

Chapter

1

Models of Care

Shelley Riphagen

Paediatric Critical Care Retrieval Services

Since 1995, Paediatric Critical Care Retrieval has been growing and developing in the UK. In the late 1990s, Paediatric Retrieval was delivered by almost every PICU in the United Kingdom with over 20 services of varying size, throughout the country.

In 1997, the South Thames Retrieval Service (STRS) was established to deliver paediatric critical care retrieval for the PICU at Evelina Children's hospital, based at Guys hospital at that time, and additionally for two smaller specialised PICU's at Kings College (hepatology, neurosurgery and trauma) and St George's hospitals (oncology, neurosurgery and trauma) in South London.

The number of children being admitted into these three intensive care units from South London and the South East of England, the most densely populated and rapidly growing area in the UK, meant that the retrieval activity quickly reached a critical mass. This justified the establishment of two teams, with availability 24/7 all year round. This remains the case today.

Integrated or Independent

While STRS amalgamated retrieval activity from three intensive care units very early on to achieve a cost-effective critical mass to deliver an excellent service, most other PICUs continued to deliver their own transfers. The exception, in the early 2000's was the establishment of the Children's Acute Transport Service (CATS), serving north London and North Thames. This service amalgamated the transfer activity from three PICU's in north London. The newly formed service moved out of its base at Great Ormond Street Hospital to develop the first stand-alone retrieval service, not integrated within any PICU.

Many retrieval services across the UK followed suit, with all except two of the ten present in 2020, regarded as 'stand-alone' services, and the service in South England – Southampton and Oxford Retrieval Service (SORT), based in the Southampton PICU – representing the only other integrated service.

Choosing the Best Model

There is no straightforward answer to the question of 'what is the best model of retrieval service?' The model chosen for regional retrieval needs to be a balance of activity, staffing, funding, accommodation for the service and many other factors.

There are advantages and disadvantages to both, as evidenced by the fact that throughout the rest of the world, including North America, Europe and Australia, good examples of both types of service, operating well, continue to exist.

The most important factors that keep STRS integrated in the Evelina PICU are:

- Significant national and international recruitment factor for nurses and doctors for the PICU/STRS.
- Ability to train doctors and nurses to solo competence/independent retrieval practice in a short time in the relative safety and with direct consultant supervision in the PICU or the Evelina operating theatres with the combined volume of work in PICU and STRS providing ample clinical experience.
- Flexibility of doctors and nurses to work between services as the need arises on a specific day, with the immediate availability of staff to step into a retrieval position if a team member calls in ill.
- Doctors and nurses can work clinically in the PICU, supporting colleagues, while awaiting tasking of the retrieval team, without risk of losing clinical skills or becoming bored in the quieter periods. Year-on-year for 23% of shift time, there is no retrieval activity, and this time can be spent supporting colleagues in PICU, for example undertaking in-hospital patient transfers to CT, MRI etc.
- Skill and knowledge levels of retrieval teams are maintained at high level due to ongoing clinical activity and exposure both on retrieval and in the PICU.
- Parents commend the fact that their child may be retrieved by a doctor or nurse the day before and then looked after by the same clinical team the following day or week. This provides huge comfort and continuity for the child and family, and some closure to the team regarding the outcome of care after transfer.
- Lastly drugs and equipment can be rotated from the retrieval service into the PICU to ensure that equipment used infrequently on retrieval but more commonly in PICU does not become out of date.

However, a significant compromise is that:

- The STRS working day is always clinically busy with little ‘downtime’ to recharge and reflect. Professional support with prevention of burnout and stress-related problems has become an increasing focus in medicine in general, with paediatrics and PICU considered high-risk areas. Time for case-based reflection needs to be part of the normal working day to mitigate this.
- Due to the clinically busy nature of the job, there is little time for publishing research or audit. Anything of this nature is generally undertaken in team personal time, above and beyond their clinical commitment
- Conflict of need can arise if the retrieval teams are not supernumerary to the PICU numbers. STRS does not work in this manner, and retrieval teams are rostered separately, above the clinical numbers required to undertake care in the PICU.

Chapter

2

Logistics and Organisation

Shelley Riphagen and Karen Starkie

Organisation

The success of an organisation is dependent on some fundamental requirements being met. This is true for a retrieval service.

- There must be a clear and compelling **philosophy or mission** with a **shared sense of purpose** supported by all involved.
 - The best critical care outcome for the child and family, delivered by expert teams working collaboratively, from presentation to discharge.
- A **culture of trust and respect** must exist within the organization.
 - Every team member, involved in all aspects of care of child and family, is supported to deliver the highest quality of care.
- User friendly **systems** are in place that **augment service delivery**.
 - Guidelines, drug calculator, referral algorithms, checklists improve speed and quality of care.
- There is a strong **focus** on the **end user**.
 - The child and family's care must be optimised and the district general hospital and retrieval teams must feel valued and supported.
- The workforce must be **empowered** to deliver an **ever improving service** based on creative ideas and problem-solving identified at the front line.
 - Good ideas, creative thinking and problem solving from the point of delivery of care must be encouraged. New ways of working should challenge old dogma and be positively supported to drive improvement.

Logistics

The logistics of the retrieval process must be clearly articulated, documented and practiced so that the complex task of retrieval becomes simple and automatic.

- The referral call is received via a single paediatric critical care network referral number.
- The telephone call and all the clinical information must be recorded digitally for record, legal and audit purposes.
- The call is taken by a clinically capable individual who can document and prioritise relevant clinical information quickly.
- After or while the call is taken, it must receive immediate paediatric critical care retrieval consultant attention for triage, further advice and outcome decision.
- If and when retrieval has been agreed, all members of the team must be activated swiftly.

- Pre-checking of equipment, drugs and travel routes must complete within the shortest time possible. Preferably some checks should be completed at shift start.
- Once activated, and en route to the child’s bedside, the team must make contact with the referrers for update status of the child.

Checklists

Checklists of repeated processes and tasks ensure that these can be undertaken at speed, under pressure without important aspects being omitted, independent of the team experience. STRS has a number of checklists seen below in Table 2.1 to ensure standardisation and speed, independent of clinical teams.

Table 2.1. STRS Checklists

STRS checklists	Details
Ambulance start shift	Complete vehicle checks: fuel, tyres, brakes, check vehicle clean. All electrical equipment is on charge and in good working order. Oxygen cylinders three-quarters full or above and operational.
Retrieval team start shift	Check and prepare equipment; ventilators, emergency grab bag restocked and sealed, to ensure team can launch quickly.
Retrieval team call activation	Prepare patient/weight-specific equipment; ventilator, airway adjuncts, drugs, including controlled/fridge drugs and fluids. Print drug and equipment calculator.
Pre-departure at base	Paperwork; medical, nursing, parent information, emergency drug calculation sheet. Destination hospital and receiving PICU details and phone numbers. Mobile phone with base consultant contact numbers.
Pre-departure in ambulance	All kit present: cardiac monitor, suction, defibrillator, infusion pumps fully charged and working. Oxygen cylinders checked and turned on, spare identified, oxygen splitter present for use in theatres. Weight-appropriate ambulance securing harness or baby pod available for use. Stretcher secured safely in floor bracket, ambulance inverter activated. Team introduce themselves, confirm fit to travel, confirm hospital destination.
Pre-departure after stabilisation	Ensure patient has identification band and parents aware of transfer. Airway patent, secure and suctioned, spare airway equipment to hand, ventilation adequate and oxygen cylinders full plus an extra cylinder. Patent IV access x2, with an extension set ‘rescue line’ attached, emergency drugs sedation, paralysis and fluid boluses prepared and available. Monitor physiological alarms set, pupils checked and lubrication applied if intubated, blood gas and glucose checked. Urinary catheter inserted if required or clean nappy. Referring hospital notes, X-rays copied for transfer, STRS consultant and receiving PICU updated on interventions, infusions, condition and ETA.

Table 2.1. (cont.)

STRS checklists	Details
Pre-departure, child in ambulance	Patient secured safely on stretcher and stretcher secured in vehicle. All equipment secured in place, accessible and charging. Ambulance power supply activated (inverter), ventilator switched from oxygen cylinder to ambulance wall supply. Parent shown where to sit and informed of need to remain seated and secured (seatbelt) at all times, even in an emergency.
Child delivered to PICU, pre team departure	Full patient handover given by the medical and nursing team. All patient’s notes, results and paperwork handed over to the receiving team. Drug infusion doses checked and confirmed, social issues, safeguarding concerns or incidents are handed over to the receiving team. Parents are introduced and shown where to wait.
Kit restocking	On arrival back at base team complete ‘hot debrief’ to identify areas of good practice and what could have worked better, and to ensure all are physically and psychologically well. The team then take the used kit and drugs to retrieval base, clean and restock ambulance and kit, and take a short break.

Air retrieval adds an additional layer of complexity to retrieval.

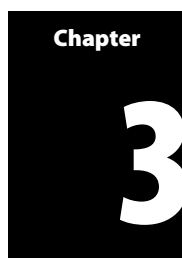
- Weather adds a degree of unpredictability. Temperature control of patient and team must be added to checklist.
- Where there is no helipad on site, a road transfer is required on either side of the team either arriving at the child or at the PICU, and the logistics and communication of this must be added to checklist.
- Air-retrieval-specific checklists should be in place.

Data Quality and Audit

- All members of the service are responsible for data accuracy.
- All data relating to the referral and the retrieval must be recorded on a written or electronic form.
- Data quality and accuracy should be reviewed in a time-sensitive manner so that where there are questions regarding information recorded, this can be validated by the team members involved, with direct memory that is fresh enough to be accurate.
- Retrieval data must be captured electronically at some point in the process of retrieval, so that activity can be audited daily, weekly, monthly and annually.
- The reporting and recording of clinical and other incidents must be encouraged and made easy, so that patterns can be detected and learning instituted.

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- Where there is learning that may pertain to other retrieval services, there should be a mechanism to share information in an anonymous but timely manner with other retrieval services.
- Activity data covering quantity and quality of service delivery must be published and available to the network clinical teams so that performance can be evaluated and acted upon.
- Service activity should be benchmarked against other similar services to ensure performance is optimised.



Air Retrieval

Karen Starkie

Logistics

Tasking an Air Retrieval

Ambulance road transfers are the easiest and most economic means of transferring an intensive care patient over relatively shorter travel distances. They account for 97% of all STRS patient transfers but represent a smaller proportion for other teams internationally, where air retrieval can represent up to 15% of the transfer activity, dependent on a combination of geography, aircraft and landing site availability and patient acuity.

When distance, speed of retrieval or urgency of team attendance are critical, aeromedical transfer should be considered.

This may be in the form of rotary (helicopter) or fixed wing (aeroplane) aircraft.

Rotary Transfer

The aircraft used in the inter-hospital transfer helicopter service provided for children in the UK are bespoke, purpose-designed vehicles equipped for children's intensive care support in the air and funded entirely charitably through the Children's Air Ambulance (Figure 3.1). The significant advantages of rotary transfer are avoidance of airport delays, with significantly reduced travel times, the ability to transfer hospital to hospital and to avoid the effects of altitude and acceleration, experienced with fixed wing air transfers. These have to be weighed against the disadvantages of confined space, noisy environment, increased communication challenges, lack of access to mains electricity, limited number of providers and the flight restrictions imposed by weather.

Fixed Wing

Aeromedical fixed wing transfers have the added advantage of being almost unrestricted by weather, along with more room to treat the patient. There is less noise, communication is easier and it is also easier for the team to undertake medical and nursing interventions.

Fixed wing aircraft have the advantage of speed and over-water flight; however, access to airports, travel time to and from airport to hospital, and set landing time are significant limitations. There are additional clinical considerations relating to the effects of altitude on hypoxia and gas expansion, and the acceleration/deceleration effects on cardiovascularly or neurologically unstable children.

Due to the fact that fixed wing transfers are commonly used for longer distance transfers, and staff are undertaking prolonged, high concentration work in a hypoxic



Figure 3.1 The Children's Air Ambulance preparing for a retrieval. (A black and white version of this figure will appear in some formats. For the colour version, please refer to the plate section.)

environment, greater planning is required to ensure the team are able to take rest and sleep breaks to maintain patient safety.

As a retrieval service, it is important to be ready for any eventuality.

Forward planning saves time and lives. Easy accessibility to contact details of reputable air providers is essential. Staff and patient safety is paramount. STRS will only undertake aeromedical transfers, rotary or fixed wing, if the aircraft has two pilots available during transfer.

Other Considerations

- Space available on board.
- Facilities on board: oxygen piped or cylinders only. Check cylinders have both a flow meter and Schraeder valve outlet and patient ventilator is compatible with the valve.
- All equipment and kit must be safely secured at all times in the aircraft.
- Cost of the aircraft transfer and whether medical personnel from the air provider have to accompany the team. This provides the benefit of the team being able to remain as medical passengers but may reduce the opportunity for one or both parents to accompany their child on flight transfer.
- Ambulance transfer from airport to patient bedside and back to aircraft.
- Requirement to refuel during transfer.
- Commercial flights are often more difficult to organise as the times and dates are less flexible, securing equipment and oxygen more challenging, and there is limited room to operate in the cabin, usually in full public view.
- Large airports usually have a medical centre available for the team prior to boarding.

Landing Sites

- Hospital helipad or helideck makes inter-hospital transfers smoother and faster by reducing patient bed to bed transfer time. Not all helipads are lit, restricting 24-hour use.
- If there is no helipad on site, a secondary road transfer will be required. Arranging the ambulance in advance is essential. Check compatibility of ambulance trolley with air stretcher, ability to secure equipment safely in vehicle, and confirmed expected time of arrival to prevent patient and team waiting in a field. Clear instructions regarding pick

up point are essential. Using the ‘what3words’ app will help ambulance crews find the team’s exact location.

- A second ambulance transfer may also be required from the airfield to the receiving PICU or hospital. The more land transfers required, the longer the journey and potential increase in delays, incidents and patient instability. Adding all these time points may negate the usual time saving afforded by air transfer.

Team

- Team composition is dependent on staff availability and experience, number of seats and weight of personnel for rotary wing aircraft transfers. One team member must be flight trained.
- A parent is usually taken in preference to a third team member.
- All members of the team, including the parent, must declare themselves ‘fit to fly’.
- International medical flights require the same identification and visa approvals as non-medical flights. The patient and parent also require valid travel documents.

Parents

STRS always tries to accommodate at least one parent to accompany their child during retrieval. For flight transfers the parent must be able to speak good English, to understand emergency instructions from the pilot.

Flight Equipment

- Establish how the patient can be secured in the aircraft: vacuum mattress, stretcher compatible with aircraft, baby pod, or incubator. Patient-securing harnesses and straps must be flight certified and compatible for both road and air if a secondary road transfer is required.
- Medical equipment must be flight certified and able to be secured safely in the aircraft (Figure 3.2).
- Flight bags size and contents (Table 3.1) should be minimised to essentials only (Figure 3.3).



Figure 3.2 Baby pod secured to air stretcher. (A black and white version of this figure will appear in some formats. For the colour version, please refer to the plate section.)

Table 3.1. Flight bags

Cabin Bag	Intervention Bag
Patient-specific airway bag	Cannulation pack
Controlled drugs and cardiac arrest drugs*	Intubation kit
Grab pouch	Nasogastric and catheter pack
Intra-osseous vascular access kit (e.g. EZ IO)	Chest drain kit
Paperwork	Arterial kit
Pneumothorax kit	Central line kit
Oxygen equipment	IV fluids pack
IV equipment	Cricothyroidotomy kit
IV fluids in flight	



Figure 3.3 Flight bags with colour-coded grab sections. (A black and white version of this figure will appear in some formats. For the colour version, please refer to the plate section.)



Figure 3.4 A selection of in-flight patient ear defenders. (A black and white version of this figure will appear in some formats. For the colour version, please refer to the plate section.)

- Essential equipment includes: portable suction with yankaur and suction catheters; portable manual suction unit; cardiac monitor with ECG, pulse oximetry, non-invasive blood pressure with age appropriate cuff and temperature probe. Capnography is standard of care if the patient is ventilated. Invasive pressure monitoring is ideal if the patient is requiring inotropic support; however, these infusions must be run through syringe drives not via pressure bags.
- A back up monitor, defibrillator or pulse oximeter and extra leads should also be available. Take extra straps to ensure all equipment can be secured.
- Portable syringe infusion pumps should be used in preference to fluid bags where air within the bag will expand during fixed wing flights and potentially infuse the incorrect amount.
- To ensure patient comfort, ear defenders (Figure 3.4) should be worn during rotary flights. Temperature must be actively managed using a suitable patient warming device: