

## Modelling of maternity services in England

### Summary

This paper sets out how we used a modelling technique called ‘discrete event simulation’ to investigate a local maternity service.

### Background

In November 2013, our report *Maternity services in England* (HC 794, Session 2013-14) examined the performance and management of maternity services. As part of this, we carried out a modelling exercise to provide an insight into local management issues and the resources required to meet the Department of Health’s policy objectives for maternity services.

### Method

We used a **discrete event simulation** (DES) to model maternity services at a trust in England. The selected trust had an urban hospital site with both an obstetric unit and an alongside midwifery unit, and a separate freestanding midwifery unit.

The regional NHS commissioning support service had forecast how the demand for maternity services could change in the next 5 years. However, it had not calculated the likely effect of the change on resource requirements. To understand what pressures maternity services are likely to face, we used these forecasts to formulate scenarios for changes in demand and resource use. The scenarios included an increase in the number and complexity of births and a reduction in average length of stay. We also tested the resource implications of fully implementing the ambition for one-to-one care during established labour.

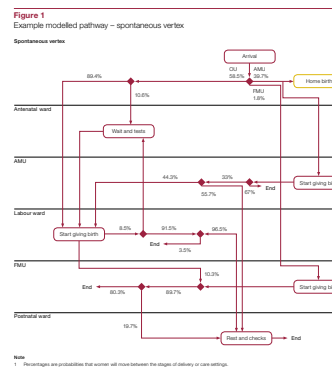
We drew up a series of care pathways, based on clinical guidance and discussions with staff at the trust. We focused on care during admission for potential delivery, so the pathways were for:

- 1 Spontaneous vertex (**Figure 1**)
- 2 Emergency caesarean section
- 3 Elective caesarean section
- 4 Instrumental births (ventouse and forceps)
- 5 No birth (women that are admitted but do not give birth, for example ‘false alarms’)

For each of these pathways, we defined the possible transfers from one facility (e.g. unit, ward, theatre) to another, and the corresponding likelihoods of women following each separate route through the pathway.

The DES model allowed us to use a real-time calendar to model care scenarios. Information on resource availability was integrated into the modelled pathways helping us to identify potential resource issues which, for maternity care, include the availability of beds, theatres and midwives.

During the development phase, we presented the model to a number of modelling and clinical specialists for comment. We used Simul8 software for the modelling.



Click to enlarge

### Data

We obtained data on women’s progress through the trust’s maternity services from: the patient administration system; Evolution (the IT system used by the midwives); and the separate theatre dataset. From each source, we extracted data for 2011-12 and 2012-13.

We undertook a range of data-cleaning exercises including:

- comparing the time stamps on the various data to assess which were the most realistic; and
- removing outliers that were likely to result from a coding error (for example, negative lengths of stay).

To ascertain the maximum available resources (beds, theatres, midwives), we used the trust’s response to the survey of maternity services, which was another part of our study methodology. We determined the resource constraints – e.g. the availability of staff and at which stages during each pathway they would be required to provide care – by interviewing trust staff and considering National Institute for Health and Care Excellence (NICE) guidance.

## Limitations

There are issues with the quality of data, which mean that the model's outputs should be interpreted cautiously. The issues include inconsistencies in the times recorded for mothers progressing to the different stages of labour.

The model is not intended to be used to suggest a resource level for trusts across England. Instead, we focused on a single trust to better understand the risks and challenges faced by the providers of maternity services.

## Results

The model suggests that, for the selected trust, bed numbers are sufficient and could probably absorb a relatively substantial increase in demand for maternity care. As demand increases, the postnatal ward is shown to be the first ward to become full.

There is, however, evidence that providing one-to-one care during labour at all times is very challenging. We observe that for about 23.5 per cent of the time (the red bars in **Figure 2**) there are more women in labour and in theatre than available midwives, and therefore it is not possible to provide one-to-one care for all women. An additional three midwives would allow for one-to-one care for all but 5 per cent of the time.

Our work found that increased use of the freestanding midwifery-led unit, which has been relatively under-used, would ease resource pressures elsewhere in the trust. It also suggests that reportedly achievable reductions in lengths of stay may provide a way of releasing substantial capacity.

## Uses

In our report, we recommended that clinical commissioning groups and trusts should agree long-term sustainable plans for the distribution and capacity of maternity services in their locality. Using methods such as those described here could help contribute to this goal, by helping the NHS to understand better the pressures that their maternity services face.

## Other resources

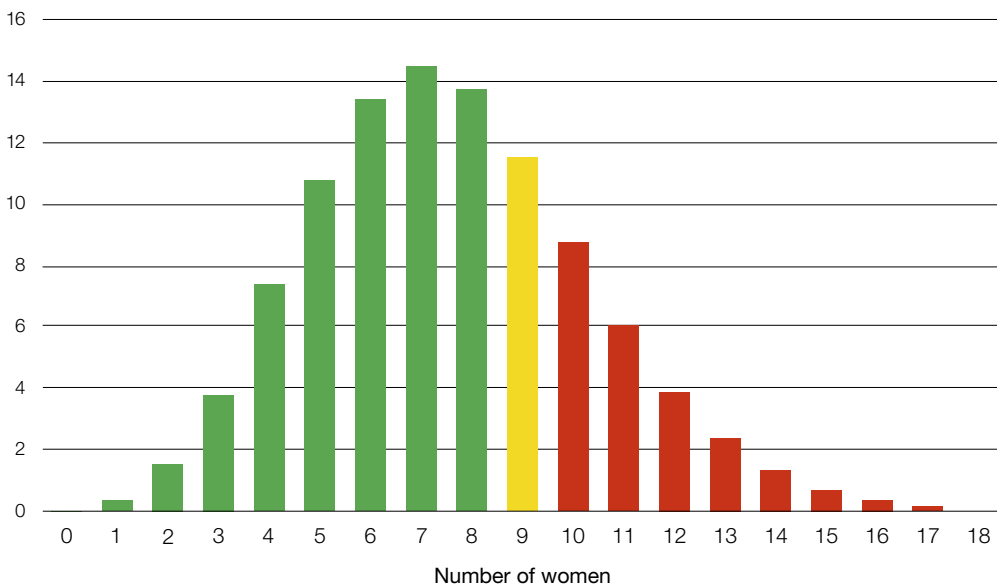
A more detailed summary of the modelling work is available on our website:

[www.nao.org.uk/report/maternity-services-england-2/](http://www.nao.org.uk/report/maternity-services-england-2/)

## Figure 2

### Women in labour ward

Percentage of time (%)

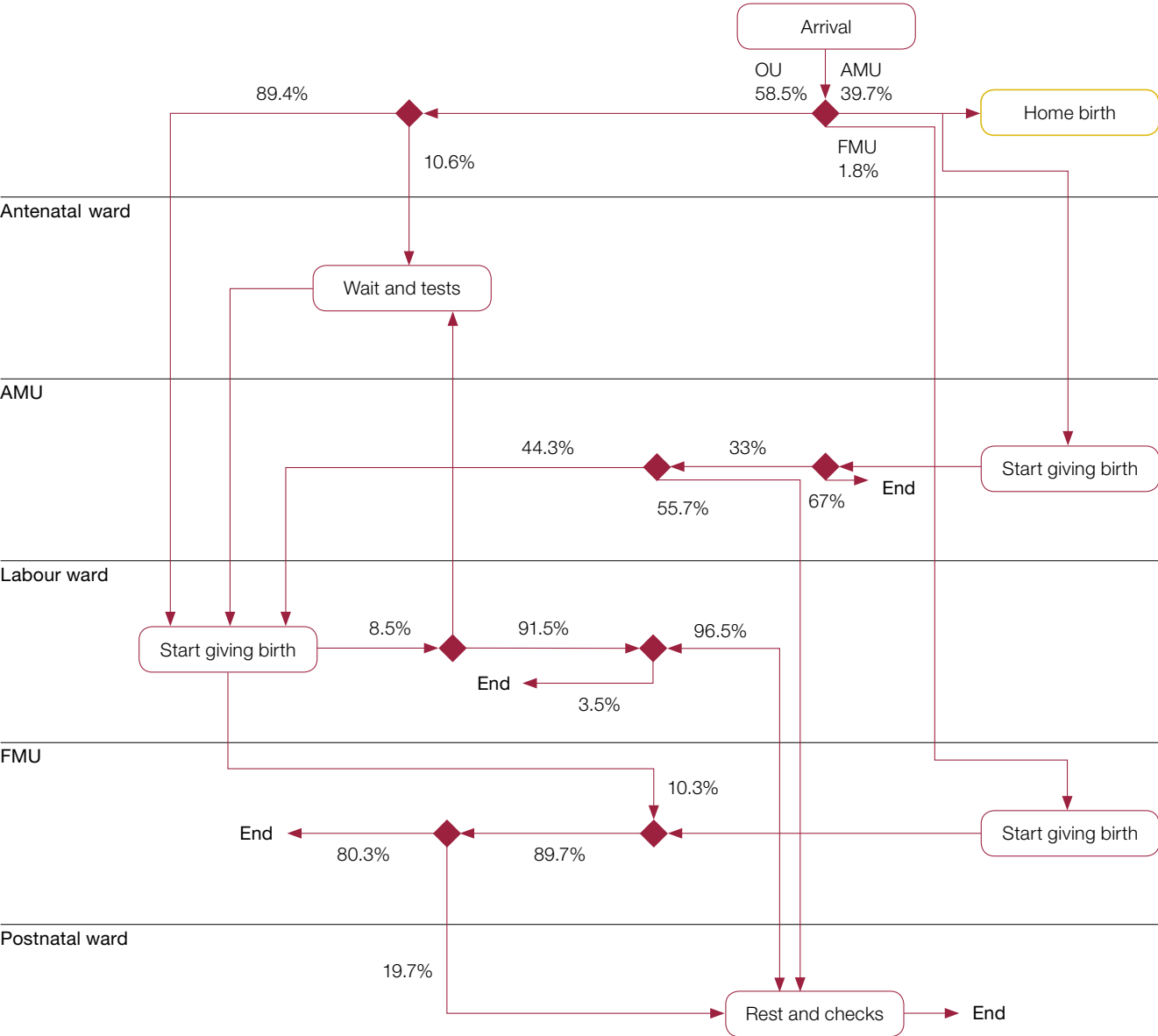


### Note

1 Amber bar shows the current number of midwives at these times.

**Figure 1**  
Example modelled pathway – spontaneous vertex

Spontaneous vertex



**Note**  
1 Percentages are probabilities that women will move between the stages of delivery or care settings.