uia PUBLIC HEALTH GROUP

2015 International Student Competition

DESIGN OF A MOBILE ISOLATION, DIAGNOSIS AND/OR TREATMENT UNIT FOR USE IN EBOLA OR OTHER COMMUNICABLE DISEASE EPIDEMICS

Project DARU

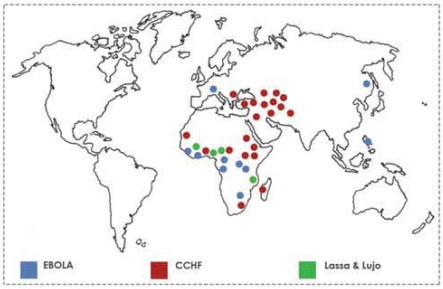
VHF

Viral haemorrhagic fever is a general tarm for a severe illness, sometimes associated with bleeding, that may be caused by a number of viruses. In our plan we focus on specific VHFs (Ebola, Marburg, CCHF, Lassa fever, Lujo), that can occur in Africa and have risk of person to person transmission. They can spread within a hospital setting, and have a high case-fatality rate and are difficult to recognize. There are also a lack of effective treatments apart from supporting care. The outbrakes occur periodically, but unpredictably. The provision of Medical care to ill patients can be challenging in any setting, particularly resource limited remote environments where VHFs tend to occur. Clinical care must be strenghtened whith minimising the risk of transmission to others, including health workers. The ability to confirm the diagnosis of VHF requires highly specialized reference laboratories, so mostly the samples are immediately sent the apprpriate reference laoratory.

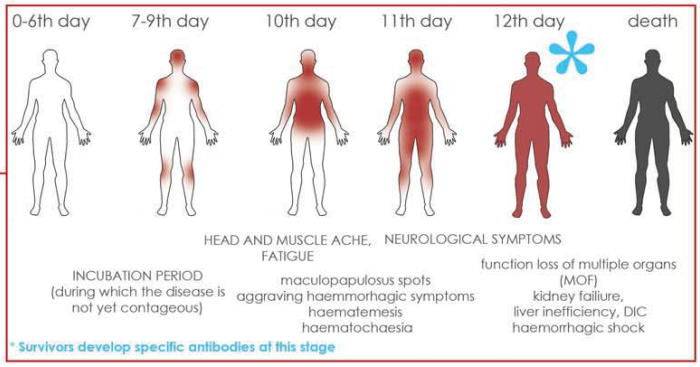
EBOLA/ Marburg Occuring contact with infected animals (bats, apes), and subsequent transmission via contact with such patient's infected blood and body fluids. Can be transmitted via coming into contact with contamined items (medical material, eating utensils) Incubation period is about 2 to 21 days. They usually begin with symptoms like flu: fever, weakness, myalgia, anorexia, they are followed by vomiting and diarrhea. Bleeding often only appears in the later stages.

CCHF Transmitted via a tick from infected domestic or wild animals, but also can be transmitted by contacting with blood or body fluids from infected animals or humans, but also occures in hospitals due to improper sterilisation of medical equipment. Rabivirin can be used against Lassa and CCHF. For CCHF, the incubation period is usually 3-7 days, and the haemorragic period is short and usually begins between the third and fifth days of infection, and appears with heamatomas and petechie.

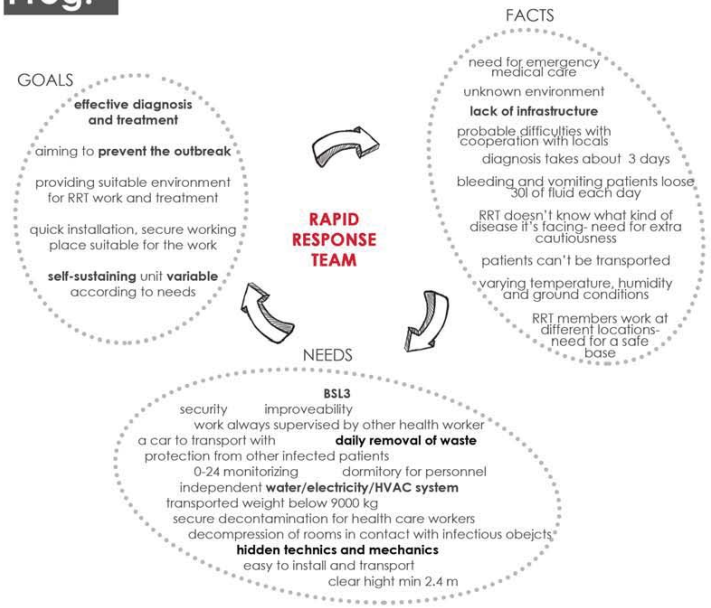
Lassa and Lujo (Arenaviridae family) Infection by exposure to the excreta of its reservoir Mastomys natalentisis. Secondary transmittion also occurs by person-to-person contacts. Lassa fever is endeic in West Africa with an estimated tens of tousands of cases annually, with highest incidence in Sierra Leone, Nigeria, Guinea, Liberia. Incubation period takes from 6 days to 3 weeks. Classic symptoms of Lassa fever are swollen face and neck, which are not seen in Ebola/Marbourg. In the first week the infected patient shows very common symptoms: shore throat, diarrhea, low blood pressure, general weakness. After 7 days its followed by oedemas of face and neck, mucosal and internal bleeding.



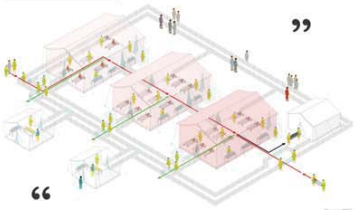
- > developing countries
- > high humidity
- > high averange temperature
- > large temperature range
- > poor infrastructure
- > lack of public transport system
- > unrest amongst ribes and countries
- > mixed religion: christianism, islam, totemism



Prog.

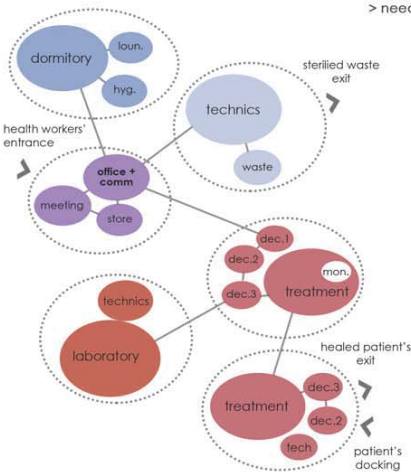


Brief



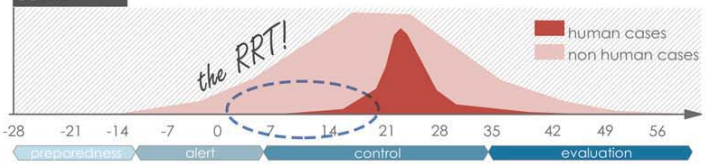
PROBLEMS OF RECENTLY USED MOBILE HOSPITALS:
- > 0 comfort
- > far from BSL requirements
- > fresh air / water, electricity supply not solved
- > slow and complicated installation, transport only in small units
- > no safe dormitory for personnel

IN CASE OF a Rapid Response Team:
- > no need for seperated treatment units (infection of incoming patient is proven)
- > no need for morgue (stay only 21-28 days)
- > fixed, decompressable construction
- > BSL3 Laboratory
- > need for an ambulance car



dormitory (for 10 people)	35 m2
toilet	2 m2
shower	4 m2
loundry	4 m2
+ technics (water filtration, incinerator, electricity)	6 m2
office+comm.+meeting+cafeteria	35 m2
store for food	10 m2
store for medical supplies	10 m2
technics (not decompressed)	40 m2
waste management	20 m2
deco.1 (dressing 1.)	5 m2
deco.2 (shower)	5 m2
deco.3 (dressing 2.)	8 m2
deco.4 (emergency shower)	1 m2
treatment +monitorized station +small store	70 m2
deco. 5 (preparing 1.)	9 m2
emergency shower (for labs)	1 m2
decontamination of specimen	2 m2
laboratory	40 m2
technics	10 m2

RRT



PRECAUTIONS
- > educating people
- > cooperation with healthcare workers, farmers
- > monitoring populations

SUSPECT OF EPIDEMIC:
- > unusually many deaths in primate populations
- > suspicious symptoms in human(s)

ACTIONS:
- > requiring supply
- > eablishment of a mobile hospital suitable for treating many patients
- > arrival of trained personnel
- > the lab of the RRT is still working,

ACTIONS:
- > supervising the territory for at least 21 days after the release of last patient
- > collecting specimen and documenting the events and actions taken

ARRIVAL of RAPID RESPONSE TEAM within 48 hours
- > collecting/examining specimen
- > separating suspected people
- > evaluating risk of epidemic

GOAL: PREVENTING OUTBREAK BY ISOLATING AND TREATING PATIENT 0

1 GOAL
6 UNITS
9 HCW-s
8 PATIENTS
21 DAYS
... COUNTLESS SAVED LIVES

if RRT IDENTIFIES OUTBREAK
- > treatment area turnes into treatment for VIP patients
- > well equipped mobile treatment center arrives

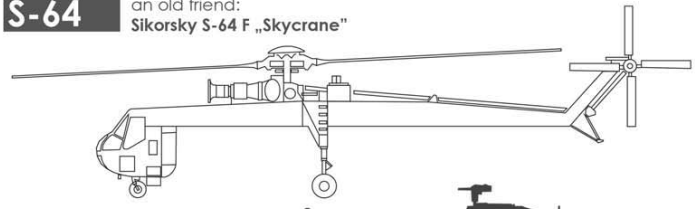
... after that RRT leaves

THE CREW: 2x 2x 2x 1x 1x 1x

WORKS FOR: 4-8-12x

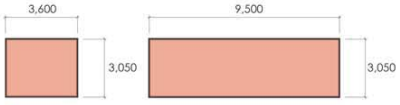
S-64

an old friend:
Sikorsky S-64 F „Skycrane"



6 x 3 x 2 x 1 x ?

born:	1962
capacity:	3 people in cockpit
weight:	8724 kg
weight (full):	**19000 kg**
speed:	169 km/h



the largest cargo capacity ever built

transported geometry

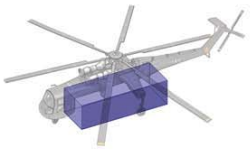
uia PUBLIC HEALTH GROUP

2015 International Student Competition

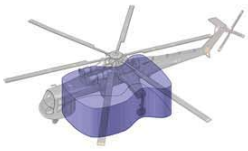
DESIGN OF A MOBILE ISOLATION, DIAGNOSIS AND/OR TREATMENT UNIT FOR USE IN EBOLA OR OTHER COMMUNICABLE DISEASE EPIDEMICS

Project DARU

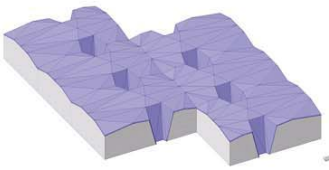
concept



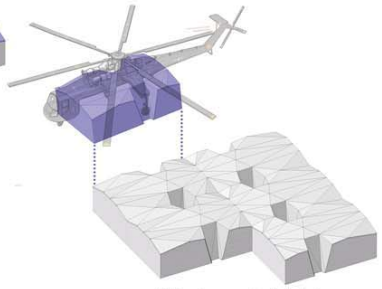
original cargo size:
2,90 x 3,20 x 9,50
30,40 m2
9500 kg



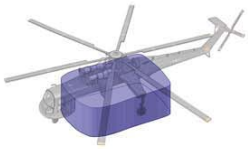
transform running gear system into a hydraulic adjusable landing system



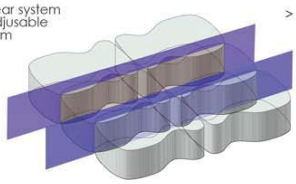
> organic landscape from above
> rectangular from sidewards



> possibility of accurate installation independent from weather & soil conditions



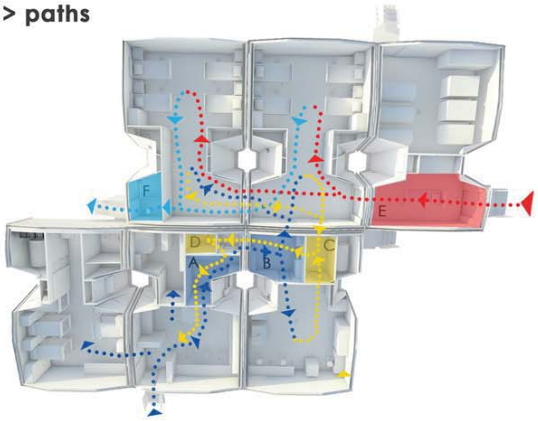
cargo size needed:
3,40 x 6,40 x 9,50
~60 m2
9500 kg



we need plain surfaces to place units easily side by side

functions

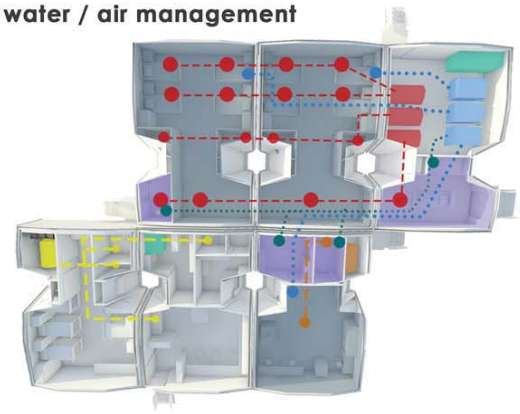
> paths



- doctors' way entering office/dorm/treatment units
- doctors' way out of contageous areas
- patients' way entering treatment unit
- cured patients' way leaving treatmentunit

A dressing room 1- put on underwear of PPE
B dressing room 2- put on PPE
C 1st decontaminating shower, wearing PPE
D 2nd decontaminating shower, undressed
E reception of patients/cleaning/dressing
F exit shower of cured patients

> water / air management



wastewater management
- 1st circle- treatment units and reception area
- 2nd circle- laboratory and decontamination
- 3rd cirlce - dormitory and kitchen

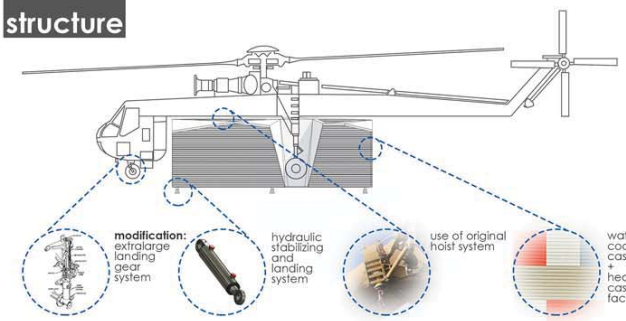
- generator
- autoclaves
- compressors
- water collection spot
- air filters

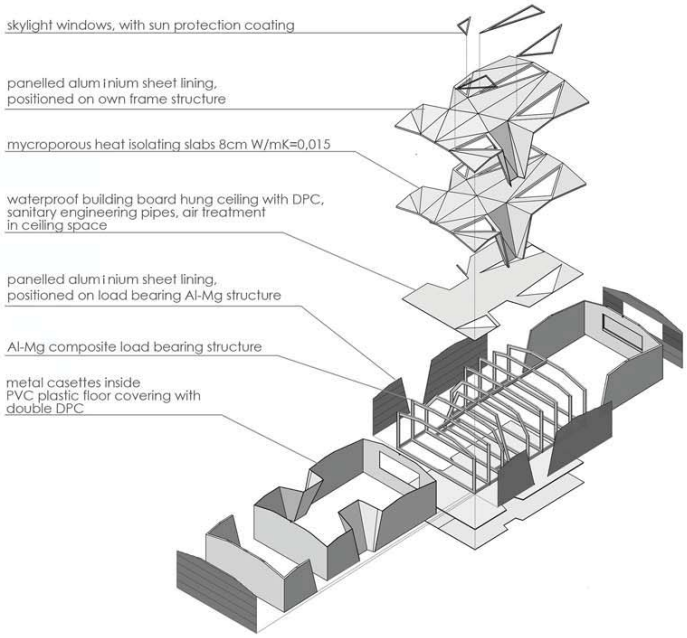
air management
- constantly decompressing duct
- airlock ducts
- decompression -15Pa
- airlock

process

1. WHO gets information about a possible human infection
2. WHO alarms RRT closest to the critical area Rapid Response Unit is prepared to takeoff
3. RRT/RRU is planted on site,
   1. dorm/office/lab
   2. treatment unit(s)/ mechanics
4. RRT canvases the area anthropologist/coordinator contacts local authorities, develop a strategy to contact people
5. epidemiologist/doctors collect specimen, goal: identifying the type of disease and **FINDING PATIENT 0 and people in having contacted them**
   ONLY CONFIRMED INFECTED PATIENTS are isolated and carried to treatment
6. constant obervation of the area, evaluation of the risk of an outbreak taking further measures if necessary

structure





variations >

THE LAB
dormitory + office + lab

RRT-1
dormitory + office + lab
+
preparation + 2 TA

RRT-2
dormitory + office + lab
+
preparation + 1 TA

THE « HOSPITAL »
dormitory + office + lab
+
2 preparation + 3 TA

PUBLIC HEALTH GROUP

2015 International Student Competition

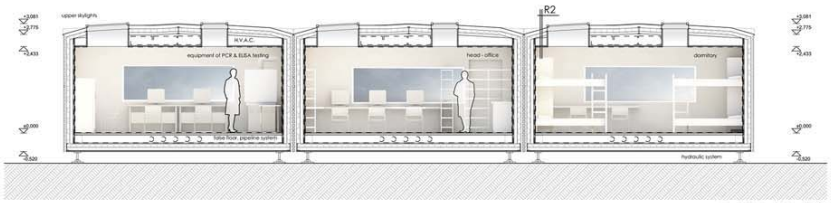
DESIGN OF A MOBILE ISOLATION, DIAGNOSIS AND/OR TREATMENT UNIT FOR USE IN EBOLA OR OTHER COMMUNICABLE DISEASE EPIDEMICS

Project DARU

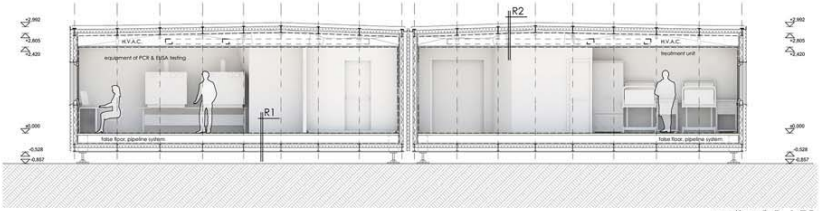
FP with 2 treatment units

1. water & rainwater container
2. grey-water filter tank
3. sawage filter tank
4. washing & drying machine
5. current diesel generator with fuel tank
6. bunks
7. mini-kitchen with microwave owens, coffee-machines
8. PPE underwear washing & drying machines
9. AC-system
10. PPE upper wear washng & drying machines
10. lab - current diesel aggregator with tank
11. lab - glovebox for PCR & ELISA testing
12. lab - freezers for preparing specimen
13. lab - air lock & decontamination of incoming specimen
14. lab - waste container, removable from outside
15. staff entrance to sawage filter tank
16. treatment area - showers
17. treatment area - toilettes
18. treatmnet area - recrompression & decontamination shower + wardrobe for cured patients
19. waste tank
20. waste container, removable from outside
21. patients' entrance - door width calculated for hospital trolleys
22. staff entrance to technical room
23. small storage with bedcloth, clothes
24. sawage autoclave and filter tank
25. HVAC equipments
26. current diesel aggregator with tank
27. cured patients' exit
28. staff's entrance
    + gastight metal doors and glazing

sections

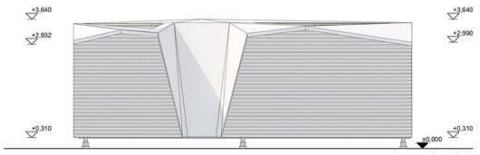


section A-A 1:75



section B-B 1:75

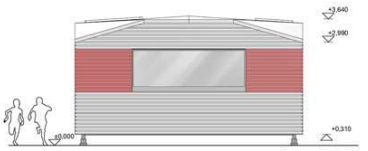
facades



facade 1:75

R1 -acid resistent plastic paving
-DPC 1.
-false floor for hidden pipeline system (min 30 cm)
-DPC 2.
-buildig board gastight floor system
-heat idolated Alu panels
-panelled Alu sheet lining

R2 - panelled Alu sheet lining
- heat idolated aluminium panels
- DPC
- building board gastight hung ceiling
- stainless steel inside wall casettes



facade 1:75

original photo by Kim Naylor