of patients and fluctuation of these numbers; cases emerging at new sites, often in very remote places; hostile communities; weak healthcare infrastructure; the lack of skilled local HCW; the lack of and wide variations in experience of international staff; the high turnover of international staff (medical staff stayed for a maximum six weeks); and the shortage of beds and ETCs. Moreover, the infrastructure of most ETCs was not optimal. It was very difficult to work in most ETCs because of the working conditions inside the tents, including the extreme heat,[134] which was also detrimental for the patients who already were dehydrated. Issues with ETC design and construction are discussed in more detail in the respective report of the Ebola review.

4.D.13 Equipment

Retractable needles and safer IV lines (self-disabling catheters for cannulas, shield catheters and single use IV rep kits) and dial flow regulators to monitor the speed of IV fluid administration were not provided due to logistical constraints and/or internal disagreement about the appropriateness of using them. Intra-osseous rehydration material was provided but never used. Oxygen concentrators were initially not provided because of biosafety issues with use for multiple patients, but were taken up late in the outbreak (in December in ELWA 3).

4.D.14 EVD laboratory diagnosis

In some ETCs, particularly early in the epidemic, there was considerable delay in EVD diagnosis. In our survey, 52% of participants reported that EVD test results were obtained within 3-5 hours, 38% said that results took between 6 and 12 hours, and 8% reported a wait of more than 12h.

Ideally, phlebotomy and laboratory analysis should be provided at ETCs on a 24-hour basis. However, this was generally not possible, and certainly not during the night. There were also problems with certain labs, such as the Lab Institut Pasteur de Dakar at Donka,[135,136] where it was unclear what was done with the patient samples after testing. On the other hand, there was good collaboration with the laboratory from the Bernhard-Nocht Institute of Tropical Medicine in Hamburg. Finally, at Donka and Nongo, MSF established its own innovative container lab that used GeneXpert for EVD diagnosis.

It is important to note that not a single Material Transfer Agreement (MTA) was signed between MSF and any of the labs that performed diagnostic tests on MSF patients. Had this been done, it could have prevented some of the problems that emerged. Patient confidentiality was seriously breached as names circulated in the lab records and beyond. All the labs kept what remained of the samples, which had been sent to them by MSF for diagnostic purposes only; these remains were aliquoted, frozen and a majority of them exported to the "home" country, without any direct information, let alone permission, from MSF or any of the patients. Most of these labs had some kind of Memorandum of Understanding (MOU) or MTA with the government.

The labs could have been more innovative in supporting MSF with other diagnostics, such as biochemistry, haematology, pregnancy tests, etc.

4.E Health Promotion (HP)

4.E.1 The strategy

While the strategy for providing HP in all ETCs was clear from the beginning, in several areas efforts

[134] *Interviews with international staff* (2015).
[135] *Ibid.*
[136] *Interviews with Ebola survivors* (2015).

on outreach and community activities were not implemented from the onset of the epidemic. In August 2014 OCB released a training document that described objectives, target population, lessons learned and recommendations.[137] While it was not an overall strategic HP document as such, this presentation was considered by the field teams to be sufficient in clarifying the broad lines of an HP strategy.

The majority of survey respondents at field level reported that they could not discern a clear HP strategy,[138] while at HQ, HP was reported to be an essential pillar in the intervention[139]. While field-based respondents felt that an overall strategic document/framework would have eased implementation, in particular when HR was absent or weak, HQ felt that only the field could define HP strategies, since they needed adaptation to local context and culture.

OCB often felt that they had no choice but to prioritise certain strategic components above others. HP activities were therefore not implemented right away in most locations.[140] At field level, there were frustrations when priorities were skewed towards clinical care rather than HP activities in the affected communities.[141]

4.E.2 HP guidelines

Interviews with respondents highlighted uncertainties regarding HP guidelines. The 2008 guidelines are limited in technical and strategic content.[142,143] Moreover, some of the guideline's important recommendations on how to establish community acceptability through effective collaboration and demystifying the ETC were not implemented at the onset of the response.[144] There were no clear reasons for not following these guidelines, and the initial lack of transparent ETCs, including a lack of visitor areas, created community resistance and barriers to care. The 2015 Draft Guideline, in digital format, was not user friendly at field level. In addition, a CD was distributed to outgoing international staff but it was not seen as being a concise guideline or a logical set of tools but rather as a fragmented file with lots of everything. Over the course of the epidemic there was clear capitalisation of tools, lessons learned and improved guidelines and technical notes. Though this resulted in a more user-friendly and comprehensive HP reference library, it was only finalised near the end of the epidemic.

4.E.3 HP implementation in the ETC

Overall, HP activities in the ETCs were the most successfully implemented HP activities by MSF. They were considered as appropriately designed and were implemented in a timely way throughout the phases of the outbreak and across all countries. They followed the 2015 Draft Ebola Guidelines in targeting patients, caretakers and health staff. A majority of survey respondents (65%)[145] found the health information given to the target population sufficient and appropriate.

Some weaknesses were highlighted during the critical months of August and September 2014 when, due to high caseload and occasional staff shortages, there was not always time to ensure quality

[137] Al Kourdi, Yasmine. "Ebola Training [PowerPoint]." MSF, August 2014.
[138] Interviews with international staff
[139] "Briefing Ebola Paper, High level Conference." March 2014.
[140] Interview with the former Head of the Ebola TaskForce
[141] Interviews international staff
[142] Interviews international and HQ and other OC personnel
[143] "Filovirus haemorrhagic fever Guideline." MSF, 2008 : Review
[144] Sterk, E. "Filovirus haemorrhagic fever Guideline." MSF, 2008, p27-28
[145] MSF. "Survey for MSF Staff in SurveyMonkey." SurveyMonkey, 2015

implementation of HP activities. Gaps in HR resulted in sharing the workload between psychosocial counsellors and health promoters in Guéckédou, Donka and Bo (October 2014). This overlap was found to distort work objectives and cause confusion among staff. However, if roles and responsibilities are clearly defined, such complementary approaches could be effective in contexts with too few staff.[146]

Issues affecting acceptance by the community arose at the ETCs in Guéckédou, Bo, and ELWA 3 when rules were implemented that restricted families in contacting their sick relatives or seeing their dead bodies[147]--restrictions not in line with MSF guidelines.[148]. These rules led to rumours and negative perceptions, and served only to increase the mystery surrounding the ETC. In all three countries, at the onset MSF was accused of *"collaborating with government to exterminate the people"* and "*stealing organs and blood to sell to the rich countries."* It was also said that "*MSF people can give injections to kill many people*" and *"bodies disappeared"* from the ETC.[149] MSF recognised these barriers but it was difficult and time-consuming to correct the misperceptions. Visitor areas were subsequently constructed and several approaches implemented to facilitate contact between family and patients, as described below (see section 4.E.5).[150]

4.E.4 HP implementation in the community and outreach

HP activities inside the community demonstrated several weaknesses in strategic design, timely implementation, and monitoring and evaluation. A short description of each location highlights some of the specific situations.

The intervention in **Guéckédou, Guinea** focused on timely implementation, and a sufficiently large HP team was recruited quickly (see Annex V.A). However, a thorough understanding of the heterogeneous community was missing, and no sociocultural assessment was done.[151] Targeting community leaders did not lead to messages being passed down into the communities. Local radio was used very little. Since coordination with other stakeholders started late, messages were not harmonised, and some were negative or inaccurate.[152] The message 'Ebola kills' was counterproductive,[153] since it led people to prefer to receive care and die at home. By mid-May, MSF decided to adapt to a more comprehensive approach of information dissemination and revised messages.[154] This was viewed as a positive contribution to more awareness at all levels of the population, and it facilitated acceptability and access to ETC care.

Macenta was dealing with similar challenges (see Annex V.B). The timing of the HP intervention was delayed and collaboration with other actors was poor. Community sensitisation by both MSF and other stakeholders on the ground remained insufficient until May. Struggling with strong community resistance, MSF tried to reinvigorate HP at the end of August by implementing targeted sensitisation activities and training NGOs and community-based organisations. However, several attempts to

[146] Interviews international staffs and HQ staffs
[147] Verschuere, Jesse. "Capitalization and evaluation of the Health Promotion response during the Ebola Outbreak in West Africa (March – December 2014)." Médecins Sans Frontières, December 2014
[148] Sterk, Esther. "Filovirus haemorrhagic fever guideline 2008." Médecins Sans Frontières, 2008, p28: 'set up the Ebola ward in a transparent way to make activities visible, e.g., Use low or mesh fences so people can see what is happening and create spaces where patients can communicate with family.'
[149] Anthropological reports and focus group discussions with survivors and communities.
[150] Interviews international and national staff
[151] Manca, Maria Cristina. "Proposition de projet de recherche anthropologique, préfecture de Gueckedou, Guinée Forestière." Médecins Sans Frontières, 7 August 2014
[152] Verschuere, Jesse. *Op. cit.*
[153] Sterk, Esther. *Op. cit.,* p27
[154] Door to door bilateral talks, printed materials, theatre, Ebola song, EMC documentary movie

collaborate with the national Red Cross were unsuccessful. Not until four months after MSF's arrival was a comprehensive sensitisation campaign started.[155] In November, a new ETC with visitor zones was constructed, and then handed over to the RC.

Donka-Conakry was the least effective in terms of timing, coverage and coordination on HP (see Annex V.C). There was an 8-month delay before effective HP community activities got underway in November. The causes were manifold and due to both internal and external factors. A decrease in cases in May 2014 gave false hope of an epidemic decline. Due to HR shortages, there was only one international HP staff member present for four weeks over a period of six months.[156] MSF decided to rely on the government's 'Commission of Communication' and the United Nations Children's Fund (UNICEF) to conduct social mobilisation. This proved to be a mistake, as their social mobilisation was ineffective.[157] Meanwhile, MSF HP activities in the ETC were managed by national staff. It was only in November, when cases started to decrease, that a HP community team was recruited and community sensitisation began. Nonetheless, according to the Sitrep, by the end of December the MSF ETC was still perceived as the 'place to die.'[158] There is no doubt that HR constraints impacted operational choices, but they also reflect the lower priority that MSF sometimes gave to HP in this intervention.

Kailahun in Sierra Leone implemented a fast and comprehensive approach to HP (Annex V.D). The first international HP staff, which had gained experience in Guéckédou, was in the field before the ETC was constructed, already starting door-to-door campaigns. Appropriate communication channels had been assessed and a mass sensitisation campaign started one month after the team's arrival. Soon after the ETC starting providing treatment, community leaders as well as survivors were active in HP, and other tools like radio, theatre and movies were being used to inform and educate. By mid-July, MSF was accepted and appreciated by the community. In Kailahun the lessons on HP from Guéckédou and Macenta were applied, and the project also had good HP leadership. The HP impact was perceived to be strong by MSF staff involved in the project. The only challenge was that the local HP team was too large (700+ national staff), which made management difficult. Also, training this large team delayed some of the implementation.

In Bo, HP in the community was first implemented one month after the ETC opened (Annex V.E). Despite the availability of national staff from the long-term GRC program, HP initially remained focused on the ETC only, reducing HP coverage. At first there was poor supervision, which led to mismanagement and poor performance.[159] Due to infection of a staff member, all community and outreach activities were put on hold until the end of October 2014. Survey respondents considered the government's militarised approach in quarantining villages to be counterproductive for MSF HP activities that were aiming to establish trust.

Foya in Liberia was a short intervention by OCB (later handed to OCG), but effective in terms of timeliness, coverage and coordination (Annex V.F). International HP staff was present and all intervention levels of HP were tackled punctually and in parallel. Coverage encompassed Foya town and the surrounding villages, and survey respondents considered it to be good.[160] The team implemented a comprehensive approach[161] that targeted all levels of the population and included

[155] Door to door bilateral talks, printed materials, theatre, Ebola song, EMC documentary movie
[156] Verschuere, Jesse. *Op. cit.*
[157] Interview with OCB staff member
[158] Sitrep W37, W43, W44, W49
[159] Verschuere, Jesse. *Op. cit.*
[160] Transparent EMC activities + mass sensitisation in and outside Foya, door to door dialogue, group sessions, survivor testimonies, community leader involvement, radio/broadcast.
[161] Transparent EMC activities + mass sensitisation in and outside Foya, door to door dialogue, group sessions, survivor testimonies, community leader involvement, radio/broadcast.

the training of sensitisation teams from other NGOs,[162] steps that ensured harmonisation of messages from the onset. From a HP perspective, Foya was the best performer, albeit for a simpler and much shorter intervention than at other sites.

In **Télimélé**, it took only six weeks to contain the outbreak. This successful outcome was due to the very fast implementation, high levels of transparency towards populations, and strong efforts in targeting stigmatisation from the start.

Monrovia, with the catastrophic situation encountered at MSF's August 2014 assessment and with a high level of tension in communities, posed severe challenges in terms of HP and of security risk to staff (Annex V.G). Nevertheless, HP staff were part of the first MSF response team, and by mid-August MSF had started training community health workers (CHW), Red Cross volunteers and community leaders. Eventually, 422 CHWs were trained and, via door-to-door sensitisation activities, increased Ebola awareness in Montserrado County. However, the government's decision to enforce mandatory cremation disregarded families' cultural expectations to preserve contact with their deceased, fuelling a sense of mistrust and abandonment within the communities and creating additional barriers to care.[163] The distribution of protection/disinfection kits in Monrovia (see sections 4.E.5 and 4.I) was considered an effective and innovative approach that should be properly evaluated, to decide whether and how to recommend it as a possible part of future outbreak response strategies.[164]

Overall, by August 2014 the role of HP in outreach activities was well defined,[165] and as long as resources were available, it was implemented. HP ensured linkage between the community and specific outreach activities like burials, ambulances, alert teams, IPC and protection/disinfection kit distributions. The latter experience is described in detail in the Logistic report of the OCB Ebola review.

4.E.5 Adaptability and innovation in health promotion strategy

HP requires constant re-assessment, and MSF demonstrated strong capacity and flexibility to adapt strategies, tools and messages for better results. In the first phase of the epidemic, HP remained focused on ETCs.[166] However, when resources were available, it expanded to include the additional layers of community and outreach (if not already covered by other actors). From the third phase of the intervention onwards, MSF was more proactive in HP.

Guéckédou initially carried out mass sensitisation via radio and TV but later adopted a more targeted approach that included the traditional chiefs, traditional healers, *chefs de quartier*, CHWs and nurses. It was suggested that even very critical and sceptical people could be targeted and turned into promoters of Ebola care.[167,168]

During Phases 2 and 3, MSF shifted to a more comprehensive approach that encompassed all population groups, using different methodologies and tools in parallel. Foya and Télimélé were good examples of early interventions and exceptional community acceptability.[169] Interestingly, the epidemic curve in both locations was short. The response was early and used radio, flyers, theatre,

[162] UNICEF, RD, Plan, Making Change, MoH, other local associations
[163] Pellecchia, Umberto. "The Breakdown: Report on Communities Perceptions and Practices to Ebola Epidemic in Monrovia, Liberia, 2014." Médecins Sans Frontières, 2014.
[164] Interviews with international and national staff
[165] Al Kourdi, Yasmine. "Ebola Training [PowerPoint]." MSF, August 2014.
[166] Verschuere, Jesse. *Op. cit.*
[167] Decroo, Tom. "Field visit report Guinea." 2015.
[168] Interview Health Promoter Liberia
[169] A Health Promoter briefing document

mobile cinema, door-to-door dialogue, group sessions and consultation with influential leaders. In addition, early coordination and training of other actors resulted in agreement on common messages. The ETC was set up in a transparent manner, creating visibility in the community.

The 'Mobile Cinema' was a particularly successful tool for explaining the ETC's function to the community. The film was much appreciated by communities, seen by large crowds and proved to be an effective and safe alternative to the ETC guided tours. This idea was instigated in Conakry and used again later in Sierra Leone and Liberia.

Establishing contact between patient and family was considered a potentially strong tool for reducing mortality. As a national staff member said in a focus group discussion conducted by the review team (see section 3.A), *"Death is not the worst thing. Being alone is the worst thing."* In these discussions there was a consensus that the feeling of 'abandonment' was the most difficult feeling to deal with, leading patients to believe that death was a better option. At the peak of epidemic, many patients got separated from their relatives during referral. MSF tried to reunite them by supplying phones or mobile credit, sending photos and videos with iPads, or through talking or sending messages over the visitor fence. Occasionally a relative was allowed in the high-risk zone. Bodies of the deceased, and sometimes their photos, were made available for family to say their last goodbyes and prayers. While the use of technology was new most of the other tools were already recommended by the MSF VHF Guidelines,[170] although they not implemented from the beginning. In addition, games, newspapers, television and other tools were provided to keep people occupied.

Inclusion of survivors in the ETC and the community was regarded by both community members and patients as particularly successful.[171] Patients sometimes felt abandoned, particularly when contact with family was difficult, and this peer-to-peer support meant they hadn't been given up on. Just as the presence and care of medical personnel was a lifeline for patients, the participation of survivors and the patient-to-patient care was said to be effective in "keeping us alive." In the community, survivors became advocates and evidence that 'surviving is possible'. This approach of proactive community/survivor engagement was empowering and restored dignity.

The distribution of protection/disinfection kits was described as an "imperfect measure."[172] However, the kits potentially had a strong impact on the behaviour of populations (this has not yet been formally evaluated; see above, section 4.E.4). Feedback from focus group discussions stated that 'with the kit, we knew what to do.' 'We were told not to touch but that is impossible when your child is sick.' These tools allowed people to care for and touch their loved ones again, and potentially helped overcome further disintegration of societal ties;[173] they empowered communities and made them part of the solution.

Throughout the epidemic, more focus was given to active detection of rumours or wrong and negative messages in the community, as these often translated into barriers to ETC care.[174] Trained health promoters effectively detected and redirected rumours through bilateral community dialogue. Roundtable discussions with ELWA 3 staff revealed that at the start of the intervention, MSF's incinerator was thought to be the place where bodies were cremated. In addition, the smoke it produced was perceived as infecting the surrounding communities. HP teams went into communities seeking dialogue and invited community leaders to see the incinerator,[175] thereby

[170] Sterk, Esther. "Filovirus haemorrhagic fever guideline 2008." Médecins Sans Frontières, 2008, p27-28
[171] FGD of Liberia ELWA 3 survivors and national staff.
[172] MSF. "Pushed to the Limit and Beyond : A year into the largest ever Ebola outbreak." Médecins Sans Frontières, March 2015.
[173] Pellechia, U. "The Breakdown: Report on Communities Perceptions and Practices to Ebola Epidemic in Monrovia, Liberia, 2014." Médecins Sans Frontières, 2014.
[174] Interview with the Head of Task Force MSF OCB
[175] ELWA 3 round table discussion, August 2014.

quickly dispelling false rumours.

MSF's decision to train other actors on HP had far-reaching positive implications. Training was provided at several locations to UNICEF, Red Cross, Plan International, Making Change, and the MoH and community organisations. Apart from improved relations between actors on the ground, this resulted in better harmonisation of messages amongst the different actors, and participants in the training became agents of change.

4.E.6 The use of anthropology in health promotion

The use of MSF anthropological assessments was initiated late in the intervention, despite the fact that MSF Ebola guidelines[176,177] recommend the use of anthropology at the onset of the intervention to establish an in-depth socio-cultural profile of affected communities.

Clearly, the behaviour of a population played a significant role in how the outbreak unfolded.[178] People's perceptions of Ebola as a disease and of those who provided aid strongly influenced the likelihood that patients would follow the public health advice they received. At the onset of the outbreak in Guéckédou, MSF had a very limited understanding of the community. Guéckédou is extremely heterogeneous, with many ethnic groups, languages and religions that each had their own funerary rituals and interpretations of Ebola. In this respect, it was complex to quickly understand many different community dynamics. Initially the community acceptance was low, rumours were out of control and tensions were high. An early analysis followed by rapid sharing of the information gleaned could have helped the team adapt approaches and tools early.

Several anthropological studies were conducted later on, but none as a baseline.[179] The objectives were to better understand perception of ETCs, barriers to care, and issues of stigma and survivors, burials, dead bodies and quarantine. Recommendations were considered useful and some were implemented. However, since the epidemic was already widespread at the time of most studies (in November and December), the recommendations came too late. Respondents reported that studies were proposed at earlier stages but could not be implemented.[180] Also, five out of the six studies were conducted in Monrovia and none in Sierra Leone. In Guinea, WHO released a few anthropological studies, but few respondents at field and HQ level were aware of them.[181]

A large majority of interviewees asserted that MSF did too little too late to better understand local culture and context, and that an earlier understanding could have benefitted the intervention. The general feedback of interviewees was that many "answers lie within the community." In addition,

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[176] Sterk, Esther. "Filovirus haemorrhagic fever guideline 2008." Médecins Sans Frontières, 2008 and "Filovirus Haemorrhagic Fever Manual 2015 [Draft]." 2015. https://www.evernote.com/pub/agsprecher/FilovirusFieldManual (accessed December 8, 2015).

[177] Al Kourdi, Yasmine. "Ebola Training [PowerPoint]." MSF, August 2014.

[178] Pols, Thomas. "Ebola outbreak 2014: a struggle between medicine and policy, Fletcher School of law and policy." 2015.

[179] Pellecchia, Umberto. "Rapid Report on quarantine in Monrovia City [Draft]." Médecins Sans Frontières, January 2015; Pellecchia, Umberto. "The Breakdown: Report on Communities Perceptions and Practices to Ebola Epidemic in Monrovia, Liberia, 2014." Médecins Sans Frontières, 2014 ; Massaquoi, Alfred. "Viewing Human Remains Before Burial - A sampling perspectives and ideologies of the Liberian People." Monrovia: Médecins Sans Frontières, 12 December 2014 ; Venables, E. "Atomic bomb, Monrovia-Liberia." December 2014; Venables, E. "Clinical Trials." Médecins Sans Frontières, December 2014.

[180] Interview with the Head of the Emergency Unit MSF OCB.

[181] Anoko, JN. "Communication with rebellious communities during an outbreak of Ebola virus disease in Guinea: an anthropological approach." Ebola Response Anthropology Platform. n.d. http://www.ebola-anthropology.net/case_studies/communication-with-rebellious-communities-during-an-outbreak-of-ebola-virus-disease-in-guinea-an-anthropological-approach / (accessed October 10, 2015).

55% of respondents to the online survey said that more cultural context should be included in Ebola pre-deployment training. Externally, MSF was also criticised for not making enough use of medical anthropology in these contexts.[182] Comments were made that MSF misses out on recruiting medical anthropologists and using their potential to help control outbreaks.[183] A question that could not be answered was whether teams used cultural knowledge available through local sources (national staff or other).

4.E.7 Health promotion and security

Acceptance is the core of any strategy for humanitarian actors' security. In an Ebola context, it seems obvious that the high levels of community fear, distrust and resistance were linked to some of the security incidents that occurred. In Guinea, the following statements were made during focus group discussions and interviews for this review in July 2015, highlighting the mistrust towards foreign and political actors as well as the ethnic tensions that Ebola seems to have exacerbated.

> *"Whites have brought Ebola to eliminate the Africans."*[184]
>
> *"It is like a war."*[185]
>
> *"A conspiracy between the political and administrative power and Whites."*
>
> *"Why only Kissi dying and the Kissi are continu(ing) to work for the Whites."*

In Monrovia, people reported feeling like they were "*battling the enemy, and the ETC was the frontline."*[186] During the first phase of the epidemic, the trust deficit towards governments in all three countries, and the barrier towards acceptance of outside interventions, resulted in denial. Ebola was "not real." Such suspicion, combined with fear, boiled over into hostility towards aid workers.[187]

Security incidents continued to occur in all three countries. Between May and November, 16 security incidents were reported, two of which resulted in fatalities. The first incident was on 4 April when an angry crowd attacked the MSF Macenta ETC, prompting evacuation of the team. It took several days to negotiate re-entry and resume work. It is worth noting that MSF had a footprint in the area for over a decade but was still not protected against the April incident. The worst incident occurred in September 2015, five months after the first EVD cases, when eight community educators were killed by village inhabitants in the Guinée Forestière region.[188] Despite efforts to improve the dissemination of information, the acceptance of outside aid interventions remained low; MSF struggled with ongoing resistance and security incidents in Guinea through January 2015.[189,190]

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[182] Anrys, Stefaan. "Mistakes in fighting Ebola repeated all over again, says pioneer." Mondiaal Nieuws. n.d. http://www.mo.be/fr/node/39939 (accessed December 8, 2015).

[183] Abramowitz, Sharon. "Ten Things that Anthropologists Can Do to Fight the West African Ebola Epidemic." Somatosphere. 26 September 2014. http://somatosphere.net/2014/09/ten-things-that-anthropologists-can-do-to-fight-the-west-african-ebola-epidemic.html (accessed December 8, 2015).

[184] Anoko, JN. "FGD with Liberian and Sierra Leonean community." 2014.

[185] Venables, E. "Atomic bomb, Monrovia-Liberia." December 2014.

[186] *Ibid.*

[187] Pols, Thomas. "Ebola outbreak 2014: a struggle between medicine and policy, Fletcher School of law and policy." 2015.

[188] "Ebola outbreak: Guinea health team killed." BBC News. 19 September 2014. http://www.bbc.com/news/world-africa-29256443 (accessed December 8, 2015).

[189] http://www.ibtimes.co.uk/ebola-crisis-msf-says-it-could-exit-guinea-if-violent-attacks-against-workers-persist-1489262

[190] Vazquez Llorente, Raquel , and Lisa Reilly . "Organisational risk management in high-risk programmes: the non-medical response to the Ebola outbreak." HPN. June 2015. http://odihpn.org/magazine/organisational-risk-

Key groups of survey respondents (e.g., experienced coordinators) asserted that health promoters played an important role in assessing the level of tension and negotiating access to communities. At ETC level, health promoters were crucial in mediating team or family disputes. In outreach, the HP workers, not wearing PPE, served as the 'advance team' to prepare the field and assess tension levels before burials or house disinfections were conducted.[191] In the community, they were called upon to resolve Ebola-related community disputes and issues around reintegrating survivors.[192]

4.E.8 Monitoring and evaluation in HP

Despite the crucial role and many contributions of HP, there were no systematic HP monitoring, evaluation tools established, or research conducted, and therefore no conclusive information on the results or impact of these activities—and, consequently, no evidence base to inform project planning or adaptation.

4.F Outreach activities and contact tracing

4.F.1 Outreach

Outreach is an important tool for staying in touch with communities and understanding concretely the evolution of the epidemic. The 2008 guidelines include references to outreach in various sections of the document, but do not clearly delineate a comprehensive set of defining activities.

In this review we define outreach (based on the definition used by interviewees) as alert response and surveillance in the community, or in other words, active case finding and analysis of transmission chains, and activities such as home spraying when a case is found in the community. In a more traditional definition, outreach could also encompass HP, IPC in non-Ebola health facilities, contact tracing, and management of dead bodies. The following sections elaborate on some of these activities.

OCB was engaged in outreach to varying degrees over the course of the outbreak, using different approaches between and within countries. There were often no specific teams dedicated to this activity, which was conducted when time was available, but cut back when teams were overwhelmed.

In Guinea, MSF integrated outreach activities into the response from the beginning in Guéckédou, but much less in Macenta.[193] Outreach was not part of the response in Monrovia until late in the outbreak, and even then (in November), when MSF was providing support in some areas with ambulances and teams, it did not cover all locations and needs.[194]

In Sierra Leone, MSF engaged somewhat in outreach in Kailahun, but was unable to engage at the requested level. The activity was run by MoH teams, with MSF providing training. The ambulance system (where MSF was not involved) was ill-prepared and quickly became overwhelmed (see section 4.D.8). Ambulances often carried many people in a single trip—the reported record was 12 patients, whose Ebola status at the time of the transport would have been unknown.[195] At least two

management-in-high-risk-programmes-the-non-medical-response-to-the-ebola-outbreak/ (accessed December 8, 2015).

[191] Verschuere, Jesse. *Op. cit.*

[192] Interview Health Promoter Liberia.

[193] Interview with the E-Coordinator Macenta

[194] Visit report Liberia, Rosa Crestani, October 2014

[195] Interview with District Medical Office staff - Kailahun

ambulance drivers were infected and subsequently died in Kailahun District.[196]

In the three countries, a hotline (free telephone numbers) to request help for suspected Ebola patients or suspected Ebola deaths was established and run by the national authorities. The organisation of these call centres was highly inadequate during some periods, with people having to wait for help for up to several days after raising an alert, due to a lack of logistics and ambulances.

An interesting outreach initiative described earlier (sections 4.E.5) and below (section 4.I) was the distribution of protection/disinfection kits in Monrovia. The kits gave people the means to protect themselves if a family member became ill, and allowed them to disinfect their homes to cut the risk of transmission.

4.F.2 Contact tracing

Contact tracing is the daily follow-up of all known contacts of an Ebola patient. OCB had little involvement in these activities for most of the reviewed period; other actors, such as the MoH and WHO had taken charge. MSF was critical of the way in which contact tracing was conducted, but numerous interviewees recognised that, given the enormous number of cases and transmission chains, in many locations (from large urban settings to rural areas that are difficult to reach) the task was impossible.

Contact tracing was implemented in an appropriate way by MSF in Guinea, specifically in Guéckédou in the first months. The success in stopping some chains of transmission in Guéckédou in an early phase was partly due to a good understanding of their evolution, thanks to the involvement of MSF epidemiologists. Later, the distance between MSF project locations and the newly affected areas (Nzerekore, Cohia, Macenta, and some northern part of the Guinea Forestière) became problematic for this work. For Conakry, the actors involved (e.g., WHO and CDC) had great difficulty covering the area required for tracing contacts.

Contact tracing was done by the MSF team for a period of time in Kailahun (Sierra Leone) but suspended after a biosecurity incident involving infection of a WHO doctor who worked and lived with the MSF team before his diagnosis, and the subsequent change of team. It was restarted later on, mostly by other actors, with MSF involvement when necessary. The same applied in Bo.

In Monrovia, before November MSF teams did not consider it possible to become involved in contact tracing, despite recognising this area as crucial from the beginning. After November, when rapid response teams were in place, contact tracing became a full part of their activities.

4.G Access to non-Ebola care

Support to health structures (through training and materials support to health facilities providing non-Ebola care to the community) has several objectives: to enable HCW to detect and report suspected cases of Ebola; to provide HCW with the means to protect themselves and their patients (e.g. standard precautions, PPE); and to enable health structures to continue providing regular care, preventing excess morbidity and mortality during the outbreak from non-Ebola causes.

As is common in Ebola outbreaks, many HCW were infected during the West African epidemic (861 confirmed cases and 499 deaths by the end March 2015).[197] Insufficient training, lack of protective material and inadequate supervision increased their risk, while poor IPC in many facilities caused this

[196] Interview with the Vice-District Medical Officer; Kailahun
[197] Ebola Situation Report, WHO, 8 April 2015

unprecedented scale of HCW deaths. These deaths, in turn, fuelled communities' mistrust and fear of using health services.[198]

4.G.1 IPC in health facilities

IPC in health structures encompasses activities such as triage, infection control, and capacity to react when an Ebola-suspected patient enters the structure. (Some of the challenges involved have already been addressed in section 4.D.8).

Although guidelines[199] were very clear regarding the implementation of IPC programmes in non-MSF health facilities, OCB failed to effectively initiate such activities at the onset. In developing countries that already suffer from weak IPC implementation, the guidelines recommend launching interventions aimed at improving these deficiencies, not only to protect staff but also to help local health structures continue providing regular care and disseminating Ebola messages within the community. However, due to HR constraints and the need to prioritise, this component was not consistently supported at the onset of the outbreak.

The Kailahun intervention was described as fast and effective overall, but the outreach strategy in health facilities was poorly implemented and delivered correspondingly poor outcomes. MSF support consisted of training on standard precautions, donation of PPE and IPC materials, and establishing triage/transit and referral. Field respondents reported that supervision and follow-up was fragmented, that the epidemic had advanced beyond a scale that MSF could manage, and that logistics constraints hindered the provision of IPC support. In addition, due to its infrequent engagement in supervision, MSF had little insight or influence on what non-MSF health staff were doing. Some MSF staff interviewed for this review commented that MSF could have mobilised more resources to implement this activity comprehensively.[200] They described the effort as half-hearted and felt that some health structures could have remained open, providing a decentralised approach to Ebola detection and referral as well as an avenue for continuing to offer non-Ebola care. Instead, the peripheral health system collapsed, with structures closing and a significant number of health staff dying.

4.G.2 Non-Ebola medical care

Throughout the region the severity and duration of the Ebola epidemic had profound effects on health systems. For example, in Monrovia, by September two-thirds of all health facilities had closed or were operating below capacity,[201] according to a telephone cross-sectional survey done at that time by MSF/Epicentre. The survey results suggest that availability of health care in Monrovia markedly decreased during the ongoing Ebola epidemic.[202] Consequently, lack of access to treatment for malaria and other infectious diseases, complicated deliveries, and other conditions, multiplied the direct Ebola deaths.

Data on general health care needs and outcomes during the Ebola outbreak are scattered, but it is

[198] In early September 2014 the government of Sierra Leone announced that all national staff working in treatment centres would receive a hazard bonus of US$ 100/week. In November it added a death payment of US$ 5000 for the families of medical staff who died of Ebola.
[199] MSF guidelines, Infection Control Outside the VHF Treatment Facility.
[200] Interviews of international staff in Kailahun
[201] Republic of Liberia. *National Ebola Response Strategy*. Republic of Liberia, 2014.
[202] Cross-sectional survey on health care capacity and utilisation, safety and hygiene measures available in health structures, and attack rate among health facility staff during the Ebola outbreak in Monrovia, Liberia August 2014. Etienne Gignoux, Epicentre

widely assumed that the health sector in Sierra Leone and Liberia almost collapsed, that the population's needs were high, and that the mortality of common and chronic diseases may have been many times higher than that of EVD. The extent of the impact and an estimate of how many avoidable deaths the virus claimed indirectly will only be known when retrospective mortality studies are completed.

One example MSF observed up close was at the Gondoma Referral Centre (GRC) in Bo, Sierra Leone. GRC was a private hospital managed by OCB since 2011 and it provided obstetric and paediatric emergency care. By August 2014 the international OCB teams felt unsafe carrying out obstetrics procedures, so the department was closed. Few paediatric doctors were available and patient numbers were declining. In early October, a local staff member became infected and died. The entire hospital was closed in November.

Some interviewees stated that MSF did not put enough effort into keeping GRC open,[203] while other staff were of the opinion that GRC could no longer guarantee staff safety. In addition, attendance was low due to fear of infection. Based on interviews with various stakeholders, the decision to suspend activities in GRC seems to have been unavoidable even if many people interviewed regretted it. Obstetrics involves activities that are highly risky during an Ebola outbreak, although a lack of obstetric services also has serious consequences for maternal and child health. GRC is considered by many as a missed opportunity to demonstrate the possibility of running essential services during an Ebola outbreak.

4.H Epidemiology

In the context of Ebola outbreak control operations, epidemiology traditionally involves:[204]

- *Outbreak investigation* – the identification of cases, determination of how case-patients became infected, description of the outbreak's spread through communities, and use of this information to find additional cases and guide outbreak control efforts.
- *Clinical epidemiology* – the description of the disease in case-patients, how it progresses, and how it responds to treatment—information that helps build an evidence base for clinical interventions.
- *Information management* – both the above sets of activities generate a significant amount of information that must be managed appropriately in order to reach valid conclusions, and shared with partners engaged in outbreak control to collaborate effectively—all with care taken to protect the confidential nature of the information.

During an outbreak, epidemiological surveillance is a key tool for identifying all cases and contacts, describing patterns of epidemic evolution, and determining how control measures work. It can therefore be valuable in helping to adapt operational strategies.

The 2008 Ebola guidelines give examples of epidemiological data collection forms[205] that were used during the present outbreak, with some adaptations made in the different projects. However, while a standardised intersectional database was being developed, it was not ready at the time of this outbreak. The 2015 draft guidelines provide more elements in terms of strategic content but were still incomplete at the beginning of this intervention.

[203] Interviews
[204] "Filovirus Haemorrhagic Fevers Field Manual 2015 [Draft]." 2015. https://www.evernote.com/pub/agsprecher/FilovirusFieldManual (accessed December 8, 2015).
[205] Sterk, Esther. "Filovirus haemorrhagic fever guideline 2008." Médecins Sans Frontières, 2008.

OCB deployed a consistent number of epidemiologists in the field (31), although not enough to cover all activities. At least one epidemiologist was at each MSF location, and sometimes more than one. But their roles and responsibilities were not entirely clear, and their priorities varied. For most of them, the main task was to collect and analyse data at the ETC. But overall, they were poorly coordinated and their analyses were rarely used to redefine strategy.

Case investigation was done at each ETC while contact tracing was usually covered by other actors, with varying degrees of success (see section 4.F.2). It was often difficult for MSF teams to understand the chains of transmission, and nearly impossible at the peak of outbreak.

In the ETCs, the purpose of data collection and analysis was to monitor activities and patient outcomes. In addition, information was used to follow the epidemiology of the outbreak and the characteristics of the patients treated.

In the ETC context, one challenge was the transfer of patient information out from high-risk zones. As ETCs grew in size, the initial strategy of shouting over the fence became less feasible and more error-prone. One solution, implemented at the Nongo ETC, was to attach paper with patient information written on it onto the Plexiglas wall of the isolation unit, allowing HCW on the other side to copy the information. Adaptations were introduced later with the use of walkie-talkies and wired scanners. In ELWA 3, documents scanned in the high-risk zone were transmitted over a secured local wireless network to a central server and automated printer. Subsequently (in November), a sophisticated PDA system, the Ebola Link Emergency Operational Support, was evaluated at ELWA 3.[206] Unfortunately this innovation was tested too late in the epidemic to be useful for the current outbreak.

Irrespective of the technology used, there was no standardised way to collect data from ETCs. This led each centre to set up its own system, which was periodically modified by the various different epidemiologists or data managers present on the ground.[207] For these reasons, the way collected data was then analysed, reported to teams and partners, and used (or not used) as a decision-making tool differed from place to place.

The compilation and analysis of data, mainly from ETCs, was carried out late. Only in October was an epidemiologist from Epicentre appointed to the Task Force and mandated to coordinate data collection and ensure that all projects gathered a common minimal core of information, produced a regular report describing the epidemic, supported field epidemiologists in basic analysis, and briefed and debriefed epidemiologists travelling to and from the field.[208]

4.I Good practices and innovative strategies

A number of innovations and good practices were tested and implemented during the West Africa Ebola epidemic. Examples from the ETC include:[209]

- Conducting the first step in triaging of patients and doing admission-related paperwork over the fence. with a 2-metre distance and without PPE;
- Managing convalescent patients over the fence, without PPE (Kailahun in September-October);
- Setting up a paediatric tent (reported to have a positive psychological impact on the children) and establishing nursing rounds separate from the physicians (Guéckédou in December);

[206] Silva Gallego, Manuel , Wim Deneweth, Brett Adamson, Robin Vincent-Smith, and Gert Verdonck. *Project ELEOS: a barcode/handheld-computer based solution for Ebola Management Centres.* Brussels: MSF, 2015.
[207] Interviews with field epidemiologists
[208] "Terms of Reference Epidemiological Support to the Ebola Task force at OCB." Brussels: Médecins Sans Frontières, October 2014.
[209] Van Den berg, R. *Clinical care in the West Ebola Outbreak.* 2015.

- Establishing separate tents for secretors, non-secretors, probable, suspected and confirmed cases (Donka);
- Grouping patients according to severity of disease and care needs (ELWA 3 in October);
- Engaging survivors in HP and care of children as *aides maternelles*, and organising a crèche for children (Guéckédou in late August);
- Opening a survivor clinic (Monrovia in November);
- Making available sterilisable telephones so patients can communicate with their family;
- Bringing in an ultrasound machine to use for examining pregnant women (Guéckédou);
- Introducing pulse-oximeters (several ETCs, end of September);[210]
- Developing new ways of transferring data out of the high-risk zone using walkie-talkies, and later using secured local wireless network (see section 4H).

Due to high staff turnover, experience gained was sometimes not transmitted to a new team. And while MSF was generally running behind the epidemic doing damage control, many lessons were learnt nevertheless. Based on these lessons, late in the outbreak MSF established a very well-functioning ETC at Nongo with very high biosecurity standards, able to provide 24-hour care with continuous monitoring of patients and a relatively high level of care.[211]

At the same time, several clinicians interviewed noted with regret the reluctance of MSF decision-makers to test innovative interventions. The MSF rationale was that protocols and guidelines needed to be kept as simple and streamlined as possible in order for staff to handle the large volumes of patients. Other clinicians commented on the limited communication about protocols and the sometimes-different interpretation of their meaning between the field and headquarters.[212,213]

However, there were some noteworthy exceptions. One was the **large-scale distribution of malaria treatment** implemented in Monrovia by Operational Centre Paris (OCP)[214] and in Freetown by Operational Centre Barcelona (OCBA) with support from OCB. The aim was to reduce malaria mortality during its peak season, given that access to treatment was drastically reduced due to the closing of many health care facilities (see section 4.G.2). These campaigns were the first times that such an intervention was carried out in an Ebola context. It was an interesting initiative that needs to be evaluated and considered for integration into future guidelines.

Another innovation was the **mass distribution of protection/disinfection kits** in Monrovia, organised with the objective of reducing Ebola transmission at the household level by improving protection of the caretaker while the family waited for an ambulance, or in the event of no bed capacity. Kits contained chlorine, soap, gloves, masks and gowns. Most of the time kits were distributed together with HP messages and social mobilisation activities and were targeted to prioritised groups (HCWs, including MSF national staff; contacts of families with an Ebola patient, etc.) and highly affected communities. The kit seems to have had a strong potential impact on the behaviour of the population.

[210] *Ibid.*
[211] Colebunders, Bob. *Personal observations.* 2015.
[212] *Interviews with international staff* (2015).
[213] *Group discussions among health care workers at Nongo* (2015).
[214] "More than 2.5 million people reached in emergency response campaign with anti-malarial medicines in Sierra Leone." *WHO.* 2015. http://www.afro.who.int/en/sierra-leone/press-materials/item/7307-more-than-25-million-people-reached-in-emergency-response-campaign-with-anti-malarial-medicines-in-sierra-leone.html

MSF was also the first Ebola responder to **use oral swabs for EVD diagnosis of deceased persons**. A capillary blood test for EVD diagnosis was evaluated.[215]

4.J Operational research and clinical trials

4.J.1 Operational research

No operational research plan existed at the beginning of the epidemic. Moreover, during the epidemic there was little proactive research planning.

Operational research started only late in the epidemic. Earlier, when ETCs were overwhelmed with patients and had too few medical staff, organising operational research did not seem possible. Results that emerged from later research, which was mostly descriptive and retrospective, will therefore be useful mainly for future EVD outbreaks.

A major difficulty in conducting operational research was (and still is) the lack of standardised data collection. ETCs used different data collection tools, which considerably complicated comparisons across projects. Clinical interventions in particular were poorly documented (placement of IV lines, treatment with loperamide, fluid replacement volumes, etc.), preventing a retrospective analysis of the outcomes from different treatments. Systematic follow-up of discharged patients was put in place only after caseloads started to decrease, and focused mainly on the EVD-positive patients. The absence of longer-term outcomes of not only EVD-positive but also -negative patients (see section 4.D.8) represents a challenge in evaluating different models of care.

Research topics were often taken up *ad hoc* by returning staff. Others were proposed by members of the Ebola experimental product platform, and protocols were developed in collaboration with the LuxOR operational research unit—for example, an evaluation of the new GeneXpert EVD diagnostic test, and a study of Ebola virus infectivity in the environment and in body fluids. The latter study started only at the end of August 2015, and therefore, at the time of the review, looked as if it would probably only be able to enrol a few patients.

Studies with small cohorts describing clinical characteristics and predictors of mortality were published early in the epidemic.[216,217,218] Based on an evaluation of the triage system at the Kailahun ETC,[219] it was recommended that EVD-suspected patients should be accommodated in single compartments prior to laboratory confirmation whenever possible. This study also highlighted the need for a rapid point-of-care diagnostic test.

Anthropological research aimed at understanding the health-seeking behaviour, funeral and burial practices, eating habits and community perceptions—resistance, fear, denial, distrust, etc.—were initiated by September, but results became available relatively late in the epidemic. At the end of the review period (March 2015), most of the study outcomes still remained to be published.[220]

To be noted is the slow publication of certain clinical findings and lessons that have practical

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[215] Strecker, T, et al. "Field Evaluation of Capillary Blood Samples as a Collection Specimen for the Rapid Diagnosis of Ebola Virus Infection During an Outbreak Emergency." *Clin Infect Dis* , 2015;61(5): 669-675.

[216] Bah, EI, MC Lamah, and T Fletcher. "Clinical presentation of patients with Ebola virus disease in Conakry, Guinea." *N Engl J Med*, 2015;372(1): 40-47.

[217] Dallatomasina, S, et al. "Ebola outbreak in rural West Africa: epidemiology, clinical features and outcomes." *Tropical Medicine & International Health*, 2015; 20(4): 448-454.

[218] Fitzpatrick, G, et al. "The Contribution of Ebola Viral Load at Admission and Other Patient Characteristics to Mortality in a Medecins Sans Frontieres Ebola Case Management Centre, Kailahun, Sierra Leone." *The Journal of Infectious Diseases*, 22 May 2015.

[219] *Ibid.*

[220] Van Den Berg, R. *Clinical care in the West Ebola Outbreak.* 2015.

importance for EVD clinical management, such as findings about potential infectiousness of placenta, amniotic fluid and foetus even when the EVD-infected mother is considered cured based on a negative blood test.[221] Overall, however, the operational research output of OCB was high, with a few dozen publications (research, commentary, letters, etc.) in the pipeline and 27 more published or accepted for publication by the time this review was conducted.[222]

Neglected research domains include areas such assessing the impact of HP; efficiency of case investigation and contact tracing; and evaluating body removal activities. Several innovative interventions introduced by MSF, such as the protection/disinfection kits and mass malaria prophylaxis, also need to be evaluated and reported.

Specific studies for which an interest was expressed either at mission or at HQ level[223] included: the characterisation/documentation of the different levels of clinical care, risk factors for mortality among children (with a particular focus on caretaker presence as a determinant in paediatric mortality), causes of unexpected late deaths, and quantification of the clinical workload per type of patient in the standardised model of care. How should care be safely decentralised? How useful or harmful were CCCs? What was the effect of the quarantine measures?

Fumes from sodium hypochlorite that appear when reservoirs are refilled and when the doors of ETCs are closed may cause cough, irritation of eyes and sleeping problems[224]. There is a need to investigate how to use the sodium hypochlorite in an optimal way so as not to harm patients and HCW.[225] Research is also needed on the development and evaluation of a better PPE that fully protects HCWs but also allows them to work for more than one hour at a time in the high-risk zone.

4.J.2 Clinical trials

The option of evaluating experimental treatments and vaccination was explored by MSF early in the outbreak, and a decision to implement trials was taken (by MSF and by others in the international scientific community) when the outbreak escalated. People in affected countries complained that treatment trials started late.[226] This was partly due to the lack of promising treatment options and experimental drugs, and to difficulties accessing many of the candidates.

MSF established an internal group, the Investigational Platform for Experimental Ebola Products, with a mandate to engage MSF in clinical trials with experimental products, initially with therapeutics, then vaccines and finally diagnostics. There was no intention to initiate other areas of research, such as investigations of the questions listed above (section 4J1). To conduct treatment trials, MSF decided to collaborate with well-established research institutes who also brought additional funding (i.e. Wellcome Trust, the European Commission from the Horizon 2020). All trial protocols were approved by the MSF Ethical Review Board and received support from the WHO Ethics Review Committee.

MSF participated in three treatment trials. There were multiple challenges to getting these trials started, such as defining protocols, patient monitoring, data- and results-sharing, dealing with ethical and intellectual property issues, and engaging with communities where the trials were to take place.

[221] Baggi, F, et al. "Management of pregnant women infected with Ebola virus in a treatment centre in Guinea, June 2014." *Euro Surveill*, 2014;19(49).
[222] *Interviews with HQ Staff* (2015).
[223] Van Den Berg, R. *Op. cit.*
[224] Colebunders, Bob. *Personal observations.* 2015.
[225] Carpenter, A, A Cox, D Marion, A Phillips, and I Ewington. "A case of a chlorine inhalation injury in an Ebola treatment unit." *J R Army Med Corps*, 15 October 2015.
[226] *Group discussions among health care workers at Nongo* (2015).

Evaluators consider the non-randomised clinical trial design was an informed and justified choice by MSF, made for both ethical and operational reasons. The decision was controversial among some non-MSF actors. Instead of using a placebo group, the trial design called for use of historical controls. While less powerful, this latter design would still detect a highly efficacious product, although not necessarily one with lower levels of efficacy.

Collaborative efforts across participating organisations and countries were challenging.[227] MSF research coordinators were sent to the trial sites to ensure good communication and collaboration between research partners and MSF research teams, and between research and clinical teams, to prepare for field implementation of the trials and to guarantee that MSF's principles and conditions for research were respected. This complex process took more time than initially foreseen, and therefore the first patient inclusions in these trials occurred only at the end of 2014 and early 2015, which was later than planned.

At that point, however, the number of patients in the ETCs had begun to decrease, which meant a reduced number of patients who could be enrolled. By March 2015 (the end of the review period) none of the treatment trials had been completed as originally designed, since all had enrolled fewer patients than envisaged. Still, when the findings of two treatment trials were ultimately analysed (the third trial was terminated very prematurely after only 4 patients were enrolled—see below) , neither of the interventions tested seemed to have a dramatic effect on survival. Beyond this conclusion, the results of these trials are difficult to interpret, due to lack of an optimal control group (only historical controls) and poor documentation of what supportive care patients received.

The following summarises the three therapeutic drug trials and their findings.

The Favipiravir trial, a non-randomised, proof-of-concept Phase II trial of an anti-viral drug approved in Japan for treating flu (and active against some other viruses), started on 17 December 2014 in Guinea. It was sponsored by INSERM, funded by the European Commission, and supported by two NGOs (MSF and ALIMA) and two laboratory networks (Belgian First Aid and Support Team (B-FAST) and European Mobile Laboratory (EMLab), the French Red Cross and the French Military Health Service. It was carried out at four ETCs Guéckédou (MSF), Nzérékoré (ALIMA), Macenta (French Red Cross) and Conakry (Caretakers Treatment Centre). Children <1 year old were excluded from the trial because their metabolic system is still immature. Pregnant women were also excluded, at the insistence of INSERM's insurance company. However, MSF prepared a separate protocol for pregnant women to receive Favipiravir, and the proposal was approved by the MSF and Guinean ERBs and authorized by the Guinean Ebola Task force. The Japanese manufacturer of the drug (Toyama Chemical) and the Japanese government were informed and gave their agreement.

The results of the trial showed that Favipiravir monotherapy had no effect on reducing mortality in patients with advanced disease or in children under the age of 7 years. [228] Comparison of the trial with pre-trial data suggests that Favipiravir monotherapy may reduce mortality in a population with less advanced disease. The use of Favipiravir as a prophylactic agent was proposed by OCB Ebola specialist, Dr Van Herp[229] but questions remain about the feasibility of adherence and on optimal dosing.

The Brincidofovir trial, led by Oxford, started on 1st January 2015 in Liberia's ELWA 3 ETC. It was delayed due to unresolved challenges for the sponsor to identify a laboratory willing to process the trial samples, for MSF to obtain from the manufacturer a guarantee of post-trial access to the drug,

[227] Interviews with HQ Staff (2015).
[228] "Preliminary results of the JIKI clinical trial to test the efficacy of favipiravir in reducing mortality in individuals infected by Ebola virus in Guinea." *Médecins Sans Frontières.* 24 February 2015. http://www.msf.org/article/preliminary-results-jiki-clinical-trial-test-efficacy-favipiravir-reducing-mortality.
[229] Van Herp, M, H De Clerck, and T Decroo. "Favipiravir--a prophylactic treatment for Ebola contacts?" *The lancet*, 2015; 385(9985): 2350.

and slowness in getting appropriate country level approvals. The Brincidofovir trial was terminated on 3rd February by the trial steering committee due to low enrolment (only 4 patients were enrolled while there were essentially no new infections arising in Liberia) and because no other trial site could be added since the manufacturer (Chimerix) abruptly decided to stop collaboration for the study, without stating the reason for its retreat.

The convalescent plasma trial started on 17 February 2015 in Guinea Conakry. The main trial sponsor was the European Commission, and the study was conducted in collaboration with the Institute of Tropical Medicine (ITM) in Antwerp.[230] The trial launch was delayed so that the National Transfusion Centre had time to prepare for performing plasmapheresis and to get buy-in from survivors, the community from which plasma donors for the study were drawn. Other factors contributing to the delay included a disagreement between MSF and the ITM consortium on protocol issues, and MSF's late decision to change strategy and use the Donka ETC, the planned trial site, to finalise enrolment of the favipiravir trial before starting this study. Some MSF staff were initially reluctant to proceed with the trial, due to its complexity and to security concerns). But it went forward, and over time enrolled a total of 102 patients.

Analysis of this cohort showed that no severe side effects were detected.[231] Convalescent plasma transfusion in the midst of an Ebola epidemic proved to be feasible, well accepted by health staff, patients and community and was found to be safe, but had no significant impact on survival. There were enough plasma donors, but data collection of vital signs was often incomplete. The trial was well appreciated by the population and there was good collaboration with an association of EVD survivors.[232] It ended on 7 July 2015 with the last patient study visit on 3 August, but convalescent plasma transfusion continued under the liability and responsibility of MSF. Guinean authorities & MSF were informed of the preliminary findings on 6 August, 2015 and further communication to key stakeholders in Guinea was done in September 2015. Study results were published in the New England Journal of Medicine on January 7, 2016. The delay in making trial results public caused tension between MSF and the Ebola-Tx consortium, since MSF had insisted that these findings should be released before publication.

MSF also participated in a WHO-sponsored Phase III vaccine trial to evaluate the efficacy and safety of the rVSV ZEBOV vaccine, in collaboration with the Norwegian Institute Agency and other academic partners. Part A of the trial, implemented mainly by WHO, was a randomised ring vaccination design (immediate versus 21-day delayed vaccination after exposure to an EVD patient). Preliminary results showed this vaccine is 100% (95% CI 74.7-100.0) effective[233] but is also associated relatively frequently with side effects, including fever (35%), arthralgia and skin lesions.[234] Part B of the trial, implemented mainly by MSF/Epicentre, was a single arm trial in frontline workers in Conakry, including extended follow-up for adverse events and immunogenicity. Analysis is ongoing.

MSF also launched and coordinated an effort to vaccinate frontline workers, including MSF staff, with this vaccine. Side effects in these individuals will need to be researched.

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[230] van Griensven, J, et al. "The Use of Ebola Convalescent Plasma to Treat Ebola Virus Disease in Resource-Constrained Settings: A Perspective From the Field." *Clin Infect Dis*, 10 August 2015.

[231] *Interviews with non-MSF Ebola experts* (2015).

[232] *Ibid.*

[233] Henao-Restrepo, Ana Maria, et al. "Efficacy and effectiveness of an rVSV-vectored vaccine expressing Ebola surface glycoprotein: interim results from the Guinea ring vaccination cluster-randomised trial." *The Lancet*, 2015; 386(9996): 857–866.

[234] Agnandji, S, et al. "Phase 1 Trials of rVSV Ebola Vaccine in Africa and Europe — Preliminary Report." *N Engl J Med* , 1 April 2015.

5. CONCLUSIONS

The following conclusions aim to answer the key questions posed at the onset of this review process. Lessons identified are highlighted in red.

MSF, and particularly OCB, played an exceptional and central role during the West Africa Ebola outbreak. Not only was MSF instrumental in raising the alarm about the outbreak; they were also the first responders to provide care, and through training and support of others they enabled many additional actors to intervene.

The objective of this review was to provide a critical analysis of the intervention and of operational and medical choices so that the organisation can capitalise on lessons learned. Here we discuss the most critical points that emerged from this process and that should be considered in future large-scale emergencies related to infectious disease outbreaks.

5.A Strong reactivity, but always one step behind

Once informed about the suspected cases of VHF in Guinea, OCB was quick to identify the cause of the outbreak and to launch a response. Reactivity in opening new projects as a response to new alerts was strong. However, with the stretched capacities and the many unknowns in this situation, the choices made during each phase of the intervention were more reactive than proactive, with only limited anticipation of the likely challenges ahead as the outbreak evolved.

In any given circumstance the response always seemed one step behind the outbreak. One key moment to reflect on might be the Sierra Leonean authorities' refusal of MSF support at the start of the epidemic in their country. Faced with that situation, OCB did not use its full political weight to advocate and negotiate for a different decision.

A lesson learned here is when and how higher-level engagement should be triggered, as a means of opening negotiations and/or strengthening MSF's ability to respond operationally.

LESSON LEARNED: In an unprecedented emergency, as this outbreak was recognised to be early on, it is imperative to consider unprecedented measures from the start—in this case, for example, the large-scale training of other responder organisations (which was successfully done, but only later on).

5.B Focus on isolation and care was detrimental to comprehensive outbreak control

Given the extent of the outbreak, OCB did not have sufficient capacity to implement all activities needed to control the outbreak. Compounding the problem, there were too few other actors present to add the required capacity. OCB's strategic choice throughout most intense period of the epidemic was therefore to concentrate on isolating sick patients from the community and providing care to these patients.

In retrospect, two specific aspects of this choice merit debate.

The first is health promotion. In many projects the implementation of HP activities, particularly in the community, was delayed and/or inadequate. While this is largely explained by the HR constraints, it also partly reflects the lower priority given to HP within MSF, the delay in availability of comprehensive HP guidance documents, the limited priority given to conducting anthropological studies, and the missing links to establishing effective communication with communities.

This review identified clear differences in HP outcomes, depending on the level of investment at the onset of the outbreak. In Kailahun, where HP was implemented quickly, with a clear assessment of local stakeholders and appropriate messages and channels, MSF was accepted and appreciated by the

community early in the outbreak. The engagement of survivors in both medical care and HP was perceived as empowering and as helping to restore dignity.

HP activities were described by many MSF staff as an important mediation tool in contexts of tension and insecurity. The environment of distrust towards government as well as foreign staff among the responding teams, combined with widespread misinformation about Ebola, became genuine concerns for staff safety. Health promoters reportedly played an important facilitating role in improving the security of teams and communities.

LESSON LEARNED: When reducing transmission of a highly contagious disease is a programmatic objective, appropriate investment towards community acceptance and behaviour change is essential. Starting health promotion efforts early and linking them to local communication directly improves programme effectiveness. Socio-cultural assessments must be conducted and used timely.

The second issue is non-Ebola health care, which was largely unavailable in the affected countries, most likely leading to increased morbidity and mortality for non-Ebola patients. Ebola guidelines describe support for health facilities providing non-Ebola care as an essential part of the response. Given the overwhelming nature of this epidemic, the lack of experienced staff, and the high levels of stress in assuring staff safety, MSF got involved in non-Ebola care only late in the epidemic. Implementing infection prevention and control, triage and diagnostics in peripheral health centres was attempted. However, these efforts were found to be ineffective and at times harmful, since there was not always sufficient HR to carry out and supervise those activities effectively and safely; therefore, at times staff safety could not be guaranteed.

LESSON LEARNED: In any future large-scale outbreak, a solution to ensure IPC at sufficient scale must be found (in parallel with patient isolation and care). This should include not only MSF structures but also health facilities in general. Some basic health care activities would not require the same HR profiles as those needed to run an ETC (e.g., they would involve WatSan specialists and more paramedical staff), and would benefit from involvement of more national staff.

5.C Big achievements and major challenges in treating Ebola patients

OCB was the first, the main and the most experienced provider of EVD care. Protection of MSF staff was the top priority, as reflected by excellent biosafety guidelines that were effectively implemented. The level of patient care fluctuated during the epidemic, with periods of low level of care during outbreak peaks when ETCs could not admit all suspected EDV patients due to shortages in the number of beds. It was a terrible dilemma for the teams. At ELWA 3, once the influx of patients decreased, there was an understandable but unjustified slowness in re-starting a higher level of care.

IV fluid provision, as an indicator for good quality of care, was at the centre of the debate. IV fluid administration is considered an essential element of EVD treatment by OCB; however, during periods when ETCs were overwhelmed, it was not possible, according to staff who worked during those phases of the outbreak. When IV fluids were used patients generally received less than 3L per day, and electrolytes were not monitored. Given the frequency of electrolyte abnormalities in patients with EVD, it is regrettable that laboratory diagnostics (I-stat) were not used more. It may be that providing only limited amounts of IV fluid in severely ill patients with EDV, and without monitoring electrolyte abnormalities, has little impact on survival. The MSF type of PPE, while providing a high degree of staff security, seriously limited the possibilities for providing a high level of care.

Mortality rates in MSF ETCs averaged 51% in 2014.

ETCs with a higher standard of care (e.g., for EVD-infected national HCW) were established by other actors (e.g., French armed forces). Such facilities on a regional level could have been be considered by

MSF not only to provide the best care to a particularly exposed group, but also to implement innovative protocols or to organise clinical trials under the best possible conditions.

To develop optimal supportive treatment guidelines for future epidemics, it will be necessary to conduct studies analysing treatment outcomes of comparable patients who received different supportive treatments, whether in MSF or non-MSF ETCs. Clinical trials evaluating different supportive treatment strategies should also be planned for future epidemics.

LESSON LEARNED: The experience gained and lessons learned throughout the response led to improvements and changes in the set-up and care at ETCs. **It is important not only to swiftly update Ebola guidelines and integrate the new knowledge, but also to design guidelines in a way that takes into account the different needs and constraints at different scales of an outbreak.** Guidelines should also address the pathway to swiftly restoring a higher level of care as soon as conditions allow after a peak outbreak period when only a basic level of care could be provided.

5.D Research planned late, but important results

Basic knowledge about EVD was limited at the start of this outbreak. Therefore, identifying the most crucial research questions and establishing mechanisms to collect and analyse information was critically important. Despite the vast potential for operational research on Ebola, there has been very little prospective planning.

The lack of standardised data collection hampered operational research. Publication of certain clinical findings and lessons of practical importance for EVD clinical management was slow, and the results obtained will therefore be useful mainly in future outbreaks. The relatively high scientific output achieved mostly after the outbreak was largely thanks to the initiative and involvement of returning field staff. However, key research questions remain to be adressed. The evidence base with respect to patient care and staff protection has not significantly grown and still relies largely on expert opinion.

Involvement in clinical trials, in particular in an emergency setting, was a novelty to OCB, and offered several important lessons. Consortia were formed with other MSF sections and with external partners to supplement in-house knowledge and capacity on clinical trial management. Premature communications hampered community involvement and compromised perceptions of the trials. Field staff may have been insufficiently involved in the design of the trials, leading to frustrations when they were implemented. To some extent this was unavoidable, given the high turnover of staff, but there should have been more internal communication on the trials and their development.

Several innovations and good practices were tested and implemented in ETC's, in areas such as organisation of care, equipment, data transfer from the high-risk zone, and care for survivors. However, there was also a perceived conservatism and a reluctance to test new ideas or change direction.

A more rapid uptake of experimental treatments, for example via compassionate use, should be considered if there is any evidence that a treatment might work and if it does not cause additional adverse events. In case of future outbreaks of an untreatable disease, MSF should consider research as an independent pillar of the response. Internationally, research has always been a pillar during larger Ebola outbreaks in the past, but MSF was not very involved.

LESSON LEARNED: If MSF wants to help fill critical gaps with scientific evidence**, it is crucial to integrate operational and clinical research into a response from the beginning**, develop plans to implement this research alongside its operational response, and publish results rapidly to maximise the chance that they can impact an ongoing response, at least during longer outbreaks.

5.E A limited and underused role for epidemiology

During any outbreak, epidemiological approaches are critical for adapting an intervention as the outbreak evolves. For months during this outbreak there was only limited MSF investment in epidemiological surveillance, due to competing priorities. Moreover, the usual Ebola epidemiological surveillance system described in MSF guidelines was devised for geographically limited outbreaks, whereas in this epidemic the need was for more capacity to assemble both a detailed picture and a global overview that could inform decision-making. However, OCB was not set up to participate in surveillance activities at the central and regional levels, and therefore lacked data and insights that are key to adapting a response.

Due to its presence in the field OCB was at the heart of the outbreak, but had few routes to gain an understanding of events early in the onset. MSF relied heavily on WHO, CDC, and other organisations, while at the same time being sceptical about their performance. Given OCB's stretched resources, it is difficult to understand why they did not request support from other parts of MSF, especially Epicentre, as soon as the outbreak was recognised as being exceptional and unprecedented.

LESSON LEARNED: Investment in epidemiological follow-up as a specific activity—in relation to operations—with appropriate means and coordination should be a priority during outbreaks from the beginning.

5.F Working with others as a key to scaling up

When OCB initially realised the scale of the outbreak and recognised that its own limits in terms of resources would quickly be reached, they made the decision to invest in building the capacity of another responding organisation (Samaritan's Purse). Training and support were provided at field level.

Through various forms of collaboration and particularly through training (including WHO), OCB played a central role in enabling other responders to provide care. Training other organisations on such a large scale was new for MSF. Due to internal delays, the well-known "first responder course" started only at the end of August 2014.

LESSONS LEARNED: Knowledge transfer to other actors was a key factor in scaling up response capacity internally and externally. For future emergencies this strategy can be replicated and developed further.

5.G Few alternatives to big dilemmas

Classical approaches to Ebola showed their limitations during this extended outbreak, which affected three highly interconnected countries in the West Africa region and reached several large urban areas. The need to reflect on alternative strategies for tackling the epidemic was expressed by MSF staff and by other stakeholders, including national governments and WHO. At times OCB was perceived as reluctant to consider alternative models of isolation and care, for several reasons (staff security, ethical issues, lack of resources).

Given the outbreak's unpredictable spread, an ability to quickly launch new projects and ETCs was key. However, OCB, together with other responders, was unable to set up enough treatment centres closer to the epidemic's shifting epicentres. (The exceptions, where OCB succeeded, occurred at the beginning in Guinea and again at a later stage with the establishment of rapid response teams.) The need to transport more patients over longer distances meant that ambulance systems were overwhelmed. and it is highly likely that EVD transmission occurred in ambulances and taxis bringing patients to the ETCs.

Another option for coping with the overwhelming situation at peak times in the epidemic was to reduce the package of care in isolation centres. This option was considered by different actors, e.g., MoH, WHO and some members of MSF. OCB was forced by extreme resource constraints to adopt this approach, in particular during one period in ELWA 3.

Deciding on a strategy for dealing with quarantine was another dilemma for OCB. Given the acute needs of people living in households or whole neighbourhoods under quarantine, OCB could have had a big impact by providing support. At the same time, OCB had publicly voiced strong arguments against quarantine, an action they saw as precluding an intervention. More flexibility in their approach could have allowed OCB to defend its principles and at the same time provide urgently needed support and even innovative action.

5.H A different starting point at the next Ebola outbreak

The priority given to safety of staff was criticised at times as limiting intervention, but OCB considered it essential not only because of MSF's duty of care towards staff, but also because it was central to being able to continue providing care. This is illustrated by the extreme negative consequences of biosecurity incidents, such as the complete evacuation of Samaritan's Purse from Liberia following a staff infection, or the threat of suspension of activities following the infection of a WHO doctor in Kailahun.

However, the availability of the vaccine and other improved tools could create different working conditions for the staff and therefore somewhat better capacity to deploy a comprehensive and effective response.

6. RECOMMENDATIONS

⇒ **Finalise all draft guidelines that were developed during the epidemic**, taking into account all lessons learned. Guidelines for future epidemics should include strategies that are adaptable to the scale of the epidemic, the available resources, and the workload.

- Specialised expert teams addressing different aspects of patient care should be established. In these teams, MSF African colleagues together with experts from different MSF sections should work together with experts from other organisations.
- There should be more emphasis on guidelines concerning IV fluid administration and monitoring of electrolytes using the i-STAT or another point-of-care test.
- Include clear guidance on health promotion with the corresponding tools.

⇒ **Improve the tools for collection and management of data**, both to ensure availability of qualitative information and retrospective analysis and to obtain clear evidence justifying operational choices at an epidemiological level and with respect to treatment outcomes, follow-up of patients, models of care, health promotion strategies, etc.

⇒ **Develop more research capacity within the organisation and collaborate with other MSF sections**. MSF should establish a research think tank for clinical and operational research. MSF should also improve its collaboration with selected other organisations/research institutions/experts and should invest further in building capacity among national/African staff. Research capacity needs to be built for investigating outbreaks of emergent or poorly understood diseases such as Ebola. Their mandate should also include the development of epidemiological and clinical monitoring tools that can be put into place quickly.

⇒ **Design new trials with antiviral drugs** and prepare to evaluate different supportive treatment strategies. These plans should be ready to implement at the start of a new outbreak.

⇒ **Develop a pool of medical anthropologists** or similar profiles that can provide expertise in setting up socio-cultural assessments and health promotion during outbreaks.

⇒ **Define a potential role for MSF in mentoring and coaching other organisations** and with the possibility to establish agreements that could include supervision and follow-up in the field.

- Invest in a policy for training other organisations in medical emergency management and care when needs surpasses MSF response capacity.

ANNEXES

Annex I: Terms of reference

http://cdn.evaluation.msf.org/sites/evaluation/files/attachments/medical.pdf

Annex II: List of interviewees

[Name, Surname]	[Function]
Abdul Karim Keita	Nurse, outreach Conakry OCB Guinea
Abdul Wahab Wann	NERC Chairman, Kenema, Sierra Leone
Adele Minimonou	Infirmiere Guéckédou and Conakry OCB Guinea
Aisata Bangura	Aide infirmiere Conakry OCB Guinea
Aissatou Lamarana Barry	Médecin Conakry OCB Guinea
Aissatu Lamarana	Infirmiere Conakry, survivor OCB Guinea
Alpha Oumar Bah	MD Nephrologist, Head dialysis Donka Hospital
Amada Dioulde Diallo	Infirmiere Conakry OCB Guinea
Amadou Sall	Virologist Institut Pasteur Dakar
Amanda McClelland	HQ Coordinator IFRC (Sierra Leone, Liberia, Guinea)
Aminata Mousa	Red Cross, Field Health Officer, Sierra Leone
Amineta Traore	HP Conakry OCB Guinea
An Calewaerts	Infection Control and Prevention/nursing care advisor OCB-HQ
Andre Goepogui	National Coordinator Neglected diseases MoH Guinea
Angeline Tinguano	E-HP Supervisor OCB
Anja De Weggheleire	MD Co-investigator plasma exchange trial, Conakry, Institute of Tropical Medicine
Anja Wolz	Emergency Coordinator (Sierra Leone, Liberia, Guinea)
Anne Sophie Loobuyk	E-HP CTE DONKA OCB
Annette Heinzelman	Medical Director OCP
Annick Thierens	MD clinical trial OCB Guinea
Armand Sprecher	MD Medical Department OCB
Axelle Ronsse	Coordinator Task Force Ebola MSF OCB
Barry Mamadou Lamine	Infirmiere Conakry OCB Guinea
Barry Moumié	National coordinator Ebola control patient care MoH Guinea
Bart Janssens	Director of Operations OCB
Beatrice Crahay	MSF Emergency Medical Coordinator Ebola Response OCB
Berete Hadi	Médecin Conakry OCB Guinea
Bernadette Gergonne	Epidemiologist Liberia OCB
Bertrand Draguez	Medical Director OCB
Bev Kauffeldt	Anthropologist in charge of operations, Samaritan Purse, Liberia
Beya Vuylsteke	Epidemiologist OCB Guinea
Bilgison Dialou	Nurse Conakry OCB Guinea
Brecht Ingelbeen	Epidemiologist OCB Guinea
Brice De Le Vingne	Director of Operations OCB

Bruno Jochum	General Director OC Geneva
Camara Appolinair	HP Conakry OCB Guinea
Carissa Guild	Field Nurse/Medical referent Guinea OCP
Catherine Juvyns	E-NAM DONKA OCB
Catherine Loua	Médecin Conakry OCB Guinea
Christian Kleine	MD, worked in Elwa3, Monrovia OCB Liberia
Craig Spencer	MD, worked in Guéckédou OCB Guinea
Cristina Falconi	Liaison Officer Sierra Leone
Daniel Chertow	MD, worked in Elwa3, Monrovia OCB Liberia
Dennis Kerr	MD, worked in Elwa3, Monrovia OCB Liberia
Diara Camara	Médecin Conakry OCB Guinea
Djenab Camara	Aide maternal, survivor Conakry OCB Guinea
Dr Alex Gasasira	WHO representative, Liberia
Dr Amara Jambai	Deputy Chief Medical Officer, MoH, Sierra Leone
Dr Anthony Oraegbu	Medical doctor SL, LB, GC
Dr Dafe Fode	Head of surveillance pillar, NERC, Sierra Leone
Dr Davide Djavili Zoumanigui	Chargé de statistique et surveillance (DPS)
Dr Fatoumata	Programme Director, WAHAB, Liberia
Dr Jean Faya Tolno	Pharmacien logisticien (DPS)
Dr Jean Magnokoi Guilavogui	MCM DPS
Dr Joseph	Responsable des agents de santé communautaire
Dr Kalissa N'fasouma	Equipe medical Out/reach
Dr Kamara Seraian	Deputy Chief Medical Officer, MoH, Sierra Leone
Dr Marc Forget	MSF FC Ebola Response Sierra Leone
Dr Moses Massaquoi	Head of case management pillar, Incident Management System, Liberia
Dr Mossaka Fallah	Head of surveillance pillar, Incident Management System, Liberia
Dr Nfansoumane Kalissa	Directeur de l'hopital (DH)
Dr Odilon Haba	Equipe medical Out/reach
Dr Remy Lamah	Ministre de la Santé
Dr Sakoba Keita	Coordinateru national reponse EBOLA
Dr Savané	Directeur de l'hopital (DH)
Dr. Abdourahamane Batchili	Coordinateur Regional de la Guinne Forestiérè, lutte contre l'Ebola
Dr. Joanne Liu	MD and President of MSF International Board
Dr. Lansana Kerouané	Directeur Prefectoral de la Sante de Forecariah
Dr. Mamadou Oury kolo Baldé	Medecin/ Equipe medical Out/reach
Dr. Mamodou Djangeray	Deputy representative OMS/ WHO
Dr. Marie claire Lamah	Medecin/ Equipe medical Out/reach
Edward Koumassadouno	Data manager HP OCB Guinea
Edward Stals	Emergency Coordinator Sierra Leone OCB

Eladji Mohamed Keita	Equipe WASH/ Out/reach OCB
Elhadj Ibrahima Bah	Médecin Conakry OCB Guinea
Ella Watson	Health Promoter SL, GC, LB -OCB
Emilie Venables	Anthropologist LB OCB
Emily Veltus	Health Promoter Sierra Leone OCB
Emmanuel Massart	E-RT DONKA OCB
Eric Goemaere	MD, coordination plasma exchange trial, Conakry OCB Guinea
Erica Wagner	Nurse, OCB Guinea
Ernestina Repeto	MD, worked in Guéckédou OCB Guinea
Esther Sterck	MD Ebola expert MSF Geneva
Etienne Gignoux	Epidemiologist Task Force (Epicentre)
Evelien Kleinen	Health Promotion/Anthropologist OCB
Fasil Tezera	Head of Mission Liberia OCB
Faya Anatole Kamano	Médecin Conakry OCB Guinea
Fernanda Felero	HQ: OCBA anthropologist
Florian Vogt	Epidemiologist Sierra Leone OCB
Fransesco Grandesso	Epidemiologist Task Force (Epicentre)
Gashmu Mallah	Chairman Resources mobilisation pillar, Bo district, Sierra Leone
Gbessay Saffa	Surveillance, Bo district, Sierra Leone
Geertrui Poelaert	Health Promoter GC OCB
Geraldine Begue	Nurse activity manager SL OCB
Gert Verdonk	Medical Task Force and MedCo Guinea
Gilles Van Cutsem	Medco Liberia OCB
Guilavogui	Equipe WASH/ Out/reach
Hadja Mariam Keita	Equipe WASH/ Out/reach
Helena Nordenstedt	MD, worked in Elwa3, Monrovia and Nongo, Conakry OCB Liberia
Hilde de Clerck	MD Medical Department OCB
Ibrahim Savany	HP community, survivor Conakry OCB Guinea
Ibrahima Wagué	Nurse, Conakry OCB Guinea
Idrissa Balde	Médecin Conakry OCB Guinea
Iris Dvorac	MD, worked in Elwa3, Monrovia OCB Liberia
Isabelle Saran Manoh	Médecin Conakry OCB Guinea
Jacob Maikere	Sierra Leone MedCo Regular Mission
Jean Clement Cabrol	Director of Operations OC Geneva
Jean Faya Tolno	Equipe WASH/ Out/reach
Jean Martin Amara	E-HP Supervisor
Jeffrey Edward	MD, worked in Elwa3, Monrovia OCB Liberia
Jerome Mouton	MSF Regular mission HoM
Jesse Verschuere	Health promoter GC, SL OCB
Jimmy Matumona	FieldCo Forecariah OCB Guinea
Joele Zbinden	Nurse, OCB Guinea
Johan Van Griensven	MD, PI plasma exchange trial, Conakry Institute of Tropical Medicine
Jose Hulsenbek	Head of Mission OCA Sierra Leone
Joseh Boakai	Vice-president, Republic of Liberia
Joseph Kaifala	Chairman, Kenema City Council, Sierra Leone

Joseph Munda Bindi	Chairman, Bo district Council, Sierra Leone
Josh Balser	Programme Coordinator, Global Communities, Liberia
Justin Junior Morel	UNICEF Consultant Social Mobilisation
Kathleen Bosteels	Nurse activity manager SL OCB
Kebe Onivogui	Survivor 2
Kekoura Ifono	Lab technician Conakry OCB Guinea
Kendall Kauffeldt	Country Director, Samaritan Purse, Liberia
Koumbassa	Equipe WASH/ Out/reach
Laurence Sailly	Emergency Coordinator Liberia and Guinea
Laurent Sury	Desk d'Urgence MSF OCP
Lena Jansson	Nurse activity manager GC OCB
Lindis Hurum	Emergency Coordinator Liberia
Luc Kézely	MD Head Neurosurgery Donka Hospital
Luis Encinas	Desk Manager Western Africa - Afrique de l´Ouest OCBA
Mahama Keyta	Directrice Prefectoral de la Sante de Forecariah
Maire Nythuh Sorlien	Health Promoter SL
Mamadou Camara	Lab technician Conakry OCB Guinea
Mamadou Oury Kolo Balde	Médecin Conakry OCB Guinea
Mandiaiou Diakite	MD Head Donka laboratory, Head of Medecine Donka Hospital
Manu Massart	Filco Nongo OCB Guinea
Marc Poncin	MSF Emergency Coordinator OCB Guinea
Marc-Antoine De La Vega	Lab manager OCB Guinea
Marcel Langenbach	Director of Operations OCA
Maria Christina Manca	Health Promoter GC
Mariam Kamano	Infirmiere / Equipe medical Out/reach
Marie Claire Kolie	Médecin Conakry OCB Guinea
Marie Tchaton	MD, Ebola vaccin project Conakry Epicentre
Marie-Christine Ferir	Head Of Emergency Unit OCB
Mathie Faraouendeno	Supervisor HP community Conakry OCB Guinea
Maya Ronse	Antropologist,worked in Conakry Institute of Tropical Medicine
Micaela Serafini	Medical Director MSF OCG
Michel Boye	Aide infirmiere Conakry OCB Guinea
Michel Van Herp	MD epidemiologist OCB Brussels
Mickael Koume	Vice-chairman, Kailahun district Council
Mickael M. Gusu	Red Cross, Kenema Branch manager, Sierra Leone
Mme. Aminata Koumbassa	Infirmiere à la croix rouge Française
Mohamed Keita	Médecin Conakry OCB Guinea
Monica Arend-Trujillo	MD, worked in BO OCB Sierra Leone
Morrison Harouna	Red Cross, Bo Branch manager, Sierra Leone
Moussa Conde	Psychologist Conakry OCB Guinea
Mr. Eladji Mohamed Keita	Prefet Guéckédou
Namory Keita	Prof Gynecology and obstetrics Donka Hospital

Nancy Bolkharin	Red Cross, Kailahun activities supervisor, Sierra Leone
Nathalie Severy	Mental Health Advisor OCB HQ
Nfaly Magasouba	Labo Maladies infectieuses Donka Hospital
Olivier	Equipe WASH/ Out/reach
Olivier Geoffroy	Chef Delegation Croix Rouge Française
Olivier Paryss Kouta	WHO Conakry, Coordinator social mobilisation WHO Conakry
Olivier Van Eyll	Chef de Mission ALIMA Guinée Conakry, ex MSF GC
Ouo-Ouo Sakaouvogui	HP communautaire Conakry OCB Guinea
Ouyelo Goumou	Médecin Conakry OCB Guinea
Pascal Chaillet	Lab expert OCB Brussels
Petra Alders	HQ OCB Medical Officer Sierra Leone
Pierre Louis Lamah	MD Head Ophtalmology Donka Hospital
Raphael Van Den Berg	PhD operational research Luxor
Raquel Ayora	Director of Operations MSF OCBA
Regina Bash-Taqi	Health policy planning, MoH, Sierra Leone
Reginald Sumo	Health Promotion MoH Ebola Taskforce, Liberia
Robert O Cannon	Epidemiologist, Bo OCB Sierra Leone
Rosa Crestani	Head Of Task Force MSF OCB and International
Saa Sabas	Survivor 1
Said Ayub	Project Coordinator/Medical Coordinator Sierra Leone OCB
Samai Moriba	Deputy Hospital Director GRC Sierra Leone
Sangno Moriba	Médecin Conakry OCB Guinea
Séverine Calewaerts	MD gynaecologist OCB Brussels
Shevin Jacob	MD worked in Conakry and Kenema WHO Conakry
Sidibe Amadou	Médecin Conakry OCB Guinea
Sophie Masson	Epidemiologist Task Force (Epicentre)
Stephen Goajia	NERC Coordinator, Sierra Leone
Sydney Wong	Medical Director MSF OCA
Sylla Djibril	MD Head Emergency medicine Donka Hospital
Teresa Sancristobal	Coordinator Emergency Unit OCBA
Tessy Fautsch	Medco GC OCB
Thierno Hamidou Bah	Médecin Conakry OCB Guinea
Thomas Mangen	WHO Conakry and Croix rouge Francaise WHO Guinea
Tom Decroo	Research unit OCB GC Luxor
Trye Patrick	Assistant Medical Coordinator (regular mission) Sierra Leone OCB
Vivian Cox	MD, worked in Elwa3, Monrovia OCB Liberia
Yasmine Ql Kourdi	Health Promotion advisor OCB HQ
Youssouf Traore	President Croix Rouge Guinéenne
Zoumanigui	Equipe WASH/ Out/reach

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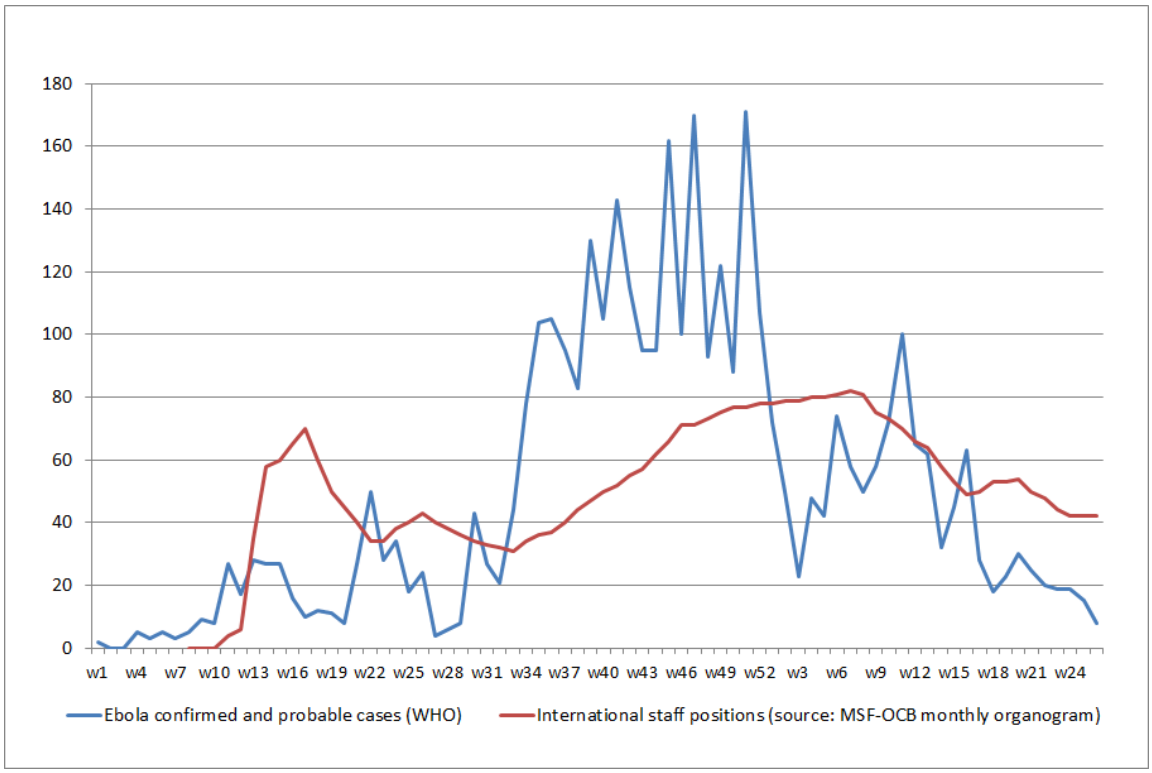
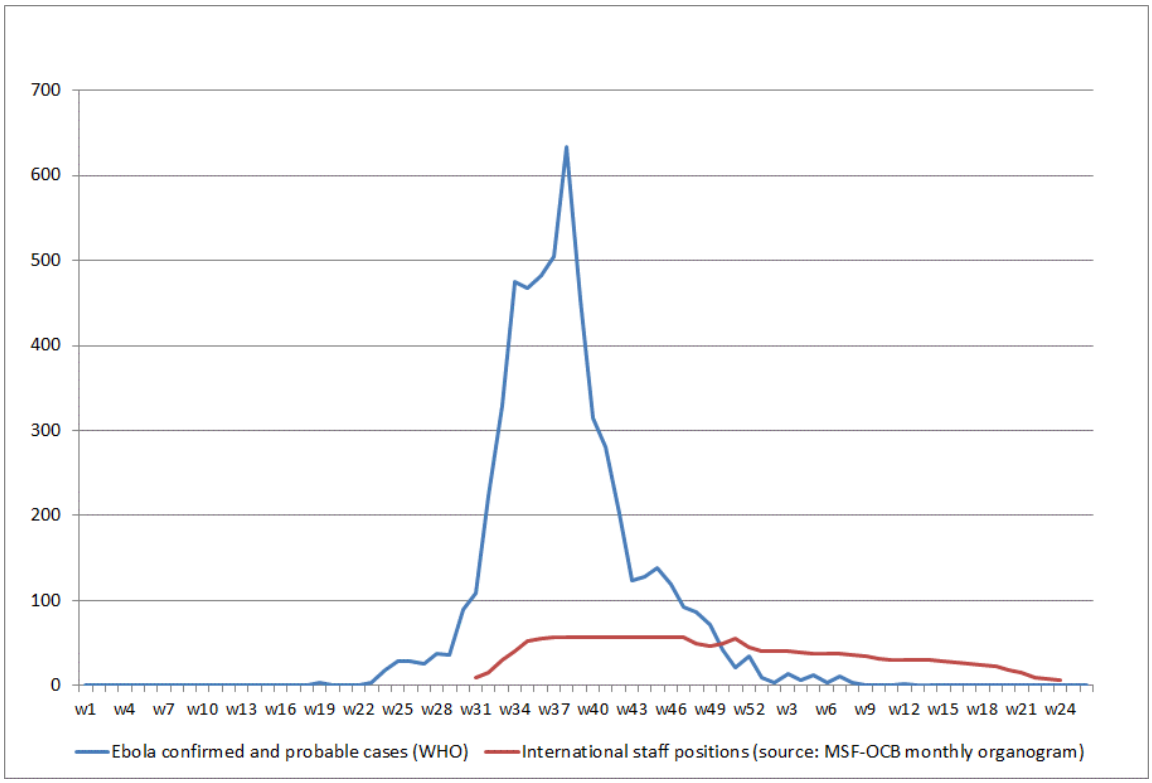
Annex IV: Timing, epidemic evolution, responsiveness, projects and human resources allocated by MSF in Guinea Conakry, Liberia and Sierra Leone

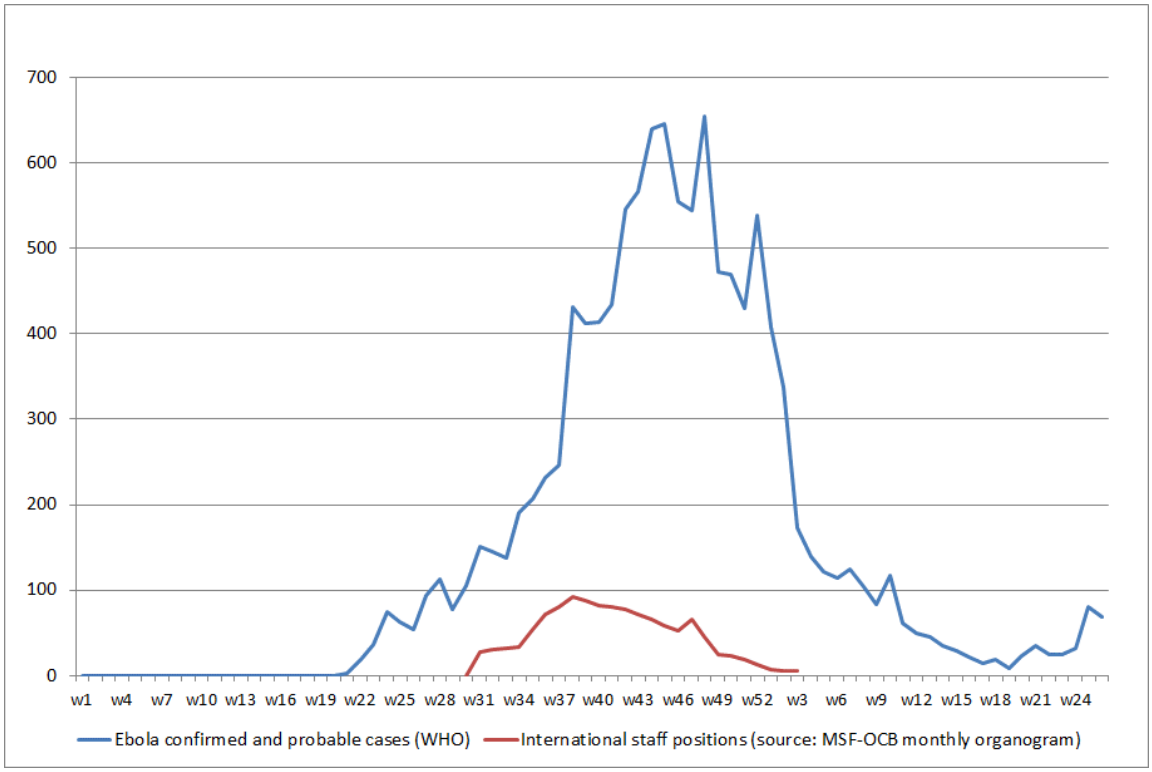
A. Guinea: Association between number of Ebola cases and international staff positions at field level (2014-2015)



B. Liberia: Association between number of Ebola cases and international staff positions at field level (2014-2015)

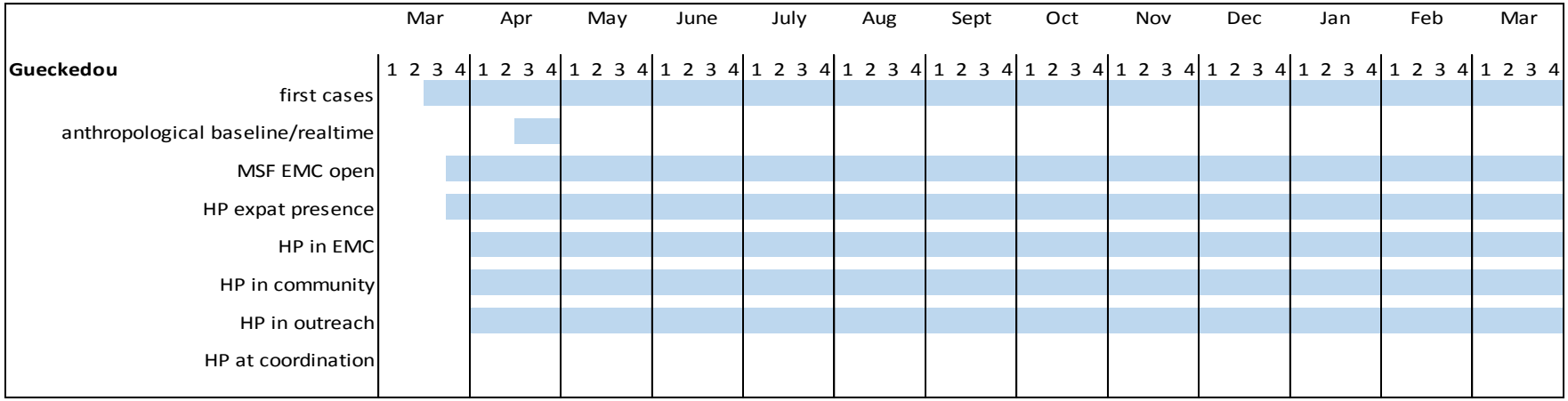


C. Sierra Leone: Association between number of Ebola cases and international staff positions at field level (2014-2015)

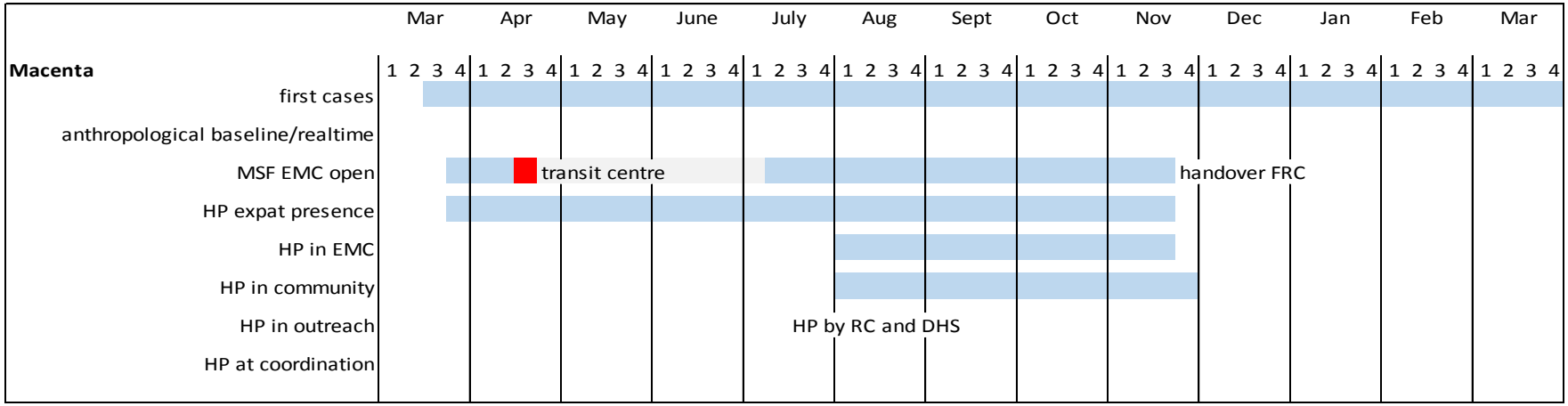


Annex V: Health promotion time line per location

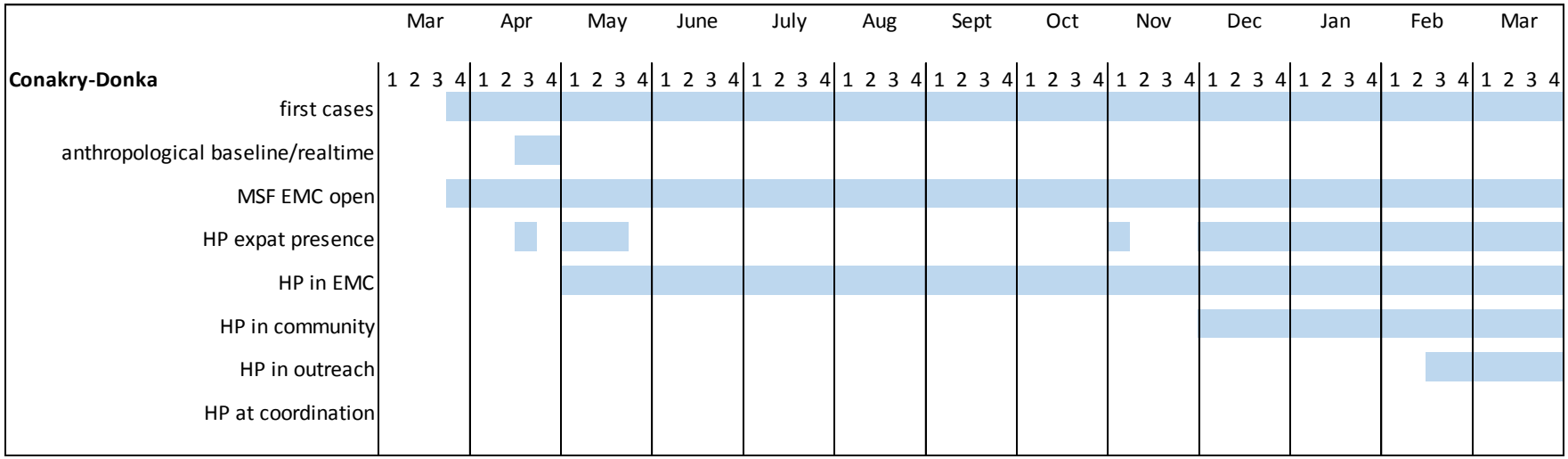
A. HP Timeline Guéckédou, Guinea Conakry (2014-2015)



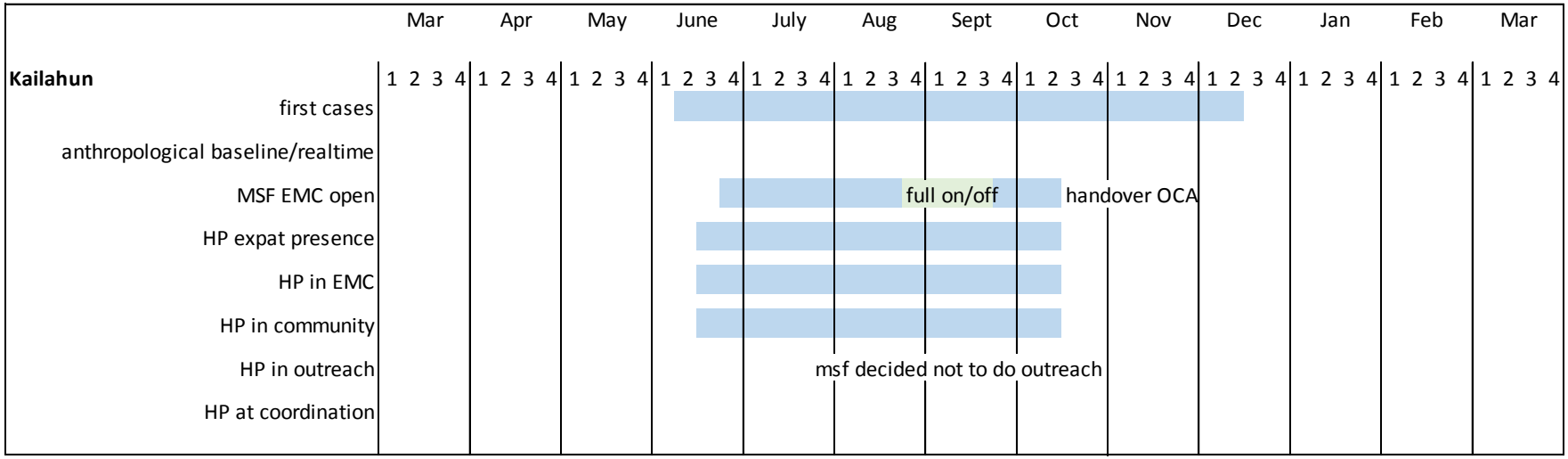
B. HP Timeline Macenta, Guinea Conakry (2014-2015)



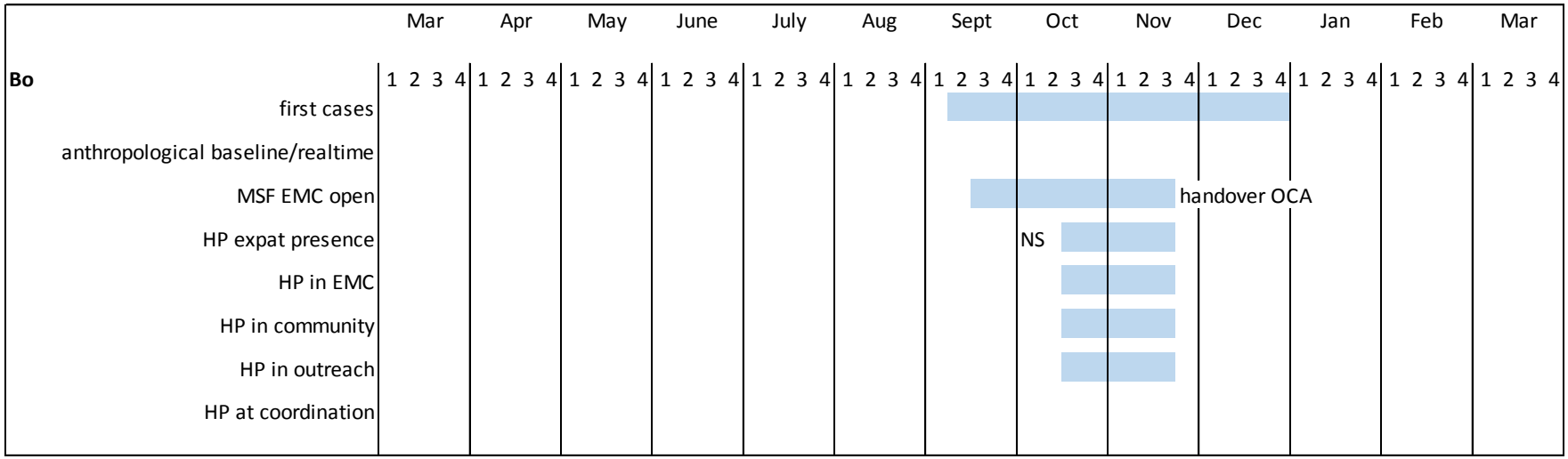
C. HP Timeline Donka, Guinea Conakry, 2014-2015



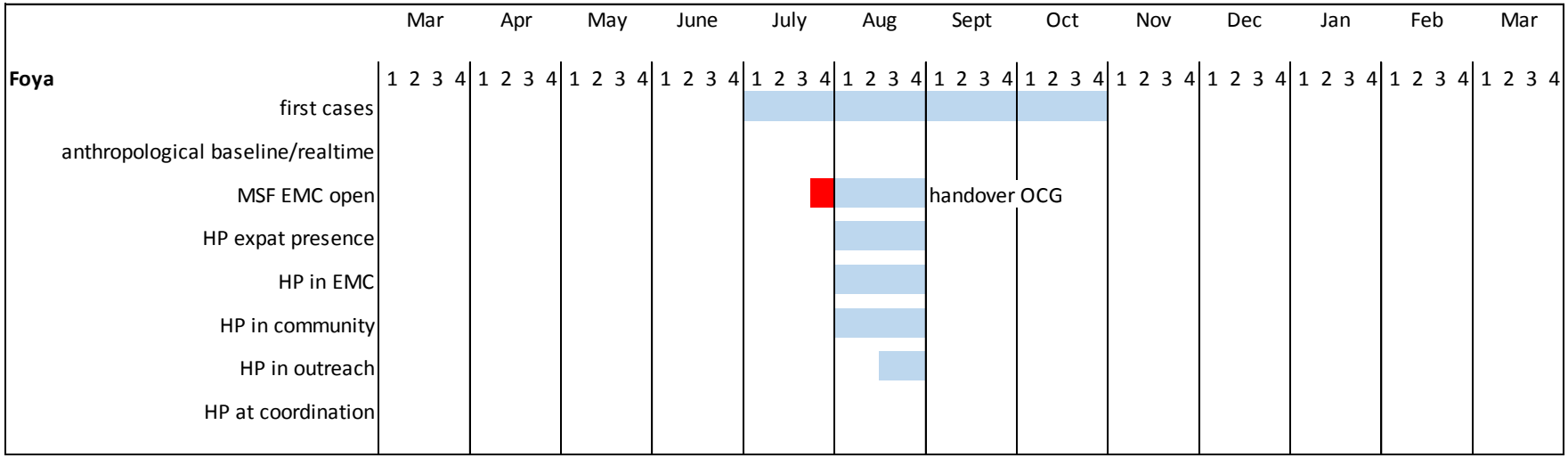
D. HP Timeline Kailahun, Sierra Leone (2014-2015)



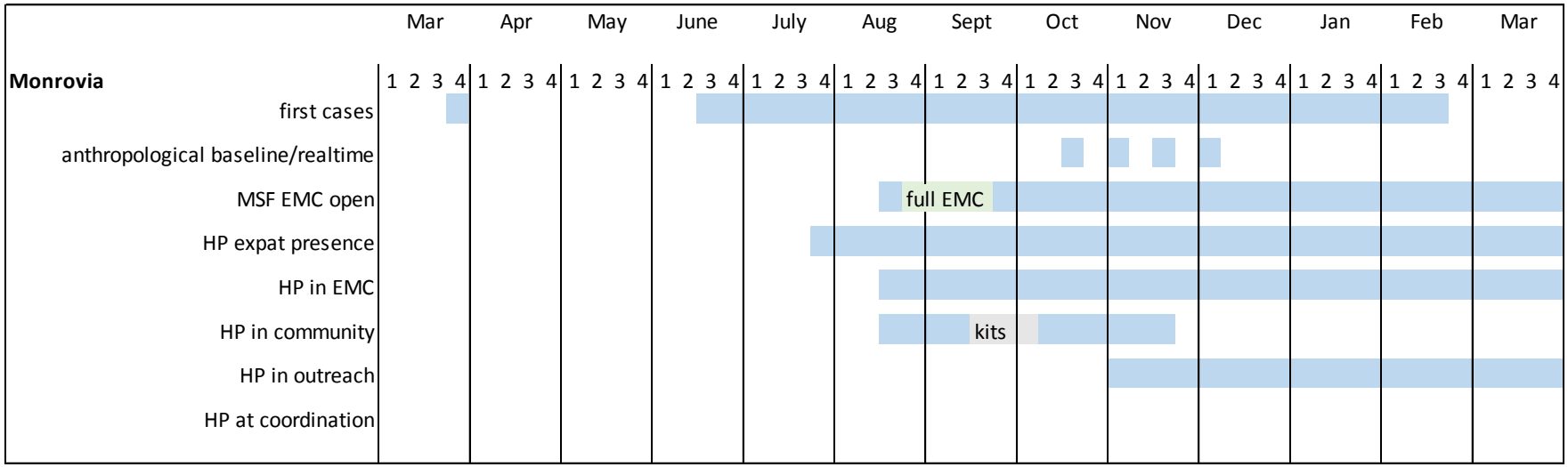
E. HP Timeline Bo, Sierra Leone (2014-2015)



F. HP Timeline Foya, Liberia (2014-2015)



G. HP Timeline Monrovia, Liberia (2014-2015)



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