NMPA

National Maternity & Perinatal Audit

Annual Clinical Report

Based on births in NHS maternity services in England, Scotland and Wales during 2023

Methods

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LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE
RCPCH Royal College of Paediatrics and Child Health
Royal College of Midwives
Royal College of Obstetricians & Gynaecologists
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Contents

Introduction

This Methods document provides details of the data sources, methods and cohort construction used for the NMPA annual clinical report based on births in NHS maternity services in England, Scotland and Wales during 2023. A State of the Nation report and supporting documents can be found online, as well as trust/board level results.

What has changed since our previous annual clinical report?

- The datasets we use have changed since previous reports; for the first time, our annual clinical report uses the English Maternity Services Data Set version 2.0 (MSDS v2.0). Unforeseen delays in the supply of this dataset from NHS England led to a significant delay in the production of NMPA reports for births occurring between 2019 and 2023. Following publication of the annual clinical report based on births occurring in 2023, data from the intervening years (2019–2022) will be reported on the NMPA website.
- We have moved to calendar year reporting, to align reporting periods with other related projects such as the *National Neonatal Audit Programme* (NNAP) and *Mothers and Babies: Reducing Risk through Audits and Confidential Enquires across the UK* (MBRRACE-UK).
- We have reviewed and revised our suite of measures, for which details of the process can be found on our website.
- We have amended our ethnic group categories to include 'Chinese' in the 'Asian' ethnic group, whereas in previous reports 'Chinese' women and birthing people were included in the 'Any Other' ethnic group category.
- Scottish data has been reintroduced into our reports and outputs.

How to use this document

This Methods document forms part of a suite of resources produced for the NMPA annual clinical report on births occurring in 2023. The following additional supporting documents can be found on our website:

- Data flow diagrams
- A measures technical specification document describing how the audit measures were constructed
- A data completeness overview, at trust/board and national levels
- An outlier policy document with trust/board responses
- A glossary explaining the terminology and abbreviations used in our reports
- The NMPA State of the Nation report on births occurring in 2023
- Country-level summary results tables
- Trust/board-level interactive data tables and funnel plots
- A line-of-sight table describing the evidence base for the recommendations in this report
- Quality Improvement (QI) resources

Results can be used to benchmark against national standards and recommendations where these exist, and to identify good practice among maternity care providers and specific clinical areas for quality improvement. Only records and maternity services which passed detailed data quality checks are included in these results. This means not every maternity service at every trust/board has results for every measure.

Selection of audit measures

In 2022, the NMPA were re-commissioned by the Healthcare Quality Improvement Partnership (HQIP) to continue and enhance its analysis of maternity care. This recommission period began in 2023 with a rigorous review of measures used in previous audit reports. A full description of this review process can be accessed online.

The suitability of a measure for inclusion in a national clinical audit depends on a number of explicit criteria: validity, fairness, sufficient statistical power and adequate technical specification.[1] In addition to these criteria, it is also important for a set of audit measures to be balanced. In other words, the audit should cover various dimensions of care to give a complete overall picture of the service, especially in an area of clinical practice where there are very few measurable standards against which care processes and outcomes can be audited.

The measure review and selection process can be summarised as follows:

- The existing audit measures were reviewed for their continued relevance for inclusion, amendments were made by grouping certain measures together to maximise scope, and a small number of measures were identified as being no longer clinically relevant or reportable due to insufficient data completeness, and were removed. Several measures remained unchanged to allow for comparisons to be made against previous years' data and the reporting of trends over time.
- Additional potential candidate measures were identified from clinical guidelines, national reports, quality improvement initiatives, published literature and consultation with audit stakeholders.
- All existing and potential new measures were reviewed for applicability by the NMPA team and evaluated against the criteria for validity, fairness, sufficient statistical power and adequate technical specification.
- A final measure selection was carried out in partnership the audit's stakeholder groups comprised of clinicians, commissioners, data controllers, policymakers, voluntary organisations and maternity service users

As the NMPA reports results using data from the devolved nations, measures of maternity care must be identifiable across heterogeneous national maternity datasets which differ in terms of content, design, data completeness, data granularity and quality of data

List of audit measures for 2023

The final list of audit measures included in the NMPA annual clinical report on births occurring in 2023 is:

Late booking	Of women and birthing people who give birth to a singleton baby between 24^{+0} and 42^{+6} weeks, the proportion attending the first appointment with a midwife (booking) after 10^{+0} weeks of gestation.	
Preterm birth	Of women and birthing people who give birth to a singleton baby between 24^{+0} and 42^{+6} weeks of gestation: a) the proportion whose baby is born preterm between 24^{+0} and 36^{+6}, and:	Of those, the proportion whose birth is recorded as: b) spontaneous c) iatrogenic
Induction of labour	Of women and birthing people who give birth to a singleton baby between 37^{+0} and 42^{+6}, the proportion who have an induction of labour.	
Small for gestational age babies	Of term singleton babies born small for gestational age (defined as below the 10th birthweight centile using the British 1990 charts*), the proportion who are born at or after their estimated due date (40 weeks of gestation).	
Third- and fourth-degree perineal tears	Of women and birthing people who give birth vaginally to a singleton baby between 37^{+0} and 42^{+6} weeks, the proportion who experience a third- or fourth-degree perineal tear.	
Episiotomy	Of women and birthing people who give birth vaginally to a singleton baby between 37^{+0} and 42^{+6} weeks, the proportion who have an episiotomy.	
Vaginal birth with and without the use of instruments	Of women and birthing people who give birth to a singleton baby between 34^{+0} and 42^{+6} weeks, the proportion giving birth vaginally:	a) without the use of instruments b) with the use of instruments (overall) c) with the use of forceps d) with the use of ventouse
Caesarean birth	Of women and birthing people who give birth to a singleton baby between 34^{+0} and 42^{+6} weeks, the proportion who have:	a) an unplanned / emergency caesarean birth b) a planned / elective caesarean birth c) a caesarean birth reported by selected Robson groups
Vaginal birth after caesarean (VBAC)	Of women and birthing people giving birth to a singleton baby between 34^{+0} and 42^{+6} that is their second baby, after having had a caesarean birth for their first baby, the proportion who give birth vaginally.	
PPH ≥1500 ml	Of women and birthing people who give birth to a singleton baby between 34^{+0} and 42^{+6}, the proportion who have a postpartum haemorrhage of ≥1500 ml.	
Unplanned maternal readmission	Of women and birthing people who give birth to a singleton baby between 37^{+0} and 42^{+6} weeks, those who have an unplanned overnight readmission to hospital within 42 days of birth.	

* Cole et al, British 1990 growth reference centiles for weight, height, body mass index and head circumference fitted by maximum penalized likelihood. 1998. PMID: 9496720

Apgar Score <7 at 5 minutes	Of liveborn singleton babies born between 34^{+0} and 42^{+6} weeks of gestation, the proportion who are assigned an Apgar score of less than 7 at 5 minutes of age.
Skin-to-skin contact	Of liveborn singleton babies born between 34^{+0} and 42^{+6}, the proportion who receive skin-to skin contact within one hour of birth.
Breast milk	Of liveborn singleton babies born between 34^{+0} and 42^{+6}, the proportion who receive: a) any breast milk at first feed b) any breast milk at discharge from the maternity unit

The NMPA's approach to data collection

The NMPA differs from many other NCAPOP (National Clinical Audit and Patient Outcomes Programme) audits in that it brings together available data sources (i.e. those that are already collected either for clinical or hospital administrative purposes) rather than collecting primary data to create a bespoke audit dataset. By using existing datasets and linking these together, it eliminates the burden on clinical staff of data collection for the sole purpose of the NMPA.

The NMPA uses national-level centralised maternity datasets for each participating nation. The use of such datasets is advantageous as NHS trusts and boards are mandated to submit data to the centralised dataset according to a specification. This improves alignment of data items and coding before the NMPA receives data. Such an approach adheres to the principle of 'collect once, use many times' advocated by national data collection strategies. We hope that by using these datasets for national audit and feeding back results to trusts and boards, the NMPA will help to drive up the quality of the data contained within them year-on-year.

The NMPA's data Technical Specifications can be found on the NMPA Website.

Data sources used in the annual clinical report

The NMPA annual clinical report uses English, Scottish and Welsh data from the following sources:

England: Maternity data from the Maternity Services Data Set (MSDS v2.0), are linked to Hospital Episode Statistics Admitted Patient Care (HES APC) administrative data. These are linked to the ONS register of live births, stillbirths and mortality, as well as the PDS birth notification dataset which together form the ONS-PDS spine. All pseudonymised English datasets are controlled and supplied directly to the NMPA by NHS England.

Wales: Maternity data from the Maternity Indicators data set (MIds) (which includes the Initial Assessment (IA) dataset) are linked with selected variables from the National Community Child Health Database (NCCHD). Those are then linked to administrative data from the Patient Episode Database for Wales (PEDW) Admitted Patient Care (APC). All pseudonymised Welsh datasets are controlled and supplied directly to the NMPA by The Digital Health & Care Wales (DHCW).

Scotland: Maternity data from the Maternity Inpatients and Day Cases - Scottish Morbidity Record (SMR-02) and the Scottish Birth Record (SBR) are linked to data from the General Acute Inpatients and Day Cases - Scottish Morbidity Records (SMR-01). Those are then linked to data from the National Records of Scotland (NRS) register for live births, still births and death. All pseudonymised Scottish datasets are controlled and supplied directly to the NMPA by Public Health Scotland (PHS).

A data flow diagram for NMPA data from each of the devolved nations can be found online.

How has the data changed compared to previous reports?

The last NMPA report, published in 2022, presented data for births occurring between 1 April 2018 and 31 March 2019 for England and Wales only. Terms of involvement and data sharing agreements between the Scottish Government and HQIP commissioned audits have been re-established, and so we can once again include Scottish data in our results and outputs.

For the first time, we have used the updated MSDS v2.0 to produce our clinical report on births occurring in 2023. Unforeseen delays in the supply of this data from NHS England led to a significant delay in the production of NMPA reports for births occurring between 2019 and 2023. We initially received one large transfer of MSDS v2.0 data for births occurring between 2019 and 2023. Going forward, the NMPA will receive quarterly MSDS and HES APC updates from NHS England as part of our current data sharing agreement.

The challenges of implementing and refining MSDS v2.0 upgrades incorporated largescale structural changes compared to its predecessor (MSDS v1.5). This has included mandating clinical data entry from both electronic and paper records, the introduction of a new clinical terminology Systematized Nomenclature of Medicine Clinical Terms (SNOMED CT), additional data items, and updates to pre-existing data items.

SNOMED CT has shifted MSDS from the requirement for data to be input under the framework of specific items or categories to an open system where over 350 000 diagnoses, anatomical structures, events, observations, procedures, substances, organisms, interventions, situations, and concepts are numerically coded, and can be submitted in numerous locations. While this offers maternity care providers the possibility to submit more comprehensive data, for the NMPA this has presented the challenge of managing vast amounts of data that are organised in a non-standardised way, and requires intensive processing and cleaning. In some instances, SNOMED CT coding has replaced data capture using well established variables with defined data fields, leading to a decrease in data completeness and quality.

Both MSDS and HES APC continue to report operative procedures and diagnoses using the OPCS Classification of Interventions and Procedures version 4 (OPCS-4) and the International statistical classification of diseases and related health problems revision 10 (ICD-10) coding structures respectively, which are used for the numerator construction in many NMPA measures. OPCS-4 is a NHS coding system used for operations, interventions and procedures performed in the NHS, and ICD-10 is an international coding system of diseases, findings, and symptoms developed by the World Health Organisation.

Data quality

The NMPA team asseses data quality in four ways:

Data completeness

For each key data items required by the NMPA, we exclude sites or trusts/boards if the proportion of records missing this information exceeds 30%. An overview of data completeness on some of the key variables is available online in the Data Completeness documents.

Distribution

For many key variables, we define acceptable ranges within non-missing values. We exclude strongly outlying sites or trusts/boards that have a rate that is either too low or too high to be plausible (i.e. where no clinical reason for this level of variation could be envisaged). For example, a site with an obstetric unit will fail the gestational age check if the proportion of babies born at term (37^{+0} to 42^{+6} weeks) is less than 70%.

Within dataset consistency

For some variables, it is possible to perform internal consistency checks within the dataset. For example, it would be implausible for a woman or birthing person who is coded as having labour onset as '*not applicable – delivered prior to labour onset via caesarean section*' to also be coded as having given birth vaginally. We check that these types of implausible records are rare within the dataset. Where consistency issues are detected, the variable identified as being the least plausible is set to missing for that record.

Between dataset consistency

For a few key variables, it is also possible to check for consistency between the different source datasets. For example, for England, gestation length at birth is available in the main maternity dataset MSDS as well as the ONS-PDS spine and the HES APC dataset. This is extremely valuable in the sense that it allows better decision making when cleaning the data, particularly when addressing within-dataset consistency issues on key variables. Where consistency issues are detected, the source identified as being the most plausible and/or reliable is retained for that record.

Additionally, in some rare cases where important data quality issues on a given measure affect an entire site or trust/board, it is sometimes possible to substitute that measure with that of an alternative source dataset for that given site or trust/board.

Assessment criteria were developed based on previous work.[2] The four data quality assessment approaches detailed above each serve a different purpose and, together, improve the likelihood of detecting poor quality data. For example, data quality assessment based on the proportion of missing data alone would not be sufficient, as it could lead to the inclusion of records from hospitals with seemingly complete data but with an observed distribution of data outside the expected range

of values. By combining these approaches we can be confident that the published figures are based on data that have met at least a minimum standard of completeness and consistency.

Details of data quality checks performed for each measure as well as data item definition and alternative sources available for each can be found online in the Technical Specifications document

Data analysis

Minimum requirements for inclusion in the analysis

The analysis in the clinical report for births in 2023 is restricted to:

- trusts/boards that passed the NMPA trust/board-level data quality checks
- birth records within those sites and trusts/boards that contain the required data to construct the measure
- birth records within those sites and trusts/boards that contain the required data to construct case-mix adjusted results (where adjustment is applicable)

The number of trusts/boards for which results are available therefore varies from measure to measure, depending on the specific data requirements.

Construction of audit measures

The statistics in the clinical report are given as the proportion of events occurring within a group of women and birthing people or babies. The reference group of women and birthing people or babies (the denominator) changes between audit measures. As a general principle, the denominator for each measure is restricted to women and birthing people or babies to whom the outcome or intervention of interest is applicable. For example, the measure of the '*proportion of women and birthing people with a third or fourth degree tear*' is restricted to those who gave birth vaginally. A full description of these groups is contained in the Technical Specifications under each measure.

For measures relating to maternal care, results are presented per woman or birthing person giving birth. For measures relating to the care of the baby, results are presented per baby born. In order to compare like with like, measures are restricted to singleton births

Case-mix adjustment

When presenting figures for individual health service providers, it is often appropriate for audit measures to take into account how similar the patient groups are at each service, and how they differ between services. Clinical and demographic characteristics of women can affect both the demands placed on the maternity service and the outcomes of care. In turn, some women and birthing people and babies with more complex needs and at higher risk are referred to specialist services. Accounting for risk factors which are outside the control of care providers is essential before fair and meaningful comparisons across services can be performed.

In the NMPA clinical reports, we control for differences in the case-mix between services by adjusting results using logistic regression models. These models adjust for risk factors that are outwith the control of the maternity services such as age, parity, previous caesarean birth and clinical risk factors that may contribute to variation in performance between organisations. Neonatal factors included in the case mix are birthweight and gestational age.

Previous case-mix adjustment models used in our earlier reports included: maternal age, parity, previous caesarean birth, birthweight, gestational age, Body Mass Index (BMI}, smoking status at booking, diabetes, hypertension, pre/eclampsia, placental problems, poly/oligo/anhydramnios. However BMI, smoking status at booking, diabetes, hypertension, pre/eclampsia, placental problems, poly/oligo/anhydramnios were removed from the model for 2023 due to some trusts having insufficient data completeness for those items or poor linkage to HES APC from which some of those are derived.

Since the clinical report for births in 2017-18 the NMPA's case-mix adjustment no longer includes ethnicity or Index of Multiple Deprivation (IMD). This amendment, is so that our results accurately show the inequalities in maternity outcomes and do not mask the variation in outcomes associated with differences in a woman or birthing person's ethnic or socio-demographic background.

Further details, including which case-mix factors were used in each model, are given in the measures technical specification.

Reporting

All results for the NMPA's Annual Clinical Audit reports can be found on our website.

Levels of reporting

The State of the Nation report provides country-level summary results.

For births in 2023, we report trust/boards-level results as well as region-level data in the interactive tables available on our website. This will allow services to benchmark themselves against other services as well as national averages.

Presentation of results on funnel plots

A funnel plot (explained on our website in a short video) is a graphical method for comparing the performance of organisations.[3] The main advantage of this technique is that it takes the size of each organisation into account. This is important because the amount by which the result of an individual provider may vary from the national mean is influenced by random fluctuations that are related to the number of births within the provider.

In the sample funnel plot in Figure 1, results for England are shown as blue circles and for Wales as lilac squares. The dotted lines show the 95% control limits and the dashed (outer) lines the 99.8% control limits. Five percent of trusts would be expected to lie outside the dotted lines and 0.2% outside the dashed lines due to chance. Here, many more trusts and boards lie outside these lines. This is an example of overdispersion.

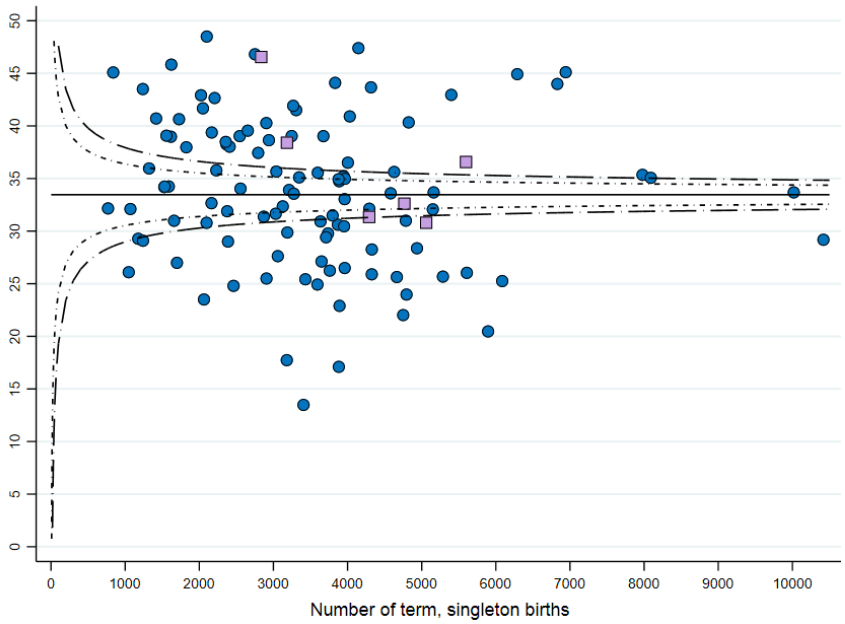

Figure 1: Sample funnel plot

The control limits within funnel plots highlight how much of the variation between providers exceeds that expected to occur due to chance alone. For the NMPA's three 'outlier measures', this is taken as an indication of care quality. For other measures, we use funnel plots only to show where there are substantial systematic (non-random) differences between services.

Several of the funnel plots presented in the clinical report show evidence of a phenomenon known as overdispersion.[4] 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 possible explanations for overdispersion include differences in data quality, the limitations of the risk adjustment methods and 'clinical uncertainty.' This means variation in practice as a result of the absence of clear evidence-based clinical standards and different clinician preferences. We have attempted to limit the impact of differences in case-mix and in data collection and coding practices between sites as well as trusts/boards. However it is likely that some of the systematic variation between providers reflects clinical uncertainty.

Interactive funnel plots are available on the NMPA website, as well as data tables and overviews of all results per trust/board and site.

The NMPA's outlier reporting

The NMPA's measures selected for outlier reporting were chosen because they represent adverse outcomes for women or babies with potential serious or long-term effects. Trusts/boards with results for these measures that are higher than would be expected by chance alone are notified and asked to investigate why this might be the case. The measures included in the outlier reporting for the 2016-17 clinical report were:

- Proportion of women who sustained a 3rd or 4th degree perineal tear
- Proportion of women with an obstetric haemorrhage of 1500 ml or more
- Proportion of singleton, term, liveborn infants with a 5-minute Apgar score of less than 7

Potential outlier indicator reporting was not performed for NMPA annual clinical reports on births occurring between 1 April 2017 and 31 March 2018, and between 1 April 2018 and 31 March 2019. For the 2017-18 clinical report, this was due to a lower proportion of English NHS trusts that could be included, resulting in low confidence of an accurate national average for which to base outlier reporting on, and also due to poor timeliness of the data; for the 2018-19 clinical report this was due to the same issue of poor timeliness.

Potential outlier reporting has been reintroduced for the clinical report for births occurring in 2023 based on the following definitions:

- Proportion of women and birthing people giving birth vaginally to a singleton baby between 37^{+0} and 42^{+6} weeks of gestation, who experience a third- or fourth-degree tear
- Proportion of women and birthing people giving birth to a singleton baby between 34^{+0} and 42^{+6} weeks of gestation, who have a postpartum haemorrhage of 1500 ml or more
- Proportion of liveborn, singleton babies born between 34^{+0} and 42^{+6} weeks of gestation, with a 5-minute Apgar score less than 7

A full description on the NMPA's Outlier Policy is available on the NMPA website.

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This report was prepared by the NMPA project team:

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For further information and resources, please visit the NMPA website where you can also subscribe to the email newsletter for regular audit updates: https://maternityaudit.org.uk

Alternatively, you can contact us at: nmpa@rcog.org.uk

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