

Chapter 4

Aeromedical Evacuation

Introduction

Evacuation of injured personnel using rotary or fixed-wing aircraft has revolutionized the rapid transport of casualties from areas where there is either inadequate or no care available, to medical treatment facilities (MTFs) where essential and/or definitive care can be rendered. Although use of an aircraft can decrease transport time, the aeromedical environment creates unique stresses on the injured patient. The following are terms that describe evacuation of patients using aircraft.

- **Casualty evacuation (CASEVAC)** is the movement of a casualty from the point of injury to medical treatment by nonmedical personnel. Casualties transported under these circumstances may not receive en route medical care. Typically, this involves a helicopter returning from the battlefield.
- **Medical evacuation (MEDEVAC)** is the timely, efficient movement and en route care provided by medical personnel to the wounded being evacuated from the battlefield to MTFs using medically equipped vehicles or aircraft. Examples include civilian aeromedical helicopter services and Army air ambulances. This term also covers the transfer of patients from the battlefield to an MTF or from one MTF to another by medical personnel, such as from ship to shore.
- **Aeromedical evacuation (AE)** generally utilizes US Air Force (USAF) fixed-wing aircraft to move sick or injured personnel within the **theater of operations (intra**theater) or between two theaters (**inter**theater), such as moving a casualty from Afghanistan to Germany. This is a regulated system in which care is provided by AE crewmembers. The AE crews may be augmented with Critical Care Air Transport Teams (CCATs) to provide intensive care unit level care.

- **En route care** is the maintenance of treatment initiated prior to evacuation and sustainment of the patient's medical condition during evacuation.

Medical Considerations for Patients Entering the Medical Evacuation System

Medical Considerations/Requirements

- Medical evacuation request includes requirement for surgical equipment and/or providers.
 - Patient is stabilized for the anticipated mode and duration of travel.
 - Patient's airway and breathing are adequate for movement.
 - Patient's IV lines; drainage devices; physiologic monitoring devices (arterial catheters, intracranial pressure monitors, EKG leads, pulse oximeter, capnometer); and tubes are fully secured and patent.
 - Small pneumothoraces have the potential for expansion at altitude, so early placement of a chest tube should be considered. Any patient with a pneumothorax regardless of the size should have a chest tube before any flight.
 - Heimlich valves on chest tubes are functioning.
 - Foley catheters and nasogastric tubes are placed and allowed to drain.
 - Patient is covered securely with both a woolen blanket, and an aluminized blanket, or other warming system for air transport.
 - Three litter straps are used to secure the patient to the litter.
 - Earplugs should be provided to patients during flight.
 - Personal effects and all medical records accompany the patient.
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- Evacuation of a patient is initiated by the originating/sending physician according to established procedures. Patient administration personnel normally provide the administrative details and coordination required to accomplish the evacuation. Due to differences in the type of evacuation assets used and their effect on the patient's medical condition (eg, flying in

the pressurized cabin of an aircraft), requests to transport patients via the USAF AE system must also be validated for evacuation by the theater validating flight surgeon.

- For patients evacuated from Role 2 MTFs or Forward Surgical Teams (FSTs), the brigade surgeon (or designee) determines the evacuation precedence for all patients requiring evacuation from that facility. This is done in consultation with the FST's chief surgeon and/or senior nurse. When a patient is readied for evacuation from the FST by USAF assets, the supporting Patient Movement Requirements Center (PMRC) should be contacted at the earliest possible time. This allows the PMRC sufficient time to coordinate airlift and patient movement item requirements.

Implications of the Aviation Environment

- **General considerations prior to transport.**

- Due to altitude effects, restricted mobility, limited staffing en route, and unpredictable evacuation times, the referring physician should tailor vital signs monitoring requirements and frequency of wound and neurovascular checks.
- Some therapies that might not be required in a fixed MTF are appropriate for AE.
 - ◆ For example, patients with significant medical or surgical conditions should have Foley catheters, nasogastric tubes, provisions for IV pain medications, extended duration IV antibiotics, and appropriate nutrition.
- Consider liberal use of fasciotomies/escharotomies.
- Consider securing the airway with a prophylactic endotracheal tube.
- Wounds dressed for delayed primary closure. Unless directed otherwise, the AE crew does not routinely redress wounds. However, if a patient develops fever or sepsis en route, wounds must be inspected.
- The use of splints is preferable. Circumferential casts should be avoided or bivalved. Document neurovascular checks prior to and frequently during flight. Unrecognized extremity compartment syndrome in patients with regional blocks has the potential to be devastating.

- **Decreased barometric pressure.**
 - The volume of a gas bubble in liquid doubles at 18,000 feet above sea level. Cabin pressures in most military aircraft are maintained at altitudes between 8,000 and 10,000 feet. If an aircraft has the capability, the cabin altitude can be maintained at lower levels, but this will significantly increase flight time and fuel consumption.
- **Consider cabin altitude restriction (CAR) for the following:**
 - Penetrating eye injuries with intraocular air.
 - Free air in any body cavity.
 - Severe pulmonary disease.
 - Decompression sickness and arterial gas embolism require CAR at origination field altitude. Destination altitude should not be higher than origination altitude. Transport on 100% oxygen (by aviator's mask if available).
- **Pneumothorax:** Chest tube should be inserted for all pneumothoraces given the risk of expansion at altitude. All pneumothoraces must be drained prior to strategic air transport. A Heimlich valve or approved collection system must be in place prior to patient transfer to the flight line.
- **Air Splints:** Should be avoided.
- **Ostomy Patients:** Vent collection bags to avoid excess gas dislodging the bag from the stoma wafer. Use a straight pin to put two holes in the bag above the wafer ring.
- **Decreased Partial Pressure of Oxygen:** Ambient partial pressure of oxygen decreases with increasing altitude. At sea level, a healthy person has an oxygen saturation of 98%–100%. At a cabin altitude of 8,000 feet, this drops to 90%, which corrects to 98%–100% with 2 L/min of oxygen.
- **Neurosurgical Patients:** Hypoxia may worsen neurological injury. Adjust ventilator settings to meet increased oxygen demands at altitude.
- **Acceleration Stress:** Traumatic brain injury patients can experience transient marked increases in intracranial pressure during takeoff or landing. Patient positioning onboard the aircraft helps minimize this risk (head forward on takeoff, head aft on landing).
- **Thermal Stress:** Plan for cabin temperature changes from 15°C (59°F) to 25°C (77°F) on winter missions, and from 20°C (68°F)

to 35°C (95°F) on summer missions. Normothermia should be maintained by using approved devices.

- **Noise:** Exposure to noise can produce problems with communication and patient evaluation (auscultation is impossible—use noninvasive blood pressure monitoring and/or an arterial line). Provide the patient hearing protection. Audible medical equipment alarms are useless.
- **Decreased humidity:** Airplanes have very low cabin humidity at altitude. Evaporative losses will increase; therefore, patients will require additional fluids, especially those with large burns and those at risk for mucous plugging.
- **Patient movement in nuclear, biological, and chemical (NBC) environments:**
 - Nuclear and chemical casualties must be externally decontaminated and time allowed for off-gassing of residual chemical agent.
 - Movement of biological casualties varies by the nature of the agent, its mechanism of transmission, and the period of communicability during the course of illness.
 - Any NBC AE movement may be delayed due to the following:
 - ◆ Aircraft decontamination time.
 - ◆ Availability of noncontaminated aircrew.
 - ◆ Cohorting of similarly exposed patients.
 - ◆ Highly communicable diseases (eg, plague and smallpox) require special approval (command and diplomatic) before AE.
 - ◆ Chemically or radiologically contaminated casualties must be decontaminated before entering the AE system unless the theater and USTRANSCOM commanders direct otherwise.

Medical Evacuation Precedences

- Depending on the service, the type of evacuation assets used, and the evacuation environment, the timeframes for effecting evacuation differ. Refer to Table 4-1.
- **The USAF AE system:** The Air Force's AE system requires the availability of a secure landing strip, which can support the fixed-wing platforms that are used to move casualties. AE is a regulated, in-transit visible system utilizing a variety

of opportune aircraft with dedicated medical crews and equipment, primarily C-130, KC-135, and C-17. The medical crews are made up of flight nurses, aeromedical technicians, and medical attendants trained to perform routine care to stable patients during transport. This system is not designed as a primary/scene response team.

- AE personnel and equipment for inflight supportive patient care and flight line support operations.
- Organic communication network for medical facilities and airlift C2 agencies.
 - ◆ Aeromedical Evacuation Liaison Team (AELT): 4- to 6-person communication team, usually co-located with an MTF, to coordinate requests with the AE system.

Table 4-1. Evacuation Precedences*

Movement Precedence	Army, Navy, Marines (MEDEVAC)	Air Force (AE)	Description
Urgent	Within 1 h	ASAP	Immediate AE to save life, limb, or eyesight
Priority	Within 4 h	Within 24 h	Prompt medical care not available locally Medical condition could deteriorate and patient cannot wait for routine AE
Routine	Within 24 h	Within 72 h or next available mission	Condition is not expected to deteriorate significantly while awaiting flight

AE: aeromedical evacuation; ASAP: as soon as possible; MEDEVAC: medical evacuation.

*Timeline may vary based on patient requirements and logistical constraints.

- Aeromedical Staging Facilities (ASFs), generally located at major transit points, manage the administrative processing and staging, providing limited medical care of casualties entering or transiting the AE system. Patients are normally held only for 2–6 hours prior to evacuation.

- ◆ ASFs range in size/capability from small units deployed in support of Special Operation Forces to 100-bed facilities.
- **Reporting a patient for AE:** Originating physician consults with local flight surgeon to determine the en route care plan and timing of evacuation.

Due to the complexity of the aeromedical evacuation system, physicians must identify points of contact (local flight surgeons, the Aeromedical Evacuation Liaison Team, aeromedical staging elements, and the Patient Movement Requirements Center), verify and test lines of communication, and rehearse patient evacuation drills and procedures before the actual need arises.

- **Patient stability:** Patients validated for transport by AE must be stabilized as completely as possible prior to evacuation (airway secured, hemorrhage controlled, shock treated, and fractures immobilized).
 - Communicate the condition, AE category (ambulatory or litter), and movement precedence (see Table 4-1) of the patient to the PMRC, as communications assets allow (Table 4-2).

Table 4-2. Patient Movement Requirements Center Contact Information

PMRC	Commercial Telephone Number	Military Telephone Number
Global (Scott AFB, Illinois)	1-800-303-9301 or 1-800-874-8966	DSN 779-4200 or 8184
EUCOM Theater (Ramstein Air Force Base, Germany)	011-49-6371-47-2264 or 2235/2243	DSN 314-480-2264 or 2235/2243
PACOM Theater (Hickam AFB Hawaii)	808-448-1602	DSN 315-448-1602

AFB: Air Force Base; DSN: Defense Switched Network; EUCOM: European Command; PACOM: Pacific Command; PMRC: Patient Movement Requirements Center.

- To ensure optimum care, communicate with the accepting physician, and provide diagnosis, care rendered, and subsequent medical care plan (next 24–48 hours).
- Ensure that the patient has adequate quantities of supplies and medications for duration of transfer (at least 24 hours **intra**theater and 48 hours **inter**theater).
- **Local flight surgeon responsibilities.**
 - Authority for determining whether patients are physiologically ready for air transport.
 - Resource for AE system information, communication, and coordination (Table 4-3).
- **Request versus requirement:** AE **requests** and patient movement **requirements** are different. Physicians at originating MTFs submit requests for movement, timing, destination, suggested support therapies, etc. Only the validating flight surgeon (usually located at PMRC; not the local flight surgeon) and the PMRC can validate those requests, which then become AE requirements.

Table 4-3. The Aeromedical Evacuation Process

Activity	Location Where the Activity Occurs
Request for AE mission	Originating physician
Validation for AE	PMRC (establishes AE requirement)
Clearance to move by air	MTF (referring physician and local Flight Surgeon)

AE: aeromedical evacuation; MTF: medical treatment facility; PMRC: Patient Movement Requirements Center.

- **Validation versus clearance for USAF AE.**
 - AE **clearance** is a medical care event; **validation** is a logistical event.
 - **Clearance** is a decision between the referring physician and the local flight surgeon, addressing:
 - ◆ Description of the medical condition of the patient.
 - ◆ Probability that the patient can survive transit through an aviation environment.
 - ◆ What the patient needs to make the trip safely.
 - ◆ En route medical capability requirements.

● **Key steps for USAF AE patient request.**

- Contact local flight surgeon and AE liaison for clearance consultation.
- Determine the patient's AE category, based on diagnosis and ability to self-help in an emergency during flight.
- Determine need for CCATT (see next page). The CCATT adds an additional level of support to the AE system for movement of *stabilized* patients who require a higher level of medical therapy or who have the potential to experience significant deterioration during movement. The CCATT physician is the clinical authority and, with the other team members, is responsible for documenting and providing care. CCATT members may be called on to consult and/or assist in the care of other patients.
- A five-person burn transport team can augment the AE system as required for inhalation injury and/or severe burns.
- Determine if special requirements exist for transport (eg, CAR and splinting). Contact the Burn Center at SAMMC (210-233-5815, 210-222-BURN [2876], or DSN 471-2816) prior to initiating movement.
- Determine patient movement items required (eg, ventilators, pulse oximeters, among others). Flight surgeon must verify that all items accompanying the patient are cleared for in-flight use.
- Determine the patient's movement precedence.
- Submit request.

Selection of the CCATT Patient

When deciding if a casualty requires the expertise of a CCATT, the provider needs to assess what requirements the casualty will have during transport.

Basic Definition of a CCATT Patient

Patients requiring CCATT transport include those in need of intensive nursing care, constant hemodynamic monitoring, mechanical ventilation, frequent therapeutic interventions, or other medical or surgical interventions vital to sustain life, limb, and eyesight during movement of the patient through the aeromedical environment.

To ensure mission success, a CCATT should be used to move the patient if any of the criteria listed below are present.

Use a CCATT if the patient:

- is intubated
- requires aggressive fluid administration or has received more than 10 units of blood products in the past 24 hours
- requires blood replacement or vasopressor support
- requires invasive hemodynamic or intracranial monitoring
- requires frequent suctioning or nebulizer treatments
- has an increasing oxygen requirement
- has undergone a vascular reconstruction
- has unstable angina
- has a condition requiring the need to initiate/continue IV drips for pain relief, anticoagulation, etc, while in flight
- has an unstable spine fracture
- requires the Vacuum Spine Board for movement
- has altered mental status
- will require electrolyte replacement and monitoring in flight.

If there is a question about whether a patient without any of the previously described criteria should be moved via CCATT, the sending provider should contact the theater validating flight surgeon. Consultation with all providers involved is fundamental in ensuring that the appropriate resources are used to move the patient safely.

Critical Care Air Transport Teams (CCATTs)

Intensivist Physician

- Capable of providing short-term life support, including advanced airway management, ventilator management, and limited invasive (nonoperative) procedures.
- Trained in critical care medicine, general surgery, anesthesiology, or emergency medicine.

Critical Care Nurse

- Experienced in managing patients requiring mechanical ventilation, invasive monitoring, and hemodynamic support.

Cardiopulmonary Technician

- Experienced in the management of patients requiring mechanical ventilation and invasive monitoring.
- Experienced in troubleshooting ventilatory support, portable laboratory devices, and monitoring systems.

After it is determined that a casualty requires the expertise of a CCATT, the next step lies in the preparation of that casualty for transport. The most important aspect in ensuring that the movement of a critically ill or injured patient is successful lies in the preparatory phase. To accomplish this task, the sending facility must make certain that all aspects of the Intertheater Transport Checklist are followed (see next page).

Upon arrival of the CCATT, a one-on-one report should be given to the team, thus ensuring that any changes of patient condition have been addressed. Whenever possible, it is preferred that the sending physician directly speaks to the CCATT physician prior to departure. This will ensure that a smooth transition of care is accomplished.

Humanitarian Transport Requests

- The process of arranging routine humanitarian evacuations out of theater can take more than 6 months.
- Appropriate patient selection is critical. Ideally, these patients have a single, fixable, stable problem.

Intertheater Transport Checklist

Name _____ DOB _____ SSN _____

Originating Facility _____ Destination Facility _____ Date _____

INTERVENTIONS	Initial
Patient Validated and Manifested for Flight: <ul style="list-style-type: none"> - AF Form 3899, Patient Movement Record completed - Notify destination facility accepting physician and Burn/Lung Team as appropriate - Determine need for medical/non-medical attendant or CCATT - Ensure identification card/passport/orders are with patient 	 _____ _____ _____
Patient Transport Considerations: <ul style="list-style-type: none"> - Maximize patient pre-flight condition (See AFI 41-307, AE Patient Considerations & Standards of Care) - Consider special equipment and need for equipment waiver - Determine need for restraints - Consider isolation precautions - Consider need for Over-size Litter (OSL) for patients in excess of 350 lbs (Green/Black DECON litter including patient & equipment) - Consider need for Stryker Frame bed (spinal stabilization/traction/pronation) - Determine need for blood product administration in-flight; contact blood bank as appropriate 	 _____ _____ _____ _____ _____ _____
Patient Preparation: <ul style="list-style-type: none"> - Ensure patient identification and allergy bands are on patient - Complete patient care orders written for in-flight care - Pharmacy orders sent for medication preparation - Recently extubated patients should have been stable for 4 hours since extubation (unless approved by CCATT physician) - Verify airway patent; insert/secure ETT tube - Ensure adequate & functional IV access; secure; label IV tubing w/ med/fluid name for easy identification - Insert and secure arterial line; ensure transducer is correctly positioned and easily accessible - Insert Foley catheter for patients with difficulty ambulating or who cannot use bedpan/urinal while supine - Ventilated patients: <ol style="list-style-type: none"> 1. Switch to transport ventilator at least 2 hrs prior to flight to ensure tolerance 2. Obtain/review pre-flight chest x-ray/ABG 3. Suction immediately prior to transport - Change dressings as close to patient departure time as possible - Perform anti-hijacking and complete associated documentation - Empty Foley and all drains immediately prior to departure - Obtain and document discharge vital signs/labs/I&Os, etc. - Administer pain/sedation medication 	 _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____
Miscellaneous Preparation: <ul style="list-style-type: none"> - Obtain adequate oxygen supply for transport - Obtain all transport equipment and supplies - Obtain blood products - Obtain medications and IV fluids - Obtain copy of chart, x-rays, etc. - Gather personal property and complete associated documentation - Complete patient education (e.g.: self-administered medication, etc.) 	 _____ _____ _____ _____ _____ _____
Patient Litter: <ul style="list-style-type: none"> - Prepare Green/Black/DECON litter with litter pad and clean linens (back rest and IV pole, as applicable) - Pad patient appropriately; add and secure equipment - Cover with sheets and blankets - Apply at least two litter straps - Place Ambu-bag with face mask at head of litter 	 _____ _____ _____ _____
Medical/Non-medical Attendant: <ul style="list-style-type: none"> - Ensure original deployment and travel orders to return to AOR - Provide point of contact for arrival and departure; planned itinerary back to AOR 	 _____ _____

ABG: arterial blood gas; AE: aeromedical evacuation; AF: Air Force; AFI: Air Force Instruction; AOR: area of responsibility; CCATT: Critical Care Air Transport Team; DECON: decontamination; DOB: date of birth; ETT: endotracheal tube; hrs: hours; I&Os: intakes and outputs; IV: intravenous; med: medicine; SSN: Social Security Number; w/: with.

Data source: Joint Theater Trauma System Clinical Practice Guideline for Intratheater Transfer.

- The lack of suitable host nation care must be confirmed and documented. Regional care is preferred over transport to the continental United States (CONUS).
- Individual cases for humanitarian evacuation out of theater are unlikely to be successful without a passionate advocate. Personalizing the case with photos and compelling narrative is crucial for success.
- The approval process is complex and requires coordination with the local US embassy or State Department, host nation medical officials, and transit nations' ministries of foreign affairs or equivalent.
- All evacuated children must have an attendant. Those needing military transport require "Secretary of Defense Designee" status.
- Coordination also includes travel to the receiving medical center once in CONUS, obtaining diplomatic transit clearance while waiting in a third country for ongoing transport, and arrangements for return transport. Clearances must cover both the patient and the nonmedical attendant.
- Contact the servicing Patient Movement Requirements Center early for guidance.

**For Clinical Practice Guidelines, go to
http://jts.amedd.army.mil/index.cfm/PI_CPGs/cpgs**

