# Qualified Aeromedical Evacuation in the Extended Task Spectrum of National and International Military Missions

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## HISTORY

The history of aeromedical evacuation (AE) is short and closely associated with the beginning of manned aviation. Its origins are credited to the Dutch medical officer De Mooy who, in about 1910, was the first to conceptualize the air transport of wounded patients and to describe the interaction of road, rail and air transport. Air transport of wounded patients in hot-air balloons, frequently mentioned in the context of the Franco-Prussian War, however, must be considered a military anecdote as there is no historical evidence for it.

First documented evidence for the routine employment of aircraft for the transport of wounded patients exists for the First World War when France established an aircraft ambulance organization. During the Spanish Civil War (1936 – 1938), the air transport of wounded patients to Germany was conducted on a larger scale. JU-52 type aircraft were equipped with 10 stretchers. In addition, there were seats for up to 8 soldiers. Medical oxygen was available and administered during the crossing of the Alps.
By time of the Second Word War, organized air transport of wounded patients had been established in the military. The US-Army Air Corps for instance had evacuated 1.25 million patients by aircraft and with limited in-flight care (flight nurses) by 1945. While approximately 4% of the wounded were dead by the time they arrived for the first emergency surgical treatment during the Second World War, this percentage could be reduced to 1% during the Vietnam War when the introduction of helicopters for air rescue missions was brought to bear on a large scale.
The operational need for a qualified AE system can also be inferred from the example of operation Desert Storm where approximately 30,000 allied soldiers were evacuated from the operational theater for reasons of health. During the KFOR/SFOR mission, the German Air Force evacuated 3o2 soldiers in 1999 by air, of which 25 patients were under critical conditions. During the UN Interfet mission in East Timor (21. 10. 1999 – 23. 02. 2000) in 47 missions 230 soldiers and civilians were evacuated from East Timor to Darwin / Australia, of which 25 patients needed intensive care.

## OPERATIONAL REQUIREMENTS

NATO strategy changed with the end of the Cold War. The integration of crisis reaction forces in the new military strategy of NATO, that is determined by the basic characteristics: ***concentration of forces, flexibility, global mobility, multinationality and rapid augmentation*** requires an efficient medical service. In addition to the conduct of national sovereign tasks, it must have the capability for international cooperation in the sense of interoperability (standardization).
This determines the employment options of the medical service within the scope of national and collective defense and peace support operations.
In this context, the military requirement is that the mobility and flexibility of medical support during operations must correspond to the mobility and flexibility of the units to be supported. Thus the transport of wounded and sick patients receives a new status as far as quality and quantity are concerned.
The responsiveness of the medical service and especially of an efficient AE system must be adjusted to the responsiveness of the international UN crisis reaction forces, of NATO reaction forces and to that of the forces employed for rescue and evacuation operations and must be available for ad-hoc operations within the

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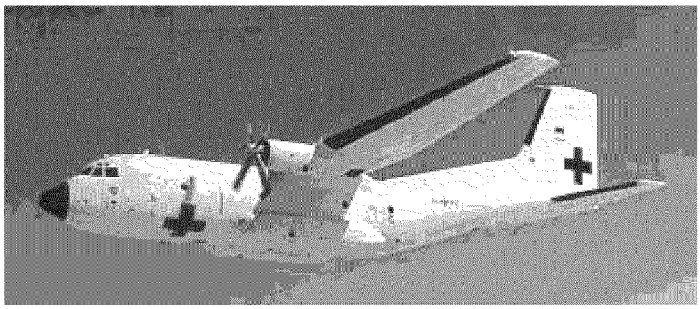
scope of disaster and emergency relief if required. An efficient air transport system for wounded patients is definitely required operationally for sustained operations to establish sustainability and to cope with periods of peak requirements.

*Fig. 1: Transall C 160 (Dietmar Plath)*



In addition, the Surgeon General of the Bundeswehr in his technical guideline dated September 27th 1995 set forth the following maxim for the medical support of Bundeswehr servicemen abroad (quote):
"The maxim of task accomplishment in the medical service is that the soldiers in the event of an illness, accident or injury shall receive medical care, that, as far as the result is concerned, corresponds to the medical standard in Germany."

This must certainly also apply to the medical evacuation chain.
The implementation orders for German aeromedical evacuations are set forth in the "Fachdienstliche Anweisungen des Inspekteurs des Sanitätsdienstes der Bundeswehr" (Technical Directives of the Surgeon General, Bundeswehr) B 45.01. At NATO level, AE is established in STANAG 3204 and a conceptual NATO document on "Aeromedical Evacuation" is expected to be promulgated soon (AJP – 4.10; Allied Joint Medical Support Doctrine). This impressively underlines the status of qualified aeromedical evacuation within NATO.

**Aeromedical Evacuation(AE)** is the movement of patients under medical supervision by air transportation. It may include up to three phases that are complementary:

**Forward AE.** That phase of evacuation which provides airlift for patients from the battlefield to the initial point of treatment and to subsequent points of treatment within the combat zone.(National responsibility)

**Tactical AE.** That phase of evacuation which provides airlift for patients from the combat zone to points in the Communications Zone (COMMZ), and between points within the COMMZ.

**Strategic AE.** That phase of evacuation which provides airlift for patients from overseas areas or from theatre of active operations, to home nation, to other NATO countries.

In addition to the AE requirements based on operational reasons – the German Army for example reported a daily transport requirement of 480 patients for long range (strategic) air transport - the extent of AE is increased by the "Evacuation Policy" determined by the military command. This policy establishes the maximum period of a soldier's unfitness for service in the operational theater. If, according to medical prognosis, this period will be exceeded, the soldier is to be evacuated as soon as this is possible and can be justified from a medical point of view.

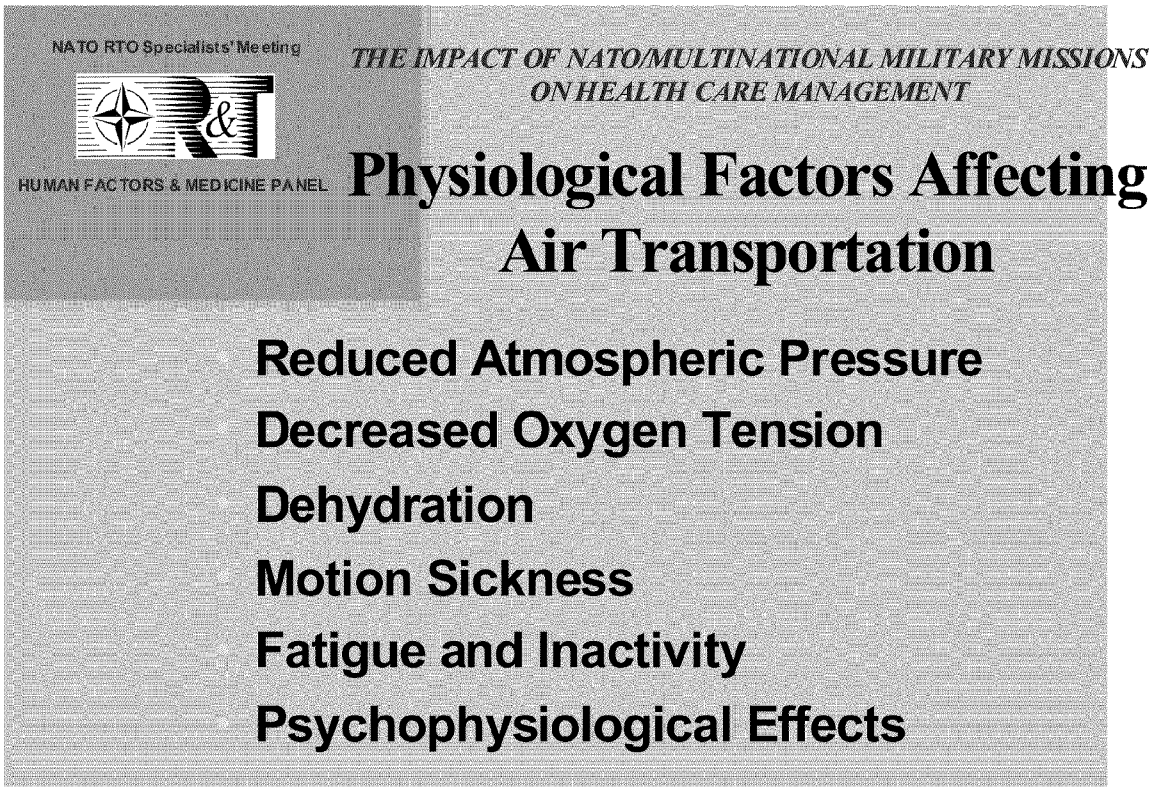
## GENERAL/AEROMEDICAL ASPECTS

Aeromedical evacuation is usually the fastest and in many cases the only live saving mode of transportation. It is conducted in the knowledge that the immediate clinical care for acute conditions will decisively improve the patient's prognosis on mortality, invalidity and the development of posttraumatic stress conditions. In view of this, the modular medical facilities in the operational theater are indispensable assets of the qualitative and scalable medical support that must be complemented at all levels by aircraft that are properly equipped and assigned to air transportation forces.

Upon conduct of appropriately thorough preparations there should be no absolute contra-indication against an AE, given sufficient personnel and material. Qualified aeromedical evacuation of wounded and sick patients can only be conducted as efficiently as possible if the medico-technical requirements are met and the accompanying medical personnel is appropriately trained. Basic knowledge of aeronautics, aviation medicine and flight physiology must be demonstrated in addition to the clinico-technical expertise in emergency and intensive medicine.

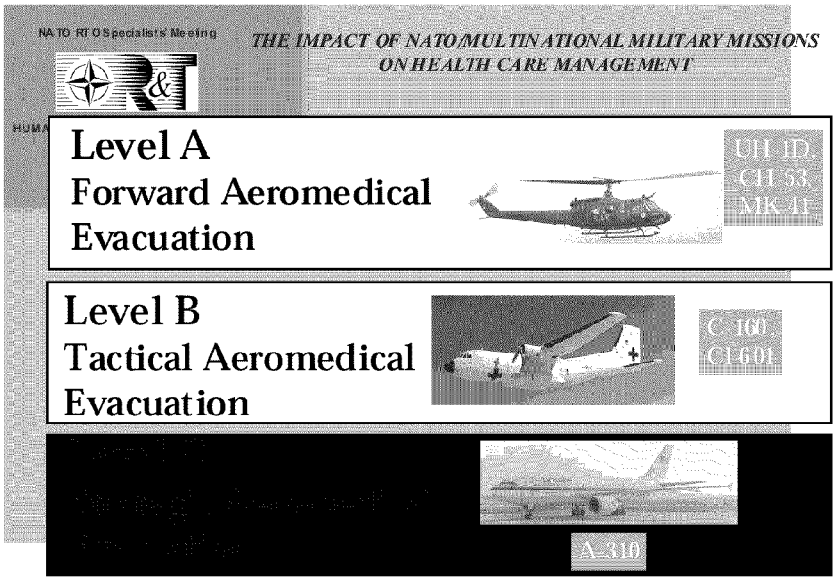
The accompanying medical personnel should belong to the aircrew and be subject to the appropriate airworthiness criteria. The immense logistic and financial effort required can only be justified if the in-flight medical care meets the standard of the personal medical care provided at home.

In this context, however, the physiological factors that influence air transportation are of particular aeromedical importance *(Fig. 2)*.



## MEDICAL SERVICE SPECIAL ISSUES

During operations, the totality of military services is provided at three functionally coordinated levels *(Fig. 3)*.




**Level A (NATO: role 1-2)** comprises pre-clinical emergency medical care as well as, depending on the situation, emergency special surgical and internist measures (emergency station, rescue center). At this level the medical service is tasked with the maintenance of the physical vital functions and the establishment of the fitness for travel. This also involves efficient ground and air based means of transportation for medical evacuation.

**Level B(NATO: role 2+ to 3+)** includes the multidisciplinary clinical and ambulant treatment of acute conditions in all relevant medical disciplines (deployable hospitals, Host Nation Support).
The controlled and medically monitored aeromedical evacuation will be conducted at this level.

**Level C (role 4)** comprises further clinical care and rehabilitation outside the operational theater (preferably in the home country).
This is the domain of relieving aeromedical evacuation by means of which patients submitted to medical (intensive medical) monitoring are transported to receiving medical facilities outside the operational theater in the event of deployments or when local capacities are exceeded.

## OPERATIONAL NEED FOR MEDICAL MONITORING

Especially in the tactical and strategic area, the operational concept described above results in an extended operational spectrum for AE, which impressively demonstrates the necessity of in-flight intensive medical monitoring.

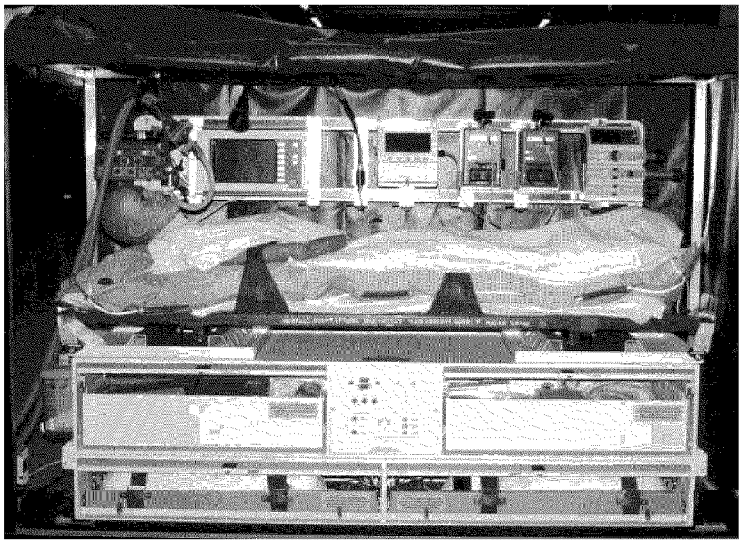
- Within the scope of the preparation of operations and during the buildup of medical facilities in the operational theater, an efficient AE system for the qualified medical support of the soldiers deployed is to be established before the modular medical facilities are put into operation.
- Bundeswehr missions to be conducted without a sufficient preparation period for the medical service require a highly responsive medical support system that also meets emergency/intensive medical requirements. Well trained specialist personnel and medical equipment are transported to the operational theater immediately and ensure a qualified evacuation of patients.
- When the crisis reaction forces of all services are employed to full operational strength (50.000 soldiers), the number of wounded and sick patients incurred is expected to exceed the overall capacity of the currently planned four deployable hospitals of the Bundeswehr Joint Medical Service and the German Army

Medical Service (Level B) even before the end of the second day of combat after the outbreak of hostilities (worst case scenario) if insufficient AE capacity cannot ensure the required relieving air transportation including transports involving intensive medical monitoring. The medical support during crisis reaction operations must be prepared, as far as plans and organization are concerned, for a massive number of wounded and sick patients.

- Analogous considerations for international crisis reaction operations in different operational theaters produced similar results.
- A sufficient AE capacity providing intensive medical monitoring and the additional option of intensive medical treatment is a prerequisite for the provision of aid within the scope of humanitarian missions and also of other non-article 5 missions (civil-military cooperation) during a large scale damage event where the medical infrastructure is insufficient.
- In view of the maxim of medical support during operations abroad, various traumata/posttraumatic conditions require a fast aeroevacutaion from level B to a medical facility at level C for definite treatment and for the relief of the modular medical facilities (maintenance of personal medical care). These include
  - **Severely burnt patients**, who can be evacuated to special clinics with comparatively little effort during the first 24 hours after incurring the burn and subsequent to first clinical treatment to ensure the provision of an adequate therapy (transplantation surgery, dialysis, intensive medical care).
  - **Polytraumatised patients** with or without burns and an imminent posttraumatic, dialysis-requiring renal failure with the consecutive failure of several organs must be evacuated to medical facilities capable of providing dialysis, after emergency surgical treatment.
  - **Neurologically traumatised patients,** who, after the necessary neurosurgical treatment, must be evacuated to an appropriate level C medical facility for further care and rehabilitation (apallic syndrome, tetraplegia).
  - **Toxicological diseases** of patients exposed to chemical warfare agents indicate long term respiration, especially in the event of inhalation traumata, which requires the evacuation from the operational theater to relieve local medical capacities.

In order to meet these requirements, a patient transport unit (*fig. 4*) for AE was developed and is currently in service.

*Fig. 4: Patient transport unit*



If required, the patient transport units, that are suitable for transports involving intensive medical monitoring, can be employed as a backup system in a modular way to expand the intensive medical capacities at level B. This requires a sufficient maintenance float of patient transport units.

## IMPLEMENTATION

At **level A** aeromedical evacuation as well as air rescue is the responsibility of the individual services.
The primary and secondary qualified **air transport by helicopter (forward area)** comprises:

- the fast and immediate transport of specialists and medical equipment to the location of employment in cases where no medical infrastructure is available (mountains, woodlands, at sea)
- the direct and comfortable transport of emergency patients to individual medical care facilities – medically monitored whenever possible
- the secondary transport of intensive care patients to specialized medical facilities
- SAR operations in accordance with ICAO and IMO regulations
- CSAR operations in accordance with the respective military requirements.

The military proportion of the overall German air rescue system is considerable. Eighteen Bell UH 1D (German Air Force) and six MK 41 Sea King (German Navy) military helicopters from all parts of Germany are integrated in the system. In 1997, they received 13,585 alerts, conducted 11,343 missions (false alert rate: 2,242 = 17%) and accumulated a total of 5,933 flight hours. 9,921 patients received emergency treatment, 4,673 of whom were transported further by helicopter due to the given indication.
The employment of helicopters for primary therapy has become the standard method in rescue situations involving potentially fatal conditions. **"Train in peace as we plan to function in war".**

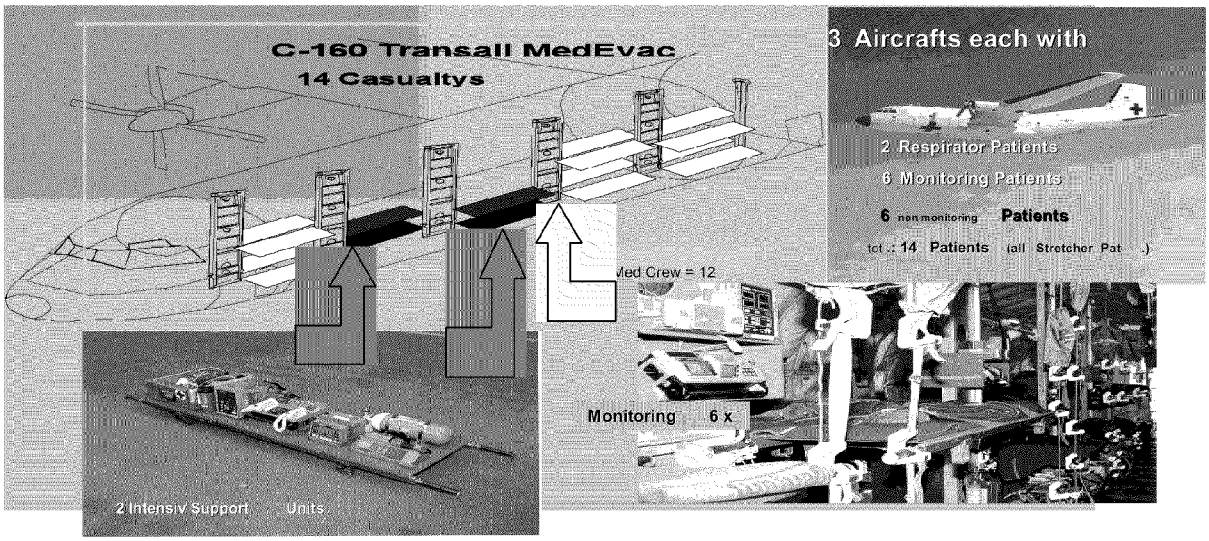
For the area of the German Air Force, the employment of SAR helicopters was defined and specified in the crisis reaction concept of the German Air Force. After the phasing out of the Bell UH 1 D weapon system currently employed, two NH90 LTH/SAR helicopters will be assigned to each GAF rescue center.
CH 53G, Bell UH1D and MK 41 Sea King helicopters are available for the **short-range** air rescue regimen (forward AE) of up to 500 km.

In addition to the transportation of wounded/sick patients, installed conversion kits also allow emergency treatments and the medical monitoring of vital bodily functions. The accompanying medical personnel generally consists of 1 to 4 air rescue specialists trained as rescue assistants.
Physicians with the specialty of rescue medicine, anesthetists or other specialists will be employed in accordance with the given requirements.

C-160 Transall (*Fig. 1*) and CL-601 Challenger aircraft are available for **Tactical** aeromedical evacuation.
The capacity of the **Transall** aircraft generally allows the transport of 62 patients in lying position. However, this conversion kit will only be employed in exceptional cases as it does not allow state-of-the-are medical care and adversely affects flight safety.

In order to provide in-flight medical care, the number of patients to be transported in lying position was reduced to 14. The conversion kit includes 2 intensive care units and 6 monitoring stations providing transport capacities for 2 intensive care patients and up to 12 patients with moderately severe injuries, six of whom can be constantly monitored (*Fig. 5*).

Fig. 5: *Transall C-160, 14-Patient version*



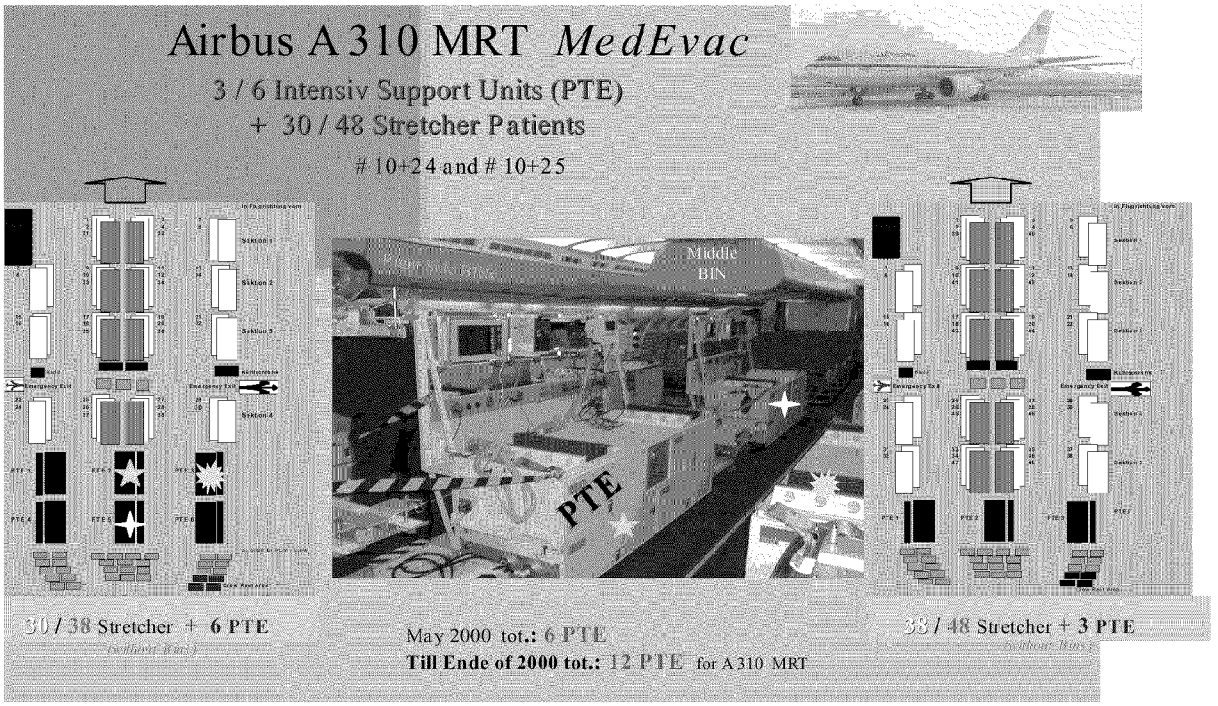

Additional sitting passengers can also be transported.
As a matter of principle, the accompanying medical team consists of 2 physicians with the specialty of emergency medicine, 2 rescue assistants, 4 rescue medics and 4 nurses.

The power supply of the medical equipment such as monitors, electrocardiographs, defibrillators, pulsoxymeters, respirators, perfusors and blood pressure monitors is accomplished via the aircraft power supply system as well as via internal storage batteries and are certified for in-flight operation. In addition, oxygen and drug reserves are also carried on board.
All four C-160 Transall aircraft can currently be configured for the transport of 14 patients. The emergency medical conversion kit can be installed in **Challenger** CL601 type aircraft. It allows in-flight intensive care for one patient. As a matter of principle, the medical crew consists of one physician (emergency physician), one rescue assistant, and one medical attendant. Three emergency medical conversion kits are available for personal aeromedical evacuation.

**Strategic Aeromedical Evacuation:**

With the conversion of the Airbus A310 to a freight configuration with a large freight door it is now possible to configure this aircraft for large scale strategic aeromedical evacuation missions.
The AE A 310-300 medical conversion kits for the **A 310** aircraft are currently in service to ensure long range transport of a minimum of 250 patients a day.
The conversion kits have a modular configuration. Allowing the implementation of various configurations, a maximum of 38 stretchers, 48 seats and 6 intensive care stations can be installation (*fig. 7*).

Fig. 7: *Airbus A310 conversion kit in different configurations*




in 2000: + PTEs for Challenger CL-601 and C-160 Transall

The intensive care units (patient transport units, above) have been designed to the most advanced aspects of medical engineering. They are compatible with civil aircraft types and can be employed globally. The conversion kit also includes a laboratory unit. The provision of a telemedical terminal is planned.
A total of 4 sets, containing 54 stretchers, that can be refitted with up to 6 intensive care stations are to be procured. Possible configurations of a set are shown in fig.7.

## OUTLOOK

Sufficient and qualified AE capacities at and between all levels of medical care are a prerequisite for the fast, competent and, if indicated, intensively medically monitored transportation of critically sick and/or wounded patients to facilities that provide final specific personal medical care/rehabilitation.
To this end, the structural and procedural prerequisites (command, control, communication, computer, information = c4i) must be given highest priority, to control and coordinate the flow and transfer of patients. The command and control organization, procedures and assets must be such, that they can meet the requirements of all possible AE related employment options for various scenarios, including joint operations, under multinational or national operational com mand and control.

**This requires:**
- qualified and trained designated evacuation units
- centralized command, control and communication (c3)
- standardized international procedures
- standardized compatible medical equipment
- all-weather capable aircraft with day /night capability and worldwide communication capability
- appropriate conversion sets for intensive medical monitoring
- civil-military cooperation (NATO CAPC).

The Office of the Air Force Surgeon is currently preparing an operational concept for the aeromedical evacuation in the Bundeswehr that is to meet the qualitative and quantitative requirements of the forces. Based on a careful analysis of ACE Directive 85-5 the German Army reported a daily aeromedical evacuation requirement of 480 wounded and sick patients. The A 310 AE conversion kit is able to meet this requirement at the national level and ensure long range aeromedical evacuations adjusted in type and extent. This is of particular importance in view of the mobility and flexibility of future operations (logistic tail).
In support of these operations, the German Air Force Surgeon established a training course for medical officers at the Air Force Institute of Aviation Medicine (Aeromedical Evacuation of Wounded and Sick Patients, Familiarization for Military Physicians) that is to enable the participants to conduct aeromedical evacuations on their own responsibility. The course prerequisites are clinical knowledge, emergency medical competence and aeromedical experience. Similar regulations apply to the "Training of medical orderlies for the attendance of sick and wounded patients during aeromedical evacuations" that is also held at the Air Force Institute of Aviation Medicine.

In addition a MEDEVAC medical detachment that is to conduct aeromedical evacuations was incorporated into the establishment of the air transport units. It can be complemented by the flight operations medical detachment. The multilateral contacts aimed at a cooperation in the field of aeromedical evacuations complement these supporting measures.

During multinational operations within the scope of NATO, UN or the WEU the resources available must be used in a responsible and intelligent way. Customary national routines sometimes undermine this objective. The qualified aeromedical evacuation of wounded and sick patients is to be adapted to the requirements of a competently adjusted medical support with specialist expertise, creativity and innovation in its future task spectrum.

## SUMMARY

The combination of a coordinated medical care system for wounded personnel at the medical facilities of the three levels A, B and C and qualified forward-, tactical- and strategic aeromedical evacuation forms the basis required to meet the requirements resulting from the flexibility and mobility of the units to be supported. A functional AE system is a decisive factor in the provision of fast and qualitatively adjusted medical support between and within all levels of medical care. This increases the morale of the forces and ensures wide acceptance of the medical service.

The German Air Force Medical Service takes up this task with competence and the employment of all forces and assets considering also the multinational interoperability in that field..
In addition to medicine **for** the third dimension, medicine now also **enters** the third dimension.

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