ORIGINAL ARTICLE

Effect of a centralised transfer service on characteristics of inter-hospital neonatal transfers

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Objective: To determine the effect of a centralised neonatal transfer service on numbers of neonatal transfers and the time taken for teams to reach the baby.
Design: Prospective census of neonatal inter-hospital transfers between May and July 2004. Comparison with a previous census undertaken before introduction of the service. Analysis of requests for antenatal in-utero transfer to the regional emergency bed service.
Setting: Geographically defined area in London and southeast England.
Patients: Babies transferred to or from a neonatal unit.
Interventions: Introduction of a centralised neonatal transfer service.
Main outcome measures: Numbers of transfers, time taken for teams to arrive to the baby (response time).
Results: During the census there were 835 transfers with an increase of 34% from the previous census (n = 619). Most of the increase was in urgent transfers for neonatal intensive care. There was a mean of 4.4 urgent transfers a day, with 3.9 elective and 0.8 short-term transfers. Over the same period in-utero transfers decreased. Response times improved from a median of 2 h in 2001 to 1.45 h in 2004 ($p<0.05$). The 90th centile fell from 6 h to 4.9 h.
Conclusion: Following the introduction of a centralised neonatal transfer service, response times improved significantly. An increase in the numbers of transfers for medical intensive care was associated with a reduced number of in-utero transfers. To balance the improved safety and accessibility of neonatal transfer, similar developments may be needed to facilitate in-utero transfer.

Neonatal transport in the UK has traditionally been the responsibility of individual neonatal units and local ambulance services, with sick newborn babies retrieved by regional neonatal intensive care units for more than 30 years. In the past decade, specialised neonatal transfer teams have developed, following the example of successful services in Australia, France and North America. Such teams cater for many hospitals and their development is being driven by recommendations for neonatal network development within the UK.[1]

Centralised services have advantages in terms of equipment standardisation, development of specialist skills and co-location of ambulance and clinical personnel. However, there is concern that centralisation could produce longer response times, especially in a congested urban setting.

In a previous census of neonatal transfers in a geographically defined area in London and the southeast of England, we detailed the numbers of transfers of babies between neonatal units, their reasons and the time delays incurred.[2] Since that study, the area has introduced a centralised neonatal transfer service consisting of four teams serving 53 hospitals. The service employs dedicated clinical and ambulance staff with specialised vehicles and equipment to support neonatal intensive care. The present study repeats the previous census and describes the changes in numbers and types of transfer that have taken place, and the effect of the service on response times.

METHOD

For the present census, we used voluntary reporting of transfers of babies in or out of neonatal units in hospitals in the former Thames regions, a contiguous area of southeast England consisting of London, Kent, Surrey, Sussex, south Essex and Hertfordshire. This geographical area was included to allow comparison with the previous census in 2001, using an identical data collection process.[2] A total of 53 hospitals were approached, of which 45 were able to directly provide full data (see appendix 1 for the list of hospitals). The period covered by the census was from 1 May to 31 July 2004 (92 days). The study was approved by the clinical governance committee of the service.

We defined neonatal transfers as transfers to or from a neonatal unit, as this identifies a group of babies with similar clinical needs more effectively than a simple postnatal age cut-off.

Census forms were sent to senior staff on each neonatal unit, and they were requested to complete the forms as close as possible to the time of the transfer. Staff classified the transfer as urgent (first transfer of a baby for intensive or specialist care), elective (mainly babies returning to their local hospital after such treatment) or short-term (babies transferred for specialist opinion or day case treatment, generally returning the same day). Any ambiguous cases were clarified with the reporting unit. Transfers both in and out of the unit were recorded to give a greater chance of capturing all transfers. The data from the source and destination units were then matched to avoid double counting, and there were no ambiguous cases in this matching process.

Anonymised data included source and destination hospital, reason for transfer, gestation, birthweight, date and time of transfer (including time requested, time team despatched, time team arrived to the baby, time baby arrived in destination hospital), staff and vehicles used. Response time was defined as time from the first call requesting the transfer, to the team or ambulance being with the baby. For babies being moved by the referring hospital, the response time was recorded as the time taken for an ambulance to reach the referring hospital. Data

were compared with the previous 2001 census. In the 2004 census, the London Neonatal Transfer Team was able to distinguish calls in which the team was immediately available from calls in which the team was occupied and had to stack the call. Response times were compared for these types of calls. The Mann–Whitney U test was used for time comparisons as the data had a skewed distribution.

Details of numbers of births in the study area were obtained from published data of the Office for National Statistics,[3] specifically excluding births in districts outside the census area.[4] To provide an external validation, the London Ambulance Service provided logs of calls in which a vehicle from their neonatal vehicle fleet was requested, in addition to those calls taken by the Neonatal Transfer Service. These logs were matched against the census data to determine the number of transfers in this area which had been missed by the census.

Service characteristics

In 2001, individual hospitals provided neonatal transfers, generally using ambulances from their local ambulance service. The Neonatal Transfer Service began operation in 2003, reaching the current level of service provision by March 2004. It consisted of a 24-hour emergency team in London and four partial teams with a daytime service in Kent, Surrey and Sussex. Initial predictions envisaged a second team in London, which has not yet been funded. Consequently, the service concentrates on emergency transfers and sometimes has to stack or refuse calls. The service has a central contact telephone number through which the referring hospital requests transfer and if necessary, cot finding. Following this, the Neonatal Transfer Service despatches a fully staffed team with its own incubator and ambulance to the baby and finds a cot in an appropriate neonatal unit. If no cot is identified at the time of the call, the team will despatch to the baby, with cot-finding taking place during the course of the journey and during the stabilisation process.

The emergency bed service provides cot-finding for antenatal in-utero transfers within the study area. It provides a list of hospitals with neonatal cots to the duty obstetrician in the referring hospital, who then has to confirm the transfer with both the neonatal unit and the labour ward in the receiving hospital. The service provided us the numbers of requests per month for antenatal transfers together with the numbers which translated into antenatal transfer between January 1997 and December 2004. Numbers of requests and transfers were correlated against time during the period before and after introduction of the Neonatal Transfer Service. We then analysed the total numbers of antenatal and postnatal requests over this period for evidence of seasonality.

RESULTS

Numbers of transfers

During the census period in 2004 there were a total of 835 transfers. Table 1 shows the daily and annual equivalents in comparison with the 2001 census. There was an increase in the number of urgent transfers from a daily mean of 2.7 transfers in 2001 to 4.4 transfers in 2004. During the year 2004, there were 192 178 births in the study area (fig 1), comprising 30% of the births in England and Wales. The number of transfers of all categories represents a rate of 17.2/1000 live births, with urgent transfers responsible for 8.3/1000 live births.

The increase in transfers since the original census was mainly in numbers of urgent neonatal intensive care transfers, which became the commonest reason for neonatal transfer. In 2004, 155 babies were transferred for neonatal intensive care (compared with 84 in 2001), 124 were transferred for surgery, 70 were transferred to neonatal cardiology services, and 17 were transferred to neurological or cerebral cooling services. Of the elective transfers, 93% were babies returning to their local hospital following specialist care.

Table 1 Numbers of transfers in or out of hospitals in the study area during the neonatal transfer census periods of 2001 and 2004

	All transfers	Urgent	Elective	Short-term
Numbers of transfers during the census period				
May–July 2004	835	401 (48%)	360 (43%)	74 (9%)
Jan–Mar 2001	619	241 (39%)	314 (51%)	64 (10%)
Mean daily number (range)				
May–July 2004	9.1 (0–17)	4.4 (0–10)	3.9 (0–11)	0.8 (0–3)
Jan–Mar 2001	6.9 (0–14)	2.7 (0–8)	3.5 (0–11)	0.7 (0–4)
Annual equivalent numbers of transfers				
May–July 2004	3313	1591	1428	294
Jan–Mar 2001	2510	977	1273	260

The census periods covered three months; the daily and annual equivalent numbers of transfers are shown. Between 2001 and 2004 there has been an increase in the number of transfers, principally in the number of urgent transfers, which have also increased as a percentage of the total transfers.

After the introduction of the Neonatal Transfer Service, 64% of emergency transfers were carried out by dedicated neonatal transfer teams and another 10% by specialised paediatric intensive care teams (table 2). Only 5% of emergency transfers were carried out by the traditional method of the destination unit retrieving the baby. However, a large proportion of elective and short-term transfers were still being carried out by the hospital from which the baby was being transferred.

Validation of data

The census identified 708 transfers in or out of London Ambulance Service area hospitals during May–July 2004. The call logs identified 129 "neonatal" calls in addition to the work carried out by the Neonatal Transfer Service during the census period, of which 111 resulted in patient transfers.

Only 25 neonatal transfers identified from the London Ambulance Service logs had not been recorded by the census, of which 11 were between neonatal units, with the remainder involving transfers between neonatal and paediatric specialist wards. Inclusion of these 25 transfers would have increased the recorded transfers in London by 3.5%, or total transfer numbers by 3%. To allow comparison with the previous census, these transfers were not included in further analyses.

Only seven emergency transfers originated from hospitals outside the census area, and only 14 elective return journeys

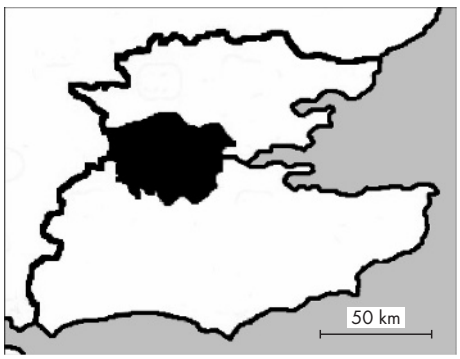

Figure 1 Map of the census area, with the London health authorities shown in black and the surrounding counties outlined. Within this geographically compact area, there are in excess of 190 000 births annually, which constitute 30% of the total in England and Wales.

Table 2 Breakdown of transfers by type of team carrying out the transfer during the census period. Data are n (%)

Transfer team	All transfers (n = 796)	Emergency (n = 382)	Elective (n = 346)	Short-term (n = 68)
Neonatal transfer team	369 (46)	245 (64)	108 (31)	16 (24)
Paediatric transfer team	45 (6)	39 (10)	6 (2)	0 (0)
Source hospital	299 (38)	76 (20)	171 (49)	52 (76)
Destination hospital	73 (9)	19 (5)	54 (16)	0 (0)
Other	10 (1)	3 (1)	7 (2)	0 (0)

For 39 transfers, the team performing the transfer had not been recorded on the census forms.

took babies back to hospitals outside the census area. As these numbers are small and are almost exactly offset by the numbers of missed cases, they have not been taken into account when calculating the numbers of transfers/1000 live births.

Time for teams to reach patients

Between the two census periods there was a significant reduction in the delay between the need for transfer being identified and the retrieval team reaching the baby, from a median of 2.0 h in 2001 to 1.45 h in 2004 (table 3, $p<0.05$). The 2004 figure includes transfers carried out available centralised transfer teams, stacked calls and transfers by local hospitals, whereas the 2001 figure represents transfer by local teams from referring and receiving hospitals. For an available London Neonatal Transfer Service team, the 90th centile for reaching a baby had fallen from 6 h before the availability of dedicated neonatal teams in the 2001 census to 2.8 h in 2004. However, for stacked calls, response times in 2004 were just as long as in the 2001 census.

Antenatal transfers

From 1997 to 2002 there was a steady increase in the number of requests and the actual number of completed antenatal transfers (fig 2). Regression against time showed a significant upward trend in the number of requests ($r = 0.79$, $p<0.001$) and in the number of transfers ($r = 0.80$, $p<0.01$). Following introduction of the Neonatal Transfer Service in 2003, there was a non-significant downward trend in requests ($r = 0.31$, $p = 0.14$) and a significant downward trend in the number of antenatal transfers ($r = -0.60$, $p<0.01$).

Total antenatal and postnatal requests in these years did not show any quarterly seasonal effects ($F = 1.06$, NS). There was minimal difference in the mean number of transfers a month in January–March (106 a month) compared with May–July (102 a month). For individual months, December was the busiest month (seasonal factor 142%) with February being the quietest month (seasonal factor 84%).

DISCUSSION

This study describes the effect of introducing a centralised neonatal transfer service between several hospitals in a densely populated area generating 30% of the live births in England and Wales. Introduction of the service was associated with shorter response times to reach the baby than with the previous services delivered locally by each hospital. Despite longer distances from a centralised base, dedicated transfer teams are able to leave on a call immediately, especially where there is integrated clinical and ambulance provision. This avoids the need to assemble a team from existing hospital staff together with an ambulance before the team can be despatched to the baby.

Table 3 Median and 90th centile for response times to emergency transfers in the 2001 and the 2004 census

Year of census	Median response time (hours)	90th centile response time (hours)
All emergency transfers		
2001	2.0	6
2004	1.45	4.9
London Transfer Team in 2004		
Team available	1.2	2.8
Stacked calls	2.3	5.3

Response time was the time taken from a transfer being requested to a team and its ambulance arriving to the baby. There was a significant reduction in the delay between the need for transfer being identified and the retrieval team reaching the baby ($p<0.05$). In 2004, response times for the London Neonatal Transfer Service were significantly longer when the team was engaged on another call at the time of referral and had to stack the call ($p<0.01$).

If anything, improvements from the viewpoint of the referring hospital and baby were underestimated. In the previous study, we counted delays only from the time at which a destination cot had been identified, but in the current census, delays were counted from the time at which transfer and cot finding were first requested, often before a destination hospital had been identified. At this stage of its development, the service did not have the resources to respond immediately to all calls. It was disappointing that when calls were stacked, delays were just as long as those which occurred before the introduction of the service. Following the introduction of the service it appeared that few tertiary centres carried out traditional retrievals, with most simultaneous calls resulting either in calls being stacked or transfers being performed by the referring hospital.

Between the two study periods there was an increase in numbers of postnatal transfers. Although the census periods covered different months of the year, data from the emergency bed service did not show a quarterly seasonality. If anything, there were marginally fewer requests for transfer during May–July compared with January–March (102 *v* 106 a month). The difference in the numbers of transfers cannot therefore be attributed to seasonal differences. Comparison with external ambulance service data shows over 98% capture of transfers in the 2001 census and over 96% capture in the current study, so the increase in transfers cannot be attributed to differences in reporting between the census periods.

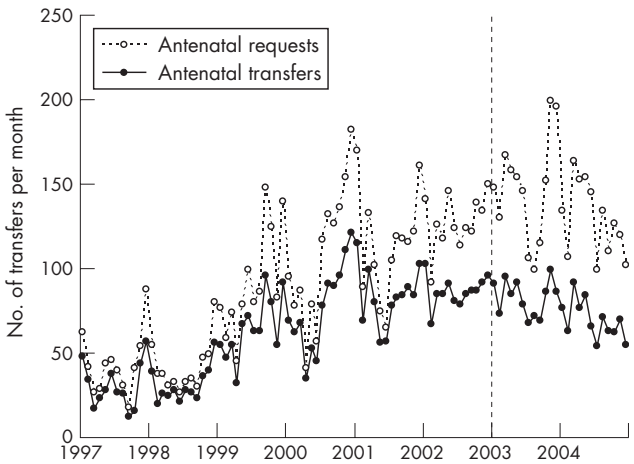

Figure 2 Numbers of requests per month to the Emergency Bed Service for antenatal in-utero transfers and the number of completed antenatal transfers.

What is already known on this topic

- Centralised neonatal transfer services have been operating in Australia, North America and Europe for many decades and are now being introduced as part of the movement towards integrated neonatal networks in the UK.
- The effect of centralisation on response times and numbers of transfers needs to be assessed.

What this study adds

- Response times improved following the introduction of the centralised service, but numbers of transfers also increased from 8.3 to 17.2 transfers/1000 live births.
- This was accompanied by a reduction in antenatal in-utero transfers; systems to facilitate antenatal transfer may be required to balance improved access to neonatal transfer services.

The current rate of transfer of all categories represents a rate of 17.2/1000 live births, with urgent transfers responsible for 8.3/1000 live births. The increase in transfers since the previous census may be related to an increased recognition of the need for transfer with the development of neonatal networks and the agreed designation of neonatal units within networks. The presence of an organised transfer service may also make appropriate transfers easier to organise.

However, it is also possible that easily accessed postnatal transfer services are contributing to a shift from in-utero to postnatal transfer, especially if antenatal transfer is becoming more difficult. Increasing requests to the emergency bed service for assistance with in-utero transfer during the past decade reflect problems in locating neonatal cots in hospitals that also have vacant labour ward capacity. In the past, problems were mainly one of neonatal cot shortages,[5] but it appears that labour ward capacity is also contributing to these problems (G Hayter, personal communication, 2006). With increasing emphasis on continuity of care for local women,[6] labour wards may be less able to cope with referrals from outside their normal catchment area. The reduction in successful antenatal transfers since introduction of the transfer may represent staff abandoning the demoralising and time-consuming process of arranging an in-utero transfer, in the knowledge that a single postnatal request to the transfer service is likely to result in a successful neonatal transfer.

Antenatal in-utero transfer remains the method of choice for threatened delivery of an extremely preterm baby. No matter how well equipped, postnatal transfer represents a physiological challenge that is best avoided. In certain specific circumstances, postnatal transfer may be preferable because a mother is too sick to be moved, or because the fetus requires immediate delivery. Where neonatal cots are available without co-located labour ward capacity, postnatal transfer of the more mature baby may avoid extremely long distance in-utero transfers.[7] However, to facilitate appropriate in-utero transfers, systems are needed in which maternity staff can make a single call, as in the Neonatal Transfer Service, with administrative staff then negotiating and confirming both neonatal cots and labour ward placement.[8] A recent London Assembly report has recommended that the most rational way to optimise use of maternity and neonatal resources may be to develop perinatal, rather than purely neonatal, networks.[9]

This census has demonstrated the ability of centralised but dedicated neonatal transport services to deliver a substantial improvement in response times for emergency neonatal transfers. However, the increase in transfers following introduction of the service may indicate an undesirable shift from antenatal to postnatal transfer. Improved systems for arranging in-utero transfer may be necessary to reverse this trend.

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Competing interests: None declared.

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APPENDIX 1: CONTRIBUTORS

DATA ENTRY AND ANALYSIS

Data from the census returns was entered on to a database for analysis by Dr E Cavazzoni, Dr T Reyes, Dr Y Baki, Ms S Silby, Dr H Khan, Dr S T Kempley, Dr N Ratnavel. Analysis was by Dr S T Kempley and Dr Y Baki. Mr G Hayter analysed and supplied data from the Emergency Bed Service. Ms Lyn Sugg (Senior Operations Officer) supplied data from the London Ambulance Service.

HOSPITALS WHICH PROVIDED COMPLETE DATA FOR THE CENSUS

Barnet, Basildon, Brighton, Canterbury, Chase Farm, Conquest Hastings, Darenth Valley, Ealing, East Surrey, Epsom, Frimley Park, Hospital for Sick Children Great Ormond Street, Guys, Hammersmith, Hillingdon, Homerton, King George's, Kings College, Lewisham, Lister Stevenage, Maidstone, Mayday Croydon, Medway, North Middlesex, Northwick Park, Pembury, Princess Alexandra Brighton, Princess Royal Farnborough, Queen Elizabeth Woolwich, Queens Mary's Sidcup, Royal London Whitechapel, Royal Brompton, Royal Free, Royal Surrey, St George's, St Helier, St Mary's Paddington, St Peter's Chertsey, St Thomas, Watford, West Middlesex, Whipps Cross, Whittington, William Harvey, Worthing.

HOSPITALS WHICH WERE APPROACHED BUT WERE NOT ABLE TO PROVIDE FULL DATA

Chelsea and Westminster, Colchester, Eastbourne, Kingston, Queen Elizabeth Welwyn Garden City, Queen Elizabeth Queen Mother Margate, St Richards, University College Hospital.