Setting up a UK-based perinatal aeromedical transport and retrieval service

The need for a nationally funded and co-ordinated perinatal air transport service for England and Wales is well recognised. Considerable expertise, resources and infrastructure are required to establish a high-quality, safe service. This article describes the development of a national and international, fixed-wing, perinatal air transport and retrieval service based at Oxford Airport.

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Development of perinatal centres across the UK provides co-location of high-risk obstetrics, maternal and fetal medicine alongside neonatal intensive care. The benefits, in terms of outcome and survival, justify transfer of high-risk mothers and neonates to a perinatal centre. However, perinatal services in the UK are continually stretched beyond capacity and this, combined with the unpredictable nature of certain obstetric and neonatal emergencies and increasing centralisation of specialty services, contributes to an increasing need to move patients between facilities.

The recognisable hazards of the transfer of a high-risk patient must be balanced against the potential advantages gained after arrival at the receiving unit. Access to a specialised perinatal air transport capability can help to mitigate potential adverse consequences of either long distance or time-critical transfers to ensure the best possible outcomes for mother and baby. Currently, England, Wales and Northern Ireland do not have the benefit of access to clinically led and nationally funded specialty air transport services for newborn infants or sick mothers. Although the Scottish Air Ambulance Service and the Ministry of Defence have provided significant support to England and Wales over previous years, access to these resources is unsustainable in the future.

This article describes the instigation and

Keywords

aeromedical; air transport; neonatal intensive care; high-risk obstetrics

Key points

Bennett C., Moran L., Collins S. Setting up a UK-based perinatal aeromedical transport and retrieval service. *Infant* 2012; 8(6): 194-197.

1. Increasing centralisation of specialty services and capacity pressures on perinatal centres necessitate the transfer of neonates and obstetric patients between facilities.
2. Access to a safe and high-quality air transport service may provide a clinical advantage in long distance and time-critical transfers.
3. Air ambulance services must comply with both aviation and healthcare regulatory bodies.

FIGURE 1 A fixed-wing air ambulance.

development of a national and international, fixed-wing, perinatal air transport service based at Oxford Airport, complementing an existing paediatric intensive care and adult critical care aeromedical capability. The relationship between the multi-professional facets of the operation and the legal compliance required to deliver a high quality and safe perinatal aeromedical transport and retrieval service are described.

Setting up a perinatal air transport service

The opportunity to develop a perinatal air transport service within the robust infrastructure of an existing and well-regarded air ambulance company based locally in Oxford was fortunate. The operator already had appropriate aviation endorsements, fully owned and highly suitable aircraft, 24-hour logistical support, flight crew and engineering provision. Their cumulative experience (accrued over 27 years), an excess of 16,000 missions and their willingness to invest in the set-up costs of specialty equipment and team training, facilitated the timely development of a high-quality and clinically led service.

Operational and legal considerations

It very quickly became apparent that an air ambulance service is an excellent example of a high stake/high cost operation which is dependent on the optimal deployment of each and every component of the service. A process of continual monitoring, evaluation and the ability to bring about positive change set the framework for quality, safety and value for money (**FIGURE 2**).

Legally, an air ambulance service must comply with both aviation and healthcare regulatory standards. The European Aviation Safety Authority, Joint Aviation Authority (Europe) and Civil Aviation Authority (CAA) govern aviation response. Air ambulance flights (other than primary mission or search and rescue helicopter flights) operate under CAA rules and regulations in the same way as civilian (commercial) public passenger transport. This includes a robust auditing process for all aspects of the service, including airworthiness of the aircraft, engineering and servicing portfolio, pilot training, duty hours and re-accreditation, flight operations, aircraft insurance and safety management systems. There is also a

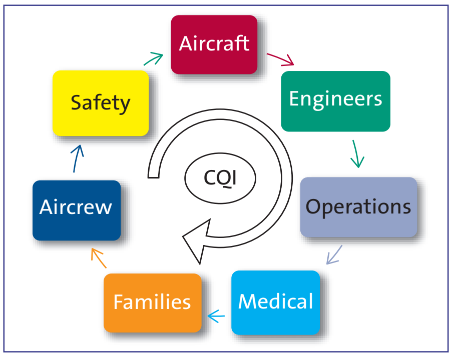

FIGURE 2 Interplay between the elements of an air ambulance service and the need for continuous quality improvement (CQI).

regulatory requirement that all medical equipment taken on board the aircraft is aviation-safe and certified for use on designated aircraft. The service should hold an Air Operations Certificate (AOC) that defines its compliance with CAA regulations, the area of operation for each aircraft type and the accountable, nominated posts of responsibility. The additional benefit of access to on-site engineering allows better fleet management as there is faster turnaround time and routine servicing can be scheduled to complement the demands of the service.

All air ambulance services in England and Wales should be registered with the healthcare regulatory body – the Care Quality Commission (CQC). Criteria for registration are dependent on the type of patients cared for by the service. For those services undertaking critical care transfers this includes transport services and medical advice, treatment of disease and injury plus diagnostic services. This allows for invasive monitoring for the transport of the critically ill patient. CQC compliance incorporates the storage and checking of drugs, maintenance of equipment, cleanliness and infection control policies, staff checks (eg criminal records bureau), patient nutrition and feedback from users and clients. The service should have appropriate personal liability and medical indemnity insurance. It is particularly important to ensure that insurance covers all aspects of clinical work undertaken as many policies specifically exclude care involving labour and delivery, unless separately negotiated.

The European Air Medical Institute (EURAMI) undertakes benchmarking of UK air ambulance services. The service described in this article has been awarded EURAMI's highest-level accreditation – 'Special Care'. The US-based Commission on Accreditation of Transport Services (CAMTS) is gaining in popularity for many UK-based services with provision for independent accreditation of both land and air transport provision.

The service is operational 24/7 with on-call availability of both medical and operations staff. The operations team are responsible for trip planning including landing permits, overflight permissions and airport handling arrangements. All missions are planned to take into account flight and medical crew duty hours as well as entry and exit (customs) regulations. In addition to general trip planning and logistical support, the operations teams can also arrange appropriate land transfer ambulances or replenishment of medical consumables including oxygen, if required during the mission.

Family-centred care

The priority to deliver a family-centred model of care led to the instigation of a parent forum that was involved from the start of service development. Their input has proved invaluable and has supported the endorsement that BLISS has kindly given to the service. It is particularly important to understand a family's wishes to accompany their baby or partner, to be included in their care or to have a photographic diary of the transfer.

Requirements for the service

A review of published literature highlighted the most common clinical indications for air transport in neonatal and high-risk obstetric patients. This enabled definition of the hazards of flight and adverse events and permitted construction of a profile of strategies to manage predictable hazards. The mitigation of flight stresses, including amelioration of noise and vibration, and the effect of altitude (in terms of oxygen availability and expansion of gases) were taken into account. The support received from the Scottish Air Ambulance Service and other aeromedical services overseas was invaluable. The collated information, combined with an understanding of operational logistics and parent feedback, enabled construction of a list of equipment and drugs and training and operational requirements for the service. A scope of care was developed along with standard operational policies (SOPS), clinical guidelines, quality assurance policies and safety frameworks, including an

FIGURE 3 Loading twin infants and equipment on to the aircraft.

application for confirmation of approval from the CAA for the carriage and use of nitric oxide in the air. The service contributes to the medical team clinical governance processes including 'no blame' reporting of incidents or near misses and auditing and monitoring of key performance indicators.

It was clear that the service needed to have capability to provide facilities for *in utero* and *ex utero* transfers, double stretcher capability (for combined neonatal and obstetric transfers or twins) and sufficient space to accommodate the appropriate escorting medical team and a family member, whenever possible. Likely neonatal transfers included long distance repatriation as well as step-up care, including nitric oxide and provision for transfer on extracorporeal membrane oxygenation (ECMO). At present a 60-minute response time can be achieved for the majority of urgent requests; additional senior staff provision would be required to provide a fully immediate service.

Staff selection

The aeromedical team included consultants and senior trainees from neonatal, anaesthetic and high-risk obstetric backgrounds. Senior midwives joined senior neonatal nurses and nurse practitioners, experienced in both intensive care and transport medicine. Personal qualities included good communication skills, the ability to work independently, flexibility and enthusiasm. All staff were encouraged to notify their indemnity authority, hold appropriate personal travel insurance and ensure that they had received vaccination cover appropriate to potential overseas destinations. A suitable uniform was provided.

Training

The learning objectives for the multi-disciplinary perinatal aeromedical training programme were defined. All faculty members undertook CAA-approved crisis resource management (CRM) training with the pilots. The training programme includes aviation physiology, safety around the airport/aircraft, emergency procedures and familiarisation with equipment. Candidates were oriented to the aircraft including the rehearsal of loading and unloading of the equipment and/or patient and response to clinical and in-flight emergencies. A written test assessed knowledge and understanding of fundamental principles of aeromedical transport. A rolling schedule of continuing education was instigated to provide refresher training, *in situ* simulation, enhanced team working skills, familiarisation with new equipment and an opportunity to look at case studies and lessons learnt. Individuals were encouraged to gain familiarity with the management of both obstetric and neonatal emergencies by undertaking external, nationally recognised, resuscitation courses.

Equipment

Three incubator systems were designed and constructed on a LifePort stretcher base and bridge to be fully compliant with CAA regulations. Two of the systems were twin intensive care systems comprising a BabyPod, ventilator, multichannel monitor, capnography equipment and infusion pumps. The other – a neonatal critical care system – included provision for heat and humidification in both the incubator and ventilator circuit and incorporated a Draeger Isolette, ventilator, high-flow circuit, multichannel monitor, six infusion pumps and provision for nitric oxide. The implementation of these systems has been entirely clinically-led to provide an optimal platform for high-quality care equivalent to that provided within the regionally based newborn intensive care services. Obstetric equipment, as advised by the high-risk obstetric co-ordinators included a positioning wedge, delivery pack, a Doppler fetal heart monitoring device and portable ultrasound.

The equipment bags were organised in procedure-related packs and in such a way that the medical flight crew, in accordance with health and safety recommendations, could realistically carry them. Loading equipment onto the aircraft, safe stowage and access in-flight was carefully considered and rehearsed in training (**FIGURE 3**). Patient specific factors and worst-case scenario plans were reviewed. Where possible, equipment, including drug infusions, is secured within the immediate patient environment. Medical equipment dependent on a power supply remains fully charged and ready for deployment, with back-up battery supplies where indicated. In flight, the equipment can generally be run from an AC supply in the LifePort base unit, however all systems should be able to function independently during loading or transfer and in case of power failure. The teams are familiar with the battery life of their respective equipment and also the necessary calculations to ensure adequate supply of compressed air and oxygen. Power plug adaptors and country-specific oxygen connectors are required for international transfers.

Choice of aircraft

The aircraft selected for the service are all fixed-wing rather than rotary-wing (helicopter). They have been selected on the basis of available space to comfortably accommodate:

- patient stretcher
- a medical team, usually comprising a doctor and nurse
- an attending parent or family member
- two pilots
- access to the entire patient

This format may be adjusted slightly if the aircraft is in double stretcher configuration. In general, fixed-wing aircraft provide greater patient access and reduced flight stresses (noise and vibration) compared to the rotary-wing aircraft more commonly selected for air ambulance missions. The cabin is pressurised and this can be adjusted to fit with a patient's medical needs – something that is not achievable in a rotary-wing aircraft. Fixed-wing aircraft have greater fuel efficiency, speed and range, yielding better performance over longer distances compared to rotary-wing aircraft.

Large loading apertures and height are important safety considerations (**FIGURE 4**). Loading and unloading a patient carries a high risk and any aircraft design that reduces this risk is extremely significant. The aircraft and incubator stretcher systems are fitted with certified restraint systems and the flight crew are responsible for loading appropriate floatation systems for the medical crew and passengers. Additional measures are deployed for the amelioration of adverse flight stresses dependent on the clinical need of the patient.

Communication

The medical teams are deployed with a designated mobile phone loaded with all relevant contact numbers. Satellite phones in the aircraft enable the escorting team and supervising consultant to remain in contact throughout the duration of the transfer and also allow liaison with the receiving treatment facility. Teams are equipped with a ground positioning system-tracking device in case of emergencies. All referrals to the service come directly through a single point of contact with the operations team. The mission and medical details are passed immediately to the specialty on-call consultant to provide clinical input to deployment planning from the very outset. The operations team will instigate mission planning and co-ordinate conference calls, as required. These calls include the treating clinician in direct communication with the neonatal and/or obstetric consultant or senior co-ordinator plus a member of the operations team. All senior specialty co-ordinators have received aeromedical training in addition to their professional expertise.

Experience of the service

The service was launched in March 2011 and has completed over 40 missions (50,000 air miles). These have been distributed evenly between national (England, Wales and Scotland) and international destinations. Two-thirds of the transfers have involved high-dependency or intensive care patients. A specialty consultant, present at the airport to ensure that the team were fully briefed prior to departure, supervised (or delivered) all transfers. The median distance for long distance repatriations of preterm infants in the UK was 306 miles (range 157 to 558 miles). International destinations have included the European mainland, the Channel, Canary and Balearic Islands, Cyprus, Sicily, Morocco, Nigeria and Kazakhstan. International transfers have included repatriation to overseas locations as well as retrieval from abroad to a variety of destinations across the UK, Republic of Ireland or other European destinations. Funding sources have included the NHS, travel insurance providers, charitable donation and the Ministry of Defence.

FIGURE 4 Loading a patient on to the aircraft.

Neonatal indications for aeromedical transfer have included step-up for respiratory problems (including ECMO), congenital surgical, neurosurgical and cardiac anomalies, sepsis and long distance repatriation following preterm delivery. All incubator systems provide access to conventional ventilation modalities plus continuous positive airway pressure (CPAP) and low flow oxygen (including twin capability). The intensive care incubator includes provision for a high-flow therapy heated and humidified system.

Obstetric indications for aeromedical transfer have included threatened premature birth (including multiple pregnancy), antenatal haemorrhage and maternal cardiac disease. Interestingly, there have been no births in flight. One mother gave birth at the referring centre prior to air transfer back to the UK; the majority of mothers in threatened preterm labour delivered with 48 hours of arrival at their destination hospital. Combined perinatal missions have involved co-transfer of sick neonate and high-risk postnatal mother following lower uterine segment caesarean section (LUSCS).

Conclusion

Considerable resources and infrastructure are required to support a high-quality perinatal aeromedical transfer service capable of providing *in utero* transfer, *ex utero* singleton and twin repatriation and intensive care (including nitric oxide and provision for transfer on ECMO).

The need for a nationally funded air transport service for England and Wales is well recognised. It now falls to clinicians to take this forward. Representatives from the Neonatal Transport Group and the British Association of Perinatal Medicine are collaborating with members of the Paediatric Intensive Care Society Transport Group to develop a clinical users service specification for perinatal and paediatric air transport services that can be presented to national commissioners.

Acknowledgements

The authors are extremely grateful to members of the aeromedical teams, colleagues in the neonatal unit and obstetric service, the family advisory group and all departments at AirMed.

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