# The Birthplace in England Research Programme: further analyses to enhance policy and service delivery decision-making for planned place of birth

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# Scientific summary

## Background

The Birthplace in England national prospective cohort study was designed to compare aspects of the safety of birth by planned place of birth at the start of labour care: in obstetric units (OUs), alongside midwifery units (AMUs), freestanding midwifery units (FMUs) and at home. The study found that:

- Women planning birth in a midwifery unit and multiparous women planning birth at home experienced fewer interventions than those planning birth in an obstetric unit with no impact on perinatal outcomes.
- Nulliparous women who planned home birth also had fewer interventions, but had poorer perinatal outcomes.
- For nulliparous women the intrapartum transfer rate was high in settings other than an OU.
- A non-negligible proportion of planned home and midwifery unit births were to women at 'higher 'risk of complications.

The purpose of this project was to further explore factors influencing interventions, transfers and other outcomes in different settings and to address questions relating to the organisation and delivery of services.

## Aims and project overview

The aim of this Birthplace 'follow-on' project was to support the development and delivery of safe, equitable and effective maternity services and to inform women's choice of birth setting by strengthening the evidence-base relating to planned place of birth:

- To describe and explore the impact of maternal characteristics, service configuration and other variations in the organisation and delivery of services on birth outcomes, with a particular focus on interventions and maternal outcomes which impact on future pregnancies, such as caesarean section or complicated vaginal delivery.

- To describe intrapartum transfer rates and explore the possible impact of factors relating to the organisation and delivery of services on transfers.
- To explore the clinical characteristics, management and outcomes of 'higher risk' women who opt for a non-OU birth.

The research was conducted as a series of five, complementary studies each addressing a set of research questions related to a specific topic:

- **Study one** explored the variation between units (for OUs, AMUs and FMUs) and NHS trusts (for home births) in rates of intervention and maternal outcome in 'low risk' women planning birth in each setting, and explored whether known characteristics of the unit or trust were associated with variation in these rates.
- **Study two** explored relationships between ethnicity, area deprivation and maternal age and interventions and maternal outcomes in 'low risk' women, and explored whether the associations between planned place of birth and the study outcomes were modified by ethnicity, area deprivation and maternal age.
- **Study three** explored factors affecting intrapartum transfers from AMUs, FMUs and planned home births and described aspects of the transfer process. The study explored: the relationships between maternal characteristics and the risk of transfer; the variation between unit and NHS trust transfer rates and whether known unit trust characteristics were associated with variation in these rates; whether transfer rates varied by time of day or day of the week; the urgency and duration of transfers from planned FMU and home births.
- **Study four** explored time of day and day of week variations in interventions and maternal outcomes.
- **Study five** explored the characteristics, management and outcomes of women at 'higher risk' of complications planning birth in midwifery units or at home. The study described the socio-demographic and clinical characteristics of 'higher risk' women planning birth in non-OU settings; described and explored the risk of transfer, reasons for transfer and timing of transfer; evaluated perinatal and maternal

outcomes in 'higher risk' women planning birth at home compared with 'higher risk' women who planned birth in an OU and 'low risk' women planning birth at home.

## Data

Data from the Birthplace cohort study, collected during April 2008-April2010, were used for all five studies. In studies one to four participants were 'low-risk' women with 'term' pregnancies planning vaginal birth in 43 AMUs (n=16573), 53 FMUs (n=11210), at home in 147 NHS trusts (n=16632) and in a stratified, random sample of 36 OUs (n=19379). Study five focused on 9,319 women in the Birthplace cohort with pre-existing medical and obstetric risk factors ('higher risk' women).

## Patient and public involvement

User involvement in the original Birthplace research programme ensured that the data collected and outcome measures used reflected the needs and priorities of women using maternity services. Representation of service users on the Birthplace 'follow-on' co-investigator group and active engagement with other users' representatives has continued throughout this follow-on project.

## Component studies

### *Study 1: The impact of service configuration and organisation on interventions and maternal outcomes in 'low risk' women*

*Main research questions*

- What is the variation between individual units and NHS trusts (for home births) in rates of intervention and maternal outcome?
- Is there evidence to suggest that rates of intervention and maternal outcome in planned OU, AMU and FMU births are affected by known unit or configuration characteristics?

- Is there evidence to suggest that rates of intervention and maternal outcome in planned home births differ in trusts with a high/low volume of planned home births?

## *Methods*

*Population*

- 'Low risk' women planning birth in an OU, AMU, FMU or at home.

*Main outcomes*

- Unit/NHS trust rates of instrumental delivery, intrapartum caesarean, 'straightforward birth', and 'normal birth', adjusted for maternal characteristics.

*Main unit/trust characteristics considered as explanatory variables*

- Measures of: unit size, midwifery staffing levels, proportion of births in the trust that were planned to take place outside an OU, distance/travel time to nearest OU (FMUs only), 'volume' of home births in the trust (home births only).

*Analysis*

- Funnel plots were used to explore the variation in intervention/outcome rates between units/trusts.
- Simple, weighted linear regression was used to evaluate the association between unit/trust characteristics and rates of intervention/maternal outcome.
- All analyses were stratified by parity.

## *Results*

*What is the variation between individual units and NHS trusts (for home births) in rates of intervention and maternal outcome?*

- There was greater variation in intervention rates than would be expected by chance in planned births in all settings and this variation was not explained by maternal characteristics.

- For planned OU and AMU births, there was considerably greater variation than would be expected by chance for all four intervention and outcome measures considered, particularly for nulliparous women.
- For planned FMU and home births there was considerably greater variation in interventions and outcomes than would be expected by chance for some of the measures considered, but relatively little unexplained variation in intrapartum caesarean section rates. For planned home births there was also relatively little unexplained variation in rates of instrumental delivery.

*Is there evidence to suggest that rates of intervention and maternal outcome in planned OU births are affected by known characteristics of the OU or the configuration of services?*

- The proportion of births in the trust that were planned outside an OU was significantly associated with higher intervention rates in planned OU births in `low risk' women, and in particular with higher rates of intrapartum caesarean section in both nulliparous and multiparous women.
- Having an AMU in the hospital was associated with significantly higher intrapartum caesarean section rates in nulliparous 'low risk' women planning an OU birth and significantly lower rates of 'normal birth' and 'straightforward birth' in multiparous 'low risk' women planning an OU birth.
- The magnitude of the observed significant associations was small.
- Because of the small number of OUs in our sample with an AMU on site, we could not assess the independent effects of the percentage of non-OU births and the presence of an AMU.

*Is there evidence to suggest that rates of intervention and maternal outcome in planned AMU births are affected by known characteristics of the AMU?*

- With the exception of intrapartum caesarean section in nulliparous women and instrumental delivery in multiparous women, where associations were not

significant, we found a significant association between the size of the unit and intervention rates.

- 'Low risk' women who planned birth in larger AMUs tended to have higher intervention rates and lower rates of 'normal' and 'straightforward birth', but when we conducted a sensitivity analysis in which we repeated the analysis after excluding one large AMU which appeared to be an outlier, none of the associations with AMU size were significant.

*Is there evidence to suggest that rates of intervention and maternal outcome in planned FMU births are affected by known characteristics of the FMU?*

- In nulliparous women, we found a significant association between the size of the FMU and rates of instrumental delivery, 'straightforward birth' and 'normal birth'; intervention rates tended to be lower in larger FMUs.
- In nulliparous women we also found a significant association between the distance of the FMU from the nearest OU and instrumental delivery rates and rates of 'straightforward' and 'normal birth'. Intervention rates tended to be higher in more distant FMUs. However, as more distant units tended to be smaller it was not possible to clearly separate out the independent effects of size and distance.
- None of the FMU characteristics considered were significantly associated with variations in rates of intrapartum caesarean section for either nulliparous or multiparous women.
- With the exception of one significant association (which may be a chance finding), none of the FMU characteristics considered was associated with variations in intervention rates for multiparous women.

*Is there evidence to suggest that rates of intervention and maternal outcome in planned home births differ in NHS trusts with a high/low volume of planned home births?*

- Multiparous 'low risk' women who planned home birth in a trust where numerically more home births took place were significantly more likely to have a 'normal birth'

and multiparous women who planned birth in a trust with a higher proportion of home births tended to have lower instrumental delivery rates and higher rates of 'normal' and 'straightforward' birth. The magnitude of the association was modest and very little of the variation in intervention rates was explained by the measures of 'volume' considered.

- No significant associations with either measure of 'volume' of planned home births was observed for nulliparous women, but this may be due to the limited number of nulliparous women in the home birth sample.

## Study 2: The effect of planned place of birth on interventions and maternal outcomes for different groups of 'low risk' women

### *Main research question*

- Does the effect of planned place of birth on interventions and maternal outcomes vary for specific sub-groups of 'low risk' women, particularly those defined by parity, age, ethnicity and the level of deprivation of their area of residence?

### *Methods*

#### *Study population*

- 'Low risk' women planning birth in an OU, AMU, FMU or at home.

#### *Main outcomes*

- Instrumental delivery, intrapartum caesarean, 'straightforward birth', 'normal birth'.

#### *Analysis*

- Multivariable Poisson regression to evaluate associations between planned place of birth, ethnicity, Index of Multiple deprivation and maternal age and each of the study outcomes.
- Interaction terms were added to investigate whether the effect of planned place of birth was modified by Ethnicity (While versus non-White), Index of Multiple

Deprivation (most deprived 40% versus more advantaged 60%) or maternal age (<35 versus ≥35 years).

- All analyses were stratified by parity.

## *Results*

### *Ethnicity*

- Across all settings, we observed an increased risk of intrapartum caesarean section in 'low risk' non-White women compared with 'low risk' White women, but our findings did not suggest that the benefits of planned birth in a non-OU setting differed for White and non-White women. Planned birth in an AMU, FMU or at home was associated with a similar reduction in caesarean section in both White and non-White women and there was no evidence that the pattern was different for instrumental delivery, 'normal birth' or 'straightforward birth'.

### *Women living in areas with higher levels of deprivation*

- After adjustment for other maternal characteristics, we did not observe any difference in the risk of intervention (instrumental delivery, intrapartum caesarean section, 'normal birth', 'straightforward birth') between women living in more and less disadvantaged areas.
- The association between planned place of birth and some interventions was significantly modified by the level of deprivation of the area in which the women lived, but the differences were small. Planned birth in a non-OU setting was significantly associated with a reduced risk of instrumental delivery and intrapartum caesarean section and a significantly increased chance of 'straightforward' and 'normal birth' irrespective of whether the woman lived in a more or less advantaged area.

### *Maternal age*

- In nulliparous women, the risk of instrumental delivery and intrapartum caesarean section increased with increasing maternal age and the chances of having a 'straightforward birth' or 'normal birth' decreased with maternal age. There were no clear trends with maternal age in multiparous women.
- The association between planned place of birth and risk of instrumental delivery and intrapartum caesarean section was not significantly different for women aged 35 or older compared with women aged under 35. In some analyses the relationship between planned place of birth and chances of a 'straightforward' or 'normal birth' was modified by maternal age. In particular, older nulliparous women who planned birth in a non-OU setting had a significantly increased chance of a 'straightforward' or 'normal birth'.

## Study 3: Factors affecting intrapartum transfer of 'low risk' women and the transfer process

### *Main research questions*

- What maternal characteristics known at the start of care in labour are most strongly associated with intrapartum transfer?
- What is the variation between units and NHS trusts (for home births) in the proportion of women who are transferred, and are known unit/NHS trust characteristics associated with variation in transfer rates?
- Do intrapartum transfers vary by time of day or day of the week?
- What is the duration of transfers from planned FMU and home births; does this differ if the woman is transferred for potentially urgent reasons?

### *Methods*

#### *Study population*

- 'Low risk' women planning birth an AMU, FMU or at home.

#### *Main outcomes*

- Transfer to an OU during labour or within 24 hours of birth.

- Time from decision to transfer to first assessment by a midwife or obstetrician in the receiving OU.

*Analysis*

- Multivariable Poisson regression to evaluate associations between maternal characteristics and risk of transfer.
- Funnel plots were used to explore the variation in transfer rates between units/trusts.
- Simple, weighted linear regression was used to evaluate associations between unit/NHS trust characteristics and unit/NHS trust transfer rates.
- For each component of the transfer process, duration was described using the median, interquartile range; transfer time was displayed graphically using cumulative distribution curves.

## *Results*

*What maternal characteristics known at the start of care in labour are most strongly associated with intrapartum transfer?*

- Parity, maternal age, gestational age and the presence of 'complicating conditions' identified at the start of care in labour were all independently associated with variation in the risk of transfer.
    - Nulliparous women had consistently higher rates of transfer compared with multiparous women.
    - 'Low risk' women who gave birth at 37-39 weeks' gestational age generally had a lower risk of transfer relative to women who gave birth at 40 weeks, and women who gave birth at 41 to 42+0 weeks generally had a significantly higher risk of transfer.
    - In nulliparous women, the risk of transfer increased with maternal age in planned AMU and FMU births; no age-related pattern was evident in

multiparous women or in nulliparous women planning home birth, but the number of nulliparous women was small in the home birth group.

    - The presence of 'complicating conditions' identified at the start of care in labour (such as prolonged rupture of membranes and meconium staining) was associated with a significantly increased risk of transfer in all three settings, with the risk doubling or tripling in planned FMU and home births.
- We did not find any significant variation in the risk of transfer associated with ethnicity (White vs non-White) or understanding of English.
- In planned FMU and home births, transfer rates showed some significant variation with body mass index (BMI). For planned FMU births and planned home births (multiparous women only), the absence of a BMI record in the woman's notes was associated with a significantly increased risk of transfer.

*Variation in transfer rates and the association between unit or trust characteristics and transfer rate:*

*For women planning a birth outside an OU, what is the variation between units and NHS trusts (for home births) in the proportion of women who are transferred from their planned place of birth during or immediately after labour?*

*To what extent can any differences in transfer rates between units and NHS trusts (for home births) be explained by the known characteristics of the unit or other aspects of the organisation and delivery of services?*

- There was greater variation in transfer rates than would be expected by chance in planned births in all non-OU settings and this variation was not explained by maternal characteristics.
- In planned AMU births, higher staffing levels were associated with higher transfer rates in multiparous women, but we cannot rule out the possibility that this association may reflect some unmeasured characteristic of AMUs with higher staffing levels.

- In planned FMU births, larger FMUs tended to have lower transfer rates in nulliparous women, although not all associations tested were significant; and FMUs situated further from the nearest OU tended to have higher transfer rates. However, FMU size and distance were correlated (more distant FMUs tended to be smaller) and it was not possible to determine whether FMU size and distance had independent effects. These two characteristics explained only a small proportion of the variation in transfer rates.
- In planned home births, for both nulliparous and multiparous women we found a significant, but modest, downward trend in transfer rates with increasing number of home births; trusts with more home births tended to have lower transfer rates.

*Do intrapartum transfers vary by time of day and day of the week in 'low risk' women planning birth in each setting?*

- Transfers did not occur uniformly throughout the day (24 hours) in FMUs and AMUs, but descriptive plots did not suggest a 'meaningful' pattern of peaks or troughs in these settings or in home births.

*Urgency and duration of transfer from FMUs and planned home births:*

*What is the timing and duration of transfer in planned home and FMU births?*

*In planned home and FMU births, does the duration of transfer differ for women transferred for reasons likely to require more urgent transfer compared with women transferred for potentially non-urgent reasons?*

- The median total transfer duration (from the decision to transfer through to first assessment in the OU) was 60 minutes for FMU transfers and 49 minutes for home birth transfers. Median transfer duration was around 7-10 minutes shorter for transfers for 'potentially urgent' reasons.
- For transfers before birth (which constitute the majority of transfers), the median time from start of care in labour to decision to transfer was just over 5 hours.

Transfers for 'non-urgent' reasons, e.g. failure to progress in the first stage, tended to occur slightly later.

- Our analyses indicated that transfers from home tended to take less time to arrange than transfers from FMUs, although the difference was only a few minutes, and the median 'travel time' also tended to be slightly shorter for home birth transfers.

## Study 4: Time of day and day of week variations in interventions and maternal outcomes in 'low risk' women planning birth in different settings

### *Main research question*

- Do interventions and maternal outcomes vary by time of day and day of the week in births planned in each setting?

### *Methods*

#### *Population*

- 'Low risk' women planning birth an OU, AMU, FMU or at home.

#### *Main outcomes*

- Instrumental delivery, intrapartum caesarean, 'straightforward birth', 'normal birth'
- Secondary outcomes: augmentation and epidural analgesia.

#### *Analysis*

- We used logistic regression to investigate the associations between time of day/day of the week and each outcome measure, adjusted for maternal characteristics.
- Time of birth was classified as follows: weekday night (Monday – Thursday 17.00-08.59), weekday day or 'office hours' (Monday to Friday, 09.00 – 16.59) and weekend (Friday 17.00-Monday 08.59).

### *Results*

- In planned OU births, instrumental delivery was more likely, and 'straightforward birth' and 'normal birth' less likely, in births which occurred on weekdays during

'office hours' compared with births which occurred at night. In nulliparous women without 'complicating conditions' at the start of labour care we found that those who gave birth during weekday 'office hours' were less likely to have an intrapartum caesarean section compared with those who gave birth at night. Epidural analgesia was more common in births which occurred during weekday 'office hours' compared with weekday nights, particularly in multiparous women. Descriptive plots revealed an apparent 'peak' in augmentation and epidural in births which occurred at the end of the day and in the early evening.

- In births planned in AMUs and at home there was no clear association between time of day/ day of the week and any of our main outcome measures. In planned AMU births, multiparous women who gave birth on weekdays during 'office hours' or at weekends were more likely to have had their labour augmented, compared with those who gave birth on a weekday at night.
- In nulliparous women who planned FMU birth, those who gave birth during weekday 'office hours' were less likely to have an intrapartum caesarean section compared with women who gave birth at night. In multiparous women, those who gave birth on weekdays during 'office hours' or at weekends were less likely to have a 'normal birth', compared with those who gave birth on a weekday at night. Epidural use was more common during weekday 'office hours' in this group.

### Study 5: The characteristics and management of 'higher risk' women in non-OU settings

*Main research questions*

- What are the socio-demographic and clinical characteristics of 'higher risk' women who plan birth in non-OU settings?
- What is the risk of transfer in 'higher risk' women in each setting; how does this compare with the risk of transfer in 'low risk' women and to what extent are risks modified by the presence of 'complicating conditions' at the start of care in labour (such as prolonged rupture of membranes)?

- Does the presence of clinical risk factors or 'complicating conditions' influence the timing of transfer?
- What is the risk of an adverse perinatal outcome in 'higher risk' women planning birth at home compared with (i) 'low risk' women who plan birth at home and (ii) 'higher risk' women who plan birth in an OU?
- What is the risk of intervention or adverse outcome requiring obstetric care in 'higher risk' women who plan home birth compared with 'higher risk' women who plan birth in an OU?

## *Methods*

### *Main study population*

- Women with known medical or obstetric risk factors ('higher risk' women) planning birth in different settings, excluding women with planned induction of labour.
- Some analyses were conducted in the restricted population of 'higher risk' women without 'complicating conditions'; in 'low risk' women; and in the restricted population of 'low risk' women without 'complicating conditions'.

### *Main outcome measures*

- Perinatal: composite measure of adverse perinatal outcome encompassing 'intrapartum related perinatal mortality and morbidity' (the original Birthplace primary outcome) and neonatal unit admission within 48 hours for more than 48 hours. For comparability with previous analyses, we also considered the original Birthplace primary outcome on its own: this was a composite of (intrapartum stillbirth, early neonatal death, neonatal encephalopathy, meconium aspiration, brachial plexus injury and fractured humerus or clavicle).
- Maternal: composite of intrapartum interventions and adverse outcomes requiring obstetric care (augmentation, instrumental birth, intrapartum caesarean section, general anaesthesia, blood transfusion, third or fourth degree perineal trauma, maternal admission to higher level care).

- Transfer to an OU during labour or within 24 hours of birth.
- Time from start of labour care to decision to transfer.

*Analysis*

- We used Poisson regression to investigate the associations between planned place of birth and the study outcomes, adjusted for maternal characteristics.
- Transfer timing and duration was analysed using methods described in Study 3 above.
- A sensitivity analysis was conducted in which we changed the length of stay criteria for the neonatal admission component of the perinatal outcome measure to admission within 48 hours for more than 4 days.

*Results*

*What are the socio-demographic and clinical characteristics of women known to be at 'higher risk' of complications prior to the onset of labour who plan to give birth in non-OU settings?*

- 'Higher risk' women who planned birth at home or in an FMU were more likely to be older, White, multiparous, married or living with partner and living in less deprived areas compared with 'higher risk' women who planned OU birth. 'Higher risk' women who planned birth in an AMU were more similar to the OU group.
- Compared with 'higher risk' women planning OU birth, those planning birth in a non-OU setting were less likely to have multiple risk factors and had a different distribution of risk factors. Having a BMI>35kg/$m^2$ was common in all planned birth settings. Previous caesarean section was the most common risk factor in multiparous 'higher risk' women planning OU birth, but this was also a common risk factor in 'higher risk' women planning home birth. Pre-eclampsia or pregnancy induced hypertension was less common in 'higher risk' women planning non-OU birth, while other risk factors, e.g. post-term pregnancy, were more common. Fewer 'higher risk' women planning birth in the non-OU settings had 'complicating

conditions' noted at the start of care in labour compared with 'higher risk' women planning OU birth.

*Pattern of transfer in 'higher risk' women and 'low risk' women with 'complicating conditions' who plan birth in a non-OU setting:*

*How are 'higher risk' women who present for planned birth in a non-OU setting managed with respect to transfer? For example, for women who are transferred, what is the distribution of time from start of labour care to the decision to transfer? Does the decision to transfer and timing of transfer depend on maternal characteristics or the presence of other medical/obstetric risk factors?*

*How are 'low risk' women managed with respect to transfer from non-OU settings when they are found to have 'complicating conditions' at the start of care in labour?*

**'Higher risk' women**

- The proportion of 'higher risk' women who were transferred to an OU during labour or after the birth was broadly similar in all three non-OU settings (46- 56% in nulliparous women and 18-23% in multiparous women). Compared with the other two groups, more women planning birth in an AMU were transferred during labour and fewer after birth. Compared with the planned home birth group, more 'higher risk' women planning birth in a midwifery unit were transferred primarily because they had risk factors which made them ineligible for non-OU birth.
- In the planned home birth group, after adjustment for maternal characteristics, 'higher risk' multiparous women were more likely to be transferred compared with 'low risk' multiparous women, but there was no difference in the risk of transfer between 'higher' and 'low risk' nulliparous women.
- In the planned FMU and AMU groups, 'higher risk' women were more likely to be transferred compared with 'low risk' women.

- In all three non-OU settings decisions to transfer were made sooner in 'higher risk' women who had 'complicating conditions' noted at the start of labour care compared with those who did not.

**'Higher risk' women compared with 'low risk' women with 'complicating conditions' noted at the start of care in labour**

- Women without known pre-existing risk factors who were found to have 'complicating conditions,' such as prolonged rupture of membranes, meconium staining and breech presentation, consistently had higher transfer rates than 'higher risk' women without 'complicating conditions' and appeared to be transferred sooner after the start of labour care than both 'low' and 'higher risk' women without 'complicating conditions'.

*Is there any evidence that in 'higher risk' women, the increased risk of adverse perinatal outcomes observed in planned home births relative to planned OU births is attributable to the planned delivery setting as opposed to differences in the clinical characteristics of the two groups?*

- Compared with 'low risk' women planning home birth, 'higher risk' women planning home birth had a significantly higher risk of our main perinatal outcome ('intrapartum related mortality and morbidity' or neonatal admission within 48 hours for more than 48 hours).
- In 'higher risk' women, compared with planned OU birth, planned home birth was associated with a significantly reduced risk of an adverse perinatal outcome (defined as above). The difference reflected a higher neonatal admission rate in planned OU births. This finding was not materially altered by adjusting for maternal characteristics or risk factors, and remained of the same order when the definition of the neonatal admission component of the outcome measure was changed to admission for more than four days.

- When the measure of adverse perinatal outcome was restricted to include only 'intrapartum related mortality and morbidity', a measure that encompassed intrapartum stillbirth, early neonatal death and specific intrapartum related morbidities (the original Birthplace primary outcome), planned home birth was not associated with a significant difference in risk compared with planned OU birth, but the direction of effect was reversed with a higher proportion of adverse outcomes in planned home births. Because of the small sample size the analysis of this uncommon outcome had limited power to detect a difference in risk, and it was not possible to adjust for maternal characteristics other than parity.
- Planned home birth was associated with a reduced risk of maternal intervention or adverse outcome requiring obstetric care and an increased probability of having a 'straightforward birth' compared with planned OU birth.

## Conclusions

### *What this project adds*

- Differences between units' intervention rates are not explained by the characteristics of the women planning birth in them. Our findings suggest that some aspects of configuration of care may be associated with higher intervention rates in 'low risk' women planning OU birth and that FMUs and home birth services with a higher 'volume' of births may have lower rates of some interventions, however the magnitude of these significant associations is small. .
- 'Low risk' women who plan birth in a non-OU setting have a lower risk of intervention during labour and birth, irrespective of ethnic background, age or relative socio-economic disadvantage, compared with women who plan birth in an OU.
- Nulliparous women aged 35 or older or whose pregnancy is prolonged (41-$42^{+0}$ weeks' gestation) have a 40-50% chance of transfer if they plan birth in a non-OU setting. 'Complicating conditions' identified at the start of labour care, e.g.

prolonged rupture of membranes, significantly increase the chance of transfer in both nulliparous and multiparous women.

- Transfer from an FMU or a planned home birth takes, on average, around 50-60 minutes from the decision to transfer to first assessment in the OU.
- Some interventions in planned OU births may be more likely in births occurring during weekday 'office hours' and intrapartum caesarean section may be more common at night.
- 'Higher risk' women who plan birth at home have fewer risk factors and a different distribution of risk factors compared with 'higher risk' women planning OU birth.
- Compared with 'low risk' women planning home birth, 'higher risk' women planning home birth have an increased risk of an adverse perinatal outcome.
- The babies of 'higher risk' women who plan birth in an OU are more likely to be admitted to a neonatal unit for more than 48 hours than the babies of 'higher risk' women who plan birth at home, but it is uncertain if this reflects a real difference in morbidity.

*Implications for practice and policy*

- **Expansion and reconfiguration of midwifery-led intrapartum care**
    - The expansion of non-OU intrapartum care could potentially reduce intervention rates in 'low risk' women, but major changes, for example centralisation of services in larger units (OUs and AMUs) or changes to unit admission criteria need to be accompanied by appropriate monitoring and evaluation.
    - Among FMUs, larger units not too distant from an OU may achieve the lowest transfer and intervention rates, but smaller more remote FMUs are also associated with reduced intervention compared with planned OU birth and offer choice to women.

- The primary Birthplace findings, together with the findings of this study support a policy of increasing provision of home birth services to support multiparous women who wish to plan birth at home.

- **Clinical thresholds for intervention and transfer**
  - Time of day variations in intervention in planned OU births suggest that non-clinical factors may be leading to an 'excess' use of epidurals and augmentation in women labouring during 'office hours'. Obstetric units need to examine whether their practices and procedures, and staffing levels and skill mix, contribute to this and implement strategies to promote 'normal birth' and reduce unnecessary interventions.
  - Our findings add to the evidence of a marked age-related increase in interventions, including augmentation, instrumental delivery and intrapartum caesarean section, in nulliparous women. There is a need for further investigation of factors contributing to higher intervention rates at older ages.
  - The high neonatal admission rate in planned OU births at term is costly and the separation of mother and baby may have negative consequences. Prolonged admission of term babies with suspected sepsis or hypoglycaemia might be a suitable topic for local audit.
- **Informing women's choices**
  - Some groups of women, including older nulliparous women and women more than a week past their due date, have a high probability of transfer. Advice to women considering where to plan birth should include information about the chances of transfer and of obstetric intervention.
- **Routine maternity data systems**
  - Changes are required to routine maternity data systems to facilitate monitoring of outcomes by planned place of birth and to enable the main Birthplace analyses to be repeated routinely.

*Areas for further research*

- **Research to support strategies to safely reduce intervention rates in OUs and maintain low intervention rates in planned births in non-OU settings**
    - Comparison of aspects of labour care in different settings.
    - Exploration of factors underlying the time of day variations in intervention rates in OUs.
    - Research into the mechanisms that lead to lower intervention rates in midwifery-led care.
- **Understanding women's preferences and choice**
    - Research to explore aspects of choice that women value and the factors that influence their preferences and choices.
- **'Higher risk' women**
    - Research to determine why some women with commonly occurring risk factors choose to plan birth in non-OU settings.
    - Research into outcomes for women with common risk factors such as BMI>35kg/$m^2$ and post-term pregnancy who plan birth in an AMU.
- **Neonatal unit admission** Research exploring the reasons for the high admission rate in planned OU births at term.