# National Neonatal Transport Programme Guidelines for Air Transport When Using the Irish Air Corps' EC 135 and AW139 Helicopters

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# Introduction:

**The National Neonatal Transport Programme (NNTP)** established in March 2001, is a rapid response service for the stabilisation and transportation of premature and ill neonates. The goals of the programme are:

1. To provide quality, standardised care for neonates up to the age of six weeks who require transport to regional neonatal/surgical intensive care units nationally.
2. To improve patient outcomes by providing transport teams skilled in the anticipation and delivery of emergency and intensive neonatal medicine.

Since December 2013,the service is available seven days a week, 24 hours /day . The NNTP is funded by the HSE and transport teams are drawn from the Coombe Women and Infants' University Hospital, the National Maternity Hospital and the Rotunda Hospital together with Eastern Region Ambulance Service. Each of the three hospitals is on call for NNTP transports for one week at a time (on a rotational basis). A designated neonatal nurse, neonatal registrar and ambulance person together with a dedicated NNTP ambulance are available for transport daily.

For practical purposes, most neonatal transports in Ireland are best undertaken as road transfers. However in circumstances where factors such as distance, adverse road conditions or urgency of transport are paramount, air transport is the preferred option. As the demands for the services of the NNTP continue to increase, so too have the requests for air transport

**A Service Level Agreement (SLA)** has been prepared by the Department of Defence and the Department of Health and Children in consultation with the Health Services Executive, the Defence Forces and the Air Corps in respect of provision of Air Ambulance Services.

The Air Corps Air Ambulance Service is an emergency inter-hospital transfer service for the essential rapid transfer of patients between hospitals. The scope of service currently provided includes: **Air Transport of Neonates requiring immediate medical intervention in Ireland**

The Air Corps will provide helicopters or fixed wing aircraft and flying crews for NNTP Transports dependent upon the following:

- Availability of suitable aircraft
- Availability of flying crews
- Suitability of weather conditions

The NNTP has developed a specific transport module for air transport that integrates into the Irish Air Corps' EC135 and AW139 helicopters. This lighter weight incubator/ventilator system and trolley can be loaded safely and accommodated securely in these aircraft and also into the NNTP's dedicated ambulances and other national front line ambulance

# PROTOCOL NO 1

## Air Transport Sequence of Events using EC135 & AW139 Helicopters

**Transport accepted by the NNTP transport team on call**

⇓

**The decision to transport by air is made by the NNTP Transport Consultant/or Neonatologist in charge of the transport. The decision to travel by air is made on clinical grounds, but all air transports should be discussed in advance with the NNTP Co-ordinator, Clinical lead or designate in view of the logistics involved.**

⇓

**Transport consultant /medical team /Co-ordinator contacts the National Air-Ambulance Control Centre (NAAC) (Protocol 2) to request Air Ambulance - He/she specifies Priority or Routine Call**

⇓

**NNTP team also call NAS control to activate NNTP driver and ambulance**

⇓

**NACC arranges transport with Air Corps Operations Section and if required, organises suitable ambulance to meet aircraft at destination**

⇓

**NACC confirms Air Corps acceptance to conduct transport with NNTP team.**

⇓

**NNTP ambulance (containing NNTP's air transport ancillary equipment) (protocol 4) collects team from base hospital and travels to Baldonnel airbase within 30 mins.**

⇓

**While NNTP team is en route, Air Corps Ops load the NNTP's air transport module and trolley (kept in Baldonnel) into aircraft**

⇓

**On arrival at Baldonnel, the NNTP team transfer ancillary air transport equipment from ambulance to aircraft and ensures all is functioning**

⇓

**NNTP team boards aircraft and calls referring hospital when leaving to give ETA**

⇓

**On arrival at destination, incubator is unloaded onto NNTP trolley. This trolley can be secured in NAS frontline ambulance locks**

⇓

**Transport team arrives at referring hospital, stabilises infant**

⇓

**Team travel with infant to helicopter (in a national ambulance if required)**

⇓

**NNTP team phone NACC/ ambulance driver and receiving hospital with ETA**

⇓

**Incubator with infant is loaded into helicopter by Air Corps staff**

⇓

**Travel back to Baldonnel**

⇓

**Arrive and Air Corps staff unload incubator from helicopter**

⇓

**Incubator loaded into NNTP ambulance and travel to receiving hospital**

⇓

**Clean incubator system is returned to Baldonnel in NNTP ambulance**

## PROTOCOL NO. 2

### Requesting Air Corps Air Ambulance Service

**All NNTP requests for Air Corps Air Ambulance Service will be made by the consultant, co-ordinator, registrar or nurse in charge of the transport stating whether the request for air transport is 'Priority' or 'Routine'[1] and will be channelled through:**

## The National Air Ambulance Control Centre (NACC)

## Tel: 1850 211869

The control centre will make contact with the Air Corps Operations Section:

**01 4037502/ 01 4592493/ 01 4592494/01 4037800**

- Ambulance Control will complete the details as per the Air Ambulance Request form (Appendix 4) and pass the details to Operations Section, Air Corps.
- The Air Corps Operations sections will then confirm all details with Ambulance Control, who in turn will pass on confirmation and timings etc. to the NNTP requestor and receiving control centre.
- Throughout the transfer, it is imperative that the Requesting Control Centre maintains close contact / co-ordination with the Air Operations section, the NNTP requestor and the receiving HSE Ambulance Control

[1] **Priority Call**: NNTP require information re IAC availability for mission within 15-20minutes and that aircraft is available to fly within the hour
**Routine Call:** NNTP require information re IAC availability for mission within 15-20minutes and that aircraft is available to fly on the day requested.

# PROTOCOL NO 3

## The Decision To Travel By Air

The National Neonatal Transport Programme is primarily a ground transfer service and the decision to transport by air must be made on the basis of the urgency of the transport in relation to the infant's clinical condition and not solely on the distance to be travelled.

### 3.1 Factors to be considered by NNTP when deciding on Mode of Transport

- Diagnosis and medical stability of the neonate, including analysis of possible complications in his or her condition during transport
- Urgency of providing a higher level of care
- Level of medical care that the infant is currently receiving
- Distance and duration of transport to the receiving hospital
- Geographic characteristics that affect expedient transport
- Methods of transport available ( AAP,1999)

### 3.2 Choosing the Rotary Wing (helicopter) Transport Mode

Helicopter transfer is the preferred NNTP transport mode when:

- There is an urgency of transport in relation to distances >180 kms.
  (ie: Letterkenny, Tralee, Castlebar, Sligo, Cork, Galway)
- There is an urgency to provide a higher level of medical care than is available at the referral centre
- Adverse road conditions impede ground transport

It is important to note that although helicopters provide a means of rapid transport, distance alone should not influence the choice to transfer by air. (AAP,1999)

### 3.3 Factors that affect transport in the Irish Air Corps' helicopters

- The infant may not be suitable for air transport as he/she can be adversely affected by the increased risks associated with air transport which include: hypothermia, hypoxia, expansion of gases trapped in a body cavity, noise and vibration
- Unstable infants who are likely to require interventions en route are also unsuitable for air transport in the EC135 as access to the infant is restricted. Access to the infant is much less restricted in the AW139 aircraft.

- Air transport may be affected by:

  weather conditions (eg: high wind or fog)

  availability of suitable landing site

  unavailability of aircraft

  unavailability of an ambulance that can accommodate the NNTP incubator to transfer between landing site and referring hospital (Health Canada,2007)

### 3.4 Special considerations

Although air transfer is often considered just another way of transporting a patient, there are great differences between this kind of transport and ground transport. An infant may be exposed to some specific risks during flight. Therefore, the accompanying medical and nursing personnel must have a good understanding of the basics of aerospace medicine and the specific interactions that might occur for a particular illness or injury.
*( Please refer to section 10 )*

The following neonates require special consideration in flight

- Neonates who have or who may develop airway compromise (e.g., moderate to severe lung disease such as pneumonia or respiratory distress syndrome or airway problems.)
- Infants with gas trapped within any body cavity (e.g., pneumothorax)
- Extremely premature infants
- Infants with congestive heart failure.
- Infants with severe anaemia
- Infants who have had thoracotomy or laparotomy (if possible, such infants should not be moved within 10 days after the surgery except in pressurised aircraft) (Health Canada, 2007)

The recommendations of the NNTP in determining the most appropriate mode of transport should be documented on the infant's chart.

### 3.5 Transport Mode Advantages

**Road Ambulance**

- Available
- Can be used in most weather conditions
- Infant transferred only twice (into and out ambulance)
- Adequate cabin space
- Minimal weight restrictions for numbers of passengers
- Easily diverted
- Relatively lower cost

**Helicopter**

- Rapid Transport Time
- Can reach otherwise inaccessible areas

### 3.6 Transport Mode Disadvantages

**Road Ambulance**

- Longer transit times
- Mobility limited by road and traffic conditions

**Helicopter**

- Requires unobstructed landing sites
- Weight limits
- May require multiple patient transfers
- Limited fuel capacity which limits range
- Restricted by weather
- Noise and vibration interference
- No cabin pressurisation
- Increased costs

### 3.7 Hazards of Air transport

- Adverse weather conditions
- Dimmed lighting (at night)
- Potential for electromagnetic interference
- Lack of cabin space to perform emergency procedures (Not in AW139)/ inability to stop
- Infant can be adversely affected by air-leaks, noise and vibration (Jaimovich,2002)

# PROTOCOL NO 4

**4.1 The NNTP's air transport module contains the equipment listed below mounted on a base plate which is secured in the EC135 and AW 139 helicopters while in flight and secured on a specific aero-medical trolley when in the NNTP designated ambulances and other front- line ambulances.**

**N.B *This equipment is certified for use in the Air Corps' EC135 and AW 139 Helicopters Only***

| Air Transport Equipment Item | No | Model | Storage |
|---|---|---|---|
| Incubator plus AC & DC cables | 1 | TI 500 (Draeger) | These items belong to the NNTP and are stored in Baldonnell for NNTP's exclusive use |
| Suction Unit & Canister plus AC&DC cables | 1 | Atmoport N (Atmos Medizin Technik) | |
| O2 Hose and Flow-meter | 1 | | |
| O2 Regulator with Double Outlet | 1 | | |
| Air Regulator with Single Outlet | 1 | | |
| Elevating trolley & batteries (x2) & charging device | 1 | AAT/Lifeport interface(Paraid) | |
| ECG/Resp/BP/Sa02 Monitor plus AC &DC cables | 1 | Encore (Propaq) | These items are provided by the Irish Air Corps and kept in Baldonnell |
| O2 Cylinder | 1 | E Size (BOC) | |
| Air Cylinder | 1 | E Size (BOC) | |
| Base plate for incubator | 1 | AAT for EC135 | |
| Platform for Loading Trolley into AW139 | 1 | For AW 139 Only | |
| Medical Rack Mount for 3 Space Perfusers | 1 | | |
| Ventilator plus O2 &Air Hoses | 1 | babyPAC B100 (pneuPAC.) | These items are kept in the main NNTP dedicated ambulance and must be brought to Baldonnell and transferred to the air transport module for all air transports |
| Ventilator Tubing | 2 | Standard (Cruinn) | |
| O2 Analyser and T piece | 1 | Handi Medical (Maxtec) | |
| Syringe Pumps plus 2 Combi & DC Leads | 6 | Perfuser Space (B.Braun) | |
| Neonatal ECG, SaO2, IBP, NIBP cables | 4 | For Propaq Encore Monitor | |
| Handheld Pulse Oximeter | 1 | Rad 5 (Massimo) | |
| Blood Glucose Analyser | 1 | HemoCue (AccuScience) | |
| Blood Analysis System | 1 | Irma SL (Diametrics Med) | |
| Nitric Oxide Monitor | 1 | NOxBOX plus (Bedfont Science) | These items are kept in the main NNTP dedicated ambulance and must be transferred to the air transport module for iNO air transports |

## 4.2 Propaq Monitor

'Air Worthiness Certification' and space limitations require that the NNTP use the Propaq 'Encore' Monitor provided by the Air Corps. The Propaq monitor is mounted on the aircraft wall in flight in the EC 135 only but otherwise needs to be fixed to the incubator for travel in the AW139 and outside of the aircraft.

**This monitor is similar to the Propaq CS monitors used on the NNTP's new ground transport modules except that;**

- this monitor defaults to adult mode and **must be changed to neonatal mode** each time it is turned on .
- the screen is yellow and white
- the SaO2 operation on this monitor also uses 'Massimo' technology rather than 'Nellcor' and require 'Massimo' compatible disposable SaO2 probes

**NB. The NNTP provides its own neonatal ECG/ Resp., IBP, NIBP & SaO2 leads and disposable SaO2 probes for this monitor.**

### 4.3 Equipment Checklists

All other equipment for air transports kept in the NNTP designated ambulance, is checked daily as per Protocol 11 and recorded on the 'NNTP Air Transport Equipment Checklist' (Appendix 1).

Prior to departure a checklist of equipment transferred from the ambulance to the aircraft is also completed. (Appendix 2)

Copies of instructions for use of equipment items are also kept in ambulance. (Appendices 4-10)

# PROTOCOL NO. 5

## Power Capabilities of Equipment

Incubator T1500

- The incubator TI500 now has two batteries that should last for at least 150 mins once fully charged.
- The incubator can be plugged into the DC source on the helicopter
- It should be plugged into an AC source (eg. Ambulance, hospital) during the transport whenever possible to conserve the battery life

Propaq monitor

- The Propaq monitor has a battery life of at least 5 hours once fully charged.
- The monitor can also be plugged into the DC source on the helicopter
- It should also be plugged into an AC source whenever possible to conserve the battery life

Braun 'Space' syringe pumps

- The Braun syringe pumps have a battery life of at least 8 hours (at 25 mls. per hour) once fully charged
- They can be plugged into the aircraft's DC source by way of the 3 way 'combi' leads
- They should also be plugged into an AC source whenever possible to conserve battery life

Atmos Suction Unit

- The atmos suction unit should operate for approx 45 mins on battery power when fully charged
- It can be plugged into the DC source on the aicraft

BabyPac Ventilator

- The ventilator is pneumatically powered and does not require electricity except for the alarm illumination which depend on AA Batteries – extras to be carried by team

NoBox Monitor

- Battery powered (6 A5 batteries –please bring extra)

Sao2 Monitor

- Battery powered (3 AA batteries –please bring extra)

**NB:**

****It is only possible to use the AW 139 aircraft's DC source once the engines are turned on, so be aware that NNTP equipment is otherwise running on own batteries.****

**When travelling to your destination on board the aircraft, run the incubator on the DC supply in the aircraft to keep it warm. Remember however that when equipment is being powered by the DC source on the aircraft the batteries are not being charged simultaneously.** This is different from the usual situation that when the equipment is being powered by AC, the batteries are being charged simultaneously.

# PROTOCOL NO 6

## GAS REQUIREMENTS FOR AIR TRANSPORT

**Neonatal Requirements & Provisions**

- The BabyPac ventilator requires varying litres of Gas/min to operate depending on the O2 requirements and ventilator settings ( see manual)
- The maximum Gas usage when 100% O2 is required on a mode of CMV with active PEEP **is 11lts/min**
- The incubator system has an E size O2 and Air Cylinder( 680lt capacity) which each last approx 58 mins. in either 100% O2 or 21 % room air respectively.

**EC135 and AW139 Capacity:**

- The primary source of Medical Air/O2 during the transport is supplied by the helicopter systems

- The EC135 and AW139 helicopters MUST have the capacity to supply air and O2 for a complete neonatal transfer to the furthest hospital destinations in Ireland. This includes pre-start, taxi, in flight, arrival and possible wait for an ambulance at either end. It must also take into account sufficient gases for a diversion en route

**The EC 135 Helicopter ,**

- O2 cylinder has a supply of 2220lts which should last **a minimum of 3 hours 20 mins. at 11lts per minute in 100%**

- Medical Air supply is two 2 E size cylinders which equals 1360lts. This should last **a minimum of 1 hour 55 mins at 11lts per minute in 21% O2 or Room Air.**
- Note: ventilator entrains air so less medical air should be used from supply.

**The AW139 Helicopter**

- O2 is supplied via the Life -port System underneath the incubator and has a supply which equates to 2700lts. This should last **a minimum of 4 hours at 11lts per minute in 100%**

- Medical Air supply is also via the Life port system which utilises an air compressor. Therefore the air supply should be limitless when the electrical supply is active.

**Gas Usage:**

- It is important to remember that when ventilating on less than 100% oxygen and more than 21% that the time limit for the gas is longer
- It is estimated that the longest flying time (Dublin-Tralee) is 1hour and 10 minutes however every effort to conserve gases should be made in case of unforeseen delays

# PROTOCOL NO 7

## Procedure for Loading/Unloading Incubator System:

**The loading and unloading of the incubator system is the responsibility of the Irish Air Corps but the NNTP medical team continue to be responsible the patient throughout the procedure.**

**EC135 Helicopter**

The NNTP air transport incubator trolley has a battery activated raising and lowering mechanism. This needs to be at a midway height to load into the 135 aircraft and at the maximum level to load into the NNTP ambulance. (Adjust level accordingly while en route to either vehicle to hasten procedure.)

- The top frame assembly separates from the trolley and glides into the helicopter on a wheel based system, which securely locks into the aircraft.
- The power and medical gas supply from the helicopter are then connected.
- The trolley base is then loaded in the aft of the helicopter

♦ When loading the incubator with the patient into the helicopter, one of the NNTP medical team should stay on the ground while the other is in the helicopter to ensure constant visualisation of the patient

♦ Check the ventilator tubing connections are secure prior to and after loading of the incubator into the helicopter.

♦ The incubator should be secured into position on the aircraft before connecting the air and oxygen tubing to the helicopter gas supply for travelling. The NNTP team member observing the infant indicates to the Air Corps staff when it is OK to change over gas supplies.

♦ Remember that to supply **> 70% O2 via the BabyPac** both gas supplies should be plugged into the walled source in the aft section of the helicopter but **the Air needs to be turned off at the cylinder in the cabin .**

♦ The DC cables from the aircraft are then attached to the equipment

♦ While the infant is being observed the 'Propaq' monitor is now disconnected from the patient, removed from the trolley, carried outside the aircraft and then fitted to the wall mount in the aircraft where it is then reattached to the infant .

♦ The reverse of this procedure applies to unloading the incubator when the infant is on board.

## AW 139 Helicopter

The NNTP air transport incubator trolley has a battery activated raising and lowering mechanism but an elevated platform which is supplied by the Air Corps and travels in the hold is also required to load into the AW139. The trolley is wheeled onto the platform and the wheels are then locked . The Trolley needs to be at the maximum level on this platform to load into the AW 139 aircraft and NNTP ambulance. (Adjust level accordingly while en route to either vehicle to hasten procedure.)

- The top frame assembly separates from the trolley and glides into the helicopter ( from the side) on a wheel based system, which securely locks onto the Life-Port medical system in the aircraft.
- The power and medical gas supply from the helicopter are then connected to the Life port system by the crew.
- The trolley base and platform are is loaded in the aft of the helicopter

- When loading the incubator with the patient into the helicopter, one of the NNTP medical team should stay on the ground while the other is in the helicopter to ensure constant visualisation of the patient
- Check the ventilator tubing connections are secure prior to and after loading of the incubator into the helicopter.
- For access during flight, the syringe drivers normally housed to the rear of the trolley will now need to be moved onto the aircraft's medical rack (specific mount).
- The incubator should be secured into position in the aircraft before connecting the air and oxygen tubing to the helicopter's Lifeport gas supply for travelling.
- The DC cables from the aircraft's Life-port system are then attached to the equipment
- **NB: Although connected to the Life-port system no external gas or power is available to the incubator or ventilator until the system is switched on by the crew after the aircraft engines are running**.
- The incubator will continue to display 'DC source' Power when switched to Life-port system but the Life-port power display will only be illuminated when it is turned on.
- The NNTP team member observing the infant indicates to the Air Corps staff when it is OK to change over gas supplies.
- Remember that to supply **> 70% O2 via the BabyPac** both gas supplies should be plugged into the Lifeport System but **the Air source needs to be turned off .**
- The reverse of this procedure applies to unloading the incubator when the infant is on board.

## PROTOCOL NO 8

## General Air Safety Issues

Helicopter safety involves common sense and adherence to the safety procedures and protocols as explained by the Air Corp staff.

- Do not enter the airfield area or embark/ disembark from the aircraft until instructed to do so by the Air Corps staff.
- Never approach or leave the aircraft from the rear when the blades are in motion
- High visibility visors to be worn when in vicinity of aircraft

# PROTOCOL NO 9

## Communications in flight

**Adequate inter-team and air to ground communications are essential at all times.**

- Protective earmuffs must be worn at all times by the transport team. The earmuffs have a built-in microphone and speakers for intrahelicopter communications. This allows you to talk to each other.
- Refrain from speaking when the pilot is in communication with the tower so that he can get take off and landing instructions etc. This will only be for about 30 seconds at a time.
- **YOU CANNOT HEAR THE EQUIPMENT ALARMS DURING TRAVEL SO IT IS IMPORTANT TO HAVE THE LIMITS SET SO THAT YOU CAN SEE THE RED ALARM LIGHTS AT ALL TIMES.**
- Alert the pilot immediately of any changes in the infants condition which may necessitate intervention.
- **You cannot use the mobile phone while in the helicopter**. However carry the mobile phone with you and take a number from NNTP ambulance staff to call prior to leaving the referring hospital with the time of arrival at Baldonnell.
- The pilot will let the ground staff know when he is landing and if you have any requests he will relay them too.

## Remember

♦ Neonatal earmuffs should be used for all air transports to reduce noise

# PROTOCOL 10

## Procedures for the use of inhaled nitric oxide (iNO) during neonatal air transfers

1. iNO cyclinders must be clearly marked with necessary hazard labels
2. iNO cyclinders must not be changed during a flight or its delivery system dismantled
3. iNO may only be carried when there is a real medical likelihood of being required
4. Both NO and $NO_2$ detectors must be carried on every flight with iNO
5. The detectors must be fully functional and tested before departure
6. In the event of an alarm the medical crew must immediately alert the flight crew of a gas leak. In such an event the flight crew will ventilate the cabin (Jesse et al, 2004)
7. The aircrew will then divert to an airport/helipad closest to a hospital with iNO facilities
8. Once the aircraft has landed, the doors will be opened allowing residual gases to be vented from the aircraft
9. Arrangements will be made for the mandatory medical examination of the air crew
10. Continuation of the flight is at the discretion of the air crew and dependent on any symptoms experienced by the crew
11. If there is a clinical issue about deterioration of the infant and the need for an urgent onward journey, a request should be made for a replacement A/C (aircorp) helicopter if available
12. Ultimately the decision lies with the A/C commander as to whether to continue the journey or not.

(Kinsella,2004) (Williams,2004)

# PROTOCOL NO 11

## NNPT Team Responsibilities

### Prior to air transport:

1. Daily checksof the 'babyPac' ventilator functions and alarms
2. Daily checks of the 'Braun' syringe drivers ensuring that the batteries are charged
3. Daily checks of SaO2 monitor and alarms
4. Daily checks of Nitric Oxide Monitor & Environmental Monitors ensuring they are calibrated every 3 weeks by Bioengineer
5. Bring ***all other equipment*** required for NNTP Air Transports to Baldonnell including :

- BabyPac Ventilator plus O2 & Air Hoses
- HandiMax O2 Analyser and T connector x 1
- Laerdal Bag& Mask System
- Neonatal ECG/RESP, NIBP, IBP, SaO2 cables & 'Massimo' compatible Sao2 Probes for Air Corps' Propaq Encore Monitor
- Syringe Pumps x 6 plus 2 Combi & 2 AC Leads
- SaO2/HR monitor & 'Nellcor' probe
- Ventilator Tubing and Humidification chambers x 2
- Temp probe for incubator
- Disposable suction liner and tubing
- NNTP Transport bag (as for ground ambulance)
- Chemical Mattress x 2
- Ear Muffs for infant
- Insulating cover for incubator
- Extra AA and A5 batteries
- Blood Glucose Analyser*
- Blood Analysis System*
- Nitric Oxide Monitor*
- NO Detector Monitor*
- NO2 Detector Monitor*
- NO Cylinder & Regulator* ( * = as required)

### During air transport

1. NNTP team is responsible for the infant and medical equipment at all times throughout the transport process

### Following air transport

1. Ensures all equipment is cleaned appropriately and restocked as necessary (eg. temp probe, suction liner & tubing , restrainer straps, linen etc)
2. NNTP ambulance team returns incubator, suction unit, 'propaq' monitor, O2 & Air regulators and trolley to Baldonnell.

## PROTOCOL NO12

## Air Corps Responsibilities

**No 3 Operations Wing, Irish Air Corps** is responsible for:

1. The storage of the following equipment in a secure, clean environment:
   a) Incubator AC Cable and DC Cable
   b) Atmos Suction apparatus, AC Cable and DC Cable
   c) Propaq Encore monitor, AC Cable and DC Cable (provided by Air Corps)
   d) E size Air cylinders ( Provided by Air Corps) and regulator
   e) E size O2 cylinders ( Provided by Air Corps) and regulator with double attachment
   f) O2 Hose attached to
   g) O2 Flowmeter
   h) EC135 base plate
   i) Aero-medical trolley and battery pack
   j) Charging device for trolley and extra battery
   k) Elevation Platform for Loading into Aw139
   l) Space Infuser Mount for Medical Rack
2. Reporting any faults or problems as soon as they are detected to the NNTP team on call on **0818 300188** or the NNTP coordinator on **0876787190**
3. Keeping the incubator plugged into an AC source in order to keep the battery fully charged.
4. Performing daily checks of the incubator ensuring that :
   a) the battery charging light is illuminated when the incubator is plugged into the AC source
   b) the incubator temperature is set at 37oC and the incubator air temperature is reading close to 37oC and feels warm
   c) the heat output light is illuminated
   d) Checking the interior light
   e) Provide incubator DC connection for aircraft ( See manual)

4 . Daily checks of the functionality of the suction unit ensuring
   a) The battery is kept fully charged
   b) Cannister is present and intact
   c) Providing DC connector for aircraft (See manual)

5. Daily checks of the aeromedical trolley ensuring that.
   a) It functions correctly
   b) The battery pack is kept fully charged ( See manual)
6. Supplying the E size O2 and Air Cylinders for the incubator ensuring that
   a) They are full at the beginning of each transport
   b) The regulators, O2 & Air Hoses and O2 Flowmeter are attached and functioning
7. Provide the Propaq monitor and AC and DC leads and ensure
   a) Functionality
   b) Battery is kept fully charged
   c) Is maintained as per manufacturers recommendations

8 Provide 2 DC leads for Space Infusion pump

9. Provide elevation platform and syringe pump mounting device for AW139

# PROTOCOL NO 13

## EQUIPMENT MAINTENANCE

**The NNTP is responsible for**:

1. The preventative maintenance service of the incubator and battery

2. The preventative maintenance service of the suction unit

3. The preventative maintenance of the aero-medical trolley
4. Informing the Air Corps if there are any additional or new equipment to be carried in EC135 helicopters that are not listed in these protocols
5. Informing the Air Corps if scheduled maintenance on aero-medical equipment, which is owned by NNTP and carried on transfers, has not been carried out for whatever reason
6. Ensuring that after an air transport, all equipment is cleaned appropriately and restocked as necessary
   (eg. temperature probe, suction liner & tubing , restraint straps, linen)

7. Ensuring that NNTP ambulance team returns incubator, suction unit, 'Propaq' monitor, O2& Air regulators and trolley to Baldonnell.

**The Air Corps is responsible for**:

1. The maintenance of all AC equipment carried on neonatal transfers, as per the manufacturers instructions

2. Informing the NNTP co-ordinator of any significant issues in relation to changes in the EC135 interior or AAT ( air ambulance) equipment.

3. Informing the NNTP co-ordinator of any significant periods of helicopter unavailability

# THE BASICS OF AEROSPACE MEDICINE

## THE ATMOSPHERE

The atmosphere surrounding the Earth is divided into four stratified layers: the troposphere, the stratosphere, the ionosphere and the exosphere. The layer closest to the earth, the troposphere extends up to 60000 ft (18290 m) at the equator and up to 30000 ft (9145 m) at the poles. (Canada Health,2007)

Both the un-pressurised rotary-wing aircraft and the pressurised fixed-wing aircraft used by the Irish Air Corps' for neonatal air ambulance fly in the troposphere. The EC135 helicopters generally fly at levels of 1000-1500 feet (300-450m) above the ground as they are single pilot helicopters and generally do not carry sufficient fuel reserves to fly at higher altitudes (under what is known as IFR – instrument flight rules) The AW139 helicopters operate at levels up to 5000 ft (1200-1500m) as it is a larger twin-pilot helicopter with the ability to carry sufficient fuel reserves for IFR flight. The King Lear Jet and Casa airplanes (pressurised) usually fly within 20000 -30000 ft (6096-9145 m) above the ground. (Irish Air Corps information).

As an aircraft ascends in the troposphere, the following factors come into play:

- **the temperature drops (by 2°C for every 1000 ft [300 m] ascended)**
- **atmospheric pressure falls**
- **water vapour is reduced ( Jaimovich,2004)**

## COMPOSITION

The atmosphere is composed primarily of oxygen and nitrogen .

| Gaseous Components of the Atmosphere | |
|---|---|
| **Gas** | **% of Total** |
| **Oxygen** | 21 |
| **Nitrogen** | 78 |
| **Trace gases** | 1 |
| **Total** | 100 |

## BAROMETRIC (ATMOSPHERIC) PRESSURE

Barometric (atmospheric) pressure is the pressure exerted against an object or a person by the atmosphere. The pressure is usually measured in millimetres of mercury (mm Hg) or Kilopascals (kPa) for medical purposes. As an aircraft ascends, barometric pressure falls

| Barometric Pressure at Various Altitudes | | |
|---|---|---|
| **Altitude (ft)*** | **Barometric Pressure: In mm Hg** | **Barometric Pressure: In kPa** |
| **Sea level** | 760 | 101.3 |
| **1 000** | 733 | 97.7 |
| **1 500** | 707 | 94.2 |
| **3 000** | 681 | 90.8 |
| **5 000** | 632 | 84.2 |
| **10 000** | 523 | 69.7 |
| **20 000** | 350 | 46.6 |
| **25 000** | 282 | 37.6 |
| **30 000** | 226 | 30.1 |
| *1000 ft = 304.8 m. | | |

## GAS LAWS

Changes in atmospheric pressure affect the human body according to the following laws governing atmospheric gases.

### DALTON'S LAW

The total pressure of a mixture of gases is equal to the sum of the partial pressures of the individual gases present.
*Physiological significance:* Oxygen transfer from the air to the vital organs of a human being is a direct result of atmospheric pressure. Increasing altitude results in a drop in atmospheric pressure. As this occurs, the pressure of the individual gaseous components in the atmosphere also decreases. Therefore, the availability of oxygen declines as altitude increases, which results in oxygen deficiency (hypoxia). Even healthy people will suffer hypoxia during unpressurised flight above 10,000ft, and the impact on a seriously ill or injured person is greater than that on a healthy person.

### BOYLE'S LAW

The volume of a gas is inversely proportional to its pressure when temperature remains constant.

*Physiological significance:* As altitude increases, atmospheric pressure drops, and gases (including gases trapped in any body cavity) expand. The expansion of gases causes an increase in the pressure on surrounding tissues and may result in tissue damage. This expansion of gases explains the effects of changes in atmospheric pressure on ears, sinuses, teeth and the gastrointestinal tract. Gas in the middle ear or the sinuses that expands under these conditions may not be vented adequately, which can result in pain, inflammation and, in the case of the middle ear, the possibility of rupture of the ear drum. (Canada Health,2007)

# TYPES OF AIRCRAFT

**PRESSURISED AIRCRAFT**

In medical terms, use of a pressurised aircraft allows control of the atmospheric pressure within the aircraft ("cabin altitude") to meet the patient's needs. Pilots and air medical escorts can work together to provide the optimal cabin altitude for the patient, according to clinical needs and aviation safety.

Types of Pressurised Irish Air corps Aircraft

- Casa
- Lear Jet (Irish Air Corps information)

**UNPRESSURISED AIRCRAFT**

The role of unpressurised aircraft in the transport of acutely ill clients is limited by the altitude restrictions indicated for various medical conditions
These restrictions force the unpressurised aircraft to fly at altitudes much lower than usual. This factor has several important implications for the transport of acutely ill clients:

- Lower-altitude trips may take longer because of inclement weather, which delays the arrival and subsequent treatment of the client at the receiving hospital
- Greater turbulence at lower altitudes may result in:
  - more hemorrhage in a infant with injuries to an organ (e.g., liver or spleen)
  - more pain, especially in clients with musculoskeletal trauma
  - greater anxiety leading to higher oxygen demands and resultant cardiovascular or pulmonary deterioration
  - greater risk of vomiting and possible pulmonary aspiration
- Greater turbulence at lower altitudes will also directly affect medical care by:
  - making invasive procedures such as initiating an IV line more difficult
  - adversely affecting the performance of medical personnel because of air sickness (i.e., nausea, vomiting, faintness, anxiety)

Aviation considerations may prevent flight at the altitude that offers the best cabin altitude for the infant. In such situations, overall safety must be the major consideration. Nevertheless, it is important that the clinicians keep the pilot fully informed of the infant's clinical status so that appropriate decisions can be made. (Canada Health,2007)

***Types of Unpressurised Aircraft***

- EC 135
- AW 139
- The Eurocopter 135 is unpressurised but with adequate pre-transfer stabilisation offers few disadvantages in terms of altitude associated problems.

# PHYSIOLOGICAL EFFECTS OF FLIGHT

## ALTITUDE AND OXYGEN DELIVERY

The availability of oxygen declines with increasing altitude because of a drop in barometric pressure (according to Dalton's law; see above). The higher the cabin altitude, the lower the atmospheric pressure inside the aircraft and the more significant the effect on tissue oxygenation. These changes are most pronounced in unpressurised aircraft, where cabin altitude is essentially the same as true altitude

### Oxygenation

- Although this is not a significant problem with helicopter transfers, it is worth remembering in respect of respiratory compromised infants that;
  - as altitude increases and barometric pressure decreases, the partial pressure of gases also decrease, thus reducing arterial PaO2
- This can lead to hypoxaemia and O2 requirements may increase.
- Problems may occur if infant already requires 100% O2 or if significant ascent is necessary (Canada Health,2007)

### Factors relating to Neonates that influence the development of hypoxia in flight

- *Altitude:* Tolerance decreases as altitude increases
- *Rate of ascent:* Tolerance decreases as rate increases
- *Time at altitude:* Tolerance decreases as time at altitude is prolonged
- *Individual tolerance:* Individual variation in tolerance may be due to individual metabolic rate, diet and other factors
- *Physical fitness:* Tolerance increases with physical fitness
- *Physical activity at altitude:* Oxygen consumption is greater than normal in infants who are distressed
- *Environmental temperatures:* Tolerance decreases with extreme cold or heat
- *Medications, toxic substances:* Oxygen utilization is inhibited by some drugs and toxins (e.g., carbon monoxide) (Canada Health,2007)

## MANAGEMENT

- Identify infants at risk before transport
- Use pulse oximeter to monitor oxygen saturation
- Bring adequate amounts of oxygen
- Supply oxygen and titrate it to maintain appropriate saturations for the individual infant
- Because the aircraft environment is very dry, humidify the oxygen using 'Humidivents', unless flight time is expected to be less than 1 hour
- Treat underlying causes of hypoxia (e.g., administer blood for severe anemia or acute and significant blood loss)
- Reduce cabin altitude to minimize the hypoxia associated with flight (Canada Health,2007, Cornette,2004)

## ALTITUDE AND EXPANSION OF TRAPPED GASES

With increasing altitude, gases within body cavities expand (according to Boyle's law; see above - therefore as an aircraft ascends, the barometric pressure decreases and the volume of gas within a closed space expands.Such expansion does not result in any difficulty if the concomitant pressure can be relieved. However, if the gases are "trapped" in an organ with inelastic walls and the gases continue to expand within the walls of the organ, some degree of pain and other clinical symptoms and signs may be experienced.

**Volume Expansion of Gases**

| Altitude (ft) | Altitude (m) | Relative Gas Volume |
|---|---|---|
| **0** | 0 | 1.0 |
| **5 000** | 1500 | 1.2 |
| **10 000** | 3000 | 1.5 |
| **15 000** | 4500 | 1.9 |
| **18 000** | 5400 | 2.0 |
| **20 000** | 6000 | 2.4 |

## PRESSURE AND GAS EXPANSION

- Gas expansion is small (10-15%) at the altitude of helicopters (1000- 5000ft).
- However this can affect any body cavity containing air including the stomach, intestines, middle ear, sinuses and existing airleaks (eg.Pneumothoraces).
- Ensure all ETTs are patent and if chest drain in situ, leave open not clamped.
- Insert and drain oro-gastric or naso-gastric tube especially in case of Diaphragmatic Hernia
- Give infant a soother during ascent and decent (when appropriate).
- Use analgesics in accordance with the severity of the infants condition
- If possible, avoid transporting an infant by air if he/she has a concurrent URTI
- Restriction of cabin altitude or a more gradual descent (or both) will help (Canada Health, 2007)

## RESPIRATORY SYSTEM

Aviation factors affecting lower respiratory tract conditions (eg., bronchiolitis):

- Reduced atmospheric pressure (leading to gas expansion)
- Decreased presence of water vapour (leading to dehydration)
- Reduction in partial pressure of oxygen leading to hypoxia

Over-pressurisation syndrome (relating to Boyle's law; see above) may develop when alveoli spontaneously rupture in association with gas expansion during ascent. This is most common in clients with air-trapping disease such as asthma, bronchiolitis or emphysema. Sudden decompression in the aircraft results in rapid expansion of gases, which could result in pneumothorax, pneumomediastinum or air embolus.

- Pre-existing pneumothorax could become a tension pneumothorax if not treated appropriately (Canada Health,2007) (Barry and Leslie,2003)

## THERMAL ISSUES

### Thermal environment

- The importance of maintaining an appropriate thermal environment for the neonate and the avoidance of cold stress has been well documented.
- Environmental factors include cold hangers, unsheltered areas, chill generated by rotating wing in vicinity of helicopter effects of altitude

As aircraft ascends the frame cools, resulting in a drop in temperature of up to 2oC for each 1000 feet altitude and in unheated military helicopters this may put high demands on the incubator system (Jaimovich,2004)

- To reduce heat loss and to conserve battery power of the incubator system:
- Cover incubator/turn up cabin heat/use hats/bubble wrap/chemical mattresses
- Incubator used for air transport must always have fully charged batteries at the beginning of a transfer. DC power cables suitable for both the aircraft and the ambulance should be taken. Strong sunlight can also cause problems with incubator overheating, and incubator covers are useful in this situation.

## NOISE

During all modes of transport, sick and premature neonates are exposed to higher levels of sound than the 45-50 db recommended in the NICU (Jaimovich, 2004)

- The highest exposure is during air transport
- In aviation physiology, it is well accepted that noise stress and episodes of hypoxic stress are additive in their effect on the compromised infant
- Exposure to sudden noise in infants with Hypoxic Ischaemic Encephalopathy can be associated with desaturations
- Ear muffs for infants only reduce noise by 7db- however should still be used
- Cover incubator
- Increase O2 as appropriate

## VIBRATION

- Vibration is not usually detrimental to the infant, but can dislodge lines and tubes and adversely effect monitoring equipment.
- During transport all lines should be secure and visible, particularly arterial lines, to allow observation without the need to open the incubator.
- Squishon gel filled mattresses and restainers for infant can help reduce the effects of vibration on both the baby and equipment.

## TAKE OFF AND LANDING

- Rapid acceleration during take off, with the infant secured head forward, theoretically results in reduced cerebral perfusion.
- Conversely, on landing, rapid deceleration may cause a sudden rise in venous cerebral perfusion.
- There is provisional evidence that premature infants undergoing transfer may have a higher incidence of intra-ventricular bleeding.
- However, the clinical effect of these controllable events requires clarification.

(Fenton et al 2004)

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## Appendix 1

### EQUIPMENT KEPT ON NNTP AMBULANCE FOR AIR TRANSFERS IN EC 135 and AW139 HELICOPTERS

Please ensure that the following items are transferred from the NNTP ambulance to the aircraft for air transports and replaced on ambulance after transfer

| **Date:** | **Signature:** | | |
|---|---|---|---|
| | **Equipment Item** | **Checked onto Aircraft** | **Replaced in Ambulance** |
| 1 | BabyPac Ventilator plus O2 & Air Hoses | | |
| 2 | HandiMax O2 Analyser and T connector x 1 | | |
| 3 | Laerdal Bag& Mask System | | |
| 4 | Neonatal ECG/RESP, NIBP, IBP, SaO2 cables | | |
| 5 | 'Massimo' Sao2 Probes for Propaq 'Encore' Monitor | | |
| 6 | Syringe Pumps x 6 plus 2 Combi & 2 AC Leads | | |
| 7 | Rad 5 SaO2/HR monitor & 'MASSIMO' probe | | |
| 8 | Ventilator Tubing and Humidification chambers x 2 | | |
| 9 | Temp probe for incubator | | |
| 10 | Disposable suction liner and tubing | | |
| 11 | NNTP Transport bag (as for ground ambulance) | | |
| 12 | Chemical Mattress x 2 | | |
| 13 | Ear Muffs for infant | | |
| 14 | Insulating cover for incubator | | |
| 15 | Blood Glucose Analyser* | | |
| 16 | Blood Analysis System* | | |
| 17 | Nitric Oxide Monitor* | | |
| 18 | NO Detector Monitor* | | |
| 19 | NO2 Detector Monitor* | | |
| 20 | NO Cylinder & Regulator* ( * = as required) | | |
| | | | |

## Appendix 2

### Daily Function Checks by NNTP Nurse of Equipment Kept in Ambulance

| Month: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Check BabyPac Ventilator | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Syringe Drivers X6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SaO2 & HR Monitor7 Leads | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NoBOX Monitor | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No Environment Monitor | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NO2 Environment Monitor | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Haemacue Machine | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Blood Gas Analyser Cal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ambulance Supplies | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Air Transport Supplies | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NO Therapy Supplies | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ‘Cooling ‘Supplies | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Initials | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

## Appendix 3

### Perfuser' Space Syringe Driver Battery Maintenance

- In order to obtain maximum battery life (eg. 8 hours@ 25mls/hr) please discharge and recharge the batteries completely once a MONTH as prompted by perfuser device . To initiate the discharge process –
- The pump must be attached to an AC power source-the" Battery maintenance" and the OK – key will be displayed after switching off the pump . By pressing the OK key and ▲ key the discharge process will start.
- After completely discharging the battery it will be completely charged again if the process in uninterrupted.

**The total duration of the battery maintenance process takes approx twelve hours**

| Date Charged | Comments | Signature | Next Charge Due |
|---|---|---|---|
| | | | |
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# Appendix 4.

**This form is completed by the NACC with information received by telephone from the NNTP. It is then forwarded by the NACC by fax to the IAC .**

**National Ambulance Service**

**REQUEST FORM for**

**AIR CORPS AIR AMBULANCE SERVICES**

| | |
|---|---|
| Date: | Time: |
| Name/Title of requestor: | |
| Phone No of requestor: | |
| Nature of Mission: | |
| Time Limitations: | |
| ***Inter-hospital Transfer*** | |
| From | To |
| ***Offshore island to Mainland Hospital*** | |
| From | To |
| ***Organ retrieval/transplant*** | |
| From | To |
| Other type of Mission: | |
| Equipment required: | |
| Patient status: | |

| | | |
|---|---|---|
| Patient Ventilated | Y | N |
| CPAP | Y | N |

| | | |
|---|---|---|
| Staff Travelling: | | |
| Name / Address of patient: | | |
| Age: | Sex: | Weight: |
| Ward: | Consultant: | |
| *Is the patient's illness likely to expose the aircrew to infection*<br>*If Yes, you must inform the Air Corps Group Duty Officer* | **Y** | **N** |

**Flight Details:**

| |
|---|
| Time call accepted by Air Corps: |
| Name of person accepting call: |
| ETD at point of origin: |
| Estimated Flight time: |
| ETA to Destination: |
| Additional Information |

| | | |
|---|---|---|
| Control Staff please record the following: | | |
| Mission completed: | Y | N |
| If NO, who cancelled the call: | | |
| Ambulance booked at destination: | Y | N |
| Name and Service of person who accepting booking: | | |
| Call-back number: | | |
| Taxi booked for staff: | Y | N |
| Name of person who booked the taxi | | |
| Time call initiated: | Time completed: | |

## Additional Information required if patient travelling overseas;

| Name | Passport Number | Date of Birth | Medical Staff/Relative |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

| Please record any other significant information here: |
|---|
| |

**Landing at UK airports;**

On occasion, the Air Corps may land at a specific landing area at certain airports. When booking an Air Ambulance, please check with the Air Corps Operations if they can confirm the landing point in the airport. This information will expedite the pick up of the patient by the UK based Ambulance Service.

**Return of Medical Staff**

On some occasions medical staff may be transported back to Ireland by the Air Corps Air Ambulance aircraft after the mission.
If this is the case, it is vital that a time be given by the requesting hospital as to when the staff would be returning to the airport from the UK hospital.
There are restrictions in certain airports as to amount of time that the aircraft can remain on the ground. EMC's need to bear in mind that this aircraft may be required for another mission.

| | |
|---|---|
| Emergency Medical Controller: | |
| Time : | |
| Date: | |

## Appendix 5.

## Estimated Journey Times, Available Helipads and Night flying Capabilities

**When flying using :**

**VFR-Visual Flight Rules** – In this mode the pilots are clear of cloud and rely on visual information to fly

VFR Times are worked out using the following:

- Flight time home plus:-
  - Departure and climb time of 3mins
  - Arrival time of 3mins

**VFR 140Kts Still Wind (Normal cruise speed)**

| Hospital | Distance | Time | Nearest IF Airport | Night Approved |
|---|---|---|---|---|
| Castlebar | 107NM | 49min | EIKN 17.5NM | Yes |
| Cork | 111NM | 52min | EICK | Yes |
| Crumlin | 5NM | 9min | EIME 5NM | No |
| Galway University | 93NM | 45min | EICM 5NM | Yes |
| Galway Merlin Park | 93NM | 45min | EICM 3NM | No |
| Letterkenny | 127NM | 1:00Hr | EIDL 25NM | Yes |
| OLL Dun Laoghaire | 10NM | 10min | EIME 10NM | No |
| Sligo General | 92NM | 45min | EISG 4.5NM | Yes |
| Tallaght | 3NM | 8min | EIME 3NM | Yes (Cranes!) |
| Tralee | 133NM | 1:03min | EIKY 8NM | No |
| Waterford | 67NM | 0:35min | EIWF 5NM | No |
| Wexford | 57NM | 0:30min | EIWF 24NM | No |

**VFR 160Kts Still Wind (In time critical cases only as aircraft vibration WILL increase)**

| Hospital | Distance | Time | Nearest IF Airport | Night Approved |
|---|---|---|---|---|
| Castlebar | 107NM | 46min | EIKN 17.5NM | Yes |
| Cork | 111NM | 47min | EICK | Yes |
| Crumlin | 5NM | 8min | EIME 5NM | No |
| Galway University | 93NM | 40min | EICM 5NM | Yes |
| Galway Merlin Park | 93NM | 40min | EICM 3NM | No |
| Letterkenny | 127NM | 53min | EIDL 25NM | Yes |
| OLL Dun Laoghaire | 10NM | 10min | EIME 10NM | No |
| Sligo General | 92NM | 40min | EISG 4.5NM | Yes |
| Tallaght | 3NM | 8min | EIME 3NM | Yes (Cranes!) |
| Tralee | 133NM | 55min | EIKY 8NM | No |
| Waterford | 67NM | 32min | EIWF 5NM | No |
| Wexford | 57NM | 27min | EIWF 24NM | No |

**When flying using :**

**IFR – Instrument flight rules** – In this mode the pilots are relying on their instruments en-route to their destination prior to using visual information to land. This would usually be at night or in bad weather

IFR Times **to** Baldonnel are worked out using the following:

- Flight time home plus:-
  - Departure and climb time of 3mins
  - Approach time at Baldonnel of 12mins

**IFR flight time from the Pads to Baldonnel Still Wind**

| Hospital | Distance | Time | Nearest IF Airport | Night Approved |
|---|---|---|---|---|
| Castlebar | 107NM | 58min | EIKN 17.5NM | Yes |
| Cork | 111NM | 1:01min | EICK | Yes |
| Crumlin | 5NM | N/A | EIME 5NM | No |
| Galway University | 93NM | 54min | EICM 5NM | Yes |
| Galway Merlin Park | 93NM | 54min | EICM 3NM | No |
| Letterkenny | 127NM | 1:09Hr | EIDL 25NM | Yes |
| OLL Dun Laoghaire | 10NM | N/A | EIME 10NM | No |
| Sligo General | 92NM | 54min | EISG 4.5NM | Yes |
| Tallaght | 3NM | N/A | EIME 3NM | Yes (Cranes!) |
| Tralee | 133NM | 1:12min | EIKY 8NM | No |
| Waterford | 67NM | 0:44min | EIWF 5NM | No |
| Wexford | 57NM | 0:39min | EIWF 24NM | No |

IFR Times **to** Hospitals are worked out using the following:

- Flight time to overhead IFR Airport (IAF) plus:-
  - IF Departure and climb time to 4000ft of 5 mins extra
  - Approach time at Airport of 12mins
  - Flight time from DA/MAP to the hospital
  - 3Min Approach/Recce into Pad

**IFR flight time from Baldonnel to the Hospital Pads**

| Hospital | Distance | Time | Nearest IF Airport | Night Approved |
|---|---|---|---|---|
| Castlebar | 107NM | 1:10 | EIKN 17.5NM | Yes |
| Cork | 111NM | 1:01min | EICK 3NM | No |
| Crumlin | 5NM | N/A | EIME 5NM | No |
| Galway University | 93NM | 1:02 | EICM 5NM | Yes |
| Galway Merlin Park | 93NM | 1:02 | EICM 3NM | No |
| Letterkenny | 127NM | 1:18 | EIDL 25NM | Yes |
| OLL Dun Laoghaire | 10NM | N/A | EIME 10NM | No |
| Sligo General | 92NM | 1:07 | EISG 4.5NM | Yes |
| Tallaght | 3NM | N/A | EIME 3NM | Yes (Cranes!) |
| Tralee | 133NM | 1:21 | EIKY 8NM | No |
| Waterford | 67NM | 0:54 | EIWF 5NM | No |
| Wexford | 57NM | 1:02 | EIWF 24NM | No |