Medical aerial evacuation as European emergency response capacity: Analysis and way forward

Final Report

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TABLE OF CONTENTS

1 EXECUTIVE SUMMARY

AKNOWLEDEGEMENT

The completion of this study would not have been possible without for the continous support of our associated experts, Laurent de Pierrefeu, Dr. Laurent Taymans and Gino Claes.

In spite of their incredibly busy agenda, they provided fruitful advises and guidance during the entire duration of the study.

Among its missions and tasks, the European Commission Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG ECHO) has the mandate to provide assistance, relief and protection to victims of natural or man-made disasters around the world (art.214 TFEU[1]), and to support and coordinate civil protection mechanisms of Member States (art.196 TFEU).

To ensure this mandate, DG ECHO has launched the European Emergency Response Capacity (EERC), commonly referred to as the "voluntary pool". It consists of a range of national emergency response capacities made available by countries participating in the EU Civil Protection Mechanism (UCPM Countries) in order to conduct EU emergency response operations[2].

Now the European Commission is working to develop rescEU, a programme designed to create a new European reserve of capacities in the UCPM for exceptional emergencies. rescEU capacity reserve would be set-up for major incidents, that could be called upon as a last resort, should other solutions have been exhausted (such as the Voluntary Pool).

The rescEU programme was initiated in May 2019 through the set-up of a first reserve of a capacity of firefighting plane. The second area of interest is now Medical Aerial Evacuation (MEDEVAC) capacities. Thus, this study has as an objective to analyse the potential needs for a European Medical Aerial Evacuation capacity in the context of emergency response mobilised through the EU Civil Protection Mechanism. The study focus is on fixed-wing (aircraft) and not rotary wing (helicopters) capacity.

The key objective of this study was to assist DG ECHO in identifying the types of patient' needs which may require a European aerial MEDEVAC capacity, but also to analyse existing aerial capacities used at national level and identify potential gaps. This report aims at proposing actionable recommendations for the best way forward and suggesting minimum technical requirements for the development of a European MEDEVAC capacity under rescEU.

In close relation with DG ECHO, the Member States, Participating States[3] and several experts in the field of civil protection and MEDEVAC, a tailored methodology has been implemented to reach these objectives and lead to a series of key findings and results.

The combination of in-depth desktop research on all the UCPM countries, 15 targeted interviews, semi-structured survey and regular consultations of experts allowed to collect data on the existing capacities of 27 out of 34 UCPM Countries[4]. For the seven remaining countries, namely Czech Republic, Hungary, Iceland, Montenegro, North Macedonia, Serbia, Slovenia, no sufficient information was found on available sources and contact were not successful.

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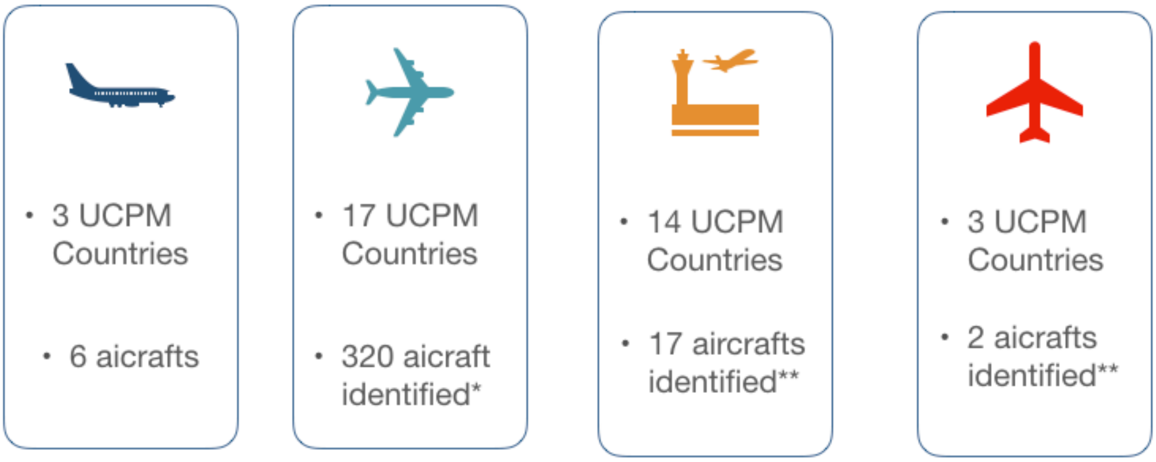
[1] Treaty on the Functioning of the European Union

[2] https://erccportal.jrc.ec.europa.eu/ERCmaps/20190131_DM_VoluntaryPool_offered_CECIS.pdf

[3] Article 4(12) of Decision No 1313/2013/EU provides that "Participating State means a third country participating in the Union Mechanism in accordance with Article 28(1)."

[4] For the purpose of this study, UCPM Countries will stand for both EU and non-EU countries that participate to the UCPM.



** For UCPM Countries that rely on military capacities, their existing transport cargo capacities have been identifyied but it does not provide information on the number of HID or Non-HID MEDEVAC Kit available to configure the aircrafts*

*** For UCPM Countries that rely on capacities from service providers or loan from a military organisation, there is not always a specific number of aicrafts allocated to the country*

The information gathered confirmed that for a majority of Union Civil Protection Mechanism (UCPM) Countries[5], there are two critical gaps in terms of Medical Aerial Capacities for the transport of patient during major crises.

Firstly, 7 out of 15 UCPM Countries interviewed confirmed lacking public aerial fixed-wing capacities for the transport of multiples (more than 4) patients during large scale events.

Indeed, except for three UCPM Countries, namely Turkey, Romania and Poland which do have civilian public aircraft to transport up to four patients, there is no public civilian fixed wing capacity able to transport multiple patients within the 27 UCPM Countries analysed.

The only countries who confirmed not having a capacity gap for the transport of multiple patient are those who can rely on military cargo transport capacities (France, Spain, Italy, United Kingdom, Turkey, etc.).

Nota Bene: On the request of DG ECHO, a distinction has been made between public civilian and public military aerial capacities during the research. One of the objectives of the study was to map public civilian (operated by non-military personnel) capacities. The data highlighted that most of the UCPM Countries do not have public civilian aircraft but often rely on military aerial capacities. This is why they have been included in the mapping of capacities but distinctly of public civilian capacities.

[5] To date, all EU Member States, as well as 6 Participating States (Iceland, Norway, Serbia, North Macedonia, Montenegro and Turkey) participate to the UCPM

If UCPM Countries tend to currently rely on external capacities to transport multiple patients (such as service providers, loans from other countries or military organisation), the consultation of UCPM Countries representatives and MEDEVAC experts among the Member States showed a growing interest in a more sustainable and European solution.

The second capacity gap identified is MEDEVAC capacities for the transport of highly contagious patients. The 2014 Ebola outbreak in West Africa led several UCPM Countries such as Norway, Luxembourg or Germany to develop dedicated capacities and equipment for the transport of Highly Infectious disease (HID) patients. During the outbreak, the time needed to set-up the capacities and obtain certifications for those capacities was so long that most of the transport of HID patients was performed by a U.S. private company (Phoenix Air). The countries who decided to set-up a capacity solely dedicated to the transport of HID patients such as Germany or Luxembourg dismantled it a year after because of the elevated maintenance costs.

Other countries such as France, Spain and the United Kingdom relied on their military aircraft and CBRN/HID equipment and protocols to transport a limited number of patients, but do not have a dedicated capacity for HID patients.

Five UCPM Countries (Bulgaria, Estonia, Germany, Ireland, Romania) clearly stated that they have a capacity gap for the transport of HID patients and according to the data collection a dozen of other UCPM Countries do not have any capacity for such MEDEVAC scenario.

An on-going project led by the Nordic countries to develop a joint capacity for the transport of HID patients demonstrates that pooling resources for this very specific capacity could be interesting for countries who cannot dedicate an important budget to build this capacity at national level.

In order to respond to these two gaps identified, a series of solutions and recommendations have been proposed to foster the actions already implemented by the Commission, with the Voluntary Pool, to set-up a MEDEVAC capacity under rescEU. These recommendations aim at increasing and harmonising in the long-term UCPM Countries European MEDEVAC response capacities with the support of the European Commission.

Recommendation #1: The European Commission should continue encouraging UCPM Countries to pool existing capacities for the transport of both HID and non-HID patients by developing strong incentives, in particular the partial refund of recurring costs and support for the certification processes.

UCPM Countries with existing capacities (public or private)

Short-term

Recommendation #2: The European Commission should study the set-up of a dedicated funding mechanism for UCPM Countries to secure aerial response capacities through contract services with commercial airlines or specialized service providers in view of integrating the resulting capacities into the Voluntary Pool or rescEU.

UCPM Countries with major capacity gaps/shortages

Short to medium term

Recommendation #3: The European Commission should study the set-up of a dedicated funding mechanism within rescEU for UCPM Countries to develop/acquire MEDEVAC modules (HID and non-HID) and use existing capacities.

UCPM Countries with existing modular capacities not dedicated to MEDEVAC

Short to medium term

Recommendation #4: The European Commission should study the set-up of a dedicated funding mechanism for UCPM Countries to acquire public aerial capacities equipped for the MEDEVAC of HID and/or non-HID patient matching the minimum technical requirements of the Voluntary Pool or rescEU.

UCPM Countries with a shortage of civilian public capacities

Long-term

2 USEFUL DEFINITIONS

CBRN patients – CBRN stands for Chemical, Biological, Radiological, and Nuclear issues that can be harmful through their accidental or deliberate release, dissemination, or impact. "CBRN patients" refers to patients contaminated by hazardous chemical, biological or radioactive substances and or materials[6].

Civil protection – Civil protection assistance consists of governmental aid delivered in preparation for or in the immediate aftermath of a disaster in Europe and worldwide. Aid takes the form of in-kind assistance, deployment of specially equipped teams, or experts in assessing and coordinating support in the field[7].

ERCC - The Emergency Response Coordination Centre (ERCC) is the heart of the EU Civil Protection Mechanism and coordinates the delivery of assistance to disaster-stricken countries, such as relief items, expertise, civil protection teams and specialised equipment. The Centre ensures the rapid deployment of emergency support and acts as a coordination hub between all EU Member States and the 6 additional UCPM Countries, the affected country, and civil protection and humanitarian experts.[8]

HID patients – Patients with a Highly Infectious Disease (Ebola, SAR, etc.).

ICU patients – Patients in need of intensive care or high dependency care[9], requiring dedicated medical equipment, support and personnel such as severe burn victims, trauma patients, etc.

Lightly Injured Patients – Patients whose medical condition allows them to sit during an aerial evacuation.

MEDEVAC – For the purpose of this study, the MEDEVAC acronym stand for Medical Aerial Evacuation. The transport of patients by aircraft to a health facility, with dedicated medical personnel to provide care to the patient during the flight.

rescEU – rescEU entails a new European reserve of capacities which initially includes a fleet of firefighting planes and helicopters. However, rescEU's scope goes beyond forest fires and it is expected to include response to other threats such as medical emergencies or chemical, biological, radiological, and nuclear incidents.

Stretchers – Patients that must be immobilised on stretchers, a light frame made from two long poles with a cover of soft material stretched between them, used for carrying people who are ill, injured during medical aerial evacuation[10].

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[6] https://ec.europa.eu/home-affairs/sites/homeaffairs/files/what-we-do/policies/crisis-and-terrorism/securing-dangerous-material/docs/cbrn_glossary_en.pdf
[7] Definition of the European Commission, DG ECHO
[8] https://ec.europa.eu/echo/what/civil-protection/emergency-response-coordination-centre-ercc_en
[9] http://www.md.ucl.ac.be/didac/hosp/architec/UK_Intensive_care.pdf
[10] Cambridge Dictionary

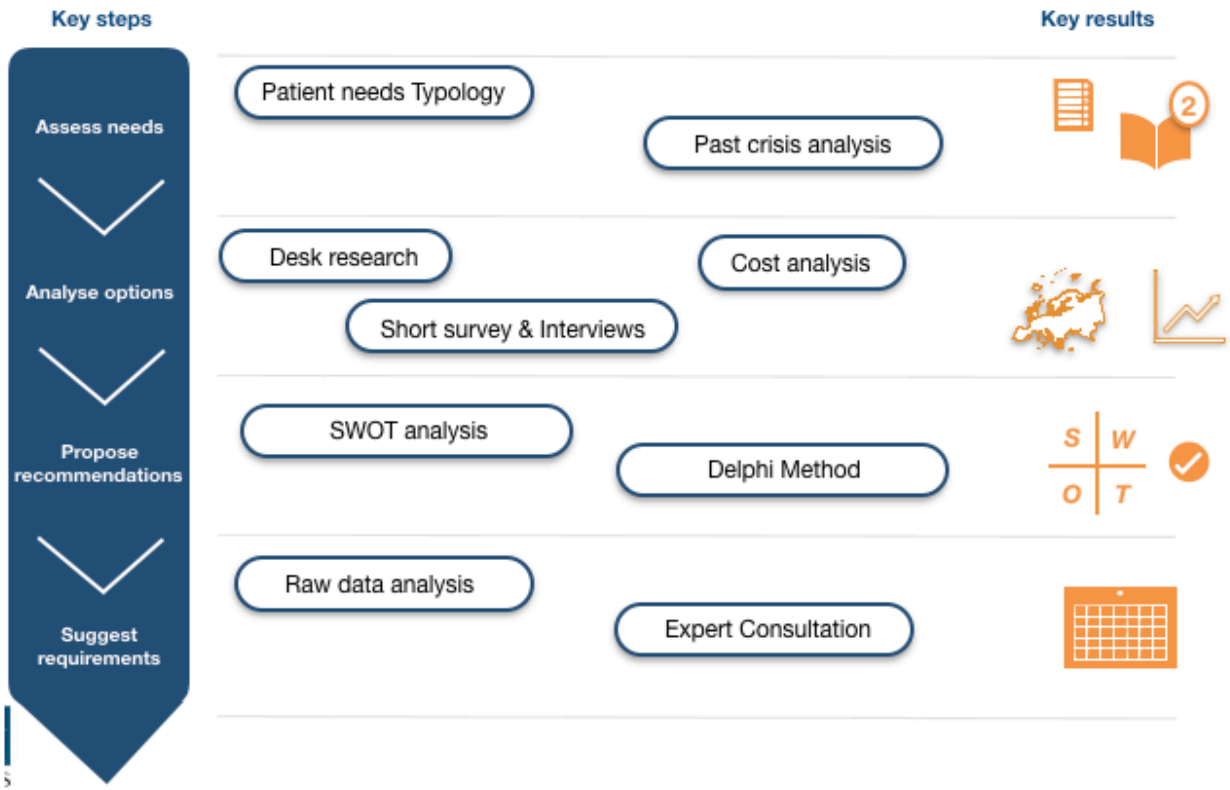
UCPM - The EU Civil Protection Mechanism's objective is to strengthen cooperation between UCPM Countries in the field of civil protection, with a view to improving prevention, preparedness and response to disasters.

Voluntary Pool (or EERC European Emergency Response Capacity) - The European Civil Protection Pool brings together resources from 23 UCPM Countries, ready for deployment to a disaster zone at short notice. These resources can be rescue or medical teams, experts, specialised equipment or transportation. Whenever a disaster strikes and a request for assistance via the EU Civil Protection Mechanism is received, assistance is drawn from this pool.

3 OVERVIEW OF THE METHODOLOGY

OVERALL APPROACH

The objective of this Final Report is to present the key results and outcomes of the study, as well as suggest minimal technical and quality requirements for the development of a European MEDEVAC capacity.



METHODOLOGY OF THE STUDY

A series of key tasks were implemented to conduct the study based in-depth data collection, gathering the lessons learnt and return of experience collected from UCPM Countries.

Task 1: Assess patient needs and define MEDEVAC scenarios

The first step consisted in conducting a series of interviews to define the principal patient needs on which to base the European capacities with experts in the following fields:

- Emergency Medical response.
- Crisis management and Civil Protection.

This data collection phase led to the identification of 4 potential main patient needs for which a European capacity(ies) would be relevant:

- Light injured patients.
- Patients on stretchers.
- Patients in needs of intensive care.
- Highly Infectious disease (HID) patients.

The research team then conducted desktop research to identify and select past crises and disasters to identify the response requirements used and the best practices which could apply for each scenario associated.

This resulted in a sample of 12 relevant crises, which were chosen to provide a representative/balanced overview regarding the following criteria:

- Location: EU/Europe; outside EU.
- Nature of incident: fire, earthquake, tsunami, pandemic, etc.
- Scale of the crisis: number of casualties; number of European citizens to transport.
- Patient needs: lightly injured patients, patients on stretchers, patients in need of intensive care, HID.
- Availability of data.

The analysis of the past major crises highlighted a series of key elements to support the definition of scenarios which could require a European MEDEVAC capability.

Based on the insights and inputs collected from the experts and the desk research, 2 response scenarios within rescEU were drafted:

- Scenario 1: European MEDEVAC capacity for the transport of Highly Infectious Disease Patients: mid to long range cargo airliner.

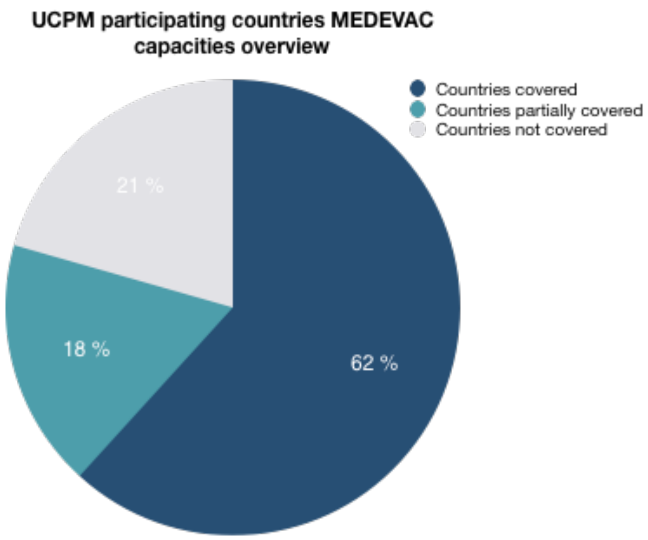
- Scenario 2: European MEDEVAC capacity for the transport of non-HID Patients: mid to long range modular airliner.

Task 2: Analyse existing options and conduct an overview of current approaches and capacities

The first step consisted in reviewing existing aerial MEDEVAC modalities used by the 34 UCPM UCPM Countries to define the main approaches and capacities deployed in case of a major crisis.

The overview was conducted by implementing three activities in parallel:
- Desktop research;
- A semi-structured survey;
- Targeted interviews.

These combine activities allowed to collect data for **27 countries out of 34 UCPM Countries**.



NB: Countries for which contact were not successful and limited data was found in open source: Czech Republic, Hungary, Iceland, Montenegro, North Macedonia, Serbia, Slovenia.

The prime focus of the research was to understand the current approach towards MEDEVAC for each country, the responsible authority in case of major crises, the type of aerial capacities used and identify potential gaps.

The second step consisted in conducting desktop research to define resources needed for each approach and to collect data on the response requirements.

The research aimed at collecting operational data from various resources to be taken into account for the set-up and use of a MEDEVAC capacity such as the vector (the aircraft), the human resources (aircrew, medical team) and/or the equipment (technical and medical equipment, consumables).

The third step aimed to evaluate and analyse the various capacities and approaches identified.

Two activities were conducted in parallel:

- A series of phone interviews and a tailored survey sent to MEDEVAC experts within UCPM Countries;
- Internal analysis, evaluation processes and consultation of associated experts.

These activities led to the collection of stakeholder feedbacks and lessons learnt on the different approaches, their costs and their feasibility.

This phase resulted in a differential analysis of the approaches highlighting:

- The main benefits and added value;
- The limits and constraints;
- The challenges.

The final step consisted in the analysis of input gathered from the experts and the desktop research to draft solutions adapted for the development of a European MEDEVAC capacity within the two scenarios identified in the previous task.

Task 3: Propose recommendations

Preliminary solutions were presented to DG ECHO along with the results of Task 2. The presentation led to fruitful discussions on solutions' feasibility, or their ability to respond to a small scale or large-scale event.

Based on DG ECHO’s feedback and input, along with the finalisation of the overview of the capacities and cost analysis, the Project Team refined the initial modalities.

Starting from these modifications, the solutions were put in perspective based on their feasibility in short- or long-term horizon, and the severity of the crisis for which they could be used.

This phase led to the harmonisation and drafting of four solutions for the aerial medical transport of HID patients and four solutions for the aerial medical transport of non-HID patients, each adapted to a particular timeframe and crisis level.

In a second step, a SWOT analysis was built for each solution by answering the following questions:

- What is this solution's competitive advantage?
- Which existing factors support it?
- What do others perceive its benefits to be?
- What can undermine the feasibility and deployment of the solution?
- Are there other existing issues/difficulties?
- Which current / future trends could be supported by the solution?
- Which actors are likely to be positively impacted by the solution?
- What future obstacles could prevent from deploying this solution?
- Are there environmental/structural/political factors that could jeopardise the feasibility of the solution?
- Do the technology / skills on which the solution is based risk becoming outdated?

Following the analysis of the SWOT the project team devised initial recommendations for DG ECHO to set up a rapidly deployable European MEDEVAC capacity adaptable to the crisis intensity level and time frame.
The recommendations were shared with internal experts for a first review to collect their feedbacks and gather their observations on the feasibility of the recommendations.

Based on their comments, the recommendations were refined and enriched before being finalised.

Task 4: Suggest minimal technical and quality requirements

Building on the overview of past crises identify in Task 1 and the overview of UCPM fixed-wing aerial capacities of the UCPM Member in Task 2, the project team elaborated a classification of the capacities according to several criteria:

- Type of capacity: type of plane (short, medium, long-haul aircraft, configuration);
- Patient transport capacity: number of patients and patient needs (lightly injured, stretchers, ICU, HID patients);
- Aircrew: number of pilots, co-pilots, etc;
- Medical personnel: number of doctors, nurses, medical technicians, etc;
- Deployments requirements: time needed for the plane to be ready for departure;
- Deployment radius: geographic zone in which the plane can operate;
- Comments: other qualitive information collected.

The data collected was integrated into a structured database. The analysis of the raw data saw the emergence of several key elements at this stage:

- The type and configuration of the aircraft is logically adapted to the number of patients, their pathology and the flight duration;

- The composition of the aircrew depends on the type of aircraft used and the standards followed (commercial airline standard, professional organisation standard (IATA), national legislation);
- The composition of the medical team depends on both the number and pathology of patients to be transported and the standards/guidelines followed;
- Deployment timeframe can vary from 3h to 48h depending on the operator and the relevant authority's requirements;
- The deployment radius logically depends on the type of plane used.

Drawing from the results of the previous step, a series of interviews were conducted to collect additional information on the technical and qualitative requirements applied during major crises during which MEDEVAC operations took place. Internal and external experts from CEIS's and DG ECHO's networks were contacted to be interviewed.

Questions were drafted to validate quantitative and qualitative criteria and identify possible lessons learnt for each of the two cases:

- Scenario 1: MEDEVAC of HID patients
- Scenario 2: MEDEVAC of non-HID patients.

At the beginning of the interview, the consultant briefly presented the context of the study, followed by key questions to discuss and validate the research hypothesis and identify potential gaps. This phase resulted in series of key findings and operational elements to draft the preliminary requirements starting from DG ECHO template, a table with the following elements:

- Main characteristics of the capacity
    - Main task;
    - Optional tasks.
- Transport capacities
    - Patients;
    - Medical team per 24 hours activity, working in two shifts;
    - Flights abilities.
- Main components:
    - Aerial transport vector;
    - Configuration;
    - Flight crew per 12-hour shift;
    - Medical team per 12-hour shift;
    - On-board equipment;
    - Storage and maintenance;
    - Standard Operating Procedures (SOPs).
- Availability
    - Deployment;
    - Range (flight length in time).

Drawing from the data and information collected during the previous steps, the minimal requirements based on average of capacities and lessons learnt were suggested.

Draft tables with the preliminary requirements were sent to internal experts. Then a conference call was organised with experts to further discuss the requirements and receive additional feedback, before finalising the minimum requirement.

This phase allowed the production team to draft the following requirements for two types of capacities within rescEU and consolidate the final report. Additional information on existing standard, certification and SOPs were included.

4 KEY RESULTS

IDENTIFICATION OF PATIENT NEEDS

The consultation of both internal and external experts led to the identification and validation of 4 main categories of patient needs which could require a response under the UCPM rescEU capacity.

The data collection process allowed to highlight numerous specific medical characteristics that would require dedicated medical equipment's and trained physicians, but the associated transport characteristics remain the same.

- Single patient or small number of lightly injured patients are evacuated by commercial airliner or service providers (insurance companies) within a national level of response;
- Small scale events and domestic medical evacuation are managed by national capability or Member States solidarity and do not require EU level response;

Patient Needs	Medical Cases	Medical Characteristics	Transport characteristics	Level of response	Aerial capacity
Light injured patients	*Single classic medical or trauma pathology*	*Single patient with classic medical pathology without complication*	*NA*	*National*	*Out of scope*
	Exceptional emergency	Small number of victims with light injuries	*NA*	*National*	*Out of scope*
		Numerous victims with light injuries	Walking wounded patients who can be seated	**Voluntary Pool or rescEU***	**Modular short to long range airliner**
Stretchers	Exceptional emergency	Numerous victims with severe injuries or paralytic patients	Patients who have to be transported on stretchers	**Voluntary Pool or rescEU***	
Patient in needs of intensive care	Complex pathology	Single or multiple patient with pathology requiring complex care	Patients in need of advanced system support during the aerial transport	**Voluntary Pool or rescEU***	
Highly infectious disease patients	Complex pathology	Single or multiple patient with highly infectious disease	Patients requiring isolation/special handling for transport (isolation pod/container)	**Voluntary Pool or rescEU***	**Modular medium to long range cargo airliner**
		Single or multiple patient which have been contaminated by a chemical, biological, radiological or nuclear agent			

** The level of response would depend on the severity of the crisis (n° of patients, severity of injuries, distance from Europe…). The threshold under which a crisis would require a response from the Voluntary Pool or rescEU will be further studier when defining the requirements.*

RESPONSE SCENARIOS

4.1.1 Scenario 1: Highly Infectious Disease Patients

Scenario ID	
Name	MEDEVAC of HID Patients
Location	EU/Europe or outside EU. European country or a distant Third Country where there are European victims.
Airport landing environment	National/international Airport with suitable landing environment for a cargo plane. • Runways of appropriate length and condition; • Refuelling facilities.
Crisis context	Pandemic or outbreak of a Highly Infectious Disease (Ebola, SAR, etc.) or CBRN contamination (incident or attack) in a European country or in a Third Country with European citizens infected/contaminated. Local civil protection and emergency medical teams are at full capacity or do not have the necessary equipment to locally treat the infected/contaminated patients. A request is sent to the ERCC to activate the UCPM to organise medicalised transport of EU patients to first/second treatment care facility in Europe.
Relevant authorities	Crisis management authorities of the country hosting the capacity, ERCC, competent authorities from the European patients' home country, competent authorities from the European country that will host the patients (if different).
Objective	Mobilise rescEU MEDEVAC capacity to transport European HID patients to a HID certified care facility in the EU.
Patient needs characteristics (and/or)	• Patients with highly infectious disease transmittable by air; • Patients with highly infectious disease transmittable by fluids; • Patients contaminated by CBRN agents.
Patient needs – healthcare continuum - generic scenario	
Description	Requirements ante MEDEVAC • Isolate and manage the patient(s) in a first treatment centre to confirm the diagnosis/contamination; • Confirm admission to an appropriate facility in a centre of medical excellence (if possible).

		• Confirm flight route (Countries formal acceptance of flying over their territory with a HID patient); • Safely transport the isolated patient(s) in a dedicated ambulance to a suitable airport; • Assist the patient(s) into an isolation pod/dedicated container; • Load the container onto the plane; • Conduct security and technical checks. Requirements during MEDEVAC • Trained medical team to provide care to the patient(s) without breaking the infection/isolation protocol. Requirements post MEDEVAC • Transport of the patient(s) from the plane into an isolation area in an appropriate treatment facility; • Decontamination of the plane (if needed depending on the nature of the isolation container); • Incineration/decontamination of any contaminated or potentially contaminated equipment.
MEDEVAC response capacity requirements		
	Configuration & main components	Cargo plane able to load container/isolation pod for HID patients: • Dedicated technical and medical equipment; • Communication systems: o Radio communication systems for day and night operations with a directed or minimal relay of transmission between the authority controlling the MEDEVAC operation, the aircraft and the hosting care facility.
	Aircrew	• Aircrew team adapted to the timeframe of the flight
	Trained Medical Personnel	Required profiles: • A Medical Director responsible for supervising, evaluating and ensuring the quality of medical care • Doctors: ICU/Emergency with prehospital experience and aviation physiopathology training with experience in HID • Nurse: ICU/Emergency with prehospital experience and aviation physiopathology training with experience in HID • Technicians: ICU/Emergency with prehospital experience and aviation physiopathology training
	Protocols	• SOP(s)/procedures to isolate the patient(s)

		• SOP(s)/procedures to provide care for the patients (during transport and flight) • SOP(s)/procedures to transfer the patient(s) to an isolated area within the hosting treatment facility • SOPs/procedures to decontaminate the plane • SOPs/procedures to decontaminate the equipment.
Lessons learned and best practices		
	Findings	• **HID patients need dedicated transport to ensure that the infection protocol is not broken** • **Transport of HID patients required dedicated SoPs for the decontamination of the plane and equipment**
Main OSINT sources		
	Indicative Source	*https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5346232/* *Air Medical Transport, H. Rodenberg, Ira J. Blumen, and S. H. Thomas* *Interviews*

4.1.2 Scenario 2: Non-Highly infectious disease patients

Scenario ID	
Name	MEDEVAC of non-HID patients
Location	EU/Europe or outside EU.
Airport Landing Environment	National/international airport with suitable landing environment for a cargo plane: • Runways of appropriate length and condition • Refuelling facilities.
Crisis context	Natural disaster, major incident or large-scale crisis in a European country or in a third country which result in high number of European citizens injured. Local civil protection and emergency medical team are at full capacity or do not have the necessary equipment to locally treat the patients. A request is sent to the ERCC to activate the UCPM to organise medicalised transport of EU patients to first and/or second treatment care facility in Europe.
Relevant Authorities	Crisis management Authorities of the Country, ERCC, Competent authorities from the European patients' home country, Competent authorities from the European country which will host the patients (if different).
Objective	Mobilise the rescEU MEDEVAC capacity to transport European Non-HID patients: • Numerous lightly injured patients • Patients on stretchers • Patients in need of intensive care.
Patients' Needs characteristics	• Numerous lightly injured patients: patients whose medical condition is stable enough to allow the patients to be seated during the flight. • Patients on stretchers: patients that need to be immobilized on stretchers during aerial transport. • Patients in need of intensive care: patients in need of intensive care or high dependency care[11] which require dedicated medical equipment, support and personnel such as highly burned victims, trauma patients, etc.

[11] http://www.md.ucl.ac.be/didac/hosp/architec/UK_Intensive_care.pdf

Patient needs – Healthcare continuum scenario		
	Description	Requirements *ante* MEDEVAC • Stabilise patients in a first treatment centre; • Safely transport of the patients in a dedicated ambulance to a suitable airport; • Assist the patients onto the plane. Requirements during MEDEVAC • Trained medical team to provide dedicated care during the flight. Requirements post MEDEVAC • Transport of the patients from the plane to an adapted ambulance; • Transport of the patients to the dedicated care facility.
MEDEVAC response capacity requirements		
	Configuration & main components	Cargo plane able to transport sitting patients, patients in stretchers and patients in ICU. • Dedicated technical and medical equipment; • Communication systems: o Radio communication systems for day and night operations with a directed or minimal relay of transmission between the authority controlling the MEDEVAC operation, the aircraft and the hosting care facility.
	Aircrew	• Aircrew team adapted to the timeframe of the flight.
	Trained Medical Personnel	• A Medical Director responsible for supervising, evaluating and ensuring the quality of medical care; • Doctors: ICU/Emergency with prehospital experience and aviation physiopathology training; • Nurse: ICU/Emergency with prehospital experience and aviation physiopathology training; • Technicians: ICU/Emergency with prehospital experience and aviation physiopathology training.
	Protocols	• Policies and procedures for categorisation of severity; • Policies and procedures for priority of movement; • Policies and procedures for medical and technical capabilities needed according to the medical needs of the patients.
Lessons learned and best practices		
	Findings	• **Lightly injured patients, patients on stretchers and patients in need of intensive care can be evacuated in the same plane**

		depending on the configuration of the plane (modular) and the plane's transport capacity. • **Other sub-categories within non-HID patients such as severe burn victims, paediatric patients, patients with advanced system support will need a dedicated plane. They will also need dedicated medical and technical equipment and specifically trained medical team.**
Main OSINT sources		
	Indicative Source	*https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5346232/* *interviews*

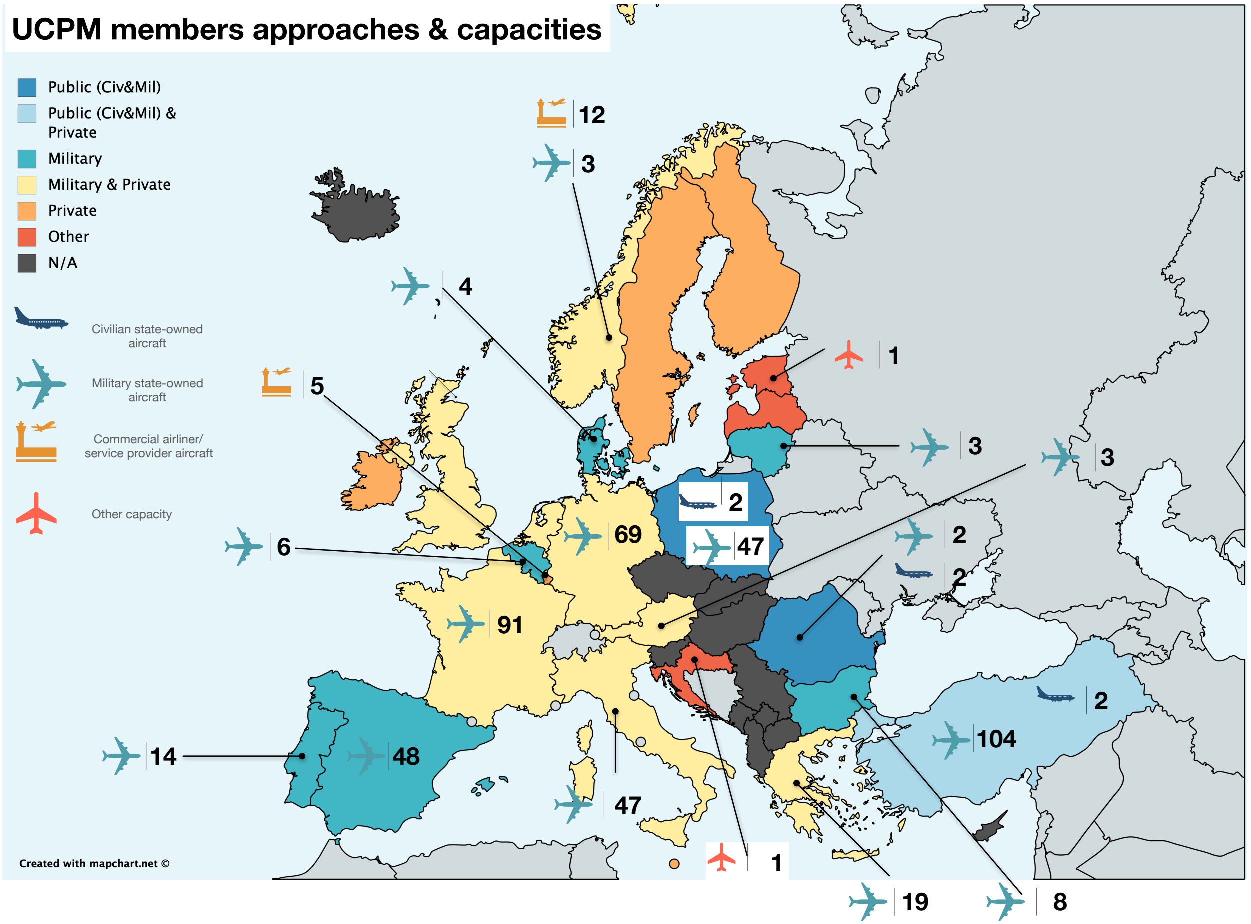
OVERVIEW OF EXISTING CAPACITIES

The medical evacuation and transport of citizens during major crises is the primary concern for the Countries of the Union Civil Protection Mechanism. MEDEVAC operations are often conducted under the supervision of several governmental entities such as Ministries of the Interior, of Health, of Defence or the entity in charge of Emergency management.

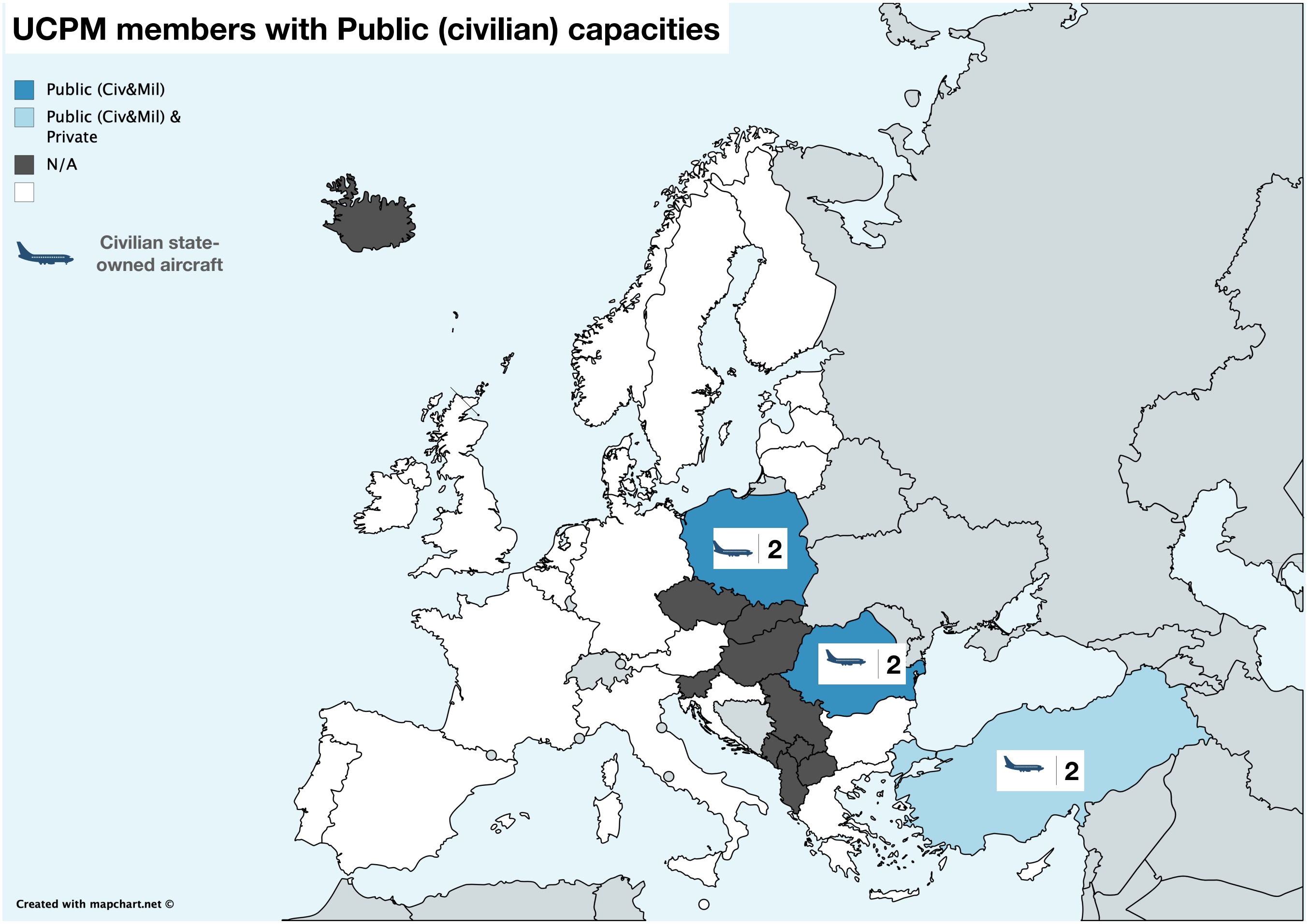
The map below presents an overview of the fixed-wing capacities identified within the 34 UCPM Countries. The overview provides information on the number of civilian public aircraft dedicated to MEDEVAC and military transport aircraft dedicated for MEDEVAC or which can/could be configurated for MEDEVAC upon request.

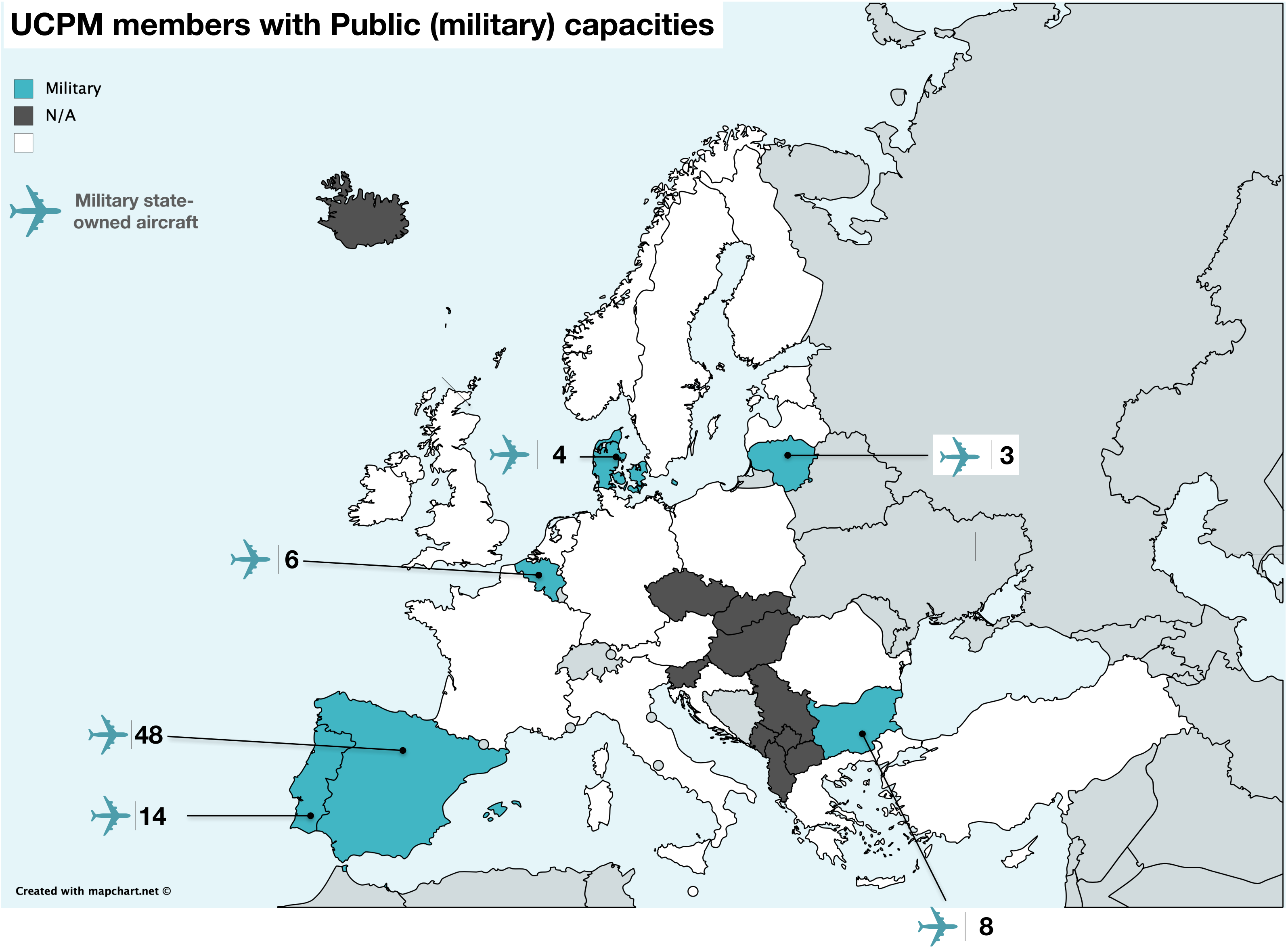
Nota Bene: This overview has been built from data collected from information available in open source and input provided by representatives of the UCPM Countries. For 7 countries, information has not been found or contact did not succeed (see chapter 4 Methodology), and are highlighted in dark grey for N/A.

List of existing capacities identified (overall overview)

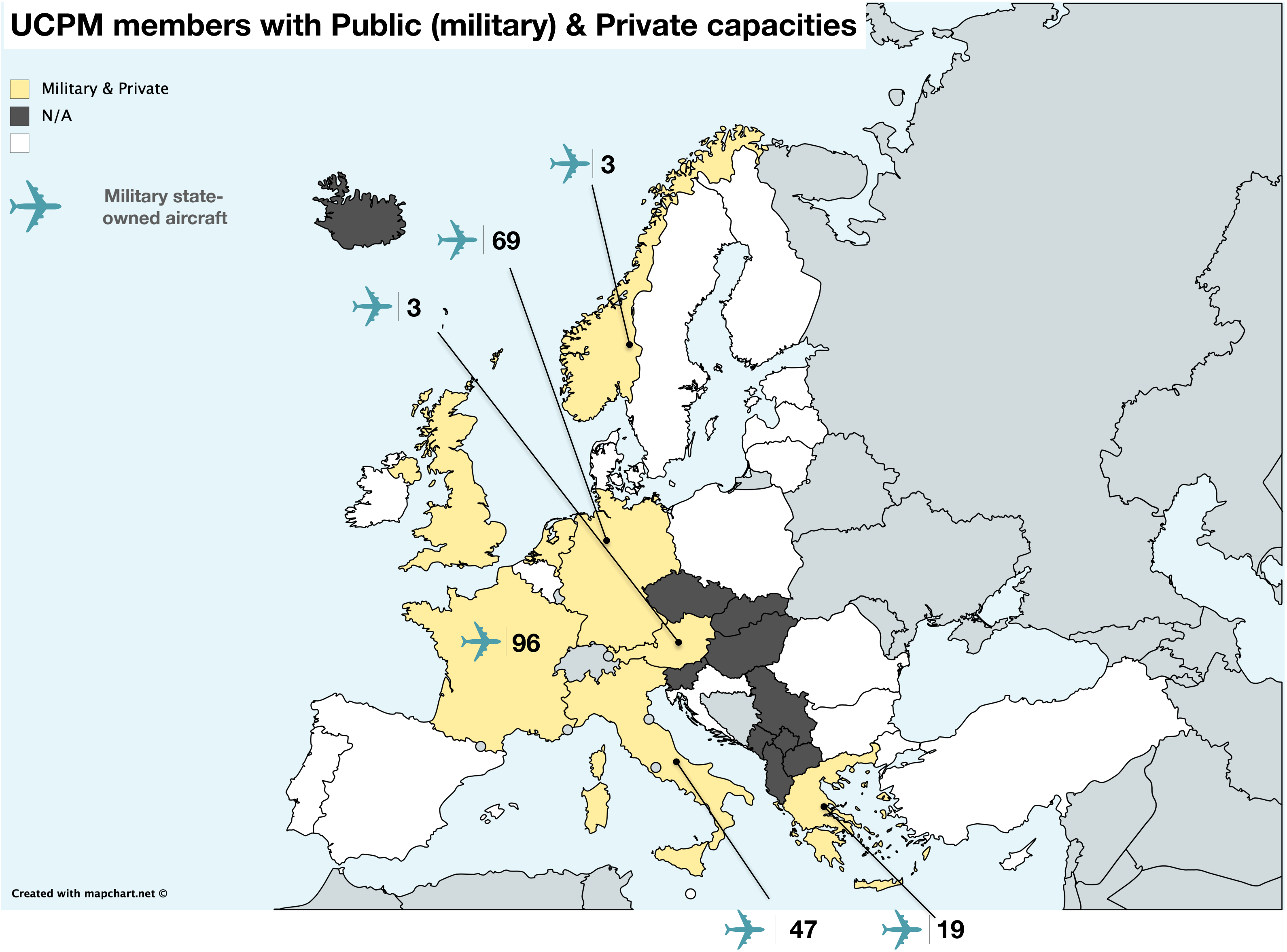


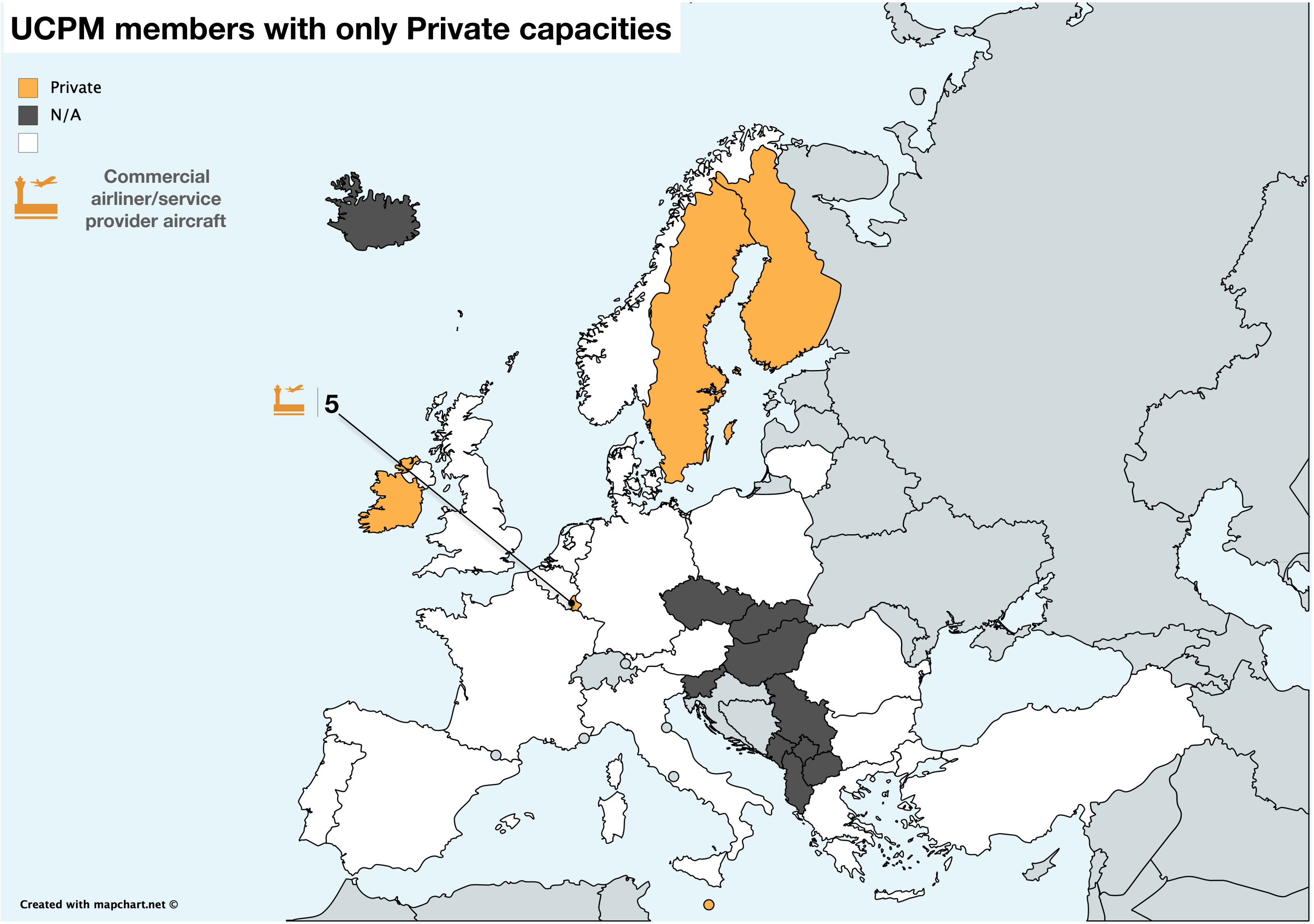
List of existing capacities identified per approach





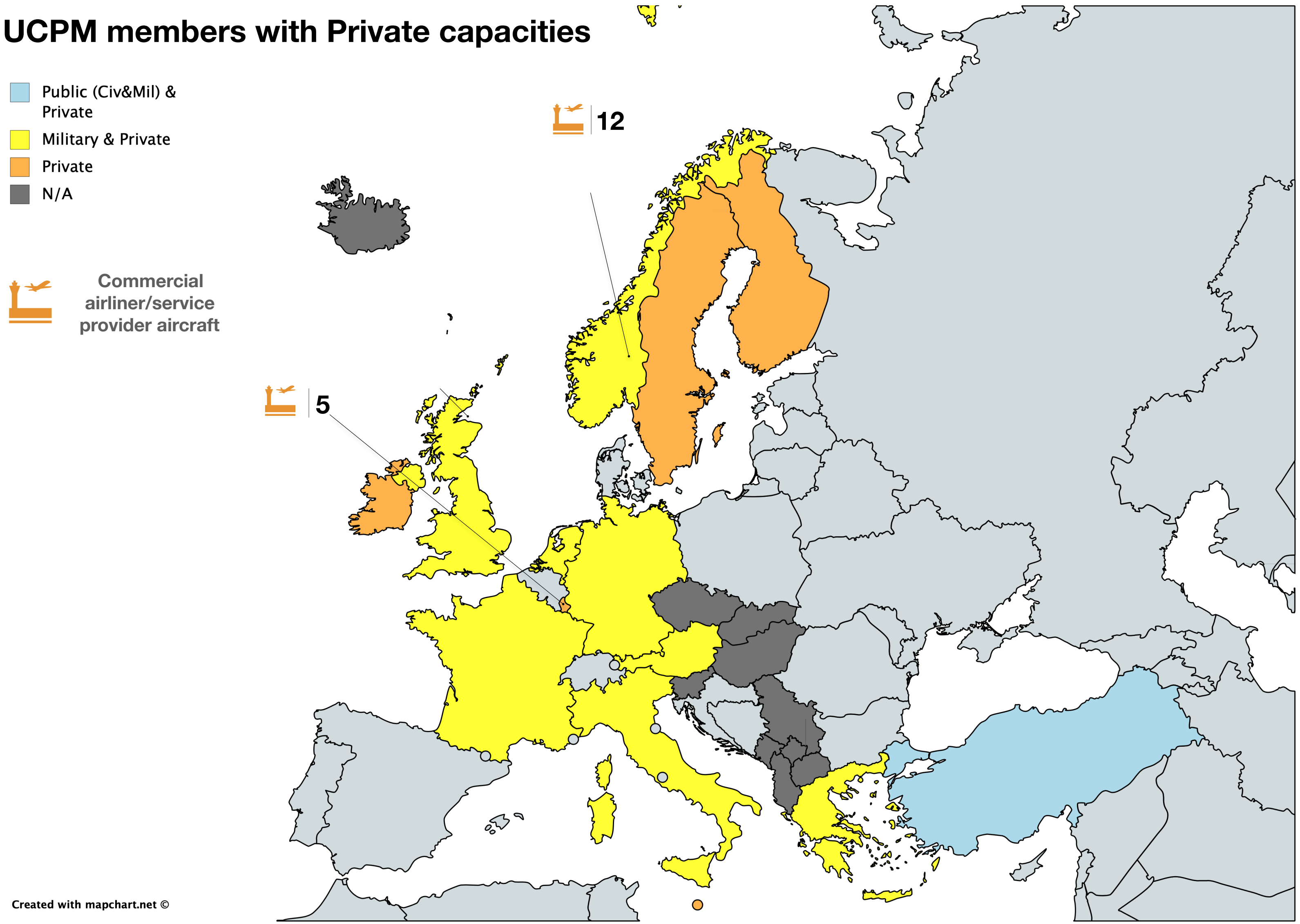
UCPM members with Public (military) capacities
Military
N/A
Military state-owned aircraft
4
3
6
48
14
8
Created with mapchart.net ©

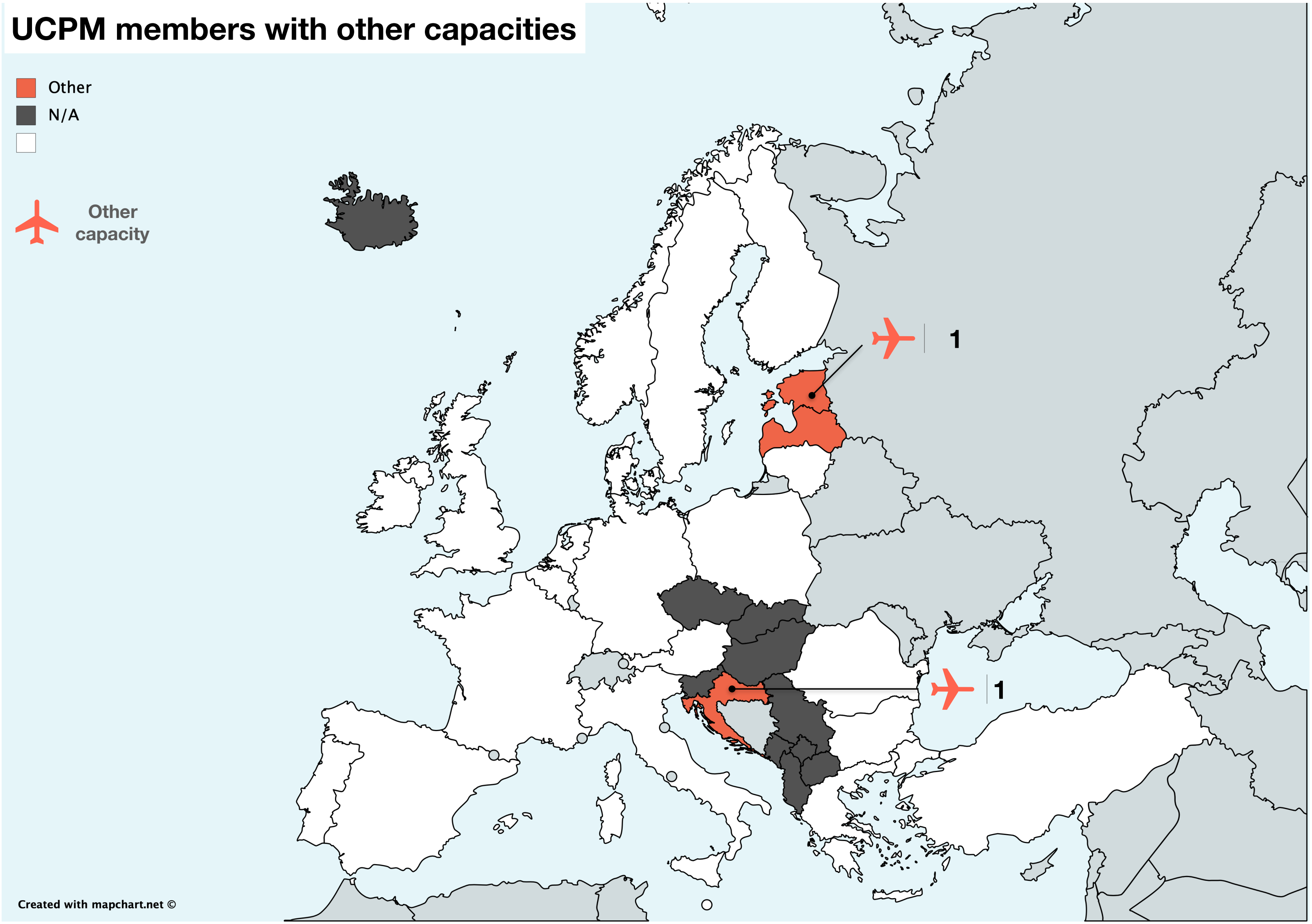

UCPM members with Public (military) & Private capacities
Military & Private
N/A
Military state-owned aircraft
3
69
3
96
47
19
Created with mapchart.net ©



UCPM members with only Private capacities
Private
N/A
Commercial airliner/service provider aircraft
5
Created with mapchart.net ©

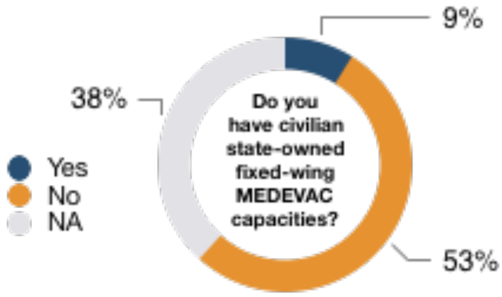
UCPM members with Private capacities




UCPM members with other capacities
Other
N/A
Other capacity
1
1
Created with mapchart.net ©

4.1.3 Observation 1: UCPM Countries rarely rely on public (civilian) capacities for major crisis.

Based on the data collected at this stage, it appears that very few countries have public (civilian) fixed-wing aerial capacities dedicated to MEDEVAC.



According to the desk research, only **9% of the UCPM Countries confirmed having public (civilian) fixed-wing aerial** capacities dedicated to MEDEVAC, namely **Poland, Romania and Turkey**;

Several reasons were highlighted by other countries for choosing other modalities:

- **Geography:** The length and surface of the national territory tends to be a strong incentive or on the contrary a limit in the definition of the aerial capacities to be used. Countries with a smaller territory tend to rely on rotary-wings capacities which are a flexible and less costly option to perform medical transport of patients.

- **Cost:** The overall cost to develop/acquire and maintain aircraft capacities dedicated to MEDEVAC tend to be seen as too important compared to the use of other approaches, in particularly since such capacities for large scale event or major crisis are not required on a daily basis (high impact, low probability events).

4.1.4 Observation 2: UCPM UCPM Countries who have public (civilian) aircrafts dedicated to MEDEVAC often rely on twin-engine aircraft with small transport capacities

According to the information provided by the three UCPM countries who have public (civilian) fixed-wing capacities**, they operate small twin-engine aircraft** which can accommodate a maximum of 2 to 4 passengers and can cover **short to medium flight lengths**.

- **Romania:** One Cessna Citation 5 (1 patient at a time) and one Piper PA-42 Cheyenne III (1 patient at a time)[12]

- **Poland:** One Piaggio P.180 Avanti and one Piaggio P.180 Avanti II[13]

- **Turkey:** Two turbo jets, equipped with stretcher and intensive care unit for up to 4 patient out-a-time.

NB: The classification of aircraft based on their range raised internal debate within the project team about the definition of short, medium and long-haul aircraft.

In aviation, the flight length is defined as the distance of a flight. Commercial flights are often categorized into short-, medium- or long-haul by commercial airlines based on flight duration, although there is no international standard definition and many airlines use airtime or geographic boundaries instead.

Table 1: Short, medium and long-haul typologies (examples): distance and geographic zone

	Short haul	**Medium haul**	**Long haul**
Association of European airlines	Europe	North Africa, Middle East	Americas, sub-Saharan Africa, Asia, Australia
Air France	Domestic (France)	Europe/North Africa	Rest of the world
Eurocontrol	Up to 1 500 km	1 500 to 4 000km	Longer than 4 000km

For this study, to keep the focus firmly on patient needs, DG ECHO recommended the team to follow a classification based on flight duration (time) as follows:

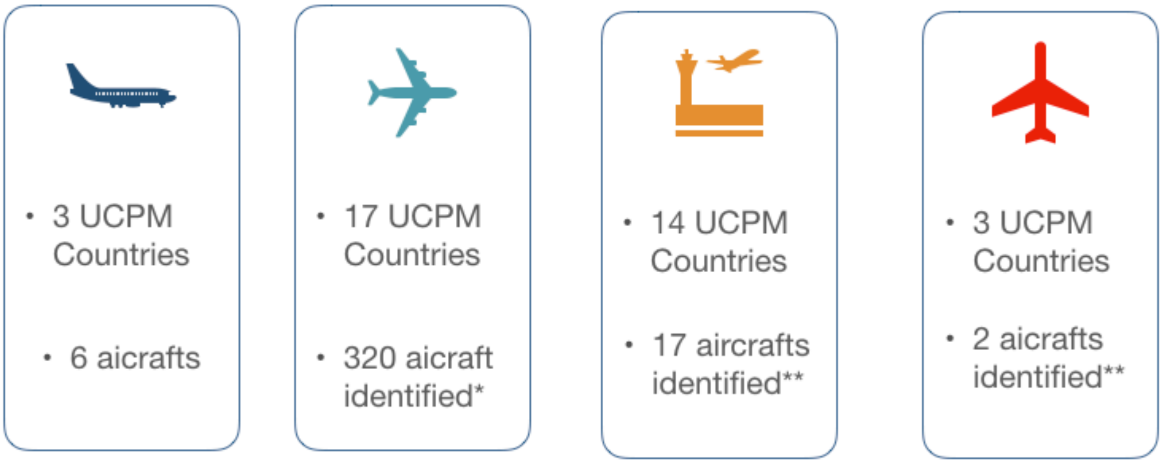
Table 2: Short, medium and long-haul typologies: flight duration

Short-haul flight:	Under 3 hours
Medium-haul flight:	3 to 6 hours
Long-haul flight:	6 to 12 hours
Ultra-long-haul flight:	Over 12 hours

[12] http://www.revistamedicinamilitara.ro/wp-content/uploads/2016/07/RJMM-vol-CXIX-nr-2-din-2016.25-28.pdf
[13] Technical specifications available at https://www.lpr.com.pl/en/about-us/piaggio-180/

UCPM Countries tend to rely on state-owned capacities able **to fly up to 6 hours.**

4.1.5 Observation 3: UCPM Countries tend to use military capacities and/or rely on contract services with commercial airliner and service providers for both HID and multiple non-HID patients



** For UCPM Countries that rely on military capacities, their existing transport cargo capacities have been identifyied but it does not provide information on the number of HID or Non-HID MEDEVAC Kit available to configure the aircrafts*

*** For UCPM Countries that rely on capacities from service providers or loan from a military organisation, there is not always a specific number of aicrafts allocated to the country*

To respond to major crises resulting in mass casualties or HID patients, **19 UCPM Countries** confirmed relying on **military aerial assets and/or contract services with commercial airliners and service providers on a case-by case basis:** Austria, Belgium, Denmark, Finland, France, Germany, Greece, Lithuania, Luxembourg, Malta, Norway, Poland, Portugal, Romania, Spain, Sweden, The Netherlands, The UK, Turkey.

Armed Forces often have transport cargo and modular aircrafts which can be used for the medicalised transport of multiple patients. According to the data collected, **17 UCPM Countries rely on military aerial capacities:** Austria, Belgium, Bulgaria, Denmark, France, Germany, Greece, Italy, Lithuania, Norway, Poland, Portugal, Romania, Spain, The Netherlands, The UK, Turkey. They tend to use on an average 2 to 3 military aircraft which can accommodate sitting patients, patients on stretchers and ICU patients.

Military cargo aircraft are also used for exceptional emergencies such as the transport of multiple critically burnt patients (Romania, 2015) or transport of HID patients (Ebola pandemic, 2014-2015, France, Germany, UK).

According to the data collected**, 9 out of 17 UCPM Countries who rely on military aerial assets also rely on aerial capacities from the private sector:**

This modality can take two different forms:

- **Framework contract services** with one or several commercial airliners or a service provider: the country secures assets through a framework contract with one or several commercial airliners or service providers. The contract is usually based on an annual fee and when a capacity is requested for an MEDEVAC operation, the country pay flight hours for the duration of the mission;

- **Contract services on a case-by-case basis** with a service provider or commercial airliner: depending on the emergency, the country awards a contract to a commercial airliner or a service provider to request a service of emergency medicalised transport.

In addition, 3 UCPM Countries only rely on aerial capacities form the private sector: Ireland, Sweden, Finland. These three countries have a framework contract with a national commercial airliner who provides aircraft configured to the government's needs.

Finally, some countries rely on other assets such as **aerial capacities operated by the police or border guards**, or **capacities from another country or a military organisation** such as NATO.

- **Croatia:** One Challenger CL-604 used for the president, the prime minister and other ministerial level officials that is used from time to time with special approval for transplant medicine or single-use medical transport in case of extreme urgency

- **Estonia:** One Beechcraft B300 (4-5 seats), operated by the Police and Border Guard Board, under the Ministry of Interior and for major crisis, "*Civilian mechanisms like bilateral agreements with neighbouring countries, and the UCPM would most probably be preferred. However, NATO's support is definitely an asset*";

- **Latvia:** no fixed-wing capacities, use of NATO aerial capacities if needed;

Key Finding 1: The main public (civilian) aerial capacities currently operated by UCPM Countries are short to medium range aircraft with reduced patient transport capacities.

Key Finding 2: The only aerial fixed-wing capacities which can accommodate more than 7 passengers are military cargo aircraft or assets provided by commercial airliners or services providers through contract services.

4.1.6 Four main approaches identified

The overview of the capacities used by the UCPM Countries revealed **4 different approaches:**

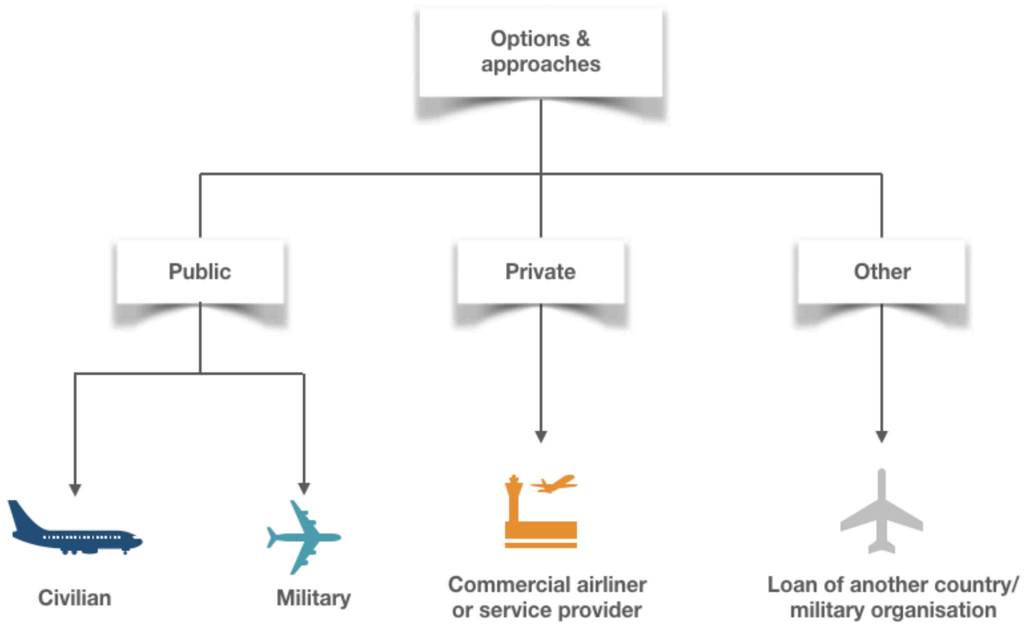
- **The use of public (civilian) aircraft dedicated to MEDEVAC**;

- **The use of military aircraft:** dedicated to MEDEVAC or cargo which can be configured for passenger transport or MEDEVAC;

- **The use of civilian aerial capacities through contract services** with commercial airliners or service providers;

- **The use of assets from another country (civilian or military) or from a military organisation**.

The lessons learnt collected from the relevant stakeholders and additional input gathered from the desk research can be summarised as follows:



A general assessment of each approach based on the lessons-learnt and return of experience was conducted according to several criteria:

- **Availability:** On an average, the countries relying on this approach can use their capacity?
    - Grade: 1 (rarely, capacities are not fully allocated for civilian major crisis) to 3 stars (always, capacity fully dedicated to civilian major crisis);

- **Range:** On an average, the countries relying on this approach can use their capacity for long flight haul.
    - Grade: 1 (only for short flight haul) to 3 stars (for long to ultra-long flight haul);

- **Deployment:** On an average do the countries relying on this approach can use their capacity rapidly.

    - Grade: 1 (not rapidly deployable, more than 24 hours) to 3 stars (rapidly deployable, less than 24 hours);

- **Maintenance:** On an average do the countries relying on this approach have to support important cost to maintain their capacity.
    - Grade: 1 (low cost) to 3 Euro symbols (important cost);

- **Overall Cost:** On an average do the countries relying on this approach have to support an overall important cost to setup and sustain the capacity?
    - Grade 1: (low cost) to 3 Euro symbols (important cost);

	Availability	Range	Deployment	Maintenance	Cost
Civilian state-owned	★★★	★☆☆	★★★	€€€	€€€
Military	★☆☆	★★★	★☆☆	€€€	€€
Commercial airliner or service provider	★★★	★★★	★★☆	*Non applicable*	€€
Loan of another country/military organisation	★☆☆	★★★	★☆☆	*Non applicable*	*Non applicable*

4.1.7 Observation 1: The use of state-owned aerial capacities guarantees autonomy, availability and the upkeep of skills and expertise

The ownership of national dedicated civilian aerial MEDEVAC capacities can seem to be the best approach to deploy an adequate response in case of a major crisis. It **ensures available, rapidly deployable capacities fully dedicated to major emergencies.**

Aerial assets can be **developed and/or purchased according to the precise needs of the country**: civilian jets, modular twin-engine aircrafts, cargo aircrafts, etc. This approach ensures that public sector (civilian or military) expertise and skills are retained.

This approach **maintains a strategic capacity** and allows the country to conduct its MEDEVAC operation in total autonomy without depending on a third party.

4.1.8 Observation 2: the use of state-owned civilian or military capacities is costly

The development and maintenance of a national aerial MEDEVAC capacity (civilian or military) bears a variety of costs:

- **Development and/or acquisition costs**;
- **Maintenance and storage costs**;
- **Other costs**: human resources, technical and logistics, administrative, etc;

According to one of the interviewees, the annual flat rate of their framework contract with a commercial airliner is € 300,000, while the purchase of the same aircraft would cost € 101 million, in addition to maintenance and other costs. **The cost analysis was the main reason for the country do decide to rely on the use of private sector capacities rather than develop and maintain their own national capacities**.

4.1.9 Observation 3: The use of military capacities can limit aircraft availability but leverages military experience and skills

Military cargo aircraft, be they dedicated to MEDEVAC or multi-mission, **will always give priority to military operations.**

UCPM Countries who rely on military assets are aware that **they run the risk of unavailability of military aircraft if these are already deployed for a military operation.** This also explained why they tend to also combine the use of military assets with contract services with service providers on a case by case basis, to cover capability gaps.

Air ambulances in Armed Forces date back the start of World War I, when British forces in Turkey first used a biplane to transport a wounded soldier to a medical facility for treatment. The flight required 45 minutes to complete and saved the patient an arduous 3-day journey by land[14]. Nowadays, EU Member States' Armed Forces have dedicated capacities to medically transport and evacuate injured soldiers. They often rely on rotary-wing capacities, more adapted to transport patients from the point of injury to a safe location for first care treatment (CASEVAC) but **they also use fixed-wing assets from military jets to multi-mission cargo aircraft to transport patients back to national territory (STRATEVAC)[15]**. Some UCPM countries decided to rely on the expertise and experience of their Armed Forces, which gain proven skills and developed robust processes by conducting MEDEVAC operations for injured soldiers. They cooperate with them to organise MEDEVAC during large-scale events.

In these cases, **the Armed Forces provide not only the aerial capacity and the pilots but can also provide the medical personnel**. Mixed civil-military teams are also

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[14] http://www.airambulanceone.com/history-of-air-ambulances/
[15] https://www.military-medicine.com/article/3329-the-aeromedical-evacuation.html

a possibility, with personnel from the ministry of health or the relevant civilian crisis management department or medical personnel from NGOs.

By relying on military assets, **countries can have access to larger and amortised capacities**, able to transport more patients.

4.1.10 Observation 4: The use of private capacities guarantees availability on demand

The main added value of the use of private sector aerial capacities, according to interviewees, is availability on demand. **Availability and ability to be deployed in a certain amount of time is a contractual obligation** between the government and the service provider or commercial airliner.

Another benefit raised by interviewees is that there is **no need to have dedicated facilities to host the aircraft and store the equipment.** The maintenance of the aircraft is also not a concern for the Authority. The service offers can include a wide range of options: the provision of experienced pilots, medical teams, etc.

However, the decision to externalise a response capacity to a private operator raise the question of **the loss of strategic skills** within the public organisation.

CAPACITY GAPS ANALYSIS

4.1.11 Capacity gaps identification based on the overview of existing capacities

According to the overview of existing capacities within the 34 UCPM Countries, it seems like there are **no civilian state-owned capacities for the transport of mass casualties**.

These capacities are too costly to develop/acquire and maintain, this is the reason why UCPM Countries usually rely on military transport cargo aircrafts or aircrafts from commercial airliner or service providers with larger transport capacities.

There is also **a shortage of permanent capacities for the transport of HID patients.** Several UCPM Countries developed a dedicated capacity which was not maintained in a long-term because of the costs (Luxembourg, Germany).

4.1.12 Capacity gaps according to the UCPM Countries

In addition to the overview of their current capacities, 15 UCPM Countries where asked **to confirm if they have an aerial capacity gap for MEDEVAC at the moment.** The two aerial capacity gaps raised by UCPM Countries are aerial capacities for the transport of mass casualties and for the transport of HID patients.

- **Aerial capacities for the transport of mass casualties**: 5 out of 15 members interviewed confirmed they lack capacities for the transport of mass casualties: Bulgaria, Croatia, Estonia, Ireland, Romania;

- **Capacities for the transport of HID patients:** 7 out of 15 members interviewed confirmed they lack capacities for the transport of HID patient: Bulgaria, Croatia, Estonia, Germany, Ireland, Romania, Sweden;

According to the interviews and survey conducted, 5 UCPM Countries confirmed **they have no capacity gap**: Austria, France, Italy, Spain and Turkey.

Nota Bene: The 3 other countries which replied to the survey (Belgium, Luxembourg and Malta) did not answer the question but the data collected from open source about their current capacities confirmed that they are facing similar gaps.

These two gaps identified are in line with the response scenarios needs defined in the previous phase.

DIFFERENTIAL ANALYSIS AND COSTS

4.1.13 "All-in" versus modular approach: modularity to foster preparedness

An analysis of the capacities currently used by the UCPM Countries, along with the input from MEDEVAC experts and stakeholders led to the identification of key elements on the **configuration of MEDEVAC capacities.**

Major disasters and crises often lead to unpredictable damages and consequences. Crisis management and Civil Protection authorities cannot anticipate the exact number of patients or the pathologies which will lead to an aerial Medical evacuation**. Patient needs can be very different from one crisis to another and will require specific equipment and resources.**

As a consequence, the "all-in" approach does not seem adapted to the development of a European rescEU aerial MEDEVAC capacity. It would require a capacity adapted to all types of patient needs, which would be both costly and complex to develop and maintain.

Building on lessons learnt from past crises, a **modular cargo aircraft** would be more adapted if it can accommodate either:

- Non-HID patients: seats for lightly injured patients, stretchers, or specific modules for patients in need of ICU, modules for severe burn victims or paediatric patients, etc.

- HID patients: Isolation containers, pods or other systems which may be developed in the near future.

Modularity means more flexibility in adapting the aerial capacity to the crisis. A modular approach is therefore based on two assets:

- **The vector:** a modular cargo aircraft

- **The equipment adapted to patient needs:** kits, modules, stretchers, support systems, medical equipment, drugs and reusables, etc.

Both the vector and the equipment need to be stored and maintained.

4.1.14 The role of private versus public resources

4.1.14.1 Overview of the costs to develop a capacity

The development of an aerial MEDEVAC capacity encompasses three series of costs: fixed costs, recurring costs and other costs.

Fixed costs: the development versus acquisition of vectors and MEDEVAC modules

Fixed costs include expenses which only occur once or very punctually. In this case, the fixed costs for the setting up of an aerial response capacity would be the development or acquisition of a vector (one or several aircraft(s)) and the development or acquisition of the modules (one or several HID isolation pod(s), ICU module(s), stretcher(s), etc.).

- **Development vs acquisition of an aircraft**

The development of an aircraft from design to production, testing and certification is a long, complex and costly process. The overall cost of developing aircraft is directly linked to the level of production and units sold.

Development costs and unit price: illustrations

	Boeing 777	**Airbus A330**
Units sold	1,616 (March 2019)	9,027 (30 September 2019)
Development programme costs	$5 billion	$2 billion (1984)
Unit cost	Boeing 777-200ER: $306,6 million (2019)[16]	A320: $101,0 million (2018)[17]

Joint development programme tends also to be more costly than a capacity developed by a single provider. As an illustration, the overall A400M programme was estimated at 20 billion euros in 2003 for an initial order of 174 aircrafts but actually reached 30 billion euros in 2017[18].

However, commercial airlines rarely pay catalogue prices but instead tend to benefit from important discounts based on the size of the order. A study conducted by Ascend Worldwide and published in Challenges[19] highlighted that discounts range from 35 to 60% for the biggest commercial airlines.

[16] http://www.boeing.com/company/about-bca/#/prices
[17] https://www.airbus.com/content/dam/corporate-topics/publications/backgrounders/Airbus-Commercial-Aircraft-list-prices-2018.pdf
[18] https://www.challenges.fr/entreprise/defense/l-airbus-a400m-l-avion-qui-valait-30-milliards_567663
[19] https://www.challenges.fr/salon-du-bourget/le-vrai-prix-des-avions-d-airbus-et-de-boeing_10040

Aircraft unit costs: Price index versus market price (source: Ascend Worldwide, 2013)

	Boeing 737-800:	**Airbus A320-200**
Price index on catalogue	$89,1 million	$91,5 million
Market price after discount	$41,8 million	$38,75 million

A third approach can also consist in leasing aircrafts from a manufacturer.

According to a study conducted by Alex Philip, Director of Marketing Airline Economic Analysis at Boeing in 2016,[20] direct purchase versus leasing approach have both their benefits but with different costs to be taken into account for an airline:

	Direct Purchase	**Leasing**
Characteristics	• Airline pays advance payments directly to manufacturer • Airplane is financed with loan secured by a mortgage • The airline gains equity in the airplane as it pays down the loan NB: Several financial institutions usually participate in the loan	• The airline gains equity in the airplane as it pays down the loan • The airline gains equity in the airplane as it pays down the loan • Airline leases the aircraft from the lessor • Airline usually pays maintenance reserves to the lessor • Airline returns airplane to lessor when lease ends • Airline may have option to renew lease of purchase aircraft at fair market value
Costs	• **Capital costs** o Advance payments o Cash down payment (equity) o Principal and interest payments • **Maintenance costs** o Paid directly to maintenance	• **Leasing costs** o About 0,8 to 1 % of aircraft cost per month o Actual leases are determinated by aircraft supply and demand • **Maintenance costs**

[20] https://www.iata.org/whatwedo/workgroups/Documents/ACC-2016-GVA/ACC2016_Alex_PHILIP.pdf

	provider or performed in house. o Reflective of maintenance honeymoon, mature phase, and aging phase • **Residual value** o Sale of aircraft at fair market value at end of study period or end of economic life offsets initial capital costs	o Paid to lessor and available for scheduled maintenance o Typically, equal to mature maintenance cost for aircraft but can vary widely o Excess may be withheld at end of lease to fulfil return conditions • **Security deposit** o Typically, equal to 3 month +/- of lease payments o Returned to airline at end of lease

For the transport of HID patient, operators (public or private) also had to **take into account expenses for the adaptation/modification of the aircraft.** As an example, Luxembourg Air Ambulance had to **modify its 3 Learjet 45, an operation which cost around €100.000 per aircraft.**

- **Development vs acquisition of a module (HID and non-HID)**

Development and acquisition of HID isolation module and related equipment

Since the start of the Ebola Outbreak in West Africa, public actors, service providers, university hospitals and research centres have intensified their work on the development of isolation modules for the safe transport of HID patients. At the beginning of the Ebola crisis, there were very few aircraft equipped for the transport of HID patients[21]. The UK Air Force had been working on this issue for several decades[22] but the solutions currently used by the service providers are relatively recent.

Several systems were developed to quickly respond to the growing demand (see case-studies in annex). These systems were usually single-use solutions relying on impermeable transparent plastic sheeting in a cargo plane with containment unit (isolation bubble) or tent.

In the last couple of years, more robust and long-term solutions were developed, which can be re-uses or transport several patients at a time and sometimes do not require the aircraft to be decontaminated or for the medical personnel to wear Personnel Protective Equipment (PPE)[23].

[21] http://www.cidrap.umn.edu/news-perspective/2014/09/very-few-aircraft-equipped-evacuate-ebola-patients
[22] https://wwwnc.cdc.gov/eid/article/25/1/18-0662_article
[23] https://www.who.int/medical_devices/meddev_ppe/en/

Phoenix Air or EpiGuard have developed dedicated systems, which is a costly process as illustrated in the case-studies in annex.

As an example, EpiGuard was founded in 2015 and commercially launched the EpiShuttle in 2018. The **total development cost to bring the EpiShuttle to market was approximately € 4 million** (including soft funding)[24].

Price and costs

According to the nature of the module, which can range from isolation bubble to full container/sarcophagus, and from single or multiple patient transport capacity, the unit cost is variable.

As an illustration, the unit cost for **a complete and ready to use EpiShuttle is € 37.500.** After using the EpiShuttle to transport a highly contagious patient, some parts like filters, gasket, and mattresses must be replaced as part of the decontamination procedure. EpiGuard sell this complete kit as **the EpiShuttle Disposable Kit for € 850.** Beyond this, no medical or technical equipment is required, although they sell some equipment such as stretcher adapters and medical racks to ease transportation.

The "bubble" stretcher" included in the isolation system provided by Luxembourg Air Ambulance **costed €15.000 per unit**.

Development and acquisition of non-HID modules and related equipment

The MEDEVAC kit market is very competitive with numerous providers in the civilian sector. The supply side of this market features a strong presence of SMEs. These SMEs tend to have a stronger national client base and small revenues from exporting their products.
Costs of modules can greatly differ from one provider to another, but the products are mature and there are multiple European providers.

The non-HID modules and kits can encompass various medical equipment such as:
Air Ambulance Equipment

- ICU module, stretchers,
- Minimum Equipment
- Multi parameter vital sign monitor w/defib-pace
- Backup Monitor
- AED
- Ventilator
- Electric seringues (X2)
- Mucous suction unit
- Vacuum mattress
- Cervical collar
- Splints (set of 3)
- Medical bag (w/equipment) (est.)

[24] Interview EpiGuard. A complete case study about the use of the EpiShuttle is provided in annex.

- Nurse bag (w/equipment) (est.)
- Burn bag
- Stretcher system (w/loading ramp)
- Portable O2 bottles
- Personal protective equipment (PPE) (X2)
- Misc (pillow, sheets, blankets, transfer mat etc)
- Admin equipment

According to a service provider, **the air ambulance equipment for the transport of one patient in need of intensive care cost on an average 260.000€ per flight[25].**

Specialist equipment (as needed)

- Difficult airway management
- Ultrasound
- ECMO
- Baby Pod
- Incubator

An illustration of detailed equipment costs is provided in annex.

Recurring operating costs: Personnel, maintenance & consumables

Recurring costs encompass general and operating expenses and are generally seen as indirect costs. For the setting of an aerial response capacity, the recurring operating cost would be cost of personnel (aircraft crew and medical team), the cost of aircraft maintenance and the cost of consumables (aircraft consumable and medical consumable).

Personnel expenses

- ***Aircraft Crew:***
  - Pilot wages and benefits for each MEDEVAC mission:

According to the German pilot association Cockpit, starting salaries at Ryanair are between €25,000 and €30,000 a year. After five years, co-pilots can earn €70,000. Experienced captains make a maximum of €130,000[26]. The wages can be very different according to the country, the airline, the operator (public, private) and pilots' average wage also increases depending on the size of the aircraft and the routes flown[27].

- ***Medical team:***
  - Flight doctors' wages & benefits.

Flight doctors wages also depend according to their country, their organisation (public/private hospital, NGO, independent, service provider, etc.).

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[25] See an illustration of detailed list of cost per equipment in annex.
[26] https://www.dw.com/en/being-a-pilot-isnt-what-it-used-to-be/a-45038289
[27]https://www.icao.int/MID/Documents/2017/Aviation%20Data%20and%20Analysis%20Seminar/PPT3%20-%20Airlines%20Operating%20costs%20and%20productivity.pdf

According to Zip recruiter, the Belgium national wage average for flight doctors is $190, 673 annually[28]. They must be experienced in ICU/Emergency with prehospital experience and aviation physiopathology training.

- Flight nurses' wages & benefits:

Flight nurses' wages also depend according to their country, their organisation (public/private hospital, NGO, independent, service provider, etc.).
According to Zip recruiter, the Belgium national wage average for a flight nurse is $81, 093 annually[29]. Flight nurses must be registered nurses and have a specialty in ICU/Emergency and with prehospital experience and aviation physiopathology training.

Finally, a crucial recurring cost which need to be integrated in personnel expenses are continuous training costs. For both the medical team and aircrew, a specific and continuous training is key whether it be for the transport of patient in need of intensive care or even more for the highly contagious patient.

Maintenance expenses

Maintenance expenses usually include direct airframe and engine maintenance cost, plus "burden" or overheads (hangars and spare parts inventory).

According to the data collected by IATA's Maintenance Cost Task Force (MCTF), airlines spent $67,6 billion on Maintenance Repair and Overhaul (MRO), **representing around 9,5% of total operational costs[30].**

Although maintenance costs, as a percentage of airplane-related operating costs (AROC), will vary — depending on such factors as airplane type, average flight segment length, and airplane age — typical maintenance costs range from approximately 10 to 20 percent of AROC. Large carriers, for example, have maintenance budgets in excess of $1 billion[31].

As an illustration, **the annual maintenance costs of a C130J-30 is $7, 350 million**[32].

- **Aircraft consumables: Fuel, electricity**.

Nota Bene: these expenses vary according to the type of aircraft used, patient needs (medical equipment system electricity consumption) and the duration of the flight.

- **Medical consumables.**

Other costs

As series of other costs must be taken into account:

- Continuous training costs for both aircrew & medical personnel
- Insurance fees for the aircraft and personnel (in particular for the transport of HID patient)
- Risk premium for pilots and medical staff (in particular for the transport of HID patient)
- Aircraft servicing costs (ground handling, landing fees, etc.)

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[28] https://www.ziprecruiter.com/Salaries/Flight-Medicine-Physician-Salary
[29] https://www.ziprecruiter.com/n/Flight-Nurse-Jobs-Near-Me?near_me_location=Brussels,BE
[30] https://www.iata.org/whatwedo/workgroups/Documents/MCTF/MCTF-FY2016-Report-Public.pdf
[31] http://www.boeing.com/commercial/aeromagazine/aero_15/costs_story.html
[32] https://fr.wikipedia.org/wiki/Airbus_A400M_Atlas#cite_note-refJ-38

- Certification process costs[33]
- etc.

[33] Certification process see https://www.air-ambulance.com/press/id/26/air-ambulance-and-medical-equipment-regulations

4.1.14.2 Comparative costs analysis of the approaches based on returns of experience

Comparative costs analysis of the approaches for the transport of HID patient: Public versus private

	Cost of use of state-owned permanent capacity	Cost of capacity from a service providers
HID	**Case-study 1: Germany**	**Case-study 2: Luxembourg**
	Approach and use-case: Germany developed an Ebola capacity in 4 months, namely an **Airbus A340-300** "Robert Koch", built from a Lufthansa plane in cooperation with the Robert Koch Institute (RKI) for the aerial medical transport of HID patient.	**Approach and use-case**: Luxembourg Air Rescue (LAR), a private company, received financing from the Ministry of the Interior to place 1 MEDEVAC Ebola configured plane (**a Learjet XR45 with an Air Ambulance Isolation System and "bubble" stretcher**) in CECIS (2014-2016)[34].
	Cost: • Around 700.000€ per transport of patient • **€ 1,5 million/month** to maintain the capacity.	**Cost**: Transport of 1 Ebola patient cost **€ 160.641,00** (with 85% refund from the European Commission. (deployment cost) **Recurring costs:** Ensure availability of crew and medical personnel in 12h (turnover & training: 12 doctors, 12 nurses, 20 pilots, technicians)
	Lesson learnt: The development and maintenance of aerial capacities solely dedicated to the transport of HID patients is **very costly** considering the fact that it is only used it for a very small number of patients. Thus, the ad-hoc capacity was **dismantled after 6 months** because of lack of German HID patients to transport, and it was deemed too expensive to maintain a dedicated capacity	**Lesson learnt:** The solution offers maximum flexibility when a fast answer is required for a limited number of HID victims. In the case of this evacuation, the plane with the required configuration and relevant equipment was immediately available, as were the experienced crew and medical teams familiar with procedures and standards to respect. However, **it was estimated as too costly to be maintained** (cost of personnel training and personnel turnover), which is why the capacity was removed from the pool and the contract with LAR terminated. Nowadays, it would take a minimum of 3 weeks for LAR to relaunch the capacity (time necessary to train the personnel) and in 2020-2021, the "bubble" acquired will be obsolete and it will take more time for LAR to acquire new ones (developed in the UK).

[34] Sources: URL: https://hcpn.gouvernement.lu/en/actualites.gouvernement%2Bfr%2Bactualites%2Btoutes_actualites%2Bcommuniques%2B2015%2B03-mars%2B12-ebola.html and https://luxtimes.lu/archives/12692-luxembourg-helps-repatriate-suspected-ebola-patient;

Comparative costs analysis of the approaches for the transport of non-HID patient: Public versus private

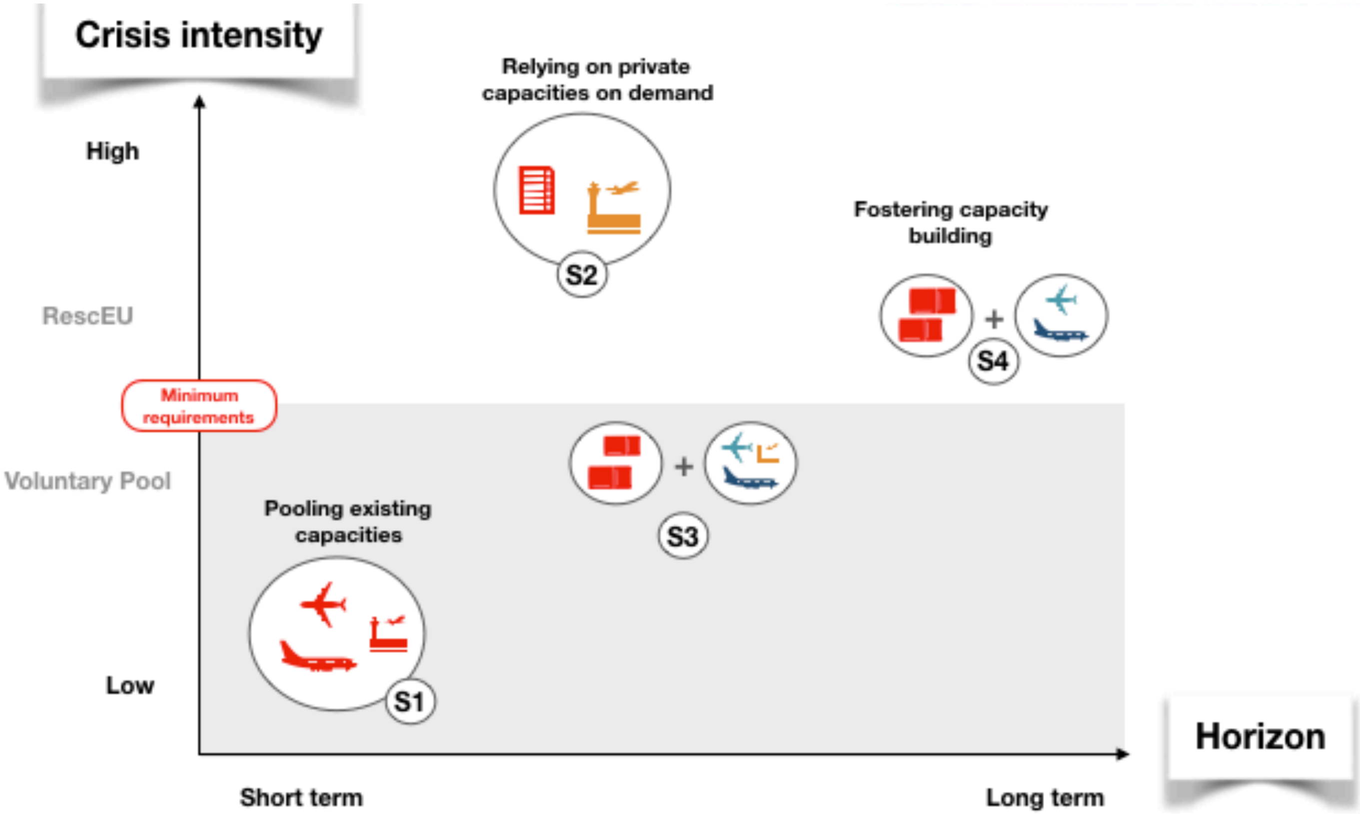
	Cost of use of state-owned permanent capacity	Cost of capacity from a service providers
Non-HID	**Case-study 3: Romania**	**Case-study 4: Sweden**
Non-HID	**Approach and use case:** Romania use military state-owned planes to ensure the aerial medical transport of victims during major crises. In October 2015, hundreds of people were severely burnt in a nightclub in Bucharest after a major fire.	**Approach and use case**: Since 2006, the Swedish National Air Medevac (SNAM) concluded a service contract for medical evacuation operated by Scandinavian Airlines (SAS). Following the Mumbai attacks, SNAM used a SAS passenger aircraft (Boeing 737-800 converted in 6 hours by SAS into a large-scale air-ambulance and staffed by trained medical personnel. When the mission was completed, and in accordance with the SNAM organisation plan, the plane was restored to its original condition no later than 12 hours after the previous one.
Non-HID	**Cost:** • The cost of operating a **CJ27 airplane per hour, based on approximately 400 hours of flight a year, is € 5,000 (without salaries, personnel).**	**Cost**: • In 2008, the total cost of the **Mumbai mission was SEK 5,7 million or € 525,997**. According to a commercial operator "it would have cost just as much as if the mission were carried out with small ambulances with space for one patient per plane, e.g. Lear Jet SNAM stands out as more cost-efficient when considering the quality of care, the space and the expertise offered by the SNAM flight, as well as the possibility to transport significantly more patients in one flight"[35]. • The service contract costs annually **SEK 1,760 million or € 162,412.99 million without the cost of flight hours for each mission.**
Non-HID	**Lesson learnt:** In Romania, it is cheaper to use military state-owned MEDEVAC planes in the event of a major disaster, which are **already paid off** and used for other mission, epecially regarding maintenance and storage costs. Service providers are more expensive regarding indirect costs.	**Lesson learnt**: The SNAM can fly anywhere in the world, on a very short notice, and is able provide a high level of medical ability in evacuating injured persons after a great accident or terrorist attack. Said differently, the SNAM/SAS solution offers experienced medical staff with high quality equipment and aircraft. However, **time restriction associated with the rental of the plane creates more pressure on the medical crew** because one extra-hour spent is an hour to pay. This constraint reduces the flexibility of the solution, especially when administrative procedure and decision-making process are lengthy.

PROPOSED SOLUTIONS

SOLUTIONS PROPOSED FOR THE VOLUNTARY POOL AND RESCEU FOR THE TRANSPORT OF HID PATIENTS

Solution 1	Pooling of existing UCPM Countries civilian and military state-owned capacities equiped for MEDEVAC of HID patients and capacities secured through framework contract with commercial airlines and/or service providers which offer a transport service for HID patients
Solution 2	European funding for UCPM countries to secure, via a framework contract, services with commercial airlines and/ or service providers which offer a transport service for HID patients
Solution 3	EU funding for the development and acquisition of HID MEDEVAC Kits (containers/pods, equipment's) and support the use of existing civilian and military state-owned capacities or contract services with commercial airlines
Solution 4	EU funding for the development and acquisition of HID MEDEVAC Kits (containers/pods, equipment) and for the acquisition of new/additional public capacities by one or several UCPM countries

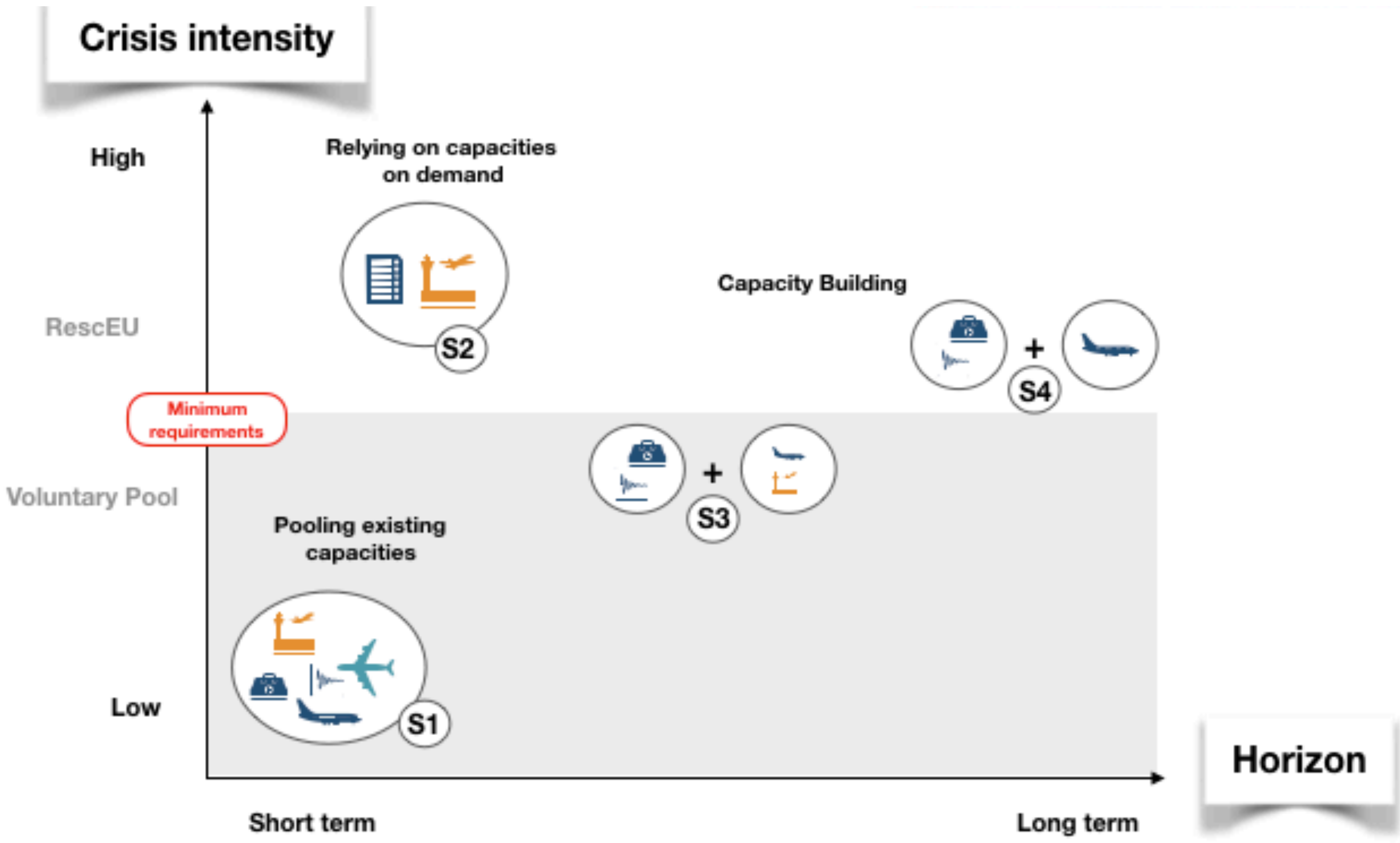
SOLUTIONS PROPOSED FOR THE VOLUNTARY POOL AND RESCEU FOR THE TRANSPORT OF HID PATIENT BASED ON CRISIS SEVERITY AND TIME HORIZON



SOLUTIONS PROPOSED FOR THE VOLUNTARY POOL AND RESCEU FOR THE TRANSPORT OF NON-HID PATIENT

Solution1	Continue pooling of existing UCPM Countries state-owned aerial capacities (civilian and military) with dedicated kits, modules and equipments and existing UCPM Countries aerial capacities secured through contract services with commercial airlines and service providers;	
Solution 2	European funding for UCPM Countries to secure, via a framework contract, services with commercial airlines and/ or service providers which offer a transport service for non-HID patients;	
Solution 3	EU funding for the acquisition of Medevac Kits (stretchers, medical equipment) and support the use of existing civilian and military state-owned capacities or contract services with commercial airlines;	
Solution 4	EU fundings for the acquisition of new/additional civilian state-owned aerial capacities and standardized kits, modules and equipment by one or several UCPM Countries.	

SOLUTIONS PROPOSED FOR THE VOLUNTARY POOL AND RESCEU FOR THE TRANSPORT OF NON-HID PATIENT BASED ON CRISIS SEVERITY AND TIME HORIZON



SWOT ANALYSIS

4.1.15 Analysis of solutions for a European MEDEVAC capacity for HID patient

Solution 1: Pooling of existing UCPM Countries civilian and military state-owned capacities equipped for MEDEVAC of HID patients and capacities secured through framework contracts with commercial airliners and/or service providers which offer a transport service for HID patients.

S	W
• Experienced aircrew and medical teams • Proven procedures and processes • Tested standards	• Only few capacities available in Europe which rely on military aircraft or service contrat with private operators • Availability of military assets • Few mature european HID module
O	**T**
• Foster and extend the scope of the Voluntary Pool • Increased support between the PS • Reduced costs	• Obtain political agreement of PS to allocate the public (military) capacities • Obtain agreement of the private operators to allocate the capacities

Solution 2: European funding for UCPM Countries to secure, via a framework contract, services with commercial airliners and/or service providers which offer a transport service for HID patients

S	W
• Relying on experienced aircrews and medical teams • Flexible solution & tailored services on demand • No need to maintain aerial capacity or medical equipment	• Public procurement processes (speed, complexity) • Number of European private actors willing to transport HID patients
O	**T**
• Offer response capacities for UCPM Countries in the short term • Harmonisation of MEDEVAC quality and technical standard for the transport of HID patient at European level	• Strategic skills externalised to the private sector (losing competence in the long term) • Obtain political agreement of PS • Obtain agreement of the private operators to allocate capacities

Solution 3: EU funding for the development and acquisition of HID Medevac kits (containers/pods, equipment's) and use of existing civilian and military state-owned capacities or contract services with commercial airliners

S	W
• Lessons learnt and best practice from the Luxembourg contrat with LAR • Ongoing similar project in Nordic countries can provide lessons-learnt	• Development and acquisition time cycle & costs for HID module • Certification process time cycle & costs • Availability of aerial capacities

O	T
• Incentive for UCPM Countries to build up their capacities at national or regional level • Foster UCPM Countries collaboration and European R&D • Create European standards for HID module	• Political decision at UCPM Countries level • Obtain agreement of private operators or allocation of public capacities • Overall costs • Obsolescence of HID module

Solution 4: EU funding for the development and acquisition of HID Medevac kits (containers/pods, equipment) and for the acquisition of civilian and/or military capacities by one or several UCPM Countries

S	W
• Lessons learnt from Luxembourg and Norway • Incentive for UCPM Countries to build up their aerial capacities at national or regional level	• Development and acquisition time cycle & costs of HID module • Aerial capacities acquisition and maintenance costs • Recurring costs

O	T
• Foster European R&D and create European innovative products for the transport of HID patients • Increased cooperation between UCPM Countries • Create European standards for HID module	• Political decision at UCPM Countries level • Obsolescence of HID Module

4.1.16 Analysis of solutions for a European MEDEVAC capacity for non-HID patient

Solution 1: Continue pooling of existing UCPM Countries state-owned aerial capacities (civilian and military) with dedicated kits, modules and equipment's and existing UCPM Countries aerial capacities secured through contract services with commercial airliners and service providers;

S	W
• Experienced aircrew and medical teams • Proven procedures and processes • Mature equipment • Existing standards	• Very few public capacities available • Availability of public capacities for multiple patients (only military) • Lack of interest from private operators
O	**T**
• Fostering and extending the scope of the Voluntary Pool • Increased support between the UCPM Countries • European offer worlwide	• Obtain political agreement of UCPM Countries to allocate the public capacities in the Voluntary Pool • Obtain agreement of private operators

Solution 2: European funding for UCPM Countries to secure, via a framework contract, services with commercial airliners and/or service providers which offer a transport service for non-HID patients

S	W
• Rely on experienced aircrews and medical teams • Flexible solution & tailored services on demand • Mature equipment & high quality standard • No need to maintain aerial capacity or medical equipment	• Public procurement processes (speed, complexity) • Certification process (time cyle & costs)
O	**T**
• Offer response capacities for UCPM Countries in the short term • Harmonisation of MEDEVAC quality and technical standard for the transport of non-HID patient at European level	• Strategic skills externalised to the private sector (loss of competence in the long term) • Political decision at UCPM Countries level

Solution 3: EU funding for the development and acquisition of Medevac Kits (stretchers, medical equipment's) and use of existing civilian and military state-owned capacities or contract services with commercial airliners

S	W
• Ongoing project in Nordic countries can provide lessons-learnt • Create European standards for non-HID module	• Development and acquisition time cycle & costs for MEDEVAC module • Availability of public aerial capacities for multiple patient (only military aicrafts) • Highly competitive market (for develoment of non-HID module)
O	**T**
• Incentive for UCPM Countries to build up their capacities at national or regional level • Foster UCPM Countries collaboration and European R&D	• Political decision at UCPM Countries level • Obsolescence of modules

Solution 4: EU funding for the development and/or acquisition of civilian state-owned aerial capacities and standardised kits, modules and equipment;

S	W
• Incentive for UCPM Countries to build up their aerial capacities at national or regional level • Create European standards for non-HID module	• Development and acquisition time cycle for non-HID module • Aerial capacities acquisition and maintenance costs, recurring costs • Highly competitive market (for develoment of non-HID module)
O	**T**
• Foster European R&D and create European innovative products for the transport of non-HID patients • Increased cooperation between UCPM Countries	• Political decision at UCPM Countries level • Obsolescence of non-HID Module

RECOMMENDATIONS

4.1.17 Recommendations for Solution 1 – (Continue) Pooling Capacities for MEDEVAC of HID and Non-HID Patients

Recommendation #1: The European Commission should continue encouraging UCPM Countries to pool capacities for the transport of both HID and non-HID patients by developing strong incentives, in particular the partial refund of recurring costs and support for the certification process.

According to the results of the study, the only currently existing civilian public aerial capacities, (namely those of Romania, Poland and Turkey), do not meet the requirements defined in the UCPM Implementing Decision (2014/762/EU, Annex II).

However as highlighted in the capacities overview, several countries have aerial capacities which could be included both in the Voluntary Pool or in rescEU: military transport aircraft dedicated to MEDEVAC or which can be configurated with MEDEVAC modules, or aerial capacities secured by UCPM Countries via contract services with commercial airlines.

These capacities, if pooled, could offer a rapidly deployable MEDEVAC response from different regions of the EU with amortized aircraft and experienced medical teams and crews.

Since the launch of the implementation Act for a MEDEVAC module within the UCPM, only one module was registered (Luxembourg, Ebola module with LAR as a service provider) but decommissioned 2 years later because of the high costs of maintaining the capacity (as illustrated in Draft report 4).

The main reason raised by interviewees not to maintain their dedicated capacities was a matter of resources. To meet the minimum technical requirements as defined in the Implementation Act (2014/762/EU), which require an availability for departure within a maximum of 12 hours after the acceptance of the offer, the capacity module needs to include enough medical personnel for 24/7, 365 availability, and ensure that the personnel (medical and crew) are continuously trained and the equipment ready. **The Implementation Act for the Voluntary Pool allows the refunding of deployment costs (up to 85%) but not of recurring costs,** a major downside according to UCPM Countries and operators.

→ The European Commission should study new incentives to convince UCPM Countries who have MEDEVAC capacities (public or private) to register them in the Pool and ultimately within rescEU:

- **Study the added value of modifying the Implementation Act for the Voluntary Pool to include a partial refund of recurring costs** (training of medical personnel and aircrew, maintenance, etc.) for capacities matching the minimum requirements.
- **Include a partial refund of recurring costs in the rescEU** Implementation Act

Nota Bene: The refund could be proportional to the availability of the aircraft.

- Capacities fully integrated in the Voluntary Pool, available 24/7 and 365, which can be deployed in 12 hours for non-HID patient and in 24 hours for HID patient could receive a refund of 85% for both deployment and some of the recurring costs.
- Capacities fully integrated in the rescEU, available 24/7 and 365, which can be deployed in 12 hours for non-HID patient and in 24 hours for HID patient could receive a refund of 85% for both deployment and some of the recurring costs.
- Capacities which could be requested on demand but are also used for other purposes, such as military capacities, could receive a refund of 85% for deployment costs and a special grant for recurring cost if they have been used under the UCPM during the year.

- **The European Commission could offer to UCPM Countries willing to register their MEDEVAC capacity (public or private) in the Pool or rescEU to facilitate the certification process of the modules, medical team and aircrews** via the participation in European exercises such as MODEX, or supporting financially of administratively the certification process for aircraft with EASA.

Nota Bene: The certification process for aircraft, personnel and equipment is long and costly, in particular for the transport of HID patient.

"The time needed for us to obtain our certification for our Ebola Module with EASA and finalise the administrative process was so long, that we were able to only use it twice whereas Phoenix Air conducted more than 80% of all Ebola patient transport during the outbreak. The European certification process was a liability and prevented us [European service provider] from answering the demand in time."

The **European Commission support could provide an incentive for UCPM Countries to register their public capacities but also to convince private Operators** who concluded a contract with a UCPM Countries to integrate the Pool or rescEU.

4.1.18 Recommendations for solution 2 – EU funding for UCPM Countries to secure capacities through contract with private sector

Recommendation #2: The European Commission should study the set-up of dedicated funding mechanism for UCPM Countries to secure aerial response capacities through contract services with commercial airlines or service providers and integrate the resulting capacities in the Voluntary Pool or in rescEU.

As illustrated in the capacities overview, there are important differences between UCPM Countries in their MEDEVAC capacities. France for instance relies on 11 MEDEVAC modules for the transport of ICU patients and lightly injured patients, and solutions for the transport of Highly contagious patients, but could also convert more than 90 military cargo aircraft on demand. Estonia, at the other end of the spectrum has no fixed-wing aerial capacities for MEDEVAC, for the transport of mass casualties or of HID patients.

For countries with a confirmed capacity shortage, the main constrain is the cost of developing or acquiring and then maintaining such capacities (as illustrated in Draft Report 3 - Options). This is especially true for capabilities dedicated to low-probability, high-impact crises. Acquiring and maintaining an expensive dedicated MEDEVAC capacity for a long duration, to respond to an event seen as unlikely (mass casualties) or for a very small number of patients (Ebola) is difficult to justify economically and politically.

As a result, several UCPM Countries, such as Sweden, Finland, or Ireland, have opted for framework or service contracts with commercial airlines or service instead of maintaining their own capacities.

Leveraging these countries' experience, services from private operators could provide a quick response to medical transport needs for exceptional emergencies.

→ **The European Commission could develop a dedicated funding mechanism to support countries or groups of countries willing to secure MEDEVAC capacities through a framework contract with a private operator.**

The amount of the funding could be adapted according to different cases:

- Up to 60% refund on the framework contract annual fees for a capacity which match the minimal technical requirements of the implementation Act of the Voluntary Pool and will be registered in the Pool;

- Up to 70% refund on the framework contract annual fees for a capacity which match the minimal technical requirements of the implementation Act of rescEU and will be registered in rescEU.

To encourage both UCPM Countries and private operators, it will be **important to remind that as soon as registered in the Pool or rescEU, they may be able to benefit from the partial refund of deployment cost and recurring costs as proposed in Recommendation#1.**

Nota Bene: A noteworthy initiative which could be also studied, is the launch of a call within rescEU for a framework contract for the transport of HID patient which could be financed by the UCPM Countries. The call could be opened to European consortiums.

4.1.19 Recommendations for solution 3 – EU funding for the development/acquisition of Module and use of existing capacities

Recommendation #3: The European Commission should study the set-up of dedicated funding mechanism within rescEU for UCPM Countries to develop MEDEVAC modules (HID and non-HID) and support the use of existing modular capacities not dedicated to MEDEVAC.

Throughout the data collection to identify current approaches and existing capacities, it was noted that **several UCPM Countries owned several or numerous cargo transport aircraft which could be configured to conduct MEDEVAC missions.**

As an illustration, Germany owns 2 Airbus A340-300, 3 Airbus 319, 31 A400M, 4 Global express 5000, 29 Transall C160 and has ordered 3 Global express 6000, 3 C-130J Super Hercules, 22 A400M and 3 A350. Bulgaria owns one A319, 1 Pilatus PC-12,1 Antonov An-24, 2 Let L-410, 3 Alenia C-27J, 1 Antonov An-2 and 1 Falcon 200 all operated by their Ministries of Defence. Those aerial capacities are **primarily dedicated to military operations and not configured for MEDEVAC.**

→ The European Commission could create a dedicated funding mechanism for the development or acquisition of MEDEVAC module (for both HID and non-HID) by one or several UCPM Countries and support the use of existing modular capacities.

The amount of the funding could be adapted according to different cases:

- Up to 60% refund on the development and/or acquisition of a HID module and adaptation of a capacity which match the minimal technical requirements of the implementation Act of the Voluntary Pool and will be registered in the Pool;

- Up to 60% refund on the acquisition of a non-HID module and adaptation of a capacity which match the minimal technical requirements of the implementation Act of the Voluntary Pool and will be registered in the Pool;

- Up to 70% refund on the development and/or acquisition of a HID module and adaptation of a capacity which match the minimal technical requirements of the implementation Act of rescEU and will be registered in rescEU.

- Up to 70% refund on the acquisition of a non-HID module and adaptation of a capacity which match the minimal technical requirements of the implementation Act of rescEU and will be registered in rescEU.

Nota Bene: Non-HID modules/kits are a mature market for which it does not seem useful to develop additional equipment, and therefor to for the Commission to refund development cost.

To encourage both UCPM Countries and private operators, it will be important to remind that as soon as registered in the Pool or rescEU, they may be able to benefit from the partial refund of deployment cost and recurring costs as proposed in Recommendation #1.

The implementation of these proposal could benefit from the experience of the Nordic Countries who launched a project to co-develop a HID module which could be integrated in an aircraft provided by SAS (Swedish commercial airliner) via a framework contract. This project aims to providing several countries with a flexible capacity and share the costs.

4.1.20 Recommendations for solution 4 – EU funding for the acquisition of Module and capacities

Recommendation #4: The European Commission should study the set-up of dedicated funding mechanism for UCPM Countries to acquire public aerial equipped for the MEDEVAC of both HID and non-HID patient matching the minimum technical and quality requirements of the Voluntary Pool or rescEU.

The Nordic Project for the transport of HID patients relies on the use of capacities from the private sector. However, **some UCPM Countries expressed their intention to find long term publicly sourced solutions to their MEDEVAC capacity gap.**

As presented in the analysis of the different approaches (Draft Report – Options) and highlighted in the SWOT analysis of solution 2, the externalisation of MEDEVAC capacities to a private operator may lead to the loss of certain key skills in the public sector. Some UCPM Countries may be intent on keeping these skills within their organisations.

One another note, some UCPM Countries depend on military organisations (e.g. NATO) or other countries' public or private capacities to respond to specific patient needs such as the transport of multiple patients (Ireland with the U.S., Romania with NATO) or the transport of HID patient (Phoenix air used for 80% of the medical evacuation of European citizen during the 2014-2016 Ebola Outbreak in West Africa).

These situations raise the question of the availability of the capacity (for NATO military aircraft for instance) and of the externalisation of a strategic capacity to a third country which is not a member of the UCPM.

→ The European Commission could propose a dedicated funding mechanism for the development and/or acquisition of a MEDEVAC module (for both HID and non-HID) and facilitate the acquisition of aerial capacities by several UCPM Countries.

The amount of the funding of the development/acquisition of modules could be adapted according to different cases:

- Up to 60% refund on the development and/or acquisition of a HID module which match the minimal technical requirements of the implementation Act of the Voluntary Pool and will be registered in the Pool;

- Up to 60% refund on the acquisition of a non-HID module which match the minimal technical requirements of the implementation Act of the Voluntary Pool and will be registered in the Pool;

- Up to 70% refund on the development and/or acquisition of a HID module which match the minimal technical requirements of the implementation Act of rescEU and will be registered in rescEU.

- Up to 70% refund on the acquisition of a non-HID module which match the minimal technical requirements of the implementation Act of rescEU and will be registered in rescEU.

Facilitate the collaborative acquisition and sharing of MEDEVAC aerial capacities matching the technical requirements of the Voluntary Pool or rescEU.

→ The European Commission could facilitate the acquisition of aerial capacities by a group of UCPM Countries by supporting the establishment and

implementation of collaborative projects to pool and share modular aircrafts which could be configurated for MEDEVAC by:

- **Offering a forum for identifying common capacities response needs** and potential synergies at regional level;
- **Giving a political impulse**;
- **Providing a financial, technical, legal and operational expertise**;

Nota Bene:

- *Non-HID modules/kits are a mature market for which it does not seem useful to develop additional equipment, and therefor to for the Commission to refund development cost.*
- *The aviation market is mature and propose a wide range or aircrafts which could meet the minimal technical requirements of both Voluntary Pool and rescEU, reason why it does not seem useful to develop additional aircraft, and therefor to for the Commission to refund development cost.*

To encourage both UCPM Countries, it will be **important to remind that as soon as registered in the Pool or rescEU, they may be able to benefit from the partial refund of deployment cost and recurring costs as proposed in Recommendation#1.**

MINIMAL TECHNICAL AND QUALITY REQUIREMENTS FOR RESCEU

4.1.21 Quality and technical standard, certifications and standard operating procedures.

Air ambulance operator (public or private) are following different quality and technical standards, use certified equipment and implement standard operating procedures (SOPs) for the medicalised transport of patient.

4.1.21.1 Aircraft and cabin crew standards

Whether in a public or private service provider case, aircrafts, pilots and cabin crew deployed for a MEDEVAC operation must be compliant with the following rules set up by the European Union Safety Aviation Agency (EASA):

Documents	Description	Link
Regulation on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91	Basic regulation for civil aviation, including medical certification of aircrew.	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R1139&from=EN
Regulation laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council	Technical requirements and administrative procedures related to civil aviation aircrew.	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02011R1178-20190109&from=EN
Regulation laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and the Council	Technical requirements and administrative procedures related to air operations.	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02012R0965-20140217&from=EN
Regulation amending Regulation (EU) No 452/2014 as regards the deletion of templates for the authorisations issued to third country operators and for the associated specifications	Regulation related to third countries operators (TCO).	https://www.easa.europa.eu/sites/default/files/dfu/Commission%20Regulation%202016.1158.pdf

Regulation laying down airspace usage requirements and operating procedures concerning performance-based navigation	Regulation laying down airspace usage requirements and operating procedures concerning performance-based navigation. It applies to providers of air traffic management/air navigation services (ATM/ANS), and operators of aerodromes (hereinafter 'providers of ATM/ANS') that are responsible for putting in place instrument approach procedures or air traffic service (ATS) routes, where they provide their services.	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R1048&from=EN
Regulation amending Implementing Regulation (EU) No 923/2012 as regards the update and completion of the common rules of the air and operational provisions regarding services and procedures in air navigation (SERA Part C) and repealing Regulation (EC) No 730/2006	SERA - Standardised European Rules of the Air.	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R1185&from=EN
Regulation laying down a list classifying occurrence in civil aviation to be mandatorily reported according to Regulation (EU) No 376/2014 of the European Parliament and of the Council	Regulation related to occurrences related to the operation of the aircraft, technical conditions, maintenance and repair of the aircraft, air navigation services and facilities, aerodromes and ground services.	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R1018&from=EN
Regulation laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances, as well as for the certification of design and production organisations (recast)	Regulation related to initial airworthiness.	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02012R0748-20150721&from=EN
Regulation on additional airworthiness specifications for a given type of operations and amending Regulation (EU) No 965/2012	Additional airworthiness specifications.	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R0640&from=GA

Regulation on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval or organisations and personnel involved in these tasks (recast)	Continuing airworthiness.	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02014R1321-20190305&from=EN

4.1.21.2 Transport of patients

There is no harmonised European Standard Operating Procedures (SOPs) related to the aerial transport of patients regardless of the actor considered (military, public or private service provider).

- Certification and license for pilots, doctors, nurses and technicians are usually issued by the home country of the individual considered. For instance, in France, the Direction Générale de l'Aviation Civile (DGAC) is in charge of issuing certification for flight doctor, while the Organisme pour la Sécurité de l'Aviation Civile (OSAC) delivers aircraft mechanic license.
- There is an obligation of insurance for every MEDEVAC operation. Doctors are usually responsible for all medical gestures, while engineers are responsible for the aircraft as such. The responsibility mechanism can be very complex in case of a litigation, especially if there is an accident in a third country.

Despite the absence of common SOPs, quality standards charts are developed by professional associations. The most commonly followed are:

- **EURAMI – European Aeromedical Institute**[36]
    - Operational experience/maturity
    - Personnel and infrastructure
    - Aircraft

[36] https://eurami.org/

- **CAMTS – Commission on Accreditation of Medical Transport Systems**[37]
  - Quality of patient care
  - Safety of the transport environment
- **NAAMTA – National Accreditation Alliance Medical Transport Applications**[38]
  - Transport safety
  - Patient care
  - Quality management and continuous improvement

Below, some examples of standards developed by EURAMI (non-exhaustive) for air ambulance and applicable to the cabin crew, the medical staff, the service provided, the management of the operation, the training followed, the insurances, etc.

<u>Standards related to safety and quality management</u>

Safety and Quality management	**Quality control**	• The aeromedical service has a quality management committee that meets on a regular basis • The aeromedical service has a written policy defining the quality management system and its processes.
	Quality audit processes	• The aeromedical service has quality management tools designed to collect, monitor and assess the activities and performance of the service continuously and in real time.
	Safety management	• The service operates its safety management system (SMS) in conformance to the regulations promulgated by the aviation regulatory body which has jurisdiction in the area(s) of the service's operations. • The safety management system is understood and followed at all levels and by all staff and and/or subcontractors.
	Risk management	• The safety management system is linked with risk control/management, so that concerns raised through the risk management process can be followed up through the continuous quality control program.

[37] https://www.camts.org/
[38] https://naamta.com/

Standards related to mission operations

Mission operations	**Operations**	• The logistic management and handling of aircraft, aircrew, engineering, medical crew, and all the support needed to successfully complete an air ambulance transport is undertaken by an operations department.
	Communications	• The communications centre is available 24 hours a day all year round. • Staff are aware that noise and other distractions must be minimised in the communications area while personnel are involved with a medical transport mission.
	Flight planning	• Maps and navigation charts for the entire area(s) of operation are readily available. • Flight planning hardware and software must be updated on a continuous basis, so that all charts, maps, documents, and references are always current.
	Operations personnel	• There shall be adequate personnel to provide full coverage of all operations activities using a staff rota that enables 24 hours cover all year round. • Shall have a full command of the official languages of the country in which the aeromedical service is based, as well as of English if the service is not based in an English-speaking nation.
	Incident plan	• The aeromedical service must have a readily accessible post incident plan as part of the flight following policy so that appropriate search and rescue efforts are initiated in the event that an aircraft is overdue, or radio communications cannot be established or verified.

Standards related to medical management

Medical management	**Medical department overview**	• The service has a dedicated and integrated medical department, the structure of which is described using one or more hierarchy charts. The charts show the following details of the medical management structure. • Medical department of the service employs appropriately qualified and experienced personnel in key office-based appointments.

	Standards for medical personnel	• Successful completion of the educational components specified by the training program are documented for each member of the flight medical personnel. • Each individual member of the medical department is appraised at a regular assessment/evaluation meeting by one or more senior medical managers, during which their training record and mission logbook are checked to ensure the established minimum standards of the service are upheld.
	Medical training	• The service holds current and historical evidence of planned and structured training programs including attendance records of all flight medical personnel employed or contracted by the service. • Performance of each flight medical crew person at each training session is measured against a set of minimum standards of competency and currency, as established by the Medical Director and based on the Mission statement and scope of the service.
	Medical personnel	• The service employs a Medical Director (may be called 'Chief Medical Officer', 'Senior Flight Physician' or such other term as is preferred by the air ambulance service) who is available for consultation within normal day-time working hours. • The service employs a clinical manager, who may be a Flight Nurse Manager (otherwise known as 'Chief Flight Nurse', 'Senior Flight Nurse' or such other term as preferred by the air ambulance service) or other health care professional of similar seniority. • If the service employs its own Flight Doctors (also known as Flight Physicians). Every flight physician employed by the service, both full and part-time, shall comply with the following criteria: o Possesses a license to practice and is professionally registered in the country in which the air ambulance service is based o Has at least two years of relevant clinical experience, in either anesthesia, intensive care medicine, or emergency medicine. o (If undertaking critical care transfers) – Has at least 12 months experience in a critical care environment o Maintains clinical currency in an acute medical role on a weekly or monthly basis o Has full command of the official language of the country in which the air ambulance service is based o Has a good working knowledge of the English language if the service is operating internationally o Continuing education is provided and documented for flight doctors and is specific and pertinent to the mission statement and scope of care of the air ambulance service • Specialist personnel may be employed or sub-contracted for neonatal, paediatric, advanced critical care transfers (such as extra- corporeal membrane oxygenation transports), or other highly specialised areas of clinical practice.

Standards related to clinical practice

Clinical practice	**Scope of service**	• All the aircraft to be accredited are configured to match the specific needs of each patient by the instillation of a stretcher system with monitoring and therapeutic devices and by the carriage of medical gases and other Medical consumables, as well as by resourcing appropriate medical staffing for the level of patient care required.
	Medical resources	• The service must demonstrate compliance with national medicines management laws, regulations and procedures • Evidence must be provided to demonstrate compliance with national and/or local regulations and recommendations concerning medical gases. • The service must provide a list of all major items of medical equipment.
	All medical consumables	• The service has stock-checking and supply systems which tracks shelf-lives, servicing due dates, and levels of consumables immediately available for use.
	Medical capabilities	Clinical management during missions • The service must demonstrate an appropriate method for selecting the number of flight medical crew on each mission, and their skill mix or specialty status. • Flight medical personnel are involved in the clinical decision making in terms of care provided during the mission Patient transport documentation • Evidence must be provided that preparation for transport is based on a patient medical report, clinical and logistic risk analysis, assessment of medical equipment and supplies needed, as well as the logistics and geography of the mission. • Evidence shall also be provided that preparation for transport is based on a clinical and logistic risk analysis • A patient care transfer record is completed during every mission. Minimal requirements for items to be documented are: o Purpose of the transport o Clinical assessment of patient prior to departure from point of origin o Patient condition at predetermined time inverals during the transfer o Treatment, medications, and patient's response to treatment and medications o Transport modalities for all stages of the transfer o Transfer timings

		o Names and professions of flight medical crew o Transfer timings o Details of the referring and receiving medical teams and conformation of receipt of clinical handovers

Standards specific to private service providers

Standards specific to private service providers	**Business ethos**	• The aeromedical service clearly specifies its scope of care. • The aeromedical service has a written code of ethical conduct that demonstrates ethical practices in business and marketing. • The aeromedical service audits its routine of external providers of patient transport and care to ensure they offer the same level of ethical service. • The aeromedical service is properly directed and staffed according to the mission statement, anticipated individual needs, and scope of services offered.
	Legal compliance	• The aeromedical service demonstrates compliance with the legal requirements and regulations of the government, aviation regulatory body and local agencies under whose authority it operates.
	Financial requirements	• The service must provide a description of the way the service is funded, supported by evidence from audited accounts. A statement from the accountant is sufficient. • There must be evidence in audited accounts to demonstrate that the service has sufficient financial reserves to sustain normal operations for at least three months. A statement from the accountant is sufficient.
	Insurance	The aeromedical service shall hold an appropriate level of insurance cover (according to the scale of the scope of its business) in the following areas: • Third party liability indemnity cover for each aircraft with limits set by the relevant aviation regulatory body • Malpractice indemnity cover for health care professionals with limits of USD 3 million or above • Health insurance, including injury and accident cover with death in service benefits • Loss or damage of essential assets (aircraft, medical equipment)

	Human resources	• Staff shall receive feedback and appraisals at regular intervals. • There is a clear reporting mechanism to upper level management.
	Management hierarchy	• There shall be a well-defined line of authority. • There shall be a policy that specifies the lines of communication and authority between the medical management team and the aviation team.
	Air ambulance philosophy	• Evidence shall demonstrate that quality patient care is not compromised by financial pressures. • Patient care treatment and monitoring must be provided continuously and without any disruption during the whole transport.

4.1.22 Minimum requirements – Proposed Threshold between Voluntary Pool and RescEU for HID patients

	Voluntary Pool	RescEU
Tasks	Transport a highly infectious disease patient to health facilities for medical treatment in the EU.	Transport highly infectious disease patients to health facilities for medical treatment in the EU.
Main characteristics	Minimum 4 crew members Minimum 4 medical personnel (1 coordinator, 1 doctor, 1 nurse, 1 technician)	Min 4 crew members Medical personnel (1 coordinator, 1 doctor*, 1 nurse*, 1 technician) * per patient
Transport capacities	Capacity to transport 1 patients per flight Ability to fly day and night.	Capacity to transport up to 4 patients per flight Ability to fly day and night.
Main components	Medium to long range airliner	Medium to long range modular airliner
Availability	Availability for departure maximum 24 hours after the acceptance of the offer.	Availability for departure maximum 24 hours after the acceptance of the offer.

4.1.23 Scenario 1: Minimum requirements for a Highly Infectious Disease Patients MEDEVAC Capacity under RescEU

Main characteristics	
Main task	Transport highly infectious disease patients to health facilities for medical treatment in the EU
Optional tasks	Transport of other highly contaminated patients (e.g. CBRN)
Transport Capacities	
Patients	Capacity to transport up to 4 HID patient per flight
Medical team tasks per 24 hours of activity, working in two shifts.	Medical team capable of providing maintenance care for 1 HID patient
Flight abilities	Ability to perform continuous operations (night and day)

Main components	
Aerial transport vector	Medium to long range cargo airliner
Configuration	Containerized, modular system
Flight crew per 12-hour shift	Minimum of 4 crew members: 1 pilot, 1 co-pilot, 1 turnaround coordinator, 1 flight technician if necessary
Medical teams per 12-hour shift	- 1 coordinator - 1 Medical doctor - ICU/Emergency with prehospital experience and aviation physiopathology training and experience in HID patients* - 1 Registered nurse - ICU/Emergency and with prehospital experience and aviation physiopathology training and experience in HID patients* - 1 Medical technician ICU/Emergency with prehospital experience and aviation physiopathology training with experience in HID containers/isolation pods *per patient
On board equipment	- Medical equipment to provide maintenance care to HID patients during flight.
Storage and maintenance	- Medical equipment storage and maintenance (drugs and consumables); - Maintenance and storage of HID module (isolation container/pod);
SOPs	• SOP(s)/procedures to isolate the patient(s) • SOP(s)/procedures to provide care for the patients (during transport and flight) • SOP(s)/procedures to transfer the patient(s) to an isolated area within the hosting treatment facility • SOPs/procedures to decontaminate the plane and equipment
Availability	
Deployment	Availability for departure in maximum 24 hours after the acceptance of the mission
Range (flight length in time)	Ability to perform a 6 to 12+ hours flight without refuelling

Key points

- **Optional task:** The transport of patients contaminated by contagious bacteriological agents requiring isolation is a patient need which could be envisaged in the future and which could be addressed by a similar capacity than the European aerial MEDEVAC capacity for HID patients in the framework of rescEU;

- **Patient transport capacity:** The capacity to transport several HID patients may change with evolving isolation systems (dimensions, etc.). A minimum of 1 HID-patient transport capacity is suggested;
- **Aerial transport vector:** A medium to long range aircraft would enable the rescEU capacity to transport HID patients from outside EU. A cargo aircraft is necessary to load the isolation container of HID patients;
- **Configuration:** The aircraft need to be modular, containerized to fit an isolation container;
- **Flight crew per 12-hour shift:** The exact composition of the crew will depend on the plane and operator standards but as a minimum the crew team should encompass 1 pilot, 1 co-pilot, 1 turn-around coordinator;
- **Medical team per 12-hour shift:** The exact composition of the medical team will depend on the number of HID patients transported and operator standards but as a minimum the medical team should encompass:
  - 1 medical coordinator;
  - 1 medical doctor and 1 registered nurse per patient, all with prehospital experience and aviation physiopathology training and with experience in HID;
  - 1 Medical technician with experience in HID isolation containers;
- **Deployment:** The aircraft should be available for departure maximum 24 hours after the acceptance of the mission, allowing enough time to mobilise the flight crew, trained and experienced medical team, organise the logistics and obtain the flight authorisation;
- **Range (flight length in time):** To transport EU HID patients from outside the EU, the aircraft should have the ability at the minimum to perform a 6 to 12+ hours flight without refuelling, which corresponds to a medium- to long-range airliner.

Conclusion Scenario 1:

According to the return of experience of Luxembourg Air Rescue (LAR), **a minimum of three aircraft equipped for the transport of HID patients** (based on the minimal technical requirements) would be necessary to meet up with the deployment criteria.

This minimum number would allow to **take into account maintenance and repair cycle. For instance, with one aircraft in maintenance, there will be at least two that could be deployed alternatively.**

4.1.24 Minimum requirements – Proposed Threshold between Voluntary Pool and RescEU for non-HID patients

	Voluntary Pool	RescEU
Tasks	Transport disaster victims to health facilities for medical treatment.	Transport disaster victims to health facilities for medical treatment.
Main characteristics	Self-sufficiency (Article 12)	Min 8 crew members:* *If necessary for sitting patients Medical personnel* * according to number & pathology of patient
Transport capacities	Capacity to transport 50 patients per 24 hour. Ability to fly day and night.	Capacity to transport: 40 sitting patients; or 10 patients in stretchers; or up to 6 patients in need of intensive care (ICU) Ability to fly day and night.
Main components	Helicopters/planes with stretchers	Medium to long range modular airliner
Availability	Availability for departure maximum 12 hours after the acceptance of the offer.	Availability for departure maximum 12 hours after the acceptance of the offer.

4.1.25 Scenario 2: Minimum requirements for a Non-Highly infectious disease patients MEDEVAC capacity

Main characteristics	
Main task	Transport disaster victims to health facilities for medical treatment in the EU.
Optional tasks	Transport of other modules: EMT, water purification unit, field hospital, etc.
Transport capacities	
Patient transport capacity per flight (or)	- Capacity to transport 40 sitting patients, OR - Capacity to transport 10 patients in stretchers, OR - Capacity to transport up to 6 patients in need of intensive care (ICU).
Medical team tasks per 24 hours of activity, working in two shifts.	Medical team capable of providing: - Maintenance care for up to 6 ICU, or 10 patients in stretchers or 40 lightly injured patients - Advanced life support care in case of emergency to all types of patients

Flight abilities	Ability to perform continuous operations (night and day)
Main components	
Aerial transport mean	Medium to long range airliner
Configuration	Modular system
Flight crew per 12-hour shift	Minimum of 8 crew members: 1 pilot, 1 co-pilot, 1 turnaround coordinator, and 4 cabin attendants* *If necessary for sitting patients
Medical team per 12-hour shift	- 1 coordinator - 1 chief medical officer - 1 chief nurse - 1 Medical doctor - ICU/Emergency with prehospital experience and aviation physiopathology training per 2 patients - 1 Registered nurse - ICU/Emergency with prehospital experience and aviation physiopathology training per patient - Medical technician - ICU/Emergency with prehospital experience and aviation physiopathology training if necessary (for ICU) NB: The exact number of medical doctors and nurses will depend on the number and pathology of the patients
On board equipment	- Medical equipment to provide maintenance care to all patients during the flight - Medical equipment to provide advanced life support care in case of emergency to all type of patients
Storage and maintenance	Medical equipment maintenance and storage (drugs and consumables) Maintenance and storage of the equipment: ICU modules, stretchers
SOPs	- SOP(s)/procedures to provide care for the patients (during transport and flight) - SOPs to transport patients from the aircraft to the hospital on arrival
Availability	
Deployment	Availability for departure maximum 12 hours after the acceptance of the mission
Range (flight length in time)	Ability to perform a 6 to 12+ hours flight without refuelling

Key points

- **Optional task:** The transport of other modules of the Voluntary Pool could be an added value during a crisis (water purification unit, EMT 1 or 2, high capacity pumping, etc.
- **Patient transport capacity: The** capacity to transport several non-HID patients will depend on the type of plane. An evaluation of the transport capacities of several medium-range airliners leads to the following suggestions of a minimum for the rescEU capacity according to each patient need:
  - Lightly injured patients: Minimum 40 patients (transport of less than 40 patients could be covered by the voluntary pool) or;
  - Patients in stretchers: Minimum 10 patients in stretchers (transport of less than 10 stretchers could be covered by the voluntary pool) or;
  - Patients in need of ICU: Up to 6 patients in need of ICU (transport of less than 6 ICU patients could be covered by the voluntary pool).
- **Aerial transport vector:** A medium to long range aircraft would enable the rescEU capacity to transport non-HID patients from outside EU;
- **Configuration:** The aircraft should be modular, to be configurated for either sitting patients, stretchers or ICU modules.
- **Flight crew per 12-hour shift:** The exact composition of the crew will depend on the plane and operator standards but as a minimum the crew team should encompass 1 pilot, 1 co-pilot, 1 turn-around coordinator and if necessary, and 4 flight attendants (for sitting patients);
- **Medical team per 12-hour shift:** The exact composition of the medical team will depend on the number of non-HID patients transported, their exact pathology and operator standards but as a minimum the medical team should encompass:
  - 1 medical coordinator;
  - 1 chief medical officer;
  - 1 chief nurse;
  - 1 medical doctor - ICU/Emergency with prehospital experience and aviation physiopathology training per 2 patients;
  - 1 registered nurse - ICU/Emergency with prehospital experience and aviation physiopathology training per patient;
  - 1 Medical technician ICU/Emergency with prehospital experience and aviation physiopathology training if necessary (for ICU systems);
- **Deployment:** The aircraft should be available for departure maximum 12 hours after the acceptance of the mission, allowing enough time to mobilise the crew, trained and experienced medical team, arrange logistics and obtain the flight authorisation;
- **Range (flight length in time):** To transport EU non-HID patients from outside the EU, the aircraft should have the ability at the minimum to perform a 6 to 12+ hours flight without refuelling, which correspond to a medium to long-range airliner.

Conclusion Scenario 2:

Considering the **diversity of pathologies** and patient that are included in the non-HID scenario, and type of crisis that could require the European Non-HID Medevac Capacity, **it would be more adapted to create regional reserve of capacities at EU level.** The exact number of aircrafts within each regional reserve should be defined according to the region's specific needs and based on Member States & Participating States assessment.

5 ANNEXES

STANDARD MEDICAL EQUIPMENT FOR AIR AMBULANCE

Equipment for an air ambulance can differ from one MEDEVAC operation to another depending on the patient's needs.

- All the removable materiel used is directly certified by the relevant constructors;
- Stretchers in particular must be certified by a specific EASA (European Union Safety Aviation Agency) supplemental type certificate (STC) guaranteeing their suitability in different aircrafts.

Below, examples of list of equipment that can be found in an air ambulance.

5.1.1 Example from EURAMI (European Aeromedical Institute)

Patient carriage and movement	• Aircraft stretcher system(s) with loading device(s) • Vacuum mattress • Carrying sheet or transfer mattress • Memory foam mattress • Scoop stretcher • Isolated extremity immobilisation devices (Sager, hare, Donway, etc) • Upper spinal immobilisation collars
Airway	• Onboard oxygen cylinder (min 3000 L) with regulator • Portable oxygen cylinder (min 400 L) with regulator • Flow meter (standard) • Flow meter (low flow) • Spare Bodok seals for independent cylinders • Spare oxygen cylinder key/spanner for independent cylinders • Oxygen masks (with and without reservoir/rebreathing; fixed fraction; anaesthetic) • Nasal cannulated • Nebulisation device • Oropharyngeal airways • Nasopharyngeal airways • A suction device and suction catheters
Ventilation	• Bag/valve/mask with oxygen reservoir and tube to connect to oxygen source • Laryngoscope(s) with suitable blades • Endotracheal tubes (range of sizes) with connectors • ET tube fixing materials • Tracheostomy kit (range of tracheostomy tubes; insertion stylets; inflation tube clamp; inflation syringe) • Magill forceps • Alternative devices for difficult airway management kit (examples include but are not limited to: Combitube; LMA; FastTrach; Trachlight; straight blades, McCoy laryngoscope; bougie introducers) • Air portable transport ventilator (obligatory for advanced critical care transport) • Controlled and assisted ventilation

	• PEEP-valve, adjustable • CPAP system (indubated & non indubated patients) • BIPAP/Bi-level system • Pressure and volume control • Triggered/non-triggered • Oxygen monitoring system • Low pressure alarm • Oxygen supply tubing with various connectors • Chest drainage kit (thoracostomy tube; drainage bag; surgical instruments) • Heimlich valve or Asherman seal
Circulation	• Appropriate equipment for placing and maintaining intra-venous access • Appropriate equipment for placing and maintaining intra-osseous access • Appropriate equipment for placing and maintaining intra-arterial access (obligatory for advanced critical care transport) • Syringe driver (s) • Infusion pump(s) • IV pole(s) got mounting fluids • IV pressure bag(s)
Patient monitoring	• Cardiac monitor • 12-lead ECG (obligatory for advanced critical care transport) • Defibrillator with rhythm display, recording and documentation of patient data • External transcutaneous pacing (obligatory for advanced critical care transport) • Automatic non-invasive BP monitoring system • Invasive BP monitoring system (obligatory for advanced critical care transport) • Pulse oximeter • Electronic temperature monitoring • End tidal capnometer (obligatory for advanced critical care transport)
Diagnostic equipment	• Stethoscope • Manual blood pressure device (sphygmomanometer or electronic) • Thermometer (minimum range 15C – 42C) • Diagnostic light • Blood gas analyzer (obligatory for advanced critical care transport) • Blood labs analyser(s) for hemoglobin and electrolytes (obligatory for advanced critical care transport) • Blood glucometer

Nursing	• Vomit bag • Kidney bowl • Bed pan • Bed pan inserts • Non-glass urine bottle or receptacle • Absorbent gel • Biological fluids spill kit • Shaprs container • Bedding equipment (sheets, blankets, pillows, pillowcases) • Waste bags (standard and clinical) • Wound treatment materials • Treatment materials for wounds caused by burns and corrosives • Adhesive fixing materials • Nasogastric tube with accessories • Sterile surgical gloves
Personal protection	• Skin cleaning and disinfection material • Non-sterile gloves • Aprons • Googles • Face masks/guards
Miscellaneous (as per scope of the service)	• Small surgical kit (e.g. scalpels, suture holder, forceps, scissors, clamps, etc) • Emergency delivery set • Physical restraint systems • Electrical extension plug bank for medical equipment • International electrical adaptors for medical equipment • Cool box for medications and temperature sensitives consumables • Temperature monitoring recorder (non-clinical) for cool box • Electrically powered medical devices shall have a self-contained power supply so that the devices do not rely on the power supply from the aircraft

5.1.2. Examples from service providers

5.1.1.1 Example 1: International SOS

Minimum equipment	Example	Quantity per patient	Price	Total
• Multi parameter vital sign monitor with defibrillator pace	• Corpuls 3	• 1	• 45,000 €	• 45,000 €
• Backup monitor	• PropaqLT	• 1	• 8,000 €	• 8,000 €
• AED	• Corpuls AED	• 1	• 1,500 €	• 1,500 €
• Ventilator	• Newport HT70	• 1	• 20,000 €	• 20,000 €
• Electric syringes	• Braun perfuser compact	• 2	• 2,500 €	• 5,000 €
• Mucous suction unit	• Laedal	• 1	• 1,000 €	• 1,000 €
• Vacuum mattress	• Ferno	• 1	• 500 €	• 500 €
• Cervical collar	• Laerdal	• 1	• 75 €	• 75 €
• Splints (set of 3)	• Ferno	• 1	• 350 €	• 350 €
• Medical bag with equipment (estimate)	•	• 1	• 10,000 €	• 10,000 €
• Nurse bag with equipment (estimate)	•	• 1	• 5,000 €	• 5,000 €
• Burn bag	•	• 1	• 1,500 €	• 1,500 €
• Stretcher system (with loading ramp)	• Lifeport	• 1	• 175,000 €	• 175,000 €
• Portable O2 bottles	•	• 1	• 0 €	• 0 €

• Personal protective gear (uniform, shoes, glasses)	•	• 2	• 350 €	• 700 €
• Miscellaneous (pillow, blanket, sheets, transfer mat, etc)	•	• 1	• 150 €	• 150€
• Administrative equipment	• Ipad and Electronic Health Record (HER)	• 1	• 1,500 €	• 1,500 €
• TOTAL				• 275,275 €

Specific equipment (as needed)	Example	Quantity per patient	Price	Total
• Difficult airway management	• Fibroscope	• 1	• 5,000 €	• 5,000 €
• Difficult airway management	• Video laryngoscope	• 1	• 5,000 €	• 5,000 €
• Ultrasound	• Clarius	•	• 7,500 €	• 7,500 €
• ECMO (Extracorporeal Membrane Oxygenation)	•	• 1	• 250,000 €	• 250,000 €
• Baby Pod	• Baby Pod	• 1	• 9,000 €	• 9,000 €
• Incubator	• Drager	• 1	• 6,000 €	• 6,000 €

5.1.3. EpiShuttle – Return of experience

Company	EpiGuard
Development cost	€ 4 millions (€ 2,5 millions from H2020)
Launch year	2018
Price	€ 37.500 per unit
Size	Outer dimensions : L = 2285mm, W = 640mm, H = 695mm
Weight	58 kilos (standard configuration)
Certification	• Class 1 medical device • Compliant with CEN 1789 - 10G crest test (crash, vibration, rapid decompression) • AS/NZS 4535:1999 - 24G crash test

Transport compatibility	• Ambulance
	• Helicopter
	• Plane, fits in C130:
	    ◦ Up to 10 EpiShuttle in the same plane (5 rows of 2 Epishuttles)
	    ◦ Recommend 60 cm clearance on either side of the EpiShuttle and 100 cm clearance on the head-end

Stretchers compatibility	• Stryker • Ferno • Stollenwerk
Patient loading in the pod	About 15 minutes to load the patient in the EpiShuttle. A team of 4 people is required to perform this task: 2 to load the patient into the pod and affix monitoring and treatment equipment, then 2 new (clean) people to put the top lid on and clean off any residue.
Size of the patient	• Weight (max): 150 kilos • Length (max): 198cm
Decontamniation procedure	No decontamination of the transport used is required. However, it is necessary to replace filters, gasket, mattress. EpiGuard Sell this complete EpiShuttle Disposable kit for € 850.
Use	• Democratic Republic of the Congo - Uganda

Strengths	Technical aspects:
	
	• Multiple use (not single-use) - up to 20 times
	• Robustness of the device and no leaking possible thanks to the absence of zippers (sometimes not reliable at the lowest points)
	• Ease of use, intuitive and no need for tools
	• No calendar life except for the gloves and filters (other solutions have approximately a 3-5 years shelf life)
	• Transport vector (ambulance, plane, helicopter) do not need to be decontaminated. It reduces the financial and time cost of decontamination
	
	Medical staff perspective:
	
	• Medical staff do not need to wear full protective gear (PPE) during transport (but required for the loading of the patient). Advantage:
	    • They can work longer shifts
	    • Prevent/reduce any careless mistakes due to fatigue
	• Easy to monitor the patient with medical monitoring equipment and delivering treatment through intravenous lines
	• Medical staff has a full access to the patient's body (head-end) - useful for semi/invasive procedures
	
	Patient perspective:
	
	• Easy communication between the medical staff and the patient: the clear / see-through lid gives good lighting and an easy visual contact with the patient. On the patient point of view, the clear view of the environment outside of the pod gives him/her with a feeling of oversight and control
	• Contain safety belts
	• Body position reported as comfortable including for long-haul flight

Weaknesses/Challenges	Price:
	• More expensive than other devices regarding direct cost (but more sustainable on a long-term perspective)
	Technical aspects:
	• The size and weight of the pod makes it risky to carry as a standard, the pod should be used with a trolley/carriage but due to the heavy weight, there is a risk of losing balance sideways
	• Multiple platforms in a transport chain : in particular for long distance transport, the use of different transport modes required to make sure that the pod fits in all vehicles, can be secured/fastened in all vehicles, and that ports, blower units, mechanical ventilators and monitoring equipment can be physically accessed in all vehicles. Same goes with staff competency: is the transport team following all the way or the pod is handling over to a new team at every step?
	Medical staff perspective:
	• Despite the easy use of the pod, the composition and training of the team is crucial to avoid any failures. The team needs to be composed of:
	  ◦ Hygienists / Infection Prevention Controllers (IPC)
	  ◦ Health care professionals with training in Inter-facility Medical Transport
	  ◦ Logisticians
	  ◦ Dedicated team leader
	  ◦ Security officer / Communication officer
	  ◦ Driver / pilots
	• Potential issues that can arise: no knowledge of flight altitudes, equipment being forgotten, vital equipment being play led in inaccessible location, poor securing within vehicles, refusal to transport because pilots are fearful of contamination, delays in transport due to lack of executive leadership.
	Patient perspective:
	• Require and intercom for communication in noisy airplane/helicopter
	• Regarding the size of the patient, the width of the pod is a challenge, as larger persons tend to get squeezed a bit sideways
	• The form of a coffin can present a cultural challenge: some people might refuse to be put in a box depending on knowledge and belief systems of the patient

Sources	• EpiGuard Website • Interview with Michael Eimstad, Vice President Sales and Marketing of EpiGuard • Interview with Espen Rostrup Nakstad, Director, Chief Physician, Norwegian National unit for CBRNE Medicine • Interview with Carl Robert Christiansen, Team Leader, Norwegian Directorate of Health
Videos (exercise)	• https://stolav.no/nyheter/2019/se-video-fra-hoyrisikosmitteovelsen • https://www.youtube.com/watch?v=OlcTPhsQLtQ&app=desktop

CASE STUDIES ON EXISTING CAPACITIES FOR NON-HID PATIENTS

5.1.4. Case study 1: civilian state-owned capacity

Case-study 1: Civilian State-owned MEDEVAC capacity – Romania and Poland		
	ROMANIA	**POLAND**
	Competent Authority(ies) • The department for Emergency Situation within the Ministry of Internal Affairs in cooperation with the Ministry of Defence	Competent Authority(ies) • Polish Medical Air (Non-profit Organisation) rescue under the Ministry of Health
	Civilian Capacities • 1 Cessna Citation V Turbo- Jet • 1 Piper PA 42 (turboprop) - Cheyenne Other capacities: Military asset for single and mass casualties, NATO assets	Civilian Capacities • 1 Piaggio P.180 Avanti • 1 Piaggio P.180 Avanti II Other capacities: Military asset,
	Patient Transport capacity • Cessna Citation 5: 1 patient at a time • Piper Cheyenne: 1 patient at a time	Patient Transport capacity • Piaggio P.180 Avanti: 1 or 2 patients • Piaggio P.180 Avanti II: 1 or 2 patients

	Availability • 24/7 Deployment • Cessna: Based in Bucharest, deployed for long distance • Piper: Based in Bucharest, deployed for shorter distance	Availability • 24/7 Deployment Secondary missions: • Internal flights inside Poland • Repatriation from European countries • Transportation of patients to specialist hospitals in Europe
	Personnel & Equipment onboard • Personnel: N/A • Equipment: N/A	Personnel & Equipment onboard • Personnel: two pilots, paramedic, doctors • Equipment available: FW Draeger ITI 5400 incubator Oxygen supplementation, LifePak Defibrillation system, Propaq 206 E life parameters monitoring including ECG, oxygen saturation (Sa02), capnography (oxygen dicarboxide level in respiratory tract), arterial blood pressure (invasive and non-invasive method possible), LTV Pulmonetic or Oxylog 3000 high-tech respirator and up to four automatic infusion syringes. Vacuum stretcher is available on request.
	Main Sources • *Interview Dr. Raed Arafat* • *https://www.degruyter.com/downloadpdf/j/amma.2018.64.issue-1/amma-2018-0007/amma-2018-0007.pdf*	*Main Sources* • *https://www.lpr.com.pl/en/about-us/history/* • *https://www.lpr.com.pl/en/about-us/piaggio-180/* • *http://www.aerolite.ch/Aerolite/Medienspiegel/Polish_Air_Rescue.pdf*

5.1.5. Case study 2: MEDEVAC Military capacities

Case-study 2: MEDEVAC military capacity – France - MORPHEE	
	Competent Authority(ies) • The Ministry of the Armed Forces
	Public Capacities • 11 C135FR – MEDEVAC KIT MORPHEE (also compatible with A 330MRT and A400M multi role tanker) The C135FR strategic tanker was chosen as a suitable vector. Eleven aircrafts were modified to accommodate the medical solution. These aircrafts have a cargo capacity. • 2 Falcon 200
	Patient Transport capacity • Falcon 200: 1 or 2 patients at a time • C135FR – MEDEVAC KIT MORPHEE: 3 to 12 patients • ICM module capacity: 1 ICU seriously injured • LCM module capacity: 2 ICU less seriously injured Two configurations have been approved: Configuration 1: Transport of 6 ICU on ventilatory support Configuration 2: Transport of 4 ICM module and 4 LCM module (total 12 patients) NB: MORPHEE also offers a module servitude to provide equipment's for the management of 12 patients for 10 hours (40 drawers with equipment and infusion therapy).
	Availability • C125FR: Permanently available

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- Falcon 2000: Permanently available

Deployment

- Falcon 200: Deployment radius: 4 105 km
- C135FR: They have a high range. Their autonomy of 10 hours of flight can cover all theatres of operations in which the French military are actually involved.

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Personnel & Equipment onboard

The technical platform MORPHEE consists of two types of modules for the transportation of patients and a module of servitude. The "patient transportation" modules were made by the Austrian society Air Ambulance Technology, which specializes in the development of medical aircraft.

The first type of module, Module Seriously Injured or Intensive Care Module (ICM), allows the management of a patient on a respirator.

The second type of module, Module Slight Injury or Light Care Module (LCM), allows the support of two lightly wounded patients.

Figure 1. Intensive Care Module

Figure 2. Light Care Modules

A work plan with a floor area of 1.4 m2, with a strong light and a power supply, allows the preparation of therapeutics. Approximately 40 drawers hold equipment and infusion therapy.

Furniture is installed to be available on both sides. This includes a refrigerator for blood products and certain drugs and compartments for electrical equipment: ultrasound portable device, mini-laboratory, electrocardiogram, and defibrillator with an external electro-systolic drive system. In the other furniture can be placed a folding table and two mini-carts (trolleys), to have a crash cart or a cart of care at the bedside of the patient.

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Medical Team

The medical team includes 11 to 12 persons. This is a mixed team composed of medical and paramedical staff from hospitals, medical services unit, and air conveyors. It consists of:

- 2 anaesthetist-resuscitators,
- 2 aviation physicians,
- 2 anaesthetist nurses,
- 2 air conveyors,
- 2nurses of the Air Force.
- A 12th place is reserved for a specialist (neurosurgeon, psychiatrist, cardiologist) or a liaison officer as part of a mission for the benefit of another nation.

The team is sized to ensure its ability in taking charge of approximately 6 to 12 injured people during approximately 10 hours for a mission lasting a total of 30 to 50 hours.

Maintenance & Overall costs

Equipment Maintenance: Supplies and equipment must be in a constant state of readiness, which can be challenging. Equipment that is seldom used must be inspected regularly for normal function, battery charge, and expiration dates.

Overall costs: N/A

Main Sources

- http://www.transfair.fr/casestudies/morphee-press-en.pdf

5.1.6. Case study 3: Contract with service provider

Case-study 3: Civilian State-owned MEDEVAC capacity – Norway

Competent Authority(ies)

- Directorate for Health and cooperation with Defence Ministry
- The National Air Ambulance Services of Norway is responsible for the flight operations nationwide and the Local Health Authorities are responsible for the medical side of the operation and providing doctors and nurses.

Private Capacities operated by two service providers Norsk luftambulanse AS and Lufttransport AS

- 9/11 Beechcraft 250 twin-turboprop
- 1 intercontinental jet

Patient Transport capacity

- Beechcraft 250: 2 stretchers or 4 seated patients

Availability

- 24/7, 365

Deployment

- Beechcraft 250: Ferry Range 3 185km
- Jet: Intercontinental

Dedicated plane available at 6 airports (Alta Airport, Bodø Airport, Kirkenes Airport, Høybuktmoen, Oslo Airport, Gardermoen, Tromsø Airport and Ålesund Airport, Vigra).

Personnel & Equipment onboard

Personnel and flight crew:

- Two-flight crew as well as specialist nurses

Equipment and systems:

Anti-collision system), advanced terrain collision warning system or other ground obstacles (EGPWS) and Flight Data Recorder (so-called black box). The aircraft also has a modern and advanced satellite-based navigation system, advanced autopilot, weather radar as well as modern instrumentation (so-called glass cockpit) and electronic maps.

Overall costs

- 300 000 €/year for having the right to use the planes,
- Additional costs if they are used +staff, maintenance, etc.

Main Sources

- *Interview Dr. Olsen*
- *http://www.luftambulanse.no/about-national-air-ambulance-services-norway*
- *http://www.luftambulanse.no/beech-b250-king-air*

CASE STUDIES ON CAPACITIES FOR HID PATIENTS

5.1.7. Case-study 1: Ad-hoc HID capacity and solution Illustrations

Case-study 1: Ad-hoc HID capacity and solution Illustration		
Context	Several outbreaks of the Ebola virus in West Africa have recently affected countries in the region with widespread and intense pandemics. As a consequence, several health care workers were accidentally exposed to the virus while in direct contact with infected patients. It was decided to evacuate them by plane to Europe for treatment.	
Country	**Germany**	**Norway and the World Health Organisation (WHO)**
Aircraft	Germany developed an Ebola capacity in 4 months, namely an Airbus A340-300 "Robert Koch", built from a Lufthansa plane in cooperation with the Robert Koch Institute (RKI) for infectious disease.	The plane used was a C130.
Transport capacity	• One patient at a time • Deployment radius: 13,240 KM without refuelling	• One patient at a time • Deployment radius: 3,800 KM
HID solution	Germany made use of an ICU-biocontainment unit (3 tents and 1 airbag): "This built-in plastic tent contains outer and inner locks, and a third chamber is the patient unit with equipment used for intensive care. It also contains facilities for waste management and was suitable for final disinfection procedures. A device was invented by Lufthansa suitable to take up pressure and prevent air leakage from the high-level isolation unit in case of unexpected loss of pressure in the cabin."	Norway provided 3 isolation units named "Epishuttle" to the WHO for the transport of patients with highly infectious diseases. The system is "a single-patient isolation and transport system designed to provide maximum patient safety while allowing critical care and treatment to

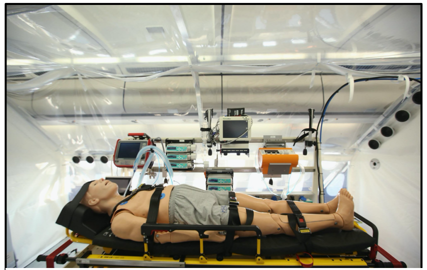

Figure 1: A mannequin in the isolation unit (Source: Burger & Shaade, 2016)

The treatment area is marked by red lines, the inner and outer chamber are marked in yellow and green, respectively.

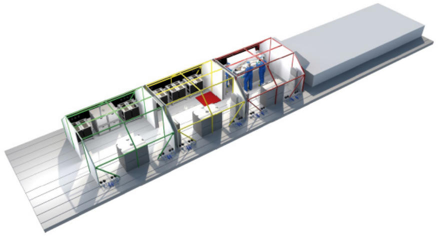

Figure 2: Sketch of the German high-level isolation unit (Source: Burger & Shaade, 2016)

be performed"[39]. The container does not need a special aircraft as everything is isolated within the bubble.

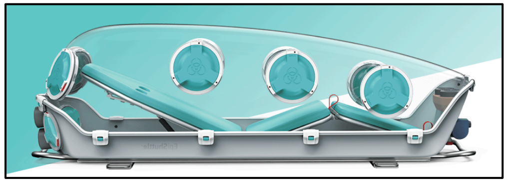

Figure 3: EpiShuttle, (Source: Epiguard)

Characteristics of the EpiShuttle:

- Size: 2285 mm L x 640 mm W x 695 mm H
- Weight: 58 kg
- Patient maximum size & weight: 198 cm/150 kg
- Power source: rechargeable Li-ion Battery 14,4 V 2,6Ah
- Can be used in ambulances, helicopters and airplanes and reuse up to 20 times
- Adaptable to different type of stretchers
- Vehicle or aircraft used to transport HID patients does not need to be disinfected after transport, while medical personnel do not need to wear full PPE.
- Soft mattress, belts, visibility through transparent hardtop, 8 glove ports offering access to all parts of the patient's body;
- Ventilation system: 15 air exchanges per hour, positive and negative pressure modes.

[39] Epiguard, URL: https://epiguard.com/purchase/. See also : http://www.cbrneportal.com/epishuttle-to-be-used-to-isolate-and-transport-patients-in-ebola-outbreak-norway-contributing-to-response-in-the-democratic-republic-of-congo/

		• Reusable, can be safely disinfected and re-assembled in less than 2 hours  **Figure 4: EpiShuttle being unloaded off the plane (Source: Epiguard)**
Overall costs	• Deployment costs: around 700.000€ • Maintenance costs: € 1.5 million / month according to experts. The ad-hoc capacity was dismantled after 6 months because of lack of German HID patients to transport, and it was deemed too expensive to maintain a dedicated capacity.	• The overall costs of an operation including the use of an EpiShuttle depends on the set up. • The unit cost for a complete and ready to use EpiShuttle is € 37.500. After using the EpiShuttle to transport a highly contagious patient, there are some parts like filters, gasket, and mattresses that must be replaced as part of the decontamination procedure. EpiGuard sell this complete kit as the EpiShuttle Disposable Kit for € 850.
Lessons learnt	• The development and maintenance of aerial capacities solely dedicated to the transport of HID patients is very costly considering the fact that it is only used it for a very small number of patients;	• The shuttle runs on DC-power for some hours. Extra Batteries/DC-connection will be needed for longer transports. • In the set-up of the Shuttle offers to the Democratic Republic of Congo, the shuttle is operated as a stand-alone concept with just regular consumables and spares
Sources	• *Interview with Dr. Boeckel* • *Reinhard Burger & Lars Schaade, "Ebola virus disease preparedness in Germany: expertise focused in specialized laboratories, competence, and*	• *Interview with Dr. Olsen* • *Epiguard.com*

	treatment centers" in The Ebola Epidemic in West Africa: Proceedings of a Workshop, November 2016	

5.1.8. Case-study 2: Transport services of HID patient by private service provider

	Service-provider (SOS International)	Service-provider 2 (Phoenix Air)
Context	In the context of the Ebola outbreak in West Africa in 2014, the transport of Ebola infected patients was conducted by private service-providers. SOS international evacuated two doctors from Sierra Leone to the Netherlands.	In the context of the Ebola outbreak in West Africa in 2014, the transport of Ebola infected patients was conducted by private service-providers. During the 2014-2015 Ebola outbreak, Phoenix Air transported 41 HID patients.
Plane used	• Challenger 600 air ambulance	• Gulfstream Ⅲ Aircraft • B747-400 cargo aircraft
Transport capacity	• One patient at a time • Staff: 1 Pilot, 1 co-pilot, 1doctor, 1 coordinator, 1 nurse, 1 flight attendant, 1 technician	• Gulfstream Ⅲ Aircraft: 1 patient out a time in the Airborne Biological Containment System (2 crew and 2 medical staff) • B747-400 cargo aircraft: 4 patients out of time in the Containerized Biological Containment System
Deployment & Availability	• Deployment radius: 7,400 KM without refuelling • Operation concluded in 36H (logistics, return trip) • The plane was available in 24H including logistics preparation, gathering a flight crew, and obtaining relevant authorisations to fly with HID patients.	• Availability: 24/7, day and night • Deployment: Phoenix Air transported 41 HID patients to hospital facilities in both the U.S. and Europe.
Container used	• No container was used as neither patient was in the symptomatic phase of the virus (free of fever) and therefore not infectious. The patients were therefore transported with the staff wearing full personal protective equipment (PPE).	• At the beginning of the outbreak, A cooperative effort between the Center for Disease Control, the U.S. Department of Defense and Phoenix Air in 2007 led to the development of the ABCS (Airborne Biological Containment System), a single patient, negative pressure isolation unit.

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Conduct of the operation:

Initial evaluation of the patient to assess the level of infection;
Ground transport of the patient from working location to Freetown airport (100 KM);
Patients were temporally held in quarantine at a UNICEF facility while authorisations to cross the borders were given and planned flight routes confirmed. The crew also received permission to make an emergency landing if needed, and a backup plan was set up in case one of the patients became unfit for transfer;
Pre-flight assignment delivered to the patients;
Refuelling stop in Morocco.

Ground transfer from Schiphol airport (Amsterdam) to Leiden University Medical Centre by the Dutch Ministry of Foreign Affairs and Health (RIVM) for definitive evaluation and treatment.

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Now, a multi patient transport unit, the CBCS (Containerized Biological Containment System), which has the capacity to transport four highly contagious patients in an ICU environment has been developed.

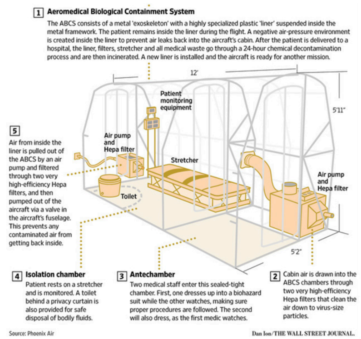

Figure 5: ABCS system (Source Phoenix Air)
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<td>Maintenance</td>
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The inside surfaces of the plane were disinfected after the flight.

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Each plane has to undergo a 24-hour decontamination process before it can be used again. The liner, filters, stretcher and all medical waste go through a 24-hour chemical decontamination and then are incinerated.

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Overall costs	• € 150 000 – 200 000 ($ 200,000[40] according to other experts)	• The cost per flight with the ABCS depend on fuel, distance, time and other factors but it costed $200,000 to fly 1 missionary from Liberia to Atlanta (U.S). • The U.S. State department received a 5 million$ grant from a philanthropist to develop and test the CBCS
Lessons learnt	• One of the main challenges was to obtain the authorisation to transport and repatriate these healthcare workers to a healthy and non-exposed population. It means that the first concern for transporting a HID patient is not so much the transport phase but organising the reception of the individual in the country, taking into consideration the availability of required material and equipment, and managing public authority's communication. • The necessity to transport of Ebola patients depend on the stage of the virus within the patient – the latter need to be stable enough to tolerate the journey.	• The development of a multi patient transport unit, the CBCS (Containerized Biological Containment System), provide a solution which do not require decontamination of the whole plane but does require an aircraft with a large cargo door to be loaded.  Phoenix Air The Containerized Biocontainment System (CBCS) is loaded onto the main cargo area of a Kalitta Air 747-400. Phoenix Air has a partnership with the Michigan-based airline. **Figure 6: The CBCS Unit being load in the cargo aircraft (Source: Popular Mechanics)**
Main Sources	• *"Case Study: evacuation of doctors exposed to Ebola in Sierra Leone", SOS International, 2014*	• *https://phoenixair.com/air-ambulance/contagious-disease-transport/* • *https://phoenixair.com/special-planes-are-lifeline-for-ebola-patients/*

[40] Robert Roos, "Very few aircraft equipped to evacuate Ebola patients", Center for infectious disease research and policy (CIDRAP), 16/09/2014

	• *Robert Roos, "Very few aircraft equipped to evacuate Ebola patients", Center for infectious disease research and policy (CIDRAP), 16/09/2014* • *Interview with Dr. Taymans.*	• *https://www.popularmechanics.com/flight/a28246718/the-airplanes-that-rescue-ebola-patients/*

5.1.9. Case-study 3: Military

UK Air Force	
Context	For 40 years, the British Royal Air Force has maintained an aeromedical evacuation facility, the Deployable Air Isolator Team (DAIT), to transport patients with possible or confirmed highly infectious diseases to the United Kingdom. Since 2012, the DAIT, a joint Department of Health and Ministry of Defence asset, has successfully transferred 1 case-patient with Crimean-Congo haemorrhagic fever, 5 case-patients with Ebola virus disease, and 5 case-patients with high-risk Ebola virus exposure.
Plane used	• Boeing C-17 Globemaster
Transport capacity	• 1 to 3 HID patients • Staff: 1 Pilot, 1 co-pilot, 1doctor, 1 coordinator, 1 nurse, 1 flight attendant, 1 technician
Deployment & Availability	• Deployment: • Operation concluded in 24 to 36H (logistics, return trip): activation of the team in • The plane was available in
Container used	• The United Kingdom uses a larger closed T-ATI system for the transfer of infected patients (Figure 1), a design that provides patient comfort and medical care while maintaining containment for the duration of the transfer mission. • The sealed T-ATI system includes an ATI frame and disposable envelope. It is maintained under negative pressure by a HEPA-filtered ventilation system that uses aircraft power when emplaned and battery power when outside the aircraft, while the cabin pressure is maintained at a standard cabin altitude of 8,000 feet. Clinically, this system maintains the arterial oxygen hemoglobin saturation at ≈90% in healthy patients, even inside the negative-pressure envelope. Additional oxygenation is possible through the

	use of portable oxygen cylinders and tubing passed into the envelope through sealed delivery ports. Cables for monitoring equipment, such as electrocardiogram electrodes, pulse oximeters, and blood pressure sensors, also pass through the ports, as does tubing for parenteral fluids or medication. • Thumbnail of Larger Trexler Air Transportable Isolator patient transport systems enable care providers to access a patient via half-suits along the side of the patient; however, manual dexterity is severely impaired. • Larger Trexler Air Transport Isolator patient transport systems enable care providers to access a patient via half-suits along the side of the patient; however, manual dexterity is severely impaired • Clinical access consists of a half-suit on either side of the T-ATI; an additional half-suit can be fitted to permit access to the head and neck of the patient for intubation, if required (Figure 5). Arm and glove ports along the side of isolator enable multiple staff to access the patient simultaneously (Figure 1). At the foot of the envelope are 2 clinical waste disposal areas.
Medical equipment	• Medical equipment likely to be needed for the management of the patient during the flight, such as intubation equipment, bag-valve mask, suction units, and intravenous access equipment, must be placed within the envelope before sealing the unit.
Medical team	• To move a single highly contagious patient requires 12 personnel: o IPC nurses, o an RAF consultant physician and anesthetist, o a civilian infectious diseases consultant from the Royal Free HLIU team, o medical assistants, o a medical and dental support system technician to assess and monitor T-ATI integrity, and o a medical support officer, who acts as a liaison with the host nation nonclinical staff, ensures involvement of legitimate personnel only, and minimizes press access. o Oversight of the whole mission is provided by a team leader/flight director who remains removed from direct clinical care and allows the clinical team to focus solely on the patient's needs without distraction. o Additional staff are considered for flights involving >2 patients, depending on the clinical scenario, and the United Kingdom maintains the capability to activate 2 teams concurrently if required.
Lessons learnt	• Once the T-ATI is sealed, the patient's care does not require staff PPE. Upon the aircraft's return to the United Kingdom, a dedicated T-ATI Jumbulance is positioned at the receiving airbase to transport the T-ATI and to minimize the risk for external contamination.

	• As the sole UK provider of air transfer of highly infectious patients, the MOD has extensive standard operating procedures for the retrieval of both civilian and military patients with EVD.
Main Sources	• *https://wwwnc.cdc.gov/eid/article/25/1/18-0662_article*

5.1.10. Case-study 4: NGO

Case-study 3: MEDEVAC of HID patients by an NGO	
Context	In the context of the Ebola outbreak in Guinea 2014, three health workers working in the Ebola Treatment Centre (N'Zerekore, Guinea) managed by the NGO Alliance for International Medical Action (ALIMA) were infected by the virus. The NGO decided to evacuate the patients by air to the Treatment Center for Carers (Conakry) run by the French Army's medical corps. The aerial evacuation was conducted by another NGO, Aviation Sans Frontières (Aviation without borders), which concluded a convention with the French Ministry of Foreign Affairs for a 9 months mission coordinated by the French Embassy to Conakry to support NGOs acting on the ground, including the transport of infected patients.
Plane used	• Cessna 208 Caravan F-OJCC
Plane capacity	• 1 Ebola patient at a time (Max 9 passengers) • Deployment radius: 1,982 KM without refuelling • Crew: 1 pilot, 1 co-pilot, 1 doctor, 1 nurse • Flight altitude: 10500 ft (3200m) • Flight duration: 2 hours
HID Solution	• Health workers were transported by air in the "Human Stretcher Transit Isolator-Total Containment (Oxford) Limited" (HSTI-TCOL) negative pressure isolation pod manufactured by TCOL company.

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- Characteristics:
    - Size: 2300 mm L x 800 mm W x 1100 mm H
    - Weight: 45 kg
    - Include a stretcher, 4 grips, a transparent PVC envelope with 8 gloves attached to a metallic frame, a filtration and depression engine with 2 high efficiency particulate air filters (HEPA – H14), a manometer, a thermometer, and a hygrometer
    - The air depression device works with an electric engine powered by two 12 V batteries and generates a depression between 2 and 5 mm of water (batteries life: 6 hours)
    - Ambient air penetrates through the filter attached outside the pod; contaminated air is eliminated by a second filter screwed inside. Air renewal is 20-30 volumes per hour.

Figure 7: The isolation pod HSTI-TCOL in preparation phase (Source: BMC Emergency Medecine)

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- Protocol:
    - The HSTI-TCOL is prepared near the aircraft;
    - Patients were assisted in entering the isolation pod by 2 doctors, in full personal protective equipment (PPE);
    - An intravenous line is threaded through a dedicated aperture in the isolation pod, allowing the delivery of fluids and medication to the patient if required in flight;
    - The pod is sealed with the patient inside;
    - The outside of the pod is sprayed with chlorine solution by staff in PPE;
    - The air depression system is checked before take-off;
    - The pod is loaded in the plane: the patient is not fastened inside but the pod is strongly tied to four tie-down fittings inside the aircraft;
    - All the patient's needs during the flight are anticipated and placed inside the pod before the door is closed;
    - Full PPE is provided on the plane for all crew UCPM Countries in case of unplanned pod failure;
    - Once arrived, the patient is immediately transported and supported by the medical team;
    - All wastes carrying infectious risks are collected to be incinerated;
    - The plane is decontaminated using a chlorine solution at every point of contact between the pod and the plane;
    - When status of the patient is known:

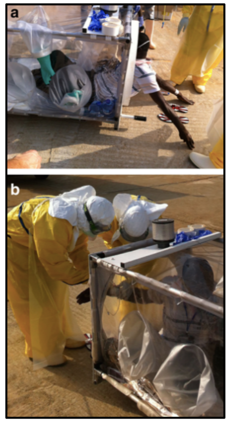

Figure 8: Loading of the patients (Source: BMC Emergency Medecine)

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	▪ If negative, the pod is cleaned with a chlorine solution; ▪ If positive, the pod is incinerated, the metal frame and the engine of the pod are strictly decontaminated.
Overall costs	• 4000$ per hour – 20,000$ for a flight inside Guinea
Lessons learnt	• HSTI-TCOL small height and weight offers great advantage when used on a light aircraft as « CESSNA CARAVAN ». The assembly of the pod is fast and easy allowing for quick deployment. The size of this pod is also suitable for road transfer in a 4-wheel drive vehicle to the airport before aerial evacuation. In addition, the number of PPE dressed personnel needed for preparing the patient and the transfer is lower than for the heavier version of the pod, « VATI » which weighs 112 kg and doubles the amount of staff needed. Finally, this stretcher allows a closed monitoring of the patients. • But the pod has also a few downsides. First, the patient in the pod is not tied down, which can be dangerous in case of in-flight turbulence. Secondly, due to the limitations of medical care possible in the cramped conditions during transport, the patient has to be stable, conscious and not agitated, without haemodynamic or respiratory disturbance. Once the pod is sealed, there is no further access without breaching infection control. As a result, if a patient deteriorates in-flight, intervention is limited to IV rehydration, anti-emetics and IV sedation. Only patients well enough to survive transport can be evacuated.
Main Sources	• *Jean-Michel Dindart, Olivier Peyrousset, Romain Palich, Abdoul Bing, Richard Kojan, Solenne Barbe, Souley Harouna & Nikki Blackwell, "Aerial medical evacuation of health workers with suspecte Ebola virus disease in Guinea Conarkry – Interest of a negative pressure isolation pod – A case series", Correspondence, BMC Emergency Medicine, 2017* • *Mission Ebola en Guinée, Nouvelles de Guinée : Retour de mission du Dr Jean-Michel DINDART, 2015, URL : http://sfmc.eu/mission-ebola-en-guinee/* • *"Aviation Sans Frontières débute sa mission en Guinée pour lutter contre l'épidémie Ebola", Aviation Sans Frontières, 22/12/2014, URL: https://www.asf-fr.org/actualites/aviation-sans-frontieres-debute-sa-mission-en-guinee-pour-lutter-contre-lepidemie-ebola* • *"Ebola, point de situation du déploiement de l'armée française en Guinée", Ministère des Armées, 10/07/2015, URL: https://www.defense.gouv.fr/fre/operations/prepositionnees/actualites/ebola-point-de-situation-du-deploiement-de-l-armee-francaise-en-guinee* • *"Répondre à une épidémie de maladie à virus Ebola. Guide opérationnel", Croix rouge française, 2016, URL: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=21&ved=2ahUKEwji06ST3evkAhUOllAKHdi6DkcQFjAUegQIBRAC&url=https%3A%2F%2F*

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