The efficient use of the maternity workforce and the implications for safety and quality in maternity care: a population-based, cross-sectional study

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Scientific summary

Use of maternity workforce and implications for maternity care

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Background

The performance of maternity services is seen as a touchstone of whether or not we are delivering high-quality NHS care. Staffing has been identified in numerous reports as being a critical component of safe, effective, user-centred care. Large variations in outcomes and of women's experiences exist by NHS trust and there is little empirical evidence regarding the impact of maternity workforce staffing and skill mix on the safety, quality and cost of maternity care in the UK.

Although maternity care is the commonest reason for hospital admission among women aged 15–49 years in the UK, there is lack of agreement on what measures should be used. Safety measures developed for general populations often do not include measures appropriate for pregnant or postnatal women. There are also methodological issues to address, for example population, context of care, data quality, variation in outcomes within and between units, and whether or not risk adjustment is used to address confounding factors.

Hospital Episode Statistics (HES) provides information on care provided by NHS hospitals and for NHS hospital patients treated elsewhere in England. Several studies have used HES data, and show that, despite data quality issues, analyses using judicious cleaning and case-mix adjustment can be useful in identifying variations in patterns of maternity care. All studies have found unexplained variation in a range of indicators across NHS trusts after adjusting for background characteristics and case mix and suggest further research to understand the impact of organisational and staffing factors, and the impact on cost.

Objectives

The aim of this project is to understand the relationship between organisational factors, maternity workforce staffing, skill mix, cost and indicators of safe and high-quality care. Therefore, this research aims to answer the following questions:

- How do organisational factors affect variability in maternal interventions and maternal and perinatal outcomes?
- What is the relationship between maternity staffing, skill mix and maternal and perinatal outcomes?
- What is the relationship between maternity skill mix, cost and outcomes?

Methods

Data

We acquired routinely gathered data for 2010–11 from NHS and other sources.

Data cleaning

The study restricted the records to NHS hospital deliveries resulting in a registrable birth. Duplicate delivery records were removed from the mothers' records. The babies' birth records also contained duplicate records. These duplicates were not removed, as the majority of the project's work concentrated on the mother's delivery record and the resources were not available to clean both. We consulted with the CQC regarding the Maternity Data Quality – Indicator specifications for maternity-related measures included within its surveillance programme. Where there were multiple records relating to the same

delivery episode, one record was chosen by using a scoring system that selected the record which contained information most relevant to the project.

We used the full census of women's deliveries in HES, which contains 656,969 delivery records, so there was no bias caused by non-response. Any biases would therefore be caused by missing data, poorly recorded data or omitted variables from the risk adjustment model. Sample sizes for some indicators were reduced by the choice of denominator to create the indicator.

Outcome measures

The selection of indicators was decided in consultation with the advisory group and informed by needing to have a balance of positive and negative indicators, the importance to women, costs, and the availability and quality of coding within the HES data set. Three indicators were derived to indicate a healthy mother and healthy baby, thus reflecting a concept of harm-free care, avoidance of longer-term morbidity, and a positive outcome. The mode of birth indicators were chosen to compare important processes and outcomes across trusts and with other studies. Ten final indicators (some were composites) that measured maternal and infant outcomes were developed. A decision was taken not to include any trust where fewer than 80% of women could be coded for a particular indicator. Combining this with missing postcode data meant that the percentage of delivery records used in the multilevel models was as follows: healthy mother and healthy baby indicators ($n = 431,391$; 66%), normal birth ($n = 467,022$; 71%), intact perineum ($n = 439,730$; 67%, or 89% of women who had a vaginal delivery), and delivery with bodily integrity, spontaneous vaginal delivery, elective caesarean, emergency caesarean and all caesareans ($n = 584,435$; 89%).

Independent variables

We included mothers' characteristics measured at the individual level known to affect the outcomes of interest. These included age, parity, ethnicity, area socioeconomic deprivation as measured by the Index of Multiple Deprivation, geographical location (urban/rural) and region.

Characteristics measured at trust level included size measured by number of deliveries, teaching status, maternity configuration (drawing on Birthplace in England typology of whether or not alongside and free-standing midwife units are part of trust provision) and staffing variables. These included staffing levels [full-time equivalent (FTE) obstetric medical staff, midwives and maternity support staff/100 maternities, FTE all staff/100 maternities] and skill mix (doctor/midwife and midwife/support worker ratios).

Level of clinical risk was measured according to the National Institute for Health and Care Excellence (NICE) intrapartum care guideline [NICE. *Intrapartum Care: Care of Healthy Women and Their Babies During Childbirth*. NICE Clinical Guideline 55. 2007. URL: www.nice.org.uk/guidance/cg55/resources/guidance-intrapartum-care-pdf (accessed 10 september 2014)] by allocating women retrospectively to lower-risk, individual assessment and higher-risk status at the end of pregnancy. Conditions listed in the NICE intrapartum care guideline were matched by one of the project team to relevant *International Classification of Diseases* version 10 (ICD-10) codes, of which there are about 12,000. For certain conditions, other types of codes were matched, such as Office of Population Censuses and Surveys or HES Data Dictionary data items. Matching of codes was checked by another member of the project team, who is an obstetrician, and disagreements were resolved by consensus.

Analysis

Multilevel logistic regression models, where mothers (deliveries) were nested within trust, were fitted to the 10 maternity (dichotomous) indicators.

Three sensitivity analyses were performed (1) on trusts with a single obstetric unit, (2) on different levels of NICE risk assessment and (3) to test the effect of increasing/decreasing staffing levels on outcomes by parity and clinical risk group.

The economic analysis attempted to model maternity services from a production economics perspective to identify the relationship between inputs and outputs, and more specifically for this study the relationships between the different labour inputs. In particular, we wanted to establish the extent to which the different roles are substitutes or complements, that is competing or aiding inputs.

Results

Women's outcomes were largely determined by their clinical risk (based on NICE guidance), parity and age. Outcomes did vary by deprivation and ethnicity but these effects were lower by an order of magnitude. The effects of trust size and university status were small. Larger trust size reduces the chance of caesarean, but also reduces the chance of a healthy mother and healthy baby outcome(s) and increases the chances of other childbirth interventions.

Approximately 1–2% of the total variation in the outcome indicators was attributable to differences between trusts, whereas 98–99% of the variation was attributable to differences between mothers within trusts. The linear effects of the staffing variables were not statistically significant for eight indicators. The exceptions were as follows: increasing the number of midwives improved a woman's chance of delivering with bodily integrity and having an intact perineum. An analysis of the multiplicative effects of parity and clinical risk with the staffing variables was more revealing. Increasing the number of doctors has the greatest impact on outcomes in high-risk women and increasing the number of midwives has the greatest impact in low-risk women. However, caution needs to be exercised with increase in the number and deployment of support workers. Although increased numbers of support workers impacted on reducing childbirth interventions in low-risk women, it also had a negative impact on the healthy mother and healthy baby outcome(s) in all women.

We used trust-level data to investigate relationships between outcome measures, midwifery staffing levels and the cost of providing maternity services for NHS trusts in England. Higher midwifery staffing levels were associated with higher costs of each delivery, although the relationship was not strong. Only around 17% of the variation among trusts' delivery costs could be accounted for by variables included in this model. The remaining variation in the average cost of a delivery was not accounted for by maternal characteristics, size of trust, number of FTE registered midwives employed or antenatal spend and must be due to other factors not included in the analysis.

After adjusting for maternal characteristics and trust size, no relationship was found between the proportion of expenditure spent on antenatal care and operative delivery rates, or between higher operative delivery rates and higher delivery costs. Variations in costs between trusts were not related to the numbers of women having operative deliveries.

There was no association between cost per delivery and the normal birth rate, intact perineum rate, or any of the three healthy mother and healthy baby indicators, and women's experience of maternity care as measured by the average of the CQC scores. A relationship could not be found that explained postnatal costs in terms of variations in operative delivery rates once adjustments were made.

Having a higher proportion of women at increased clinical risk was associated with more expensive maternity care, as was the level of area deprivation, which approached statistical significance. These factors are currently reflected in the maternity pathway payment system. There appeared to be economies of scale across the total maternity episode (antenatal, intrapartum and postnatal care) by trust size, which were increased in trusts on a single site. However, larger trusts were associated with lower scores for women's experience, although no relationship was found between trust size and any clinical outcome.

From this study, the increased investment in staff did not necessarily have an effect on the outcome and experience measures chosen, apart from a higher intact perineum rate and higher levels of bodily integrity in trusts with higher levels of midwifery staffing.

The economic modelling analysis found midwives to be complements with both consultants and other doctors in the production of deliveries; that is, they should be used in combination. Consultants and other doctors were found to be substitutes for each other. Midwives and support workers were also found to be substitutes for each other. A major limitation is that we were not able to analyse impact of medical staffing, because of problems in combined data for obstetricians and gynaecologists.

Conclusions

There is some indication that staffing levels have positive and negative effects on some outcomes, and deployment of doctors and midwives where they have the impact that is most beneficial is important. Managers may wish to exercise caution in increasing more support workers in high-risk settings.
There appears to be little opportunity for role substitution.

There are wide variations in a range of outcomes that remain after adjustment for sociodemographic and background risk. Further research is required on what may be influencing unexplained variation, such as organisational climate and culture, use of NICE guidelines in practice and variation of models of care within trusts.

Organisational factors, such as trust configuration, size, models of care, staffing levels, skill mix, staff deployment and safety culture, and women's choices remain unknown factors in the understanding of important influences of the quality and safety of maternity care. Better staffing data, especially in relation to consultant activity, would enable a more definitive analysis.

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