Royal College of
Obstetricians and Gynaecologists

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MEDICINE

Patterns of Maternity Care in English NHS Hospitals

2011/12

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Abbreviations

HES	Hospital Episode Statistics
HESID	Hospital Episode Statistics Identification Number
HSCIC	Health and Social Care Information Centre
ICD-10	International Classification of Diseases, 10th edition
LSHTM	London School of Hygiene and Tropical Medicine
NICE	National Institute for Health and Clinical Excellence
OPCS	Office of Population, Censuses and Surveys Classification of Surgical Operations and Procedures, 4th revision
RCOG	Royal College of Obstetricians and Gynaecologists
VBAC	vaginal birth after caesarean section

Glossary of terms

Case mix

Clinical and demographic characteristics of patients affect both the demands placed on the service and the outcomes of care. Case mix is a term used to refer to how similar the patient groups are in an organisation and should be taken into account when comparing organisations.

Cephalic

The normal presentation at childbirth where the fetus is in a longitudinal lie and the head enters the pelvis first.

Fairness

The extent to which an indicator used for comparative purposes takes into account differences in case mix between hospitals or units.

Hospital Episode Statistics (HES)

A data 'warehouse' that includes records of all inpatient admissions and day cases in English NHS hospitals, with the data being extracted from local patient administration systems.

HES maternity tail

In HES, each episode related to the delivery of a baby can capture details about the labour and delivery (for example, parity, mode of delivery, gestational age, birthweight) in supplementary data fields known as the HES 'maternity tail'.

Indicator

A statistic that can be used to describe levels of performance that, in turn, can help identify possible problems and/or opportunities for improvement within a service.

Intrapartum

The medical term relating to the time spanning labour and delivery

Multiparous

The medical term used to describe a woman who has given birth before.

Outcome indicator

A type of indicator which measures the outcome of care received. Outcome indicators can be difficult to interpret as differences between organisations do not necessarily reflect differences in the quality of care.

Primiparous

The medical term used to describe a woman who is giving birth for the first time.

Process indicator

A type of indicator which measures a process of care (what was done to whom, and when), for example, the instrumental delivery rate. Process indicators are valid measures of quality if they are based on strong evidence for a particular treatment or intervention: the more patients without contraindications who receive a proven therapy, the better.

Random variation

A statistical term that refers to the tendency for the estimated value of a parameter to deviate randomly from the true value of that parameter. In general, the larger the sample size, the lower the impact of random variation on the estimate of a parameter. As random variation decreases, precision increases.

Risk adjustment

When presenting figures for individual hospitals, indicators must take into account how similar the patient groups are at each organisation. Risk adjustment is a statistical technique that takes account of these factors, which are outside the control of care providers. It is essential for fair and meaningful comparisons across hospitals.

Routine data

Data routinely collected by hospitals for administrative purposes. The data are primarily intended for health service planning and guiding the reimbursement of health care expenses, but can also be used to study patterns of care. HES is an example of a routine database.

Statistical power

The ability of a statistical test to detect a meaningful effect. It depends on the sample size, significance level of the test, and the size of effect defined as meaningful.

Term

For the purpose of this report, a term pregnancy is defined as a gestation which has lasted for at least 37 complete weeks.

Validity

The extent to which an indicator reflects quality of care. An indicator is valid if differences in the values of the indicator across various providers reflect differences in the quality of care, and if it is clear which end of the indicator spectrum represents high quality.

Foreword

During the time frame of this report, there were almost 670 000 deliveries within the English NHS. Despite maternity care being one of the leading causes of admission to hospital, up until now there has been an astonishing lack of robust information on even simple clinical outcomes on a national basis.

Using data that are submitted routinely by each English NHS hospital, this report from the Royal College of Obstetricians and Gynaecologists (RCOG) has begun what I hope will become an annual account of the practice and outcomes of maternity care in England that will eventually encompass the whole of the UK. This report represents an important first step on a long journey to improve our ability to monitor and improve the quality of care for women and their families.

As we acknowledge in the report, the data on which our analyses are based are not as accurate as we would have liked; however, until these data are used to provide information to allow for meaningful benchmarking, encouraging clinicians to take ownership of their own hospital data and attempts to drive up quality will be difficult.

The introduction of a National Maternity Dataset for England from April 2013 should provide a rich and accurate source of information on the care of pregnant women. Its arrival is to be welcomed, as is a greater recognition of the need for measuring patient-reported outcomes and their experience of care. However, robust analysis and clinical commentary of this data will be required and I envisage the RCOG being able to provide this function. Another priority is to enable the linkage of mother and baby records so that we are able to have a complete picture of performance. It is what the profession needs and the public wants.

The RCOG is committed to supporting maternity services by producing robust and clinically meaningful information in a timely manner. I hope this will be the first of many such reports.

David Richmond
Vice President (Clinical Quality), Royal College of Obstetricians and Gynaecologists
May 2013

Executive summary

Challenges for maternity services

Maternity services make a fundamental contribution to all effective healthcare systems. In England in 2011–2012, almost 670 000 admissions to NHS hospitals resulted in the birth of a baby (Appendix 1).

For the vast majority of women in England, maternity services ensure that childbirth is safe for both mother and child (King's Fund, 2008). The rate of stillbirth is 5.4 per 1000 births, while direct maternal mortality is around 6 per 100 000 pregnancies. Nonetheless, the quality of care delivered by maternity units in the UK continues to attract a high level of scrutiny (King's Fund, 2008; Cantwell et al., 2011). The rates of stillbirth and maternal mortality are higher than in many other European countries (Hogan et al., 2010; Cousens et al., 2011). There is also substantial variation within England itself. Outcomes vary among hospitals and across women from different socio-economic and ethnic backgrounds (RCM, 2011; Cantwell et al., 2011; CMACE, 2011). Regional variations exist in the proportion of term babies admitted to specialist neonatal care, as well as the rate of emergency readmissions of babies within 14 days of birth (RCPCH, 2012).

Performance measurement in maternity care

The growth of evidence on variation in maternity care and outcomes has coincided with increasing demands on hospitals to publish information on the quality of the care they provide (Darzi, 2008; Department of Health, 2012). Such information aims to fulfil various roles: informing policy making at regional and national levels; supporting clinicians and providers to improve care through comparative benchmarking, identifying unexpected levels of performance and protecting public safety, and providing consumer information to facilitate choice of maternity care provider.

However, there is little consensus about what information should be published. Many performance indicators for maternity care have been proposed. A recent review of RCOG guidance documents revealed 290 quality indicators covering 96 clinical categories, with up to 18 definitions for each category (Sibanda et al., 2013). Outcome indicators are of intrinsic interest and are crucial in the assessment of patient safety, but they pose problems for monitoring the quality of maternity care as poor outcomes are relatively rare. Maternal mortality may act as a sentinel indicator to investigation but the signal to noise ratio is too low to be used for quality improvement as big differences in the quality of care can be lost in mortality statistics (Mant and Hicks, 1995; Hayward et al., 2001).

Process indicators provide a valuable alternative. They are often based on strong evidence for a particular treatment or intervention, and so can be direct measures of the quality of care: the more patients without contraindications who receive a proven therapy, the better. However, using process indicators to measure quality in maternity care is complicated by the fact that the "best" care often depends upon the individual context, which includes the woman's preferences as well as factors such as parity, past obstetric history, fetal presentation, length of gestation, and the presence of pre-existing or pregnancy-related clinical conditions.

The RCOG Clinical Indicators Project

The Royal College of Obstetricians and Gynaecologists has initiated a programme of work to develop valid, clinically relevant, methodologically rigorous and technically robust performance indicators for maternity care that improve upon the comparative information currently available. This project, carried out in collaboration with the London School of Hygiene and Tropical Medicine (LSHTM), set

out to examine the validity of potential performance indicators, and to determine how successfully these could be used to compare performance between maternity units using available data.

This report describes the progress made towards this aim. We present a suite of eleven risk-adjusted indicators for English NHS maternity units that can be derived using Hospital Episode Statistics (HES) data. The selection and technical specification of the indicators was guided by a panel of clinical and methodological experts. The reported performance metrics are clinically relevant, methodologically rigorous, and technically robust, and in that way more authoritative than the comparative information published by others so far.

At present, there are insufficient data available to present a complete picture of the quality of maternity care in England. The eleven indicators selected for this report focus on five areas of intrapartum care: induction of labour; caesarean section; instrumental delivery; third and fourth degree perineal tears; and emergency maternal readmission. Additional indicators will be incorporated as new data become available. Key areas for future reports will be the development of neonatal outcome indicators, as well as measures of maternity service user experience.

Despite the limitations of the currently available data, the initial set of indicators suggests wide variation in both practice and outcomes between maternity units in England. The results are summarised in Table 1.

Table 1 Summary of findings

Indicator	Subset of population used	National mean (%)	Mean of bottom 10% of units (%)*	Mean of top 10% of units (%)*
Induction of labour rate	P,S,T,C	26.9	16.9	37.0
	M,S,T,C	21.4	13.5	29.4
Percentage of induced labours resulting in emergency caesarean section	P,S,T,C	30.2	20.4	40.3
	M,S,T,C	13.2	5.8	22.1
Percentage of spontaneous labours resulting in emergency caesarean section	P,S,T,C	11.6	7.0	17.2
	M,S,T,C	6.2	2.9	9.2
Elective caesarean section rate	P,S,T,C	2.8	1.2	5.0
	M,S,T,C	12.1	7.2	15.0
Percentage of elective caesarean sections performed before 39 weeks of gestation without clinical indication	S,T	30.3	18.0	52.5
Instrumental delivery rate	P,S,T,C	24.2	16.4	31.8
	M,S,T,C	7.5	3.8	11.5
Percentage of instrumental deliveries carried out by vacuum extraction (vacuum : forceps delivery ratio)	S,T,C	49.3	24.2	72.1
Percentage of attempted instrumental deliveries resulting in emergency caesarean section	S,T,C	3.1	1.1	7.0
Third and fourth degree perineal tear rate among unassisted vaginal delivery	P,S,T,C	4.0	2.0	6.8
	M,S,T,C	1.4	0.6	2.4
Third and fourth degree perineal tear rate among assisted vaginal delivery	P,S,T,C	6.9	3.0	11.0
	M,S,T,C	2.5	0.4	4.6
Emergency maternal readmission within 30 days of delivery	S,T,C,V	0.8	0.3	1.6
	S,T,C,CS	1.4	0.3	3.4

C = cephalic presentation; CS = caesarean section deliveries; M = multiparous women; P = primiparous women; S = singleton deliveries; T = term deliveries; V = vaginal deliveries;.

* After adjustment for maternal demographic and clinical risk factors available in the dataset.

The indicators were derived for appropriate subsets of all deliveries. For all indicators, multiple and preterm deliveries were excluded. In this way attention is focused on a more homogeneous group of women whose maternity care is most affected by clinical uncertainty. Additional exclusions were applied to each indicator, as detailed in the main body of the report.

We would, however, caution against the over-interpretation of the observed patterns of care. Variation between organisations can arise from factors other than the quality of care, including the influence of random fluctuations and differences in data quality and case mix between hospitals. Conclusions about quality of care can only be reasonably drawn after differences due to these factors are excluded. At this stage of the project, the influence of all these factors cannot be differentiated. In particular, there is a need to improve the completeness and consistency of routine maternity data and we hope that this report will act as a stimulus for clinicians and maternity units to improve their data collection activity.

Despite these limitations, or rather because of them, the results in this report must not be ignored. The report should act as a trigger for reflection by local services upon practices and lead towards improvements in terms of data quality, indicator design and, ultimately, the quality of maternity care.

Key recommendations

For maternity units:

1. *Examine causes of variation*. NHS maternity units should examine the figures from this report and identify causes of variation at a local level. These indicators should be used as a basis for reflection on current practice.
2. *Data quality improvements*. Units should aim to enter complete data into the HES maternity tail. Units should also ensure standard coding definitions are followed to improve consistency, such as the distinction between induction and augmentation. Clinicians must take ownership of their own data in order to drive up quality.

For researchers:

1. Work must be undertaken to clarify 'acceptable ranges' of performance for intrapartum care processes and outcomes.
2. There is also a need to better understand the relationships between different process and outcome indicators.
3. Work is required to link routine data with other sources of data in order to create a balanced suite of indicators. Priority areas should be neonatal outcomes and measures of user experience.

1 Introduction

There are increasing demands on providers to monitor and publish information on the quality of the care they provide and the outcomes achieved for patients. One stimulus for this is the UK Government's commitment to developing an NHS Outcomes Framework to support the commissioning of NHS services. The framework will be used to assess performance, drive forward quality improvement, increase transparency and aid accountability in the NHS (Department of Health, 2012).

Maternity services are a major component of NHS hospital services. Obstetric admissions are among the leading causes of hospitalisation for women in England, accounting for 668 936 discharges in 2011–12 (NHS IC, 2012).

The safety and quality of care delivered by maternity units in the UK continues to attract a high level of public interest. Although maternal death is a rare event in the UK, the rate is considerably higher than many other European countries (Hogan et al., 2010), and the UK's stillbirth rate is among the highest in developed nations (Cousens et al., 2011). Following a number of high profile cases, an independent inquiry was established to examine the safety of NHS maternity services, which concluded that, "the overwhelming majority of births in England are safe; however, some births are less safe than they could and should be" (King's Fund, 2008 p.2).

Recent reports have also served to highlight the inequality in maternal death rates between hospitals and among women from particular socio-economic and ethnic backgrounds (Commission for Healthcare Audit and Inspection, 2006; Cantwell et al., 2011), as well as regional variation in the choices given to women regarding their delivery care (NHS IC, 2012; Redshaw et al., 2010; Care Quality Commission, 2010).

In addition to these studies using special data collections, clinical practice and outcomes within maternity services are increasingly being described using routinely collected hospital data. These datasets, although intended primarily for health service planning and guiding the reimbursement of healthcare expenditure, are now recognised as a valuable source of data for measuring maternal outcomes as well as monitoring the volume of use of particular obstetric procedures about which there are questions of overuse or underuse. Specific studies using routine maternity data have highlighted variation across hospitals in certain clinical practices such as the proportion of women undergoing emergency caesarean section (Bragg et al., 2010) as well as the timing of elective caesarean section (Gurol-Urganci et al., 2011).

A number of organisations are now using routine data to produce annual statistics for English NHS maternity services. These organisations include both public sector and voluntary organisations (such as the Health and Social Care Information Centre (HSCIC) and Birthchoice UK) and commercial companies (such as Dr Foster and CHKS) which aim to provide an information service to women, clinicians and/or hospital managers.

However, for various reasons, most maternity indicators currently being derived from routine data are not easy to interpret. This is partly due to the lack of clinical detail contained in routine data and the absence of evidence for best practice for particular obstetric situations. It is also at least in part related to the lack of validity of some of the measures currently being derived from routine data.

An example of a commonly used maternity indicator that is difficult to interpret is the overall caesarean section rate. Lower caesarean section rates are often assumed to reflect better care. However, there is also a threshold below which the caesarean section rate is too low and babies may be harmed. One problem is that there are no established guidelines for determining this threshold. A second problem is that as elective caesarean sections become increasingly popular, this measure may no longer be a reliable marker of quality of care but rather one of patient choice (NICE, 2011). Several techniques can aid the interpretation of this indicator, for example, stratifying the results by type of caesarean section or specific delivery characteristics (Robson et al., 1996; Main et al., 2006), or statistical adjustment that takes into account risk factors for caesarean section among different populations.

The difficulty faced by clinicians and managers in interpreting some of the currently available maternity statistics highlights the need to improve the usefulness of the information being produced on NHS maternity services. To address this issue, the Royal College of Obstetricians and Gynaecologists (RCOG) has adopted a strategic aim to develop a repository of clinical maternity data to provide information that can be used to enhance evidence-based practice within the specialty.

The purpose of this report is to describe the first phase of this work, namely the derivation and validation of a suite of indicators using currently available, routine English hospital data. This work represents a first step towards the development of a balanced suite of indicators that could be used by maternity services to monitor local obstetric care and improve quality of care. An important part of this first stage of the project has been the development of methods to enable fair comparisons of maternity services. This report describes the progress made towards achieving this aim.

Using these indicators, this report describes differences in practice and outcomes across maternity services in English NHS hospitals. However, we caution against the over-interpretation of the observed variation between hospitals. The causes of variation in maternity care are complex. Variation between organisations can arise from:

1. the influence of **random fluctuations**
2. differences in **data quality** between hospitals
3. differences in **case mix** between hospitals
4. differences in the **quality of care** provided.

Conclusions about quality of care can only be reasonably drawn after differences due to factors 1–3 are excluded. At this stage of the project, the influence of all these factors cannot be separated. In particular, there is a need to improve the completeness and consistency of routine maternity data within England and we hope that this report will act as a stimulus for clinicians and units to improve their data collection activity. A high-quality national database would facilitate the development of more robust and clinically meaningful indicators.

We acknowledge these limitations and recognise that this is the start of a long journey to improve quality of care in maternity services. We anticipate that the suite of indicators will expand over time to give a more complete picture of maternity care, from initial contact with antenatal services to postpartum care. Key areas for development will be neonatal outcomes and measures of maternity service user experience.

And yet, despite these limitations, or rather because of them, the results in this report must not be ignored. The report should act as a trigger for reflection by local services upon practices and lead towards improvements in data quality, indicator design and ultimately to the quality of maternity care.

Box 1 How were the indicators developed? A summary

- The selection and technical specification of the indicators was guided by a panel of clinical and academic experts, including representatives from the obstetric and midwifery professions, statisticians and health service researchers.
- 194 existing maternity indicators were identified from 30 sources and assessed according to explicit evaluation criteria: validity; fairness; statistical power; and possibility of technical specification using Hospital Episode Statistics (HES) data.
- Eleven indicators were selected for further development.
- Each hospital's data quality was carefully assessed. Indicators were not calculated for hospitals with high levels of missing or inconsistent data in key fields.
- Indicators were derived for appropriate subgroups of women and risk adjusted for relevant demographic and clinical factors in order to allow fair comparisons to be made between units.
- Results are presented using funnel plots, which allow the size of each institution to be taken into account when comparing performance.

2 Data source

2.1 Data source: Hospital Episode Statistics

The indicators included in this report have been derived using Hospital Episode Statistics (HES) data. HES is a data 'warehouse' that includes records of all inpatient admissions and day cases in English NHS trusts, with the data being extracted from local patient administration systems. In future versions of this report, we hope to include similar data from the Patient Episode Data for Wales (PEDW) in Wales, the Information Services Division (ISD) in Scotland, and the Hospital Inpatient Statistics (HIS) in Northern Ireland.

In HES, each record contains data on the patient demographics (for example, age, sex, ethnicity, postcode), the episode of care (for example, hospital name, date of admission and discharge) and clinical information. Diagnoses for each patient are recorded using the International Classification of Diseases, 10th edition (ICD-10) (WHO, 2010). Procedures performed during an episode are coded using the Office of Population, Censuses and Surveys Classification of Surgical Operations and Procedures, 4th revision (OPCS) (NHS Connecting for Health, 2012). In addition, each episode related to the delivery of a baby can capture details about the labour and delivery (for example, parity, mode of delivery, gestational age, birthweight) in supplementary data fields known as the HES 'maternity tail'.

One of the advantages of HES is that each patient is assigned a unique identifier (HESID). This makes it possible to study longitudinal patterns of care, such as rates of unplanned readmission following a particular procedure, as well as enabling the tracking of patients between hospitals.

2.2 Quality of HES data

Using HES data has several advantages for trying to describe patterns of care and outcomes in English NHS maternity services. Firstly, it is readily available and is therefore a cost-effective source of data. Secondly, over 96% of all deliveries in England occur in NHS hospitals and are therefore captured by HES (Birthplace in England Collaborative Group, 2011). This substantially reduces the risk of selection bias when deriving national and provider-level statistics. Similarly, this high level of completeness gives large sample sizes for indicators that are based on all deliveries. Thirdly, the data are able to capture multiple procedures and diagnoses at an individual level, and so provide a rich description of patient case mix.

Despite these advantages, there are also some important limitations. Some commentators have raised concerns about the accuracy and completeness of diagnosis and procedure coding in HES (Evans et al., 2010). However, other studies have demonstrated that the majority of NHS trusts submit good-quality data to HES that conform to national recommendations (Knight et al., 2013; Kirkman, 2009; Nouraei, 2009). Moreover, by combining diagnosis, procedure and administrative codes, researchers have been able to develop coding frameworks that allow assessment of miscoding to identify hospitals with divergent coding practices (Johal et al., 2012). A recent systematic review of discharge coding accuracy in routine UK data found that primary diagnosis accuracy has improved from 73.8% to 96.0% in the ten years since the introduction of Payment by Results. The authors concluded that routinely collected data are sufficiently robust to support their use for research and managerial decision making (Burns et al., 2012).

Particular concerns have been raised about the credibility of HES maternity data. In a letter published in the *BMJ* in 2012, Brennan et al. (2012) expressed their surprise at finding over 17 000 male inpatient admissions to obstetric services between 2009 and 2010 in HES. This letter generated widespread concern that basic information such as the sex of the patient was being erroneously

entered on a large scale. However, a reply from the NHS Information Centre revealed that almost all of these episodes were related to male newborns and were therefore likely to have been birth-related episodes treated by associate specialties (Roebuck, 2012). This example highlights how, at first glance, raw HES data can be misleading if not subjected to careful data quality checks and systematic analysis.

A second limitation of HES maternity data is that it does not capture all relevant clinical information about patients. For example, certain maternal risk factors such as body mass index, smoking and alcohol consumption are not recorded, meaning that these factors cannot be taken into account in risk adjustment models.

Third, a national data warehouse like HES raises important issues around the standardisation of data definitions among units. Divergent coding practices can undermine meaningful comparisons and lead to inappropriate incentives and penalties being given to hospitals. Discrepancies in coding tend to occur where confusion exists about the definition of a particular data item. For example, based on our analysis of HES maternity data, it appears that some units are failing to differentiate between induction and augmentation of labour, leading to an overestimation of the induction of labour rate. This might apply to other data fields as new diagnostic definitions emerge. For example, the definition of gestational diabetes is likely to change, and the uptake of the new criteria into clinical coding practices will inevitably vary between hospitals. Efforts are required on the part of the HSCIC to ensure that NHS hospitals with known divergent coding practices are brought in line with national recommendations.

Finally, the completeness of the HES maternity tail varies among NHS trusts. Key data items such as the parity, onset of labour, gestational age and birthweight are missing in over 20% of records overall, with some NHS trusts not submitting usable maternity tail data for any deliveries. The completeness of the maternity tail has improved in recent years. Nonetheless, it is often a limiting factor for enabling the construction of precise performance indicators.

To overcome these problems, we have taken steps to ensure that the maternity statistics we derive from HES are as valid and reliable as possible by:

1. carefully cleaning the data to remove duplicates and records not relating to a delivery episode
2. identifying units with missing or inconsistent data
3. making appropriate adjustments for case mix variation (see Chapter 4 and Appendix 2).

Through this robust analysis of the data, we hope to challenge the perception that HES data is inaccurate and enable clinicians to understand its potential more clearly. We hope that, in turn, this will lead to improvements in the quality of routine maternity data.

3 Review of maternity indicators

3.1 What makes a good indicator?

An indicator is a statistic that can describe levels of clinical performance, and that can consequently help to identify possible problems and/or opportunities for improvement within a service. Such information aims to fulfil various roles: informing policy making at a regional or national level; supporting clinicians and providers to improve care through comparative benchmarking, identifying unexpected levels of performance and thereby protecting public safety; and providing consumer information to facilitate choice of maternity care provider. Indicators can serve as a basis for reflection on current practice or act as the starting point for monitoring changes in clinical practices and outcomes over time.

Performance indicators may cover the *structure* of care (the setting in which care is organised and delivered); the *processes* of care (what was done, to whom and when) or the *outcomes* of the care received (Donabedian, 2005). These categories of indicator each have relative strengths and weaknesses. Outcomes indicators are of greater intrinsic interest, but are often hard to interpret because differences in outcome across organisations may not necessarily reflect differences in the quality of care. Conversely, process indicators are often based on strong evidence for a particular treatment or intervention, and so can be direct measures of the quality of care: the more patients without contraindications who receive a proven therapy, the better.

In some cases, an indicator can be difficult to classify. For example, the emergency caesarean section rate could either be considered a process measure (as caesarean section is an intervention initiated by a clinician) or an outcome of the care received earlier in labour (for example, emergency caesarean section following induced labour).

The suitability of an indicator depends on a number of explicit criteria: validity; fairness; sufficient statistical power; and adequate technical specification (Table 2). In addition to these criteria, it is also important for a suite of indicators to be *balanced*. In other words, the suite should cover various dimensions of care to give a complete overall picture of the service.

Table 2 Checklist for the evaluation of quality indicators

Is this indicator *valid*?
Is it likely that differences in the indicator reflect the quality of care?
Is it clear which end of the indicator spectrum reflects better quality of care?
What is the *statistical power*?
What is the average number of patients within each unit with the procedure or outcome of interest?
What is the average number of relevant events within each unit?
What is the chance that a true outlier will be detected (in a unit of average size)?
Is the indicator *fair*?
How big are the case mix differences of patients treated by different units?
How well are important case mix differences captured by the available data?
How well does the risk adjustment approach reduce the impact of case mix differences?
Is the *technical coding* of the indicator and other relevant clinical information *adequate*?
How well can the patient population of interest be defined with the available codes?
How well can the important case mix difference be captured by the available codes?
How well can the procedures or outcomes that define the indicator to be captured?

Numerous monitoring criteria have been proposed for maternity services, but there has been little consensus about which indicators should form a balanced suite for monitoring purposes. The measurement of quality in maternity care is made more complicated by the fact that the 'best' obstetric care pathway is dependent upon various factors, including parity, past obstetric history (for example, previous stillbirth, previous caesarean section), fetal presentation (for example, cephalic, breech, transverse), length of gestation, and the presence of pre-existing or pregnancy-related clinical conditions.

For maternity care, a balanced suite of indicators would ideally include structural, process and outcome measures relating to how a unit treats different women in different categories of obstetric risk throughout the maternity pathway, from antenatal to postnatal care services. This ideal set would also include measures of user experience, which are not available in routine datasets but are nonetheless essential for understanding the outcome of care and must be captured along the entire maternity care pathway. The Care Quality Commission conducts a triennial survey of maternity service users. Unfortunately, these data were not available for the time period covered by this report. A survey is being planned for 2013, and we envisage that measures of experience will feature in future versions of this report. We will also seek to incorporate the data from the new "friends and family test" that is being rolled out in late 2013 (Department of Health, 2013).

3.2 How were the indicators selected?

The process to select the indicators for this report began with a rapid literature review of the indicators used to describe the clinical practices and health outcomes of maternity services in Europe, Australia, New Zealand and the USA. We identified 194 different indicators from 30 sources (Appendix 3). Of these, 107 were process measures, 62 were outcome measures and 25 were structural measures. 31 related to the antenatal period, 73 to intrapartum care, 56 to obstetric complications, 20 to neonatal care and 14 to the postpartum period. Precise definitions for each indicator were extracted where these were stated in the reviewed documents.

Next, we determined which of the indicators could be derived using HES maternity data. This resulted in a shortlist of 28 indicators. The shortlisted indicators were grouped into six themes: induction of labour; mode of delivery; anaesthetic use; perineal tears; maternal morbidity; and emergency readmission. A panel of clinical and academic experts, including representatives from the obstetric and midwifery professions, statisticians and health service researchers, assessed each shortlisted indicator according to specific criteria in Table 2. A list of panel members is presented in Appendix 4.

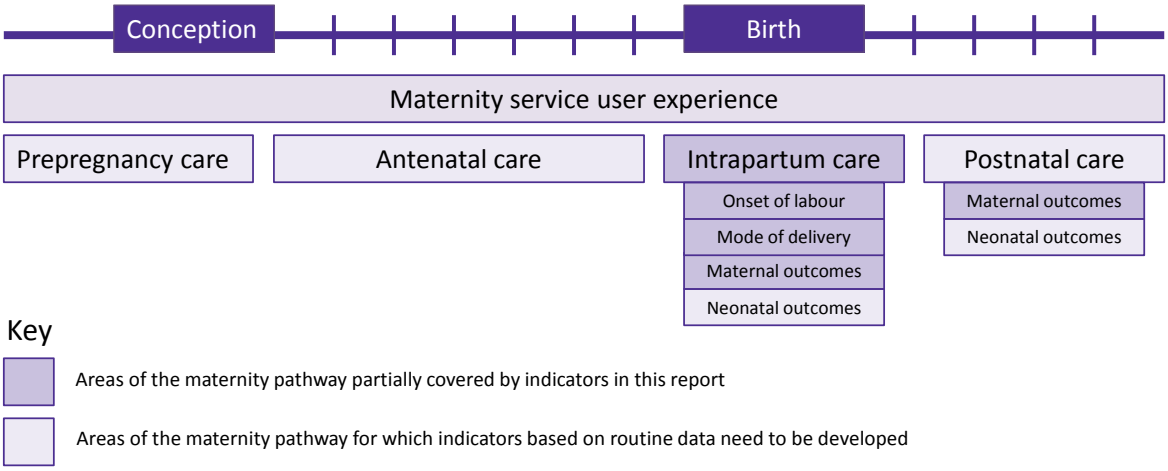
The results of the panel's evaluation are presented in Table 3. Eleven indicators were selected for further development, including both process and outcome measures. The final selection is heavily skewed towards intrapartum care and represents only what is currently possible to derive using routinely available data, rather than an ideal set of maternity indicators covering all aspects of quality, from antenatal through to postnatal care (Figure 1). Nonetheless, this work is an important first step in allowing the clinical effectiveness and efficiency of maternity care in England to be monitored locally.

It is important to note that the selected indicators are not entirely independent of one another. The relationships between them are often complex. For example, a high caesarean section rate may be reflected in a lower rate of instrumental deliveries, which may in turn affect the rate of failed instrumental deliveries, third and fourth degree tears and emergency readmissions. These complex relationships must be borne in mind by maternity units when interpreting their results. We plan to undertake further work to examine the relationships between indicators at a national level in order to improve best practice guidance.

Table 3 Evaluation of potential intrapartum care quality indicators derivable from HES maternity data

Indicator	Selected (✓/×)	Reason for exclusion (if applicable)
Theme: Induction of labour		
Induction of labour rate	✓	–
Induction of labour resulting in emergency caesarean section	✓	–
Theme: Mode of delivery		
Elective caesarean section rate	✓	–
Emergency caesarean section rate	✓	–
Instrumental delivery rate	✓	–
Percentage of instrumental deliveries carried out by vacuum extraction (i.e. vacuum : forceps ratio)	✓	–
Caesarean section after failed instrumental delivery	✓	–
Unassisted delivery rate	×	Limited clinical usefulness (information already captured by other mode of delivery indicators)
Normal birth rate (defined as unassisted vaginal deliveries with a spontaneous onset of labour, without general, spinal or epidural anaesthetic)	×	Data quality issues (missing data and poor internal agreement)
Elective caesarean section without indication before 39 weeks of gestation	✓	–
Vaginal birth after caesarean section (VBAC)	×	Data quality issues (poor VBAC coding). Questionable validity given element of women's choice
Theme: Anaesthesia		
General anaesthetic rate (caesarean section deliveries)	×	Power issue (too rare an event) Data quality issues (missing data and poor internal agreement)
Epidural rate (vaginal deliveries)	×	Data quality issues (missing data and poor internal agreement)
Epidural resulting in instrumental delivery	×	Data quality issues (missing data and poor agreement)
Theme: Perineal tears		
Episiotomy rate (vaginal deliveries)	×	Data quality issues (coding reliability of episiotomy unknown)
Intact genital tract rate (vaginal deliveries)	×	Data quality issues (coding reliability of episiotomy unknown)
3rd/4th degree perineal tear rate (unassisted deliveries)	✓	–
3rd/4th degree perineal tear rate (instrumental deliveries)	✓	–
Other obstetric trauma rate	×	Power issue (too rare an event)
Theme: Maternal morbidity		
Eclampsia rate	×	Power issue (too rare an event)
Postpartum hysterectomy rate	×	Power issue (too rare an event)
Severe postpartum haemorrhage (PPH) rate	×	Technical specification not possible (no codes to indicate amount of blood loss)
Uterine rupture rate	×	Power issue (too rare an event)
Composite maternal morbidity indicator	×	Technical specification (development and validation work needed)
Prolonged labour resulting in emergency caesarean section	×	Data quality issue (coding reliability of prolonged labour unknown)
>2 nights in hospital following vaginal delivery	×	Deemed a poor indicator of maternal morbidity due to differences in hospital policy/capacity
>4 nights in hospital following caesarean section	×	Deemed a poor indicator of maternal morbidity due to differences in hospital policy/capacity
Theme: Emergency readmission		
Emergency readmission within 30 days of delivery	✓	–

Figure 1 Areas of the obstetric pathway covered by the indicators in this report



4 Deriving indicators for English NHS hospitals

4.1 Methodology used in this report

The development of the indicators followed a robust, systematic process in order to maximise their usefulness for supporting clinical quality improvement.

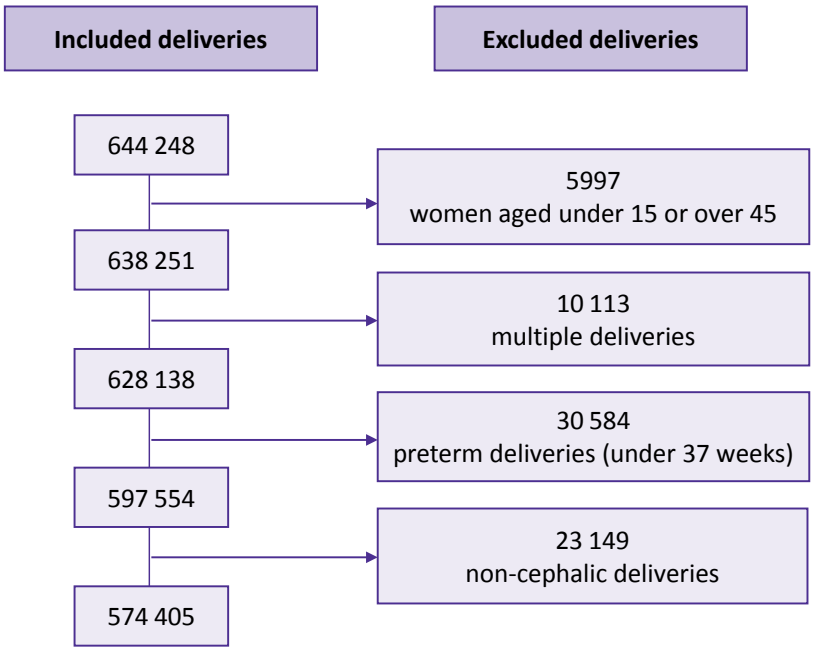
Selection of the cohort

The figures produced in this report are based on HES maternity data for the financial year 2011/12. Duplicate records were identified on the basis of HESID and date of admission. After removing duplicates, delivery records were defined as those which contained information about a delivery in either the maternity tail or the OPCS procedure fields.

The resulting sample of 644 248 deliveries was then restricted to women aged between 15 and 45 with singleton, term, cephalic deliveries (Figure 2). By concentrating on this group, attention is focused on the group of women whose maternity care is most affected by clinical uncertainty and which varies the most between providers (Robson et al., 1996; Main et al., 2006).

Methods were developed to identify hospitals with unreliable data in the fields required to calculate the indicators. These methods used to assess data quality for each indicator are described in Chapter 5. We have not calculated indicators for hospitals which failed the data quality tests for the required data item(s).

Figure 2 Data flow



Hospital level analysis

For simplicity, most previous publications of HES maternity data derive statistics for NHS trusts. This has the effect of masking differences between hospitals within a trust. For this report, we calculated the indicators at the level of the individual maternity unit. This allows us to investigate variation at the level most relevant to clinicians and maternity service users.

To discriminate between individual maternity units, we used information from two data fields in HES: provider code (procode) and treatment site (sitetret). Data from the 2011 RCOG Workforce Census were used to determine which of these data fields better defined each unit in HES, on the basis of the reported number of deliveries. Mergers which took place during the 2011/12 financial year were identified using data from the NHS Organisation Data Service. Maternity units with less than 1000 deliveries or which closed during the financial year were excluded, leaving 164 units. These units ranged in size from 1122 to 7566 (mean = 3943; SD = 1480).

Analysis and case mix adjustment

We present annual statistics for each English NHS maternity unit that met our minimum data standards. The statistics are defined as proportions and they correspond to the rate at which a particular event occurs within a group of women. The reference group of women (the proportion denominator) changes between the indicators.

When presenting figures for individual hospitals, indicators must take into account how similar the patient groups are at each organisation. Clinical and demographic characteristics of patients can affect both the demands placed on the service and the outcomes of care. Accounting for these risk factors, which are outside the control of care providers, is essential before fair and meaningful comparisons across hospitals.

In this report, we control for differences in the case mix between hospitals in several ways. First, the results of many indicators are stratified by parity because it has a major influence on pregnancy and delivery outcomes. Overall, the sample of analysed data contained primiparous (43.3%) and multiparous (56.7%) women.

Second, all indicators have been risk-adjusted for case mix using an appropriate regression model. This model adjusts for risk factors which are beyond the control of the provider such as age, ethnicity, level of socio-economic deprivation, and clinical risk factors. For each indicator, the demographic and clinical risk factors available in HES (Table 4) were included in the risk adjustment model on the basis of their relevance to the indicator in question. Multiple logistic regression was then used to estimate the probability of each woman in the sample having the outcome of interest on the basis of her characteristics. These probabilities were summed at the unit level to give each unit's predicted rate of the outcome. Risk adjusted rates were produced by dividing each unit's unadjusted rate by its predicted rate, and multiplying this ratio by the national mean rate. Further details are given in Appendix 2.

4.2 Presentation of data using funnel plots

A funnel plot is a graphical method for comparing the performance of institutions using cross-sectional statistics (Spiegelhalter, 2005a). The main advantage of this technique is that it takes the size of each institution into account. This is important because the amount by which a hospital's indicator value may vary from the national mean is influenced by random fluctuations that are related to the number of deliveries at its maternity unit (Figure 3).

The control limits within funnel plots highlight how much of the variation among organisations is over and above what would be expected due to chance alone. In some cases, this approach has been used to label organisations outside the funnel limits as outliers with 'good' or 'poor' levels of performance. We do not use funnel plots in this way and it is not our intention to label hospitals with indicator values beyond the outer control limits as outliers. We have used funnel plots only to show where there are substantial systematic (non-random) differences between maternity units.

Table 4 Demographic and clinical risk factors available in HES

Risk Factor	Categories	Frequency in 2011/12 singleton, term, cephalic delivery sample (%)
Maternal age	15–19	5.1
	20–24	19.0
	25–29	28.2
	30–34	28.8
	35–39	15.3
	40–45	3.6
Ethnicity	White	71.9
	Asian	10.9
	Afro-Caribbean	5.7
	Other	3.9
	Unknown	7.6
Level of deprivation (based on Index of Multiple Deprivation)	1 (least deprived)	14.8
	2	15.7
	3	18.4
	4	22.8
	5 (most deprived)	28.3
Parity	Primiparous	43.3
	Multiparous	56.7
Gestational age (completed weeks)	37–39	45.7
	40–41	35.5
	≥42	4.1
	Unknown	14.7
Birthweight	<2500 g	2.6
	2500–4000 g	76.8
	>4000 g	10.9
	Unknown	9.8
Previous caesarean section (among multiparous women)	Yes/No	20.4
Pre-existing hypertension	Yes/No	0.4
Pre-existing diabetes	Yes/No	0.5
Gestational diabetes	Yes/No	3.1
Pre-eclampsia/eclampsia	Yes/No	1.5
Placenta praevia/abruption	Yes/No	0.7
Polyhdramnios/oligohydramnios	Yes/No	2.0

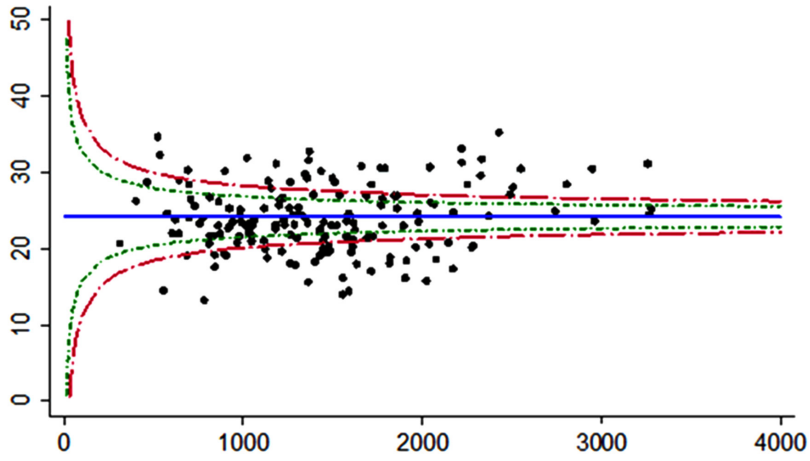
Several of the funnel plots presented in this report show evidence of a phenomenon known as *overdispersion* (Speigelhalter, 2005b). Overdispersion occurs when a greater level of variability among providers is demonstrated than can be explained by chance and the existence of a few outlying units. Important explanations for overdispersion are differences in data quality, the limitations of the risk adjustment methods and clinical uncertainty.

We have attempted to limit the impact of differences in case mix and in data collection and coding practices between hospitals. It is likely that much of the systematic variation between hospitals reflects clinical uncertainty. Consequently, we concluded that it would be premature to make speculative conclusions about whether differences in the patterns of maternity care reflect differences in quality.

Figure 3 How to interpret a funnel plot

Each ● represents a hospital

The **vertical axis** measures the frequency of the outcome, expressed as a percentage. The dots higher up are hospitals with a higher rate of the outcome



The **horizontal axis** measures the number of deliveries per year. The dots further to the right are hospitals with more deliveries

The **blue horizontal** centre line shows the national mean: in the example above this is 24 events per 100 deliveries

The **green dotted** lines constitute the inner funnel limits. These limits define the range of percentages that are within two standard deviations of the national average. One would expect only one in 20 hospitals to have a percentage that is outside these limits if the observed variation was due to chance alone

The **red dashed** lines constitute the outer funnel limits. These limits define the range of percentages that are within three standard deviations of the national average. One would expect only one in 500 hospitals to have a percentage that is outside these limits if the observed variation was due to chance alone

5 Results

5.1 Induction of labour

Background

Since the mid-1980s, rising rates of induction of labour have been reported in England, Scotland, the USA and Australia (NICE, 2008; NHS Scotland, 2005; Joseph et al., 2003). Several observational studies indicate that labour induction may be associated with poorer outcomes for women and their babies (Maslow and Sweeney, 2000; Cammu et al., 2002) including an increased risk of emergency caesarean section when used in primiparous women at term (Ehrenthal et al., 2010). In addition to the potential harm of unnecessary induction, concerns have also been raised about the increasing costs for the NHS, and the lack of attributable health benefits (Thomas and Paranjothy, 2001; Kaufman et al., 2002).

National clinical guidelines in the UK recommend that induction of labour is only indicated when it is likely that a better outcome will result if labour is initiated than if the pregnancy continues (NICE, 2008). This would suggest that the majority of the observed variation in rates of induction among hospitals should be explained by the clinical characteristics of women presenting for obstetric care.

Construction of the indicators

1. ***Induction of labour rate***
   Definition: the proportion of labours that are medically or surgically induced.
   Numerator: induced labour is defined using the delivery onset (delonset) field in the HES maternity tail. Failed induction (ICD-10 code O61) is also included in the numerator as this represents intention to treat.
   Denominator: all deliveries, excluding: elective caesarean section; emergency caesarean section before the onset of labour; women with premature rupture of membranes (ICD-10 code O42); and records missing information on delivery onset.
2. ***Percentage of induced labours resulting in emergency caesarean section***
   Definition: the proportion of women with induced labours who go on to deliver by emergency caesarean section.
   Numerator: emergency caesarean section is defined using OPCS codes R18 and R25.1. Where OPCS delivery codes are missing (< 1% of records), the delivery method (delmeth) field from the maternity tail is used instead.
   Denominator: induced labours, excluding women with premature rupture of membranes (ICD-10 code O42).

Assessment of data quality

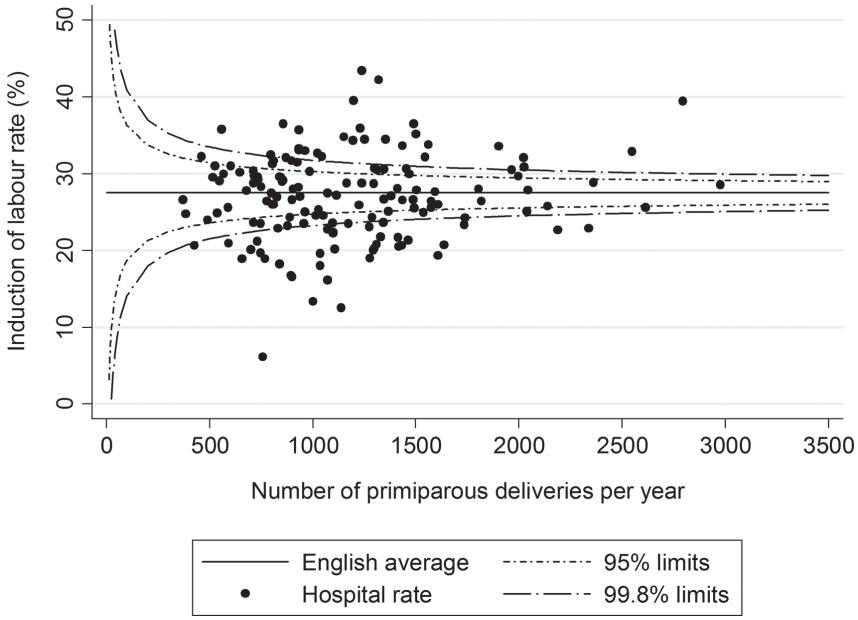
The quality of each hospital's induction of labour coding was carefully assessed. Hospitals were excluded if more than 30% of delivery records were missing information about the onset of labour or if there were less than 500 observations in the denominator. In addition, hospitals were excluded if less than 10% or more than 50% of all labours were induced. Good-quality data were available for 152/164 hospitals.

Results

Induction of labour rate

Among hospitals with good-quality data, the mean induction of labour rate for primiparous women was 27.5%. After adjusting for relevant clinical and demographic risk factors, the rates for individual hospitals ranged between 6.1 and 43.4%. More than a two-fold difference exists between the rate in hospitals that were in the top 10% and those in the bottom 10% (16.9% and 37.0%, respectively).

Figure 4 Funnel plot showing rates of induction of labour among primiparous women, adjusted for maternal characteristics and clinical risk factors

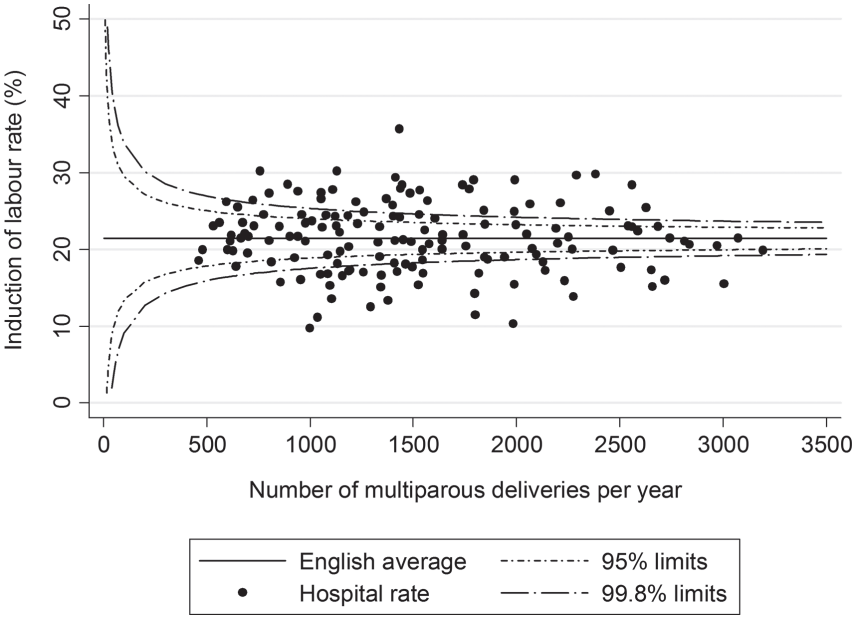


30 out of 152 (20%) hospitals are above the outer funnel.

38 out of 152 (25%) hospitals are below the outer funnel.

Among multiparous women, the mean induction of labour rate was 21.4%. After risk adjustment, hospital-level induction of labour rates ranged between 9.7 and 35.7%. More than a two-fold difference exists between the rate in hospitals that were in the top 10% and those in the bottom 10% (13.5% and 29.4%, respectively).

Figure 5 Funnel plot showing rates of induction of labour among multiparous women, adjusted for maternal characteristics and clinical risk factors



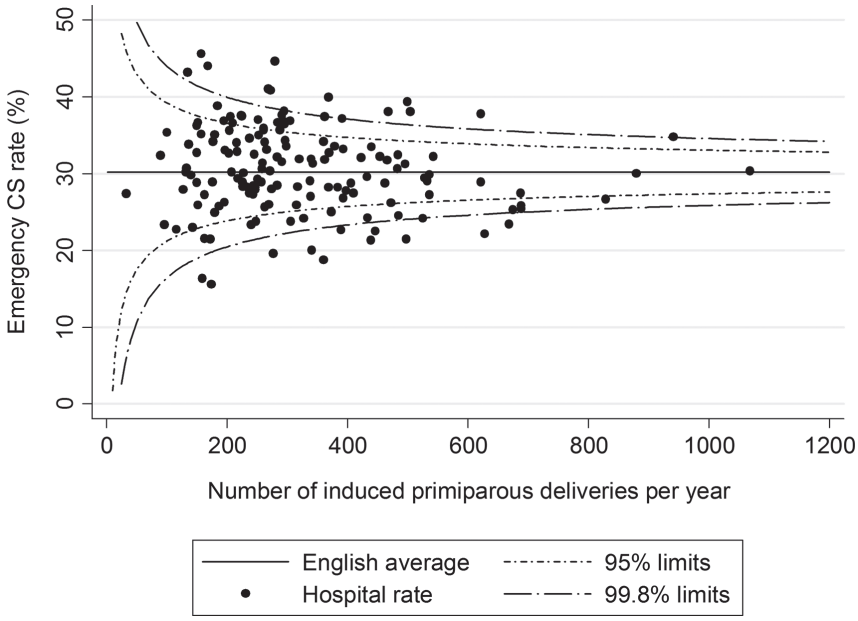
33 out of 152 (22%) hospitals are above the outer funnel.

35 out of 152 (23%) hospitals are below the outer funnel.

Percentage of induced labours resulting in emergency caesarean section

Among primiparous women with induced labours, the mean rate of emergency caesarean was 30.2%. After risk adjustment, rates of emergency caesarean section in individual hospitals ranged between 15.6 and 45.6%. A two-fold difference exists between the rate in hospitals that were in the top 10% and those in the bottom 10% (20.4% and 40.3%, respectively).

Figure 6 Funnel plot showing rates of induced labour resulting in emergency caesarean section among primiparous women, adjusted for maternal characteristics and clinical risk factors

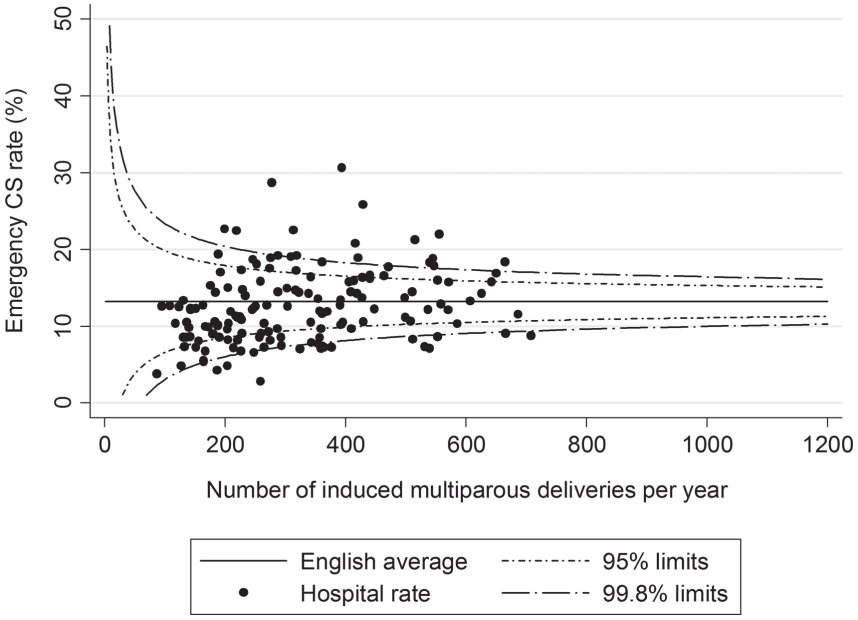


12 out of 152 (8%) hospitals are above the outer funnel.

12 out of 152 (8%) hospitals are below the outer funnel.

Among multiparous women whose labours were induced, the mean rate of emergency caesarean was 13.2%. After risk adjustment, this rate ranged between 2.8 and 30.7% at a hospital level. There was almost a four-fold difference between the rates of hospitals that were in the top 10% and those in the bottom 10% (5.8% and 22.1%, respectively).

Figure 7 Funnel plot showing rates of induced labour resulting in emergency caesarean section among multiparous women, adjusted for maternal characteristics and clinical risk factors



16 out of 152 (11%) hospitals are above the outer funnel.

16 out of 152 (11%) hospitals are below the outer funnel.

Interpretation of results

For both primiparous and multiparous women, there was wide variation in the rate of labour induction among hospitals which was unexplained by demographic and clinical risk factors, including premature rupture of membranes, pre-eclampsia, diabetes and poly-/oligohydramnios.

There are several possible explanations for the observed overdispersion in induction of labour rates among hospitals:

1. Coding inconsistencies. We have attempted to reduce the impact of data errors by excluding hospitals in which more than 30% of records are missing onset of labour data, or which have overall induction of labour rates of less than 10% or more than 50%. However, some of the variation may be explained by divergent coding practices, for example, the inclusion of labour augmentation in this field. The issue of differentiating between induction and augmentation of labour is problematic and further guidance for coders is required from the Health and Social Care Information Centre in order to ensure that coding practices are standardised between hospitals.
2. Inadequate adjustment for case mix. Our risk adjustment model captures the major demographic and clinical risk factors for induction of labour. One limitation is that the model does not capture previous obstetric complications which may be used as an indication for labour induction to reduce the risk of recurring complications such as stillbirth. However, we do not anticipate that the inclusion of this risk factor would significantly improve the model's fit. Our results are consistent with a recent study from Scotland, which found that more than 25% of the variation in the induction of labour rate remains unaccounted for after adjustment for case mix variation (Humphrey and Tucker, 2009).
3. 'True' variation as a result of clinical uncertainty and inconsistent clinical management policies between units.

Considerable variation was also seen among units in the percentage of induced labours resulting in emergency caesarean section. We can speculate that a high rate of emergency caesarean section following induction could indicate either overuse of induction in women with unfavourable cervixes or without cervical priming, or induction earlier in gestation than is recommended by the National Institute for Health and Clinical Excellence (NICE, 2008). It has been suggested that hospitals with a policy of outpatient induction, using slow-release prostaglandins and 24-hour dosing will see lower emergency caesarean section rates. Unfortunately HES data does not capture information on cervical priming with prostaglandins, nor does it distinguish between different types of medical induction. In future reports, we plan to further stratify this indicator by time of induction. However, before this refinement to be implemented, the completeness of gestational age field in the maternity tail must improve from its current level of 88%.

Expert Opinion Box 1

This degree of variation in the induction of labour rate after controlling for case mix should lead hospitals to examine the timing, indications and methods of labour induction closely.

It is difficult to understand why there is such a difference in the emergency caesarean section rate between hospitals in the top and bottom 10%. In addition to concerns about the quality of care, this represents a significant caesarean section burden from both a workforce and financial perspective. What approach allows the intervention rates to remain low in some units?

Most units in England are struggling to maintain high-quality intrapartum care because of workload. A liberal induction of labour policy will increase workload and consequently the additional risks of intervention associated with induced labour compared with a spontaneous labour. Opportunities to increase normalisation of birth and mitigate workload should be championed. Learning lessons from those hospitals that maintain lower induction of labour rates will add value to the quality of care provided.

The methods and setting for induction of labour are changing. Many units around the UK are using newer and innovative methods for induction of labour such as slow release prostaglandin preparations and outpatient induction of labour. The effect of these newer approaches may influence outcome over time. Maternity units must ensure that their policy of induction of labour is compliant with NICE Guidelines (NICE, 2008).

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5.2 Elective and emergency caesarean section

Background

Caesarean section increases the risk of maternal complications such as haemorrhage, infection and thrombosis (Deneux-Tharaux et al., 2006) as well as the risk of uterine rupture, placenta praevia and placenta accreta in subsequent pregnancies (Landon et al., 2004; Yang et al., 2007; Villar et al., 2006). Neonatal complications after delivery by caesarean section, although infrequent, include fetal respiratory distress syndrome, pulmonary hypertension, iatrogenic prematurity, and difficulty with bonding and breastfeeding (Churchill et al., 2006; Shorten et al., 2007). On the other hand, there is also a threshold below which the caesarean delivery rate is too low and both maternal and neonatal health is compromised.

Since the 1970s, many developed countries have experienced substantial growth in the caesarean section rate (WHO 1985; Belizan et al., 1999; Althabe et al., 2006). In England, for example, the rate of caesarean sections has increased from 9% in 1980 to 25% in 2011/12 (NHS IC, 2012). Striking variation in this rate has also been reported (Menacker et al., 2006). Studies examining both hospitals within a region (Coonrod et al., 2008; California Office of Statewide Hospital Planning and Development [OSHPD], 2007) and doctors within a hospital (Main, 1999) have shown a three- to five-fold variation, even once multiparous, breech, preterm and multiple births are excluded. Many authors have shown that physician factors rather than maternal characteristics or obstetric diagnoses are the major driver for the difference in rates within a hospital (Goyert et al., 1989; Luthy et al., 2003; Bragg et al., 2010).

For elective caesarean section, NICE recommends that, in uncomplicated pregnancies, these should not be carried before 39 completed weeks of gestation because of an increased risk of respiratory morbidity in newborns (NICE, 2011). Similar recommendations have been included in guidance from other countries (ACOG, 2007) and recent publications have provided further evidence on the relationship between the timing of an elective caesarean section and admission to neonatal intensive care (Zanardo et al., 2007; Hansen et al., 2008; Yee et al., 2008; Clark et al., 2009; Farchi et al., 2009; Tita et al., 2009). Moreover, recent population-based studies have also shown that long-term health and developmental outcomes for early term infants (37–38 completed weeks) are worse than those of full-term babies (Lindstrom et al., 2009; MacKay et al., 2010; Boyle et al., 2012).

It has been suggested that maternity services and commissioners use timing of elective caesarean as a quality indicator to support clinical practice. A similar quality measure of elective delivery at 37–39 weeks of gestation has already been adopted by the US Joint Commission (Joint Commission, 2012).

Construction of the indicators

1. ***Percentage of spontaneous labours resulting in emergency caesarean section***
   Definition: the proportion of women with spontaneous onset of labour who go on to deliver by emergency caesarean section.
   Numerator: emergency caesarean section is defined using OPCS code R18 and R25.1. Where OPCS delivery codes are missing (<1% of deliveries), the delivery method (delmeth) field from the maternity tail is used.
   Denominator: all deliveries, excluding: induced onset of labour; elective caesarean section; emergency caesarean section before the onset of labour; women with premature rupture of membranes (ICD-10 code O42); and records missing information on delivery onset.
2. ***Elective caesarean section rate***
   Definition: percentage of all deliveries carried out by elective caesarean section
   Numerator: elective caesarean section is defined using OPCS code R17. Where OPCS delivery codes are missing (< 1% of deliveries), the delivery method (delmeth) field from the maternity tail is used.
   Denominator: all deliveries

3. ***Elective caesarean section performed before 39 weeks of gestation without clinical indication***
Definition: the proportion of elective caesarean sections performed at less than 39 weeks.
Numerator: elective caesarean sections performed at less than 39 completed weeks of gestation.
Denominator: elective caesarean sections without clinical indication (see Appendix 5 for exclusion criteria). For this indicator, non-cephalic deliveries have been included in the calculation to increase power. Results for primiparous and multiparous women also have been combined. This is because there was little difference in the mean rate between the two groups and combining them serves to increase the statistical power.

Assessment of data quality

Mode of delivery is well recorded in HES, with strong levels of internal agreement between OPCS delivery codes and the maternity tail (Knight et al., 2013). One hospital did not record any elective caesarean sections and was therefore excluded from this indicator.

For the 'percentage of spontaneous labours resulting in emergency caesarean section' indicator, hospitals were excluded if more than 30% of delivery records were missing information about the onset of labour or if the number of observations in the denominator was less than 500. Hospitals were also excluded if the overall unadjusted rate of spontaneous labours was less than 50% or more than 90%. Good-quality data were available for 152/164 hospitals.

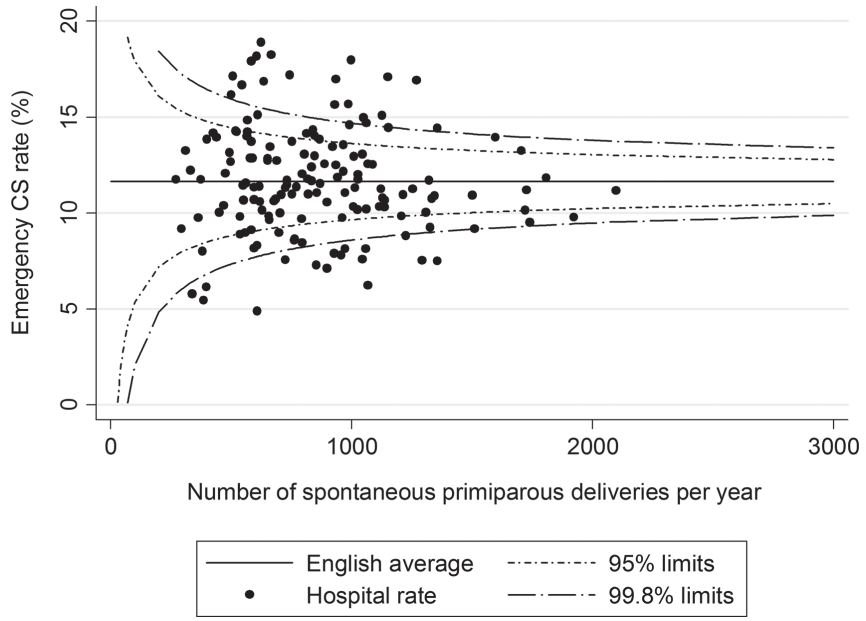
For the 'elective caesarean section before 39 weeks' indicator, hospitals were excluded if more than 30% of delivery records were missing information about gestational age at delivery. Good-quality data were available for 147/164 hospitals.

Results

Percentage of spontaneous labours resulting in emergency caesarean section

The mean emergency caesarean section rate for primiparous women was 11.6%. After adjusting for relevant clinical and demographic risk factors, individual hospitals' emergency caesarean section rates ranged between 4.9 and 18.9%. More than a two-fold difference exists between the rate in hospitals that were in the top 10% and those in the bottom 10% (7.0% and 17.2%, respectively).

Figure 8 Funnel plot showing rates of spontaneous labour resulting in emergency caesarean section among primiparous women, adjusted for maternal characteristics and clinical risk factors

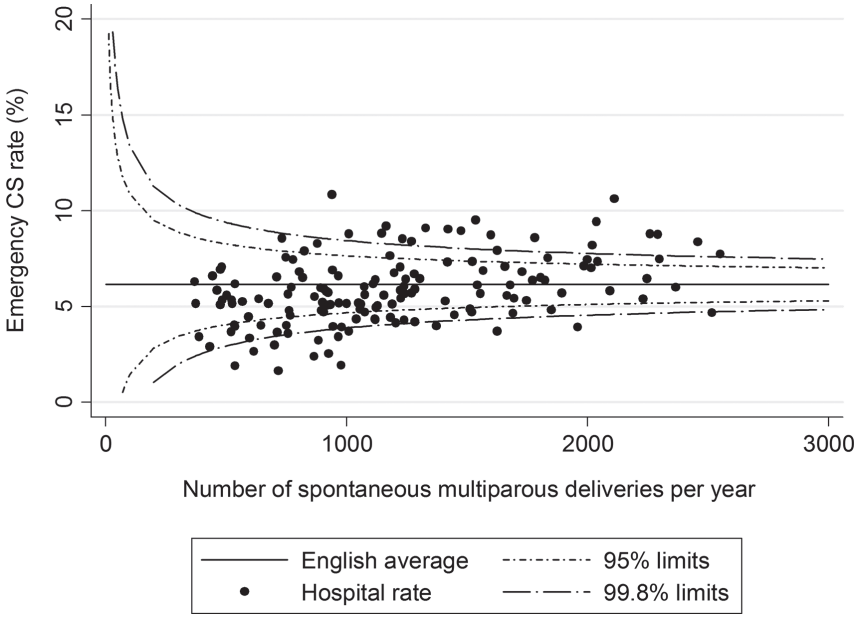


20 out of 152 (13%) hospitals are above the outer funnel.

16 out of 152 (11%) hospitals are below the outer funnel.

The mean emergency caesarean section rate for multiparous women was 6.1%. After risk adjustment, emergency caesarean section rates for individual hospitals ranged between 1.7 and 10.9%. There was a three-fold difference between the rates in hospitals that were in the top 10% and those in the bottom 10% (2.9% and 9.2%, respectively).

Figure 9 Funnel plot showing rates of spontaneous labour resulting in emergency caesarean section among multiparous women, adjusted for maternal characteristics and clinical risk factors



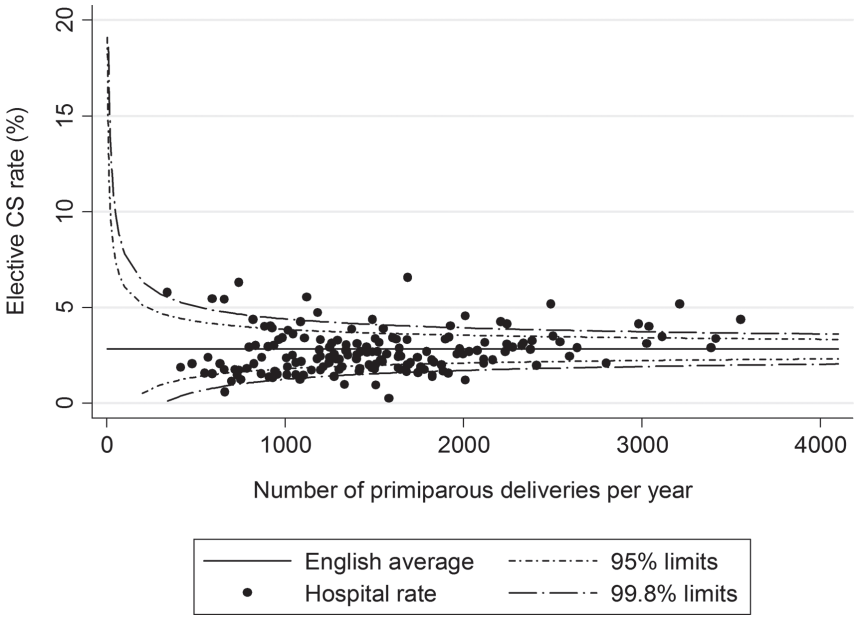
19 out of 152 (13%) hospitals are above the outer funnel.

14 out of 152 (9%) hospitals are below the outer funnel.

Elective caesarean section

The mean elective caesarean section rate for primiparous women was 2.8%. After adjusting for relevant clinical and demographic risk factors, elective caesarean section rates in individual hospitals ranged between 0.3 and 6.6%, with eight hospitals having a rate above 5.0%.

Figure 10 Funnel plot showing rates of elective caesarean section among primiparous women, adjusted for maternal characteristics and clinical risk factors

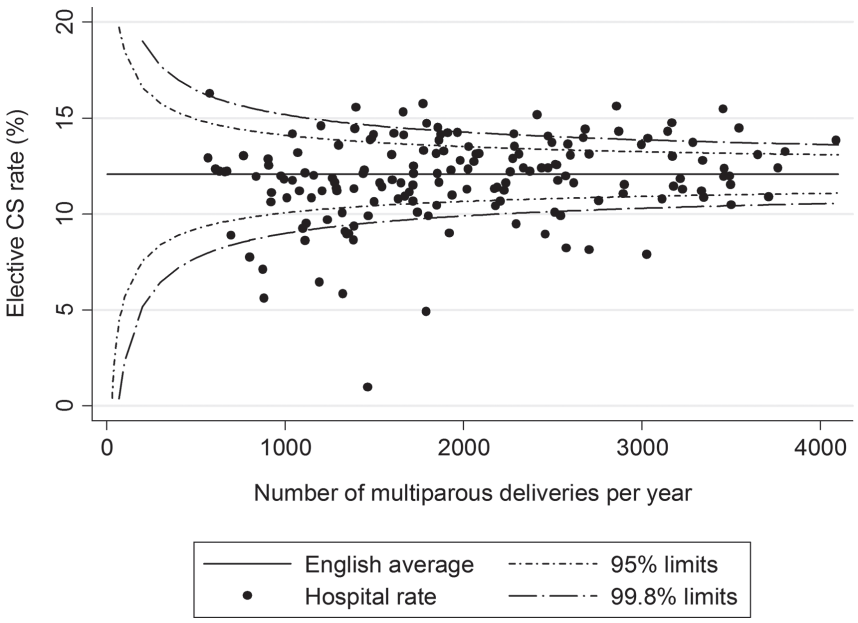


17 out of 163 (10%) hospitals are above the outer funnel.

11 out of 163 (7%) hospitals are below the outer funnel.

The mean elective caesarean section rate for multiparous women was 12.1%. After risk adjustment, individual hospitals' elective caesarean section rates ranged between 1.0 and 16.3%. More than a two-fold difference exists between the rate in hospitals that were in the top 10% and those in the bottom 10% (7.2% and 15.0%, respectively).

Figure 11 Funnel plot showing rates of elective caesarean section among multiparous women, adjusted for maternal characteristics and clinical risk factors



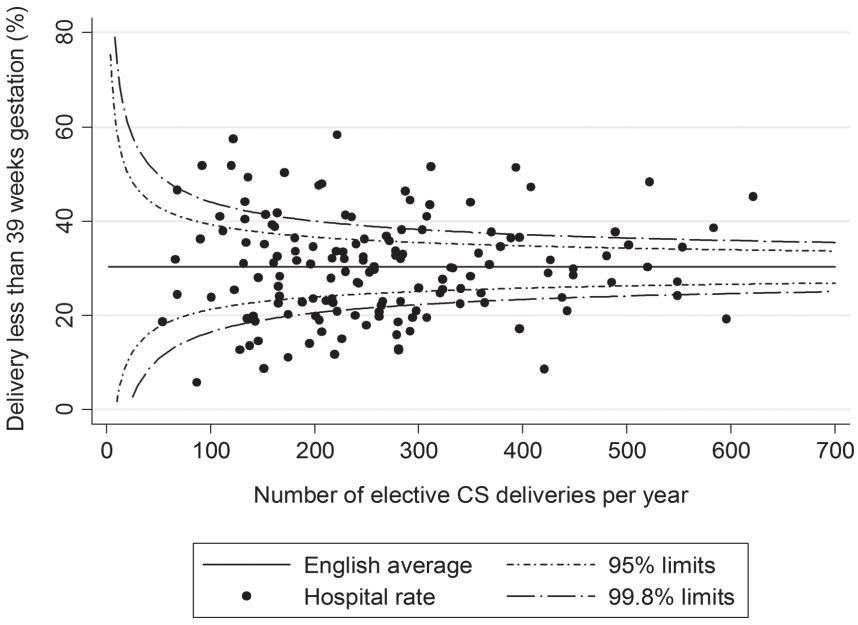
17 out of 163 (10%) hospitals are above the outer funnel.

22 out of 163 (13%) hospitals are below the outer funnel.

Elective caesarean section performed before 39 completed weeks of gestation without clinical indication

Among hospitals with good data quality, the mean rate of elective caesarean section before 39 completed weeks of gestation was 30.3%. There was little difference in the mean rate between primiparous (27.9%) and multiparous (30.9%) women. After adjustment for case mix variation,

Figure 12 Funnel plot showing rates of elective caesarean section performed before 39 completed weeks of gestation without clinical indication, adjusted for maternal characteristics and clinical risk factors



26 out of 147 (18%) hospitals are above the outer funnel.

32 out of 147 (22%) hospitals are below the outer funnel.

hospital-level rates ranged between 5.8 and 58.2%. This variation was evident across all hospitals with the mean rate of the top 10% of hospitals being 52.5%, compared with 18.0% for hospitals in the bottom 10%.

Interpretation of results

Emergency caesarean section

We describe considerable national variation in the proportion of spontaneous labours resulting in emergency caesarean section, with between 24% and 22% of hospitals falling outside the expected ranges for primiparous and multiparous women, respectively. The results have been adjusted to control for differences in the proportion of women with risk factors for emergency caesarean section, including pre-eclampsia, diabetes and placenta praevia, between units.

One factor that may contribute to the high level of observed variation in the emergency caesarean section rate is related to the definition of an emergency caesarean section. This term can be used to cover a wide range of clinical situations, from an immediate threat to the life of the woman or fetus to a situation requiring early delivery although there is no maternal or fetal compromise (NICE, 2011). Allied with this is the lack of a precise definition for fetal compromise or dystocia (Librero et al., 2000), both common reasons for emergency caesarean section. The result may be that some of the observed variation among hospitals is explained by differences in the way clinical indications and emergency caesarean sections are defined and coded.

Several studies have established that rates of caesarean section are influenced by the use of electronic fetal monitoring and fetal scalp blood sampling, the use of partograms, active management of labour, labour and delivery guidelines and whether or not consultants are involved in the decision-making process (Alfirevic et al., 2004; Brown et al., 2008; NICE, 2011). Despite the possible influence of differences in coding discussed above, the observed variation in emergency caesarean section rates suggests that hospitals should examine whether use of caesarean section locally can be made more compliant with recent NICE guidelines on caesarean section and intrapartum care (NICE, 2007; NICE, 2011).

Elective caesarean section

A similar pattern of national variation can be seen in elective caesarean section rates after adjustment for case mix variation, with 17% and 23% of hospitals falling outside the expected range. It can be argued that a greater willingness on the part of the clinicians to accede to women's request for an elective caesarean section may be a major contributor. However, a previous study using HES data concluded that maternal request in the absence of any clinical indication was unlikely to contribute substantially to the variation (Bragg et al., 2010).

For multiparous women, a large amount of between-hospital variation in the unadjusted elective caesarean section rate was explained by just one factor, previous caesarean section. The issue of whether previous caesarean section should be included as a risk-factor for elective caesarean section is a contentious one, with some commentators arguing that including it reduces the true variation observed by accepting that some hospitals that are less willing to attempt vaginal birth after caesarean section (VBAC) than others. If this factor was not included in the risk adjustment model, more variation between hospitals would be observed in the adjusted rates.

The mean rate of elective caesarean sections performed before 39 completed weeks of gestation without clinical indication ranged from 5.8% to 58.2% at individual units. This suggests there is considerable inconsistency in clinical management policies between NHS maternity units. This is despite a decreasing trend in England overall in the proportion of elective caesareans performed before 39 weeks. A recent study using HES data demonstrated that the overall proportion of elective caesarean deliveries performed before 39 completed weeks steadily fell from 61% in 2000/01 to 37% in 2008/09 (Gurol-Urganci et al., 2011).

Expert Opinion Box 2

The variation in the elective caesarean section rate for multiparous women may to some extent reflect differences in the uptake of VBAC among units. It is generally accepted that the rates of attempted VBAC are dependent on counselling by senior clinicians including midwives. In some units, specialist VBAC clinics have been shown to encourage VBAC. Audit and robust outcome data from VBAC clinics would provide useful evidence to support commissioning such services.

The recent guidance on maternal request for caesarean section by NICE may also contribute to the observed variation in the elective caesarean section rate and should be monitored. The impact on the future reproductive health of this group of women and the implications for maternity services warrants closer investigation of the factors promoting variation.

NICE recommends that elective caesarean sections should not be carried out before 39 completed weeks. This is primarily because of the increased risk of respiratory morbidity in newborns, with recent studies showing poorer long-term and developmental outcomes for early term infants. This indicator is an ideal commissioning lever to use as a 'barometer' of compliance with national guidelines and could be used effectively to reflect standardisation and evidence-based practice.

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5.3 Instrumental delivery

Background

Outcomes following instrumental delivery include an increased risk of maternal pelvic floor injuries and birth trauma compared with unassisted vaginal deliveries. While the overall rate of instrumental delivery has remained roughly stable over the last 30 years at 10–13%, there has been a significant rise in the proportion of instrumental deliveries using vacuum extraction. By 2011/12 these made up half of all instrumental deliveries (NHS IC, 2012).

Failed instrumental delivery resulting in emergency caesarean section represents a negative outcome for the woman and increases the risk of severe neonatal morbidity. While failed application of the instrument is less likely for forceps delivery than vacuum extraction, there is also a higher chance of third or fourth degree perineal tears with this method. While UK clinical guidelines on instrumental delivery point out the risks associated with each type of instrument, they state that the choice of instrument ultimately depends on the clinical circumstance and the practitioner's level of skill and experience (RCOG, 2007; NICE, 2011).

Construction of the indicators

1. ***Instrumental delivery rate***
   Definition: the proportion of deliveries in which forceps or vacuum cups were used.
   Numerator: instrumental delivery is defined using OPCS codes R21 (forceps) and R22 (vacuum). Where OPCS delivery codes are missing (<1% of deliveries), the delivery method (delmeth) field from the maternity tail is used.
   Denominator: all deliveries, excluding: elective caesarean section, emergency caesarean section before the onset of labour.
2. ***Percentage of instrumental deliveries carried out by vacuum extraction (i.e. vacuum extraction: forceps delivery ratio)***
   Definition: the proportion of instrumental deliveries carried out by vacuum extraction.
   Numerator: vacuum extraction is defined using OPCS code R22. Where OPCS delivery codes are missing (<1% of deliveries), the delivery method (delmeth) field from the maternity tail is used.
   Denominator: all instrumental deliveries (forceps and vacuum). Results for primiparous and multiparous women have been combined as there was little difference in the mean rate between the two groups and combining them serves to increase the statistical power.

3. ***Percentage of attempted instrumental deliveries resulting in emergency caesarean section***
   Definition: proportion of attempted instrumental deliveries which result in emergency caesarean section.
   Numerator: failed instrumental deliveries resulting in emergency caesarean section. Failed instrumental delivery is defined using ICD-10 code O66.5. Emergency caesarean section is defined using OPCS code R18 and R25.1. Where OPCS delivery codes are missing (<1% of deliveries), the delivery method (delmeth) field from the maternity tail is used.
   Denominator: all attempted instrumental deliveries (successful and failed). Results for primiparous and multiparous women have been combined as there was little difference in the mean rate between the two groups and combining them serves to increase the statistical power.

Assessment of data quality

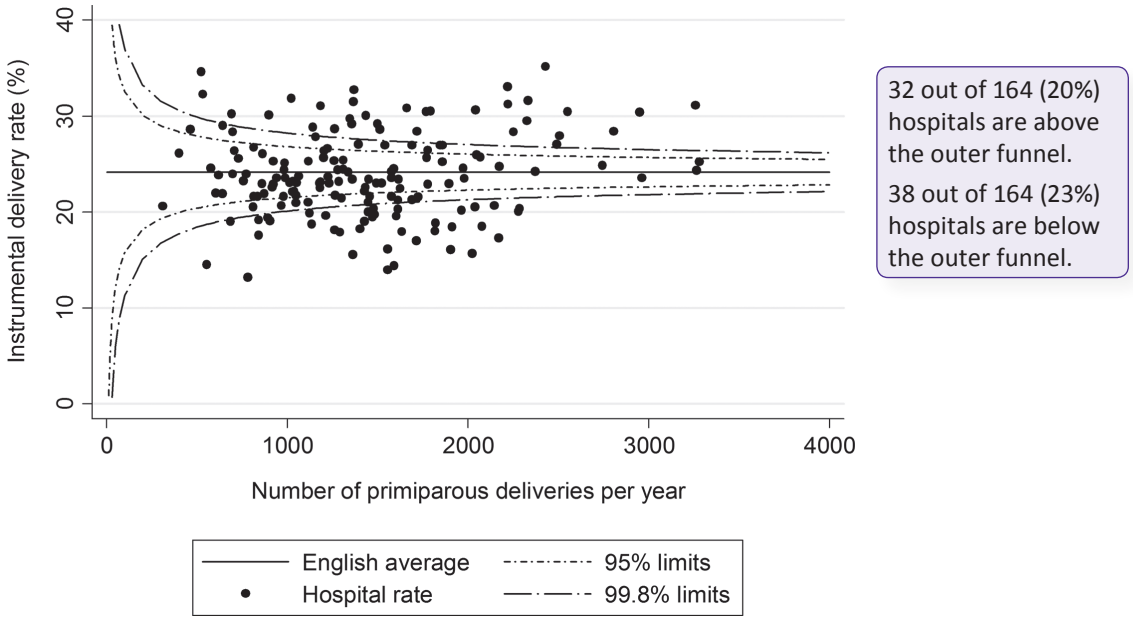
Mode of delivery is well recorded in HES, with strong levels of internal agreement between OPCS delivery codes and the maternity tail (Knight et al., 2013).

For the 'percentage of failed instrumental deliveries resulting in emergency caesarean section' indicator, hospitals were excluded if the failure rate was less than 1%. Good-quality data were available for 90/164 hospitals.

Instrumental delivery rate

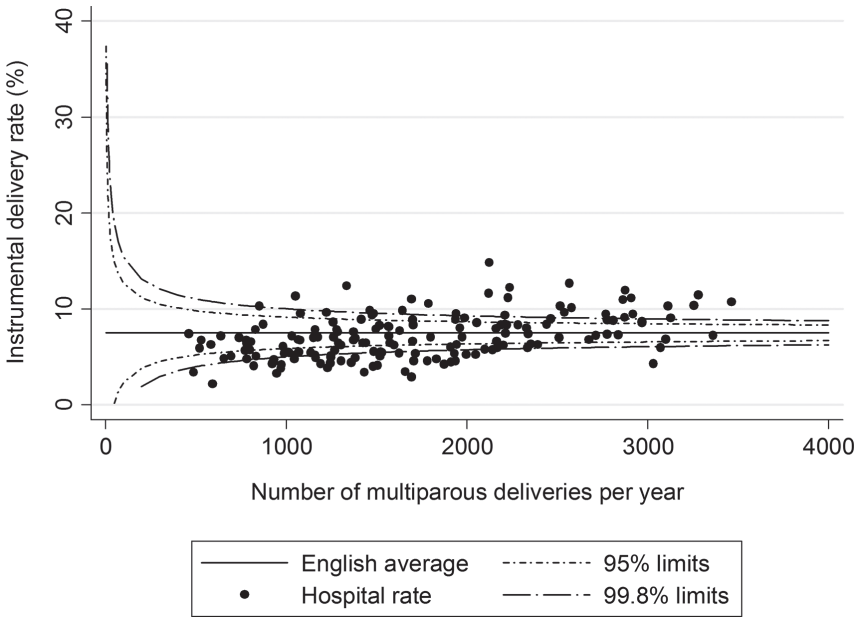
Among primiparous women, the mean instrumental delivery rate was 24.2%. After adjusting for relevant clinical and demographic risk factors, individual hospital instrumental delivery rates ranged between 13.2 and 35.1%. Almost a two-fold difference exists between the rate in hospitals that were in the top 10% and those in the bottom 10% (16.4% and 31.8%, respectively).

Figure 13 Funnel plot showing rates of instrumental delivery among primiparous women, adjusted for maternal characteristics and clinical risk factors



Among multiparous women, the mean instrumental delivery rate was 7.5%. After risk adjustment, individual hospital instrumental delivery rates ranged between 2.2 and 14.8%. There was a three-fold difference between the rates in hospitals that were in the top 10% and those in the bottom 10% (3.8% and 11.5%, respectively).

Figure 14 Funnel plot showing rates of instrumental delivery among multiparous women, adjusted for maternal characteristics and clinical risk factors



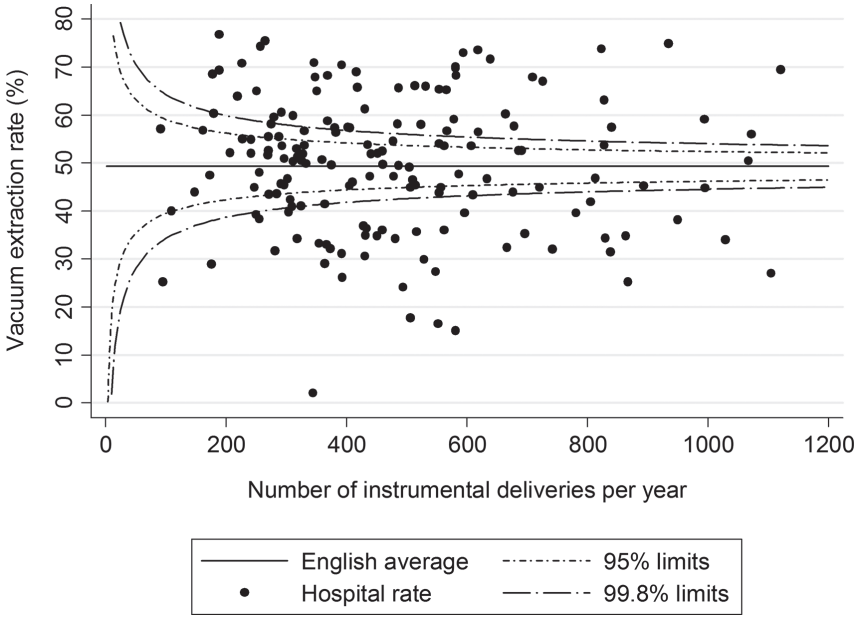
28 out of 164 (17%) hospitals are above the outer funnel.

41 out of 164 (25%) hospitals are below the outer funnel.

Percentage of instrumental deliveries carried out by vacuum extraction (i.e. vacuum : forceps ratio)

At a national level, the mean ratio of vacuum : forceps deliveries was 49 : 51. However, at an individual hospital level, the percentage of instrumental deliveries performed using vacuum extraction ranged between 2.0 and 76.7%. This variation was evident across all hospitals with the mean rate of the top 10% of hospitals being 72.1%, compared with 24.2% for hospitals in the bottom 10%.

Figure 15 Funnel plot showing vacuum extraction: forceps delivery ratios, adjusted for maternal characteristics and clinical risk factors



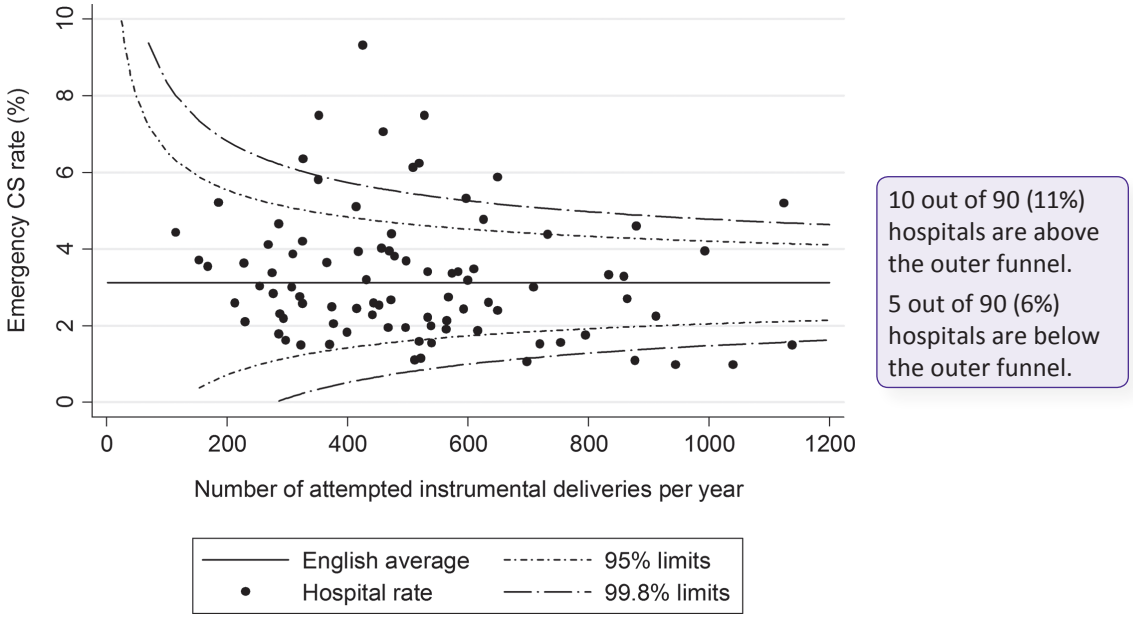
50 out of 164 (30%) hospitals are above the outer funnel.

42 out of 164 (26%) hospitals are below the outer funnel.

Percentage of attempted instrumental deliveries resulting in emergency caesarean section

At a national level, the mean rate of attempted instrumental deliveries resulting in emergency caesarean section was 3.1%. Among individual hospitals, the failure rate ranged between 1.0 and 9.3%. There were seven hospitals in which the rate was above 6%.

Figure 16 Funnel plot showing rates of attempted instrumental delivery resulting in emergency caesarean section, adjusted for maternal characteristics and clinical risk factors



Interpretation of results

There was widespread variation in instrumental delivery rates between hospitals even after adjustment for differences in maternal age, ethnicity, socio-economic deprivation and clinical risk factors. Over 40% of hospitals fall above the outer funnel limit for both primiparous and multiparous women.

There was also large variation in the ratio of vacuum extraction : forceps deliveries among hospitals. 55% of hospitals are outside the funnel limits for this measure, with the percentage of instrumental deliveries carried out by vacuum extraction ranging from 2 to 77%. This may be a reflection of the lack of recommendations concerning choice of instrument in existing clinical guidelines. The variation may also reflect inconsistent training opportunities with each method among clinicians, clustered within hospitals. The RCOG will keep a watchful eye on this variation in practice and its impact on training opportunities.

We found that 11% of hospitals had a higher than expected rate of failed instrumental delivery resulting in emergency caesarean section, with a maximum rate of 9.3%. Higher rates for this indicator may be associated with a lack of training in the application of instruments. However, the failed instrumental delivery rate is probably best interpreted in the context of additional data. Hospitals with high rates for this indicator may wish to examine the percentage of instrumental deliveries carried out by vacuum extraction as failed delivery with selected instrument is more likely with this method.

A hospital's failed instrumental delivery rate is also likely to be influenced by the extent to which clinicians are willing to attempt instrumental delivery in the first place, as opposed to referring women for emergency caesarean section. For this reason, a provider's emergency caesarean section rate should be monitored simultaneously. Furthermore, a high failed instrumental delivery rate may be related to poor selection criteria for trial of forceps/vacuum in the second stage of labour. The RCOG urges all maternity units to implement its recommendation that consultants on-call should be present to supervise inexperienced trainees in operative vaginal delivery (RCOG, 2009).

Expert Opinion Box 3

Why is there such huge variation in rates, success and method of instrumental delivery between hospitals after case mix adjustment?

Hospitals need to consider their own figures in relation to other their indicators and their peers. Is their unusually high or low rate reflected in a reciprocal low or high emergency caesarean section or spontaneous vaginal birth rate?

Is the unit following national guidance about management of the second stage or performing instrumental birth very liberally? This may reflect in an increase in maternal morbidity including third and fourth degree tears.

Is there a reluctance to perform instrumental birth, resulting in an increased caesarean section rate? It is known that immediate caesarean section in the second stage compared with trial of instrumental birth increases maternal blood loss and length of stay without a concomitant reduction in neonatal admission to Special Care (Murphy et al., 2003; Tempest et al., 2013).

The enormous variation in the ratio of vacuum : forceps raises many questions. What influences the choice of instrument in units? Does being outside the funnel in either direction have a positive or negative impact on emergency caesarean section rates, failed instrumental delivery or maternal and neonatal complications? (Murphy et al., 2003; Burrows et al., 2004; Tempest et al., 2013).

The answers to these questions have the potential to increase the consistency of birth experiences among women and reduce emergency caesarean section rates and thus impact on maternal morbidity in the index and also in future pregnancies. This may also have a beneficial impact on the use of human and other resources within maternity services. Some of this can be done by hospitals reviewing their own practice, but research is also needed (Majako amd Gardener, 2008; O'Mahony et al., 2010).

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5.4 Third and fourth degree perineal tears

Background

The indicators in this section are intended to flag cases of potentially preventable third and fourth degree perineal tears during vaginal delivery. Such tears extend to the perineal muscles, anal sphincter and bowel wall and require surgical repair after birth. Possible complications include anal incontinence after repair (Laine et al., 2011) as well as poorer overall quality of life (Samarasekera et al., 2008). These types of tears are not possible to prevent entirely, but their likelihood can be reduced by employing appropriate labour management and care standards (Aasheim et al., 2011).

A recent study using HES data found a three-fold increase in the rate of third/fourth degree perineal tears in England between 2001 and 2011 from 1.8% to 5.9%. This increase remained after adjusting for risk factors including maternal age, ethnicity, instrumental delivery, episiotomy and birthweight (Gurol-Urganci et al., 2013). The most likely explanation for this increase is improvements in the diagnosis and coding of perineal tears in routine hospital data.

Obstetric trauma indicators have been used by the US Joint Commission as well as by various international quality initiatives analysing obstetric data (Ministry of Health (New Zealand), 2012; Department of Health (Victoria, Australia), 2012). The measure has also been adopted as a patient safety indicator by Dr Foster, the US Agency for Healthcare Research and Quality and the OECD.

As the risk of a perineal laceration is significantly increased for instrumental deliveries, we report rates for this population separately.

Construction of the indicators

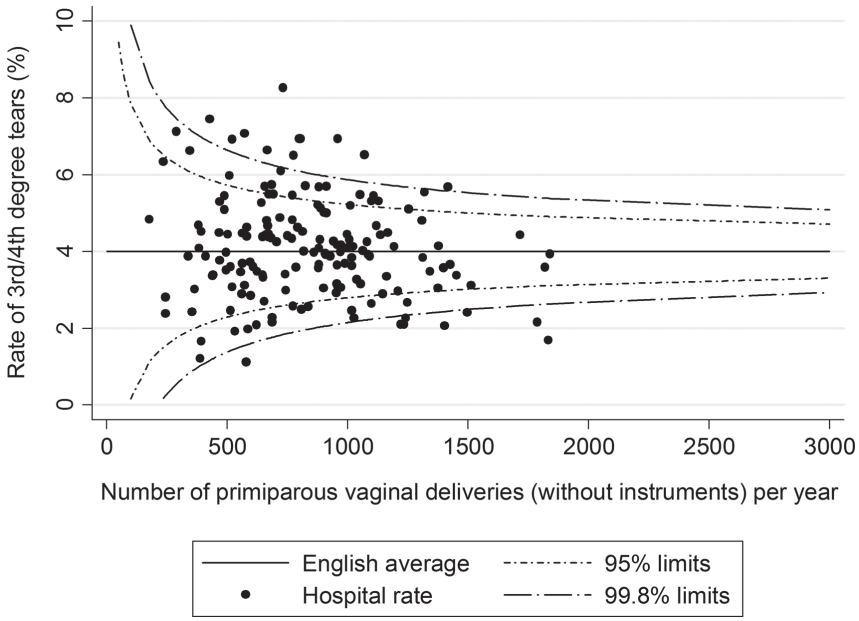
1. ***Rate of third and fourth degree tears among unassisted vaginal deliveries***
   Definition: The proportion of women with a third or fourth degree perineal tear after unassisted vaginal delivery.
   Numerator: Women with a third or fourth degree perineal tear. A tear is defined by the presence of an ICD-10 code for a third or fourth degree tear (O70.2; O70.3) *and* an OPCS procedure code for repair of a third or fourth degree tear (R322; R325).
   Denominator: all unassisted vaginal deliveries, defined using OPCS codes R23 and R24. Where OPCS delivery codes are missing (<1% of deliveries), the delivery method (delmeth) field from the maternity tail is used.
2. ***Rate of third and fourth degree tears among instrumental vaginal deliveries***
   Definition: As above after assisted (instrumental) vaginal delivery.
   Numerator: As above.
   Denominator: all assisted vaginal deliveries, defined using OPCS codes R21 and R22. Where OPCS delivery codes are missing (<1% of deliveries), the delivery method (delmeth) field from the maternity tail is used.

Results

Third and fourth degree tears (unassisted vaginal deliveries)

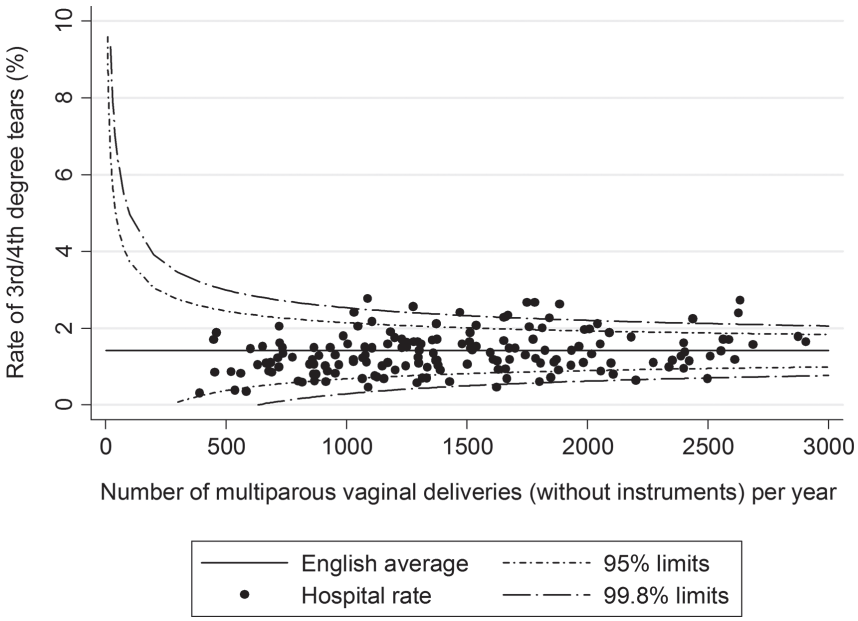
Among primiparous women, the mean rate of third and fourth degree tears among women with an unassisted vaginal delivery was 4.0%. After adjustment for case mix variation, hospital-level rates ranged between 1.1 and 8.3%. More than a three-fold difference exists between the rate in hospitals that were in the top 10% and those in the bottom 10% (2.0% and 6.8%, respectively).

Figure 17 Funnel plot showing rates of third and fourth degree tears (unassisted vaginal deliveries) among primiparous women, adjusted for maternal characteristics and clinical risk factors



Among multiparous women, the mean rate of third and fourth degree tears among women with an unassisted vaginal delivery was 1.4%. After adjustment for case mix variation, hospital-level rates ranged between 0.3 and 2.8%, and the pattern of variation follows the control limits fairly closely.

Figure 18 Funnel plot showing rates of third and fourth degree tears (unassisted vaginal deliveries) among multiparous women, adjusted for maternal characteristics and clinical risk factors



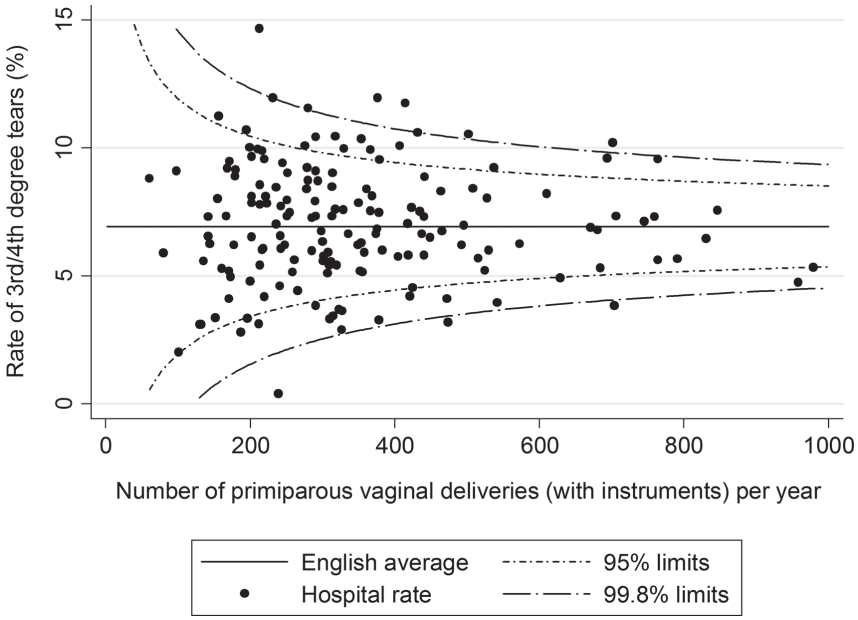
12 out of 164 (7%) hospitals are above the outer funnel.

3 out of 164 (2%) hospitals are below the outer funnel.

Third and fourth degree tears (assisted vaginal deliveries)

Among primiparous women, the mean rate of third and fourth degree tears among women with an instrumental delivery was 6.9%. After adjustment for case mix variation, hospital-level rates ranged between 0.4 and 14.7%. More than a three-fold difference exists between the rate in hospitals that were in the top 10% and those in the bottom 10% (3.0% and 11.0%, respectively).

Figure 19 Funnel plot showing rates of third and fourth degree tears (assisted vaginal deliveries) among primiparous women, adjusted for maternal characteristics and clinical risk factors

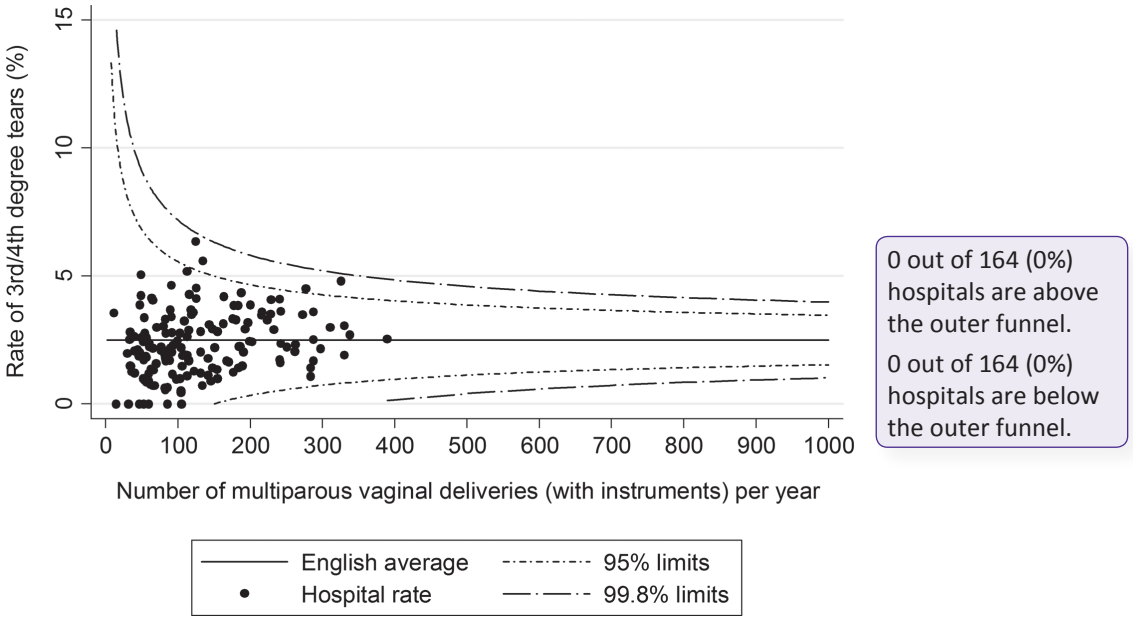


7 out of 164 (4%) hospitals are above the outer funnel.

3 out of 164 (2%) hospitals are below the outer funnel.

Among multiparous women, the mean rate of third and fourth degree tears among women with an instrumental delivery was 2.5%. After adjustment for case mix variation, hospital-level rates ranged between 0.0 and 6.3%, and the rates are all within the outer control limits.

Figure 20 Funnel plot showing rates of third and fourth degree tears (assisted vaginal deliveries) among multiparous women, adjusted for maternal characteristics and clinical risk factors



Interpretation of results

The proportion of deliveries involving higher degree lacerations can be a useful indicator of the quality of obstetric care and can assist in reducing these adverse events. An unusually high rate of third and fourth degree perineal tears may be worth investigating for potential quality problems, for example, overuse or underuse of episiotomy (Hartmann et al., 2005; Dudding et al., 2008). Although episiotomy codes are available in HES, we chose not to include these in the risk adjustment model as (1) the reliability of these codes is unknown, and (2) the use of episiotomy is within the provider's control.

Variation between hospitals may also be the result of differences in coding practices and in the diagnosis of perineal tears. An unusually low rate of perineal tears may be a cause for concern as it could indicate either under-reporting or under-diagnosis of these lacerations before discharge, leading to delays in reparative surgery. This possibility raises concerns about the validity of this indicator. In particular, the RCOG does not support the way that this indicator has traditionally been used by benchmarking organisations such as Dr Foster, whereby a low rate of tears is assumed to reflect better quality of intrapartum care. We recommend that these hospitals should be called upon to investigate their coding of third and fourth degree tears.

Although the funnel plots presented in this section show some evidence of variation in the rate of third and fourth degree tears between hospitals, for both unassisted and assisted vaginal deliveries the vast majority of hospitals fall within the expected range. However, insufficient statistical power (particularly for multiparous women) means that further data are necessary before robust conclusions can be drawn. This highlights that, for some indicators, it might be sensible to analyse data from more than one year.

It is worth noting that the third and fourth degree perineal tear rate is best interpreted by providers in the context of additional data. In particular, since providers may shift more women to caesarean sections for indications that might increase the rate of tears (such as small pelvis/large fetus, or previous obstetric tear), a provider's caesarean section rate should be monitored simultaneously. In addition, providers may want to interpret this indicator in the context of their epidural anaesthesia and episiotomy rates.

Expert Opinion Box 4

As we can see from these data, there is considerable variation in the rates of third and fourth degree tears depending on the mode of delivery and the setting. The overall rate in the literature is around the 6% mark in hospitals where a careful rectal examination is carried out immediately after delivery. In addition, instrumental delivery carries a higher rate simply due to reduced time for stretching of the perineum.

The variation we see here is probably a result of both poor detection in units with very low rates (missed tears due to an inadequate examination being performed) and also delivery practices (such as failure to perform an adequate episiotomy, or failure to control the delivery) at the top end of the scale.

Sometimes patients request not to have an episiotomy under any circumstances, resulting in a higher likelihood of midline damage to the sphincter mechanism. There is quite a body of evidence now that a medio-lateral episiotomy is protective, and this is recommended for all instrumental deliveries to prevent third or fourth degree tear (NICE, 2007). We should be aiming to standardise the care of the perineum at delivery, using a medio-lateral episiotomy sooner rather than later in order to prevent damage and midwives probably need to be more confident in their cutting technique, as we see a certain amount of reluctance to cut adequately. In addition the head should be controlled at delivery (with panting) to make sure there isn't a sudden tear.

Finally, all patients after vaginal delivery should have a very close examination of the perineum with careful rectal examination, cleaning away all the blood to check that no fibres are exposed while the examining finger lifts the rectal mucosa (Andrews et al., 2009). If perineal care was standardised, we should see an evening-out of the expected third degree tear rate to around 6% overall.

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5.5 Emergency readmission within 30 days of delivery

Background

Monitoring the rate of unplanned readmission within 30 days of discharge is a common way of using routine data to assess hospital performance. Such indicators have been used for a wide variety of conditions and patient subpopulations, and giving hospitals access to comparative figures may act as a trigger to examine practice. Consequently, the indicator could help to prevent potentially avoidable readmissions and lead to improved levels of care.

Emergency maternal readmission to hospital within 30 days of delivery represents a deviation from the normal course of postnatal recovery and an undesirable maternal outcome. A 30 day follow-up period is used because a majority of readmissions related to the pregnancy, birth or puerperium will occur within this time frame.

Construction of the indicator

1. ***Emergency maternal readmission within 30 days of delivery***
   Definition: the proportion of women who are readmitted to hospital as an emergency within 30 days of delivery.
   Numerator: emergency maternal readmission to any NHS hospital within 30 days of delivery, excluding cases where the mother remained in hospital for more than 10 days following delivery, or where the mother was readmitted accompanying a sick infant. An emergency admission was defined as any unplanned inpatient admission, referred via A&E, a GP, a consultant outpatient clinic or any other means.
   Denominator: (a) vaginal and (b) caesarean section deliveries.

Assessment of data quality

Deliveries missing a date of birth in both the maternity tail and the procedure date field (1%) were excluded as readmission within 30 days could not be calculated.

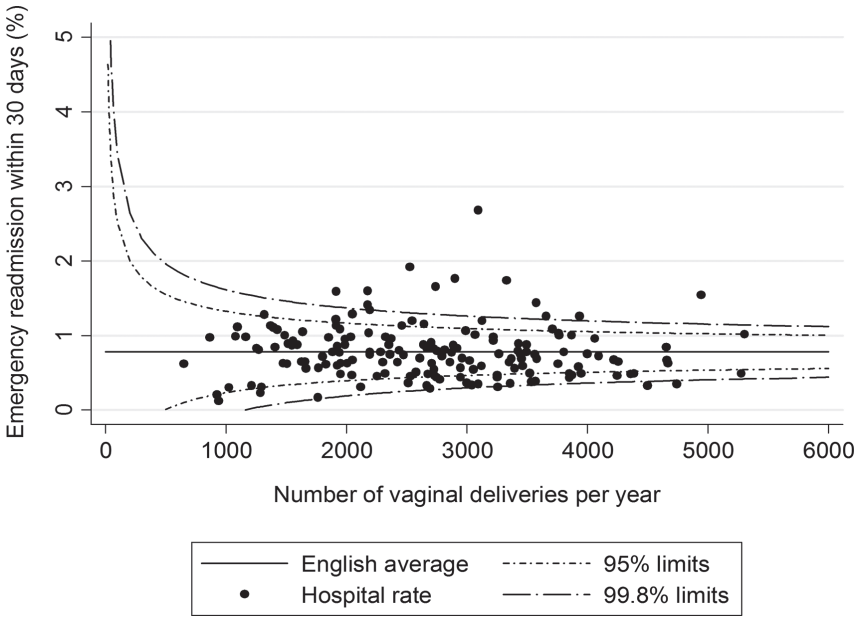
Women who remained in hospital for more than 10 days following delivery (0.05%) was also excluded from this calculation.

Results

Emergency maternal readmission within 30 days of delivery

Among vaginal deliveries, the mean rate of emergency readmission to hospital within 30 days of delivery was 0.8%. After adjustment for case mix variation, hospital-level rates ranged between 0.1 and 2.7%. The mean of the top 10% of hospitals was 1.6%, compared with 0.3% for the bottom 10%.

Figure 21 Funnel plot showing rates of emergency maternal readmission within 30 days of delivery among vaginal deliveries, adjusted for maternal characteristics and clinical risk factors

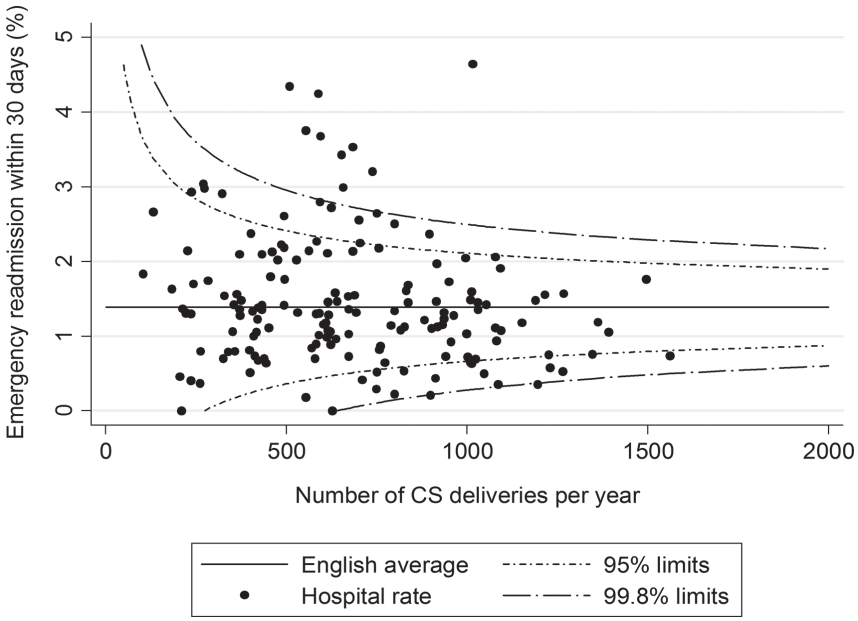


12 out of 164 (7%) hospitals are above the outer funnel.

3 out of 164 (2%) hospitals are below the outer funnel.

Among caesarean section deliveries, the mean rate of emergency readmission to hospital within 30 days of delivery was 1.4%. After adjustment for case mix variation, hospital-level rates ranged between 0.0 and 4.6%.

Figure 22 Funnel plot showing rates of emergency maternal readmission within 30 days of delivery among caesarean deliveries, adjusted for maternal characteristics and clinical risk factors



9 out of 164 (5%) hospitals are above the outer funnel.

2 out of 164 (1%) hospitals are below the outer funnel.

Interpretation of results

In 2011/12, among the 574 405 women with singleton, term, cephalic deliveries, 4990 (0.87%) women were readmitted to hospital as an emergency within 30 days of delivery. Among these admissions, the distribution of primary diagnoses is given in Table 5.

Table 5 Primary diagnoses among women readmitted to hospital within 30 days of delivery

Primary diagnosis	Frequency (%)
Infection/puerperal sepsis	13.8
Blood loss (including sequelae e.g. severe anaemia)	12.4
Complications related to the circulatory system	8.3
Complications related to lactation	7.9
Chest pain	7.3
Abdominal pain	5.3
Complications related to the urinary system	4.6
Headache/migraine	3.3
Wound disruption	2.9
Complications related to the respiratory system	2.7
Mental health problems	1.6
Haemorrhoids	1.5
Retained placenta	0.8
Unspecified postnatal complications	12.1

In our sample, 0.8% and 1.4% of women had an emergency readmission within 30 days after vaginal delivery and caesarean section, respectively. These results are consistent with studies from Canada and the USA which demonstrate that caesarean delivery is associated with a doubling of risk of postpartum readmission (OR 1.8 and 1.9). In these studies, the diagnoses associated with significantly increased risks of readmission after caesarean delivery compared with spontaneous vaginal delivery also included pelvic injury/wounds, obstetric complications, venous disorders and thromboembolism), and major puerperal infection (Lydon-Rochelle et al., 2000; Liu et al., 2005). In our risk adjustment model for this indicator, we have chosen not to control for perineal tears or thromboembolism because these factors are influenced by the provider to some extent.

The variation seen in emergency readmission among hospitals may reflect differences in coding practices. For example, hospitals with an apparently high readmission rate may be recording non-emergency admissions erroneously as emergencies, leading to an overestimation in the rate of emergency readmission. Hospitals should examine their admission method coding to ensure that this indicator can be reliably calculated in future.

Lower readmission rates within a hospital could suggest that better care was received during the delivery episode, or may indicate that women were better prepared by staff for discharge (for example, by being given clear instructions about caring for surgical wounds to prevent infection, or good directions regarding medication regimens). A low readmission rate may also point towards well organised support services in the community once a woman is transferred home, or at other levels of the hospital before a woman is admitted as an inpatient. On the other hand, a low readmission rate could be related to reduced capacity; higher thresholds for readmission may exist where there are bed shortages, particularly for borderline cases. These conflicting interpretations therefore challenge the validity of this indicator as a measure of quality.

Expert Opinion Box 5

Many factors influence readmission to hospital after delivery. The above data show clearly the most common reasons for readmission are related to infection and sepsis and blood loss.

Women who have delivery by any means other than spontaneous vaginal delivery have a greater chance of being readmitted. There is therefore a significant link between the mode of delivery and readmission rates and thus decreasing caesarean section and instrumental delivery rates should result in a reduction in readmissions. Women who have a caesarean section have a greater chance of readmission for intrauterine infection, wound complications and thromboembolic events whereas after an instrumental delivery readmission is likely to arise from complications arising from the perineal wound or haemorrhage.

All obstetricians will be aware that the death rate for sepsis increased from 0.85 to 1.13 per 100 000 maternities between the last two confidential enquiry reports. With the formation of MBRRACE-UK this year the first themed report will be based on maternal sepsis (MBRRACE, 2013). With awareness of maternal sepsis being at the forefront of the minds of maternity carers, it is possible that the high incidence of readmissions for infection represents a lower threshold for readmission as a result of this heightened state of awareness. Alternatively, this could suggest failings in the prophylaxis or early identification of infection. Future safety programs in maternity must therefore include infection as a matter of priority.

In monitoring their readmission rates, maternity units should also keep in mind that some of these clinical outcome indicators may be surrogates of process of care. Readmissions with complications relating to lactation may be localised infection, neonatal problems or difficulties in the education of breastfeeding that may have arisen as a result of either discharge too soon from hospital or inadequate community support.

Finally, monitoring and publishing readmission rates may highlight performance indicators that units may not be aware of. An example of this is readmission of women with thromboembolic phenomena. Some units will be measuring these data but most will not as such patients are likely to be managed by primary care and fast track thrombosis services which many NHS trusts have set up to improve access to and speed of care. Knowledge of performance in this area is likely to prompt assessment of compliance with national guidance for the administration of postpartum thromboprophylaxis.

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6 Conclusion

Many indicators have been defined to describe the practice and outcomes of maternity care. The collection of these into a balanced suite of indicators depends on many things, not least having ready access to complete and reliable data sources that contain the required information. The National Maternity Dataset may eventually provide the principal data source but this is currently unavailable. The main alternative source of data is routine administrative health datasets like HES. In this report, we begin the process of defining appropriate indicators that are methodologically robust, clinically valid and could be implemented nationally using these data. We demonstrate that, in the short-term, it can provide detailed information on the process of care and some clinical outcomes for important groups of pregnant women. However, the indicators represent only a first step towards a balanced suite of indicators for monitoring the quality of maternity care.

Using the measures available, there is large variation in some cases of intrapartum care nationally over and above what is expected by random fluctuations. This variation both reflects and impacts upon the clinical uncertainty surrounding certain procedures, equity of access to services, health outcomes and the efficient use of NHS resources. It is a source of serious concern for the specialty because it suggests that not every woman is getting the best possible care during labour and delivery.

The issues highlighted by these results and the way forward are now discussed in more detail.

6.1 Validity of performance indicators

The maternity indicators that can be derived from HES vary in the sophistication of their construction and the degree to which they are generic (readmission within 30 days) or specific (elective caesarean section performed after 39 weeks) in nature. The challenge remains to establish the degree to which the interpretation of these indicator values is unambiguous and which indicators represent valid measures of quality.

Quality in healthcare is a multifaceted concept, not amenable to a single performance measure or simple metric. There is now broad agreement that the key domains of quality are: effectiveness, safety, capacity, patient-centredness, equity, access and timelines (Institute of Medicine, 2001). As we assert in the Introduction, the results presented in this report are a first step towards measuring certain aspects of quality related to the effectiveness and efficiency of intrapartum care services. However, we currently lack information on important aspects of care such as service user experience and the figures in this report cannot be used to build robust conclusions regarding quality in the broadest sense of the term.

The main difficulty in drawing conclusions based on this report lies in defining which variation is unwarranted. Some level of variation is to be expected and indeed encouraged: eradication of all variation is certainly not a reasonable aim. The following comment by Al Mulley (2010) applies as much to maternity services as to other specialties.

> *If all variation were bad, solutions would be easy. The difficulty is in reducing the bad variation, which reflects the limits of professional knowledge and failures in its application, while preserving the good variation that makes care patient centred. When we fail, we provide services to patients who don't need or wouldn't choose them while we withhold the same services from people who do or would generally making far more costly errors of overuse than of underuse.*

For many of the process indicators, the questions posed by Bob Evans over two decades ago are still highly relevant today:

> *If variations represent evidence of inappropriate care, **which** care is inappropriate? Are the regions, or institutions, or practitioners with high rates over-providing, or are the low ones under-providing, or does the 'best' rate lie somewhere in the middle (or beyond either end)?*
>
> Bob Evans (1990)

Even for outcomes which are indisputably negative such as third and fourth degree tears or failed instrumental deliveries, it is not realistic to expect the rate of these complications to be zero. Some level of higher degree lacerations is inevitable unless all deliveries are performed by caesarean section. Likewise, some level of failed instrumental delivery is inevitable unless instrumental delivery is never attempted. The key to improving the validity of these indicators lies in defining acceptable ranges for these outcomes.

Case-ascertainment and data completeness

HES has a high level of case ascertainment. Data completeness for many data items is also high. For example, few delivery records in this analysis had missing values for age and for dates required to calculate the performance indicators. However, for the diagnosis and procedure fields, the level of missing data in HES is difficult to measure. Further work is required:

- to validate HES data against a random sample of case notes to estimate of the level of miscoding in this population
- by individual organisations to improve the level of completeness of maternity tail
- to standardise definitions to improve coding consistency between units.

Statistical power

It is necessary to consider the statistical power to accurately report differences between NHS trusts when evaluating a potential indicator. There are two factors that need to be considered in power calculations: (1) the number of events that occur over a defined time period (the denominator) and (2) the frequency of the outcome (numerator).

In the case of maternity care, the size of the denominator can be large, such as when it is based on all deliveries. In other situations, such as emergency readmission within 30 days of caesarean section, the number of events at each hospital is reduced to around 10 cases, which increases the impact of random fluctuations of the indicator values. In these circumstances, more than one year of data might be required to be able to draw fair conclusions.

Formal statistical power calculations are also required to set minimum numbers of procedures for individual clinicians or hospitals, below which a comparison against targets is not meaningful.

Technical specification and reliability of performance indicators

The technical specification of an indicator needs to be sufficiently robust to ensure that it is not unduly influenced by records with poor or inconsistent data. In HES, there is the possibility that indicators can be affected by omission or miscoding of diagnoses and procedures.

Although a recent systematic review of coding accuracy in routine UK data found that 96% of primary diagnoses codes were accurate, we cannot assume that similar accuracy applies to maternity diagnoses. Most indicators used in this report have robust technical specifications because they are calculated from OPCS and ICD-10 codes where possible, rather than data from the maternity tail which is missing in approximately 20% records. Nonetheless, there are several areas in which the limitations of HES data adversely affect the adopted definitions. For example:

- Our analysis of OPCS codes for induction of labour (R14-15) suggest that over 40% of all labours are induced. We assume that this implausibly high rate is the result of contamination of labour augmentations in this field. We therefore elected to use the 'onset of labour' field from the HES maternity tail which gives a more realistic induction of labour rate of 21%. However, this decision meant that we had to exclude 12 units from our analysis owing to high levels of missing or inconsistent maternity tail data.
- ICD-10 codes are available for preterm (O60) and post-term (O48) deliveries; however, gestational age in weeks is only available from the maternity tail. Unfortunately, this field

is missing in approximately 12% of delivery records and we therefore had to exclude 18 units when constructing the percentage of elective caesarean sections performed before 39 completed weeks of gestation.

Comparability and fairness

Performance measurement should take into account the different populations and levels of disease severity treated by organisations. This requires the adequate risk adjustment of indicators.

HES contains various variables that are commonly used in risk adjustment. Age and other sociodemographic variables are standard fields and coexisting diseases/obstetric conditions can be derived from the diagnosis fields. However, not all risk factors relevant to obstetric care are available in HES (for example BMI and smoking status). It is possible to obtain information about obstetric history through linkage with historical HES data, although the methodology requires further development.

6.2 The way forward

The work presented in this report was focused to defining intrapartum care indicators that can be robustly derived at hospital level using HES data. Further work is needed to understand the relationships between the indicators as well as patterns of care that can be observed within hospitals.

We now need to consider which indicators are best suited to support different aims, whether the information is pertinent to patient safety, performance assessment or quality improvement. A programme of work is now needed not only to identify causes of variation at a local level, but to begin to define acceptable levels variation for each of the indicators developed.

Ideally, a suite of indicators is not overly restricted by limitations of data source, and the available evidence of best clinical practice. Both data quality and the evidence base related to common obstetric interventions need to be improved before further improvements can be made to an indicator set derived from routine English hospital data.

Until the National Maternity Dataset comes online, routine hospital data, linked with other sources of clinical and user experience data where possible, can be used as a stop gap. The availability of more clinically detailed data will ultimately enable the improvement of existing indicators through refinement of risk adjustment models, as well as the development of new indicators to produce a more balanced picture of the quality of maternity care.

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Appendix 1

Birth statistics for England

Key findings from the NHS Maternity Statistics 2011–12 report

- The number of deliveries taking place in NHS hospitals remained stable, increasing by 0.1% to 668 936.
- The percentage of caesarean deliveries has remained stable at 25.0% (163 859), a 0.1 percentage point increase from 2010–11.
- The percentage of deliveries medically induced has increased by 0.8 percentage points to 12.0% (72 086) since 2010–11 with a smaller increase in surgical induction.
- The percentage of instrumental deliveries increased by 0.4 percentage points to 13.0% (85 009) from 2010–11.
- The percentage of delivery episodes ending on the same day as the delivery increased by 0.7 percentage points (20.2%, 116 541) from 2010–11. There was little change in antenatal lengths of stay.
- The percentage of episiotomies increased by 0.4 percentage points to 15.2% (101 886) from 2011–11 and this increase was largely attributable to instrumental deliveries.
- The main delivery complications continue to be perineal laceration during delivery (39.9%, 267 164), fetal distress (24.4%, 163 345) and postpartum haemorrhage (13.2%, 88 314).
- The main birth complications continue to be disorders relating to short gestation and low birthweight (7.0%, 47 253), neonatal jaundice (6.5%, 43 591) and intrauterine hypoxia (5.0%, 33 734).
- There has been little change in gestation lengths from 2010–11 with 6.3% (34 925) of live singleton births born preterm between 24 and 36 weeks (6.5% in 2010–11) and 4.3% (23 974) born 42 weeks or later (4.4% in 2010–11)
- There has been little change in low birthweights for liveborn singletons since 2010–11 with 4.6% (26 503) born at low birthweight (4.7% in 2010–11) and 0.8% (4795) born at very low birthweight (same as 2010–11).
- The percentage of liveborn singleton babies weighing 4000 g or over has increased by 0.2 percentage points to 11.9% (68 383) from 2010–11.
- The ratio of miscarriages to deliveries (6.4 to 100) and ectopic pregnancies to deliveries (1.7 to 100) has remained stable since 2010–11.

Reference: NHS Information Centre. *NHS Maternity Statistics 2011–12 Summary Report* [www.hscic.gov.uk/catalogue/PUB09202].

Appendix 2

Methods

This section describes in more detail the data used in the study, the analysis undertaken and the analytical methodology.

Data cleaning and indicator definitions

The basic unit recorded in HES is the finished consultant episode (the period of time during which a patient is under the care of one consultant). A 'spell' or admission is defined as the continuous period of time spent as a patient within one hospital from admission to discharge or transfer to another provider and may therefore include more than one consultant episode.

Episodes during which a baby was delivered should capture additional information about the delivery in the 'maternity tail'. Both the mother's and the baby's record contain the same supplementary information.

For the purpose of this analysis, a delivery episode was defined as any record that contained valid information about mode of delivery in either the maternity tail or the procedure fields (OPCS-4 codes: R171 to R259).

Duplicate records were identified on the basis of matching HESID and episode start date.

The sample was restricted to women aged between 15 and 45 years. We then excluded from the analysis deliveries with one or more of the following three characteristics:*

- Multiple deliveries were defined as delivery episodes with an ICD-code for a multiple birth (Z37.2–7) OR strong evidence of a multiple birth in the maternity tail (>1 valid date of birth [dobbaby], birthweight [birweit] , birth order [birord] AND >1 in the number of babies [numbaby] field).
- Preterm deliveries <37 weeks were defined as delivery episodes with an ICD-10 code for preterm delivery (O60).
- Non-cephalic deliveries were defined as delivery episodes with an OPCS code for breech delivery (R19-20) OR a maternity tail code for breech delivery (delmeth_1 5-6) OR an ICD code for breech delivery (O80.1; O83.0; O83.1) OR an ICD code for maternal care for malpresentation (O321; O641; O321; O322).

Parity was defined using the 'numpreg' field in the maternity tail; however, where this value was missing (15% records), we identified previous births by linking historical birth records from 1997 to March 2011, using the patient's HESID. This method also enabled us to calculate parity for women delivering in hospitals where the observed ratio of primiparous to multiparous women was outside the expected range of values. This was defined to be 25% to 55%, and corresponded to the overall primiparous rate in England and Wales ±15%

Induction of labour was defined using the delivery onset field in the maternity tail (delonset 3-5).

Mode of delivery was defined using OPCS codes R19-R25. Where these were missing or invalid (<1% deliveries) the delivery method (delmeth_1) field from the maternity tail was used.

Third and fourth degree perineal tears were defined by the presence of an ICD-10 code for a third or fourth degree tear (O702, O703) *and* an OPCS procedure code for repair of a third or fourth degree tear (R322, R325).

* The only exception to this rule was the 'proportion of elective caesarean sections performed before 39 weeks of gestation. For this indicator, breech deliveries were also included in the sample to increase the statistics power.

Gestational age in weeks was defined using the gestational age field in the maternity tail (gestat_1).

Emergency readmission was defined using the administration method field in the main HES database (any 'admimeth' beginning with 2, 3 or 8).

Date of birth was defined using the date of birth (dobbaby_1) field in the maternity tail. Where this was missing the operation date corresponding to the delivery procedure (R19-R25) was used.

Case mix adjustment

For each indicator, multiple logistic regression models were used to estimate the probability of a woman having had each intervention or outcome of interest on the basis of her age, ethnicity, level of socio-economic deprivation, and relevant clinical risk factors. Risk factors were included in the model on the basis of their relevance to the indicator in question and their completeness in the HES database. Interactions between maternal age and the clinical risk factors were examined but were not included in the final model because they did not significantly improve the model's fit (likelihood ratio test, P value>0.3).

Risk factor definitions:

- Age was defined using the age at start of episode (startage) field in the main HES database. Values were re-coded into 6 categories: (1) 15–19, (2) 20–24, (3) 25–29, (4) 30–34, (5) 35–39 and (6) 40–45.
- Ethnicity was defined using the ethnic category (ethnos) field in the main HES database. Values were re-coded into 5 categories: (1) White, (2) Asian, (3) Afro-Caribbean, (4) Other and (5) Unknown.
- Deprivation was defined using a five category indicator that was derived from the English Indices of Deprivation 2009 ranking of the English super output areas. The categories were defined by partitioning the ranks of the 32 480 areas into quintiles and were labelled 1 (least deprived) to 5 (most deprived).
- Birthweight was defined using the birthweight (birweit) field in the HES maternity tail. Values were re-coded into 4 categories: (1) <2500 g, (2) 2500–4000 g, (3) >4000 g and (4) missing.
- Gestational age in weeks was defined using the gestational age field in the maternity tail (gestat_1). Values were re-coded into 4 categories: (1) 37–39 weeks, (2) 40–41 weeks, (3) >41 weeks and (4) missing.
- Previous caesarean section was defined by linking each woman's HESID to her historical birth records from 1997 to 2010. Method of delivery was extracted from historical records. Caesarean section was defined using OPCS codes R17-18. Where OPCS codes were missing or invalid (<1% deliveries) the delivery method (delmeth_1) field from the maternity tail was used.
- Pre-existing diabetes was defined using the ICD-10 codes O240-O243.
- Gestational diabetes was defined using the ICD-10 codes O244 and O249.
- Pre-existing hypertension was defined using the ICD-10 codes O10-O11 and I10.
- Eclampsia was defined using the ICD-10 codes O14-O15.
- Placenta praevia/placental abruption was defined using the ICD-10 codes O44-O45.
- Polyhydramnios was defined using the ICD-10 code O40. Oligohydramnios was defined using the ICD-10 code O41.0.

The probabilities of the intervention or outcome of interest for women who delivered at the same hospital were then summed to give the hospital's predicted rate. Risk adjusted rates of for each hospital were produced by dividing the hospital's unadjusted rate by its predicted rate, and multiplying this ratio by the national average.

For more information on the methodology used for this report, please contact Hannah Knight, Research Fellow for Health Informatics at the RCOG, hknight@rcog.org.uk.

Appendix 3

Sources of maternity indicators included in the review

UK

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RCOG. *Safer Childbirth: Minimum Standards for the Organisation and Delivery of Care in Labour*. June 2007

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USA

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Appendix 4

Indicator Consensus Group membership

Jan van der Meulen (Chair)	Professor of Health Services Research and Policy, London School of Hygiene and Tropical Medicine
David Cromwell	Senior Lecturer, Health Services Research and Policy, London School of Hygiene and Tropical Medicine; Director, Clinical Effectiveness Unit, Royal College of Surgeons
Anita Dougall	Director, Clinical Quality, Royal College of Obstetricians and Gynaecologists and Qualified Midwife
Ipek Gurol-Urganci	Lecturer, Health Services Research and Policy, London School of Hygiene and Tropical Medicine
Sara Johnson	Executive Director, Quality and Knowledge, Royal College of Obstetricians and Gynaecologists
Mervi Jokinen	Practice Development Advisor, Learning, Research and Professional Development, Royal College of Midwives
Tony Kelly	Consultant Obstetrician & Gynaecologist, Honorary Clinical Senior Lecturer and Associate Medical Director for Quality & Innovation, Brighton and Sussex University Hospitals
Mark Kilby	Professor of Fetal Medicine and Clinical Lead in Fetal Medicine, Birmingham Women's Foundation Trust; President of the British Maternal & Fetal Medicine Society
Hannah Knight	Research Fellow for Health Informatics, Royal College of Obstetricians and Gynaecologists
Marie McDonald	Clinical Director, Women's Services, Guy's & St. Thomas' Foundation Trust
Eddie Morris	Consultant Obstetrician & Gynaecologist and Clinical Director, Norfolk & Norwich University Hospital; Chair, Safety and Quality Committee, Royal College of Obstetricians and Gynaecologists
David Richmond	Medical Director and Consultant Gynaecologist & Obstetrician, Liverpool Women's Hospital; Vice President, Clinical Quality, Royal College of Obstetricians and Gynaecologists
Helen Scholefield	Consultant Obstetrician, Liverpool Women's Foundation Trust
Gordon Smith	Professor of Obstetrics and Gynaecology, University of Cambridge

Appendix 5

Clinical indications for elective caesarean section before 39 weeks of gestation

These exclusion criteria were adapted from definitions used by the US Joint Commission Perinatal Core Measures with the help of Drs Diana Hamilton-Fairly and Daghni Rajasingham. Elective caesarean section was defined as a plan made for caesarean section more than 2 days before delivery.

Table 6 Conditions possibly justifying elective caesarean section before 39 completed weeks

Condition	ICD-10 code
Oedema, proteinuria and hypertensive disorders in pregnancy and childbirth	O10.0-9
Pre-existing hypertensive disorder with superimposed proteinuria	O11
Gestational [pregnancy-induced] hypertension with significant proteinuria	O14.0-9
Unspecified maternal hypertension	O16
Diabetes mellitus arising in pregnancy	O24.4
Diabetes mellitus in pregnancy, unspecified	O24.9
Liver disorders in pregnancy, childbirth and the puerperium	O26.6
Other specified pregnancy-related conditions	O26.8
Maternal care for (suspected) damage to fetus by radiation	O35.6
Maternal care for rhesus isoimmunization	O36.0
Maternal care for other isoimmunization	O36.1
Maternal care for poor fetal growth	O36.5
Oligohydramnios	O41.0
Infection of amniotic sac and membranes	O41.1
Premature rupture of membranes, onset of labour after 24 hours	O42.1
Placental transfusion syndromes	O43.0
Placenta praevia specified as without haemorrhage	O44.0
Placenta praevia with haemorrhage	O44.1
Labour and delivery complicated by vasa praevia	O69.4
Other diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism complicating pregnancy and childbirth	O99.1
Diseases of the circulatory system complicating pregnancy and childbirth	O99.4
Other specified diseases and conditions complicating pregnancy and childbirth	O99.8
Supervision of pregnancy with other poor reproductive or obstetric history	Z35.2

Reference: Specifications Manual for Joint Commission National Quality Measures (v2013 A1). Appendix A Table 11.07 [https://manual.jointcommission.org/releases/TJC2013A/].

Table 7 Conditions suggesting delivery by emergency caesarean section

Condition	ICD-10 code
Eclampsia	O15.0-9
Maternal care for unstable lie	O32.0
Maternal care for (suspected) central nervous system malformation in fetus	O35.0
Maternal care for (suspected) chromosomal abnormality in fetus	O35.1
Maternal care for intrauterine death	O36.4
Premature rupture of membranes, onset of labour within 24 hours	O42.0
Premature separation of placenta with coagulation defect	O45.0
Other premature separation of placenta	O45.8-9
Other antepartum haemorrhage	O46.8-9
Labour and delivery complicated by fetal stress [distress]	O68

Reference: Specifications Manual for Joint Commission National Quality Measures (v2013 A1). Appendix A Table 11.07 [https://manual.jointcommission.org/releases/TJC2013A/].