The Winston Churchill Memorial Trust of Australia

Report by – BRUCE WICKSTEED – 2013 Churchill Fellow

Project: To examine varied models of paediatric critical care transport services around the world with the intention of establishing a service in Western Australia

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Signed : Bruce Wicksteed          Dated: 1st July 2014
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Introduction

A six week study tour encompassing six Paediatric critical care transport services in six countries was undertaken between 1st March 2014 and 19th April 2014. Services around the world were chosen based on many factors including professional reputation, geography and demographics, as well as the model of service delivery. The aim of the tour was to examine varied models of service with the intention of using the findings to design a Paediatric critical care transport service to suit the unique geography and demographics, as well as the health care system of Western Australia.

Acknowledgements

The undertaking of an extended international study tour requires tremendous financial and professional support as well as moral and emotional support. Sincere gratitude and thanks go to many that made this possible including:

- The Winston Churchill Memorial Trust for providing a 'once in a lifetime' opportunity to travel the world and gather information that will be used to improve the level of health care available to the children of Western Australia.
- The professional guidance and support of Dr Geoff Knight, Medical Director of PICU at Princess Margaret Hospital for Children (PMH) in Perth and Ms Katherine Griffiths, Clinical Nurse Manager of PICU at PMH.
- The love and support of my wife, Sophie, and my daughters, Autumn and Maya, for encouraging me to follow my dreams.
- The incredibly generous and hospitable pioneers of paediatric critical care transport services in the many countries I visited. These include:
  - Kriston Caton, John Beca (Starship PICU, Auckland, New Zealand)
  - Tammy Bleak, Kathy Bolte, Carol Rhoades (LifeFlight, Salt Lake City, Utah, USA)
  - Allan DeCaen, Colleen Gresuiik (Stollery Childrens Hospital, Edmonton, Alberta, Canada)
  - Tova Hannegard Hamrin (Astrid Lindgren Childrens Hospital, Stockholm, Sweden)
  - Dennis Kerr, Jon McCormack (ScotSTAR, Glasgow, Scotland, UK)
  - Eithne Polke, Lynn Shields (CATS, London, UK)
Executive Summary

Contact: brucewicksteed@me.com  mob: +61 (0) 42 8888 184

Project Description: Examine varied models of paediatric critical care transport services around the world with the intention of establishing a service in Western Australia.

A study tour encompassing six countries in six weeks with immersive visits to well recognised and established services was conducted between March 1st 2014 and 16th April 2014. In most cases, the researcher was 'employed' on an honorary contract as a medical observer to allow access to all aspects of the service. Through interviews (informal and formal) as well as observation, many aspects of each service was examined including staffing models, education, communications, equipment, administration, and governance. Services visited included:

- Starship Children's Hospital, Auckland, New Zealand. Similar to Western Australia, Starship is the sole tertiary paediatric centre and services a population with considerable geographical and logistical barriers to accessing specialist paediatric health care. The retrieval service was established in 1993 and is operated out of the Paediatric Intensive Care Unit (PICU) utilising existing transport services.
- Intermountain LifeFlight, Salt Lake City, Utah, USA. A 'stand-alone', privately owned multi centre retrieval service covering Utah and surrounding states since 1987. LifeFlight utilise a dedicated fleet of aeromedical rotary and fixed wing platforms, and have developed a dynamic staffing model.
- Stollery Childrens Hospital, Edmonton, Alberta, Canada. A PICU based service established in 1994 by Prof. Allan deCaen to provide a coordinated paediatric retrieval service to central and northern Alberta, Saskatchewan, Northern British Columbia, as well as the vast region of the remote Northwest Territories.
- Paediatric Emergency Transport Service (PETS), Astrid Lindgren Childrens Hospital, Stockholm, Sweden. A PICU based service established in 2005 by Dr Tova Hannegard Hamrin incorporating a sophisticated paediatric ECMO transport servicing Scandinavia and greater Europe.
- Scottish National Paediatric Retrieval Service / ScotSTAR, Edinburgh and Glasgow, Scotland, United Kingdom. At the time of visiting, Scotland was moving from a service co-ordinated between the two main PICU's in Scotland located in Edinburgh and Glasgow, to a nationally integrated 'stand-alone' NHS operated retrieval service with paediatrics a sub specialty.
- Childrens Acute Transport Service (CATS), Great Ormond Street Hospital, London, United Kingdom. A prestigious service established in 2002 by Eithne Polke. One of the few dedicated Paediatric retrieval services in the world to be accredited with the Commission on Accreditation of Medical Transport Systems (CAMTS). Advanced Retrieval Nurse Practitioners provide clinical leadership alongside the consultants and provide a model for an emerging career pathway in advanced nursing practice.

Key Learning

- a paediatric retrieval service for the children of Western Australia is needed to provide optimal access to specialist paediatric health care in line with the rest of Australia.
- existing services can be utilised to provide a service.
- a formal paediatric retrieval service provides benefit to the paediatric community as well as the medical community via several mechanisms:
  1. Timely access to specialist paediatric critical care services- 'bringing the PICU to the child'
  2. Clear line of communication to clinical support for health care professionals via remote clinical consultation and management
  3. Improved outcomes for children by providing paediatric specialist clinicians
  4. 'up skilling' of health care professionals in non paediatric facilities via outreach education
  5. potential to develop a pathway for advanced clinical practice in paediatric intensive care nursing via the development of a Retrieval Nurse Practitioner program.
  6. potential paediatric retrieval training for intensive care, emergency medicine and or anaesthetic trainees.

Plans for dissemination of information.

- presentation to the planning committee for the new Perth Childrens Hospital
- presentation at ASA/Aeromedical conference in Brisbane, September 2014; ICIN, Perth, November 2014.
- prepare a paper for publication in a peer reviewed journal
- meetings with key figures in PMH, NETS WA and WA Health Dept.
Programme

PICU Transport - Starship Children's Hospital
LifeFlight NZ
Auckland HEMS
Auckland, New Zealand. 2nd March - 7th March 2014.
Contact: Dr John Beca, Ms Kriston Caton

Intermountain LifeFlight
Salt Lake City, Utah, USA. 9th March - 14th March 2014.
Contact: Ms Tammy Bleak, Ms Kathy Bolte

Stollery Children's Hospital
Alberta Central Air Ambulance
STARS Air Ambulance
Edmonton, Alberta, Canada. 16th March - 20th March.
Contact: Dr Alan De Caen, Ms Colleen Gresuik

Pediatric Emergency Transport Service (PETS)
Astrid Lindgren Children's Hospital
Contact: Dr Tova Hannegard Hamrin

Scottish National Paediatric Retrieval Service / ScotSTAR
Royal Hospital for Sick Children.
Edinburgh, Scotland. 30th March - 4th April 2014.
Contact: Dr Dennis Kerr, Dr Mark Davidson

Children's Acute Transport Service
London, United Kingdom. 6th April - 11th April 2014.
Contact: Ms Eithne Polke
**Background** – the current state of play in Australia

Western Australia (WA) is the only state in Australia not serviced by a specialist paediatric critical care transport service.

Most parts of Australia have adopted a model of dedicated retrieval service to provide clinical and operational coordination for paediatric retrievals. Varied models of service delivery exist around Australia and are generally designed to suit the particular demographic and geographic demands of their respective states or territories.

South Australia (SA) have established a 'stand-alone' service (MedSTAR) to co-ordinate all medical retrievals in SA with a dedicated paediatric team as part of the service. MedStar currently provide paediatric critical care transport services to the Northern Territory (NT) as there is no Paediatric Intensive Care Unit (PICU) in NT. Queensland (Qld) have recently moved from a service co-ordinated between the two tertiary PICU's in Brisbane to a dedicated statewide service called Retrieval Services Queensland (RSQ) in which paediatrics are a sub specialty. New South Wales (NSW) have a combined dedicated 'stand-alone' Neonatal and Paediatric service called Neonatal Emergency Transport Service (NETS). Victoria (Vic) has a well established service called the Paediatric Emergency Transport Service (PETS) operating since 1979 out of the Royal Children's Hospital in Melbourne servicing Vic as well as Tasmania. In 2012 PETS moved into a joint office in the hospital with NETS (Vic). Operating independently, though through a central co-ordination office, the intention is to amalgamate clinical services in the future to provide a combined dedicated Neonatal and Paediatric Intensive care transport service.

Princess Margaret Hospital for Children is the only tertiary paediatric health care facility in WA and hosts WA's only paediatric intensive care unit (PICU). Currently paediatric patients in WA are transported via the Royal Flying Doctor Service and/or St John Ambulance. Neither of these current transport services are paediatric specialists. There is an increasing body of evidence demonstrating improved outcomes from specialised paediatric retrieval teams (Ramnarayan and Polke, 2012; Ramnarayan et al, 2010; Orr et al., 2009; Vos et al, 2004; Britto et al, 1995). Clinical co-ordination of care or requests for clinical advice from paediatric intensivists at PMH are currently on an 'ad-hoc' basis leading to a variety of management standards depending on the experience of the local providers. With often considerable time to definitive care, this equates to considerable time delay to the expertise and resources of the PICU. A dedicated paediatric retrieval service with a clear line of communication and referral process would allow the PICU to effectively
be brought to the child in a very short amount of time to guide management, stabilisation and, if needed, transportation of paediatric patients.

The planned opening of the new Perth Children's Hospital in 2015 is an appropriate time to consider the establishment of a paediatric retrieval service. Although there are established paediatric retrieval services available in every other state in Australia, each has been designed with their respective demographic and geographic constraints in mind and would not necessarily represent the ideal system for WA. The granting of a Churchill Fellowship has enabled the researcher to travel to established services in developed countries in which healthcare systems operate at a similar level to that which we enjoy in Australia. The decision on which services to study was based on professional reputation/standing, as well as geographic and/or demographic dispersal that would provide the researcher some parallels with Western Australia. Although a visit to the London based Children's Acute Transport Service (CATS) does not fit this criteria, the professional standing of CATS as the largest dedicated paediatric retrieval service in Europe warrants closer study of their unique operations. Immersive visits to these services has allowed the researcher to collect information on many facets of each service and build a comparative snapshot of current international practice in this highly specialised field.

Aspects considered for each service include administration issues such as coordination, both logistical and clinical, and communication systems. Also considered is governance issues such as quality improvement and risk management mechanisms, data collection and reporting. Education, both 'in house' as well as outreach education, was examined along with staffing models and equipment. A discussion of commonalities and innovation among services visited is followed by a summary of key learnings from the study tour along with recommendation for moving forward in planning a paediatric retrieval service for Western Australia.
DESCRIPTION OF SERVICES

PICU Transport Service - Starship Children's Hospital. Auckland, New Zealand.

Overview
A formal transport service operating out of the PICU in Starship Children's Hospital in Auckland was established in 1993 by Dr John Beca and Kriston Caton (RN). As the only PICU in New Zealand (NZ) and the only specialist paediatric retrieval service they have a catchment area of 268 000 sq km containing a total population of 4.4M, with an estimated 880 000 paediatric population. Referrals may also come from Pacific Island populations such as Rarotonga. The service is responsible for inter-hospital transfers of neonatal and paediatric patients and also caters for ECMO transports if required. The PICU transport service handles around 300 referrals per year with approximately 95% requiring transport.

The PICU transport service provides a 24/7 level of cover. Funding for staffing the service is through PICU directly. Transport costs are billed to the referring service / district health board along with reimbursement costs for staffing hours whilst on transport.
Administration

– **Initiation process**

PICU transport service does not have a single direct number for all referrals. Instead, the referring physician may either phone Starship PICU directly and ask to speak with the Consultant or Registrar on duty, or alternatively, call a well advertised “one call does it all” number for retrieval requests with LifeFlight NZ who operate an independent aeromedical retrieval service. If LifeFlight NZ receive a call regarding a paediatric patient, then they will put the referring doctor in touch with the PICU medical staff.

– **Response Process and Coordination**

Patient details are entered on to a 'PICU Transport Referral' form. If the referral does not proceed to transport then this form serves as the sole record for clinical advice provided. If transport is deemed appropriate, then this form provides clinical information to assist the retrieval team in preparing for transport. To organise transport, the PICU Consultant or Registrar makes a single call to the coordinator at LifeFlight to provide details of location and acuity. The LifeFlight coordinator will then, in discussion with the PICU medical doctor, provide options on the most appropriate transport platforms based on availability, distance, weather and will take care of all logistical issues required. This leaves the clinical staff to focus solely on clinical issues. For fixed wing transports, the transport team is also assisted by a dedicated LifeFlight crewman who ensures the safe loading, unloading and transport of the transport team and patient as well as general safety of the team. That is, they provide 'eyes on the ground' for the team in determining, for example, suitability of potential family members wanting to accompany the patient and are generally able to take care of any peripheral issues that may impact on the transport.

– **Communications**

There is no telemedicine facility between PICU and the referring health service. Notification for the retrieval team is via a pager which provides brief key information. The retrieval team also carry a dedicated mobile phone and a satellite phone for communications whilst on transport. The LifeFlight coordinator communicates directly with ground transport services and provides the referring and receiving facilities with updates regarding progress of the team and expected times of arrival. Thus the coordinating transport doctor deals directly with a single contact point for all logistical issues surrounding the transport.
- **Governance**
  - **Responsibility**
    The transport service is under direct hospital hierarchy as part of the PICU. As such all clinical protocols and procedures relating to PICU clinical practice form the guidelines for the transport service. Similarly the responsibility structure for the transport team follows the established PICU structure from flight nurse through transport registrar to PICU Consultant.

- **Clinical Effectiveness and research**
  All transport documentation contains 'tagged' fields that are manually entered into a database for the purpose of monitoring operational and clinical performance. All relevant data is also collected and contributed to the PICU (PIMS / ANZICS) database. An annual report is generated and made available by the transport coordinator Kris Caton. As most of the patients transported by the team are admitted to the PICU, the opportunity for following up on a patient's progress is assured, allowing for reflection on individual and system / organisational performance. At present there is no formal mechanisms in place for feedback to (and from) the referring facility on aspects of the transport including pre-transport care, transport issues, and patient progress post admission to PICU.

- **Audit**
  All transports are reviewed by the transport coordinator on a weekly basis. Relevant data is entered into the database and the documentation is assessed for any clinical such as level of care, as well as any operational issues. The coordinator follows up with individuals / organisations as needed. Regular team / peer case reviews are not currently conducted.

- **Risk Management**
  The transport service utilises the established PICU / hospital clinical incident reporting system. Additional guidelines such as those regarding transport team fatigue management are adopted from recognised bodies such as the New Zealand Flight Nurses Association (NZFNA).
Education and Credentialing

The transport service has a defined orientation program as well as annual revalidation requirements for transport nurses. The orientation program requires nurses to complete a 12-hour orientation theory day plus successful completion of an examination with a 70% pass mark. They are also required to complete a minimum of 5 clinical 'buddy shifts' with an experienced transport nurse specialist, 75% of these buddy shifts are required to be flight retrievals of ventilated patients both paediatric and neonatal. In addition to this, nurses are required to successfully complete a 'Flight Nurse' course run by NZFNA within 2 years of commencing with the service. At present there does not appear to be a formal processes for medical staff orientation in to the transport role.

Transport nurses are expected to maintain a log book of all transports. They are required also to complete an annual 'safety / survival' and update day with at least a 70% pass mark on the exam, maintain current Advanced Paediatric Life Support (APLS) qualifications, assist in the orientation of new staff, and attend post transport debriefs when appropriate. Due to the geography of NZ and conducting helicopter retrievals over bodies of water, all staff must attend Helicopter Underwater Escape Training (HUET).

Staffing

The transport team consists of a PICU registrar and senior nurse, with the duty Consultant providing clinical oversight and ultimate responsibility for the transport. Both of these staff members (registrar and nurse) are assigned to the transport team on the roster and as such do not have a designated patient load or additional responsibilities. Ideally for the PICU, the transport nurse fulfills the function of a second 'float nurse' whilst in the unit and not preparing for a transport. The registrars are rostered to transport on a variety of shifts. These include a day shift from 0800hrs to 1600hrs, evening shift from 1600hrs to 2400hrs, after midnight there is 'on call' between 2400hrs and 0800hrs. There currently exists a disparity in shift times of medical and nursing staff. This occasionally leads to minor delays in departure and confusion regarding transport team composition.

Outreach Education

At present, it is the responsibility of each district health board in NZ to provide education to staff regarding any aspects of patient stabilisation and preparation for transport. There are currently no
formal programs / mechanisms in place through which the PICU provide outreach education to referring health services.

**Transport Platforms**
The transport service does not directly own any aircraft or road vehicles and contracts these services to established organisations as needed. Road transport is provided by St John Ambulance (SJA) in all parts of NZ excepting the capital city Wellington in which Ambulance services are provided by Wellington Free Ambulance – a community owned and operated service. SJA have designated 'baby buses' in which compatibility of fittings with the PICU transport service equipments is guaranteed and provide a priority service for PICU transport. The contract for aeromedical transport is currently with LifeFlight NZ who operate a turboprop MetroLiner in addition to a Citation jet for longer transports. If rotary wing transport is deemed the most appropriate then LifeFlight will coordinate the tasking of the Westpac Rescue / Auckland HEMS helicopter (BK117) or a Sikorsky helicopter based just north of Auckland.

**Equipment**

- **Stretcher**
  The transport rig is built around a Ferno stretcher top on a custom made fixed leg base for movement through hospital and into road transport vehicles using custom ramps. For
transfer to airframes the stretcher top is removed from the base and loaded separately. Due to compatibility, greater efficiency and air authority regulation issues, the service is working toward using a LifePort stretcher system (with stretcher bridge for equipment) which will integrate more smoothly with the LifePort aerosleds soon to be fitted to LifeFlight NZ airframes. The current patient loading system in the BK117 is a rear loading helicopter and is configured for a fixed height stretcher but can easily be converted to be compatible with a LifePort stretcher to allow smooth cross compatibility between air frames for the transport equipment.

- **Monitoring**
  The team currently use a ProPac monitor for patient monitoring but are required to also have a Phillips MRX to provide defibrillation capability.

- **Ventilator**
  A ResMed Elise is used for both invasive and non invasive ventilation. In addition to this, LifeFlight carry an Oxylog 3000+. The use of a turbine driven transport ventilator (Elise) provides flexibility and removes the dependance on a high pressure gas supply.

- **Infusion devices**
  The Alaris syringe drivers used in PICU are carried on transport. Although allowing a seamless transition back in to PICU, these pumps are bulky and cumbersome in a transport environment.

- **Portable Suction**
  The team carry a battery powered Leardal Compact Suction Unit. In addition to this, all LifeFlight NZ airframes, and the HEMS BK117, have on-board suction.

- **Transport Kit**
  A selection of 'Thomas packs' are taken on each retrieval. These are restocked as needed post transport and sealed with a cable tie to identify them as checked and ready for service.
**Overview**

LifeFlight is a well-established privately owned retrieval service as a division of Intermountain Health Care. The transport service originated as a neonatal transport service in 1968 and grew such that by 1978, LifeFlight's first helicopter base was established, making LifeFlight the seventh (7th) air medical program established in the United States. With the advent of paediatric intensive care units, the service expanded to include paediatric retrievals. Initially this was a PICU based service but changed to an independent service in 1990 incorporating neonatal, paediatric, and adult retrieval services. LifeFlight services an area more than 644,000 sq km covering not only Utah, but portions of the surrounding states including Nevada, Montana, Wyoming, Colorado, Idaho, Oregon and Arizona. The estimated catchment population is 3.5 – 4 million (2.8 million are in Utah).

LifeFlight currently own and operate a fleet of dedicated aeromedical transport platforms including both fixed and rotary wing out of 6 bases in Utah providing not only inter-hospital transportation but also primary scene response. At present there is no capability to cater for aeromedical ECMO transport. LifeFlight are one of the few aeromedical services in the USA to have achieved accreditation with the Commission on Accreditation of Medical Transport Systems (CAMTS). This accreditation ensures excellence in all aspects of their aeromedical service.
Administration

- **Initiation process**
  A well advertised single number for any transport/retrieval requests go through to LifeFlight dispatch centre who take patient details. In the case of a paediatric referral being received by the dispatch centre, the call is also forwarded through to the PICU/ED to allow clinical coordination of management. In the event of a referring facility phoning PICU directly for advice on a patient that then requires transport, the PICU Physician will activate LifeFlight via the dispatch number.

- **Response Process and Coordination**
  The central dispatch centre controls tasking of all teams from all bases. They dispatch teams based on acuity, skill sets, location, transport platform availability plus of course distance and weather. All of the bases have rotary wing aircraft but only two have fixed wing. As a general rule, the dispatch centre will default to dispatch of a rotary wing team for retrieval up to a 240 km from the base. Beyond this distance, fixed wing is the preferred airframe.

- **Communications**
  The central dispatch centre handles all communications with relevant parties and logistics such as refuelling, airport security clearances, ground transfers. The retrieval teams all carry pagers and the initial information (clinical picture, weight, infusions, ETT etc) for a job will come via the paging system to all personnel assigned for a job. In addition to this, each base has a radio 'cell call' which also announces the job and requires acknowledgement as well as allowing further interrogation of job details. Each team also carries a dedicated transport mobile phone plus a satellite phone with each airframe to allow communications with the coordinating Physician. There is no telemedicine facility at present.

- **Governance**
  - **Responsibility**
    LifeFlight retrieval teams are generally nurse led with medical oversight. An 'on call' physician is rostered for every shift to provide clinical guidance as needed to all teams. The 'adult team' is nurse/paramedic led with comprehensive protocols/clinical practice guidelines that will indicate if medical consultation is required. For the paediatric and neonatal teams, they are governed by remote medical oversight.
Prior to departure from referring facility, the lead nurse on the job (paediatric or neonatal) will phone the medical control (receiving ED Physician / Intensivist) to discuss patient condition, interventions performed and intended plan of care.

– **Clinical Effectiveness and research**

Every transport record is audited for level of care, compliance to clinical practice guidelines, and any issues either clinical or organisational. LifeFlight have developed guidelines in line with CAMTS to benchmark and guide their ongoing quality improvement across whole of service. Each manager within LifeFlight have their own portfolio of quality improvement (eg education, clinical practice, equipment etc). Managers of all teams are responsible for ensuring transport documentation is reviewed and subject to quality control. If issues are identified, they are fed back to the relevant manager for follow up. All relevant parties are included in communications regarding the issue and then a group email to all managers is sent when the issue has been resolved. For clinical staff involved in a particular transport, they have direct access to a computer system that allows them to access and review patient information. This allows them to identify subsequent pertinent clinical findings and provides a mechanism which fosters a professional reflection of care provided.

– **Audit**

Weekly case presentations and reviews are conducted and all clinical staff are encouraged to attend. It is part of the orientation process for new staff to present at least 5 cases at these meetings for peer review. All documentation used by LifeFlight contains key fields that capture data to be fed into their database for the purpose of quality improvement and accountability. Data captured does not, at this stage, contribute to any national database.

For every transport, a letter is generated by the relevant transport nurse and sent to the referring facility and specifically addressed to the staff involved in the referral. The letter outlines the case and transport and provides a brief description of events post admission at the receiving facility. If specific management / clinical issues are identified then this will be followed up from either transport physician to referring physician, or via a dedicated outreach coordinator from LifeFlight. If a 'clinical incident' is identified, then this will be addressed via a formal follow up process.
– **Risk Management**

LifeFlight have employed a dedicated safety officer for 3 days per week to monitor and administer the organisation's risk management program. They are introducing the Human Factors Analysis and Classification System (HFACS) principles into their operations on all levels to gain more insight into potential and/or actual issues to optimise the organisation's risk management procedures and policies. In addition to this, every staff member is required to complete and submit a daily safety report.

– **Education and Credentialing**

A comprehensive education program is in place within LifeFlight that not only provides a thoroughly supportive introduction to the organisation and ongoing education but also fosters a culture of clinical excellence and safety. The orientation program spans 12 weeks (minimum 288 hours) and covers clinical orientation including a course of 16 lectures and associated learning modules, clinical instruction and supervision in lab/simulation environments, clinical placements with an Anaesthetist in OT and also an ICU or ED placement tailored depending on the orientee's background to suit agreed learning objectives. Attendance and presentations at flight meetings, as well as completion of required certificates such as APLS and TNCC. In addition to this, the orientee has 'on duty' orientation with a designated mentor for at least 10 rotary wing flights and 5 fixed wing flights. This 'on duty' orientation also includes the requirement to complete a reflective journal/log of experiences that is discussed with the educator to assist in identifying learning needs.

The ongoing education program is also comprehensive and ensures a commitment to ongoing professional development.

**Staffing**

The staffing model at LifeFlight represents a dynamic system that not only optimises the specialist staff available for deployment by the service but also provides for 'cross training' across the specialities. The team on a base at any given time is comprised of a Paramedic, and Neonatal RN, Paediatric RN, and Adult RN. A standard transport team will always have a 2 team members, with the 'lead' being taken by the staff member of that speciality. If a 'scene' response (that is, out-of-hospital) job is dispatched then the Paramedic along with (usually) the adult RN will attend, in this case the Paramedic will provide clinical lead. If the 'scene' job involves a paediatric patient then the
paediatric RN would attend in place of the adult nurse. If an adult orientated inter-hospital job is dispatched, then it will usually be the adult nurse and the paediatric nurse, with the adult nurse assuming clinical leadership. In the case of a paediatric patient, the paediatric and (usually) the neonatal nurse will attend, with the paediatric nurse leading the retrieval, similarly in the case of a neonatal transport the paediatric and neonatal nurse will attend with the neonatal nurse providing the leadership.

As the LifeFlight bases are attached to a hospital, each base also provides a level of clinical expertise to the hospital. This serves not only to provide a dynamic resource for the hospital but also fosters improved relations between transport service and hospital staff. For example, the transport staff are paged to attend 'difficult' cannulations and also to attend Medical Emergency Team (MET) calls and Code Blue calls within the hospital. Another example is at the Primary Children's Hospital, the team there are involved with any transfers from the adjacent University Hospital Neonatal ICU (NICU) to the NICU at Primary Children's Hospital if surgical management is required.

Outreach Education
The LifeFlight education portfolio not only provides exceptional learning opportunities for its staff but also provides a well designed education program for referring healthcare facilities. The outreach education is provided on a scheduled basis but also 'on demand' and tailored to suit the particular health services needs or requests. LifeFlight provide this service free of charge and consider it part of their mandate to improve the level of care available to the community. An interesting initiative was in the process of being implemented at this time. This initiative is directed at improving paediatric clinical care in outlying regions by appointing 'honorary' LifeFlight nurse positions in key areas of need. These positions will be appointed to existing nurses who will then undergo intensive training and 'upskilling' in paediatric critical care, as well as LifeFlight protocols, so that they may act as a key resource person in assisting to manage the paediatric patient and prepare for transport, prior to the LifeFlight team arriving. This serves to improve the level of care the paediatric patient receives in outlying regions, and also empowers the referring facility and staff.

Transport Platforms
For road based transport out of Primary Childrens Hospital, a dedicated Ambulance and driver are provided by Gold Cross Ambulance SLC at all times. Other Ambulance providers are contracted as needed at other sites and areas to facilitate transport to and from the fixed wing aircraft. The rotary wing fleet owned by LifeFlight includes four (4) Agusta Grand, and two (2) Agusta K2 with winch
capability. The fixed wing fleet comprises three (3) Beechcraft KingAir B200. All aeromedical platforms are dedicated for aeromedical work and as such have permanent aerosleds installed and associated aircraft based loading systems.

Equipment

- **Stretcher**
  All LifeFlight aerosleds are Spectrum Aeromed and the stretcher tops are likewise Spectrum. These are generally attached to Striker drop leg stretchers although some helipads have a flat stainless steel custom trolley for conveying patients to and from the airframe.

None of the transport stretchers utilise a stretcher bridge to secure equipment. Upon questioning members of LifeFlight as to why this is the practice, no clear rationale could be provided. At present all equipment (monitors, ventilators, infusion pumps) are secured inside the airframe either to the floor or hung on dedicated securing devices. For loading and unloading of patients, this equipment must be then unsecured.

- **Monitoring**
  LifeFlight use a Zoll Propaq MD across all transport platforms.
– **Ventilator**

The Hamilton T1 is currently being phased in to all bases for adult and paediatric teams, replacing the Drager Oxylog 3000+. The modern ICU level turbine driven transport ventilators offer flexibility in ventilation modes and also eliminate reliance on high pressure gas supply which takes up considerable space and weight allowance. This ventilator is also used for its non invasive ventilation capabilities.

– **Infusion devices**

LifeFlight use a CareFusion MedSystem III for all infusion requirements. This device allows individual programming for up to three (3) separate infusions in one light and compact machine. This device is also used for infusions of inotropes in paediatric patients.

– **Portable Suction**

The Laerdal Compact Suction Unit is used by LifeFlight but they have chosen to add a larger reservoir, which increases the capacity to 500mls as opposed to the original 300mls. The downside to this addition though is that it makes the unit considerably more bulky than the standard. All transport platform also have additional suction if required.

– **Transport Kit**

The developer of the 'Thomas packs', Dr Frank Thomas, was until recently the Medical Director of Adult Services at LifeFlight. It is no suprise then that the transport kits are all based on Thomas packs. The packs are checked post mission and restocked, then sealed with a numbered tag to demonstrate readiness for future use.
Overview
The Stollery Children's Hospital PICU Transport Team was formally established in 1994 by Dr Allan DeCaen and Colleen Gresuik, both of whom still manage the service. The catchment area for Stollery Children's PICU is central and northern Alberta with an area of 440 000 sq Km. In addition to this they also service the neighbouring states of Nunavut, Yukon, Saskatchewan, north east British Columbia, as well as the vast North West Territories. The geographic isolation and demographic profile of this region of Canada provides some close parallels with Western Australia and the challenges faced by a tertiary paediatric centre servicing an enormous sparsely populated region. The PICU transport team retrieve around 200 patients per year, most by fixed wing aircraft, and with an average transport time of between 6 and 8 hours. The service provides interhospital transport including ECMO.

Administration

- **Initiation Process, Response and Coordination**
  
  All calls for critical care transfers goes through Alberta's designated call centre for coordinating patient care transitions called RAAPID (Referral, Access, Advice, Placement, Information and Destination). This call centre is staffed by Registered Nurses who have algorithmic guidance but will triage based on clinical decision making skills also. If a PICU related call is received, RAAPID will bring the PICU Consultant
in to the conference call along with the transport nurse on duty so that all concerned are part of the discussion regarding patient condition and plan of care. All calls are recorded. If the PICU Consultant is not immediately available then the duty Physician for the contracted rotary wing retrieval service STARS (Shock Trauma Air Rescue Service), is often brought in to the call to provide advice on transport options, and will provide initial advice until the PICU Consultant is available. Once a decision regarding plan of care and transport has been made, the staff at RAAPID will then consult with the Central Communication Centre (CCC) who handle all emergency (911) calls and coordinate all transport logistics for PICU retrievals. CCC will also keep all parties updated with estimated time of arrival and any changes in agreed plans. If rotary wing transport is deemed appropriate, STARS is the contracted service to provide this although at the time of visiting, the paediatric team was unable to utilise this service due to air regulations prohibiting use of the current PICU transport rig until further air worthiness accreditation was obtained. The PICU transport team were however able to utilise the fixed wing service, Alberta Central Air Ambulance (ACAA), with their existing rig.

Communications

Once initial triage has occurred, and the retrieval has been tasked and handed on to CCC, RAAPID are no longer involved. As mentioned, CCC will organise and monitor transport logistics. Any further clinical consultation is conducted via telephone, physician to physician. There is no established telemedicine facility at this stage. Alberta does however have a networked medical imaging system. The transport team carry a dedicated transport mobile phone as well as having access to a satellite phone. The transport team will always phone the PICU consultant prior to departing the referring facility to discuss patient condition, interventions and plan for care en route.

Governance

Responsibility

The transport team functions as an extension of the PICU and as such the responsibility structure mirrors that of the PICU with the PICU Consultant being ultimately responsible for the retrieval. The PICU Consultant on duty provides clinical oversight and coordination for all transports and liaises with the team on issues of patient management. The team have PICU clinical practice guidelines tailored for the transport environment and these are written and reviewed by the
PICU medical director and the transport coordinator.

– **Clinical Effectiveness and Research**

   All patients retrieved by the transport team are brought to the PICU for ongoing management and thus the transport team has direct access to the patients progress post admission. This provides for immediate reflection of care.

– **Audit**

   The transport coordinator reviews all transport case sheets for level of care provided and adherence to protocols as well as logistical issues. A 'Paediatric Transport Evaluation' form is included in the paperwork for each transport that collects information regarding logistical and clinical issues. There is also a checklist that is included in transport paperwork called 'Transport Review Triggers' that lists criteria that indicate a formal review of the transport is indicated.

– **Risk Management**

   Clinical incidences are addressed through the PICU / hospital formal incident management mechanisms. Risk management mechanisms for each transport modality is addressed through the relevant operator providing the service (eg ACAA, STARS).

– **Education and Credentialing**

   The transport nurses are required to have at least 2 years PICU experience before applying to join the team. A thorough orientation program is undertaken 'in house' by the transport coordinator, PICU consultant and lead respiratory technician for the transport team. The program is conducted over 5 days and offers a mixture of didactic and clinical scenario-based simulations to address key areas such as respiratory, cardiovascular, neurological and trauma related transports as well as a general introduction to the transport environment. The transport staff are also required to hold current certification in APLS. As part of the orientation of new staff to transport, there is provision for 'buddy shifts' in which supervised practice will be undertaken. This will occur within the hospital for intrahospital transports (eg PICU to CT) and then for interhospital transports. A checklist of competencies for transport is completed and signed off by the transport coordinator. An annual 'recertification' day is also a requirement for all transport staff. At this stage there is
no requirement for a formal qualification in aeromedical or retrieval medicine.

**Staffing**
The standard transport team is comprised a transport nurse and a respiratory technician. On occasion a PICU physician will travel as part of the team but over 70% of transports are nurse led, with the PICU physician providing remote clinical oversight. A transport nurse is rostered for every shift (on a 12 hour cycle) and is considered 'extra' to the staffing requirements of the PICU. Whilst in the hospital, the transport team are required to attend to any intra-hospital transports that are needed (eg PICU to CT / MRI) as well as responding to any MET calls or requests for 'difficult' IV cannulations on the wards. This allows the transport team to maintain skill levels and also provide a service to the hospital whilst also easing staffing demands (attending MET calls) on the PICU staff. The inclusion of intra-hospital transports to the team role also provides for orientation of new staff to principles of transport, in a controlled environment.

**Outreach Education**
No outreach education program. At present, the PICU transport coordinator is funded at 0.3 FTE and as such does not have sufficient resources to develop or conduct an outreach program.

**Transport Platforms**
The transport service at Stollery Children's does not have it's own transport assets and outsources this to local providers. For ground transport, the local ambulance service is contracted. Fixed wing services are provided by ACAA in a dedicated KingAir B200 with a LifePort aerosled. With ground transfers to and from the fixed wing provided by ACAA with their own dedicated ambulance. Rotary wing transport is contracted to STARS but at present, due to aviation regulation restrictions, the transport stretcher rigs used by PICU and NICU are not licensed for use in rotary wing aircraft. This issue is under review with the intention of gaining the appropriate approvals and resuming rotary wing operations. STARS use a BK110 as the main aeromedical platform, with a newer and larger AW139 just being commissioned. At present though the new AW139 uses a different stretcher system to the BK110, thus compounding the issues of cross compatibility of equipment.
Equipment

- **Stretcher**
  The transport service uses a LifePort stretcher top with an attached stand for the monitor and another stand for a rack of infusion pumps. The LifePort stretcher has an added layer to allow for storage drawers and medical gases. The ventilator is secured to the stretcher separately, behind the patient. A separate folding LifePort 'clip deck' is carried in the fixed wing aircraft to allow the stretcher to be secured to any drop leg stretcher base at the destination. This clip deck is generally secured to a stretcher base via four (4) velcro tabs at each corner. A dedicated Striker motorised drop leg stretcher base is kept at the hangar and one at PICU to facilitate equipment and patient transfers to and from the hangar.

- **Monitor**
  A Phillips MRX is currently being used to provide patient monitoring and defibrillation capability. The service is planning to move to Zoll monitors in the near future.

- **Ventilator**
  The transport service has chosen to carry a turbine driven Pulmonetics LTV1000 ventilator.
– **Infusion Devices**

  MedFusion 3500 syringe drivers are used. The service is planning to move to CareFusion MedSystem III devices in the near future.

– **Portable Suction**

  The transport team do not carry separate suction units, they rely on the transport platform to provide this.

– **Transport kit**

  The transport team have a series of 'Stat Packs' to organise the transport equipment and supplies. These are restocked post transport and sealed with a cable tie to indicate readiness for use.
Paediatric Emergency Transport Service (PETS)
Astrid Lindgren Children's Hospital. Stockholm, Sweden

Overview
On the grounds of the larger Karolinska University Hospital in Solna Stockholm, the Astrid Lindgren Children's Hospital is a tertiary paediatric centre for Stockholm and surrounding regions. The Pediatric Emergency Transport Service (PETS) is Sweden’s only paediatric transport service and was established by Dr Tova Hannegard Hamrin in 2005, servicing an estimated paediatric catchment population of 1.8 million children over 220 000 sq km. The Astrid Lindgren is also the ECMO centre for Sweden and thus up to 20% of PETS transports are ECMO related. The transport service offers inter-hospital transport of patients requiring admission to the PICU at Astrid Lindgren but they also will do some repatriation. An example of this would be a neonate that has required ECMO at Astrid Lindgren and is then decannulated and considered stable enough to be discharged to a NICU in the patients country or city of origin. In addition to this, the transport team also receives requests from other paediatric hospitals to perform transport to paediatric or neonatal centres other than Astrid Lindgren.

Administration
- Initiation Process
  A phone number known to referring facilities will connect directly to the duty transport doctor directly and is carried by whomever is on duty. Thus the referring physician will
have direct access to the receiving physician. The transport doctor will complete a 'referral' form capturing patient details and clinical information, also detailing clinical advice given.

– **Response process and Coordination**

The decision regarding the most appropriate transport platform to use is based on many factors including patient acuity, distance, weather and available transport platforms. If aeromedical transport is deemed most appropriate, the consultant will contact the preferred aeromedical provider directly and liaise regarding transport details. All associated ground transfers / logistics are coordinated by the aeromedical company if the transport takes place solely in Sweden. If the transport requires retrieval from, or delivery to, another country then the transport team will request the 'foreign' health facility coordinate transfers and logistics with the local ambulance provider. If ground transport is considered most appropriate, then the consultant will contact the ambulance service in Stockholm who have a Mobile Intensive Care bus that will provide transport.

– **Communication**

The PICU transport doctor carries the dedicated transport phone and keeps in contact with all relevant parties. This includes a call to the receiving PICU consultant prior to departing from a referring facility to give an update on patient condition and expected time of arrival. The transport doctor will also maintain communication with the designated liaison / coordinator of the aeromedical company.

– **Governance**

– **Responsibility**

The transport team composition is always a PICU Consultant or Anaesthetic Consultant with a transport nurse and as such the responsibility for the transport is directly with the transport doctor.

– **Clinical Effectiveness and Research**

The transport team all work in the PICU at Astrid Lindgren and as such have direct and clear access to the patient clinical progress post retrieval to the PICU. In the case of a patient being repatriated, the transport team have access to the receiving facility if follow-up is considered necessary. The members of the transport team are all involved in various ongoing research projects.
The transport team will generally contact the referring facility the day after transport to provide an update on the patients condition and progress.

- Audit
  All transportation paperwork is reviewed by Dr Tova Hannegard Hamrin for level of care, safety and logistical issues. This is carried out to ensure clinical excellence as well as a teaching tool for staff new to transport. In addition to this, a questionnaire is sent to the referral facilities after the transport to invite feedback regarding the performance of the team and the care provided. An annual report is prepared by the transport coordinator.

- Risk Management
  PETS uses the PICU / Astrid Lindgren internal incident management and reporting system to capture and process transport related incidents. These are also flagged by key fields in the transport documentation. Airframe and ground transport risk management and safety is taken care of by the contracted service provider.

- Education and Credentialing
  The transport medical staff are all required to be PICU and / or Anaesthetic Consultants. Dr Tova Hannegard Hamrin as transport coordinator, supervises induction of all medical and nursing staff. Medical staff must demonstrate supervised intra-hospital transfers of both neonatal and paediatric patients of varying acuity and complexity. They will then commence at least ten (10) supervised inter-hospital transports before being teamed with an experienced transport nurse. The nursing staff are similarly inducted in to the transport team and will only conduct transports with an experienced transport doctor until the transport coordinator deems them competent. Nursing staff are required to have at least 3 years PICU experience and post graduate qualifications in either PICU or Anaesthetics. All staff are required to maintain current qualifications in APLS / ATLS, TNCC etc. PETS provides funding to gain and maintain current qualifications.

**Staffing**

The transport team is always at least a doctor and a nurse. For ECMO transports, the team composition is expanded to allow for the higher acuity. PETS provides staff cover for a 24/7 service. The staff are rotated on to PETS for a week at a time and must be available for any
transports throughout the week. Following the initial checks of all equipment at the start of the week (and post transport), the staff are free to use their time as they wish and are not required to remain on hospital grounds but must be available to deploy within half an hour (30 mins). There are no formal fatigue management policies in place and staff are expected to monitor their own fatigue levels and alert the transport coordinator to arrange cover if they are not fit for transport. All staff are expected to be similarly self directed in maintaining familiarity and competence with all transport equipment and protocols. Most staff appear to be involved in research projects that they work on during the week when not on transport.

**Outreach Education**

PETS does not have any formal program for outreach education at this stage.

**Transport Platforms**

PETS does not have its own transport platform and contracts these services as required. For ground transport, Stockholm ambulance service has a Mobile Intensive Care Unit (MICA) bus which is staffed by an ICU nurse and a driver. This bus normally conducts inter-hospital ICU transfers for adult patients, but when required will provide transport for the PETS team and its equipment. This is a door to door service. The exception to this is if urgent ECMO retrieval is required and the MICA bus is not immediately available. In this instance, the team includes a cardiac surgeon, theatre nurse, perfusionist, PICU consultant and nurse, and associated equipment and will be collected from the hospital by Ambulance and driven on priority to the referring site. Then, when the MICA bus is available it will be dispatched and collect the team and patient for transport back to Astrid Lindgren.

The transport service has a preferred aeromedical company who provide fixed wing services using either a KingAir B200 or a Citation jet, both dedicated aeromedical aircraft. Rotary wing service is provided by Scandinavian Air Ambulance utilising dedicated aeromedical aircraft.
Equipment

- **Stretcher**

  PETS has a transport rig for infants less than 8 kg which is set up around a BabyPod capsule, and then another for any child over 8 kg. Both stretcher rigs are based on a LifePort base. These rigs are tied to stretcher bases on ground transport platforms as required for transfer to and from the aircraft. If the MICA bus is used, then the MICA stretcher base has a LifePort mechanism and will accept the PETS transport rigs directly. For loading in to the fixed wing aircraft, a LifePort manual loading ramp is used which bridges between the stretcher outside the aircraft and the LifePort aerosled inside. For rotary wing transports, the loading is manual and the aircraft used allow a stretcher to be brought up close to the wide loading doors.

- **Monitoring**

  PETS uses a Phillips transport monitor that is compatible with the larger Phillips monitors in the PICU. This allows continuity in monitoring when admitting patient to the PICU and also eliminates the need for removing monitoring cables from the patient upon transfer to the PICU bed. The downside is that a Phillips MRX is required to be also taken on transport to provide defibrillation capability.
- **Ventilator**
  On the BabyPod (<8kg) transport rig, a standard Servo I ventilator is used. For the larger child, a Hamilton T1 is the ventilator of choice. PETS are awaiting the release of the Hamilton T2 which reportedly will allow ventilation with tidal volumes as low as 20mls. When this occurs, the Hamilton T2 will be used for all PETS transports. The use of the Servo I ventilator on the transport rig mirrors the ventilators in use in PICU. This allows seamless transition of ventilation from transport to inpatient settings. The downside of using this ventilator is that it requires high pressure gas and thus the transport team are required to carry considerable oxygen supplies. The Hamilton is a turbine driven ventilator and will allow a much lighter and portable setup for the transport team.

- **Infusion devices**
  Continuing the principle of providing a mobile PICU for the transport team, the infusion pumps are the same as those used in PICU. These are the Alaris syringe drivers. Again, this allows seamless transition in to PICU, but the disadvantage is that these pumps are not very robust for transport and are reasonably bulky and heavy.

- **Portable Suction**
  PETS uses the Laerdal Compact Suction unit with the standard chamber attached which provides for a portable, lightweight unit.

- **Transport Kit**
  PETS uses an assortment of custom kit bags for transporting supplies and equipment.
Overview

The Scottish National Paediatric Retrieval Service was established in 2001 after a national review of paediatric intensive care services and recommendations made by the Paediatric Intensive Care Society. This service operates out of the two main PICU's in Scotland, one based at the Royal Hospital for Sick Children (RHSC) in Edinburgh and the other at RHSC Glasgow. The service has a catchment area of 78772 sq km (all of Scotland) with Glasgow predominantly looking after the Highlands and Island, and Edinburgh covering the Lowlands (central and northern regions). The population of Scotland is 5.3 million, with the paediatric population constituting approximately 1.15 million of this. The service in Edinburgh receives approximately 250 to 300 referrals per year. Most of the population of Scotland live in the Lowlands central regions around Edinburgh and Glasgow and also the north eastern region between Aberdeen and Inverness. The geography of Scotland, especially through the Highlands and Islands, results in some very isolated communities. Weather in Scotland is also dynamic and can provide a significant obstacle to medical services accessing these populations.

The National Paediatric Retrieval Service is currently in a period of transition to a national retrieval
service, which will operate across all specialities and lifespan, called ScotSTAR. Inspired by (amongst others) South Australia's MedSTAR program and also the Aeromedical and Medical Retrieval Service in New South Wales, ScotSTAR is designed to centralise coordination of transport assets and patient movements across all of Scotland. The service will incorporate the existing neonatal, paediatric, and adult retrieval services and be coordinated through the Scottish Ambulance Service. Dedicated specialist teams are to be available at all times and housed in a dedicated facility at the airport in Glasgow.

The following details will reflect the current operations predominantly of the service in Edinburgh rather than that of the projected national service.

**Administration**

- **Initiation Process**

  A well advertised single number is a direct line to a dedicated transport phone at the PICU main desk. The call is taken by the PICU Consultant or the Advanced Nurse Practitioner rostered for transport.

- **Response Process and Coordination**

  All details from the call are documented on a transport referral form. An average of 66% of all calls received will require mobilisation of the transport team for retrieval. The transport referral form provides a record of patient details, clinical information, and advice given. In addition to this it also captures referral source and all related details. The PICU Consultant provides overall coordination of the retrieval. The service has flowcharts indicating the response process to follow depending on the desired transport platform. If ground transport is required, a call is made to the Scottish Ambulance Service to arrange a suitable vehicle that contains the correct stretcher locking mechanism for the PICU transport stretcher. Similarly, if air transport is required, the Ambulance Service is first called, and if they are unable to assist, then arrangements are in place to access a military helicopter or the coastguard helicopter. For fixed wing retrieval, the Scottish Ambulance Service also coordinate the assets, and the transport team have a 'response' car on site at the hospital which is used to transport team and equipment to the airport. The Ambulance service coordinate the ground logistics including organising escorted access to 'air-side' for the team as well as coordinating the aircraft and ground transfers at the remote site.
Communications

The transport team carry a dedicated transport mobile phone. All logistical communications are generally handled by the Ambulance Service. The PICU Consultant liaises directly with the referring site via the phone in PICU in regard patient management. The retrieval doctor will phone the PICU Consultant prior to departure to provide information regarding patient condition and interventions as well as intended plan of care and estimated time of arrival. There is currently no telemedicine capability although consideration is being given to this for future system development.

Governance

Responsibility

Each transport is conducted by either a Retrieval Consultant, Retrieval Associate Specialist, or Retrieval Fellow. This is in addition to the transport nurse. The role of Advanced Nurse Practitioner is being developed through existing Nurse Practitioner tertiary programs in conjunction with the Retrieval Nurse Practitioner program currently offered through the Evelina Children's Hospital in London. The service currently has one (1) ANP operating as clinical lead on transports, with others at various stages in the training. The vision is to expand this capability to provide a more sustainable staffing model. The ultimate responsibility for the retrieval rests with the PICU Consultant providing clinical oversight.

Clinical Effectiveness and Research

Most of the retrievals are to the PICU in which the staff work. As such they have direct access to the patients progress post admission. A weekly transport meeting preceeds the PICU Grand Round and provides a forum in which cases from the previous week is discussed and peer reviewed. All referral calls that do not progress to transport are followed up the following day and outcomes logged and entered in to the transport database.

There is also a mechanism by which clinical effectiveness can be assessed by referring health facilities. On an annual basis, transports from each referral facility are examined and cases identified for discussion. Then, case presentations and discussions are conducted at each referring facility to allow referring services the opportunity to improve their service. This forms part of the outreach education provided by RHSC Edinburgh and Glasgow.
Families of patients transported by the service are also given a feedback form to monitor the services' performance in areas such as level of information provided to parents, staff performance, parent satisfaction as well as an open section inviting general comments.

Data from the transport service contributes to the nationwide paediatric intensive care network database (PICANet).

- **Audit**
  Each case is reviewed by the transport coordinator for level of care, as well as any other clinical or logistical issues. An annual and bi-annual report is compiled by the transport coordinator. A six monthly quality assurance meeting is held for all retrieval staff. Representatives from the Ambulance Service are also invited to attend.

- **Risk Management**
  The PICU clinical incident monitoring system is used by the transport service and data is also entered into the national health department 'Datix'. All incidents regarding road or air transport are fed back to the relevant parties in the Ambulance service.

- **Education and Credentialing**
  Medical staff on the retrieval rota are generally PICU consultants with varying levels of formal training and experience in retrievals. RHSC Edinburgh have recently appointed an A&E/Retrieval Consultant to boost consultant cover. There is generally an increasing recognition of the uniqueness of retrieval medicine as a defined discipline. At present 'in-house' retrieval training is provided for all transport staff. Although predominantly a consultant led service, there is a support toward an increasing presence of Advanced (Retrieval) Nurse Practitioners (ANP) to provide clinical lead on transports. The ANP's have a nominated consultant mentor and 'up-skilling' is undertaken within the PICU and Operating Theatres for competencies such as intubation, central line insertion, chest drains. All nursing staff are required to maintain a log book of retrieval and interventions performed to monitor regularity and efficiency of skill and to identify learning needs. The vision is for ScotSTAR to provide the retrieval component of a Nurse Practitioner program for the Scottish staff.
rather than attending the Evelina Children's Hospital in London as is currently the requirement.

Staffing
The transport service provides for team availability 24/7 and a retrieval rota comprises predominantly a transport doctor (consultant or fellow) and a transport nurse. Currently with the teams operating out of their respective PICU’s, the nurses rostered to the transport team are also required to have a patient load on the PICU. This leads to considerable strain on the transport team members and also the PICU team who are required to manage with staff member shortages for the period of the transport. This situation is less than ideal and the move to ScotSTAR will see dedicated teams 'on station' at the ScotSTAR base rather than working concurrently in the PICU.

Outreach Education
There is a substantial formal outreach education program currently provided by RHSC Edinburgh and Glasgow. The Scottish health system identifies the importance of specialist tertiary services providing outreach education and generously funds these activities. The service has a mobile simulation bus and travels to all regions of Scotland to provide paediatric related education and simulation training. In addition to this, as mentioned earlier, the team travel to referring services to provide case presentations and discussion.

Transport Platforms
All transport assets are provided by and coordinated through the Scottish Ambulance Service. The majority of transports are road based and utilise existing Ambulances. Fixed wing aircraft are generally KingAir B200's dedicated for aeromedical work. The rotary wing platform provided by the Scottish Ambulance Service is an EC135 based in Glasgow and is currently used predominantly by the Emergency Medical Response Service (EMRS).
Equipment

- **Stretcher**

The RSCH Edinburgh have a Ferno 'CCT six' rigid leg stretcher. The base is not required to be a 'drop leg' configuration as Ambulances in Scotland are equipped with loading ramps. The base can then be utilised for securing equipment. This rig is used mainly for road based retrievals due to compatibility issues with the aeromedical platforms. The fixed wing aircraft have a LifePort based aerosled. Whereas the rotary wing aircraft uses an Aerolite stretcher system. This lack of cross compatibility between transport platforms requires the transport team to utilise a 'VacMac' when undertaking aeromedical retrievals to secure the patient to any underlying stretcher system. Whilst providing an ideal compromise for the patient, all equipment is then required to be secured in an improvised manner during transport rather than having a dedicated stretcher bridge or similar. The service also has an ECMO transport rig. This is based around a LifePort stretcher and utilises a dedicated stretcher bridge for securing equipment. The ECMO rig is secured to a dedicated base for road transports and has the flexibility to be taken off the base and transferred directly in to a fixed wing platform if required.

- **Monitoring**

At present, a Propac is used but will be transitioning to a Phillips Mrx.
– **Ventilator**
  The service currently uses a Ventipac ventilator but will be moving over to Oxylog 3000+ with ScotSTAR.

– **Infusion devices**
  Braun compact syringe drivers are currently used. These have the benefit of being able to be stacked and transported in a dedicated holder.

– **Portable Suction**
  Suction is provided by a battery powered Laerdal Suction Unit (LSU). Whilst portable, this unit is reasonably bulky.

– **Transport Kit**
  RSCH Edinburgh use Thomas Packs for organising all equipment.
Children's Acute Transport Service (CATS). London, England

Overview
CATS was set up in 2002 by Eithne Polke to provide PICU retrieval services primarily to the North Thames and East Anglia Regions. Based adjacent to Great Ormond Street Hospital and part of the hospital management structure, CATS nevertheless operates uniquely as both an integrated and yet discreetly independent service. CATS entire service standards across all aspects of operation and transport modalities are accredited with the Commission for Accreditation of Medical Transport Systems (CAMTS) which ensures a 'gold standard' in retrieval medicine. Although the majority of transports CATS perform are road based, they utilise both rotary and fixed wing for specialist referrals throughout the UK and Europe. CATS fielded 2228 referrals in the 2012/13 year with 1172 transports being undertaken. Approximately 22% of the referrals CATS receives are for advice / consultation and this forms an important part of the service, providing remote support to health professionals and allowing children to be cared for in their 'home' towns which minimises disruption to the families whilst also reducing costs and pressure on PICU beds. Broadly, CATS offers expert paediatric clinical consultation, specialist inter-hospital critical care transport including ECMO, research, outreach education, as well as thorough 'in-house' education and training in paediatric retrieval.

Administration

– Initiation Process

A well advertised number provides a single referral point which is received by a
dedicated retrieval administrator based within the CATS office. The call is then immediately conferenced with the transport doctor and nurse who are also located 'on site' on the CATS office for patient assessment and triage.

- **Response Process and Coordination**
  The details of the call are documented on a referral form which forms part of the transport record providing details of initial assessment and management advice given. The team will often provide some advice to the referring institution regarding immediate management and will then discuss the case with the CATS Consultant who will prioritise the retrieval according to concurrent service needs. If road based transport is deemed most appropriate, then the dedicated CATS ambulance, also located 'on site' with driver, is mobilised. If aeromedical retrieval is indicated, then the team will liaise with CEGA to provide the required transport platform.

- **Communications**
  The CATS retrieval administrator acts as a hub for logistical information and maintains communication lines to all parties. Clinical coordination is undertaken by the transport doctor and/or ANP. The retrieval administrators are rostered to provide 24/7 cover for the service. The telephone system chosen by CATS is internet based which provides for unplanned local redundancy and allows the service to maintain communications as long as internet access can be found. The transport team carry a dedicated mobile phone and 2-way radio for communications. CATS are aiming to introduce telemedicine for clinical consultation with referring institutions as well as for the retrieval teams to communicate with the CATS Consultants from point of referral.

- **Governance**
  - **Responsibility**
    CATS is a consultant led service. The transport teams generally consist of a transport doctor / PICU fellow, and a PICU nurse or ANP. The ultimate responsibility for the retrieval is with the CATS Consultant.

  - **Clinical Effectiveness and Research**
    In addition to patient outcomes, CATS collects data on patient mortality, critical incidences, and interventions in the first 24 hours post PICU admission. All staff are encouraged to reflect on retrievals in order to improve clinical care. Every weekday
morning, the CATS team conduct a review of the previous days referrals and retrievals to encourage clinical problem based discussion. CATS staff are active in research projects and regularly contribute to peer reviewed journals as well as internal audits, present at conferences, and are representatives on various national level bodies related to paediatrics and transport.

- **Audit**
  
  All transport case sheets are audited for level of care as well as other key clinical and operational performance indicators. In addition to this, other multiple ongoing audits are in place as part of the commitment to continual service quality improvement and contribution to national databases.

- **Risk Management**
  
  The clinical governance structure of CATS is integrated into that of GOSH. CATS maintain compliance with the requirements of CAMTS accreditation as well as the UK Paediatric Intensive Care Society standards. CATS also contributes data to the national Paediatric Intensive Care Audit Network (PICANet) for PICU as well as a dedicated national retrieval specific dataset. An extensive program is in place to monitor and inform ongoing safe practice. The daily meetings are a forum in which adverse events and near misses are analysed. These events relate to transport, patient, communications, equipment and are entered into the CATS database. CATS have also established a Risk Action Group (RAG) that is comprised of members from CATS clinical, transport, and administration as well as PICU Consultants from referring hospitals in the North Thames region as well as members from the GOSH Risk Management team, and a Consultant Paediatrician from a district general hospital. The CATS RAG meet 3 monthly and monitor all aspects of the service such as clinical standards and clinical practice guidelines, education and training both within the service as well as outreach education, morbidity and mortality, health and safety standards, adherence to national standards, management of complaints, research and audit activity.

- **Education and Credentialing**
  
  CATS places great emphasis on education both within the organisation as well as a commitment to outreach education. An extensive orientation process is in place for both medical and nursing staff with a structured learning program and supervised
hands on training. Ongoing education such as weekly teaching sessions and active participation in presenting the outreach education programs ensure a high level of clinical competence among CATS staff. A log book for all staff is required to be maintained which documents training received and competencies achieved, retrievals undertaken, interventions performed, and record of ongoing professional development. All CATS staff are required to maintain current APLS / ETLS

Staffing
CATS provides a 24/7 level of staffing with two (2) teams available at all times. The team consistency is predominantly PICU fellow and nurse. Depending on experience of the duty transport doctor and/or patient acuity, the consultant on duty may also attend the retrieval. CATS employ five (5) full time Consultants with another 6 providing sessional cover. The junior medical staff cover for transport is provided by 7 clinical fellows from both GOSH and St Marys Hospital PICU's as well as 3 shorter term (6 month) senior trainee posts from PICU and Anaesthetics. CATS also currently employs three (3) Advanced Nurse Practitioners who are involved with approximately 30% of retrievals and provide clinical lead on approximately 12% of retrievals. The ANP's form an integral part of the senior clinical staff for CATS. Their role is divided into 65% clinical, 25% education and training, and 15% research and audit. CATS also employs another 4 full time nurses as well as utilizing a pool of 50 PICU nurses who have received CATS training and rotate on a sessional basis from PICU's within CATS catchment area.

Outreach Education
Part of CATS Service Standards is a commitment to providing a comprehensive outreach education program to support referring institutions. This is provided by many means including a dedicated website with information for referring health professionals on stabilisation of the child, clinical guidelines on frequently encountered patient groups, referral process and forms, medication calculator, and standard operating procedures amongst other information. CATS services over 50 referring hospitals and nominate a CATS Consultant and a CATS Nurse to act as primary contact for each of these services. CATS places great emphasis on establishing and maintaining a clinical network among their referring institutions. A program of lectures, tutorials and simulation sessions as well as case discussions is maintained by the CATS Consultants and ANP's and equates to at least 26 outreach days per year.
**Transport Platforms**

CATS has two (2) dedicated Ambulances on site for road based transport and full time Ambulance Technicians provided by St John Ambulance for these vehicles. For aeromedical retrievals, CATS outsources the provision of aircraft to CEGA or RAF.

**Equipment**

- **Stretcher**

  CATS use a LifePort stretcher top on a Ferno fixed leg base, with an incorporated Ferno stretcher bridge. This configuration allows the LifePort stretcher top to be detached from the base and transition in to aeromedical platforms as needed. The Ferno fixed leg base allows for considerable storage of medical gases underneath including Nitric Oxide with associated CareFusion controller, as well as ventilators, infusion pumps and a suction unit. The CATS Ambulances utilise a hydraulic ramp for loading and unloading. The patient monitor is generally secured to the stretcher bridge for road transports and to a LifePort stretcher bridge if aeromedical retrievals are undertaken.

- **Monitoring**

  Phillips patient monitors are used. CATS also use the smaller Phillips transport monitors which are directly compatible with the monitoring used in GOSH PICU.
- **Ventilators**
  The standard ventilator used by CATS is the Oxylog 3000+, they also carry a smaller Ventipac for redundancy. The use of a gas driven ventilator necessitates carrying such large stores of compressed gas.

- **Infusion Devices**
  The Braun compact syringe drivers allow stacking of devices with or without the storage unit, and long battery life.

- **Portable Suction**
  The Laerdal Suction Unit is used.

- **Transport Kit**
  A combination of rigid plastic tubs on wheels as well as Thomas Packs are used for transport of equipment and supplies. These kits are standardised and are restocked, checked and sealed with a tag post retrieval.
Discussion of Commonalities and Innovations among services

The following provides a comparative summary and discussion of common aspects noted among the services studied as well as highlighting some of the innovative practices observed. It is interesting to note that among the six (6) services visited, three (3) were 'integrated' services (that is, run from the PICU), two (2) were independent, and one (1) was in transition from an integrated to an independent service. This is an incidental finding and was not part of the selection process for services to study but allows, on reflection, a look at the relative strengths and weaknesses of each model. The disadvantage is that this provides a somewhat unfair comparison as the integrated service do not generally have access to the same level of resources to provide the quality of service that they perhaps aspire to. This is due largely to budgetary constraints.

The basic approach to retrieval was a common denominator among all service and these principles reflect those found in standards in Australia such as the Guidelines for Transport of Critically Ill Patients published by the Australian and New Zealand College of Anaesthetists (ANZCA PS52, 2013) as well as the draft guidelines “Standards for Aeromedical Services 2013” currently under consideration and prepared by the Aeromedical Society of Australasia. Each country visited had similar standards guiding retrieval practice published by their respective colleges / professional bodies. Whilst the clinical standards among services visited was universally high, implementation of some of the organisational aspects of conducting a retrieval service varied considerably and appeared to be related to the financial and physical resources of the service.

Administration

- Initiation (and service usage)
  Most services aim to provide a clear referral path for health professionals. The degree to which this is achieved varies. A single number for referrals allows referring health services easy and direct access to information and advice. A well advertised single number appears to result in a more consistent use of the service. The ready provision of advice has been recognised by several services as a key aspect of providing a retrieval service. This may be evidenced by comparing the number of referrals to the number of transports. For example, RHSC Edinburgh record that only 60% of referrals received result in transport, and CATS demonstrate 22% of calls received are for advice only and do not result in transport. Canada have a dedicated call centre (RAAPID) for clinical advice and referrals as described earlier but data from this service was not collected on
this study tour. The transport service operating out of the PICU at Starship Children's Hospital in Auckland NZ however report that 95% of calls received result in transport. There are many variables in play with these statistics but a clear line of communication to the paediatric retrieval service is not in place at this service and this may result in outlying services not accessing the retrieval service for early advice.

Another factor to be considered is the degree to which a relationship between the retrieval service and the referring institutions is fostered. CATS have recognised and embraced this principle and place great emphasis on establishing and maintaining a 'Clinical Network' between CATS and the referral institutions within their catchment area. This is addressed in a number of ways. Firstly the catchment area is organised into regions and CATS Consultants and ANPs are assigned a region to act as key resource contact. Personal contacts are made with key personnel within these referring institutions and the designated CATS staff members are required to maintain contact to facilitate clear two way communication. This contact is maintained through many channels including informal discussion around cases, planning and implementing outreach education programs, and informing of updates to operational guidelines. This leads to up-skilling and empowering of referring institutions and also builds familiarity with CATS among referring sites which is likely to lead to sustained service usage. Again, the lack of resources within some integrated services does not provide for this 'value added' level of service.

Another innovation that addresses this aspect was observed in Utah with the Intermountain LifeFlight service. This is a well established service that enjoys a high service demand and acknowledges the importance of educating and empowering healthcare providers in outlying areas to improve the level of paediatric care provided. This has been achieved primarily through their extensive outreach education program but they are in the process of implementing an innovative program that involves recruiting 'honorary' LifeFlight team members in the outlying services to receive enhanced education and training such that they act as key resource personnel for paediatric patients requiring transport to a higher level of care. The benefit to the service is that key relationships are formed and, apart from ensuring greater uniformity with patient stabilisation and pre-transport management, will likely lead to improved and sustained service usage through increased familiarity with the retrieval service.
Response Process and Coordination

Not all services visited had their own fleet of dedicated road and/or aeromedical transport platforms. Services such as CATS and Intermountain LifeFlight are the exceptions and this appears to be one of the distinct advantages of a dedicated independent service as the dispatch and tasking of assets takes place 'in house'. Most other services are required to outsource transport needs. The ease by which this occurs varies according to the available assets of the contracted service but universally appears to be a single phone call from the retrieval service to a coordinator at the contracted transport service. For some services such as in Scotland and Canada this is a phone call to the ambulance dispatch centre for both road and aeromedical tasking. For others such as New Zealand (NZ), this involves a direct call to the coordinator at LifeFlight NZ who will take care of fixed wing logistics directly or outsource and coordinate rotary wing transport. The service provided by LifeFlight NZ in handling the tasking of rotary wing assets is one of 'good will' and LifeFlight NZ provide this service gratis. The ease by which the PICU Transport Service in NZ activates aeromedical transport platforms is largely due to a strong relationship between the PICU Transport Service and LifeFlight NZ. Strong professional relationships between the retrieval service and the contracted service providers is an important factor in providing an efficient retrieval service and is noted in all services visited.

Communications

A clearly delineated transport coordinator role provides for a clear communications hub through which all parties can access information on estimated arrival times for the retrieval team and other logistical needs such as airport access and rendezvous details between aircraft and road transport. All services visited use dedicated transport mobile phones for communications with secondary communications also available such as satellite phone or two-way radio. A common theme among all services was that the retrieval team would phone the receiving consultant prior to departure from the referral service to give an update on patient condition, interventions performed and plan of care. This occurred even when the transport doctor was a consultant. Whether the retrieval consultant was present on the transport or providing remote clinical oversight, a clear line of communication for ongoing clinical support to the referring health facility whilst the team was en route appeared to be an important common theme.

Surprisingly, none of the services visited had an established telemedicine facility in
CATS report that telemedicine is an area of service delivery that they are committed to implementing in the near future. This is envisioned to be used for clinical consultations between the referring facility and the retrieval consultant as well as for the retrieval team to communicate with the consultant. Technological advancements are sure to see this aspect of retrieval medicine developing to a point at which mobile teleconferencing is an integral part of standard practice.

- **Governance**
  - **Responsibility**
    All services visited had a responsibility structure that resulted in the 'duty consultant' being ultimately responsible for the retrieval. Even for services in which the transport appeared primarily nurse led, this responsibility structure was clear to all personnel and ultimately provides for increased safety for the patient, personnel, and the service as a whole.

- **Clinical Effectiveness and Research**
  Most services had a mechanism in place by which the retrieval team could monitor their clinical effectiveness by following the patients progress post PICU admission. This was either through daily or weekly team meetings in which case discussions took place, or simply by working on the PICU and observing the patients progress, or through composing followup letters to referring institutions in which patients progress post admission was noted. Although not all services made formal mention of this aspect of professional development, it remains an important aspect to reflective practice and appeared to be available in all services either directly or indirectly.

All services collected data to monitor clinical effectiveness from a systems perspective. PETS at Astrid Lindgren also monitor their effectiveness as a service by sending out a questionnaire to each referring facility after a transport to invite comment on a variety of service aspects including clinical management and customer service. RHSC Edinburgh also invite comment from families of children transported by providing a questionnaire. An interest in customer satisfaction, whether from the family or the referring facility, is a common theme among services. The level of resources available to be actively involved in research projects varied widely, however all services acknowledged this as an important aspect of providing
a retrieval service.

– Audit

All services visited were actively engaged in audit activities at various levels. All services collected key data from referral and transport documentation to monitor clinical and operational performance. This data was reviewed on a regular basis and provided information to drive quality improvement. All services, with the exception of Intermountain LifeFlight, contributed data to national PICU databases. Intermountain LifeFlight contribute data to a state database. Services such as CATS and Intermountain LifeFlight have an enhanced system of audit as they maintain accreditation with CAMTS.

– Risk Management

The level of mechanisms through which risk is managed appears to be related to the organisational and governance structure and also directly proportional to the financial resources of the service. The independent services have very clearly defined and well established risk management strategies. Some of the smaller integrated PICU run services, who are require to 'multi-task' running a PICU with administering a retrieval service, appear under-resourced in this regard. Both of the independent services have, as part of their daily operations, meetings and/or reporting channels that require input from all staff on the team. Risk management and safety is not considered to be the sole responsibility of management and all staff are required to be actively engaged in risk reduction. These services reinforce this aspect. Beginning in orientation and continuing through daily practice to foster a workforce culture in which team members are empowered to take responsibility for safe practice. CATS have formed a multidisciplinary Risk Action Group that monitor all aspects of service operation regularly meet and report on risk management issues.

– Education and Credentialing

A feature common to the services visited is that they all have defined orientation and on-going education programs, to a greater or lesser extent. The dedicated independent services both demonstrate extensive education programs whereas there is greater variability in what the integrated services provide. All services demonstrate a commitment to education but the effective establishment, delivery,
and maintenance of this aspect of their service again seem to be proportional to the available resources. There also appears some variability in recognition of the need for education of medical staff in retrieval medicine. PETS (Sweden) and RHSC (Scotland) are two (2) integrated services that have mechanisms in place to ensure that medical staff are suitably orientated, educated and supported in conducting retrievals. CATS have an extensive program in place for their junior medical staff as they are generally rotating through CATS as part of their specialty training programs.

**Staffing**
A direct comparison of staffing between all services visited is difficult due to the organisational and political differences in the services and countries in which they operate. Broadly though, the core transport team is a minimum of two (2) persons. One (1) member of the transport team is generally regarded as the clinical lead although in the case of the service operating out of the Stollery Children's Hospital in Canada, a Respiratory Therapist is generally on the team also and so there is some degree of cross over in clinical expertise on different aspect of patient management. Most of the services utilise a Transport Doctor or an Advanced Nurse Practitioner to provide clinical lead on the transport, reporting to the duty retrieval consultant. The exceptions here would be Intermountain LifeFlight and Stollery Children's who utilise a Registered Nurse as clinical lead on transport with a duty retrieval Consultant providing remote clinical oversight.

The staffing model employed by Stollery Children's Hospital provides an example of an effective use of transport staffing resources within an integrated service. Whilst not on external transport, the rostered team members provide intra-hospital transport for PICU patients as needed. For example, the transport of a ventilated patient to CT. This provides a teaching opportunity in principles of safe patient transport for orientating transport staff, but also alleviates staffing shortages on the PICU that may otherwise occur. In addition to this service, the transport team are required to attend any MET calls that occur whilst they are in the hospital. For most PICU's, the activation of a MET call from the wards will result in at least two key staff members being absent from the PICU whilst reviewing the deteriorating patient. In times of high patient acuity and bed capacity in the PICU this can result in a noticeable strain on resources within the department. If available, the transport team will also attend to any 'difficult' cannulations on the wards. These services provided by the transport team provide resource and clinical benefit to the hospital and thus offset some of the financial cost of funding a PICU based retrieval service. Some of the other benefits for the transport team include the opportunity to maintain clinical and procedural skill within a controlled
The staffing model employed by Intermountain LifeFlight is worthy of note also as it represents an innovative approach to efficient staff utilisation whilst providing a high quality specialty service. The staffing model has been described in detail in the previous ‘description of services’ and is designed for a service that encompasses primary scene response, as well as adult, paediatric, and neonatal inter-hospital critical care transport. The model used allows for 'cross training' among the specialities and from speaking with staff at LifeFlight is a factor in providing job satisfaction.

Outreach Education
Of all the aspects of the retrieval services visited, this aspect has proven to have the greatest variability. There may be many factors involved in this variance such as political or cultural differences, and of course funding resources. The study tour revealed some services were providing extensive education and resources to referring institutions with a key focus of the service to be the provision of outreach education, whilst others had no formal arrangements in place. Of the services providing outreach education, the methods varied in complexity and delivery. For some, the provision of a follow-up letter to the referring institutions provided an informal method through which the referring team could reflect on management and initiate discussion with the retrieval service if needed. Other levels of outreach education ranged from lectures, to case presentations and discussion to mobile high fidelity simulation labs. For all services, a focus of the retrieval team was to foster an attitude of 'non-judgement' in regard to patient management at the referring facility, and to 'lead by example'. All services commented on the importance of providing support to the referring staff and educating through demonstrated clinical practice. If significant clinical issues were noted by the retrieval team, this would be followed up generally by the retrieval consultant in a collegial manner in the interests of ongoing professional relationships.

Transport Platforms
All services offered both road and aeromedical retrieval. As mentioned earlier, most services outsourced the provision of transport platforms to established providers.

Equipment
Another dominant theme among all services visited relates to the importance of well considered equipment selection. That is, time invested in careful assessment of needs, consultation with relevant parties such as transport service providers, and planning of the ideal design and selection of the transport rig will be well rewarded. The benefits of choosing the 'right' configuration will be
that the retrieval service will have a transport rig that is compatible across all transport platforms, complies with relevant road and aviation certification, is safe for the patient, safe for the staff to manage with good access to all equipment, and is easy to load and unload. The modern day availability of transport specific equipment is such that the need for 'custom' rigs is reduced significantly. Comments from services visited was that custom made stretcher configurations were costly in time and money not only to be produced but also to be certified.

- **Stretcher**

  The dominant arrangement among the services visited is a LifePort based stretcher top. LifePort aerosleds are ubiquitous in the aeromedical market and building a retrieval stretcher based on this system allows wide cross compatibility when undertaking aeromedical transport. The ability to package a patient once on to one stretcher that will move seamlessly between road transport and aircraft makes sound risk management sense. The use of stretcher bridges among the various services however proved to be greater in variability. Stretcher bridges compatible with the LifePort stretcher are readily available and allow securing of equipment within sight and control of the retrieval team as well as having the added advantage that all patient monitoring and infusion lines are within the confines of one unit, thus reducing the risk of decannulation and disconnection during transfer. A possible stumbling block for some services in utilising a stretcher bridge is their choice of patient monitoring and treatment equipment for transport. An approach by some services to paediatric intensive care transport has been to literally transport the PICU to the patient, including all the same equipment. Thus the impetus for equipment choice for some services was not portability, size, weight, or proven performance in the transport environment but rather the ease of transition from retrieval environment to PICU, thus their equipment proves too bulky and heavy to be secured to a stretcher bridge. There is some merit in this thinking however, especially if the retrieval team also staff the PICU. In this scenario, the transport staff are intimately familiar with the functionality of the equipment therefore reducing the chance of errors on transport and reducing stress for the retrieval team. The other advantage of course is a seamless transition in to PICU in which there is little disruption to patient monitoring or therapy. The distinct disadvantage to this approach however is the potential compromise to patient safety during transport by having multiple infusion and monitoring lines external to the stretcher top to which the patient is secured. In Australia, documents such as 'Guidelines for Transport of Critically Ill Patients' (ANZCA PS52) give clear consideration to equipment “size, weight, volume,
battery life, oxygen consumption and durability, as well as to suitability for operation under conditions of transport”. Most services though were either transitioning from earlier 'custom' rigs which were proving too cumbersome as well as having issues with airworthiness approval, or simply streamlining their equipment selection to make transport easier and safer.

– **Monitoring**
There proved to be a wide variety of monitors used among the different services. A commonality though is that all provided for at least 3 lead ECG, NIBP, SaO2, ETCO2, and at least one (1) invasive pressure line. Not all of the patient monitors used however provided for defibrillation and thus these services were also required to carry another monitor/defibrillator on transport with them, thereby adding weight and bulk. An aspect of patient monitoring that was observed among all services was the provision blood gas monitoring whilst on transport. Generally this was carried out using an iStat device with a variety of cartridges to cover all available test parameters.

– **Ventilator**
The choice of ventilator was another aspect that varied widely among services. The two main ventilators observed were the Oxylog 3000+ and the Hamilton T1. There was a universal recognition among services of the advances in high fidelity, multi-mode transport ventilators providing ICU level ventilation. There was also recognition of the advantages of using turbine driven as opposed to gas driven ventilators. The advantages include less dependance on a large high pressure gas supply and therefore a lighter and more streamlined transport rig. When transporting a ventilated infant less than 8 kg in their “baby pod”, PETS used a Servo I ventilator secured to the stretcher top. The service uses a Hamilton T1 for their other paediatric patients and intend to phase out the Servo I ventilator for transport when Hamilton release their T2 ventilator which is reportedly capable of delivering tidal volumes as low as 20mls. Intermountain LifeFlight are similarly intending to move away from using the gas driven Oxylog ventilators and implement the Hamilton turbine ventilator across all teams.

– **Infusion Devices**
The choice of infusion devices used by services varied from PICU standard syringe drivers, to proven and dedicated transport pumps. The most common choice for syringe driver among the services was a Braun compact syringe driver as these are relatively
compact and robust and have a proven track record in the transport environment. The infusion device used by Intermountain LifeFlight is a CareFusion MedSystem III and allowed for up to three (3) discreet infusions to be driven from one device, including inotropes. This is a compact, lightweight device thus saving weight and space for a service that relies heavily on rotary wing transport.

- **Portable suction**
  
The dominant devices used were either a standard Laerdal Suction Unit or the Laerdal Compact Suction Unit. The compact unit is lighter and more compact though has a smaller reservoir.

- **Transport Kit**
  
The choice of container or bag to transport equipment in varied between services although the 'Thomas' packs were common in various forms. Most services organised equipment and supplies according to systems such as respiratory, cardiac, monitoring. Common to all services was the application of a security tag of some kind on the opening of the storage bag or container to indicate that the contents had been checked and the equipment was ready for deployment.
Summary of Key Learning - Important components of a successful Paediatric Retrieval Service

There are many valuable lessons learned through this study tour. The overall affirmation is that a paediatric retrieval service provides an invaluable resource for health professionals and for the paediatric community. From observing the services visited, there are three key components to a paediatric retrieval service that appear to offer the greatest benefit. They are:

- clear and direct access to expert clinical advice
- the provision of a specialist retrieval team for the transport of a critically ill child
- provision of a thorough outreach education program

The mechanisms by which this can be achieved is observed through the following:

- A well advertised single number for referring health professionals to access expert clinical advice for patient management and, if needed, to arrange transportation to the tertiary centre.
- Clear pathways for the retrieval team to mobilise the required transport platform. Ideally, a single phone call from the team to a transport coordinator who will take care of tasking and logistical coordination.
- Reliable and clear communication channels. A designated retrieval coordinator through which all clinical communications flow such as between the retrieval team and the referring and receiving institutions. Ideally this is the duty retrieval consultant.
- A well defined responsibility structure with strong leadership.
- A governance structure that ensures the long term viability and safety of the service and allows the retrieval service to maintain a high level of self determination and a discreet identity.
- Mechanisms in place for monitoring clinical effectiveness from a professional as well as a systems perspective.
- An ongoing and regular audit system for monitoring organisational as well as clinical performance with contribution of data to national PICU databases.
- Nurturing of a strong 'grass roots' approach to risk management and the implementation of integrated mechanisms for identifying and managing risk.
- The fostering of a culture of clinical excellence among the team. In all services visited, this was a dominant feature and was reflected in high levels of staff retention and job
satisfaction. This appears to be (at least partly) as a result of:

- A thorough and supportive education program for orientation of medical and nursing staff in to the service and to the retrieval environment.
- A dynamic ongoing professional development program.
- Recognition and development of an advanced clinical practice model and a high degree of autonomy and accountability in clinical decision making (within scope of practice).
- A commitment to providing the resources for the development and maintenance of a multi-level outreach education program. The benefits of a strong outreach program include education, support and empowerment of referring health institutions, improved relationships between referring health professionals and the retrieval service, as well as improved service utilisation.

Consideration to components of a transport rig:

- The stretcher and stretcher bridge should be compatible across all intended transport platforms, be lightweight and certified for road and aviation use.
- The stretcher bridge should be lightweight and yet robust and have the load carrying capacity for all intended equipment.
- Monitoring needs to be lightweight, have good battery life, cover all desired invasive and noninvasive patient parameters, and include defibrillation capability. It should also have secure mounting to the stretcher bridge.
- Turbine driven multi-mode transport ventilators allow for a lighter and more streamlined transport rig by reducing the dependancy on large and heavy oxygen cylinders, whilst still providing for ICU level ventilation.
- Careful selection of infusion devices that are lightweight, compact and robust, have long battery life and provide for constant pressure and low flow rates, whilst also allowing for flexibility in programming.
**Conclusion and Recommendations** - “Let's get the ball rolling”

The motivation for seeking a Churchill Fellowship was multivariate and included the desire to gain some understanding of international best practice in paediatric retrieval medicine through direct observation and experience rather than purely academic readings. Primarily though the motivation was to 'get the ball rolling' on the issue of establishing a paediatric retrieval service. It seemed obvious to me from working in the tertiary paediatric centre for the past twenty (20) years that Western Australia should have a paediatric retrieval service. During my ten (10) years in PICU I was continually perplexed about how to address the apparent disparate level of healthcare available to the children of Western Australia. Questions included: “How do we improve the management resources available to health professionals who are faced with a critically ill child in both the metropolitan and rural setting? How can we get the expertise of the PICU out to the child? How can we bridge the gap between what we have in Perth and what is available for the rest of WA?”

The topic of a paediatric retrieval service has been informally discussed over many years in PICU, however the mechanisms to bring the idea to fruition has seemed elusive. The sustained population growth in Western Australia and the building of a new Childrens Hospital provides the right climate in which these discussions can be raised to a more tangible level as we plan the future of tertiary level paediatric healthcare in WA.

The preparation and delivery of this Churchill Report provides a unique opportunity to share my personal vision for a paediatric retrieval service in WA. The following is a broad statement which outlines recommendations and potential directions the path to establishing a service in the near future could take and would ideally be taken into consideration in moving forward with this issue, but represents only the opinions of this researcher.

From my observations, an independent service offers the most comprehensive approach but is considerably more resource intensive than an integrated service and requires a substantial volume of referrals to be cost effective. The volume of referrals are, among other factors, driven by population density and service usage. Given the geographic and demographic profile of WA this is unlikely to prove a workable model in the near future. A model similar to the one used by CATS provides, in my opinion, the ideal service model that combines a sound governance structure as part of the tertiary paediatric centre (Great Ormond Street Hospital), and yet has a discreet identity, and is largely self determining in operations.
I would envisage:

– establishing a relationship with the existing Neonatal Emergency Transport Service in WA (NETS WA) and building on existing infrastructure such that both services share common resources such as a central communications hub and office space, whilst maintaining a discreet identity.

– Establishing strong governance within the new Children's Hospital structure that ensures the long term viability and safety of the service and allows the retrieval service to develop and maintain a high level of self determination.

– The appointment of a PICU / Retrieval Consultant to provide strong leadership for the service. This would ideally require an additional consultant to the current PICU staff.

– Increasing the junior medical staff on PICU to include another trainee such that the registrars all contribute to the retrieval rota. This provides new opportunities in WA for training in paediatric retrieval medicine for specialist trainees, whilst providing a perpetual and cost effective staffing pool of junior medical staff.

– Employing a full-time staff member to the role of retrieval service Coordinator/Manager. This person will work closely with the Retrieval Consultant in establishing the service and providing leadership. Ideally this will be appointed in a senior nursing management role and fulfilled by someone with a strong PICU background and experience in retrieval medicine.

– Appointing a full-time staff position to the role of retrieval service Educator. This is for the development of a thorough induction / orientation program, ongoing professional development program as well as an extensive outreach education program.

– provide funding for at least a 0.5 FTE research / quality position.

– A staffing model that provides for a dedicated transport team at all times. This will require an increase to the nursing FTE quota for PICU such that there is retrieval nurse cover 24/7. The team can support the PICU and greater hospital whilst not on transport through mechanisms identified such as providing MET cover, intra-hospital transport, and difficult cannulation service. The transport staff are not counted in the PICU staff numbers for the shift and thus will not create a deficit to PICU staffing numbers whilst on transport.

– The provision of an internal training program providing for the development of an advanced clinical practice pathway for PICU / retrieval nurses. Whilst providing for a highly skilled team, this training has the additional benefit of providing a new and exciting career pathway for experienced PICU nurses. This is likely to aid in addressing the issue of senior nursing staff retention within PICU whilst also providing a perpetual cost effective staffing pool.
– Establish reliable transport contingency network utilising existing road and aeromedical transportation providers through establishment of a memorandums of understanding with each. Ideally the paediatric retrieval service will have at least a dedicated Ambulance for patient and team transport.

– Community and industry engagement to augment funding. For example, targeting mining companies and industry in the region to provide some sponsorship and support for the service. This may be financial only or through improving infrastructure to towns close to their operations such as provision of helipad at the local hospital if this is within range from Perth. Also community engagement for fund raising through key groups such as the network of Lions clubs in WA. Whilst providing funding, this activity also raises the public profile of the service and may increase service usage.

– Improved resources to the existing paediatric hubs of Broome, Port Hedland, Kalgoorlie, Bunbury and developing a capability in Albany to cater for the increasing population living in the far south of WA. This can be achieved through:
  – Formal outreach education program to up-skill, support and foster good relationships with referring services whilst also increasing familiarity with the service.
  – Development of a statewide telemedicine system. This system would not take the form of the traditional cumbersome static systems tied to specific rooms in designated centres. Rather, utilising modern mobile technology it can be used for clinical consultation for the referring health professionals as well as for the retrieval team to communicate with the consultant.
  – Increased access to training opportunities for outlying health professionals. This could take many forms but could for example be a nursing exchange program allowing a senior RN from the referring site to work in PICU whilst a PICU nurse works in the remote setting. This allows cross pollination of ideas, greater understanding of relative work environments and fosters good relationships between the tertiary centre and regional centres. In addition to this, provision for suitably qualified health professionals working with paediatric patients the opportunity to engage in 'ride along / observer' shifts with the retrieval team.
  – Consideration to future establishment of a 'satellite' service to be based in Broome with rotational staffing provided from volunteers within the retrieval staff pool. This has the benefits of providing clinical expertise to the regional hospital whilst also providing a 'rapid deployment' capability to these remote areas.
Broadly, the establishment of a paediatric retrieval service requires

– agreement in principle among all relevant parties / authorities of the need for the establishment of a paediatric retrieval service

– Establishment of a multidisciplinary advisory group / steering committee to develop a strategic plan addressing the following:

  – Careful consideration of a sustainable governance structure allowing for growth of the service and providing a high degree of self determination and a discreet identity.
  
  – Retrospective review of PICU and statewide paediatric casemix.
  
  – Review existing infrastructure / systems in Western Australia to identify areas of strength that the service can build on, and opportunities for development.
  
  – Review service models of established paediatric retrieval services in other parts of Australia.
  
  – Identify a model of service best suited to the demographic, geographic, and sociopolitical climate of Western Australia.
  
  – Define the service mission statement and service standards

– Formulate a strategic plan to address establishment and implementation of a state wide paediatric retrieval service.
**Plans for dissemination of information**

- preparation of a report for the Churchill Trust
- present report to the Medical Director of PICU at Princess Margaret Hospital for Children, Perth WA.
- Seek audience and prepare a presentation for the planning committee of the new Children's Hospital
- seek discussions with Medical Director of NETS WA
- seek discussions with key personnel in WA Health Department.
- Seek guidance regarding preparing an article for publication in a suitable peer reviewed journal
- confirmed oral presentation at 2014 ASAM+ASA+FNA Aeromedical Retrieval conference in Brisbane, Sept 2014.


Closing remarks

The impetus for this study tour was to gain an international perspective on current practice in paediatric retrieval medicine and bring to the planning table some considerations for the establishment of a paediatric retrieval service in line with international best practice. Careful consideration and planning is required such that a service is established to serve not only the current needs of the health system but continue to develop and grow to meet future needs. The current construction of and planned move to a new Children's Hospital is an excellent opportunity to consider the establishment of a paediatric retrieval service. In a land of vast geographical distance and sparse population density, a well considered paediatric retrieval service will allow the expertise of the PICU to essentially be taken to the child in a timely fashion, wherever they may be. My primary motivation however in seeking a Churchill Fellowship and preparing this report, is to generate discussion around this issue such that the community of paediatric health professionals in WA may be galvanised in to action to establish what is, in my opinion, a much needed service for Western Australia. It is my belief that we can do better to 'close the gap' on equitable access to tertiary paediatric critical care for the children of Western Australia, and the establishment of a dedicated paediatric retrieval service is key to providing this.
Reference / Resource List


