

1 df, $p < 0.0008$; relative odds of dying (95% CI) (transferred compared with not transferred) 5.34 (1.97 to 14.45).

Reviewing the same data by birth weight shows the same trends, but differences in survival are not significant (table 2). This is to be expected as in general mature growth retarded infants do well without the severe problems related to immaturity. Some of these infants will have been included in the low birthweight groups.

Discussion

These data indicate that infants of 28 weeks' gestation or less show improved survival when they are treated in recognised neonatal intensive care units compared with infants who are electively treated in smaller units. This difference is particularly important, as many of the sickest infants were transferred from the smaller units and this was confirmed by risk scoring. There was no indication that the smaller units electively retained an excess of infants unlikely to survive for terminal care. It was in the larger units that a policy of offering terminal care to very immature infants away from the labour ward was more firmly established. The mechanism for the improved survival has not been shown.

No information is available about rates of handicap. Clearly this is important and will be considered in a further study. The limited number of survivors of 28 weeks' gestation or less, however, means that a study of several health regions will be required to obtain sufficient data for comparison. Without these data our findings must be interpreted with caution.

In a recent publication that was broadly critical of neonatal intensive care, attention was focused on artificial respiratory support as the essential element.⁶ This seems inappropriate as many aspects of perinatal care have evolved in the last 20 years to produce what we now call neonatal intensive care. Any advantages that large centres have are likely to relate both to obstetric and neonatal experience with high risk deliveries rather than individual treatments. The growth and dissemination of knowledge in neonatal care has clearly produced good short term survival figures for infants of more than 28 weeks' gestation in all units.

These findings are of importance in the futures planning of neonatal care. Although centralisation of neonatal care has been advocated there has been no direct evidence to support such a move in the United Kingdom,¹⁰ although data similar to our own are available from the United States and The Netherlands.^{13 14} Our data indicate that survival of infants of ≤ 28 weeks' gestation is better when they are cared for in designated centres. It seems unlikely that future studies will be able to separate the differences in contributions of medical care (obstetric and neonatal), nursing care (neonatal and midwifery) and type of equipment between the two types of unit in a controlled manner. Based on the criteria of improved survival alone, therefore, these findings indicate that the intensive care of infants

delivered at ≤ 28 weeks' gestation and the perinatal care of pregnancies identified as high risk should be concentrated in units: that carry out at least 500 days of neonatal ventilation/year; that have at least one consultant with a special interest in the newborn, and that have continuous middle grade medical cover; that have a high level of nursing expertise and training in neonatal care; and where obstetric care for high risk deliveries is well established.

For infants of more than 28 weeks' gestation there is no indication from these data that care should take place in designated centres. A comparison between the two types of unit of these more mature babies with similar diseases has not been possible. This might be achieved in a study of several regions that would provide sufficiently large numbers to allow matching for severity of disease.

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Commentary

Provision of neonatal intensive care has been singled out by the Royal College of Physicians and the National Audit Office as an area for improvement in services,^{1 2} and the chief executive of the NHS has made it a priority for regions and districts to review their maternity and neonatal services with a view to further reductions in mortality.³ Between 1980 and 1986, in England, the number of cots for neonatal intensive care more than doubled, and birthweight specific perinatal and neonatal mortality fell in all categories of birth weight.

There are differences, however, in mortality rates for low and very low birthweight babies among health regions.⁴ This may reflect differences in the social and economic factors that affect pregnancy outcomes, but there are also differences in the funding and organisation of neonatal care. In particular, regions vary in the amount of centralisation of neonatal intensive care, and in the arrangements that are made for transfer of babies.⁵ The problem is to decide whether and how different organisation of neonatal services within a region can improve neonatal outcomes.

Field *et al* present data about the mortality among babies in the Trent region who were admitted to neonatal units categorised into two groups by their capabilities to provide intensive care. They conclude that, for babies of more than 28 weeks' gestation, mortality was not related to admission to units with different degrees of services. For babies of less than or equal to 28 week gestations they did find that there was a significantly higher mortality among babies admitted to smaller neonatal units and not subsequently transferred to a regional unit.

This finding raises questions both of interpretation of the results and of implications on policy. The conclusion that babies born at gestations of 28 weeks or less should receive neonatal care in the larger referral centres may be misleading. Apart from access to different types of care, there may be other differences among the babies treated in the different types of neonatal unit. In their analysis, Field *et al* recognise that they had not done and could not do a randomised trial. As a result, they may not have controlled adequately for the possibility of unmeasured differences among the babies receiving different types of care. This bias may arise if there were babies in the smaller units who were born too quickly for transfer to be arranged before they were born, or after delivery if the baby was thought to be too immature or too sick to survive transport. Although this decision is sometimes made independently of the regional centre, many such decisions are made after at least a telephone consultation with the regional unit.^{5 6}

If differences in mortality are partly the result of differences in unmeasured risk factors, a change in transfer policy might not reduce mortality for babies of gestations of 28 weeks or less who are born in units outside the regional referral centre but it would increase the mortality rate for admissions to the referral unit as they take in higher risk babies. It might

nevertheless wrongly be seen as a successful policy as mortality for admissions to the secondary level intensive care units would almost certainly be reduced as the case mix changed.

Another way of analysing the data is to look at the outcomes for defined cohorts of births related to access to different neonatal services, rather than at the mortality of admissions to different neonatal units.⁷⁻⁹ This has added importance when the effect of prenatal and delivery room care on subsequent outcome of very preterm births is also recognised.^{10 11} It is not enough to measure the outcome for babies of such low gestational age only in terms of mortality. Field *et al* plan to look at long term morbidity in the babies included in the Trent Neonatal Survey, and this will provide essential additional information for service planners who are trying to predict demands on families and health and social services.

Although it may be the case that care in a regional referral unit can improve the chance of survival for babies of gestations of 28 weeks or less, the problem still remains for those providing the service of how to ensure that all the babies have access to appropriate services, especially in rural areas with dispersed populations.

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