ORIGINAL ARTICLE

Census of neonatal transfers in London and the South East of England

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Objectives: To determine the number and characteristics of inter-hospital transfers of newborn infants in London and the South East of England.
Design: Prospective census of neonatal transfers over a three month period.
Setting: Transfers between the 53 hospitals that provide care for newborn infants within the former Thames regions.
Data sources: Census returns from participating neonatal units.
Main outcome measures: Number, timing, and hours of staff time spent on transfers. Gestation, birth weight, and reason for transfer of the baby. Time elapsed between request and retrieving team departing and arriving with patient.
Results: A daily average of 2.7 urgent, 3.5 elective, and 0.7 short term transfers took place during the census period. The most common reason for urgent transfer was neonatal surgery. Neonatal unit staff spent an average of 21 hours a day off their units accompanying transfers each day. It took over four hours for 90% of ambulances to set off with the retrieving team and over six hours for 90% of teams to reach the baby.
Conclusions: During the census period, services for the transport of neonates in London and the South East of England involved long delays and used appreciable amounts of staff time. It is likely that a small number of dedicated neonatal transfer teams could meet the needs identified in this census more effectively than the 53 hospitals currently involved.

In the first week of life, 10% of babies are admitted to a neonatal unit, with a smaller proportion requiring intensive care or specialised interventions.[1] Although most maternity units can provide special care and short term neonatal intensive care, a number of infants may require transfer to specialist centres for continuing intensive care, surgery, or other specialist services. Where such a need is anticipated before delivery, the preferred option is to transfer mother and fetus in utero. Unfortunately, preterm delivery, perinatal illness, and congenital malformations cannot always be anticipated, resulting in a continuing need for the ex utero transfer of babies after delivery. These vulnerable patients are often critically ill, and optimal care is essential to reduce later morbidity and mortality.

The safe transfer of a sick newborn requires more than just a vehicle.[2] Specialised equipment will usually include a transport incubator, a neonatal ventilator, infusion pumps, monitors, and age specific disposable items. Staff trained in the care of sick newborn infants will need to accompany and manage the patient during transfer. A specialised ambulance may be required to secure the baby, incubator, and staff safely without risk of injury to staff or patient.

In the United Kingdom, either the destination or the source hospital performs the majority of inter-hospital transfers of sick neonates. The effectiveness of the disparate arrangements found in many regions has been questioned.[3] In France, Australia, and North America fully dedicated neonatal transfer teams have been established for at least 20 years,[4–6] and these are now being developed in the United Kingdom. In the South East of England, plans had been developed for two centralised transfer teams based in London with local teams in Kent, Surrey, and Sussex.

To determine the requirement for such teams, robust data were needed on the numbers of neonatal transfers in this geographical region, the staff time spent on transfers, and the time taken for patients to be retrieved under current arrangements. It was not possible to determine this information from existing NHS information sources. The Thames Regional Perinatal Group (TRPG), an association of professionals involved in neonatal care in London and the South East, undertook a census of neonatal transfers during a three month period.

The area covered in the census is geographically compact, covering under 20 000 km^2, but births within it have accounted for 28% of all the births in England and Wales (about 180 000 births per annum).[7] There are 10 accredited tertiary neonatal centres that usually attempt to provide retrieval to their unit, but many of the other units provide neonatal intensive care. Neonatal surgery is available in nine units, and neonatal cardiology in three units, with retrieval traditionally provided by the source hospital. At the time of this census there were no organised systems of neonatal retrieval beyond those provided by individual hospitals and all units had to maintain a transfer capability. A number of NHS and other ambulance services were involved in transport of neonatal patients, with specialised vehicles used by the London Ambulance Service and accident and emergency vehicles used by most other county ambulance services.

METHODS

A census was carried out of all transfers to or from neonatal units within the geographical remit of the TRPG. The TRPG is a professional organisation of neonatologists, obstetricians, and neonatal nurses operating within the old Thames regions (London, Kent, Surrey, Sussex, Hertfordshire, and South Essex; fig 1). The census took place over a three month (90 day) period from 1 January to 31 March 2001, using voluntary data collection by nursing and medical staff on neonatal units. Census forms were sent to a senior consultant

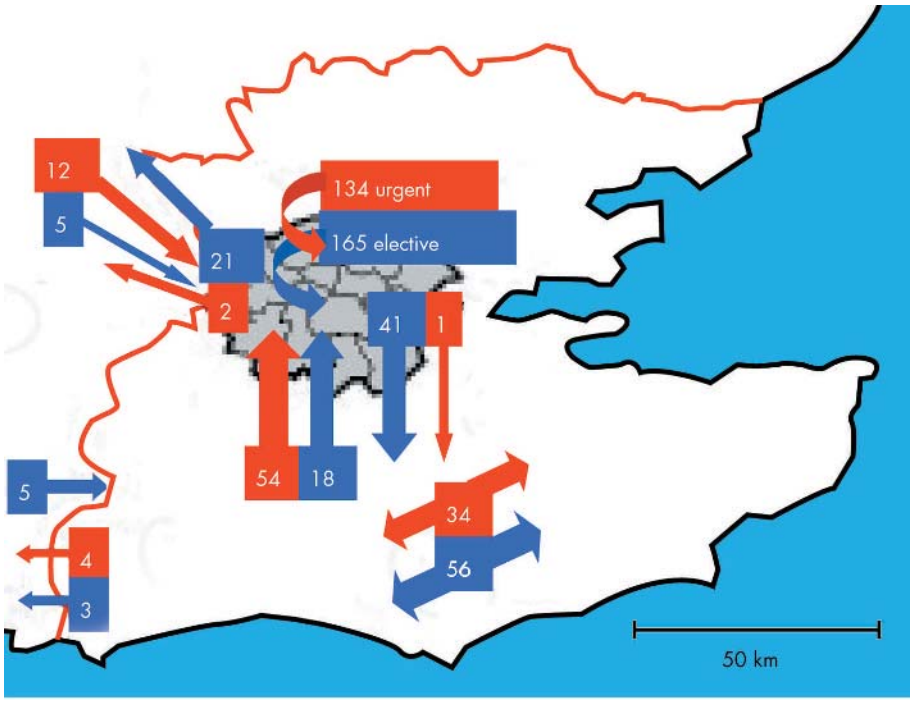

Figure 1 Geographical area covered by the census. Patient flows are indicated as numbers during the three month census travelling between or within each area (red, urgent; blue, elective).

on each unit, who was asked to nominate a doctor or nurse to take charge of data collection. Staff on duty were asked to complete the forms as close as possible to the time of the transfer. The nominated staff member returned the raw forms to the authors for analysis.

Census forms were sent to a total of 54 units (see the appendix). One unit which had left the TRPG following reconfiguration of health authority boundaries actively withdrew from the census; this left a total of 53 units from whom data were requested. Of these, 41 (77%) directly provided complete data. Each unit was asked to record transfers in and transfers out of their unit (see below). Transfers were therefore recorded to or from 11 of the 12 units who did not return any data. There were therefore data on transfers from 52/53 (98%) of the units intended to be included in the study. The one unit from whom no transfers were recorded is known to be a small unit, which does not receive referrals itself.

For each transfer in or out of their unit, staff recorded on paper forms basic non-identifiable patient data (date and time of birth, birth weight, gestation, postcode), diagnosis and reason for transfer, source and destination unit, vehicle providing the transfer, and the staff who accompanied the patient and the time they spent off their own unit accompanying the patient. Staff classified the transfer as urgent (first transfer of a baby for intensive care, cardiology, or surgery), elective (mainly babies returning to their local hospital after such treatment), or short term (babies taken for specialist opinion or day case treatment, generally returning the same day). Any ambiguous cases were clarified with the reporting unit. For urgent transfers, staff recorded the date and time that the call was made by the source unit to initiate transfer, the time the retrieving team or ambulance arrived at the source unit, and the time that neonatal unit staff spent on the transfer. For the ambulance services, all urgent cases were dealt with using a unified system of despatch and have therefore been analysed together.

Data from source and destination units were collated and matched, with the above data readily allowing dual logged transfers to be identified. There were no ambiguous cases in this matching process. Characteristics of urgent, elective, and short term transfers were analysed separately. Dual logging took place for only 11% of urgent transfers and 15% of elective transfers. All short term transfers were reported by the source unit only.

Transfers were analysed according to the geographical area of source and destination units. Three broad geographical areas were defined which reflect the organisation of neonatal services providing transfer and care. These were:

- London, Hertfordshire, and Essex
- Kent, Surrey, and Sussex
- Units outside of these areas

For those urgent transfers where times were recorded, delays were calculated as the time elapsed from the call confirming the destination of the baby. Time elapsed was calculated for despatch (the ambulance arrives with the transferring team) and for response (the team arrives at the baby). When a team in the local hospital transported the baby, both times were counted as the time for the ambulance to reach the hospital. Total hours of neonatal unit staff time were calculated for all types of transfer and then corrected for missing data to estimate the neonatal unit staff time used on transfers.

For those days on which there were more than three urgent transfers, timing was analysed in detail to identify the time window between transfer being requested and the baby arriving in the destination unit. Concurrent transfers were identified where these time windows overlapped; the maximum number of transfers taking place at the same time during that day was recorded. Elective transfers were not taken into account in this analysis, as in a centralised service they could be rescheduled without endangering patient care.

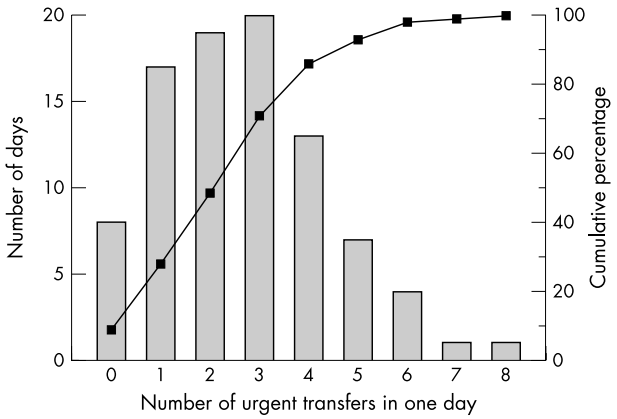

Figure 2 Daily transfer activity. Frequency distribution of the daily number of transfers, with the cumulative percentage distribution shown on the right y axis.

RESULTS

Numbers of transfers

During the census there was a daily average of 2.7 urgent, 3.5 elective, and 0.7 short term transfers (table 1). The frequency distribution (fig 2) showed that there were only 9% of days with no urgent transfers, and a daily maximum of eight transfers that occurred on only one day. There was a weekly cycle, with Sundays being the quietest and Wednesdays the busiest day. Extrapolated to a full year, there would have been an annual equivalent of 2510 transfers. Based on previous numbers of births in these regions,[7] this is equivalent to more than 13 patient movements per 1000 births.

Geographical distribution

Geographical analysis (table 1) showed that most transfers (56%) occurred within Greater London, South Essex, and Hertfordshire, and 15% occurred within Kent, Surrey, and Sussex. The remainder crossed boundaries, with a net inflow of urgent transfers into London and a net outflow of elective returns out of London (fig 1).

Clinical characteristics

Most urgent transfers were for the baby to receive neonatal surgery (41%) or neonatal intensive care (35%), but other important reasons included cardiac or neurological problems or the need for extracorporeal membrane oxygenation. Only 8% of transfers occurred because the local unit was full or understaffed, and only 2% involved transfer to a paediatric intensive care unit.

An imbalance was seen between urgent and elective transfers, which varied according to gestation (table 2). There were more elective returns than urgent transfers for the premature babies, many of whom would have been transferred in utero before delivery. The reverse pattern was seen among term babies, possibly as a result of discharge directly home from the specialist centre.

Vehicles used and external validation

The vehicle used was specified in 570 (92%) of transfers. Of these transfers, 49% were carried out by the London ambulance service, 32% by other NHS county ambulance services, 7% by NHS hospital trust ambulances, 1% by St John's ambulances, 6% by contracted or private ambulances (mostly elective), and 4% by taxi or car (mostly elective). Only two transfers used aircraft. For emergency transfers provided by NHS ambulance services, crews were taken from front line accident and emergency ambulances and usually consisted of two paramedic staff. For elective returns, a variety of drivers or paramedics were used.

Although there were no central data on neonatal transfers, the London Ambulance Service were able to identify that their specialised vehicles had been used for 135 planned and 134 urgent journeys during the census period. This compares with census data documenting that the London Ambulance Service carried out 135 elective and 130 urgent transfers during the census period. There was therefore exact agreement between the census and ambulance service for the number of elective journeys carried out by London Ambulance Service vehicles. The small disparity for emergency transfers could be accounted for within the numbers where the ambulance service had not been recorded, or they may have included some of the short term transfers.

Timing, staff time, and delays

For those transfers where the timing had been recorded, 49% of urgent and 13% of elective transfers involved travel outside of normal working hours (1730–0900). Data on timing were missing for 29% of urgent and 38% of elective transfers. When corrected for missing data, teams spent an average of 21 hours a day off their unit transferring babies (table 3). For many transfers, the details of team composition had not been completed. When units had specified team composition, most urgent transfers were accompanied by a doctor and nurse and most elective transfers by a nurse only. The timing therefore relates to team time spent on transfers and has not been broken down into medical, nursing, paramedic, and driver time.

For urgent transfers there were considerable delays between the destination for transfer being confirmed and the ambulance or team reaching the baby (fig 3). Analysis

Table 1 Numbers of transfers recorded during the census period and their geographical distribution

	All transfers	Urgent	Elective	Short term
All transfers involving census area				
Number during census	619	241	314	64
Mean daily number (range)	6.9 (0–14)	2.7 (0–8)	3.5 (0–11)	0.7 (0–4)
Annual equivalent	2510	977	1273	260
Geographical distribution: numbers during census (% in each area)				
Within London, Essex, & Hertfordshire	347 (56%)	134 (56%)	165 (53%)	48 (75%)
Within Kent, Sussex, & Surrey	92 (15%)	34 (14%)	56 (18%)	2 (3%)
Between Kent, Sussex, & Surrey and London	127 (21%)	55 (23%)	59 (19%)	13 (20%)
Transfers involving units outside of the census area	53 (9%)	18 (7%)	34 (11%)	1 (2%)

Journeys within London, Essex, and Hertfordshire could be from 1 km to 75 km, journeys within Kent, Sussex, and Surrey (KSS) could be up to 150 km, and journeys between these two areas could be up to 125 km.

Table 2 Number of urgent, elective, and short term transfers of patients born prematurely (< 37 weeks gestation) or at term

	Premature	Term
Urgent	129	99
Elective	270	44
Short term	38	25

There are more elective returns than urgent transfers for the premature babies, as many of these infants are transferred in utero. The reverse pattern is seen among term babies, who can often be discharged directly home from the specialist centre. Data on gestation were missing for 13 urgent and one short term transfers.

of cumulative centiles showed that some patients had to wait for many hours. Although the ambulance reached the transferring team within one hour in 44% of cases, it took over four hours for 90% of ambulances to reach the transferring team. As the team usually then had to travel to the baby, it took over six hours for 90% of teams to reach the baby.

Detailed analysis of the 26 days on which there were more than three urgent transfers showed that, on most (88%) of these days, concurrent transfers were taking place. There were six days on which three transfers were taking place at the same time, and one day on which four transfers were taking place at the same time. It was considered likely that on these seven busiest days, three dedicated teams capable of mobilising within 30 minutes could have reached all the patients within two hours.

DISCUSSION

This study is the most detailed analysis of inter-hospital transfer of neonates to involve the whole of London and the South East of England. Although individual hospitals were not dealing with transfers on a frequent basis, the equivalent of 2510 transfers a year were identified in this census. This is the equivalent of over 13 transfers for each 1000 births. Such a demand for neonatal transfers could provide three full time teams with an adequate average workload of over two transfers a day each.

Information is not widely available on transfers per number of births in other regions of the United Kingdom, but data supplied to us from regionalised teams in the Northern Neonatal Network showed that they carried out 373 transfers for 30 717 births in the year 2001. This is the equivalent of 12 transfers per 1000 births, a very similar figure to our own (AC Fenton, M Lal, personal communications). However, the rate of transfer will be highly dependent on patterns of organisation of maternity and neonatal services. In some regions of France, rates as high as 10% may be found where many babies are delivered in small maternity units with limited facilities for neonatal care.[8] As expected, our census showed that each individual unit's experience of neonatal transfer was necessarily very limited and a rational overview was only possible by the collation of data from many hospitals. The low rate of dual logging was disappointing, but not surprising, given that these transfers often place considerable stress on the staffing of neonatal units. This suggests that voluntary reporting systems of acute events in busy units should use a degree of redundancy in data collection at least as great as that included in this study.

The need for neonatal surgery and neonatal intensive care not available locally was the most common clinical reason for transfer. The 8% of babies transferred because their local unit was full or lacking staff represent the inadequacies of current neonatal intensive care provision, which have been identified in other studies.[9] Even if these issues are addressed, there remains an appreciable need for transfers that take place for clinical reasons.

Analysis of the gestation of transferred babies showed an excess of premature babies among elective returns. This shows that at least half of all transfers for reasons related to prematurity must have occurred before the baby was born (in utero transfer). When it is feasible, in utero transfer is the preferred method of transfer of the premature baby, and the current data show that this desirable characteristic of the service is clearly operating in a large number of cases. Once a premature baby has received its intensive care, it still needs to grow and mature, a process usually completed in the hospital closest to its home. For term babies, there was a lower number of elective returns than urgent transfers, probably because these babies can be discharged directly home after receiving surgical or other specialist treatment.

As the need for urgent transfer is by its nature unpredictable, all of the hospitals and ambulance services in the census area had to maintain a transfer capability that might be needed at any time, with 48% of urgent transfers involving travel outside of normal working hours. Considerable neonatal unit staff time was spent directly on transfers, but this almost certainly underestimates the resources that the current system uses. Before a transfer can be initiated, a local unit must first find a cot for the patient, a process that may take several hours. Transferring teams have to prepare equipment and identify staff to look after the patients they were caring for. Ambulance service staff are often taken away from front line paramedic duties and have to retrieve dedicated vehicles that can carry a transport incubator. These arrangements are clearly amenable to modernisation, with a centralised and coordinated service having the ability to greatly simplify this process. One of the greatest barriers to establishing such a system may be the way in which current costs and inefficiencies are hidden within a large number of separate organisations, whereas the funding for a centralised service would be clear and explicit.

Table 3 Time spent by neonatal unit staff out of their units on neonatal transfers

	All transfers	Urgent	Elective	Short term
Number of journeys	619	241	314	64
Data on staff time—n (%)	524 (85%)	196 (81%)	285 (91%)	43 (67%)
Hours of staff time recorded in 90 day census period				
Source unit providing staff	1019	413	437	169
Destination unit providing staff	609	405	200	4
Total for all units	1628	818	637	173
Mean (range) per journey	3.1 (1–18)	4.2 (1–18)	2.2 (1–14)	4.0 (11–13)
Daily equivalent corrected for missing data (hours/day)	21.4	11.2	7.8	2.9

The total number of hours spent by each team is presented. For most urgent transfers, the teams consisted of a doctor and nurse, whereas most elective transfers were performed by a nurse only.

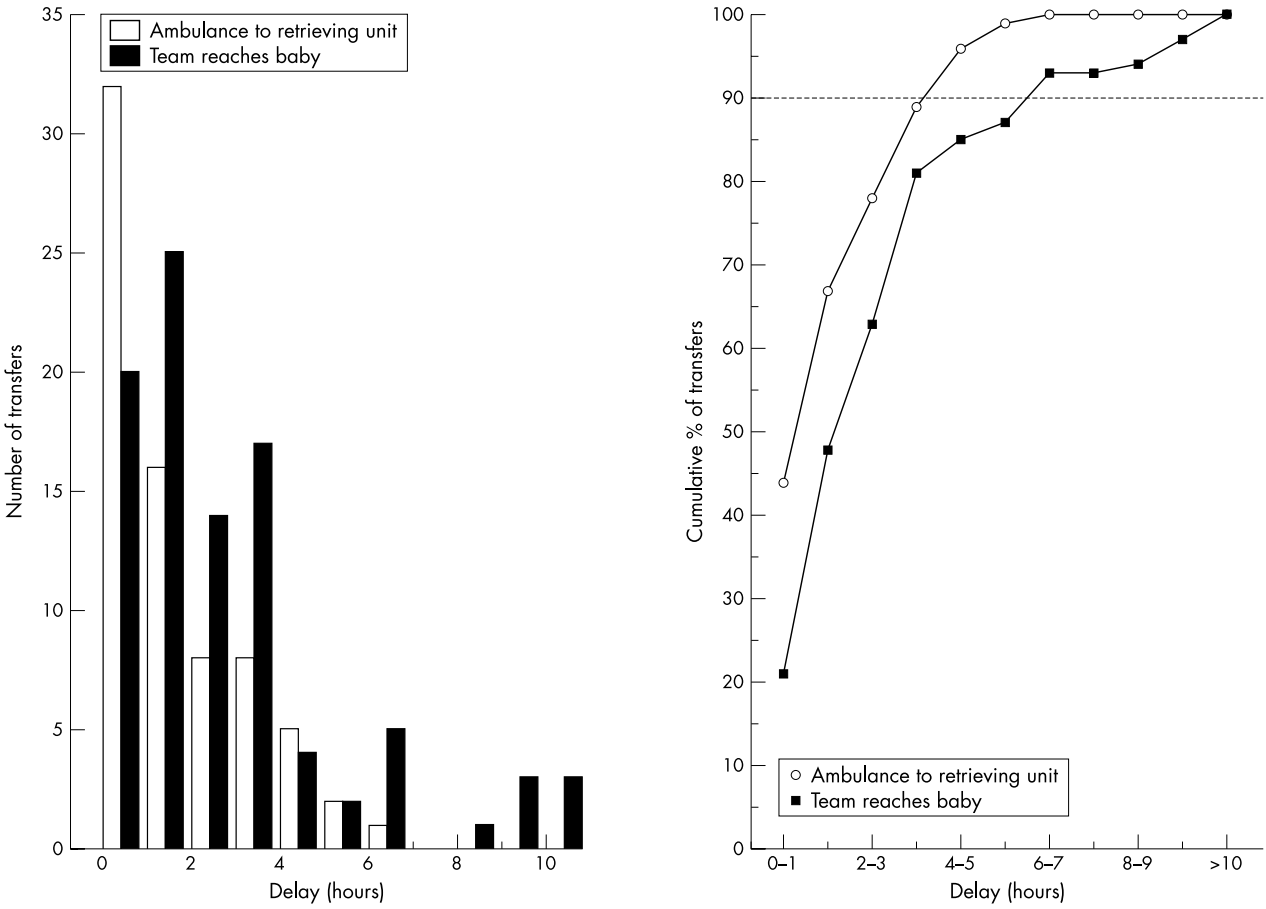

Figure 3 Time elapsed after the need and destination of transfer had been confirmed. Values are the number of retrievals in each time window, firstly for the arrival of the ambulance with the transferring team and secondly for the time elapsed from the call to the team arriving with the patient. Cumulative percentage curves are also shown.

Despite a large number of hospitals participating in the service, there were long delays in teams reaching patients, particularly as a result of delays in ambulances reaching the retrieving team. These delays are much longer than those seen in services that have dedicated neonatal transfer teams. Standards set in North America[10] state that teams "should be able to mobilise within a maximum of 45 minutes (preferably within 30 minutes)". The service in Toronto seeks to despatch their team within minutes to half an hour,[6] and during the last year has been able to achieve despatch times of an average of 12 minutes and a maximum of 20 minutes (P McNamara, personal communication). Although a dedicated nursing team in Nottingham seemed to improve the condition of the patient during transfer, they did not have a dedicated vehicle and their median time to despatch a team was 45–50 minutes, with some delays of over four hours.[11] More recent data from this team show that nurse practitioners teams were despatched more quickly than medical teams, but they still had a median despatch time of 55 minutes.[12] This suggests that immediately available vehicles and drivers may be necessary to achieve rapid response times. Detailed analysis of the busiest days from the census suggested that three dedicated teams capable of mobilising within 30 minutes could have reached all the patients within two hours.

Arrangements for transfer of neonates between hospitals in London and the South East of England in early 2001 involved a considerable amount of hospital staff and ambulance service time, yet provided a suboptimal service, with long delays in reaching vulnerable patients. It is likely that three dedicated teams could provide a better service than the 53 hospitals that are currently attempting to do so. Future arrangements should be capable of coping with considerable variations in demand with shorter delays in reaching patients.

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APPENDIX

The following hospitals provided complete data: Barnet, Basildon, Chelsea & Westminster, East Surrey & Crawley, Epsom General,Farnborough, Hammersmith, Harold Wood, Hastings, Hillingdon, Homerton, Hospital for Sick Children Great Ormond Street, Kent & Canterbury, King Georges, King's College, Kingston, Lewisham, Maidstone, Margate, Mayday, Medway Maritime Gillingham, Newham General, North Middlesex, Northwick Park, Pembury, Princess Alexandra Harlow, Queen Elizabeth Welwyn, Royal Free, Royal London Whitechapel, Royal Sussex County Brighton, Southend, St Georges, St Mary's Paddington, St Peter's Chertsey, St Richard's Chichester, University College London,

Whipps Cross, Whittington, William Harvey Ashford, Worthing.

The following hospitals were contacted but did not provide complete data: Chase Farm, Dartford, Dover, Ealing, Eastbourne, Frimley Park, Guildford, Greenwich, Guy's & St Thomas, Princess Royal Haywards Heath, Queen Mary's Sidcup, St Helier.

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