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EBOLA REVIEW

Ebola Treatment Centres: design and construction

PART I – Evaluation outcomes

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ACRONYMS

BO	Bo ETC
DirLog	Directors of Logistics Platform
DON	Donka ETC
ELW	Elwa 3 ETC
ETC	Ebola Treatment Centre
FOR	Forecaryah ETC
FOY	Foya ETC
GN	Guinea
GUE	Guéckédou ETC
HR	High Risk
KAI	Kailahun ETC
KAN	Kankan ETC
KIS	Kissy ETC
LA	Living Area
LB	Liberia
LR	Low Risk
MAC	Macenta ETC
MAG	Magburaka ETC
NON	Nongo ETC
RIOD	MSF Directors of Operations Platform
OC	Operational Centre
OCA	Operational Centre Amsterdam
OCB	Operational Centre Brussels
OCBA	Operational Centre Barcelona-Athens
OCG	Operational Centre Geneva
OCP	Operational Centre Paris
POW	Prince of Wales ETC
PPE	Personal Protective Equipment
PTP	Patient Transit Point
SL	Sierra Leone
UR	Unknown Risk
Watsan	Water, Hygiene and Sanitation
WHO	World Health Organisation
WFP	World Food Program

EXECUTIVE SUMMARY

BACKGROUND

During the 2014-2015 Ebola virus disease outbreak in West Africa, MSF built a number of Ebola Treatment Centres (ETCs). MSF set up centres in the three countries at different moments and with different MSF Operational Sections, which resulted in a heterogenic collection of solutions. This review was conducted jointly for all MSF operational centers (OCs). It was commissioned by OCA and was conducted as part of the OCB Ebola review.

The ETC Review has compared the 13 different ETCs built by the different operational centers of MSF: Donka (80 beds); Guéckédou (85 beds; Kankan (20 beds); Monrovia - Elwa 3 (250 beds); Macenta Transit Centre (35 beds); Foya (40 beds); Bo (100 beds); Kailahun (100 beds); Forecariah transit centre (10 beds - transit centre to ETC); Magburaka (100 beds); Freetown / Prince of Wales secondary school (100 beds); Freetown / Kissy (75 beds) and Nongo (72 beds).

FINDINGS

The Key findings include:

- During the period between March 2014 and March 2015 five phases of evolution in the design and construction of ETCs can be identified.
- A considerable amount of information and lessons learned on ETC design and construction were transmitted orally and not documented.
- The first centres followed the existing guidelines (2008), but the increase in patient numbers and the long term profile of the emergency demanded their revision.
- Training in Brussels presenting ETC design and construction focused only on explaining the structures' main components, such as High Risk (HR) and Low Risk (LR) zones, but not the other key design elements.
- Design and construction of larger and more complex ETCs requires advanced design tools and a high degree of on-site coordination for construction. Ideally the design team forms part of the construction team.
- Collaboration with other stakeholders in ETC construction has regularly resulted in delays.
- Site characteristics, including urban and rural, if not included into initial design reflection, often result in problems at operational stage, especially if adaptations or expansion are implemented.
- An overview of all ETC functions and their inter-relation must be part of the design reflection, including physical structure and space, functions (water, waste, laboratory), flow of materials and people, and non-ETC specific human activities such as visiting spaces, staff resting areas, etc. This overview is difficult to present in simple design sketches or blueprints and is best achieved with the use of appropriate design tools such as CAD.
- Types, sources and availability of materials must also be integrated into the design process, especially when designing ETCs expected to function for medium to long-term duration (up to 12 months or more).

CONCLUSIONS

Designing and building a good ETC requires a balance between: speed, comfort and efficiency. There are different scales within an intervention, which must be taken into account, ranging from the

individual object scale (furnishings or specific equipment) to the territorial scale (location of an ETC in relation to the epicentre and an ETC's design-build mobility).

There was a considerable amount of design adaptation implemented in the ETCs as well as technical and procedural innovations (e.g. dressing protocols, heat and ventilation in large tent facilities or improvement of patient care) arising in response to the increase in duration and scale of the outbreak. The long-term duration of the outbreak has allowed MSF to improve, innovate and adapt to the situation. These responses implied a significant research and development process, in an informal way, within each of the Operational Centres (OCs) and for MSF in general.

RECOMMENDATIONS

There are a number of specific and technical recommendations, but the main ones are:

⇒ A dedicated and coordinated capitalization process of lessons learned across the different OCs must be put into action. In addition, updating the design and construction information and practices is necessary. The participants in the capitalization must be multi-disciplinary and represent, at minimum, key ETC actors from the logistics, supply, construction, water and sanitation and medical departments

⇒ ETC designs must be based on flexibility and adaptability, both for scaling up in terms of size/beds and for adjusting to different site contexts and characteristics. This flexibility also extends to technical aspects such as the level of equipment provided or the types of materials available or to be used.

⇒ A dedicated pool or team of ETC construction persons with the necessary profiles should be established, with a dual role of being the reference team for ETC design and to be able to go to the field to follow-up and supervise the implementation and construction of their design.

PROJECT BACKGROUND

During the 2014-2015 Ebola virus disease outbreak in West Africa, MSF built a number of Ebola Treatment Centres (ETCs). ETCs are structures designed for the handling of people suspected or confirmed to be infected by the Ebola virus. ETCs constituted a fundamental tool for fighting the epidemic, contributing to the control of the outbreak by reducing the risk of transmission and allowing for the isolation of cases.

From the beginning of the emergency, different MSF sections set up ETC's in the three countries at different stages of the emergency, which resulted in a heterogenic collection of solutions. Below is a list of MSF Operational Sections and ETCs constructed by the OCs and covered by the review. This is NOT the full list of all ETC's or other sites built or operated by MSF.

OCs	ETC´s in the ToRs
OCA	Magburaka (SL)
OCB	Guéckédou (GN), Forecariah (GN), Donka (GN), Macenta (GN), Kailahun (SL), Bo (SL), Nongo (SL), Elwa 3 (LB)
OCBA	Kissy (SL)
OCG	Foya (SL), Prince of Wales (SL)
OCP	Kankan (LB)

Some ETCs were adapted structures and used existing buildings, while other ETCs consisted of completely new constructions. With respect to duration of use, some centres were temporary (two to three months expected duration) and others were semi-permanent (with an expected duration of more than twelve months in some cases). In terms of size and capacity, the centres ranged from a small size to extra-large capacity size (more than 100 beds). ETCs design and construction were strongly influenced by the unprecedented epidemic profile with the subsequent medical and biosecurity needs and by the expected duration of use of the facility. Design was also influenced by different variables such as context (political, social, cultural and physical), resources (human and material) and technical requirements (water, sanitation, shelter and electricity).

ETC design and construction had a direct impact on the quality of operations, transmission risk reduction, prevention and/or minimization of later design adjustments, waste management (normal and contaminated), treatment of patients, comfort of staff, resource optimisation and construction speed and cost. In short, design and construction have a direct influence on the impact of the response.

METHODOLOGY AND LIMITATIONS

This ETC design and construction review has been commissioned by the Directors Logistics (DirLog) platform at the request of the Directors of Operations Platform (RIOD) and is being overseen by the OCA Logistics Director with the support of the Stockholm Evaluation Unit. The key objective of the ETC Review is to compare the 13 different ETCs built by MSF : Donka (80 beds); Guéckédou (85 beds; Kankan (20 beds); Monrovia - Elwa 3 (250 beds); Macenta Transit Centre (35 beds); Foya (40 beds); Bo (100 beds); Kailahun (100 beds); Forecariah transit centre (10 beds - transit centre to ETC); Magburaka (100 beds); Freetown / Prince of Wales secondary school (100 beds); Freetown / Kissy (75 beds) and Nongo (72 beds).

METHODOLOGY

In order to carry out an effective analysis on ETCs, the review follows a structure with the following components:

- Desk study: databases from MSF logistics, watsan, the Ebola Task Force and other files from personal hard disks of people involved in design and construction were reviewed.
- Interviews: personal and group interviews of international and national staff. Some specific questions about ETC were provided to the consultants reviewing other sectors to be used during their interviews.
- Field visits: in situ visits to centres, walk around surveys, questions and discussions with the ETC staff where possible.
- Workshop: “Reviewing ETCs: design and construction”. This workshop was held to discuss, share and capitalise, among MSF OCs, on the knowledge and lessons learned concerning the process of designing and constructing ETCs.

LIMITATIONS

- The various ETCs are very diverse (different locations, times, epidemic profiles, contexts, etc.). Therefore, performing a simple comparison would only yield limited results and coherence with no deep analysis. To overcome this limitation, a general scheme for analysis covering the different characteristics of ETCs but also incorporates different contextual elements, including origin and history of the various sites, has been developed.
- Operational Centre Paris (OCP) did not attend the ETC workshop and it was not possible to contact relevant individuals for interviews.
- It was only possible to visit four centres, only two of which were still in operation. The other sites had already been decommissioned and dismantled.
- There was limited available or archived information about certain ETCs.

FINDINGS

During the period between March 2014 and March 2015 we can differentiate five phases of evolution in the design and construction of ETCs.

- Phase I: centres were established in a rapid and effective way due to proximity with existing health facilities or the use of existing buildings, using the Ebola guidelines.[1] Construction was usually achieved with a minimum of equipment and often resulted in a very temporary structure.[2], Guéckedou (GUE), Donka (DON).
- Phase II: the increase in number of cases and outbreak sites required expanding the existing centres, often resulting in constant ETC maintenance and restructuring activities.[3] It is proposed that new ETCs should be designed as independent facilities not attached to other structures. Kailahoum (KAI).
- Phase III: with record case load figures (from tens to hundreds of patients) and the increased extension of a temporary strategy period (exceeding the normal two or three months), a change in size and duration of ETCs emerged, resulting in new macro centres with a semi-permanent structures. This included the implementation of big tents but these structures also presented technical challenges.[4] The use of buildings or existing structures was now reduced to living areas or logistical facilities and no longer for HR and LR zones. The guidelines about this type of design and construction have become obsolete.[5] Foya (FOY), Bo (BO). Forecariah (FOR), ELWA3 (ELW)
- Phase IV: new ETCs incorporating the many lessons learned from the previous phases and field experience start to appear6. Site design is improved, bringing new adaptations and innovations, with more relaxed building periods of up to three weeks7. None of the new sites were used at full capacity.8 Prince of Walles (POW), Magburaka (MAG), Kissy (KIS).
- Phase V: the later construction of ETCs have a design character firmly based on conclusions and lessons learned elaborated in a master plan. New ETCs are large to extra-large, with a semi-permanent character and built over a longer construction timeframe.9Kankan (KAN), Nongo (NON).

GUIDELINES, COMMUNICATION AND TRAINING

The first centres follow the existing guidelines (2008), but the increase in patient numbers was without precedent and the long term profile of the emergency demanded a revision of the guidelines.[10]

Knowledge transfer was huge but not systematized, resulting in gaps:

- Mistakes occurred. They were rectified in centres but reappeared later.[11]
- Between field and office: much information has been lost because of the existing communication process:

1 Filovirus hemorrhagic fever. Guideline (draft for internal use). MSF 2008
2 Interview : Med OCB / Log OCB
3 Interview: Log OCB
4 Interview: Log Task Force OCB
5 Interview: Watsan OCB
6 Workshop: “Reviewing ETCs: design and construction” Sep 2015
7 Workshop: “Reviewing ETCs: design and construction” Sep 2015
8 Reports: MSF Ebola response - internal update
9 Interview: Log HQ / Log Task Force
10 Interview: Watsan Task Force
11 Interview: Watsan OCB

- A formal process for gathering information on ETCs during the debriefing was not in place.[12]
- People who worked in the construction field feel they were not given the opportunity to transmit or formalize their knowledge.[13]

- Between OCs: there has been a transfer of knowledge in specific cases, more at a personal / individual level rather than at an institutional level:
  - OCB, based on their large Ebola experience, was the main source of knowledge.[14]
  - The main knowledge transfer occurred where there was proximity in the field between OCs (such as OCG and OCBA in Freetown) and where people who had been with OCB departed and later joined another OC.[15]
- Between departments: continuous coordination meetings were held in HQ and at the field level.[16]
- Between staff and during handovers:
  - Handovers usually included written reports that were not containing much detail on construction. Such information was often transmitted orally, depending on the opportunity.
  - The accumulated knowledge was established from individuals who had been on successive MSF Ebola missions. However, most of the times the knowledge was orally accumulated. [17]
- Training presentations: ETC design and construction focused only on explaining the main parts of an ETC, such as High Risk (HR) and Low Risk (LR) zones. Many of the other design elements were not covered. [18]
  - During the training there was only a general "design exercise", with no evidence of the true complexity and challenges of ETC design and construction.[19]

OPERATIONAL CHALLENGES

Organigram

In each of the OCs there were different organizational decision-making structures and paths.[20] In MSF OCB, for example, decisions were usually taken at HQ and transmitted to the field but, in some cases, field teams worked independently from the HQ (sometimes counter to instructions). In the field, many decisions have been taken in a complex and horizontal way. In KIS and Bo daily evening meetings were held to take decisions on ETC design changes in the field. The validation process of field decisions by the OC HQs has been occasionally the cause for delays and lack of coordination. In Bo, for example, decisions taken in the field were not coordinated with the HQ.

Moreover, the decisional process has been easier where project construction management was present at ETC level:

12 Interview: HQ Log Construction OCB
13 Interviews: Watsan field OCB
14 Workshop: “Reviewing ETCs: design and construction” Sep 2015
15 Interview: Log OCBA / Log OCG
16 Interview: Watsan field OCB / MedOp OCBA / LogConst OCB
17 Interview: Watsan Task Force / Watsan field OCB / Watsan field OCA
18 Attending Training in Brussels Nov 2014
19 Presentation: Introduction to design, patient/staff flow And Personal protection.
20 Workshop: “Reviewing ETCs: design and construction” Sep 2015

- OCG based their ETC design and construction process on the criteria of construction projects.
- OCB field decisions on design were sometimes difficult when specific points - such as choice and design of waste management structures or pump versus gravity water distribution networks - were not clearly allocated between log and watsan.

In some cases, the organigram was not properly adapted to the scale and the complexity of the ETC design and construction work, with some design and construction activity not clearly allocated to a profile (e.g. log or watsan).

Responding to the epidemic profile

The place where there will be an outbreak and a number of cases is unpredictable.[21] The selection of the size, type of facility (number of beds, semi-permanent/temporary) and its location has great impact on the response. E.g. centres with large size set up as semi-permanent structure require longer construction periods, resulting in a longer delay between the decision to respond and the actual opening of the ETC.[22]

ETC components were adapted in order to cover the gaps in the response. KIS was constructed with specific focus on pregnant women after analyses revealed high mortality among this demographic.[23]

Collaboration with other stakeholders

Some centres were constructed with the involvement of other stakeholders, which caused some problems and delayed the chronogram:

- Nongo ETC (NON): subcontracting of construction by MSF to WFP resulted in long delays.
- Elwa 3 ETC (ELW): was delayed by waiting for the supply of WHO tents.

MSF was seen as a technical referent by other organizations, who followed MSF criteria for design and construction. The International Federation of Red Cross and Red Crescent Societies (IFRC's) treatment centre in Kenema is based on the training, recommendations and experience they gained from MSF at KAI ETC.[24]

Site specific contexts

Site selection is often a political decision usually taken with local authorities and not based on technical requirements. This often resulted in site-specific problems.

- NON: water table very high and problems of Biosecurity with easy flooding of latrines and waste pits during rains.[25]
- Mecenta ETC (MAC): big slope, which poses difficulties during the construction and for working inside (movement with stretchers, path with steps in PPE, etc.) after opening the centre.[26]

The localization in urban or rural contexts have positives and negatives points, as illustrated in the table below.

[21] Interview: Med/Op Task Force
[22] Interview: Med OCB / Timeline
[23] Interview: Log OCBA / Med OCBA
[24] Experience in the field.
[25] Field visit.
[26] Interview: Med OCB / Log OCB

Table 1: Urban and Rural / positives and negatives points. [27]

Urban +	Urban -	Rural +	Rural -
- Easy Access: walking and public, transport - Access to materials, equipment - Lower transport costs proximity to distributers. - Access to Water and energy services. - Higher concentration of skilled persons (artisans, medical, semi-skilled labour) and-contractors. - Easy working with other actors based close to ETC site. - Easy Medevac.	- Site selection difficult: limited options and space. - Waste water management. - Proximity to populations: acceptance, security and privacy can be problems - Traffic blockages and transport delays. - Smoke from burning pits. - Security issues related to crowded areas - Forced decommissioning and recuperation for other uses. - Management bodies: limited space for cemeteries or burial.	- Free land - Access to open space, for construction and activities such as waste management. - Less space constraints on ETC design and expansion - Lower population density and potentially easier acceptance.	- Poor access to supply & materials. - Limited health or accommodation facilities for staff (National and International) - Lack of services (water, energy). - Poor infrastructure, usually bad roads and transport delays Difficult to achieve acceptance in less-educated populations. - Medevac difficult. - Poor or non-existent local or public transports

Some centres have been developed in the proximity of or inside other health centres. This has positive and negative implications on the response and ETC flexibility:

- In Guéckédou ETC (GUE) the response was very rapid because MSF was able to use existing health facilities.[28]
- Donka ETC (DON) was built on a site inside a hospital facility without prevision of extensions. When more beds were necessary the process to extend the centre became very complicated.[29]
- Kissy ETC (KIS) was established in a school, but had to be dismantled when the school re-opened.[30]
- The distances between ETCs, health centres and laboratories impact on the running of ETCs.[31]

FUNCTIONAL-SPATIAL ANALYSIS

Functional program

The 2008 guidelines used as reference did not contain a detailed and complete functional program for the different ETC units (e.g. wards, pharmacy, store, latrines, triage, etc.). In some of the new master plans (theoretical reference plans for the ETCs) there is a list of functional units.[32] Many functional units have been added during the outbreak to improve the quality of the centre such as intensive care, delivery room and convalescents' area units.[33]

[27] Result of workshop: "Reviewing ETCs: design and construction" Sep 2015
[28] Interview: Med OCB / Log OCB
[29] Interview: Watsan / Log / Med OCB
[30] Interview: Log OCBA
[31] Interview: Med OCB
[32] Theoretical Master Plan ETC OCB and Master Plan Magburaca OCA
[33] Field visit.

Some important elements of a comprehensive functional program were not included in the design of some centres[34], such as:

- Places for praying
- Parking for national staff
- Specific place in HR zone for drying clothes or items such as buckets, with such items being dried in communal areas of the ETCs.

Special non-treatment facilities for survivors, children and pregnant woman are also critical[35].

Characterization of the dynamic space

Some centres were never modified or adapted, while other ETCs were in a state of constant transformation:

- Suspect/probable/confirmed beds were changed according to the demands.
- The purpose of some functional units was often changed:[36]
    - NON: the second dressing area being used as living area for staff.

Spatial variations and changes made during the running of the centres sometimes brought problems to the redefinition of flows:[37]

- Bo ETC (BO): changing the wards from suspected to confirmed patients brought a conflict in the HR zone flow because the new configuration required moving in the opposite direction.

Some issues regarding organization and characterization of space reduced efficiency and optimization:

- Some distances and dimensions did not combine for optimal efficiency:
    - NON: another dressing area (place where you put on PPE) needed to be built closer to the triage because the existing one was located too far away. [38]
    - KIS: enlarging the maternity ward required building another nursing station because the distance between the ward and existing station was too big.[39]
- Some functional units were located in the wrong place, which caused problems:[40]
    - BO: the latrines were positioned in a way that created a visual barrier between HR and LR zones. This is a problem because visual contact between HR and LR must maximised for the purpose of communication with staff in PPE and patients, as well as care of the latter.
    - NON: the area dedicated to psychosocial support was located in both LR and visitor areas, requiring staff to change from PPE, go out of the centre and enter from the visitor side because there was no direct connection between the two points inside of the centre.

[34] Field visit.
[35] Interview: Med OCA / Med OCBA / Watsan Task Force.
[36] Field visit.
[37] Field visit
[38] Groups interviews in field visit.
[39] Interview: Med OCBA
[40] Groups interviews in field visit.

Definition of the physical space

Flow definition for HR and LR zones is very clear. However, other areas, such as transit points or access points, were not so well defined, thus giving origin to several problems (e.g. ambulance entry and disinfection, visitor entry, discharge showers).[41] In each case, the definition of the physical space (plans) was very different:[42]

- There was a big evolution in design plans during the outbreak:
    - Foya ETC (FOY): no proper plans were drawn after the adaptations to the ETC were done.
    - MAG/NON/POW have high-quality documentation.
- Some plans are theoretical or documents produced for meetings and not useful for daily implementation in the field.
- Some plans were drawn with inadequate or inappropriate design tools:
    - KAI/FOY: plans were created with Excel.

Teams in the field have fewer tools than in the office but often the process of adaptation is much more complex than at HQ, especially during the busy construction phase, and needs to be implemented in a short time period.[43]

PHYSICAL-TECHNICAL ANALYSIS

Physical ETC infrastructure

1. In many cases the site characteristics were very poor for construction.[44]
2. The quality of the construction was very different between ETCs (e.g. quality and mounting of fittings).
3. The decision of using big tents (Rub halls) had both positive and negative implications: the space was bigger and easy to clean but the big tents need foundations, which delay the construction, and the microclimate has to be managed (heat and ventilation).[45] (See ANEXX III. Critical challenges and problems).

Technical service infrastructure

In some cases, technical designs were developed by persons who were not part of the setup teams, losing efficiency and optimization during construction.[46] Moreover, the dimensions of facilities in different centres varied greatly. For example, NON ETC had a much higher number of light points than MAG (1000 vs 300), even though the two centres had similar number of beds.[47] In many cases the facilities were over-dimensioned, losing efficiency and requiring more complicated maintenance. In BO ETC water network, for example, the distance between distribution tanks and the fundamental water points - such as laundry or chlorination – were too big and required long lines.[48]

[41] Workshop: "Reviewing ETCs: design and construction" Sep 2015
[42] Comparison between plans of the 13 centres.
[43] Interviews: Watsan field OCB / Log field OCBA
[44] Field visit / Interviews: Watsan Task Force.
[45] Interviews: Log Task Force
[46] Log field OCBA
[47] Field visit.
[48] Field visit

The technical service infrastructure of an ETC is composed of its water, sanitation and hygienic systems, as well as of its electrical, lighting, ventilation, cooling, fire and telecommunication systems. The main issues found in each of these components are the following:

Water:

- Problems in all centres are recurrent: chlorine corrosion of metallic pieces, quality of the taps, matching between pieces and fittings of different sizes and materials.[49]

Sanitation:

- The waste management area is one of the most critical points in an ETC: smoke from burning waste, burning pits exposed to rain and wind, the maintenance of incinerators, bio-security – especially for staff working in contaminated waste management.[50]
- High water tables in the latrines system is a problem with, in some cases, logistical consequences.
- The drainage network for grey water is crucial and can become problematic in torrential rains. Local communities were sensitive about drainage of the contaminated water.[51]

Hygiene:

- The ability to disinfect large spaces and open areas is an important requirement for the design of an ETC and affects the selection of materials. In HR zones, large spaces and empty areas require disinfection, even if they are not fully used. Distance is as important as space. In NON ETC the triage is very far from the next flow point, requiring that more than fifty linear metres (in a wide path) be disinfected each time a patient enters.[52]

Electrician and lighting:

- The generators were often oversized, which sometimes resulted in a waste of light consumption to maintain a minimum generator load.[53]
- The 24-hours, 7-days lighting is a sensitive issue: it negatively affects the patients' comfort but it is important for staff security.[54]

Ventilation and cooling:[55]

- High interior temperatures constituted one of the main challenges for the design and the selection of construction materials. Many types of ventilation systems have been used. Some were not adequate because of the big air volume, the geometries, the orientation and the small ventilation openings in the tents.
- The dispersion of chlorine fumes also represents a problem in smaller or confined points such as in the undressing area.

[49] Field visit.
[50] Interviews: Watsan Task Force / Group interviews in the field.
[51] Interview: Log OCBA
[52] Field visit
[53] Field visit.
[54] Groups interviews in the field.
[55] Interview: Log Task Force / Group interviews in the field.

Fire emergencies:

- There is no clear or common protocol for responding to fire emergencies.[56]
- Some centres have installed a separate water system for response to fire emergencies.[57]

Communications:

- Some problems have been solved with the support of new technologies (e.g. cameras for patient management).[58]

Construction & design application

There are several factors influencing adaptations, the main of which is the site where the ETC is located. Other factors include: bed capacity extension, the emerging of new program needs and the necessity of improving temporary structures for long term use.

Some ETC designs were more easily adaptable than others. [59] Kailahun ETC (KAI), for example, was changing and extending all the time. Its initial design and flexible construction (easy to dismantle, move and change) allowed for easy extensions.[60] GUE is another example of flexibility. Aided by the flexibility of the structure, it was continuously adapted and extended despite not being originally conceived for long term use and expansion, especially not with patients inside.

In some other cases the design of centres was completely modified in the field, while some were built exactly according to a master plan.[61] In KIS the field team made changes on site from the original ETC design, which resulted in a delayed opening of the centre. . In MAG the field adapted the original design and changed the orientation of the ETC to provide shaded areas for patients. In Prince of Wales ETC (POW) the team built the ETC according to the master plan because adaptations to the design of the site were made in the office, before starting on-site works.

Many spatial variations were done in HR zones at times when patients were present. This was very complicated and risky for staff.[62] In ELW, for example, the floors inside the HR zone tents were changed.

Embedding an ETC within existing buildings often represented a challenge for modifications.[63] In DON, flows were very complex due to the limitations posed by the existing buildings surrounding the ETC, especially after its extensions.

Material and tools resources

The selection of materials is critical for the following aspects:

Biosecurity: in ELW, the choice of using plywood for the floors (local source) brought many problems and a short lifespan.[64] In NON, the use of Plexiglas for the security post reduced staff's risk by allowing for observation without exposure.[65]

[56] Workshop: "Reviewing ETCs: design and construction" Sep 2015
[57] Field visit.
[58] Interviews: Log OCBA / Med OCBA
[59] Workshop: "Reviewing ETCs: design and construction" Sep 2015
[60] Interviews: Watsan field OCB / Watsan Task Force
[61] Workshop: "Reviewing ETCs: design and construction" Sep 2015
[62] Interview: Log Task Force
[63] Interview: Log field OCB
[64] Interview: Log Task Force / Watsan Task forces
[65] Field visit / Group interview in the field

Duration of the centre: orange fencing, which is good in short duration emergencies needs regular and high maintenance or replacement in medium and long term applications.[66]

Timeline: the selection of materials and their sourcing can determine the delay between construction start and site opening.

Some ETC facilities were constructed using local materials. However, some others - such as water, sanitation or electricity systems - were internationally sourced.[67] In terms of quantity and quality, there were generally no issues linked to the logistical and supply aspects of material sourcing. [68]

Phases (opening the centre, maintenance, extension, hibernation, decommissioning, dismantling, handover):

Some centres were designed to be built in phases, which facilitated a faster opening. Their construction continued after the opening without exposing the staff to any risk.[69] However, most ETCs were not designed around this phase concept.[70] ETC maintenance was in many cases very complicated, especially in regards to HR zones.[71] This is made even more difficult by the absence of a "book of use and maintenance" of materials and equipment, as well as by the lack of a register of the maintenance activities and needs in technical areas.[72] Finally, there is no technical documentation for site handover.[73]

ANALYSIS: PATIENTS AND STAFF EXPERIENCE

Based on interviews in the field, the feeling of the patients, visitors and national staff is that the centres provided a good standard of comfort. They regarded the ETCs as good places because the basic needs were covered: medical care, food, clothes and visiting family members were attended to or provided by the ETC staff.[74]

A critical point for the ETCs is the ability to provide and guarantee the privacy and dignity of patients while maintaining staff's security and comfort.[75] In fact, guaranteeing this combination of factors is not always easy. The need for continued visibility of patients, for example, clashed with their need for privacy (in cases where buckets are used instead of latrines, privacy is a problem). Separating women and men was difficult, especially families who naturally want to be together.

Another critical point is the management of dead bodies. Having corpses in the same space as patients for too long clearly constitutes a problem. [76] At the peak of the outbreak, this was very difficult to manage in ELW.

Staff voiced some concerns regarding their needs and comfort. In particular, the heat and the microclimate conditions in the interior of the centres were considered as critical points.[77] Moreover, patients' isolation was a cause of concern for the staff because, in some centres, it was not easy to be close to and spend time with the patients. The team in KIS solved this problem by installing telephones, cameras and speakers. Some staff members expressed the need to have places for privacy, lunch, or rest in the centre. [78] The ambience of some ETC was not considered to be very people-friendly. An

[66] Workshop: "Reviewing ETCs: design and construction" Sep 2015
[67] Interview: Log Task Force
[68] Ibid 68
[69] Workshop: "Reviewing ETCs: design and construction" Sep 2015
[70] Interviews: Log Task Force
[71] Ibid 71
[72] Ibid 71
[73] Interviews: Med OCA
[74] Group and individual interviews in the field.
[75] Group and individual interviews in the field.
[76] Group and individual interviews in the field / Interview: Watsan HQ OCB
[77] Interviews: Med OCB
[78] Group and individual interviews in the field.

example of this is BO. The staff and community nicknamed the ETC in Bo "Guantanamo" because of its appearance (security post, metallic fence, illumination during the night). [79]

Finally, staff that have been working in different ETCs agree that the last and big ETC versions (like NON) are nicer and more comfortable, but also agree that they could manage the crisis with other kinds of solutions, which are more temporary in design and more efficient in construction timeframes.[80]

ADAPTATION AND INNOVATIONS

All centres underwent some sort of innovation and adaptation. These adaptations and innovations can be classified by origin, as shown in the table below.

Table 2: Adaptations and innovations [81](See ANEXX IV. Adaptations and innovations).

To improve the quality of the care	To improve the climate conditions	To solve punctual problems
- Intensive care unit. NON - Laboratory GEN EXPERT, for rapid test results. NON - Phones for the patients. KIS - Small beds and decorated environment for babies and children. ELW - Decoration for babies. ELW - Curtains for privacy in wards. KIS - Table for convalescent patients. MAG - System of lights for day / night. MAG - Screens / video cameras /audio system for communication between staff and patients. KIS - Delivery room. KAI/MAG/KIS - Scanner / Wi-Fi / data control. GUE - Video cameras / audio system. KIS - Cinema and movie theatre for visitors and patients. POW - Play box and play area for children. MAG	- Big tents for larger space and better air flow. NON - Panel isolated walls. NON - Ventilators system. ELW / NON - Air condition. NON **To optimize the HR and work.** - Plexiglas corridor for view of patients without dressing or exposure. POW/NON/KIS - Globe box laboratory for rapid testing. NON/ELW - Meeting supply / log transfer point (LR/HR). POW - Nursing points in snake. POW - Vomiting pit. BO - Dry mattress. MAG - Grill removable in the burning pit. GUE - Concrete ring in burning pit. GUE - Plexiglas corridor. P	- Fire emergency water reserve. BO - Inclined table for transferring items and food. DON - Mix (60% - 40%) for burning. GUE - Boot Drying Tree to maximize drying space. NON/KIS - Tube to burn the pit. GUE - Automatically closing doors. NON - Triage design. NON - PVC windows for improved installation of ventilation. NON - Aluminium windows with screens for ventilation. BO - Project ELEOS: a barcode / handheld computer based solution for Ebola Management Centres

CRITICAL CHALLENGES AND PROBLEMS

There were no unique criteria for designing certain ETC parts. This resulted in discussions, sometimes delayed construction and brought a feeling of insecurity into the teams.[82] After a Task Force visit to KIS, for example, the triage area was changed. This modification brought a feeling of unsafety to the team.[83]

Guaranteeing visual contact both between HR and LR zones and from the outside to the inside of the ETC was often a challenge. Visibility between HR and LR zones is important to improve patient care and

[79] Group and individual interviews in the field. Interview: Med HQ OCB
[80] Interviews: Med OCA / Med OCBA / Med OCB
[81] Result of workshop: "Reviewing ETCs: design and construction" Sep 2015
[82] Interview: Watsan Task Force
[83] Interview: Med/Op OCBA

staff security. In BO, the patients' resting area outside of the tents could not be seen from the LR zone.[84] Visibility from the outside to the inside of the ETC is important for security reasons. In ELW it was necessary to open a window in the fence to show the visitors that dead bodies were not being cremated.[85]

Another challenging aspect was communication between HQ and the field during the adaptation process from the theoretical master plan to the real set up of the ETC.[86]

Availability of human resources was one of the main constraints for setting up ETCs. ELW size was not constrained by the ability or inability to expand its capacity to 1000 beds (that were needed and were possible to provide) but by the availability of staff to manage them.[87] Moreover, working on construction and maintenance in the HR zone, especially if patients were present, was particularly challenging.[88]

1. Balance between security of the staff to patient, and comfort/dignity for the patients: "ZOO" effect.
2. Technical points: Units in "grey area" area, transition points, triage, flows, flows of persons in survivors, convalescents and children's areas, waste management area, wards and tents, micro-climate conditions, floor, durability of materials, time of construction.[89]

Human resources

There were continuous rotations of international staff during the construction and the non-uniqueness of decisions made the process more complex, bringing problems. ELW and KIS had many rotations and changes of approach to protocols. Changes resulted in delays and technical and equipment maintenance problems.[90] The situation was complicated by the fact that MSF staff had been working in the design and construction of ETCs without prior experience of large scale design or construction.[91]

A high number of construction workers were employed in the teams.[92] In MAG, for example, MSF resorted to 500 daily workers. Construction workers were considered a special group because of their initial fear and stigmatisation. However, many construction workers later found work in the ETC, which had advantages because they knew the centre well having been involved in the whole realisation process.

A significant step forward in ETC design and construction was made when people who had been working in a centre during the running phase also became involved in the design of other ETCs.[93]

Capitalisation

There are many differences in the process and results of the various capitalisation efforts made by the different OCs. [94] OCB, which had more experience, knowledge and implemented more innovations in terms of ETC, is the OC with less capitalisation. OCG, OCP and OCBA have engaged in some capitalisation because their interventions were more limited: they managed less centres in a quieter period.

[84] Field visit.
[85] Interview: Watsan Task Force
[86] Interview: Log Task Force / Watsan field OCB / Lesson learn OCBA / Lesson learn BO
[87] Interview: Med/Op Task Force
[88] Interview: Log Task Force / Group and individual interviews in the field.
[89] Result of workshop: "Reviewing ETCs: design and construction" Sep 2015
[90] Interviews: Med OCBA / Log OCB
[91] Interviews: Watsan OCA / Log field OCB / Log OCBA
[92] Interviews: Watsan OCA
[93] Interviews: Watsan OCA / Log OCBA
[94] Document comparison.

Nonetheless, most of the OCs are interested in an intersectional capitalisation work.[95] This is made easier by the fact that:

- OCB / OCG have previously worked on capitalization together.
- This ETC Review is part of a transversal project of capitalization.
- During the Dakar regional MSF meeting there was agreement to establish a unique set of guidelines.

There are different documents from the OCs, but currently they cover all the necessary aspects:

- OCA has developed very useful technical information (watsan and construction KITS), based on their experience.[96]
- OCB is conducting separate logistics and watsan capitalisations. [97]
- OCBA has produced a document about "lessons learned" based on their experience.[98]
- OCG has developed a transversal and interesting design and construction checklist.[99]
- OCP has developed an individual design document. However, it is based on the experience of the construction process only as it was never running ETC with patients[100].

Many documents (protocols, recommendations, etc.) have been written during the last phase of the outbreak. Some of them stemmed from personal initiative and not as part of a structured OC initiative. [101]

In OCB there is no dedicated person or team working exclusively on capitalisation for this subject. Individuals contribute depending on their availability. A number of people with key knowledge are not available for contributions to these capitalisation efforts due to an already charged work agenda.[102]

[95] Workshop: "Reviewing ETCs: design and construction" Sep 2015
[96] *Consolidate Ebola Kit item list_Prioriti_Ma*. SCENARIO: EBOLA Eprep - 45 to 50 beds for 2 months.
[97] Workshop: "Reviewing ETCs: design and construction" Sep 2015
[98] Lessons Learned of the Ebola Crisis Intervention in West Africa (2014-2015). Logistics oriented. MSF-OCBA. Log Ebola Advisor, Mónica Jiménez.
[99] Principes Ebola Treatment Centres. BASIC LAYOUT PRINCIPLES 16 February 2015 Ebola Management Unit-Triage. (Check list)
[100] CT FHV 12 + 12. MSF – OCP. Centre de Traitement de Fièvre Hémorragique Virale. 12 suspects + 12 confirmes.2 mois d'activité. Mise en place en 7 jours. MSF – OCP Version Juillet 2015
[101] Document comparisons
[102] Interview Watsan Task Force / Log Task Force

CONCLUSIONS

Four main conclusive points can be obtained by the analysis of the findings presented above. The first concerns MSF's adaptability. In fact, MSF's response to the Ebola outbreak is the demonstration of what the organisation was able to achieve in terms of design and construction. MSF has worked in Ebola before, but the challenge of the recent outbreak was to significantly increase the scale of the intervention - which in construction means a new paradigm - during the most complicated moment of the emergency.

Changes in scale and duration are critical factors in the design and construction process. Adapting the response to increasingly high numbers of patients is not only a question of increasing the amount of beds in an ETC, but it also implies a change of paradigm where many new variables and needs appear. Building a structure designed for a two months duration is completely different than designing and constructing one meant for one year of activity. This increase in scale, size and time imposed by the epidemic has resulted in many new questions and problems, which MSF's response had to address.

The second conclusion regards the design/ build processes. Designing and building a good ETC requires 1) aiming for balance between speed, comfort and efficiency; 2) taking into account all the five scales of intervention (described in "Table 3") without neglecting any of them and 3) coordination and integration of numerous elements during the design phase (see "Table 4").

Table 3: Intervention scales

Territorial scale	The ETC must be close to the epicentre of the epidemic, which is unpredictable. However, there are some selection criteria for choosing sites which are linked to design and construction, such as access to materials, transport and communications.
Urban/rural scale	Looking for the best possible location includes evaluating communications and supply networks, distances to strategic points (e.g. health services), traffic flows etc.
Edificatory scale	It is necessary to be aware that the building or set of buildings must be conceived in a suitable way for both its technical role and its human functions, thus creating an optimal relation between geometric, functional and spatial components.
Constructive scale	Selecting the construction systems, the technical systems and the right materials offering the best balance between speed of response and quality.
Object scale	The small-scale furniture and equipment whose design and layout are fundamental to ensure the quality of care.

Table 4: ETC inputs

Needs	Resources	Technical & Systems		Context	
- Medical	- Human	- Shelter	- Electricity	- Epidemiology	- Socio-cultural
- Biosecurity	- Material	- Water	- Telecom	- Political	- Economical
- Comfort	- Economic	- Sanitation	- Fire	- Environ-mental	
- Chronogram					

An ETC is a complex system where all the parts are interrelated and the alteration or change of one of the parts impacts on the smooth functioning of the rest. A good design must integrate and answer to all the needs. The bigger and more complex the design and construction, the more complex are the coordination requirements for design and construction.

It is also necessary to anticipate the needs. It became clear that an ETC is much more than just an "isolation centre". The response program has become more complex, including a wider variety of activities and people living and working together (psychosocial activity areas, meeting points, training and survivors' recovery area). In addition, the ETC image has a high visibility and impact in the communities and in the media. Anticipation of the needs in design is fundamental for minimizing modifications after opening the ETC.

Another important aspect of the design and building process is differentiating between what to do and how to do it. It is extremely easy to focus on how to build something but forgetting its purpose and the needs it responds to. It is therefore essential to separate who decides what must be done from those responsible for the how. At a small scale, it is not complicated to decide the provision of some tents. However, on a larger scale the person who decides how an ETC must be constructed should also have the necessary tools to build and project an integrated version of all the design parts.

The design and construction process involves continuous and diverse problem solving. Many of the problems encountered have many variables and, therefore, multiple solutions. In such a situation the ability to choose and implement is very important. In responding to an unpredictable epidemic profile like the Ebola outbreak in West Africa, it is in fact fundamental to come up with different options and to help choosing the optimal solution, which is the simplest one, the more immediate one and/or the one that is less likely to generate problems in the short, medium and long term.

The third conclusion concerns simplicity and efficiency. MSF can build anything. Financial and material resources are not a limit when building or constructing. Nevertheless, if unlimited access to resources is combined with an uncontrolled change in the scale of construction, relaxation of focus on the optimization of best proposals becomes a concrete risk. A priori, this would not be a problem but it adds complexity to the situation and it causes the application of solutions that can generate new problems, such as increased demand on human resources and more specialized people.

Centres requiring a high degree of maintenance can pose a problem for their handover to local counterparts, who may not have the technical capacity or the financial resources to maintain the facility. Complex facilities also risk to be seen, sometimes inappropriately, as the technical reference and standard by other actors (national and international). The objective to find optimal solutions is not to reduce costs but rather to improve efficiency in construction, which is directly related to the simplicity and appropriateness of the design.

Too often the basic techniques are under-valued, unknown or ignored in favour of more advanced technological systems and practices. While an emergency puts pressure on justifying the choice of immediate solutions, reflection on the choice should also include an analysis of the consequences that the adopted systems might have at the maintenance level, their dependence on certain technologies or materials etc. The objective is not to condemn the use of technologies, but to avoid its abuse and optimize its use: for example there may be no need to install cameras or radios if the ETC design allows for the necessary visual contact between staff and patients. Equally, there is no need to have air conditioning if the ventilation and shade protection are well installed.

More basic research is needed. Knowledge, analysis and reflection are required in order to find simple solutions but these can be incompatible with emergency rhythms. Consequently, it is necessary to invest resources and time outside of the emergency response context in the search for optimal solutions fulfilling the criteria of maximum appropriateness and simplicity.

One of the major dangers of the construction solution is its intrinsic attraction. In emergencies this can become counter-productive if it evolves into a widely accepted strategy of wanting to do each time

bigger and better construction. This can redirect attention from the fundamental question of whether construction needs to be done or not and, if so, whether it needs to be "bigger and better".

The solution for a good ETC design is not a unique one and it is not a linear process with an ideal result. One should not automatically accept that the latest ETC design is the reference for future ETCs. ETC design proposals must remain adaptable to changing needs but still defined well-enough in key requirements, thus avoiding uncertainty and, therefore, possible construction errors.

Finally, the last conclusion regards the human aspect of ETCs. While an ETC needs to work like a perfect biosecurity machine in order to avoid contamination, it is also fundamental to take care of the human aspect. Many types of people with many different activities and a range of emotional states mix within the centres. It should not be forgotten that an ETC is a place where many people are going to die. Therefore, a good ETC design should include areas and places appropriate for every moment and activity. A good centre is the one that functions in the background of the day to day activities. It is not the protagonist but discreet backdrop for the scene of activities.

SPECIFIC CONCLUSIONS FOR THE FINDINGS

BACKGROUND	General background. - The duration of the epidemic has allowed a process of research and development that was unusual in emergencies, demonstrating the amazing capacity of MSF for response, adaptation, transformation and develop solutions. - Currently much of the knowledge gained remains more with individual people rather than in MSF Institution sources. Operational organigram. - The bigger the scale of construction, the bigger is complexity of the coordination required. - Coordination is fundamental to construction. To build well it is necessary to integrate the different parts. - Understanding and applying the difference between 'what' has to be done (Med + Biosecurity conditions) and 'how' it has to be done (design + construction) is essential. - In some situations, there was a gap in the project management coordination for design and construction. Epidemic profile. - To choose the adequate size and characteristic for the centres is crucial for the success of the response. - The adaptability and flexibility of the centres (GUE and KAI were built initially for few cases and then came to 100 beds) are essential. - Some big centres limit the activities of MSF to one place and limit the movements of the team. Other stakeholders. - MSF was and is a reference in D&C of ETCs. - The construction process of ETCs is more efficient when MSF is doing this independently of other stakeholders. Specific background. - The wrong selection of the site for the centres usually brings big problems during running of the centres.

ANALYSIS FUNCTIONAL-SPATIAL	Functional program - The functional program has to be defined, in order to anticipate spatial needs in the centre. - The functional program has to be defined according to the needs of each ETC depending on the size and the type of centre: small (S)/medium - large (M-L)/ extra-large (XL). Characterization of the dynamic space of programming - Open and easy views inside the centre, clearly outlined in the blue print, are essential to visualizing and managing the flows and the smooth running of the ETC. Definition of the physical space (plans) - Problems usually appeared in the areas less well-defined in the design. - The change of the scale of D & C also requires changing the skills and the tools. Inadequate tools affect the overview and impact on the detection of problems and needs. To test that the design is correct, or how the adaptation and modification affected other parts of the design, good tools are required to visualize overlap and links between the different functions (electricity, water, shelter, etc.). - The staff without appropriate expertise or tools experienced difficulties in trying to solve design problems.
ANALYSIS PHYSICAL-TECHNICAL	Physical infrastructure - There was no existing solutions to some of the problems; this outbreak was in a sense an opportunity for MSF to explore and test different options. Technical infrastructure - Many of the ETDs require a high level of maintenance in the facilities, which can pose problems for later handover to counterparts with less capacity (financial, skilled staff). - New technologies such as communication or data management need new skills, but which are sometimes not available in the host country. - In many cases there are no records of calculations for choosing technical options.

CONSTRUCTION & DESIGN APPLICATION	Adaptation to the design in the site - The selection of the site can be a huge factor which may minimize the process of adaptation. This can be offset to a degree by the quality of the work done during the design in the office. - The process of adaptation in the field is key for responding to the increased duration and for the quality of the centre. Material and tools resources - MSF has the resources and the flexibility to solve in a timely way any materials demands. - The selection of materials always depends on the context. - The quality of materials for the technical facilities is essential. Phases (open centre, maintenance, hibernation, decommission, dismantlement, handover) - The design and the construction was focused on opening and operational running as soon as possible, which had impacts on the maintenance in later phases during the long term. - The choice of materials and the duration of the ETC (temporary or semi-permanent) have a big impact on maintenance. In general, the quick temporary construction needs more maintenance.
ANALYSIS OF THE EXPERIENCE	- Continue huge effort in interventions for improving the quality of care and environmental for the patients. - The balance between privacy/dignity, comfort and treatment is important for many decisions about design and construction. - Comfort conditions are completely conditioned by the number of patients. - Heat and ventilation remains a problem to be solved, and still strongly affects the safety and the comfort for the staff.
ADAPTATION & INNOVATIONS	- The long term duration of the outbreak has allowed MSF to improve, innovate and adapted to the situation. - It has been a big process of research and development in an informal way, within each of the OCs and for MSF in general. - MSF took advantage of as an opportunity to adapt, innovate and improve its centres from the outset, both from the general perspective down to the small details.
CRITICAL CHALLENGES	- Critical factors are delimit and can be solved from the design. (See ANNEX III. Critical challenges and problems).
HUMAN RESOURCES	- A big effort in construction was achieved despite human resources difficulties. - Rotation of the person involved in the construction process should be avoided. - The conditions of the construction workers should be improved (contracts, insurance, equipment, etc.)

CAPITALIZATION	- The basis for a transversal, intersectional and complete capitalization are fundamental.
	- The results of this review bring the following useful information.
	  - Information from the intersectional Workshop in design and construction
	  - General recommendations.
	  - Detailed technical recommendations.
	- Data base of useful information.

RECOMMENDATIONS

The General Recommendations below follow the same presentation structure of the Findings and the Conclusions, to present the recommendations directly linked with each section.

Flexibility, adaptation and speed were the priorities for Design and Construction of ETCs for the first centres (even if they had other shortcoming) but that they have been lacking in other qualities. The question is whether the subsequent larger centres were “better”, being that they had less flexibility, adaption and a longer build time. Some of the answers are already described above, but the fundamental observation is that building something quickly on a big scale, of high complexity is not compatible with adaptation. Design & Construction also underwent a process that resulted in limited flexibility. In order to build something flexible and minimizing the possibility of error, it is fundamental to allow time to reflect and optimize the solutions during a period of calm or aside from the emergency context and environment.

BACKGROUND	General background ▪ MSF should improve knowledge transfer: access and format with "prosumers "concept (producers and consumers). Adapt and update the information format technology capabilities, platform where the information is in constant synchronization and update ▪ It is necessary to develop an ETC Master Plan (draft plans, with supporting information) in concordance with the Ebola guidelines, which incorporate and structure lessons learned. ▪ There is a need to develop a specific training for people who would be involved in the design and the construction of ETCs, to give them an update of the lessons learned in this recent outbreak. Operational organigram. (See table 6 below) ▪ Project management for construction and design coordination requires a person that coordinates different layers (needs, resources, time, design, shelter, water, sanitation, electricity), understands all the D & C needs and requirements, and is in constant liaison with Medical, Watsan and Logistics actors. ▪ It is important to clarify who decides WHAT must be done and who decides HOW it must be done. Epidemic profile. ▪ The ETC design needs to prioritize flexibility for different contexts (urban/rural), and different sizes or scales. Is important to have different options of design for different scales. (See table 6 below) ▪ The ETC response must include some design mobility to be able to follow the movement of the epidemic in different locations. Other stakeholders. ▪ Where possible, MSF should aim for self-sufficient and independent construction. ▪ Because MSF is seen as a reference for ETC design, it must develop a very clear base ETC design for the future that can be taken up by external users. Specific background ▪ Existing buildings can be used but their adaptation requires a qualified person, who carries out a technical survey and has the capacity to design and ETC that can be adapted quickly and in the most optimal way.

ANALYSIS FUNCTIONAL-SPATIAL

Functional programme

- A reference program which lists the various functions is proposed which will can be applied to be various contexts in relation the type of the centre defined by ETC size (S/M/L/XL) and term of duration (Short/medium/long). The program list includes mandatory and optional functional units and unit options which are fixed or ready for extensions.
- Other associated functional programmes in relation ETC must be taken into consideration such as warehouse & stores, staff accommodation or office facilities.

  (See ANNEX I. Table).

Characterization of the dynamic space of programming

Table 5: Characteristics and times of S-M-L-XL ETC

ETC S 0-18 beds	ETC M > L 18-60 beds > 60-100 beds	ETC XL n x 100 beds
-Rapid response - Could be in relation with other health structures. - Not designed for extension. - Specific program ETC S.	- Middle term response. - Independent and self-sufficient. - No pre-existing buildings for HR. - Ready for quick extension from M to L if it´s necessary. - Specific program ETC M>L.	- Long term response. - Independent and self-sufficient. - No pre-existing building for HR/LR. - 1 module = 100 beds, is possible to add more modules.(100 + 100 + 100) - Specific program ETC XL.
Temporal 1/2 days	Temporal 1 week	Temporal 2 weeks**
Semi-Permanent 1 week	Semi-Permanent 3 weeks*	Semi-Permanent 4 weeks

* Ready for first patients after one week.

** 2 Weeks the first Module with 100 beds, for the next modules 1 week

Definition of the physical space (plans)

- Access points and the surrounding spaces (outside of HR and LR) must be defined in the Master Plan.
- Persons responsible for design must utilize appropriate design tools, (hand - important for field adaptations, but other tools such as CAD better for spatial view)
- Criteria for Field plans include registering of modifications, overview of all ETC facilities, large and clear notation, no superfluous information, space for annotation, laminated copy, and references for blueprint (scale, orientation).

ANALYSIS PHYSICAL-TECHNICAL

Physical infrastructure

- To capitalize on solutions innovations for improvement before the next outbreak.

Technical infrastructure

- To design in an integrated way all the parts involved in construction to improve the construction process with more coordination and simplification of the systems from the design.
- To include in the design reflection the service in different potential phases (sometime hundred patients but sometimes two patients).

CONSTRUCTION & DESIGN APPLICATION	Adaptation to the design in the site - Adaptations to the ETC design master plan in the field should be done in situ by the people who were involved in the original design plan and done with appropriate capabilities and tools (drawing by hand, spatial vision) to propose different solutions in a short period of time, with an overview of the consequences of changes in all aspects. - To do any modification in HR after opening the centre should be minimized as much as possible. Material and tools resources - Research to find a solution for floor design. - Update the Ebola kit standard and content (Water, sanitation, electricity, shelter and telecom). Phases (open centre, maintenance, hibernation, decommission, dismantlement, handover) - The design of the centre has to facilitate next steps of the operational phases. - The decision on construction (materials, technical solutions) must include an objective to minimize maintenance or maintenance issues such as repair materials and spare parts. - The design must take into account the waste disposal of the dismantling and decommissioning of the ETC. - Introduce the use of working documents such as "Book of use and maintenance" for long-term structures. This is especially valuable for handovers and situations with continuous Human Resources rotations.
ANALYSIS OF THE EXPERIENCE	- Separate facilities (toilets and showers) for women, men and families. - To separate space for patient confirmed that are more seriously ill than others in the same space. - Address the standard of privacy using the design and the equipment. - Include privacy elements in design for the patients, with options such as screens or curtains.
ADAPTION & INNOVATIO	- Validate adaptations or innovations for the next outbreak.
CRITICAL CHALLENGES	- Implement a workshop with transversal participants to identify concrete steps for addressing the critical problems and challenges (see the ANNEX I).

<table>
<tr><td>HUMAN RESOURCES</td><td>
- Establish a construction pool with different D & C profiles and field experience, which can be available for the construction of larger-scale ETCs.
- Optimally the design process at HQ level is the person in charge of the coordination in the field during construction.
- The construction team which goes to the field for building must finish the construction before leaving.

Table 3: Proposal organigram for S-M-L-XL ETC. (See ANNEX I. Tables).
<table>
<tr><th>Proposal of organigram in M-L ETC</th><th>Proposal of organigram in XL ETC</th></tr>
<tr><td>- Construction coordinator and head of shelter.
- Head of Water and Sanitation
- Head of Electricity and telecom
- Head of Human and Material Resources and logistic/supply.</td><td>- Construction coordinator
- Head of Water
- Head of Sanitation
- Head of Shelter (carpentry/concrete)
- Head of Electricity and telecom
- Head of Human and Material Resources
- Construction logistic/supply.</td></tr>
</table>
</td></tr>
<tr><td>CAPITALIZATION</td><td>
- Implement a transversal and intersectional capitalization of D&C ETC.
- Next steps:
▪ Hold a specific Workshop to define critical points for the capitalization
▪ Establish a PERMANENT design/construction team (Med + Watsan + Log + Shelter + Project management construction) to focus in capitalization / research / development. The Watsan, Log, shelter. The project management of this team, should also be involved in the construction pool which goes to the field for managing the construction.
</td></tr>
</table>

ANNEX I: TABLES

Functional program

High Risk (HR) Area	Low Risk (LR) Area	Living/logistic Area	Technical area
- Admission of patients (suspect/probable/ confirmed). - Patients Rest Area. - Discharge Patients Showers (PTP) (probable/suspect/ confirmed). - Direct access of confirmed from ambulances (PTP). - Clean Points. - Dirty points (stock) - Clean dirty washing point - Sprayers. - Latrines HR. - Showers HR. - Vomiting Pit. - Contact with visitor. - Plexiglas corridor. - Distribution point - Transfer material point. - Convalescence area - Cellphone area. - VIP – for MSF staff - Delivery room. - Cool down place. - Place to transfer samples. - Social area.	- Personnel Access. - Control Access Point. - Taps. - Laundry. - Changing Rooms. - Clothing Store. - Drinks Store. - Personal Rest Area. - Work Meetings. - Offices. - Co-ordination Point. - Dressing Area. - Undressing Area. - Pharmacy. - Medical Store. - Laboratory (optional). - Latrines LR. - Showers LR. **Morgue** - Mortuary Store. - Washing Slab. - Deceased Patient Transfer (DPT). - Relatives Waiting Area.	- Patient Access (PTP). - Control Point Access. - Sprayer Area. **Patients Waiting Area Triage** - Sprayer Area. - Patients Waiting Area. - Triage Point. - Triage Latrine. **Living/logistic Area (LA)** - Kitchen. - Dining Area. - Food Store. - Personnel Rest Area. - Authorised Visitors. - Drivers Rest Area. - Parking. - Latrine UR. - Latrine LA.	- Water storage, treatment and control. - Chlorine Store. - Electricity and lighting. - Equipment Store. - Maintenance workshop. - Fuel store. **Waste Management Area** - LR Burning Pits. - HR Burning Pits. - Medical Material Incinerator. **Paediatric Observation Unit** - Games Area - Dormitory - Latrine. Shower. **Convalescent Areas** **Visitors Areas** - Overnight and visits. - Reception for companions. - Psycho-social care. - Promotion of hygiene. - Latrines. - Washing place.

Proposal of organigram

Proposal of organigram in S ETC	Proposal of organigram in M-L ETC	Proposal of organigram in XL ETC

- Constructor	- Construction coordinator and head of shelter. - Head of Water and Sanitation - Head of Electricity and telecom - Head of Human and Material Resources and logistic/supply.	- Construction coordinator - Head of Water - Head of Sanitation - Head of Shelter (carpentry/concrete) - Head of Electricity and telecom - Head of Human and Material Resources - Construction logistic/supply.
Construction coordinator: coordinate design and calculation/ coordinate bill of quantities / chronogram / link with Med, Biosecurity and Log / coordination of entry process / generate the plans and modifications of them it is necessary in the office and in the field / final decisions. Head of Water: support in design and calculate water net / construction of the water net / coordinate bill of quantities water / manage the workers for water. Head of Sanitation: support in design and calculate sanitary net / construction / coordinate bill of quantities / manage the workers for sanitary team. Head of Structure (carpentry/concrete) support in design and calculate structure / construction / coordinate bill of quantities / manage the workers for sanitary team. Head of Electricity and Telecom support in design and calculate facilities / construction / coordinate bill of quantities / manage the workers for electricity and telecom team. Head of Human Resources and Material/tools: Resources contract and organizing the workers / supply / store of construction materials. Construction logistic/supply. To get all the construction materials, machinery, tools.		

ANNEX II: CRITICAL CHALLENGES AND PROBLEMS

1. Units in "grey area" and transition points

- The "grey areas" and transition points have to be studied and defined in detail.
  - Triage
  - Laboratory
  - Burning pit
  - Shower for discharged
  - Direct access of confirmed cases
  - Ambulance disinfection point
  - Transfer of deceased patients
  - Patient/materials transfer points
  - Survivors / convalescents and children areas
  - Psycho-social attention
- The placement of these units are critical for the flexibility and expansion of the centre.
- Must be well-connected and in visual contact with the control centre and with the HR/LR area
- Need covered areas for protection from the sun and rain
- It´s recommended to mark on the floor where one area ends and another begins.

Figure 20: Patient transfer point, very sensitive

2. Triage

- Triage is a very complex place where many different situations happen, when designing it, it is recommended to keep this in mind:

Access to triage

- Many people may arrive and gather there, and it is unknown who may be infected.
- It is important to allow for pedestrian access and access of ambulances.
- Anticipate the arrival of patients by motorbikes and cars.
- Locate flows away from other patients and staff.
- Connection with the public highways and establish the control of outside traffic if necessary.

Access by ambulance

- Area reserved for the arrival of the ambulance and the transfer of patients.
- On occasions the patients must wait for attention in the ambulance, which is why it is recommended that there is a cover for protection from sun and rain.
- Patients can arrive on stretchers, for this reason, the dimensions of the entrances must be wide enough to allow entry.
- The ground where the ambulance parks has to have a certain degree of slope to facilitate the water drainage during disinfection; the water has to be channelled into a filtration pit.

Access control point to triage

- It must have good visibility so that the guard can control the whole area from his/her position.
- It is a place to take temperatures and record data.
- The access must be very enclosed and close to the fixed so that nobody can have uncontrolled access nor have access without disinfection.

Patients waiting area

- The place where patients with symptoms wait to be taken care of by health personnel.
- This will have to be designed to avoid a build-up of people and overcrowding.

- They should be able to see and speak with relatives while they wait to be taken care of, but separated by a safe distance.
- These have to be separate from other flows of people and not interrupt the access of ambulances.
- It is necessary to provide an area for pregnant women and those women with babies. It has to be a comfortable place protected from sun and rain.
- Avoid patients waiting and interfering with the normal functioning of the passageways and walkways.
- Avoid mixing with any other flow of people.
- Avoid seating in thoroughfares.
- The number of people waiting can vary, a large space is recommended.

Triage point

- Place where the health personnel determine which patients will be admitted.
- Triage must provide personnel access to both the Low Risk area and the High Risk area.
- A place can be set up for the health personnel, and psycho-social support require it, so they can approach the patient at a closer distance or exchange objects.

Triage latrine

- It´s necessary to have a latrine for patients and relatives to use during waiting and being attended to.
- This has to be near the fixed taps, to be disinfected after each use, as it is a risk when shared by infected and non-infected people.

Triage in special situations: Maternity Patients

- Maternity patients may pose unique problems for the triage system: It is appropriate to have a special space for them in the triage.

3. Flows

- Special attention to define the flows out of LR and HR.
- Define the flow inside HR to facilitate the extension and variations.
- The entry and exit points of the areas have to be clear and signposted, they must always be in one direction only, from areas of a lesser degree, to those of a greater degree of contamination.

Access for personnel

- To High Risk areas: through the Dressing Room area.
- To Low Risk areas: through the control point.
- To Unknown Risk area: through the control point.
- To Technical area: through the control point.

Access for patients

- Triage, by their own means - on foot or by vehicle or ambulance. (PTP).
- Direct to confirmed, by ambulance (PTP).
- From suspect, to probable.
- From probable to confirmed.

Access for visitors

- To the visitors area.

Personnel Exits

- From High Risk area: through the Undressing Area.
- From Low Risk area: through the control point.

Exit for recovered patients

- From High Risk areas (suspect/probable areas): through the Discharged Patients Happy Showers.
- From High Risk areas (confirmed area): through the Discharged Patients Happy Showers. (Happy showers are separate to other showers and used for discharged patients only)

Exit for deceased patients

- From the Morgue: through the Deceased Patient Transfer Area.

Routes and walkways

- The routes have to be in one direction only, and unambiguous, prohibiting return, and always from

lower contamination areas to those of greater exposure to the risk.

- The movement flows must be independent and be separated from others as far as possible, to avoid any conflict within the flows.
- They must be well lit.
- The routes and the walkways have to be wide, considering that, on occasion, space is needed to transport the patients on stretchers.
- They must be clear, avoiding steps, and not have lack of continuity or elements over which it is possible to stumble.
- They must have a clear layout to prevent overcrowding, as sometimes these can be points of contact of several people with different degrees of contamination or protection.
- Within the HR area it is a priority that the routes are clearly visible from the LR routes.
- The construction should be optimized because it can take too much time. Another, more time-consuming, solution for the coverage of footpaths (metal trusses and zinc sheeting) was implemented immediately but had a huge impact on the timing.

Figure 21: Steps should be avoided

Gates

- The doors or barriers must be visible and easy to handle even with gloves.
- If it's possible, only allow the option of opening in one direction.

Figure 1: System to close and open. Problem: Metallic, and small

Figure 23.

Bridges

- Bridges are needed for drainage to pass. In HR, it has to be wide enough, resistant, and without steps.

Figure 2: Many doors have to be closed with an auxiliary system (such as a stone) because they are problematic.

Figure 3: Concrete bridge

Figure 4: Iron bridge.

Signposting

- The walkways from one area to another must be properly signposted. In the HR area, the indication of the route has to be clearly signposted, as during work with PPE, disorientation can be generated.

4. Waste management area

- The selection of incinerators or burning pits should be done by the Biosecurity team.

Figure 27

Figure 28: Avoid storage of garbage and materials in the centres, especially in the dismantlement process.

Burning pits

- The prevailing winds should be noted when planning the location of the pits, in such a way that the smoke does not interfere with any part of the centre.
- In case of rain, a roofing system can be useful.
- The perimeter has to be surrounded and delimited for security.
- Separation between the different types of waste is recommended.
- Preferably round, of 2m diameter and 3m deep.
- It may be considered to have two different burning pits, one for the LR and one for the HR.
- Allow enough distance to the fence for safety but with the ability to start the fire from the Low Risk Area (with no PPE).
- Ensure 0.5% Chlorine solution point in the waste area.
- Grill system on top of the pit to allow ventilation for better combustion. The grill should not cover the hole of the pit completely, rather half of it, so the pit can be used for dumping waste during the dismantling. The objective of good combustion is to avoid the pit filling too quickly. Look for a system that allows ventilation but not letting the wind take out the waste from the grill.
- 60% gasoil, 40% petrol for better combustion.
- The burning pit should be wide enough (e.g. 2m x 2m x 3m deep).
- It should be built foreseeing an increase in demand of its use and its use during the dismantling phase.
- Anticipate an area to dig another pit, if the one in use fills up.
- The management of waste generated during the dismantling should be defined: small elements, medium and large size elements, metallic elements and construction waste.
- Special attention should be given to the treatment and closure of the waste management area, considering actions of incineration, burial or sealing with concrete.

5. Wards and tents

- Very interesting comparison about the Modular PVC tents and Trigano tents: temperature, cost, and OCA's lessons learned.
- Big tents have other needs: foundation, dividing the space, microclimate adaptation.
- Need to look for other solutions, thinking out of the Rubhall.
- The relationship between the slab and the tent structure has to be good so that no water enters
- In maternity wards and delivery rooms, ensure proper drainage inside as the cleaning procedures will require pouring large amounts of water on the floor and for it to drain properly.

Figure 29.

6. Micro-climate conditions

- Consider the orientation of the wards for the natural ventilation and orientation of the sun.
- Avoid systems of forced ventilation, to prevent contamination.

- Allow natural ventilation, mostly at night, where the chlorine has more impact.

7. KITS

- The whole kit should be packed whereby you first find and start with the general overview of the boxes and items and find manuals how to get started.
- Complete instructions on how to build or how to set up, information sheets how to use the different items and in which sequence and a blueprint of the whole construction site complete with the description of the technical assumptions required for its set-up.
- Inter-section issue: All the sections have different kits.
- OCA has an interesting proposal for kits definition.

8. Floor

- Plastic on the floor has a short life (3 months)
- Plastic on the floor in high risk areas: workers have to go inside with PPE and replace the plastic, remove nails, the whole operation is dangerous. Some floors are built with pallet and plywood on top, we have already seen cases where water on the floor has passed through the plastic and rots the plywood and pallet. The whole structure becomes unsafe when you walk on it.
- Laying the concreted floor is very slow.
- To make solid foundations for floors, the compacter was essential. In case the soil is sandier, we will have to think about a system with floor tiles

Figure 30.

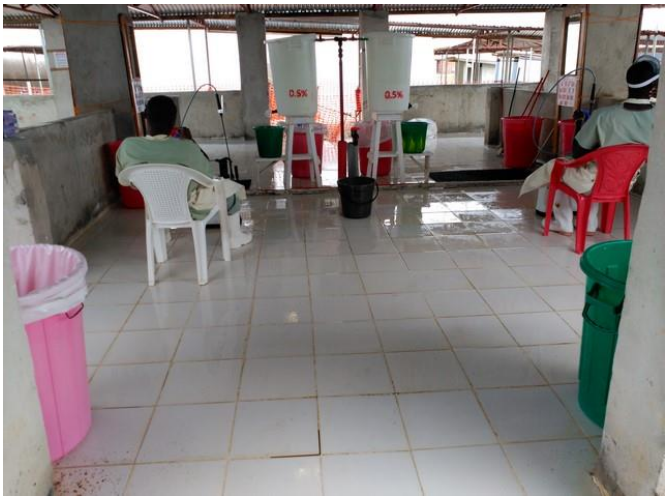
Figure 5: Plywood is inappropriate for the floor.

Figure 6.

9. Materials

- Avoid metallic parts, the chlorine ruins them.
- Tiles: were installed in the undressing area. They are costly, take time to put in place and skill to install, they are also slippery.

Figure 7: Tiles in the undressing area



- Textile tents lead to problems in the tents' materials, humidity leads to fungus growth.

Figure 8

- The orange fence net is a wonderful means for emergency situations but needs too much maintenance in medium long term.

Figure 9

-

Figure 36: Aluminium windows There were to support mosquito net, it is costly and it was consider not very efficiency.

Figure 10: Using different materials can cause leaking. Additionally, a this item with concrete and PVC is not the best solution, because in case of a broken pipe, it can´t be replaced easily; another "casing is also needed, or it must be put outside the pipe.

Figure 11: One solution for signposting in the HR.

ANNEX III: ADAPTATIONS AND INNOVATIONS

1. Curtains/screens for privacy.

A challenge inside of the big tents is looking for privacy, there were many different solutions to separate spaces the different spaces, some were fixed and others mobiles. The use of curtains in the maternity was very useful.

Figure 12: Plywood partitions.

Figure 13: Curtains in the maternity.

2. Plexiglas.

The Plexiglas can be useful in areas of transition, and grey areas as the triage or the security point, useful for protecting the staff and allow the more close and human communication.

Plexiglas lost the transparency in in contact with the chlorine. Nursing points in snake were a good solution to reduce the HR needs and the risk.

It's important for the dignity and the privacy of the patients to be sure that the persons in the Plexiglas corridor are just medical staff.

Figure 14: Plexiglas corridor

Figure 15: Plexiglas in the security point, to protect the staff.

3. Intensive care unit.

Space in HR where the sanitary people can be in visual contact with the patients throw Plexiglas, this area was more equipment.

4. Maternity area and delivery room

Very important to provide a special place for delivering, with a better drainage and some privacy and quality and comfort.

Figure 16: Delivery room fully equipped.

5. Cots and decoration for babies.

To control the children movements was essential in many occasions, for that different cots and boxes were designed.

Figure 44:

Figure 17.

6. Areas and furniture for convalescent patients.

To improve the dignity and the comfort of the recovering patients to have a nice area with a table is essential, for having lunch, play or just sit together.

7. System of lights for day / night.

A good system of illumination, with the possibility to graduate intensity to provide comfort for the patients at night and safety in the night shift for the staff.

In Magburaka there was a good and easy example.

8. Scanner / Wi-Fi / data control.

Different systems of data collections and management data based in the technology, has been develop. The ELEOS project is a good example of improving the work in the centre with technology.

9. Phones for the patients.

Some phones for communicate with the staff and with the families from the HR zone.

10. Screens / video cameras /audio system

Monitoring the patients with cameras and voice transmission has been remarked as a positive practice in ETCs. To respect the privacy of the patient, this tool should be used exclusively for medical purposes and with the awareness of the patients. It is needed to be installed by qualified technicians that can come, if needed, from HQ.

To improve the communication with the HR and especially with the pregnant woman to follow the delivery process and go inside in the best moment.

Figure 18: Cameras system.

11. TV / Cinema / Theatre.

Entertainment facilities were installed for entertainment, some place for sharing cinema patients and visitors were provide and it was very good experience. TVs were stolen in some centres.

12. Ventilators system and air condition

To improve the microclimate conditions, some ventilators were installed, but in many cases it wasn't very efficient, because the high of the ceiling or the volume of air was too big. Also some forced ventilation is not recommendable for preventing infections illness.

The air condition facilities have to be calculated for a specific volume of air, which is a strong condition for the success of the facilities.

In areas with air conditioned, which obliged to have a close area for maintaining the comfort temperature, was a problem because the ventilation needs for chlorination, mostly during night.

13. Panel isolated walls.

To maintain the comfort temperature, it was used sandwich panels for isolation. This prefabricated system was very clean and fast, and was in combination with PVC windows and doors.

Figure 19: Isolation panels and doors and windows in PVC.

14. Vomiting pit.

These should be implemented for collecting the vomit and excrement of the patients, facilitating the work of the personnel and increasing the collection capacity, avoiding the latrines filling up.

Easy opening tanks are recommended.

15. Furniture for the transfer of food and objects.

Furniture (generally tables) located between the two areas to pass objects, always from areas of lesser contamination to areas of higher contamination. They must be plastic or of any easy cleaning material.

Figure 20

16. Supply / log transfer point (LR/HR)

The good location for a transfer point was very useful, to facilitate and optimize the work.

17. Laboratory GEN EXPERT, with rapid text. Globe box laboratory.

Big improvement in the laboratory. There are a useful document with detailed information. [103]

Figure 21: laboratory

[103] Laboratory Ebola outbreak Sample handling / Lab testing. MSF Laboratory Working Group. 2014-2015

Figure 22: laboratory

Figure 23: laboratory

18. Automatically / manual doors.

Figure 24: Doors with mechanic system of close

Figure 25: Doors with mechanic system of close.

19. Fire water reserve

A specific reserve of water in case of fire emergency, in a strategic point and close to the HR.

Figure 54.

21. Equipment, furniture and others details.

Figure 26: Bell can be use from both side, from the high risk to call somebody in the low risk.

Figure 56: Different solution for protecting the PPE from the iron and shape parts.

Figure 27.

Figure 28: Cupboard for keeping things inside of the HR.

Figure 59.

Figure 60: magnetic signs where is right the patient number with F if is a female or M

Figure 29: Signpost in the HR.

ANNEX IV: REFERENCE DOCUMENTS

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Also have been checked the most representative plans of the Terms of reference centres.

ANNEX V: TERMS OF REFERENCE

TERMS OF REFERENCE: ETC DESIGN- LOG CONSTRUCTION

With support from WatSan and Medical components of the review

REASON FOR THE REVIEW

One year after MSF (OCB) launched its response to the Ebola outbreak in Western Africa, and due to the complexity and challenges that have stretched the organisation, MSF OCB requires an extensive multi-sectorial review of its intervention.

The Ebola outbreak in West Africa was first reported in March 2014, and has rapidly become the deadliest occurrence of the disease since its discovery in 1976. In fact, the current epidemic sweeping across the region has now killed more than all other known Ebola outbreaks combined. Up to 7 February, 9,167 people had been reported as having died from the disease in six countries; Liberia, Guinea, Sierra Leone, Nigeria, the US and Mali. The total number of reported cases is more than 22,828 as of February 2015.

As a result of this unprecedented outbreak MSF has custom built Ebola Management Centre's (ETCs) in Guinea, Liberia and Sierra Leone. These ETCs which range from 250 beds to 20 beds were not built on the same principles but were adapted to local realities, adapted to scale and were adapted to gained insight over time. As a result every MSF ETC possess unique attributes, strengths and weaknesses. Much like the Ebola outbreak in West Africa the design of MSF's ETCs evolved over time with the aim of providing better patient care within a resource appropriate setting, while attempting to optimize a safe work environment.

PURPOSE AND SCOPE

The overall objective of the review is to provide: a picture of the intervention through development of the ETC's, a critical analysis of the intervention and choices taken and lastly to capitalise on the information for future use.

This review will look at the time period of 1st March 2014 to 31st May 2015.

The review should focus on the appropriateness of the chosen strategies/approach and provide an analysis of the effectiveness of the intervention. The analysis should identify key learning areas based on examples of potential good practice as well as make recommendations for the future.

The reviews scope is limited to all areas of the intervention under the direct operational management of the participating MSF Operational Centres in the three countries most affected; Guinea, Sierra Leone and Liberia.

The key objective of the review is to conduct a site comparison of the 13 different purpose built MSF ETCs at: Donka (80 beds); Guéckédou (85 beds; Kankan (20 beds); Monrovia - Elwa 3 (250 bed); Mancenta Transit Centre (35 bed); Foya (40 bed); Bo (100 bed); Kailahun (100 bed); Forecariah transit centre (10) transit centre to ETC; Magburaka (100 bed); Freetown / Prince of Wales secondary school (100 bed); and Freetown / Kissy (75 beds), Nongo (72 beds).

The 2008/14 theoretical design from guideline comparison should be used as a reference.

The review will have input from both medical and Watsan consultants attached to the general Ebola Critical Review and should coordinate the review with this in mind.

EXPECTED USES AND OUTPUTS

- Critical analysis of the strategic choices and decisions
- Critical analysis of the successes at the level of implementation
- Potential areas for learning
- Recommendations for the future best practices where relevant

The review should focus specifically on the areas of the response which challenged MSF to adapt the strategy, develop new solutions or change its way of working. The review is not a classic what was done and what was not done review.

Key to the review is to first define criteria (what should a good ETC do), then compare the different ETC's against those criteria (going into detail on specific solutions and experiments). Based on this, determine what (elements) make a solution best fit for purpose (could be different based on size and location/climate), and define possible development needs.

SPECIFIC REVIEW TOPICS

1. How did the ETC design, evolve and respond to the operational needs

1. Were the existing guidelines/strategies/protocols suitable for the intervention and did they address the needs? (Appropriateness)
2. What are the main differences (structure, materials, functioning) between the different ETCs and what elements account for these differences? (Appropriateness)
3. How did the ETC designs evolve during the different phases of the outbreak? (Effectiveness)
4. What were the main innovations (e.g. functionality, biosafety, materials, patient comfort and privacy) arising within the evolution or changes in ETC designs? (Appropriateness)
5. Where appropriate and timely adaptations made in response to changes and evolution in the operational environment and if so what were they? (Appropriateness)
6. What were the main factors influencing these changes? (Effectiveness)
7. What were the main opportunities and constraints with the implementation of the ETC design strategies? (Effectiveness)

Specific Questions:

- What were the main challenges for site selection? Including access to water and waste water and site planning? Were there also social and cultural challenges for site selection?
- What elements of Biosecurity of staff and patients (cross-infection) were addressed by ETC design? (with specific attention to triage zones, patient flow, waste flow, material flow and information flow)
- Were there standards of temperature, ventilation, and humidity, lighting and acoustic environment as part of ETC design objectives? What were the challenges in attaining standards?
- How adaptable were the ETC structures to operational needs (timing, ease of expanding / reducing / rearranging the site)?
- How were the designs adapted to meet the challenges during the surge phases of the Ebola response? Were the choices appropriate?
- Are there different types of Decommissioning? (E.g. total shut down, handover of ETC structures, return of adapted facilities to original health services, etc.) What components should be included as part of the design process to facilitate decommissioning?
- What are the design implications for rural and urban approaches?
- Were resource requirements different for the different centres? What were these differences and did they have impact on ETC design and vice versa?

2. How did the design of the Ebola Management Centres (ETCs) impact on patient care and staff, patient and visitor flows?

1. How did the ETCs designs impact on patient, staff and visitor flow?; (Impact)
2. What adaptations were made to the design to improve patient, staff and visitor flow? (appropriateness)

Specific Questions:

- How did the space planning design evolve? (E.g. triage area and flows of patients, staff, visitors, waste and information).
- What standards existed for patient and staff comfort; highlighting the functionality of the ETC facility (rest area, patient privacy, visitors, ease of management of activities in a high risk area, exchange of information inside<>outside high risk)? What were the evolutions or changes in these standards during the Outbreak?

ANNEX VI: LIST OF INTERVIEWEES

Interview	[First name Last name, Title]	[Function]	Centre
International Staff			
Individual interview	David Beaupain	Log	POW
Individual interview	Mónica Jiménez	Log	KYS
Individual interview	Barnabé Adriaens	Log / Task Force	GUE
Individual interview	Javiera Puentes	Med	KYS
Individual interview	Craig Kenzie	Watsan	KAI/BO/MAG
Individual interview	Ruth Kaufman	Med	KAI / MAG
Individual interview	Mª Cristina Ruggeri	Log construction	ELW
Individual interview	Francis Cathelain	Watsan / Task force	KAI/ HQ
Individual interview	Lionel Larcim	Watsan / Task Force	ELW/ HQ
Individual interview	Adelaide Wilmotte	Log	HQ
Individual interview	Luca Fontana	Watsan	GUE/KAI/BO
Individual interview	Anibal Ordenes	Log / Task Force	ELW/HQ
Individual interview	Azzura Dinka	Watsan	ELW/HQ
Individual interview	Peter Maes	Watsan	HQ
Individual interview	Celine Van Lamsweerde	Log construction	GUE
Individual interview	Saleman Nizeyimana	Watsan	DON/NON
Individual interview	Carissa Guild	Med	MAC
Individual interview	Hilde De Clerck	Med	GUE/HQ
Individual interview	Francois Fabreguetes	Log	DON/NON
Individual interview	Helena Nordensteck	Med	NON/ELW
Individual interview	Melik Nowi	Log	NON/KAN
Individual interview	Alfred Walker	Watsan / construction	ELW
Individual interview	Jefferson Hodge	Watsan / construction	ELW
Individual interview	Marc Forget	Med	LIB
Individual interview	Anna Freeman	Coordinator outreach	KAN
Individual interview	Julian Serafin	Watsan	NON
Individual interview	Sulleman Nizeyimana	Watsan	NON/DON
Individual interview	Emmanuel Massart	Med	NON
Individual interview	Dr. Anthoni	Med	KAI/BO
Individual interview	Lamine Sow	Epidemiology	NON
Individual interview	Francis Harding	Waste Management	BO
Individual interview	Ibrahim S Daramy	Waste management	BO
National Staff			

Group interview	Jöel Zhimdan	Nurse	NON
Group interview	Millimono Suzane	Nurse	NON
Group interview	Charles Henry Kolie	Nurse	NON
Group interview	Nabé Binton	Nurse	NON
Group interview	Keita Aissata, Camara Yarie	Nurse	NON
Group interview	Camara Aminata Karifa	Nurse	NON
Individual interview	Peter Browne	Log / construction	ELW
Individual interview	Emmanuel B.Quai	Construction	ELW
Group interview	Satamata Binta BaH	Health Promotion	NON
Group interview	Canole Ellan Auman	Health Promotion	NON
Group interview	Anne Shopie Loobuyck	Health Promotion	NON
Group interview	Millimono Suzanne	Nurse	NON
Group interview	Charles Henrry Kolie	Nurse	NON
Group interview	Adama Lis Balole	Nurse	NON
Group interview	Nabé Binton	Nurse	NON
Group interview	Keíta Aissata Aide	S Auxiliar nurse	NON
Group interview	Camara Yarie	Nurse	NON
Group interview	Camara Aminata Karifa	Auxiliar nurse	NON
Group interview	Keita Amador	Plumber	NON
Group interview	Bangoura Mohamed	Plumber	NON
Group interview	Syla Abubacar	Hyginist supervisor	NON
Group interview	Yamoussa Sako	Hyginist	NON
Group interview	Daniel Karim Conteh	Watsan Supervisor / Construction	KIS
Group interview	Hazral Bual Kamara	Higinist / Construction	KIS
Group interview	Ibrahim Osiman Fofamah	Log assistant / construction	KIS
Group interview	Paul Mamohud Bangura	Log supplay / construction	KIS
Group interview	Edwin Js Yembasu	Health Promotor	KIS
Group interview	Hassan Contel	Health promotor	KIS
Group interview	Nyakeh Gaima	Health promotion	KIS
Individual interview	Mariatu Minsoray	Survivor	KIS
Group interview	Philip Mummy	Hyginist	BO
Group interview	Mohamed S. Kamara	Mygienist	BO
Group interview	Narecy Momoh	Loundry	BO
Group interview	Michael Thomas	Hyginist	BO
Group interview	Timothy M. Nijandebo	Hyginist	BO
Group interview	Martha Sandy	Hyginist	BO

Group interview	Chistopher Mansory	Hygienist	BO
Group interview	Ansu Sannoh	Laundry	BO
Group interview	Yusuf Kamara	WTU Watsan	BO
Group interview	Julius Anthony	Watch man	BO
Group interview	Emmanuel E. Lavale	Waste management	BO
Group interview	Mustapha Rogers	Watsan management	BO
Group interview	Sheku F. Kamara	Watsana Asistant Manager	BO
Group interview	Aruna Kamara	Hyginist	BO
Group interview	Alpha Tunkara	Hygienist	BO
Group interview	Aduma Fofana	Sprayer	BO
Group interview	Mohamed Lipson Kamara	Hygienist	BO
Group interview	Mohamed Kabba	Hygienist	BO
Group interview	Mohamed Gbla	Hygienist	BO
Group interview	Abdul Gbla	Hygienist	BO
Group interview	Mohamed S Swarray	Hygienist	BO
Group interview	Anma Danda	Hygienist	BO
Group interview	Lansana Mariah	Hygienist	BO
Group interview	Frank Kaillie	Hygienist	BO
Group interview	Josephine Amena	Laundry	BO
Group interview	Jeneba Momodu	Loundry	BO
Individual interview	Mahamed AS Cartel	Construction	MAG
Participants in the workshop			
OCA	Craig Kenzie	Log	
OCB	Lionel Larcim	Watsan	
OCB	Angelo Rusconi	Log	
OCB	Celine Van Lamsweerde	Log construction	
OCB	Andre Sardo	Log	
OCB	Barnabé Adriaens	Watsan and a Log	
OCBA	Mónica Jiménez	Watsan-log	
OCBA	Paul Cabrera	Technical ref. construction&shelter	
OCG	Pierre Maury	Technical ref. construction&shelter	

Stockholm Evaluation Unit

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