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# Using the National Neonatal Research Database to determine if place of birth and postnatal transfer affects mortality and brain injury

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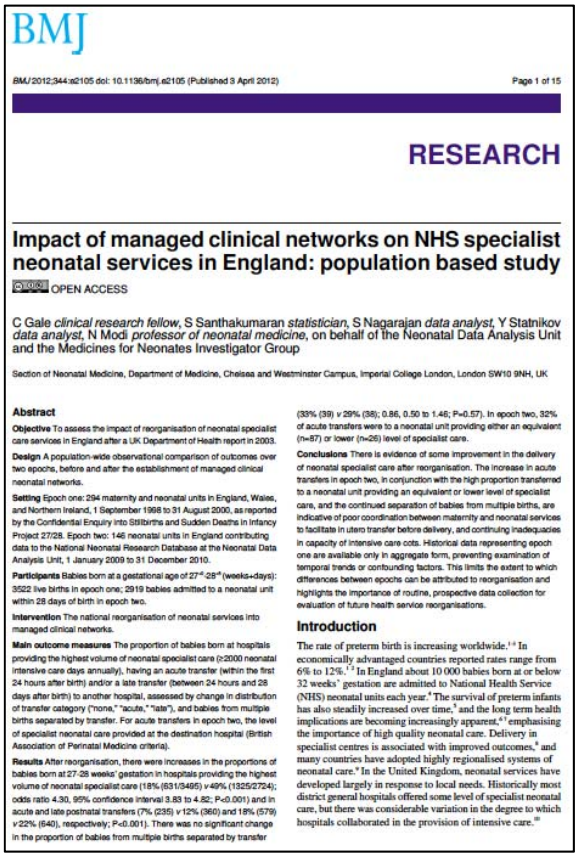
# Observational studies: Postnatal transfer



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RESEARCH

**Impact of managed clinical networks on NHS specialist neonatal services in England: population based study**

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**Abstract**

**Objective** To assess the impact of reorganisation of neonatal specialist care services in England after a UK Department of Health report in 2003.

**Design** A population-wide observational comparison of outcomes over two epochs, before and after the establishment of managed clinical neonatal networks.

**Setting** Epoch one: 294 maternity and neonatal units in England, Wales, and Northern Ireland, 1 September 1998 to 31 August 2000, as reported by the Confidential Enquiry into Stillbirths and Sudden Deaths in Infancy Project 27/28. Epoch two: 146 neonatal units in England contributing data to the National Neonatal Research Database at the Neonatal Data Analysis Unit, 1 January 2009 to 31 December 2010.

**Participants** Babies born at a gestational age of 27$^{0}$-28$^{6}$ (weeks+days): 3522 live births in epoch one; 2919 babies admitted to a neonatal unit within 28 days of birth in epoch two.

**Intervention** The national reorganisation of neonatal services into managed clinical networks.

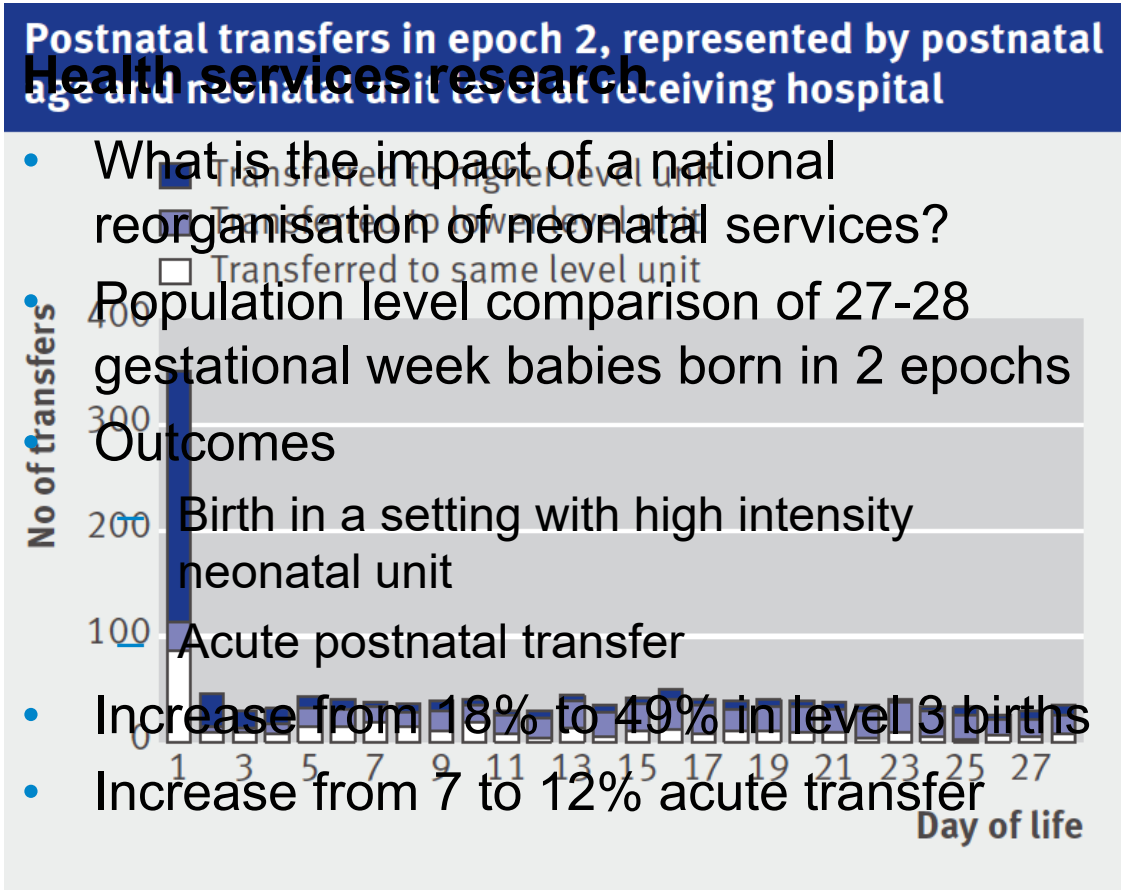
**Main outcome measures** The proportion of babies born at hospitals providing the highest volume of neonatal specialist care (≥2000 neonatal intensive care days annually), having an acute transfer (within the first 24 hours after birth) and/or a late transfer (between 24 hours and 28 days after birth) to another hospital, assessed by change in distribution of transfer category ("none," "acute," "late"), and babies from multiple births separated by transfer. For acute transfers in epoch two, the level of specialist neonatal care provided at the destination hospital (British Association of Perinatal Medicine criteria).

**Results** After reorganisation, there were increases in the proportions of babies born at 27-28 weeks' gestation in hospitals providing the highest volume of neonatal specialist care (18% (631/3495) v 49% (1325/2724); odds ratio 4.30, 95% confidence interval 3.83 to 4.82; P<0.001) and in acute and late postnatal transfers (7% (235) v 12% (360) and 18% (579) v 22% (640), respectively; P<0.001). There was no significant change in the proportion of babies from multiple births separated by transfer (33% (39) v 29% (38); 0.86, 0.50 to 1.46; P=0.57). In epoch two, 32% of acute transfers were to a neonatal unit providing either an equivalent (n=87) or lower (n=26) level of specialist care.

**Conclusions** There is evidence of some improvement in the delivery of neonatal specialist care after reorganisation. The increase in acute transfers in epoch two, in conjunction with the high proportion transferred to a neonatal unit providing an equivalent or lower level of specialist care, and the continued separation of babies from multiple births, are indicative of poor coordination between maternity and neonatal services to facilitate in utero transfer before delivery, and continuing inadequacies in capacity of intensive care cots. Historical data representing epoch one are available only in aggregate form, preventing examination of temporal trends or confounding factors. This limits the extent to which differences between epochs can be attributed to reorganisation and highlights the importance of routine, prospective data collection for evaluation of future health service reorganisations.

**Introduction**

The rate of preterm birth is increasing worldwide.[1-4] In economically advantaged countries reported rates range from 6% to 12%.[1-3] In England about 10 000 babies born at or below 32 weeks' gestation are admitted to National Health Service (NHS) neonatal units each year.[4] The survival of preterm infants has also steadily increased over time,[5] and the long term health implications are becoming increasingly apparent,[6-7] emphasising the importance of high quality neonatal care. Delivery in specialist centres is associated with improved outcomes,[8] and many countries have adopted highly regionalised systems of neonatal care.[9] In the United Kingdom, neonatal services have developed largely in response to local needs. Historically most district general hospitals offered some level of specialist neonatal care, but there was considerable variation in the degree to which hospitals collaborated in the provision of intensive care.[10]




**Health services research**

- What is the impact of a national reorganisation of neonatal services?
- Population level comparison of 27-28 gestational week babies born in 2 epochs
- Outcomes
  - Birth in a setting with high intensity neonatal unit
  - Acute postnatal transfer
- Increase from 18% to 49% in level 3 births
- Increase from 7 to 12% acute transfer

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# Does this increase in postnatal transfers matter?

## Previous studies

- Adverse outcomes with acute transfer
- Before specialist transfer teams, high uptake of antenatal steroids

## Aim

- What is the impact of early postnatal transfer on infants born at <28 gestational weeks?

## Three groups

1. Upward transfers
2. Horizontal transfers
3. Non-transferred, non-tertiary

Compared to a control group (non-transferred tertiary care)

Excluded surgical transfers

## Outcomes

- Death before discharge
- Severe brain injury (3-4 IVH, cPVL)

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# Methods

## Propensity score matching

- Logistic regression applied to all background variables
- Propensity score for each infant for being transferred
- Infants were matched on
  - Propensity score (decile)
  - Gestational age (weeks)
  - Sex
  - Exposure to antenatal steroids (yes/no)

## Covariates

- Gestational age
- Sex
- Birth weight Z-score
- Exposure to antenatal steroids
- Multiplicity
- Mode of delivery
- Apgar scores (1 and 5 minutes)
- Surfactant administered in delivery room
- Maternal smoking
- Year and month of admission
- Network

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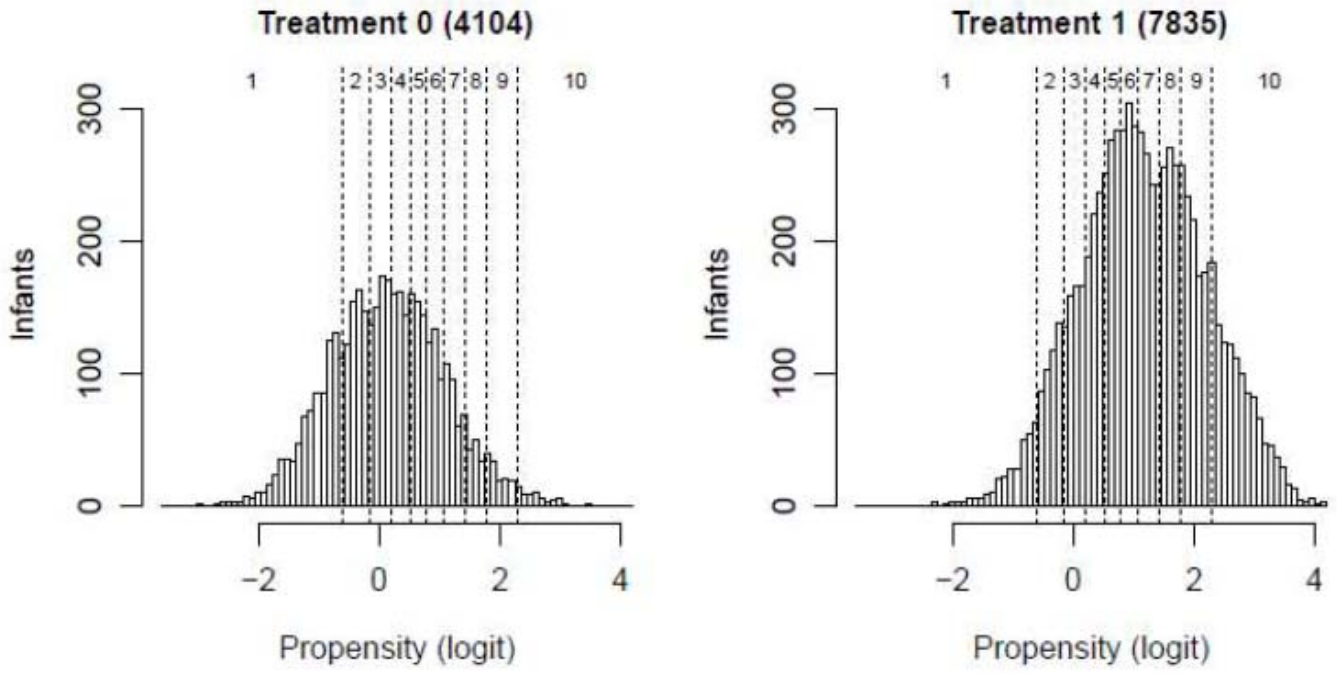
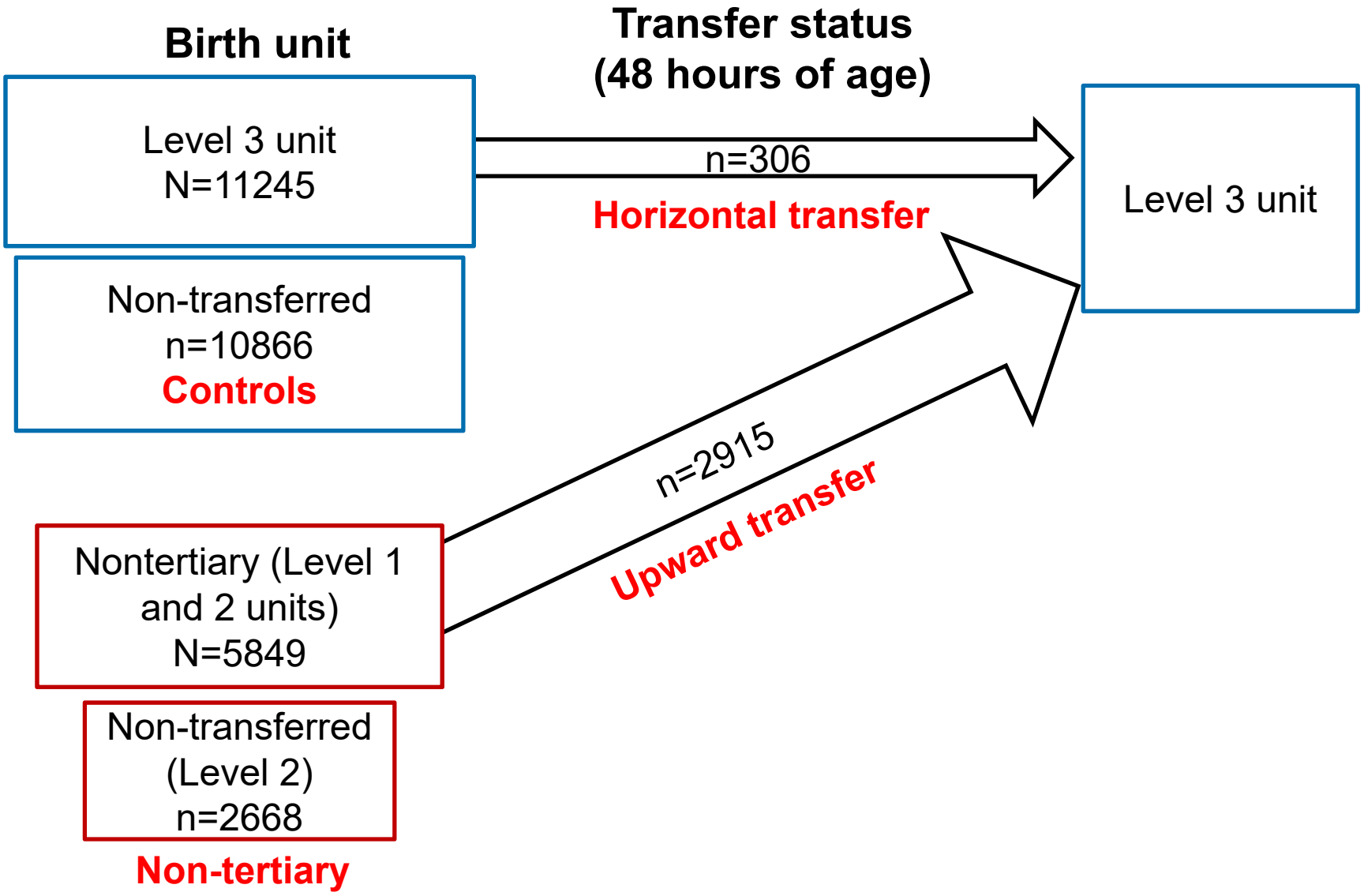
# Propensity score matching

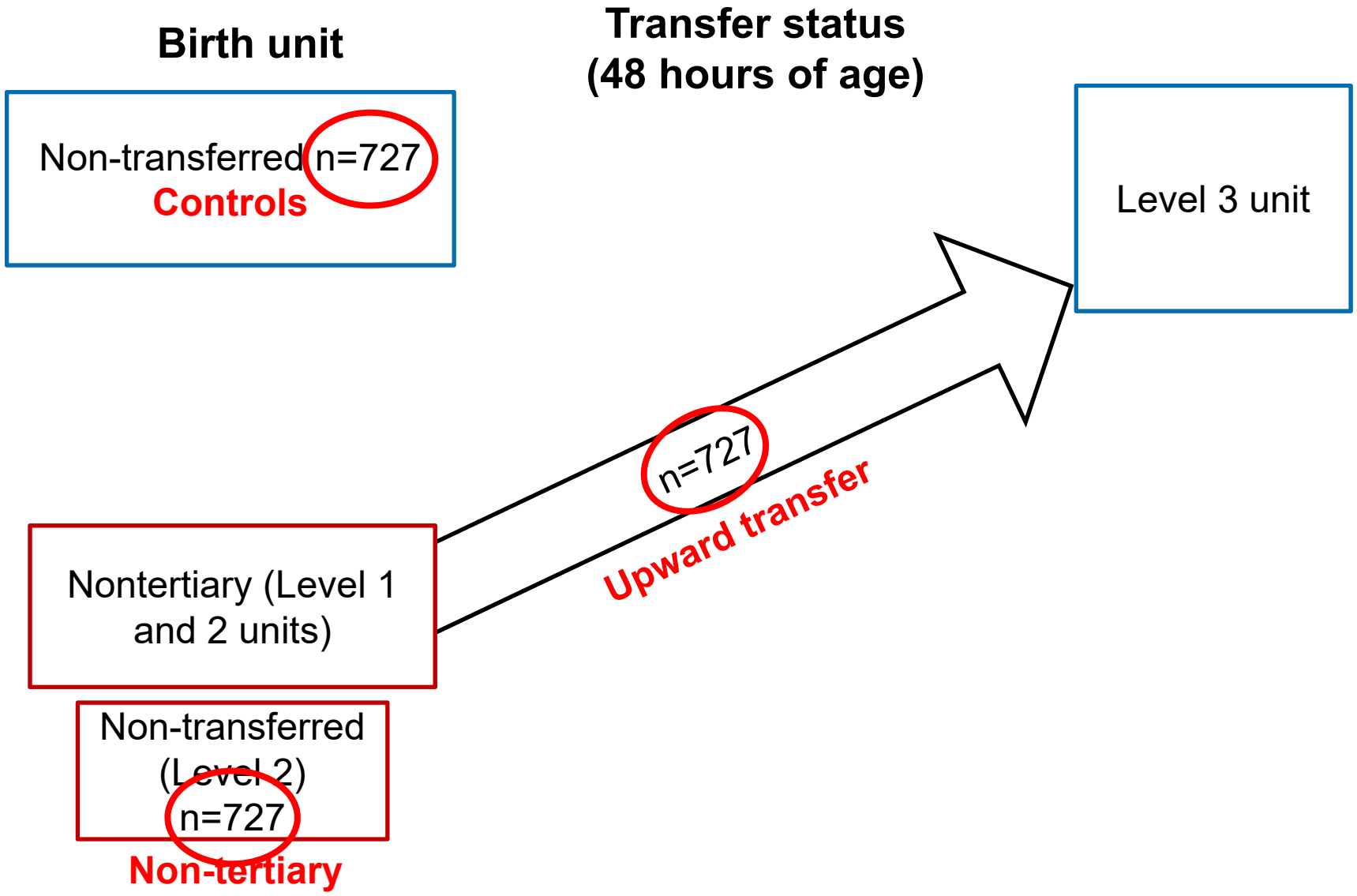



Battersby C et al., Lancet Gastroenterol Hepatol. 2017 Jan;2(1):43-51.

# Births, transfers and destination



# Births, transfers and destination



# Background characteristics and matching

| | Control (N=10,866) | Upward transfer (N=2,915) | Non-tertiary care (N=2,668) |
|---|---|---|---|
| **Gestational weeks, median (IQR[d])** | 26.0 (24.9, 27.0) | 25.6 (24.6, 26.6) | 27.0 (26.3, 27.6) |
| **Mean birth weight, grams, (SD[e])** | 807 (188) | 808 (178) | 931 (193) |
| **Birth weight z-score, mean (SD)** | -0.20 (0.89) | -0.01 (0.83) | 0.02 (0.89) |
| **Male sex (%)** | 5,799 (53.4) | 1,607 (55.1) | 1,463 (54.8) |
| **Multiple birth (%)** | 2,995 (27.6) | 672 (23.1) | 556 (20.8) |
| **Smoking in pregnancy (%)** | 1,733 (19.5) | 586 (23.4) | 503 (21.7) |
| **Caesarean delivery (%)** | 4,028 (40.1) | 936 (33.6) | 1,208 (48.5) |
| **Surfactant during resuscitation (%)** | 9,780 (94.0) | 2,743 (97.1) | 2,446 (93.7) |
| **Antenatal steroids (%)** | 9,897 (92.4) | 2,286 (79.4) | 2,255 (86.5) |
| **Apgar 1 min <3 (%)** | 1,847 (19.5) | 597 (22.5) | 409 (17.1) |
| **Apgar 5 min <3 (%)** | 385 (4.1) | 124 (4.8) | 80 (3.4) |

Background characteristics before matching

| Control (N=727) | Upward transfer (N=727) | Non-tertiary care (N=727) |
|---|---|---|
| 26 (25, 27) | 26 (25, 27) | 26 (25, 27) |
| 900 (780, 1004) | 900 (780, 1020) | 888 (759, 1020), |
| 0.099 | 0.103 | 0.099 |
| 298 (41.0) | 298 (41.0) | 298 (41.0) |
| 158 (21.7) | 162 (22.3) | 172 (23.7) |
| 129 (20.1) | 157 (24.1) | 146 (23.7) |
| 416 (57.2) | 405 (55.7) | 398 (54.7) |
| 701 (97.9) | 695 (98.0) | 683 (97.1) |
| 565 (77.7) | 565 (77.7) | 565 (77.7) |
| 144 (19.8) | 144 (19.8) | 139 (19.1) |
| 34 (4.7) | 34 (4.7) | 25 (3.4) |

Background characteristics after matching

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# Results

Acute postnatal transfers are still increasing

- 18.4% in 2008 and 21% in 2015

| Group | Survival without brain injury | Survival without brain injury in matched controls | Effect size % (95% CI) | OR (95% CI) | NNT (95% CI) |
|---|---|---|---|---|---|
| Upward transfer | 57.0% | 68.8% | -11.80 (-6.21, -17.39) | 0.60 (0.47, 0.76) | 8.47 (16.10, 5.75) |
| Non-tertiary care | 64.4% | 68.8% | -4.38 (1.11, -9.87) | 0.82 (0.64, 1.05) | - |

In extremely preterm infants birth in a setting without tertiary neonatal care is associated with worse outcomes

- Seen whether infants are transferred or not

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# Observational studies

## Strengths

- Efficient
- Population coverage
- Allows use of objective outcomes
- Detailed background data allowed matching on multiple variables
- Account for multiple known confounders

## Limitations

- Not randomised
- Risk of bias (unmeasured confounders)
- Data items not all defined
- Data accuracy not reported or accounted for in all data items

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# Conclusions

- Upward transfer resulted in increased severe brain injury and lower survival without severe brain injury
- Every effort should be made to deliver extremely preterm infants in centres providing tertiary neonatal care
- Modern, specialised neonatal transfer teams cannot alleviate the effect of being born in the wrong place

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# Acknowledgements

All families who have taken part

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