Newborn Emergency Transport

Andrew Berry
Department of Neonatology,
Royal Alexandra Hospital for Children, Sydney

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Proceedings
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Andrew Berry FRACP
Head
Department of Neonatology,
Royal Alexandra Hospital for Children
Sydney

Clinical director
NETS (Newborn Emergency Transport Service)

Honorary medical director
Child Flight Inc.

For rural practitioners, easy access to expert advice has always been particularly relevant for the pediatric patient. "One-phone-call" should be sufficient to consult and/or activate an expert retrieval team. One in 90 newborns need retrieval in N.S.W. "NETS" retrieves the majority using road (<50km), by Child Flight helicopter (50-500km) or air ambulance (>500km).

The provision of intensive care to sick or preterm babies has been shown to improve both the chances of survival and the quality of survival. In most patient groups, such care is cost-effective, viz. the cost of providing intensive care is outweighed by the savings which accrue from the good outcomes achieved.

Facilities for neonatal intensive care (Level 3 or tertiary care) are necessarily centralised to Units which are not only appropriately equipped and staffed but can maintain an adequate quantity of care to maintain quality of service. This is generally agreed to require a "critical mass" of between 10 and 12,000 annual births in the referral area of the Unit. Such centres are restricted to large cities. Where such services are attempted in smaller centres there are distinct deficiencies in the quality or constancy of care. In 1990, there were 19 tertiary newborn intensive care centres in these cities of Australia.

There are approximately 60 relatively large hospitals with delivery rates of 1,000 to 4,000 and Level 2 neonatal facilities. The biggest group of these hospitals are in NSW and Victoria. In other states birth numbers outside the capital centres are limited to a handful of hospitals.

Level 1 hospitals comprise the largest group of hospitals in which the emphasis is on the care of the newborn. The challenge is to develop optimal strategies for dealing with the unexpected. In utero transfer to a Level 3 or 2 hospital is emphasised as the preferable strategy to emergency transport of the neonate.

Nationally, there are over 300 hospitals with maternity facilities. A few years ago there was nearly this number in NSW alone. Now only 140 hospitals are authorised to maintain
obstetric services in NSW; most of them providing Level 1 neonatal care. This contraction in numbers has been accompanied by three contemporary phenomena:

- A centripetal trend toward larger health facilities; largely cost-driven.
- Increasing community expectations of clinical outcomes for newborns; related to an increasingly informed public, reduced fecundity and a tendency to delay planned childbearing to an older maternal age.
- Increased travelling distances for maternity care and increased inconvenience for the at-risk patient.

The provision of Level 2 neonatal care is the role of most of the Base Hospitals in NSW. It depends upon obstetric, anaesthetic and paediatric expertise being available on site, nursing staff trained and experienced in Level 2 neonatal care, a certain level of equipment and a specified minimum case-load. Whilst many of these hospitals will have a neonatal respirator, its use is restricted to short-term, pre-transport mechanical ventilation. However in most of these hospitals virtually all sick or traumatised adult patients (including those needing mechanical ventilation) can be cared for in the adult intensive care. Only for patients requiring neurosurgery or with burns might transfer to the city be required. In addition, various difficulties in arranging transfer; including access to city beds, delays in obtaining transport and a flawed system of cost recovery have discouraged an appropriate threshold for in-utero transfer. Concern has been expressed that this "milieu" might lead to higher risk obstetric patients being retained for delivery in inappropriate places. It certainly has been an essential factor in the planning of emergency transport facilities for newborns. The Base hospital cannot and will not be the referral centre for Level 3 newborn patients unless country populations explode in numbers to delivery rates 5 to 10 times higher.

To offer intensive care to infants born outside the Level 3, Tertiary Unit, a streamlined system for timely and safe transfer is required. The urge to hastily transport such infants before starting intensive care should be discouraged, since infants, more so than most critical patients, tolerate transportation poorly if not appropriately prepared. The retrieval strategy involves speedy deployment of a neonatal intensive care team to the patient, stabilisation and institution of intensive care and finally the transportation phase. Employing this approach will not only reduce the chance of clinical deterioration en route but has been shown to improve the clinical condition of the baby during the trip. The message is to "take intensive care to the baby rather than take the baby to intensive care". Skilled neonatal retrieval is also known to improve morbidity and chance of survival whilst also significantly reducing duration of hospitalisation and therefore costs.

The requirements for effective newborn and paediatric transport include:

(i) A 24 hour a day telephone number giving access to perinatal advice on a direct, "one-phone-call" basis.
(ii) The right advice; at the level requested (nursing, registrar, consultant).
(iii) A readily available transport team with neonatal ICU skills.
(iv) A self-contained, mobile intensive care module.
(v) A system for rapid deployment using appropriate road and air vehicles.
(vi) Adequate patient stabilisation aiming to institute definitive intensive care and, at the very least, to minimise transport risks.
(vii) Un-interrupted provision of intensive care support en route (eg. no hand-bagging between vehicles).
(viii) Effective communication and feed-back between the 3 clinical parties; referring, receiving and transporting team.
(ix) An outreach education program; using the emergency retrieval as a foundation.
In all of this, good community liaison is vital. The “consumer” should be aware of the benefits of having the best of both worlds with referring and receiving hospitals working in a complementary manner, linked by effective newborn transport.

In NSW, NETS is a specialised service designed to make intensive care available to all sick babies, wherever they are born. The service includes expert telephone consultation, bed-location, liaison with sub-specialists and, of course, skilled and timely inter-hospital transportation.

In NSW (as in other states) there is a hotline (02/ 692.6666) for use in requesting urgent retrieval. Calls on this number are answered by a NETS nurse, registrar or consultant neonatologist. Details of the case are taken, immediate management discussed where appropriate and arrangements for deployment of the team made.

Telephone consultation is also available on the NETS “chatline” 02/ 692.6465. Referring staff wishing to discuss clinical management, make elective transfer arrangements or identify which Neonatal Units have beds available should call on this number.

NETS provides a retrieval team and a self-contained mobile system emulating the “Level 3 ventilator bed”. Each system comprises an adapted incubator with facilities for controlled and humidified oxygen administration, mechanical ventilation, parenteral fluid and drug administration and monitoring of a number of physiological parameters. Each retrieval team consists of a NETS clinical nurse specialist and a neonatal retrieval registrar. Neither staff member has competing duties which might delay a response to calls and are specifically trained for retrieval. Registrars rotate to NETS for 3 months at a time from the paediatric training program.

Babies can be transported to any of the 8 designated neonatal intensive care units in NSW or to Canberra; according to the request of the referring doctor and bed availability. Long distance retrievals are available.

NETS has access to three major methods of transport; a road ambulance, the ‘Child Flight’ helicopter or pressurised fixed-wing air ambulance. The choice of vehicle will depend upon travelling distance, clinical urgency and availability of NETS teams. Child Flight is used between outer Sydney and about 500km road distance. This includes Bega, Wagga, Dubbo and Coffs Harbour. Outside that range, fixed wing air ambulance is used. At present the use of the Child Flight helicopter over fixed wing ambulance suffers a charging premium although the actual costs of the aircraft are both around $7 per kilometre. Child Flight and the air ambulance can accommodate two NETS systems; for twins or the transport of other multiple patients.

A rapid response time offers earlier emergency care and/or transport at an earlier time. In either case, since the decision to use a particular mode of transport may precede an unexpected deterioration, it is recommended to err on the side of rapid response in cases of doubt.

Response time depends not only on outbound travel time but more particularly on the time to mobilise the team, equipment and vehicle. A list is available with response times for individual hospitals as collected from actual experience. Broadly speaking, NETS can have a team on its way in 45-60 minutes (by road), 20-30 minutes (by Child Flight helicopter) and 2 hours (by fixed wing). Adding travel time to this gives country centres an expectation (depending on distance) of 1 to 3 hours for Child Flight and 3 to 6 hours for fixed wing air ambulance.
There are two NETS teams available at any time. On average, one is out at any one time and frequently both are out. If necessary, a third team can usually be mobilised. However the main factor affecting team availability is the length of time spent on individual retrievals. Each unnecessarily lengthy retrieval ties up retrieval staff, reducing the chance that a team will be available when another urgent request is received.

**Foetal transfer**

Despite the sophistication of neonatal retrieval, the ideal time for transfer is before birth, when both mother and foetus can be moved. Advice about marginal cases should be sought from a perinatal adviser who can be contacted through NETS or the regional perinatal centre. Even if there is difficulty allocating a neonatal intensive care bed to the foetus after birth, it is still preferable for the birth to be in a perinatal centre rather than a district or base hospital. If subsequent neonatal transfer is required, the infant will have benefited from birth in a Level 3 environment.

**Which infants should be transported?**

Infants requiring skills or facilities not available at the hospital of birth will need transfer to a larger centre. The decision about transfer will be influenced by factors which might be variable such as the availability of appropriate staffing and supervision. Considering how often neonatal problems are progressive, the timing of transfer is often just as critical the decision itself. There are suggestions that referrals are more often late than early; often through a natural concern not to make transfers or “waste” a NETS team unnecessarily. There should be a small but significant “false positive” rate of retrieval requests to achieve a negligible “false negative” rate. The concern is that the opposite is true of current referrals.

Broad clinical guidelines and indications for transfer are as listed. For most of these patients, retrieval will be appropriate. Some will be adequately transported with an escort from the referring hospital or air ambulance flight nurse. NETS can assist in making this decision.

1. Low birth weight infants (< 2500g); especially < 1800g should be in Level 2 neonatal nurseries with facilities for oxygen therapy, intravenous access, cardio-respiratory monitoring and blood gases. Specialist paediatric medical and nursing staff should be available.

2. Very low birth weight infants (< 1500g) should (at least initially) be nursed in Level 3 neonatal nurseries with 24 hour medical care on site and ready access to mechanical ventilation.

3. Infants with respiratory distress of early-onset, rapid in progression or persisting beyond 5-6 hours.

4. Babies requiring more than FiO2 for more than 2 hours should be monitored with regular blood gases as well as skin oxygen or saturation monitoring. If this is not feasible, transfer should be considered.

5. Respiratory distress associated with aspiration of meconium follows an unpredictable course and therefore should be referred early.

6. Infants with cyanosis persisting despite oxygen therapy.

7. Infants who become unwell after initially being well in the hours following birth.
8. Infants with depression following perinatal asphyxia. Scoring an "Apgar" at the time of assessment for transfer can be helpful in asphyxia and any other condition. A "score" of less than 8 should be considered for transfer.

9. Unwell infants with shock, lethargy, poor feeding, weak cry, cyanosis or vomiting.

10. Infants with apnoea or seizures.

11. Infants with bleeding from any site.

12. Infants who may require exchange transfusion for jaundice.

13. The infant of a diabetic mother.


15. Heart failure or arrhythmia.

16. Infants requiring special diagnostic and/or therapeutic services.

**What to do whilst awaiting transport?**

For babies with respiratory distress (and most importantly in diaphragmatic hernia) or bowel obstruction, place a gastric venting tube (FG8). Nurse the baby prone or decubitus (left side up) and minimise handling. Babies requiring oxygen should have it via a head-box oxygen delivery system.4

A saturation monitor is useful for larger babies but a transcutaneous oxygen monitor is preferred for smaller babies (< 1500g) who may be put at risk by hyperoxaemia. Babies outside the neonatal period may be more easily monitored using a saturation pulse oximeter. Keep the F2 high enough to maintain a pink colour, saturation > 90% or skin oxygen above 60 mmHg at all times. Gently suction the mouth to remove major secretions. A disposable short Y sucker (FG12) is recommended.

Maintain the baby’s temperature around 36.5 (skin). The recommended incubator temperature for normal birth weight infants is 31°C ranging to 37°C for the smallest infants (< 1000g). Smaller babies may benefit from Webril or Velband tape around the limbs and head. If using a open incubator or "resuscitaire" with radiant heater, do not interpose any insulation foil between the heater and baby. Difficulty warming a baby may indicate poor perfusion and require improved tissue oxygenation.

Check the blood sugar using a strip. Correct hypoglycaemia with IV D10W (10% glucose) at 5ml/kg followed by an infusion at the maintenance fluid rate. A guide to fluid rates based on the day of age is as follows:

<table>
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<tr>
<th>Days of age</th>
<th>Weight</th>
<th>Fluid rate</th>
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<tbody>
<tr>
<td></td>
<td>1 kg</td>
<td>4 ml/kg/hour</td>
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<td></td>
<td>2 kg</td>
<td>5 ml/kg/hour</td>
</tr>
<tr>
<td></td>
<td>3 kg</td>
<td>5 ml/kg/hour</td>
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</tbody>
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Place an IV in a peripheral vein or umbilical vein for management of fluids, dextrose or electrolyte problems. In summary, keep the baby pink, warm and sweet.
What should the referring hospital provide?

Referring staff are asked to provide:

1. NETS Perinatal Transfer form (completed with consent for transfer and treatment obtained and signed)
2. Copies of relevant letters, charts and results.
3. Original x-rays
4. Maternal blood (10ml in a “clotted” tube)
5. Cord blood (if available; 10ml in a “clotted” tube)
6. Placenta (if available)

Give the parents access to the baby while awaiting NETS. No matter how sick or abnormal the baby, the parents should have the opportunity to see and touch the baby. Some parents may choose not to do so and the taking of photographs by the staff may subsequently be very much appreciated.

What does the NETS team do in your hospital?

The team will introduce themselves and ask clinical questions; including progress since the referral call. The retrieval system will be parked alongside the baby’s incubator and connected to mains power, oxygen and medical air (where available). The team and your doctor will assess the baby’s need for further treatment prior to transfer and discuss their plan with the accepting consultant and your staff. If intubation is required, they will normally wish to move the baby onto an open radiant system for the procedure. A large procedure trolley, a bin and sharps container should be handy. Usually, a blood gas (where available) and x-ray will be performed prior to about half-way through the stabilisation. It may save time for you to call your radiographer and technical officer ahead of time. Depending on the wishes of the mother and her medical condition, it may be possible for her to be transferred with the baby. Whether this happens with the NETS team or separately in another vehicle depends on space restrictions in the ambulance. The NETS team can discuss this with referring staff and the parents. Otherwise, the parents can travel at another appropriate time to be re-united with their baby. Most intensive care nurseries have parent accommodation facilities attached or nearby. Contact the admitting NICU for details about availability.

What happens after NETS leaves?

The team will transport the infant to the selected admission hospital and then contact staff of the referring hospital following the baby’s admission. Naturally, parents are distressed at this time and support from family and friends should be facilitated. They will be given a booklet by the NETS team which encourages them to maintain telephone contact with the admitting unit staff and to visit as soon as possible. As soon as the baby can be cared for in the referring hospital again and it is safe and practical to move the baby, it might be possible to arrange for transfer back. The intensive care staff will liaise with the referring physician, referring hospital staff and the parents about this possibility.

Liaison

Successful infant transport depends on good liaison between NETS, referring doctors, nurses and hospitals and the receiving Units. Outreach education workshops can be arranged for nursing staff and medical staff can attend a refresher week with NETS in Sydney.
Feedback

NETS welcomes feedback about the service and seeks suggestions for improvement in the Service to better provide for the needs of patients.

References

1. Above 1,000g birthweight there is a clear cut cost-benefit but not under 1,000g where costs exceed financial benefit

2. Adelaide – 2, Brisbane – 2, Melbourne – 4, Newcastle – 1, Perth – 2, Sydney – 7, (Canberra – 1), (Hobart – 1), (Townsville – 1).

3. Newborn Paediatric
   Qld (Brisbane) (07/ 840.8111 RCH: 07/ 253.8111)
   Townsville (0777/ 73.0245)
   Victoria (NETS) (03/ 347.7441 PETS: 03/ 345.5522)
   S.A. (08/ 332.4612 ACH: 08/ 367.7000)
   W.A. (09/ 340.2222 PMH: 09/ 382.8222)

   Combined newborn and paediatric
   Hunter region (NSW) (049/ 24.3000
   POWCH (NSW) (02/ 399.4444)

4. Oxygen and Air at a combined flow of 8-10 L/min through a heated humidifier and headbox.