SHOULD PERSONNEL WHO TRANSFER CRITICALLY ILL CHILDREN BE ON A SPECIALIST REGISTER?

A CLINICAL TOPIC REVIEW

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Introduction.

Paediatric intensive care in the United Kingdom has been centralized to 29 paediatric intensive care units (PICUs) providing 246 beds (ref.1). Some of these are in specialist centres such as neurological and neurosurgical units. This followed recommendations in 1994 by Fleming (ref.2) and organization on a regional basis is now the accepted practice; the principle is that available resources need to be concentrated to reach an acceptable level. It was also recommended in 1997 (ref.3) that adult intensive care units ("AICUs") should not continue to care for children beyond resuscitation and transfer, although it has been pointed out (ref.4) that this is without evidence of poor outcome in the UK. Centralisation has been pursued, and thus the average distance between patient and PICU has increased. Whilst the evidence from the USA would suggest that survival of the sickest children is better if they are treated in tertiary referral centres, (odds ratio 8.11, p<. 05; ref.5), transportation of critically ill children is a hazardous business (ref.6-9). The following problems arise:

A. What happens during a PICU transfer?

B. Who actually performs PICU transfers?

C. What skills are required for PICU transfers?

D. How do we ensure personnel are competent?

In 1993 it was recommended that dedicated teams should move children requiring transfer to PICU (ref.10). A postal survey of UK PICU's in 1995 (ref.11) showed that the majority of units thought that arrangements for transfer of the critically ill child were unsatisfactory. The UK is certainly behind many developed countries in the approach to this highly specialised area of medicine. It may be because the problem involves many specialities that the approach is so piece-meal and haphazard. Can we justify the expense of dedicated transport teams for critically ill children?

Method.

A three-part question was formulated.

In [paediatric patients requiring transfer] is [a specialist transfer team better than a non-specialist team] at [reducing mortality, morbidity, and transfer adverse events]?

Using Medline 1966 to June 03, Dialog DataStar interface. Limited to Human and English. Using the automatic “Children” filter, words in whole document.
[transport$] OR [transfer] OR [transfers] OR [transferring] OR [retriev$] AND [critical$] OR [critical-illness] OR [critically ADJ ill] OR [critically ADJ injured] OR [critical-injury] OR [critical ADJ care] OR [intensive ADJ care].

This produced 623 references, of which 125 addressed the issue.

Using Embase 1974 to June 03, Dialog DataStar interface, as above for Medline.

This produced an additional 2 references.

Hand search of references in each relevant article.

A. What happens during a PICU transfer?

We need to know what will probably have to be done, and what may have to be done.

We thus need to know;

1. What categories of patient are we transferring?
2. What is their clinical course likely to be?
3. What are the common transfer problems?
4. What transfer problems can we predict for this particular patient?

1. What categories of patient are we transferring?

Patients can be categorized according to either anatomical system involved or severity of illness. Each PICU should know (from audit) their case mix for both types of categorization.

Anatomical system involved.

Dean (ref.12) found neurological and respiratory illness and trauma to account for about 90% of transfers, and Henning (ref.13) found 46% to be respiratory and 43% to be neurological. A more detailed breakdown is required, as within each of these two main anatomical systems there is a wide range of either illness or injury.

In a regional PICU in the UK in one twelve month period (October 2000 to September 2001,Royal Manchester Childrens Hospital, Pendlebury, personal communication), of a total of 247 transfers by the Paediatric Emergency Transport Services (PETS) team, the breakdown was as follows.

Respiratory infection	68	27.5 %
Neurological infection	40	16.2 %
Seizures	39	15.8 %
Other respiratory problems*	26	10.5 %
Neurological trauma	23	9.3 %
Sepsis	10	4.0 %
Cardiac	9	3.6 %
Genetic	8	3.2 %
Post operative	8	3.2 %
Miscellaneous**	8	3.2 %
Metabolic	6	2.4 %
Near miss SIDS	2	0.8 %

* Includes apnoeas, near drowning, smoke inhalation, obstruction, pulmonary hypertension, asthma and failure.

** Includes hepatic encephalopathy, overdose, near hanging, unknown.

Severity of illness.

Henning (ref.13) used the Denver Patient Status Category (appendix 1) for severity of illness, and found that of 100 consecutive paediatric transfers:

21% were category 5, 6 died.

51% were category 4, 2 died.

25% were category 3, no deaths.

3% were category 2, no deaths.

These figures were thought to be similar to previous work that they had looked at. Other scoring systems include the Paediatric Risk of Mortality (PRISM) score (ref.14) and the Glasgow Meningococcal-Sepsis Prognostic Score (GMPS), (ref.15). Use of these scoring systems can be of benefit by identifying earlier those children who will benefit from transfer, for audit purposes, as a tool for obtaining funding, and more controversially for performance indicators in hospital league tables.

It has been shown that the probability of physiological deterioration during transport increases with the pre-transport severity of illness (ref.16). Those with PRISM scores >10 were more likely to deteriorate during transfer, whilst those less severely ill (PRISM <10) could safely be transferred by non-specialist teams. Other work (ref.17) confirmed this positive predictive value between high PRISM score and both PICU admission (95%) and interventions (90%), but showed low negative predictive values for both, (56% and 68% respectively). This means that an uneventful transfer could not be predicted on the basis of a low pre-transfer PRISM score.

A system of classification is also useful for predicting what equipment (for example inotropic drugs) and personnel will be required. Equipment is usually generic, and at the moment the transport team consists of whichever doctor and nurse are on duty at the time. When we are refined enough to have a choice of staff based on experience, and extra staff such as respiratory therapists and physiotherapists, the classification of patients will help to provide optimal patient care.

2. What is their clinical course likely to be?

To be able to predict the clinical course of any patient requires both theoretical knowledge and practical experience. This enables the clinician to recognize patterns of illness and subtle signs of change, either deterioration or improvement. Clinicians must be able to anticipate problems, as anticipated problems are easier to deal with. Interventions are difficult to perform in transit, and thus any procedures that may be needed for a particular patient should be performed prior to departure. A district general hospital (DGH) based paediatric junior doctor may well not have seen the severity of illness that requires PICU, or have advanced airway experience, and an anaesthetic junior may have no paediatric experience.

3.What are the common transfer problems?

To correctly categorize problems (obstacles to smooth retrieval) one must know when in the process of retrieval they arise and whether they are clinical, administrative, equipment / machine, or outside influence (such as weather and traffic). Some, indeed most, are then preventable.

Henning (ref.13) found a median of 4 problems per patient retrieved by a dedicated PETS team. The breakdown of the retrieval process identified those problems arising;

(a) During the referring telephone call (median of 1),

(b) On arrival of the PETS team (median of 2)

(c) During stabilization and transit (median of 1).

Commonly the problems related to the above groups are as follows:

(a) Airway and breathing 50%, diagnostic 23%, cardiovascular 15%, other 12%

(b) Airway and breathing 55%, cardiovascular 13%, neurological 7%, other 25%

(c) Equipment 50%, assessment 14%, cardiovascular 12%, neurological 12%, transport 12%

The problems can also be categorised as:

Preventable	Better education of the referring doctor, 24% of problems.
	Better training, organisation and protocols of PETS team, 28% of problems.

Unpreventable by either of the above methods.

Fuller (ref.18) looked retrospectively at 39 children who had been transferred into the Children's Hospital of Western Ontario. 97% of these children had airway compromise as a result of their disease process. When an anaesthetist had **not** been involved (29/39 cases) at the referring hospital 43% required intervention by the transfer team. Where an anaesthetist **had** been involved (10/39 cases) no further intervention was required. This could be interpreted as that whilst nearly all of these very sick children require advanced airway management and anaesthetic input at an early stage, it would be appropriate for a non-anaesthetist to transfer the child if they had been intubated already.

It is obvious from ref.13 and 18 that airway and breathing problems are dominant in the first 2 stages of the retrieval, and thus advanced airway skills are essential if these problems are to be resolved prior to transit. It is unfortunate that exposure to paediatric cases for anaesthetic trainees is now becoming less routine, and in some teaching hospitals and DGH's no paediatric anaesthetics are performed.

Edge (ref.6) looked at problems either as physiological (vital sign change or clinical deterioration) or intensive care-related (equipment adverse incidents). They found that with staff not specifically trained in transfer skills, there was a 20% occurrence of equipment adverse incidents (in 92 transfers) against 2% (in 45 transfers) with specialist teams ($p<0.05$).

MacNab (ref.19) showed that of the secondary insults that occurred, 8% were when a PICU resident and paediatric-trained escort accompanied the child (group III), 20% with paediatric-trained escorts alone (group II), and 72% with adult-trained escorts with or without a non-

paediatric physician (group I) accompanying the child. The average number of insults per child in each group was

Group I	1.9
Group II	0.4
Group III	0.13

This vividly demonstrates the value of training the escorts, which consisted of an 18 month course, ongoing training, and re-certification. This is far beyond any training that occurs in the UK. It must be stressed that this study did not look at outcome, but each case could be studied to draw inference as to whether there was permanent morbidity.

4.What transfer problems can we predict for this particular patient?

Henning (ref.13) also drew attention to common problems particular to common conditions, and from this more focused knowledge there can be increased awareness on the part of the PETS team, increased training in dealing with particular conditions, and guidelines or protocols.
An example of this analysis is that for children with status epilepticus, there was unrecognised need for ventilation, difficulty assessing and controlling seizures, and inappropriate size or type of endotracheal tube.

B. Who actually performs PICU transfers?

In UK studies, Dryden (ref.11) showed that staff from the referring hospital performed 60% of the estimated 800 transfers, and in the prospective study by Barry (ref.9) all the transfers were done by the referring hospital. The very fact that the children are being transferred to a place of greater skill and resources could imply that the personnel at the referring hospital, performing the transfer, are not as skilled as those at the receiving hospital. This implies a second best transfer service.

In the prospective cohort study in Malaysia by Goh (ref.8) all transfers were by non-specialist teams. There was a significant deterioration over 24 hours in the PRISM scores of those patients transferred, as opposed to an improvement in the PRISM scores in direct access arm of the trial. Although it could be argued that the transfer itself was detrimental, both Britto and Cray (ref.20-21) show no deterioration with trained personnel.

C. What skills are required for PICU transfers?

Airway and Breathing.

Virtually all children who require PICU in the UK will require intubation and ventilation, and as this is not a procedure that should be performed during transfer, all children who are transferred by a PETS team will be intubated prior to departure. This may be by orotracheal or nasotracheal tube, and each has its advantages.

The main requirements for an endotracheal tube are correct placement and secure fixation. The short paediatric trachea makes correct placement more difficult and dislodgement easier than in adults. Once it has been secured, correct placement should be confirmed by clinical examination, chest x-ray (CXR) and capnography. Bhende (ref.22-24) showed the value of continuous capnography.

Ventilation requirements are different to adult patients, and specific attention must be paid to rate, volume and pressure control, PEEP etc, and different ventilators will be required for infants than children.

The child will then need to be sedated to prevent the removal of the tube, and continuous infusion is superior to bolus administration to avoid emergence. There is an argument to also paralyse the child, to prevent involuntary movement and then ventilate appropriately.

All of this points to a requirement for paediatric anaesthetic or critical care competence.

Circulation.

As shock is a common problem that is often inadequately controlled (ref.13), an understanding of fluid resuscitation and familiarity with inotropic support is required. This is a generic skill that can be obtained through acute specialities such as emergency medicine, acute paediatrics, anaesthetics or PICU.

Disease process.

Suitable paediatric experience is required to know how and when to use appropriate pharmacological interventions such as analgesics, antibiotics, anticonvulsants, bronchodilators, diuretics, inotropes, paralytics and steroids.

In cases of trauma, more surgical experience is required to assess, recognise and treat the subtle signs of occult injury.

Equipment.

Familiarity is all-important, as there is no national standardisation. This requires exposure and training rather than presumed skill. All members of the team must be familiar with everything from cannulae to ambulances.

D How do we ensure personnel are competent?

Both Britto and Cray (ref.20 & 21) showed that a specialist PICU team could transfer children safely, and Kanter and Goh (ref.7 & 8) showed there was excess morbidity with non-specialist teams. The selection of a transfer team should be based on knowledge of what is required, in terms of skills and equipment, to safely transfer that specific child. This process begins with decision to transfer from referring hospital and ends with safe arrival in the receiving PICU. A receiving hospital transfer team may not always be available, so there needs to be a pool of qualified staff.

It is not the automatic job of any particular grade or speciality of doctor, but a skill mix that may change with each particular patient. It may be the case that more than one doctor is required for some patients, and different background training required for different illnesses or injury. Some skills are regularly called upon, (and thus considered essential), such as advanced airway management, and some less frequently, such as control of intra-cranial pressure. The level of expertise in transit should be equivalent to that of the receiving unit.

Many of the conclusions drawn by Day (ref.25) still hold true, and here have been adapted for use in the UK. The requirements can be broken down into;

Team Composition.

Possession of appropriate skills is more important than job, speciality or grade.

A flexible composition to suit the patient needs better may improve outcome.

Training and skills.

Minimum standards (e.g. Advanced Paediatric Life Support (APLS), completion of a PICU rotation, specific training in transport medicine) should be set to allow staff to qualify to transport children.

The diagnostic, cognitive and procedural skills required should be tested prior to this qualification.

Continual feedback from the team supervisor to the team should occur before, during and after transfer of a patient, with a view to error avoidance this time and making improvements next time.

Ongoing training should be regular and related to the frequency and number of transports that a team performs.

Equipment.

This is the responsibility of the receiving hospital.

It should be regularly checked and maintained.

All staff should be familiar with it and specifically trained in its use.

There should not be any unnecessary delay due to unavailability of equipment, and thus it should be dedicated for purpose.

Administration and control.

Supervision should be by a senior doctor who is expert in either paediatric critical care or paediatric emergency medicine, at the receiving hospital.

Quality assurance through rigorous audit of caseload is essential, using severity scores to predict expected outcome.

The transport team are responsible to the receiving hospital, and as soon as on-scene handover is completed, the patient is their responsibility.

Communication between the team and the supervisor should be continuous, and the responsibility of supervisor.

The NHS should provide indemnity cover.

Summary

Using criteria similar to those proposed by Woodward et al (ref.26) could we justify specialised transfer teams?

Q. Is there void in the service provision to critically ill children that is recognised by the medical profession?

A. Yes, ref. 11.

Q. Does the specialised team provide an improved level of care for the community?

A. Yes, ref. 6, 7, 9, 13, 18, 23 & 24.

Q. Is there a potential increase in requirement for transfer services?

A. Yes, ref. 2.

Q. Are there likely to be intangible benefits from instituting a transfer service?

A. Yes, ref. 27 (increase in income and improvement in staffing levels and bed availability).

Although there is good evidence of fewer adverse events and lower morbidity with dedicated paediatric transport teams, there is little evidence of improved mortality (ref.8 & 27), although Barry (ref.9) showed that the PRISM score, adverse events and mortality all rose together. A PRCT looking at mortality between specialist transfer team or not would now never get past an ethics committee, as the evidence of improved care with a specialist team is overwhelming. The profession should try to optimise the care of the critically ill child. The current financial climate is not conducive to introducing expensive dedicated teams, but in the organisation of paediatric transfer we should strive for excellence. I believe that those doctors and nurses who transfer critically ill children should be competent, and proven to be so by qualification to a specialist register.

APPENDIX 1

Denver Patient Status Categories.

Status I and II.

Infrequent monitoring, no intravenous infusion, no added oxygen.

Status III.

Frequent non-invasive monitoring of vital signs, intravenous infusion, may have moderate respiratory distress or altered conscious state.

Status IV.

Emergency, usually intubated, invasive monitoring, may need pharmacological support during transport, stabilised before transport.

Status V, unstable.

Needs ongoing therapy to maintain stability during transport, and early PETS arrival and resuscitation critical for survival.

Status VI.

Probably brain dead before transport.

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