



# Clinical Guidance

# Paediatric Critical Care: Aeromedical Transfer

# Summary

Guidance for aeromedical retrieval of critically ill children.

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This guideline represents the views of STRS and was produced after careful consideration of available evidence in conjunction with clinical expertise and experience. The guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient. This clinical guideline has been produced by the South Thames Retrieval Service (STRS) at Evelina London for nurses, doctors and ambulance staff to refer to in the emergency care of critically ill children.			

Change History			
Date	Change details, since approval	Approved by	
Sept 2021	Minor Formatting Contact Numbers Updated	ELCGC Sept 2021	
Dec 2024	Extensive review of content. Physics and physiological considerations added. Oxygen calculations and estimations updated.	ELCGC Jan 2025	

# Paediatric Critical Care: Aeromedical Transfer

## INDICATIONS

- 1. Overseas retrieval or repatriation (commercial fixed wing)
- 2. Care required not available locally, or water boundary
  - >60min by road consider rotary wing
  - >120min by road consider rotary or fixed wing

NB: Aeromedical transfer may reduce out-of-hospital time but **not always** time to destination. Consider time burden on service **and** patient. Discuss with STRS consultant.

# CHOICE OF AIRCRAFT

**Rotary wing**: Drop off and pick up closer to destination (depending on distance to helipad). Cramped interior. Noise, vibration and temperature problematic. Low altitude, un-pressurised cabin. Dependant on weather conditions.

**Fixed wing:** Secondary transfers to/from airport. More space. Better environment control. More acceleration/deceleration. High altitude, pressurised cabin. Minimal weather restrictions.

- Air ambulance: Shorter range. Power & gas source may be available, check compatibility.
- **Commercial flight:** Longer range. Need to be self-sufficient for all equipment power. Cabin pressurised to ~8000ft.

## PHYSICS (Significant only during fixed-wing transport)

- **Boyle's law:**  $P_1V_1 = P_2V_2$
- All enclosed volumes increase by 30% at 8000ft (2500m) • **Dalton's law:**  $P_t = P_1 + P_2 + P_n$
- FiO<sub>2</sub> at 8000ft (2500m) = 1.33 x FiO<sub>2</sub> at sea level

## PHYSIOLOGICAL CONSIDERATIONS

#### Airway:

- Uncuffed ETT or ETT cuff filled with 0.9% sodium chloride. Aim for a small leak if possible. Monitor cuff pressures.
- Take portable suction equipment. Take manual suction (foot/ hand pump) for long journey.
- Use dummy/valsalva to equalize inner-ear

#### Breathing:

- Exclude pneumothorax. Any air leak, however small, must be drained before flight. Heimlich valves to all chest drains. Have needle thoracotomy set. Add drainage bag if effusion.
- ETCO2 monitoring essential
- Once airborne, anticipate fall in saturations & increase FiO<sub>2</sub> and airway pressures to maintain oxygenation
- If air leak or oxygenation remain problematic, discuss altitude restriction with flight team as last resort

#### Cardiovascular:

- Invasive arterial and CVP monitoring preferred
- Acceleration and deceleration at take-off & landing will impact fluid status, ICP, V/Q matching, infusion delivery (depending on patient orientation). Anticipate & manage pro-actively.

# Gastro-urinary:

- Decompress stomach with large bore NG tube on open drainage.
- Beware of trapped gas in intestine or peritoneum.
- Urinary catheter in situ on drainage. Catheter balloon filled with 0.9% sodium chloride or water.

#### Neuro:

Optimise analgesia and sedation in view of multiple stressors.

# **Environment:**

- Temperature control measures prior to flying. Temperature will fall in dry, cool atmosphere of high altitude. Use humidifier.
- Plan for transfer between ambulance and aircraft, often outdoors.
- Reduce noise with earplugs and vibration with padding.

# Lines:

At least 2 points of IV/IO access

# **EQUIPMENT**

- All equipment must be securely strapped down during the flight including oxygen cylinders
- Plan for restricted access to patient and equipment
- Expect large directional forces on all equipment and passengers (opposite on take-off and landing)
- Check compatibility of O<sub>2</sub> connections
- Equipment cannot usually be plugged in commercial airliner.
- All equipment must be entirely self-sufficient on **own battery source**. Take spare batteries in orange peli case, plug in to charge at every opportunity. May need adaptors overseas.
- All equipment taken on board must be **approved by air crew** for use (some electronics affect the airplane avionics)
- If defibrillation is required, notify pilots prior to activation
- Alarms may not be heard, monitoring may not be visible
- Pressure monitoring attached to pump (not pressure bag)
- Ensure all monitoring lines are air free (even small air bubbles will expand, coalesce & dampen trace)
- Deflate and remove/ open BP cuff after use
- Vacuum mattresses will lose vacuum at altitude. Use as an air-filled mattress in flight or re-vacuum
- Any air-filled devices (e.g. air-filled immobilisation splints) must be decompressed before take-off). Plaster casts must be split.

#### <u>STAFF</u>

- Beware of tiredness, dehydration, hypoxia, difficult communication. If long trip, plan for shifts and rest.
- Bring warm clothes.
- Follow safety instructions from air crew at all times.

## **OXYGEN CALCULATIONS**

#### Oxygen requirement (L): Journey time (min) x ventilator consumption of O<sub>2</sub> (L/min)

#### Journey time calculation:

•	Total	(minutes)
Ambulance to accepting hospital		
Ambulance to accopting beenital		
Deplaning to ambulance		
Flying time (including refueling time)		
Airport check-in and waiting time		
Ambulance to airport		
Hospital to ambulance		

#### Ventilator usage of oxygen

Hamilton estimate:

 $(ExpMinVol + Base flow + MVleak) *((FiO_2 - 21) / 79)$ Hamilton T1 **actual** O<sub>2</sub> consumption is displayed in System > Info.

## Cylinders

Size	Usable capacity	4L/min	6L/min	8L/min	10L/min	Full weight
CD	460L	1h55	1h17	0h58	0h46	3.5kg
D	340L	1h15	0h57	0h42	0h34	3.9kg
E	680L	2h50	1h53	1h15	1h08	6.5kg
IQX	2000L	8h20	5h33	4h10	3h20	18.0kg
ΗХ	2300L	9h35	6h23	4h47	3h50	19.0kg
G	3400L	14h10	9h27	7h05	5h40	39.0kg

#### Quick check table

	5 hours	10 hours	15 hours
8L/min	6xCD cyl.	11xCD cyl.	16xCD cyl.
15L/min	11xCD cyl.	21xCD cyl.	31xCD cyl.

# ALWAYS TAKE DOUBLE THE CALCULATED VOLUME OF OXYGEN REQUIRED

#### **References:**

• Guidelines for Air and Ground Transport of Neonatal and Pediatric Patients. 4th ed. American Academy of Pediatrics; 2016.