Cost-effectiveness and choice of infant transport systems

Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Three infant transport systems were examined.

1. Emergency medical technicians team (EMT), where two members are always deployed on transport and one of them is trained on infant transport. Priority is given to infant transport, but team members also provide non-infant transport.

2. Registered nurses team (RN), where two trained members are usually deployed on transport, but only one may be deployed for uncomplicated cases. The team members have hospital duties between transports.

3. Combined teams (CT), comprising a RN and a respiratory therapist who are trained in infant transport. Both members are usually deployed on transport, but only one may be deployed for uncomplicated cases. The team members have hospital duties between transports.

Type of intervention
Other: infant transportation system.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised all out-born infants requiring transportation.

Setting
The setting was secondary care. The economic study was carried out in regional Canadian Neonatal Network neonatal intensive care units (NICUs).

Dates to which data relate
The effectiveness data were gathered between January 1996 and October 1997. The resource use was estimated during April 1994 to March 1995. The price year was 1995.

Source of effectiveness data
The effectiveness evidence was derived from a single study.

Link between effectiveness and cost data
The costing was carried out prospectively on a sample of patients different from that used in the effectiveness study.

Study sample
Power calculations to determine the sample size were not performed. Of an eligible sample of 3,015 infants, the final sample included 1,931 patients (64%). A total of 1,084 infants (36%) were excluded from the study. Of these, 848 (28%) were excluded due to the fact that the transport team failed to recruit them into the study, while 236 (8%) were excluded due to incomplete information. The excluded and included infant groups were similar, but the excluded infants had marginally higher mean birth weight and gestational age.

Three study groups were considered. There were 433 patients in the EMT group, 195 in the RN group and 1,303 in the CT group. In the EMT group, the birth weight was 2,397 g (+/- 1,704), the gestational age was 34.6 (+/- 4.8) weeks and 58% were male. In the RN group, the birth weight was 2,562 g (+/- 1,109), the gestational age was 34.8 (+/- 4.7) weeks and 59% were male. In the CT group, the birth weight was 2,624 g (+/- 1,033), the gestational age was 35.6 (+/- 4.8) weeks and 61% were male.

Study design
This was a prospective, multi-centre, case-control study that involved eleven regional Neonatal Network NICUs in Canada. The method of allocating the patients to the study groups was not reported. The patients were followed until discharge from the hospital. No loss to follow-up was reported. The transport team personnel were unaware of the study hypothesis.

Analysis of effectiveness
All patients included in the study were accounted for in the analysis. The primary health outcome estimated in the effectiveness analysis was the change in Transport Risk Index of Psychologic Stability (TRIPS). This was calculated as the difference in infant status before and after transport, on the basis of four empirically weighted patient parameters. The parameters were temperature, blood pressure, respiratory distress/pulse oximetry and response to noxious stimuli. These were assessed by transport members immediately after arrival at the referring hospital and immediately after arrival at the destination hospital. The TRIPS score ranged from 0 to 65, with a low value indicating poor psychological status. A regression analysis was then conducted to assess whether the observed change in TRIPS was affected by the type of transport, after adjusting for case-mix, mode of transport, duration of transport and transport team characteristics. The study groups were somewhat different at baseline. Children transported by the EMT team were the smallest, had the lowest Apgar scores, the highest percentage of air transports, and the longest distance and duration of transport. Infants transported by the RN team had the highest percentage of treatment with antenatal corticosteroids, shorter distance and duration of transport, and the least number of air transports.

Effectiveness results
The mean pre-transport TRIPS score was 7.6 (+/- 12.1) in the EMT group, 6.7 (+/- 9.9) in the CT group, and 9.8 (+/- 11.2) in the RN group, (p<0.01).

The mean post-transport TRIPS score was 5.5 (+/- 9.3) in the EMT group, 5.8 (+/- 9) in the CT group, and 6.9 (+/- 9.5) in the RN group, (p>0.05, not significant).

The change in TRIPS score (post-transport minus pre-transport) was -1.5 (+/- 6.9) in the EMT group, -0.8 (+/- 7.2) in the CT group, and -3 (+/- 8.8) in the RN group, (p<0.01).

The main result of the regression analysis was that the type of team did not affect the change in TRIPS. The independent predictive variables were a gestational age at transport of less than 28 weeks, the duration of transport, and the pre-transport TRIPS. The remaining variables had no impact on the study results.

Clinical conclusions
The outcomes of the three transport systems were not significantly different. Therefore, the clinical conclusion was that the three infant transport systems were similar in terms of their effectiveness.
Modelling
A decision analysis based on a deterministic tree was conducted to assess the costs of the three transport systems. Each transport could be forward to the NICU or backward to a community hospital. Transport was by air or ground, and might or might not be accompanied by a physician.

Measure of benefits used in the economic analysis
No benefit measure was used in the economic analysis as the health outcomes were similar in the study groups. A cost-minimisation analysis was therefore conducted. However, the authors also performed a cost-effectiveness analysis using the change in TRIPS score as the benefit measure.

Direct costs
A 3% discount rate was used to calculate the annualised costs, although the costs were estimated over a one-year period. The unit costs were reported separately for many of the cost items included in the analysis. The health services considered in the economic evaluation were personnel and training costs. The cost/resource boundary adopted in the analysis was that of the Canadian third-party payer. The quantities and unit costs were estimated using actual data from April 1994 to March 1995 in the province of British Columbia. Several assumptions were made to populate the decision model. In particular, most of the inputs used in the decision model were derived from the relevant coefficients obtained from the regression analysis (effectiveness study). The price year was 1995.

Statistical analysis of costs
The costs were treated deterministically in the base-case.

Indirect Costs
The indirect costs were not included in the analysis.

Currency
Canadian dollars (Can$). The conversion rate of Can$ into US dollars was Can$1 = US$0.70.

Sensitivity analysis
Univariate sensitivity analyses were conducted only on the cost estimates. The model inputs varied were the number of annual transports, the ratio of RNs to EMT wages, percentage of waiting time dedicated to infant transports, discount rate, proportion of transport by air, proportion of ground transports with ambulance crew released during stabilisation, proportion of retro-transport, average duration of transports, average retention period of transport trained EMT crew, and assumption of training costs equal for all teams. A threshold analysis was carried out to identify the values of the variables at which the least costly strategy changed. The authors also tested the costs of the systems under the assumptions that both RN and CT team were transport-dedicated, that is, team members did not have hospital duties between transports.

Estimated benefits used in the economic analysis
See the 'Effectiveness Results' section.

Cost results
The total costs were Can$1,138,397 in the EMT group, Can$1,053,225 in the RN group, and Can$1,088,679 in the CT group.

The RN transport system was the cheapest method. The excess costs over RN were Can$85,172 (8%) for EMT and Can$35,454 (3%) for CT.
Under the assumption of no hospital duties between transports, the overall costs were Can$1,523,867 in the RN group. The excess cost over the basic RN model was Can$470,642, which is 45%. The corresponding overall costs in the CT group were Can$1,538,910, with Can$485,685 excess costs over the basic CT model (46%).

The RN model remained the cheapest strategy under most of the assumptions made in the decision model. However, the EMT model became the least costly option when the following variables were varied: the number of annual transports, ratio of RN to EMT wages, percentage of waiting time dedicated to infant transports, proportion of transports by air, and average duration of transports. The authors reported the threshold values at which the study results changed.

Synthesis of costs and benefits
The primary analysis was a cost-minimisation analysis, but a secondary analysis was conducted in which the authors calculated a cost-effectiveness ratio. This basically confirmed the findings of the primary analysis, as the most cost-effective strategy was the RN system, with a cost per TRIPS score per infant of Can$109.

Authors' conclusions
The effectiveness of the infant transport outcome was not affected by the method of transport. Consequently, all three transport methods were equally effective. On the cost side of the analysis, the registered nurses team (RN) was the cheapest approach for infant transportation. This finding was fairly robust, although the threshold analysis showed the critical values at which the emergency medical technicians team (EMT) could become cost-effective.

CRD COMMENTARY - Selection of comparators
The three infant transport systems were selected as all of them represented widely used interventions in Canada. You should decide whether they are valid comparators in your own setting.

Validity of estimate of measure of effectiveness
The analysis of effectiveness used a prospective case-control study, which was appropriate for the study question. The study sample was unselected, and is therefore likely to have been representative of the general population of infants requiring transfer to a NICU. A standard regression analysis was conducted to assess the impact of several factors on the estimated outcome. However, there were some factors affecting the internal validity of the analysis. The study sample was not comparable at baseline. The method of allocating the patients to the study groups was not reported and power calculations were not performed. About 36% of the eligible children were not included in the study, although the infant characteristics of those excluded were similar to those of patients considered in the study. Finally, the authors noted that selection bias could not be excluded as different institutions may choose different transport systems because a particular system is perceived to work better in that particular setting.

Validity of estimate of measure of benefit
No summary benefit measure was used in the main economic analysis as a cost-minimisation analysis was conducted. However, the authors carried out a secondary analysis combining the costs and benefits.

Validity of estimate of costs
The perspective adopted in the study was stated. It would appear that all the relevant categories of costs were included in the analysis. The unit costs and the quantities of resources were reported separately. A detailed breakdown of the costs and assumptions was given. The price year was reported, thus simplifying reflation exercises to other settings. The sources of the cost and resource use data were specified. The authors discussed the implications of different assumption in the cost analysis. The cost estimates were specific to the study setting. The costs were treated deterministically in the decision model, but several sensitivity analyses were conducted.
Other issues
The study findings were not compared with those from other studies. The authors discussed the issue of the
generalisability of the study results to other settings. In particular, although the cost data were derived from local
estimations, the sensitivity analyses illustrated the impact of each cost category on the estimated costs of the transport
systems. The overall external validity of the analysis appears to be high as the analysis of the cost data was clearly
reported. The study enrolled a sample of newborns requiring transfer to a NICU, and this was reflected in the
conclusions of the analysis. The authors reported the study results in detail and discussed some potential limitations of
their analysis.

Implications of the study
The main implication of the analysis was that all estimated infant transport systems provided services that conformed to
Canadian guidelines, thus leading to a lack of statistically significant differences in outcome among the three transport
approaches. The current practice of not including a physician on most infant transportation appears valid, as the
presence of a physician did not affect the effectiveness outcome. Emphasis should, therefore, be on the costs, namely
the relative wages of transport personnel and the productivity of ambulance teams.

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