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Mika Gissler (ed.)

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Preface

The Nordic countries have for a long time focussed on developing high-quality health services as well as patient safety. These countries have unique opportunities to measure and monitor the performance of health services, since all the countries regularly gather data using health registers.

The Nordic Council of Ministers has worked for more than 15 years on health care quality issues. The overall aim is to enable Nordic residents, politicians, health care personnel and health authorities to assess and compare the quality of health services across national borders in the Nordic countries. Another aim is to identify fields in which the Nordic countries can learn from one another with the aim of improving the quality of health services.

Three large reports have been published in Scandinavian languages:

- NHV-Rapport 2003:1: Kvalitetsmåling i Sundhedsvæsenet. Rapport fra Nordisk Ministerråds Arbejdsgruppe.
- TemaNord 2007:519: Kvalitetsmåling i sundhedsvæsenet i Norden.
- TemaNord 2010:572: Nordisk kvalitetsmåling i sundhedsvæsenet.

The Nordic Council of Ministers mandated a Working Group on Patient Safety for the years 2013–2015. The work covered three areas: the use of the Global Trigger Tool, Patient safety culture, and Patient safety indicators in obstetrics. This report covers the work on indicators. The report is divided into two parts. The first part describes a literature review on obstetric indicators measuring quality of care and patient safety. The second part gives a recommendation, prepared by a Nordic expert panel, on a core set of indicators measuring the quality of obstetric care with a focus on patient safety that are to be collected routinely from the Nordic countries. The selection of indicators is based on the results of a pilot data collection performed in 2014–2015.

Abstract

Quality and Patient Safety Indicators in Obstetrics National Institute for Health and Welfare (THL). Discussionpaper 23/2015. 115 pages. Helsinki, Finland 2015.
ISBN 978-952-302-545-5 (online publication)

A variety of indicators has been created to capture the quality and patient safety in obstetric care. There is no common consensus on a single uniform set of indicators that could be used in all countries or in different obstetric settings. Researchers and experts still disagree on which indicators best reflect the quality and patient safety in obstetric care. The problems related to current obstetric quality indicators include the lack of precise definitions as well as the variety of terms and problems to record rare cases, such as maternal deaths and severe complications.

International work to develop and improve recommended quality and patient safety indicators is valuable. Creating such indicators, especially at the Nordic level, is one attempt to address the lack of agreed common indicators. Not only could internationally accepted, common indicators enable national and international comparisons, but they could also improve clinical practices.

The Nordic expert panel with representatives from all five Nordic countries recommends the following patient safety indicators to be collected on a routine basis:

1. Process and structural indicators: Unplanned out-of-hospital deliveries, Caesarean section in general anaesthesia, Blood transfusion rate, Third or fourth degree perineal tears, Fourth degree perineal tears, Acute re-admissions for inpatient care 30 days postpartum, and Proportion of newborns with umbilical cord pH taken.
2. Outcome indicators for maternal health: Maternal mortality ratio, Peripartum hysterectomy, Uterus rupture during labour, and Postpartum bleeding with coagulation defects.
3. Outcome indicators for newborn health: Perinatal mortality, Low umbilical artery pH <7.05, 5-minute Apgar score 0–6, 5-minute Apgar score 0–3, and Combined low umbilical artery pH and low 5-minute Apgar score 0–6.

The group also concluded the need to get information on neonatal care. Moreover, two of the proposed indicators, i.e. Respiratory treatment and Brain cooling among infants with low Apgar scores, should be discussed with neonatologists before any final decisions.

The proposed indicators should be collected and disseminated annually by the Nordic Medico-Statistical Committee (NOMESCO) with the help of the NOMBIR collaboration of the Nordic Medical Birth Registers.

Keywords: measurement of quality in health care, obstetrics, patient safety

Tiivistelmä

Quality and Patient Safety Indicators in Obstetrics [Synnytysten hoitoon liittyvät laatu- ja potilasturvallisuusosoittimet]. Terveyden ja hyvinvoinnin laitos (THL). Työpaperi 23/2015. 115 sivua. Helsinki 2015.
ISBN 978-952-302-545-5 (verkkojulkaisu)

Lukuisia osoittimia on kehitetty mittaamaan synnytystoiminnan laatua ja potilasturvallisuutta. Yhtä yleisesti hyväksyttyä indikaattorilistaa, jota voitaisiin käyttää kaikissa maissa ja erilaisissa järjestelmissä, ei ole olemassa. Tutkijat ja asiantuntijat ovat edelleen erimielisiä siitä, mitkä osoittimet ovat parhaimpia mittaamaan synnytystoiminnan laatua ja potilasturvallisuutta. Nykyisten synnytykseen liittyvien laatuosoittimien ongelmia ovat tarkkojen määritelmien puute, erilaisten termien käyttö ja vaikeudet saada luotettavia tietoja harvinaisista tapahtumista, kuten äitiyskuolemista ja synnytykseen liittyvistä vakavista haittatapahtumista.

Kansainvälinen työ suositeltujen laatu- ja potilasturvallisuusosoittimien kehittämiseksi ja parantamiseksi on arvokasta. Yhteisten indikaattorien luominen, etenkin pohjoismaisella tasolla, korjaa yhdessä sovittujen osoittimien puutetta. Yhteiset indikaattorit eivät ainoastaan olisi kansainvälisesti hyväksyttyjä, mutta ne myös mahdollistaisivat kansalliset ja kansainväliset vertailut ja siten voivat myös parantaa kliinisiä käytäntöjä.

Pohjoismainen asiantuntijaryhmä, johon osallistui edustajia kaikista viidestä Pohjoismaasta, suosittelee seuraavien potilasturvallisuus- ja laatuosoittimien säännöllistä keräämistä:

1. Prosessi- ja rakenneosoittimet: suunnittelemattomat sairaalan ulkopuoliset synnytykset, yleisanestesiassa tehdyt keisarileikkaukset, verensiirtojen määrä, kolmannen tai neljännen asteen repeämät, suunnittelemattomat obstetrisista syistä tapahtuvat vuodeosastohoidot 30 vuorokauden kuluessa synnytyksestä ja niiden lasten osuus, joilta on otettu napavaltimoveren pH.
2. Äidin terveysosoittimet: äitiyskuolleisuus, synnytyksen jälkeiset kohdunpoistot, synnytyksen aikainen kohdunrepeämä ja synnytyksen jälkeinen verenvuoto, jossa hyytymishäiriö.
3. Vastasyntyneen terveysosoittimet: perinaatalikuolleisuus, napavaltimoveren pH < 7,05, 5 minuutin Apgarin pisteet 0–6, 5 minuutin Apgarin pisteet 0–3, ja yhdistetty alhainen napavaltimoveren pH ja 5 minuutin Apgarin pisteet 0–6.

Ryhmä totesi myös, että on tarpeellista sisällyttää seurantaan neonataalihoitoa koskevia osoittimia. Näistä ehdotetuista osoittimista – respiraattorihoito ja aivojen viilennyshoidossa olleet alhaiset Apgar-pisteet saaneet lapset – pitää keskustella tarkemmin neonatologien kanssa ennen lopullista osoittimien valintaa.

Nomeskon (Pohjoismainen terveystilastokomitea) olisi kerättävä ja julkaistava nämä osoittimet vuosittain yhteistyössä Pohjoismaisten syntymärekisterien yhteistyöelimen NOMBIR:n kanssa.

Avainsanat: potilasturvallisuus, synnytys, terveydenhuollon laadun mittaaminen

Sammandrag

Quality and Patient Safety Indicators in Obstetrics [Kvalitets- och patientsäkerhetsindikatorer i obsterik]. Institutet för hälsa och välfärd (THL). Diskussionsunderlag 23/2015. 115 sidor. Helsingfors, Finland 2015.
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Flera indikatorer har utvecklats för att mäta kvalitet och patientsäkerhet inom förlossningsvården. Det finns idag ingen allmänt vedertagen lista över indikatorer som skulle användas i alla länder och i olika system. Forskare och sakkunniga är av olika åsikter om vilka indikatorer som bäst mäter förlossningsverksamhetens kvalitet och patientsäkerhet. Problemen med de befintliga kvalitetsindikatorerna för förlossningsvården är bristen på exakta definitioner, användning av olika termer och svårigheten att få tillförlitlig information om sällsynta händelser, såsom dödsfall bland föderskor och allvarliga komplikationer relaterade till förlossning.

Det internationella samarbetet för att utveckla och förbättra indikatorer för kvalitet och patientsäkerhet är viktigt. Skapandet av gemensamma indikatorer på nordisk nivå, skulle möjliggöra nationella och internationella jämförelser genom vilka den kliniska praxisen kunde förbättras.

Den nordiska expertgruppen med representanter för alla de fem nordiska länderna rekommenderar regelbunden insamling av följande indikatorer för kvalitet och patientsäkerhet:

1. Process- och strukturella indikatorer: oplanerade förlossningar utanför sjukhus, kejsarsnitt under generell anestesi, anden kvinnor som fått blodtransfusion, bristningar av tredje eller fjärde graden, akut återinläggning på vårdavdelning på grund av obstetriska orsaker inom 30 dygn efter förlossningen och andelen barn på vilka navelsträngsartärens pH har uppmätts.

2. Hälsoindikatorer för mödrar: mödradödlighet, avlägsnande av livmodern i anslutning till förlossning, bristningar i livmoderväggen under förlossning och blödning efter förlossning med koagulationsstörning.

3. Hälsoindikatorer för nyfödda: perinatal dödlighet, navelsträngsartär pH < 7,05, Apgar-poäng 0–6 vid 5 minuters ålder, Apgar-poäng 0–3 vid 5 minuters ålder samt ett kombinerat värde på lågt pH i navelsträngsartär och Apgar-poäng 0–6 vid 5 minuters ålder.

Gruppen konstaterar också att det är viktigt att uppföljningen även innehåller indikatorer för neonatal vård.

Dessa föreslagna indikatorer är respiratorvård och andel barn med låga Apgar-poäng vars hjärna kylts ner, indikatorer som bör diskuteras mer i detalj med neonatologer innan de slutliga indikatorerna väljs.

Nomesko (Nordiska medicinalstatistiska kommittén) borde samla in och publicera dessa indikatorer årligen i samarbete med NOMBIR (samarbetsorganet för nordiska födelseregister).

Nyckelord: obstetrik, patientsäkerhet, mätning av kvalitet i hälsovård

Contents

1 Introduction

Patient safety means that the care and treatment provided are effective and safe. Patient safety is a fundamental element in health care; in fact, it can be seen to be a solid ground for all health care. At the same time it is also a dimension of the quality of health care. Patient safety is quality, and quality of care means that patient safety has been taken into account. According to an OECD report (2013), poor quality of care affects everyone. It undermines every goal of modern health systems, resulting in increased patient dissatisfaction, premature mortality, increased health costs, and possibly even widening health inequalities. According to the same report, measuring quality of care is a key component of many policies that aim to improve the performance of health care systems. (OECD 2013.) Because patient safety and quality of care are so closely linked, these two are strongly intertwined throughout this review.

Patient safety can be measured with the help of information collected from various different registers or, for example by conducting studies. However, making comparisons with the help of this kind of information can be difficult because there are different ways of gathering and registering data. (THL 2012.) Patient safety indicators (PSI) are tools that help to recognize adverse events, to minimize the harm these adverse events cause, to measure and monitor the quality of health services, and to compare the quality of health services across countries. The overall aim in developing patient safety indicators is to improve patient safety and the quality of health care. (TemaNord 2010.)

Traditional obstetric quality measures are many. They include maternal mortality, neonatal mortality and Caesarean delivery rates (Bailit 2007, Tapper 2013) as well as vaginal birth after Caesarean delivery and obstetric trauma, cervical tears, and the need for ureteral, bladder or rectal repair (Bailit 2007).

In the OECD Health Care Quality Indicators Project, the currently collected patient safety indicators are obstetric trauma in vaginal delivery without instrument, obstetric trauma in vaginal delivery with instrument, foreign body left during procedure, catheter-related bloodstream infections, post-operative pulmonary embolism or deep vein thrombosis, post-operative sepsis, and accidental puncture or laceration. (OECD 2013.)

There is ongoing need for developing new indicators for obstetric quality and patient safety. Some of the newer measures of obstetric quality include risk-adjusted Caesarean rates, the nulliparous term singleton vertex (NTSV) Caesarean birth rate, and the Adverse Outcome Index (AOI) (Bailit 2007). Also haemorrhage and infection during childbirth have been under study (Gregory et al. 2013). More research is still needed on many of these new indicators before they can be introduced or used on a widespread basis.

2 Review on obstetric quality indicators

This review is a part of a bigger project in health care quality. The Nordic Council of Ministers has launched several projects to develop indicators for the quality of health services. Their aim has been to promote indicator dissemination, comparison and benchmarking between the Nordic countries. In 2013 the Nordic Council of Ministers gave this project a mandate to carry on with its work in 2013–2015. The project has members from each Nordic country. The overall aim of this project is to promote evidence-based practice in health care by documenting and developing patient safety indicators in obstetric care.

The purpose of this review is, first, to get an overview of how obstetric quality has been measured in high-income countries, especially in the Nordic countries and the OECD countries, including Australia, Canada, New Zeeland and the United States, and secondly to see what experiences and comments have been made on the existing indicators. This review can be used in discussions in the field of obstetric quality and patient safety work.

2.1 Conducting a review

This review uses qualitative methods to focus on the current literature on obstetric quality indicators. It aims, on one hand, to take a look on the existing sets of obstetric indicators and, on the other, to collect experiences on the use of these indicators. While the review was made following the main principles of systematic reviews, the quality of studies was not systematically evaluated. However, a sincere effort was made to confirm that all the chosen articles were from qualified academic journals with a standard review procedure in publishing articles. The data synthesis was descriptive. Because of the qualitative nature of this the review, the results were neither statistically combined nor statistically analysed.

In this review existing national and international sets of obstetric indicators were explored and presented in Chapter 3. In the electronic data search and analysis of the existing data sets we were especially interested in the experiences and comments made on the existing indicators.

The research questions to be answered were:

- How have obstetric quality and patient safety been measured in high-income countries, especially in the Nordic countries and the OECD countries?
- What kinds of experiences are there on the use of these indicators?

Inclusion and exclusion criteria were stated in order to find scientific articles that answer the research questions. Choosing the inclusion and exclusion criteria and following them through the data selection process were a natural part of the review process.

The inclusion criteria for this review were:

- Context: obstetric care.
- Geographical limitations: only studies made in Europe and OECD countries.
- Patient group: parturients and their newborns.
- Languages: English, Spanish, German, French and Scandinavian languages.
- Time frame: from 1990 onwards.

The exclusion criteria for this review were:

- Study/article does not answer the research question.
- Study/article is not written in the languages given above.

2.2 Search in databases

An electronic data search was conducted together with a professional information specialist (Pia Pörtfors, THL National Institute for Health and Welfare) on 14 February 2014. Databases used in the search were Cinahl, Cochrane Database of Systematic Reviews, Med ProQuest, PubMed, and Web of Science. Medical subject-heading search terms and keywords were used. The key search strategy was translated for all databases with minor changes to searches due to different search logic in different databases. The main search strategy was: ((obstetric* or childbirth or birth or labour or delivery) and (quality or "patient safety")).ti. and indicator*.ti,ab,sh. Words such as labour and delivery were not used in the electronic data search, because they are ambiguous, and they resulted in many falsifying search results in the preliminary searches. For more detailed discussion of the search strategy see Appendix 1. All searches were limited to the years 1990–2014.

The search gave different results in different databases and resulted in altogether 465 articles. The search results were: Cinahl (64 articles), Cochrane Database of Systematic Reviews (10 articles), MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R), Ovid MEDLINE(R) Daily Update (307 articles), ProQuest Health Management (15 articles), PubMed (2 articles), and Web of Science (67 articles). The search results were imported to RefWorks. The removing of duplicates resulted in 399 articles that were then screened for inclusion. The selected studies were not systematically scrutinized for additional references, but a quick look at references was made in order to identify studies missed by the electronic search. This resulted in five additional articles to be found. The total number of articles screened for inclusion was, thus, 404 articles.

The selection of material for the review took place on 18–19 February 2014 and 24 February 2014. Choosing the material for the review was done in phases. Figure 1 presents the process of data selection. Studies were either included or excluded according to the inclusion and exclusion criteria. Only studies describing obstetric indicators in high-income countries were included.

2.3 Description of chosen studies

Altogether 404 articles were screened for inclusion, and 37 of them met the selection criteria. The included articles were published between 1993 and 2014, and were from the following countries: one from Denmark, one from Germany, one from the Netherlands, one from Sweden, two from the UK, two from Finland, three from Australia, seven were international (made by international expert groups), and 19 articles were from the USA. Most of these articles were published in English, but two articles were published in German and French, respectively. Of the included articles six were reviews on a certain topic, 11 presented the work of an expert panel group, and 20 were based on statistical studies where the data were extracted from registers and analysed using statistical methods.

The study context in all of these articles was obstetric, and all the included articles discussed obstetric indicators. Some of the chosen articles described published, existing sets of indicators or some of the indicators included in these, including the Zeitlin et al. (2003) article describing PERISTAT indicators for monitoring and evaluating perinatal health in Europe. Whereas some of the articles described newly created sets of indicators, including the Kesmodel & Jølving (2011) article about a national indicator project in Denmark as well as the Boulkenid et al. (2013) article about quality indicators. Most of the articles described and discussed the use and usefulness of particular indicators, for example the Baghurst (2010) article about the intact lower genital tract following childbirth and the Pyykönen et al. (2013) article about the rate of obstetric anal sphincter injuries in Finnish obstetric units.

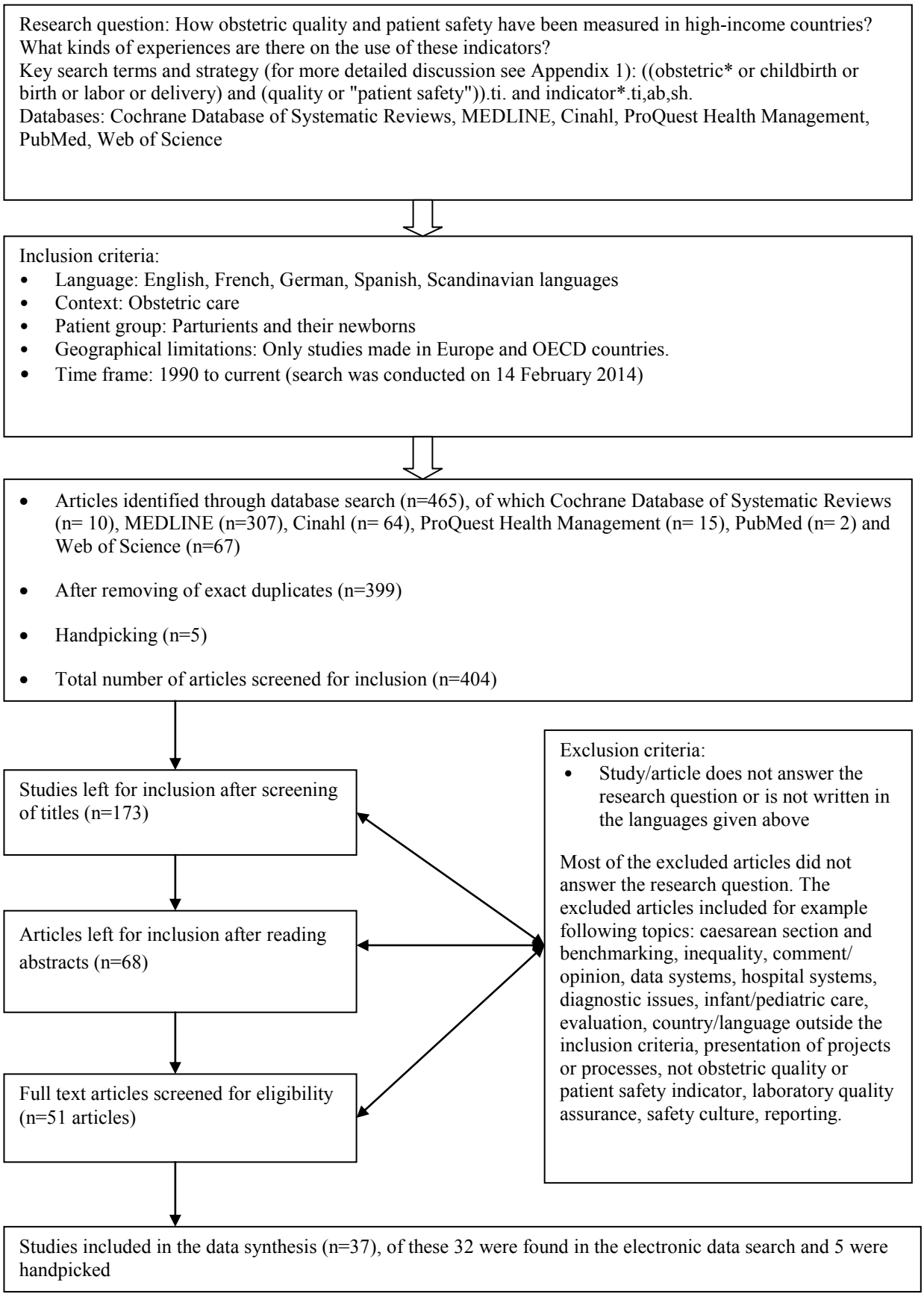

Figure 1. The process of data selection

3 Existing sets of obstetric indicators

In addition to the literature review, the aim of this study was to examine the existing, published sets of obstetric indicators. Across the world, several efforts have been made to create feasible sets of quality indicators within obstetric care. An attempt has been made to describe the practice and outcomes of maternity care with the help of these indicators. The ultimate aim has been to use these indicators to improve the quality and patient safety in obstetric care; hence, quality improvements are an important aspect of patient safety, and developing a set of quality indicators is often the first step in any quality improvement programme. (Boulkenid et al. 2013, EURO-PERISTAT 2010, OECD 2010, Knight et al. 2013, The Joint Commission, RANZCOG/ACHS 2013.)

One of our findings was that there was no ready-made list of all the existing obstetric quality indicators. In this review the existing, published sets of obstetric indicators were an important source for identifying indicators that measure quality and patient safely. These sets of indicators have been located through discussions with experts in the field and also through the literature review that was conducted in order to gather information on the use of obstetric quality indicators. Some of the existing, published sets of indicators were presented or discussed in the articles which were found in the literature review. A comprehensive presentation of the indicator sets is in Appendix 2.

A closer look was taken at the following sets of indicators: AHRQ Quality indicators; Boulkenid et al. (2013) set of quality indicators for obstetric care; Danish National Indicator Project; EURO-PERISTAT; NCHOD Health Outcome Indicators: Normal Pregnancy and Childbirth; ORYX initiative Pediatric Care Core Measure Set; OECD Patient Safety Indicators (more closely Obstetric trauma Indicators); RANZCOG/ACHS indicators; RCOG indicator for intrapartum care; and the indicators used in the WHO/OBSQID. These indicators are presented briefly in Table 1 and more comprehensively in Appendix 2, where even indicators not directly related to quality of care and patient safety are included.

The existing published sets of indicators are usually based on evidence, and extensive literature reviews on indicators have been done before creating new sets of indicators. These sets of indicators are often the result of cooperation and common consensus of various expert groups consisting of midwives, clinicians, researchers, and statisticians, for example.

AHRQ

The Agency for Healthcare Research and Quality (AHRQ) Quality Indicators (QIs) are one response to the need of multidimensional and accessible quality indicators. They include measures that providers, policy-makers and researchers can use with inpatient data to identify apparent variations in the quality of patient care. These indicators are adapted, expanded and refined based on the original Healthcare Cost and Utilization Project (HCUP) Quality Indicators dating back to the early 1990s. The Quality Indicators aim to compile hospital inpatient administrative data that provide, among other information, demographics on the patient and the provider, diagnosis codes, procedure codes, and information about the admission, payer and discharge. AHRQ quality indicators are organized into four modules: Prevention Quality Indicators (PQIs), Inpatient Quality Indicators (IQIs), Patient Safety Indicators, and Pediatric Quality Indicators (PDIs). (AHRQ Quality Indicators 2002, AHRQ Quality Indicators 2003.)

List of quality indicators by Boulkenid et al. (2013)

Boulkenid et al. (2013) presents a set of indicators that was developed in France through an extensive Delphi process. In this process an international French-speaking multidisciplinary panel assessed potential indicators extracted from a medical literature search, using a two-round Delphi procedure followed by a physical meeting. Each panellist rated each indicator based on validity and feasibility. The final set comprised 18 indicators, which were identified to assess the overall quality of obstetric care and to be routinely monitored in maternity units.

The final set of indicators is a starting point for developing a vast obstetric-care quality improvement programme based on the CUSUM chart method. This final set of 18 quality indicators is divided into three parts: Management of pregnancy and labour; Management of low risk women; and Management of newborn. Boulkenid et al. (2013) states that the feasibility of these indicators still needs to be assessed by studies conducted under the conditions of everyday practice. The final set of indicators may also require additional clarification to ensure suitability for use in quality improvement strategies. (Boulkenid et al. 2013.)

Danish National Indicator Project

Since 2000, the Danish National Indicator Project (DNIP) has been developing evidence-based and disease-specific quality indicators in the Danish health care. Childbirth was chosen as the ninth medical condition for this national quality measurement system. The aim of DNIP is to document and develop the quality of the Danish health care system as well as to provide a basis for dialogue between different factors and sides in health care. Eight indicators were chosen after an extensive work by experts and project members. The chosen obstetric quality indicators help to monitor all the births in Denmark from a quality perspective. It will also be mandatory for all Danish delivery units to register these indicators. Clinical units will also receive feedback and reports on their results. These reports may finally be used for the unit's own internal monitoring and development of quality. (Kesmodel & Jølving 2011.). DNIP has subsequently merged with other projects to form the Danish National Clinical Quality Databases. As of 2015 it has been expanded with an additional three indicators (http://www.kcks-vest.dk/kliniske-kvalitetsdatabaser/foedsler/).

EURO-PERISTAT

EURO-PERISTAT is a European collaborative effort which has compiled population-based data at a national level from routine sources – administrative or health registers, hospital discharge reporting systems, or routine surveys – and developed perinatal health indicators which help to monitor, describe, compare and evaluate perinatal health in Europe. The process of developing EURO-PERISTAT indicators was extensive and included three major components: a review of the scientific literature, a Delphi consensus process, and a study of the availability of national statistics covering the proposed indicator set. A high priority was put on improving indicators already collected routinely, but goals were also set for future indicator development. The ultimate aim of the EURO-PERISTAT effort is to routinely produce data on perinatal health in Europe. (EURO-PERISTAT 2010.) At the moment EURO-PERISTAT includes ten core quality indicators (C = core indicator) which are divided into four themes. There are also more than twenty recommended indicators (R = recommended indicator), while some indicators still need further development (F = recommended, further development is required). The indicators were updated in 2012. (EURO-PERISTAT 2012.) According to a 2010 EURO-PERISTAT report, no country was able to provide all the data required for the full set of indicators, and the availability of some key indicators was poor (EURO-PERISTAT 2010).

NCHOD Health Outcome Indicators: Normal Pregnancy and Childbirth

In England, the National Health Service (NHS) emphasized already in 1998 three essential aspects of ensuring the delivery of high quality of care: setting, delivering and monitoring standards. The National Centre for Health Outcomes Development (NCHOD) set up working groups for defining ideal indicators. Ideal indicators were defined as statistical measures of what should be known, and realistically could be known, about the outcomes of the condition in routine clinical practice. The particular concern of the working groups was to make recommendations about outcomes which may be attributable to care or the lack of it. The Pregnancy and Childbirth Working Group specified candidate indicators and made recommendations about implementation and further development of these indicators. The report presented 24 health outcome indicators for normal pregnancy and childbirth. (Troop et al.1999.)

OECD Patient Safety Indicators

The OECD Patient Safety Indicators are routinely collected and published for 34 OECD countries. These include also obstetric trauma indicators. (OECD 2013.) The OECD Health Care Quality Indicators (HCQI) project has been conducted in collaboration with OECD countries as well s a number of international partners, including the Commonwealth Fund, the Nordic Council of Ministers Quality Project, and the International Society for Quality in Health Care (ISQua). The HCQI project collects readily available care process and outcome indicators, and conducts collaborative research and development on priority indicator areas. Data are mostly compiled from administrative databases, registers and population surveys. International expert panellists actively review potential quality of care indicators using criteria such as relevance, scientific soundness and feasibility. Currently, about 40 health care quality indicators are considered suitable for cross-national data collection. The OECD HCQI project also collects and publishes biannually patient safety indicators. These include catheter-related bloodstream infections, postoperative pulmonary embolism or deep vein thrombosis, postoperative sepsis, accidental puncture or laceration, foreign body left in during procedure, and obstetric trauma after vaginal delivery with or without instrument. (OECD 2010.) Of these only obstetric trauma indicators are included in this review.

ORYX initiative

The ORYX initiative is the Joint Commission's performance measurement and improvement initiative, which integrates outcomes and other performance measure data into the accreditation process in the United States. The Joint Commission requires hospitals to submit data reports based on certain measures. These reports can then be used in identifying opportunities for improving care, optimizing care and also for benchmarking hospitals. In 2009 the Joint Commission's Board replaced the Pregnancy and Related Conditions measure set with an expanded set of evidenced-based measures that help to provide a picture of perinatal care provided during hospitalization. The idea is that improvement in these measures results in shorter hospitalizations, lower morbidity and mortality as well as in decreased costs to the patients and hospitals. The ultimate goal is to improve the quality and safety of perinatal care. Currently the Perinatal Care (PC) measure set is comprised of five measures, which are updated at regular intervals. (The Joint Commission 2014.)

RANZCOG/ACHS indicators

The Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) and the Australian Council on Healthcare Standards (ACHS) have developed clinical indicators for monitoring and promoting the quality of care in obstetrics and gynaecology. These indicators are also a part of performance assessment in hospitals and in different clinics. The overall aim is to promote safe and high-quality health care for patients. These clinical indicators are reviewed frequently to further refine definitions and update indicators. RANZCOG/ACHS has divided the indicators into 11 clinical indicator areas of which some are further divided into smaller parts. (RANZCOG/ACHS 2013.)

RCOG clinical indicators

In the UK, the Royal College of Obstetricians and Gynaecologists (RCOG) has initiated a project which aims to develop valid, clinically relevant, methodologically rigorous and technically robust performance indicators for maternity care using currently available data in the Hospital Episode Statistics. The Clinical Indicators Project is collaboration between the RCOG and the London School of Hygiene and Tropical Medicine (LSHTM). In this project there is an attempt to publish an annual report outlining the variation in care women receive during childbirth. The first such report includes 11 indicators which focus on five areas of intrapartum care: induction of labour, Caesarean section, instrumental delivery, third and fourth degree perineal tears, and emergency maternal readmission. Risk-adjustment has been made for factors that are beyond the hospital's control (e.g. mother's age and medical history). This has been made in order to enable fairer comparisons between hospitals. The selection and technical specification of the indicators was guided by a panel of clinical and methodological experts, including representatives from the obstetric and midwifery professions, statisticians, and health service researchers. Indicators represent intrapartum care, rather than an ideal set of maternity indicators covering all

aspects of quality, from antenatal through to postnatal care. There is also an ongoing effort to develop and incorporate new indicators into this set of indicators. (Knight et al. 2013.)

Swedish Quality Indicators

The Swedish quality indicator system includes both general indicators and disease/condition-specific indicators (Socialstyrelsen och Sveriges Kommun och Landsting 2014). There are two general indicators related to pregnancy: smoking habits during pregnancy and screening for risky use of alcohol during pregnancy.

There are eight additional indicators for pregnancy, delivery and newborn care: 1) the number of early induced abortions, 2) third and fourth degree perineal tears in delivery among primiparous women, 3) Caesarean section among primiparous women, 4) low Apgar scores among newborns, 5) infections related to care among children treated in neonatal wards, 6) the number of stillbirths, 7) neonatal mortality, and 8) costs per delivery episode.

WHO/OBSQID

The World Health Organization Regional Office for Europe WHO/EURO established in 1992 the Obstetrical Quality Indicators and Data Collection (OBSQID) project. It was based on the concept of continuous management and development of perinatal care in order to promote the highest quality of perinatal care in the European community. The idea was to link researchers, health care providers, and professional associations in a pan-European network using common perinatal outcome indicators. The OBSQID project provided tools for aggregated and case-based perinatal data collection and a common database. It also allowed comparison and analysis of data. Its purpose was to encourage and promote the best perinatal practices and the rational use of perinatal technologies and resources in Europe, the exchange of knowledge and expertise through partnerships between perinatal centres and to set health care providers and authorities achievable, cost-effective goals. The idea was to continuously review collected data and to hold annual workshops for health care professionals and policy-makers in perinatology. Altogether 25 indicators were presented. (Johansen & Hod 1999.)

Table 1. Published sets of obstetric indicators

AHRQ Quality Indicators	• Caesarean Delivery Rate (IQI 21) • Primary Caesarean Delivery Rate (IQI 33) • Vaginal Birth after Caesarean Rate, Uncomplicated (IQI 22) • Vaginal Birth after Caesarean Rate, All (IQI 34) • Birth Trauma—Injury to Neonate (PSI 17) • Obstetric Trauma—Vaginal Delivery with Instrument (PSI 18) • Obstetric Trauma—Vaginal Delivery without Instrument (PSI 19) • Obstetric Trauma—Caesarean Delivery (PSI 20)		
Boulkenid et al. (2013) list of quality indicators	• Nuchal translucency measurement during the first trimester of pregnancy • Three-marker screening performed during the first trimester of pregnancy • Vaginal sampling in the 9th month to screen for Streptococcus group B carriage • Epidural analgesia use • Caesarean section before labour • Caesarean section during labour • Third/fourth-degree perineal tear (full-thickness tears) • Uterine rupture • Intact perineum • Nosocomial infection of surgical site	• Blood transfusion during and/or after delivery • Maternal ICU transfer and/or admission • (ICU = intensive care unit) • Decision to breastfeed at discharge • Caesarean section before labour in low-risk woman • Caesarean section during labour in low-risk woman • Instrumental vaginal delivery • Rate of non-low-birth-weight neonatesadmitted to the NICU • Birth ≥ 37 wk with Apgar, < 7 at 5 min (wk = weeks of amenorrhoea)	
Danish National Indicator Project	• Anesthesia/ pain relief • Continuous support for women in the delivery room • Lacerations, 3rd or 4th degree • Caesarean section, grade 1 (grade 1 - life-threatening situation for mother and/or fetus) • Caesarean section, grade 2 (grade 2 - mother and/or fetus in danger, but situation not life-threatening) • Postpartum haemorrhage • Establishment of skin-to-skin contact between mother and the newborn infant • Severe fetal hypoxia • Delivery of a healthy child after uncomplicated delivery		
EURO-PERISTAT (updated list 2012)	• C1: Fetal mortality rate by gestational age, birth weight, plurality • C2-Neonatal mortality rate by gestational age, birth weight, plurality • C3-Infant mortality rate by gestational age, birth weight, plurality • C4-Birth weight distribution by vital status, gestational age, plurality • C5-Gestational age distribution by vital status, plurality • C6-Maternal mortality ratio by age, mode of delivery • C7-Multiple birth rate by number of foetuses • C8-Distribution of maternal age • C9-Distribution of parity • C10-Distribution of births by mode of delivery by parity, plurality, fetal presentation, previous caesarean section	• R1-Prevalence of selected congenital anomalies • R2-Distribution of APGAR score at 5 minutes • R3-Fetal and neonatal deaths due to congenital anomalies • R4-Prevalence of cerebral palsy • R5-Maternal mortality ratio by cause of death • R6-Prevalence of severe maternal morbidity • R7-Prevalence of tears to the perineum • R8-Percentage of women who smoke during pregnancy • R9-Distribution of mothers' education • R10-Distribution of households' occupational classification • R11-Distribution of mothers' country of origin • R12-Distribution of mothers' body mass index (BMI) • R13-Percentage of all pregnancies following subfertility treatment	• R14-Distribution of timing of 1st antenatal visit • R15-Distribution of births by mode of onset of labour • R16-Distribution of place of birth by volume of deliveries • R17-Percentage of very preterm infants delivered in units without a NICU • R18-Episiotomy rate • R19-Births without obstetric intervention • R20-Percentage of infants breastfed at birth • F1 Severe neonatal morbidity among high risk infants • F2 Prevalence of neonatal encephalopathy • F3 Causes of fetal and neonatal death other than CA • F4 Neonatal screening policies • F5 Content of antenatal care

German Agency for Quality Assurance

- Micro blood sample of fetus taken if CTG is pathological, singletons
- Micro-blood sample taken if CTG is pathological, singletons, CS
- Presence of a pediatrician in births before 32 completed weeks
- Arterial blood gas sampling taken
- Acidosis in full term singletons
- 3th or 4th degree tear in vaginal delivery, singletons
- 3th or 4th degree tear in vaginal delivery with episiotomy, singletons
- Wound complication in spontaneous vaginal delivery, singletons
- Wound complication in instrumental vaginal delivery, singletons
- Wound complication in Caesarean delivery, singletons
- Birth of a premature newborn with a birth weight less than 1500 g in a maternity ward without a pediatric unit

OECD Patient Safety Indicators (obstetric trauma indicators)

- Obstetric trauma, vaginal delivery with instrument
- Obstetric trauma, vaginal delivery without instrument

ORYX initiative Perinatal Care Core Measure Set

- PC-01 Elective delivery
- PC-02 Caesarean section
- PC-03 Antenatal steroids
- PC-04 Healthcare-associated bloodstream infections in neonates
- PC-05 Exclusive breast-milk feeding
- PC-05a Exclusive breast milk feeding considering mother's choice

NCHOD Health Outcome Indicators: Normal Pregnancy and Childbirth

- 1: General health status of mother after delivery
- 2: Incidence of post-natal depression
- 3: Smoking among pregnant women
- 4: Weekly alcohol consumption among pregnant women
- 5: Illegal drug misuse among pregnant women
- 6: Incidence of domestic violence associated with pregnancy and childbirth
- 7: Incidence and duration of breast-feeding
- 8: Maternal mortality
- 9: Stillbirth, neonatal and post-neonatal mortality
- 10: Incidence of eclampsia
- 11: Incidence of severe post-partum haemorrhage
- 12: Perineal trauma and episiotomy rates
- 13: Pain during labour and delivery
- 14: Incidence of post-natal urinary incontinence
- 15: Incidence of post-natal faecal incontinence
- 16: Gestational age
- 17: Birthweight
- 18. Maternal admissions to ICU
- 19: Use of ante-natal corticosteroids to enhance pulmonary maturity
- 20: Mode of delivery rates
- 21: Neonatal admissions to (a) intensive and (b) special care
- 22: Emergency post-natal admission of mother
- 23: Detection and treatment of rhesus iso-immunisation in pregnancy
- 24: Women's experience of maternity services.

RANZCOG/ACHS

- Indicator 1. Outcome of selected primipara
  - 1.1 Selected primipara - Spontaneous vaginal birth.
  - 1.2 Selected primipara - Induction of labour
  - 1.3Selected primipara - Instrumental vaginal birth
  - 1.4 Selected primipara - Caesarean section
- Indicator 2. Vaginal delivery following caesarean section (VBAC)
  - 2.1 Vaginal delivery following previous birth of caesarean section
- Indicator 3: Major perineal tears & surgical repair of the perineum in primipara
  - 3.1 Selected primipara - Intact perineum or unsutured perineal tear
  - 3.2 Selected primipara - Episiotomy & NO perineal tear
  - 3.3 Selected primipara - Perineal tear and NO episiotomy
  - 3.4 Selected primipara - Episiotomy AND perineal tear
  - 3.5 Selected primipara - Third degree tear
  - 3.6 Selected primipara - Fourth degree tear
- Indicator 4: General anesthesia for caesarean section
  - 4.1 General anaeshetic for caesarean section
- Indicator 5: Antibiotic prophylaxis at the time of caesarean section
  - 5.1 Appropriate prophylactic antibiotic at time of caesarean section
- Indicator 6: Pharmacological thromboprophylaxis & caesarean section
  - 6.1 Unplanned LSCS (lower uterine segment caesarean section) - pharmacological thromboprophylaxis
  - 6.2 Planned LSCS - pharmacological thromboprophylaxis
- Indicator 7: Postpartum haemorrhage/blood transfusion
  - 7.1 Women requiring blood transfusion after vaginal delivery
  - 7.2 Women requiring blood transfusion after caesarean section
- Indicator 8: Intrauterine growth restriction (IUGR) (birth weight < 2750 g at 40weeks of gestation or beyond
  - 8.1 Babies - birth weight <2,750 g at 40 weeks gestation or beyond
- Indicator 9: Apgar score < 7 at 5 min after delivery in term babies
  - 9.1 Term babies - Apgar score of <7 at 5 minutes post-delivery
- Indicator 10: All admissions of a term baby to neonatal intensive care nursery
  - 10.1Term babies - transferred or admitted to NICN or SCN
- Indicator 11: Peer review of serious adverse events

RCOG –clinical indicators	• Induction of labour rate • Percentage of induced labours resulting in emergency caesarean section • Percentage of spontaneous labours resulting in emergency caesarean section • Elective caesarean section rate • Elective caesarean section performed before 39 weeks of gestation without clinical indication • Instrumental delivery rate • Percentage of instrumental deliveries carried out by vacuum extraction • Percentage of attempted instrumental deliveries resulting in emergency caesarean section • Rate of third and fourth degree tears among unassisted vaginal deliveries • Rate of third and fourth degree tears among instrumental vaginal deliveries • Emergency maternal readmission within 30 days of delivery
Sweden – selected indicators from The National Board of Health and Welfare	• Third and fourth degree tears in primiparas • Stillborn • Caesarean sections among first-time mothers • Low Apgar scores • Neonatal deaths • Tobacco habits during pregnancy • Screening for risky alcohol consumption during pregnancy • Healthcare-associated infections in children in neonatal care • Perinatal mortality and intrauterine death
WHO (selected indicators extracted from published databases)	• Births attended by skilled health personnel (%) • Births by caesarean section (%) • Maternal mortality ratio • Neonatal mortality rate • Infant deaths • Stillbirth rate • Early initiation of breastfeeding (%) • Density of nursing and midwifery personnel (per 10 000 population) • Density of physicians (per 10 000 population)
WHO OBSQID	• Intrauterine deaths (22-27 completed weeks) • Antenatal deaths (>27 completed weeks) • Fetal deaths during delivery • Early neonatal death (0-6 days) • Late neonatal death (7-27 days) • Preterm birth (<32 completed weeks) • Major congenital malformations • Lethal congenital malformations • Apgar < 6 in 5 minutes (>31 completed weeks) • Infants with RDS • Neonatal seizures within 7 days • Maternal deaths within 42 days • Hysterectomy within 48 hours • Women with blood transfusion • Eclampsia (during pregnancy – 10days after delivery) • Women with multiple pregnancies • Multiple pregnancies detected before delivery • Parturients with no prenatal visits before birth • Births unattended by health care provider • Caesarean sections • Forceps extractions • Vacuum extractions • Insulin dependent diabetes mellitus • Non-insulin dependent diabetes mellitus • Gestational diabetes mellitus

4 Results of literature review

The number of obstetric indicators is substantial. The Clinical Indicators Project alone identified nearly 200 different indicators from 30 different sources. Of these, 107 were process measures, 62 were outcome measures, and 25 were structural measures. When these were further divided, 31 related to the antenatal period, 73 to intrapartum care (care during childbirth), 56 to obstetric complications, 20 to neonatal care, and 14 to the postpartum period. (Knight et al. 2013.) In this literature review we also found plenty of obstetric indicators. Most of these indicators were found both in the articles selected for this review and also in the existing published sets of obstetric indicators. When these were combined there were altogether 233 different indicators, presented in Appendix 3 to show the variety of indicators and their definitions.

4.1 Most-referred obstetric quality and patient safety indicators

Adverse outcome index

The Adverse Outcome Index (AOI) has been seen to be a potentially promising obstetric indicator (Janakiraman & Ecker 2010, Mann et al. 2006). The AOI is objective, clinically meaningful, and with opportunities for improvement. It is also considered to be attractive in its ability both to capture a rich range of obstetric outcomes and to incorporate both sentinel events and common complications. (Janakiraman & Ecker 2010.) But it has also some flaws. According to Walker et al. (2010) it is good to understand that the so-called adverse event may actually be an appropriate intervention for a pre-existing or pre-admission condition. Mann et al. (2006) state that adverse event rates such as the AOI alone may not reflect the quality of care for a given institution, and that is why this indicator should be used together with other measures, such as the Weighted Adverse Outcome Score (WAOS) which describes the adverse event score per delivery. Another issue is that the AOI has not yet been validated (Bailit 2007, Mann et al. 2006, Walker et al. 2010) or risk-adjusted (Bailit 2007). According to Bailit (2007) and Walker et al. (2010), there may be variations in practice and case-mix between different medical centres, and many of the items in the index of this indicator need still to be adjusted for underlying differences in patient case mix. Bailit (2007) also states that many of the elements in the index can also easily be manipulated by hospitals or providers. Mann et al. (2006) noticed, moreover, that the AOI measure can be relatively strongly influenced by admission to neonatal intensive care unit (NICU) and by third or fourth degree lacerations, because these events are more frequent than the other eight outcome measures. Moreover, it would be worthwhile to understand and determine which factors influence the AOI measures. Yet another limitation for the AOI is that it requires extensive data collection, which means that its widespread adoption may prove impractical (Janakiraman & Ecker 2010). Most of the researchers see that additional research is needed to better understand the AOI outcomes and tools (Bailit 2007, Mann et al. 2006, Walker et al. 2010).

Apgar score

The Apgar score is a widely used obstetric indicator. It is a measure given to every newborn. In this study it was included at least in the following sets of existing published sets of indicators: the Boulkenid et al. (2013) list of quality indicators, the Danish National Indicator Project, EURO-PERISTAT, RANZCOG/ACHS, selected indicators from the National Board of Health and Welfare in Sweden, and WHO OBSQID. Information on the percentage of live births with an Apgar score less than 4 and less than 7 is available for many, but not all, European countries (Buitendijk et al. 2003). The panellists in the indicator project described in Boulkenid et al. (2013) agreed that an Apgar score <7 at 5 minutes was a valid indicator in neonates born at or after 37 weeks of gestational age. Also Kesmodel & Jølving (2011) in the Danish National Indicator Project used an Apgar score <7 at 5 minutes to signal severe fetal hypoxia, if cb-pH was not available. Severe fetal hypoxia was seen to relate to an important aspect of patient safety. In the Jones et al. (1993) study, most of the respondents found the Apgar score to be a useful indicator for obstetric care with neonates <1500g with a five-minute Apgar score <5.

However, according to Boulkenid et al. (2013),an Apgar score <7 at 5 minutes was not considered relevant for babies born before 32 weeks of gestational age, in keeping with studies showing that immaturity may lead to a low Apgar score in preterm neonates who are relatively healthy. Pyykönen et al. (2014) wrote, in turn, that the widespread availability of this indicator should not be a reason to rely on it. Their study results did not support the use of the Apgar score as a patient safety indicator, and they found that both the birth asphyxia markers of arterial cord pH and the Apgar score were controversial and that results varied depending on hospital size.

Birth trauma rate

Birth trauma usually refers to physical damage that occurs to the infant during the birth process. In the Jones et al. (1993) article about Washington's Statewide Obstetrical Review and Quality System (StORQS), most of the respondents found the birth trauma rate to be a useful or appropriate measure (Jones et al. 1993). Janakiraman & Ecker (2010) also found the birth trauma rate, defined as the proportion of neonates weighing more than 2500g with birth trauma, to be a useful indicator because it uses nationally available data. According to them, the limitation with this indicator is that the risk adjustment has not been well established. More recently, however, Pyykönen et al. (2014) have noted that the birth trauma indicator may be problematic because it consists of a set of different diagnose codes. There are also significant differences between the definitions for the indicator. They see that the birth trauma indicator needs to be developed further and updated according to the current ICD-10 classification before it can be widely used as an obstetric quality indicator (Pyykönen et al. 2014).

Caesarean section rate

The Caesarean section rate is a widely-used indicator. It is clearly defined, easy to collect, and relevant to efforts aimed at decreasing maternal morbidity and health care costs (Boulkenid et al. 2013, Mann et al. 2006). According to Wildman et al. (2003), Caesarean delivery rates can reveal important aspects of obstetric practice. However, the Caesarean delivery rate as such is not a good marker of quality of care because it ignores two important sources of rate variation, i.e. patient characteristics and random variation (Bailit 2007). Even Grobman et al. (2006) share the opinion that the Caesarean rate may be reflecting systematic differences in the patient factors. Variations in hospital Caesarean rates are also highly dependent on multiple clinical and nonclinical patient characteristics. (Grobman et al. 2006.) Korst et al. (2005) found in their study that the presence of pregnancy complications upon hospital admission comprised the strongest factor affecting first-time Caesarean use among parturients; that Caesarean rates varied widely across complication types; and that complication-specific rates varied widely among hospitals. Mann et al. (2006) add that patient demand for elective primary Caesarean delivery and the literature questioning the safety of both vaginal breech delivery and VBAC have changed practice and challenge the usefulness of this rate as a quality measure. Robson (2001) has tried to solve the lack of a standardized classification system to monitor and compare Caesarean section rates by introducing the Robson's 10-group classification, based on simple obstetric parameters (parity, previous Caesarean section, gestational age, onset of labour, fetal presentation, and number of fetuses) instead of the indication for Caesarean section.

Pasternak et al. (1999), among many others, note that Caesarean section rates should not be reported as absolute rates, but as risk-adjusted rates. Reporting Caesarean section rates without appropriate risk adjustment can cause potentially misleading results (Pasternak et al. 1999, Korst et al. 2005). Risk factors influence the number of Caesarean section rates, and if absolute rates must be reported, the expected rates should be reported as well (Pasternak et al. 1999). Bailit (2007) also states that a low Caesarean rate may be harmful to perinates and that unadjusted Caesarean rates are not a good marker of obstetric quality since a raw Caesarean delivery rate does not measure neonatal outcomes.

In addition to patient factors there are several other factors that are associated with high rates of Caesarean deliveries. Such factors include, for example, geographical factors, local hospital environment and culture, practitioner style, type of medical insurance, and fear of litigation (ACOG 2000). Singh & Trivedi (2011) wrote that Caesarean section rate is the product of changing obstetric practices and societal norms and demographics. Another problem with Caesarean section rate is that there may be several different definitions of Caesarean sections. Kritchevsky et al. (1999) noticed in their study that calculated Caesarean section rates changed substantially depending on how the nominator and denominator cases were identified. Inconsistencies between

measurement systems can in turn affect the Caesarean section rate. According to them, indicator specifications for Caesarean section rate need to be articulated and carefully implemented. They think that judgments about organizational performance should only be made when the comparisons are based upon identical indicators. (Kritchevsky et al. 1999.)

If and when the indicator specification is clear, the Caesarean section rate can depict an important aspect of patient safety. Kesmodel & Jølving (2011), for example, specified the definition of two particular kinds of Caesarean sections, i.e. grade 1 (life threatening situation for mother and/or fetus) and grade 2 (mother and/or fetus in danger, but situation not life-threatening). They then described this indicator as applicable, understandable and generally acceptable. (Kesmodel & Jølving 2011.)

Intact lower genital tract or intact perineum

Baghurst (2010) states that there is no consensus on the merits of intact lower genital tract (ILGT) as an indicator for perineal management during childbirth. According to Baghurst, it has many problems, such as the definition and the practical specification of ILGT cases in clinical situations. Baghurst states that this may be the reason why it is being abandoned by some agencies and replaced with other measures, such as severe forms of tearing or later problems with functioning such as incontinence. (Baghurst 2010.) Boulkenid et al. (2013), however, see it as an important indicator because an intact perineum is an important goal in order to maximize patient comfort, minimize pain, and ensure the absence of residual discomfort due to scarring. They have been adding it to their list of obstetric quality indicators. They see that it reflects not only the absence of third/fourth-degree tears, but also the absence of both episiotomy and less severe tears during instrumental vaginal delivery. (Boulkenid et al. 2013.)

Maternal mortality ratio[1]

Maternal death is the death of a woman while pregnant or within 42 days of the termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes. To facilitate the identification of maternal deaths in circumstances in which cause of death attribution is inadequate, a new category has been introduced. Maternal deaths can be divided into direct and indirect deaths, separately reporting late deaths between 43 and 364 days after the termination of pregnancy. Many researchers state that the maternal mortality ratio (MMR), calculated per 100 000 live births, is not a sensitive marker of obstetric quality. In high-income countries the prevalence of the event has decreased to very low values, and maternal death in industrialized countries is a rare event (Bailit 2007, Mann et al. 2006, Santos et al. 2013.) The rarity of the event creates, for example, a concern for statistical effects where changes in small absolute numbers cause large fluctuations in ratios (Wildman & Bouvier-Colle 2004). The annual numbers of births vary greatly in Europe, and for rare events such as maternal death, small countries experience much more random variation in ratios. According to Zeitlin et al. (2003), the maternal mortality ratio highlights the importance of presenting information about numbers of events alongside indicators. (Zeitlin et al. 2003.)

Maternal deaths that are potentially preventable by the health care system are in the minority (Bailit 2007) and, according to Santos et al. (2013), for every maternal death there are several serious life-threatening episodes of pregnancy complications, called near misses. However, since maternal death is the ultimate adverse outcome, most of the researchers think that these are important to track (Bailit 2007, Kesmodel & Jølving 2011, Mann et al. 2006) and that a sentinel event analysis of maternal mortality should be a critical part of local quality assurance and improvement efforts (Bailit 2007, Boulkenid et al. 2013).

Yet some other researchers consider that the maternal mortality ratio may be a good indicator for health service quality even in the European context of low overall levels of maternal mortality. For example according to Wildman & Bouvier-Colle (2004), patterns in cause and timing of death in groups of higher and lower maternal mortality countries may in fact reflect differences in obstetric care or can be signs of the systems'

[1] Maternal mortality ratio is the more correct term than maternal mortality rate, since the denominator is live births instead of maternities or pregnancies.

responses to obstetric emergencies. The four most prevalent causes of maternal death found in their study were hypertensive diseases of pregnancy, haemorrhage, thromboembolism and infection, which together accounted for 65% of the maternal deaths in their analysis. (Wildman & Bouvier-Colle 2004). Also Zeitlin et al. (2003) wrote that, if ascertainment is good, maternal mortality is a measure of the quality of obstetric care, since many direct maternal deaths are associated with substandard care. One problem is that the maternal mortality ratio is extremely sensitive to underreporting, and very low levels of maternal death reflect poor ascertainment rather than good care. Differences in maternal mortality ratios reflect the success of different case-finding methods in addition to real differences in mortality (Wildman & Bouvier-Colle 2004, Zeitlin et al. 2003.) Also Lobis et al. (2005), who studied the application of the UN process indicators for emergency obstetric care to the United States, found that the case fatality rate may be an underestimate because there may be some deficiencies in the vital registration system to capture all pregnancy-related deaths.

Near miss / Severe maternal morbidity

Severe maternal morbidity or near miss could be a useful indicator when trying to measure the quality of care particularly in developed countries where maternal mortality is very rare. For every maternal death there are several serious life-threatening episodes of pregnancy complications, called near misses. (Brace et al. 2004, Santos et al. 2013.) This indicator includes the following clinical problems: major obstetric haemorrhage, eclampsia, acute renal dysfunction, cardiac arrest, pulmonary oedema, acute respiratory dysfunction, coma, cerebrovascular event including haemorrhage or thrombosis, status epilepticus, anaphylactic shock, septicaemic shock, anaesthetic problem such as aspiration or failed/difficult intubation, and admission to intensive care or coronary care unit (Brace et al 2004.).

The near miss analysis could be a valuable tool to measure avoidable severe complications of pregnancy or childbirth (Grobman et al. 2006, Santos et al. 2013). Referring to the Geller et al. (2004) study, Grobman et al. (2006) add that near miss maternal morbidity could be a useful indicator because it has been proven to be associated with adverse patient outcomes and it is also actionable in the improvement of patient care.

According to Brace et al. (2004), categories of severe maternal morbidity can be defined through local risk management systems and quantified on a national basis (study made in Scotland). However, there are still some discrepancies in the number of cases reported, and sometimes cases are also miscoded. There is also a problem with uniformity in diagnosis. It can be difficult to ensure that the reported cases are homogeneous and of sufficient severity to be included in a study of severe morbidity. (Brace et al. 2004.)

Neonatal mortality

Neonatal mortality has been seen as a poor marker for obstetric quality for various reasons. Mann et al. (2006) argue that while it is important to track neonatal mortality, it is not useful as a quality indicator because deaths occur so infrequently. Neonatal mortality is also strongly linked to low birth weight due to early gestational age (Bailit 2007). There are also problems with classification of neonatal deaths. For example, regulations about stillbirth registration can, even at European level, affect decisions about whether an event is a late miscarriage or should be registered as a live birth and a neonatal death. As a consequence, it may be difficult to compare mortality at early gestations. Furthermore, under-reporting can be a problem especially if data collection systems are not statutory. (Zeitlin et al. 2003.) There are also other problems such as problems in registering neonatal deaths. According to Buitendijk et al. (2003), some countries exclude all births at <500g from their registers. Furthermore, not all countries can provide neonatal mortality data by gestational age, birth weight or plurality, as recommended for example by PERISTAT. Some countries can provide information on gestational age and birth weight for deaths, but not for live births. Data collection may also prove to be complicated because data may need to be collected from various different sources. (Buitendijk et al. 2003.)

NICU admissions

Researchers do not have a unanimous opinion about NICU admissions as a potential indicator. Some researchers see that it is a useful obstetric quality indicator and some oppose this. Sibanda et al. (2013) included NICU admissions at term in their proposed set of obstetric quality indicators because it depicts neonatal morbidity. Also the Boulkenid et al. (2013) panel of experts included the rate of non-low-birth-weight neonates admitted to

NICU in their final set of quality indicators. In some other studies, such as the Pyykönen et al. (2014) study of perinatal measures as patient safety indicators, admittance to an NICU was not seen to be a useful indicator because there are differences in terminology and also differences in reporting between regions or even hospitals (Pyykönen et al. 2014). Another problem is that indicators based on neonatal admission to intensive and specialized care would be difficult to compile or interpret internationally, since the organization and definition of intensive and specialized care units differ widely. Moreover, the availability of on-site care and practices not related to the health status of the newborn can affect referral decisions. (Zeitlin et al. 2003.)

The rate of preterm deliveries in units without NICU may be a better marker for health care quality in the European setting. Santos et al. (2013) considered the percentage of highly preterm babies delivered in units without an NICU as one of the top five indicators. However, it may be problematic to obtain data for this indicator at international level because countries in Europe have different ways of organizing care for very preterm babies. Relatively few countries can provide this information, and the ability to evaluate the care of high-risk babies requires official or unofficial guidelines for classifying units which are not available in all EU countries. (Wildman et al. 2003.)

Obstetric trauma

Obstetric trauma (usually seen as an incidence of third and fourth degree tears) is a widely used indicator, and many experts argue that it is a useful quality or patient safety indicator in obstetric care. Sibanda et al. (2013), among others, see obstetric trauma as an important indicator because it reflects maternal morbidity. Pyykönen et al. (2013) argue that an obstetric anal sphincter injury is a suitable tool to evaluate patient safety within obstetrics and that it should be analysed in every delivery unit. Also Kesmodel & Jølving (2011) see that obstetric trauma (in their article defined as women with third or fourth degree lacerations at first time deliveries) is an indicator that can be considered to be applicable, understandable and generally acceptable and as such a useful measure of quality in obstetric care.

One of the advantages of this indicator is that it is easily accessible because data on obstetric birth trauma are often uniformly available from hospital discharge abstract data (Bailit 2007, Janakiraman & Ecker 2010). Severe perineal laceration is frequent enough and varies sufficiently among hospitals so that it could be recommended as useful outcome measure (Bailit et al. 2013). The data are also inexpensive to collect (Bailit 2007). Bailit (2007) argues that obstetric trauma ratios are useful measures but also problematic. One of the problems with this measure is that routinely collected register information may include errors (Pyykönen et al. 2013), such as accuracy of data to calculate these rates (Casey et al. 2013). According to Wildman et al. (2003), there is a relative paucity of information on this indicator. The proportion of women who experience episiotomy as a part of vaginal birth is often a more accessible measure than perineal tearing in existing European data. According to them, episiotomies are typically reported in medical registers, while tears are more likely to be ascertained from the relevant ICD codes in hospital records and, thus, to be under-reported, particularly if they are less severe. (Wildman et al. 2003.) There may also be differences in diagnostic registration of cases (Pyykönen et al. 2013). A high degree of variability in ICD-diagnoses and coding for the laceration indicator caused concern for example in the Jones et al. (1993) study.

The obstetric trauma indicator may also be associated with both patient and hospital characteristics that are external to the safety environment of the hospital (Bailit 2007, Grobman et al. 2006, Bailit et al. 2013). The Grobman et al. (2006) study showed that the frequency of obstetric trauma was significantly associated with multiple patient-specific and hospital-level factors. In multivariable regression, the risk of obstetric trauma associated with all routes of delivery was predicted by at least some patient-specific factors. That is why Grobman et al. (2006) concluded that obstetric trauma is not a good indicator for patient safety, for example.

Bailit et al. (2013) wrote about risk-adjusted models for adverse obstetric outcomes and variation in risk-adjusted outcomes across hospitals. In their study they saw that severe perineal lacerations, for example, were frequent enough and varied sufficiently among hospitals so that they could be recommended as useful outcome measures. However, they also stated that these outcomes are significantly related to multiple patient characteristics and that risk adjustment is necessary if obstetric outcomes are to be compared meaningfully between institutions. Also Baghurst (2013) suggests that risk-adjusted modelling could be useful when trying to

evaluate performance in obstetric care. When obstetric trauma ratios are risk-adjusted for patient characteristics hospital rankings, for example, may be significantly different (Bailit 2007).

Baghurst (2013) still sees that this indicator should be retained as a quality indicator, but states that one should be more flexible in its interpretation. Also Pyykönen et al. (2013) state that the confounding factors mean that these rates should be interpreted carefully. They think that the validity of this indicator as a patient safety indicator could be improved by combining it with other obstetric indicators as well as neonatal outcomes. They also see that the Robson's ten group classification, based on woman's obstetric history, should be used especially in international comparisons and in health care systems with strong centralization of high-risk parturients. (Pyykönen et al. 2013.)

Postpartum haemorrhage

Postpartum haemorrhage relates to an important aspect of patient safety (Kesmodel & Jølving 2011). This indicator has been found to be useful because it reflects maternal morbidity (Gregory et al. 2013, Sibanda et al. 2013). It is perceived to be applicable, understandable, generally acceptable (Kesmodel & Jølving 2011) and feasible (Gregory et al. 2013). It is also frequent enough (Bailit et al. 2013), varies sufficiently (Bailit et al. 2013, Gregory et al. 2013), and it demonstrates considerable opportunity for improvement, because there are many clinical strategies that can be used to affect the prevalence of this indicator. One of its stated benefits is also that it does not require a case-mix adjustment. (Gregory et al. 2013.)

The problem is that there may be several different definitions of postpartum haemorrhage. Sibanda et al. (2013), after finding 12 different definitions, highlighted the importance of having a consensus on a clear description of this indicator. They proposed that postpartum blood loss of ⩾1000ml within 24 hours of birth should be monitored, as this has been suggested as an appropriate cut-off point for major postpartum haemorrhage which should be followed by certain emergency measures. Kesmodel & Jølving (2011) have been using the same amount of blood loss (⩾ 1000ml) in their definition for postpartum haemorrhage. According to Bailit et al. (2013), postpartum haemorrhage could be recommended as a useful outcome measure. Also Gregory et al. (2013) wrote that postoperative haemorrhage could be used as a patient safety indicator also in pregnancy settings if modified. However, interpretation of the rate would require further study as degree of preventability has not yet been established (Gregory et al. 2013).

Prophylactic antibiotic use for Caesarean delivery

Prophylactic antibiotic use for Caesarean delivery is a process measure based on solid evidence that, according to Janakiraman & Ecker (2010), can be used temporarily while building consensus on a reproducible definition of wound infection. According to them its limitation is that it requires specific data collection. Kesmodel & Jølving (2011) in turn see that this measure is a measure of good clinical practice. They state that it is already in use and routinely implemented in all obstetric departments and, therefore, no real improvement in quality can be expected.

Rate of brachial plexus palsy / Erb's paralysis

The rate of brachial plexus palsy was not seen as a useful indicator by the Boulkenid et al. (2013) expert group because the occurrence of a single case would lead to an audit or to an evaluation during mortality-morbidity reviews. According to Pyykönen et al. (2014), there are variations in Erb's paralysis in different sizes of delivery units. The lower rates of Erb's paralysis in large units could be associated with the larger volume of deliveries and the variety of expertise available in these units. Differences in neonatal indicators depending on hospital size may suggest differences in treatment cultures. (Pyykönen et al. 2014.)

Risk-adjusted primary Caesarean section rate

According to Bailit et al. (2006) and Bailit (2007), risk-adjusted primary Caesarean delivery rates are a good marker for maternal and neonatal outcomes and for quality of intrapartum care. According to them, variations in rates are correlated with poor maternal and neonatal outcomes, such as infections, severe perineal lacerations, and neonatal complications. They state that it is likely that the poorer maternal and neonatal outcomes have little

to do with Caesarean deliveries themselves but may be a marker for other hospital practices that are associated with Caesarean delivery rate variation. (Bailit et al. 2006, Bailit 2007.)

Risk-adjusted Caesarean delivery rates can be calculated with the use of administrative data, such as birth certificate data. As the data are readily available, cheap and complete, it is also feasible to measure quality of care with risk-adjusted Caesarean delivery rates. (Bailit et al. 2006.) Srinivas et al. (2010), too, agreed that the risk-adjusted Caesarean delivery rate is easy to measure. However, they also identified several deficiencies in the indicator, such as its lack of acceptance by the provider community, the continued rising rate, and the influence of factors outside the hospital's control, such as patient preference for Caesarean delivery. Bailit (2007) also argued that risk-adjusted primary Caesarean may not be as reliable as a quality marker if primary elective Caesarean deliveries become more popular.

Srinivas et al. (2010) also discovered in their study that there was no association between higher-than-expected risk-adjusted Caesarean delivery rates and higher rates of adverse obstetric outcomes. They concluded that this lack of association suggests that the risk-adjusted Caesarean delivery rate may not be a sustainable measure of obstetric quality. (Srinivas et al. 2010.)

Skin-to-skin contact

Skin-to-skin contact and care has been seen to be a good measure of care in normal birth because it combines estimates of infant and maternal correlation between well-managed normal birth and well-being (Chalmers & Porter 2001). Also Kesmodel & Jølving (2011) view this indicator as applicable, understandable and acceptable. Early skin-to-skin contact between the newborn and the mother has a strong positive effect on breastfeeding, for example. It has also numerous other positive effects on the mother and the infant. According to Kesmodel & Jølving (2011), a problem may be that early skin-to-skin contact is defined differently in various studies. They defined skin-to-skin contact as one hour of skin-to-skin contact within the first two hours post-partum. It is difficult to measure or to record this indicator correctly through obstetric databases or record systems.

Support to women in the perinatal period and women's satisfaction with care

Many researchers may agree that support to women in the perinatal period and women's satisfaction with care would be interesting indicators for obstetric quality. Support for women can be considered from a health perspective as it may improve health outcomes. It also provides some indication of the quality of the social environment for women. (Zeitlin et al. 2013). Satisfaction is in turn an important indicator of perceived quality of care (Wildman et al. 2003). However, there is no consensus on these two indicators, and data are not routinely available (Zeitlin et al. 2003). There are also concerns about the feasibility of measuring and comparing provided support for example cross-nationally. The meaning of results will be influenced by the health care system in each country. Also population-level knowledge and cultural biases may affect individual perceptions of care when measuring women's satisfaction with care. (Wildman et al. 2003.) More methodological work is required before these indicators can be used appropriately (Zeitlin et al. 2003). For example, there is still need for definitions of appropriate measures and new data collection tools and methods, especially regarding women's satisfaction with services (Wildman et al. 2003).

Nulliparous term singleton vertex caesarean birth rate

Bailit (2007), Janakiraman & Ecker (2010) and Main et al. (2006) see that the nulliparous term singleton vertex Caesarean birth (NTSV CB) rate is a promising quality measure in obstetric care, although it needs to be one measure among several to fully capture the range of quality in obstetric care.

The NTSV CB rate can easily be obtained from administrative data (Bailit 2007, Janakiraman & Ecker 2010), and it is largely under the control of the health care system (Bailit 2007). It also varies widely between institutions and may reflect differences in hospital practices. Its advantage is the validated measure of differences in hospital practice (Janakiraman & Ecker 2010). However, it measures quality of care only for a proportion of women delivering babies, and preterm deliveries, non-vertex deliveries and multiparous deliveries, for example, are excluded. Some of these deliveries may have a higher risk of poor maternal or neonatal outcomes. (Bailit 2007.) Another limitation with the NTSV CB rate is that it is focused on Caesarean deliveries rather than complications (Janakiraman & Ecker 2010.) Main et al. (2006) wrote that the NTSV CB rate is

strongly influenced by elective obstetric practices. Hospitals with higher levels of NTSV early labour admissions are more likely to have higher NTSV CB rates. Main et al. (2006) add that the addition of an easily performed maternal age adjustment makes it the most promising Caesarean birth quality measure for use at hospital level. They also state, however, that any Caesarean quality measure promoted in the absence of a companion neonatal outcome measure (e.g. NTSV 5-minute Apgar score <7 rate) may have limited acceptance. (Main et al. 2006.)

4.2 Other obstetric quality and patient safety indicators

For some of the identified indicators only a few comments were found. These comments may be of interest and. therefore. they are presented here.

Acidity rate - This indicator can only be compiled in countries where pH is routinely measured and systematically recorded in all maternity units (Zeitlin et al. 2003).

AHRQ Perinatal and neonatal related patient safety indicators – These indicators include complications of anaesthesia, death in low-mortality diagnosis-related groups, foreign body left during procedure, postoperative haemorrhage or haematoma, selected infections due to medical care, transfusion reaction, birth trauma – injury to neonate, obstetric trauma – Caesarean delivery, obstetric trauma – vaginal delivery with instrument, and obstetric trauma – vaginal delivery without instrument. These indicators are useful indicators, according to Johnson et al. (2005). They are easy to identify, inexpensive to obtain, and readily quantifiable. Limitations include the inability to adjust for case-mix and do more sophisticated risk adjustment that takes into account comorbid conditions in the data. (Johnson et al. 2005.)

Anaesthesia/pain relief – This indicator, defined as birth epidural and birth spinal given within one hour from prescription, was considered applicable and understandable by Kesmodel & Jølving (2011).

Antibiotics given after pre-labour rupture of membranes (PROM) – There is a lack of evidence for important aspects of the indicator (Kesmodel & Jølving 2011).

Arterial cord pH – This is controversial as patient safety indicator. In Pyykönen et al. (2014) study cord arterial pH varied greatly between delivery units with an average of 76%. (Pyykönen et al. 2014.)

Causes of perinatal death – All countries have their own system for analysing and reporting causes of death. Cause of death data exist in many countries at least for neonatal deaths (Buitendijk et al. 2003), but the causes are not necessary confirmed by a physician or given in a formal (legal) process (Gissler et al. 2010).

Composite neonatal adverse outcome (defined as occurrence of any of the following restricted to term, non-anomalous singleton infants: neonatal stay longer than maternal stay by ⩾3 calendar days, 5 minute Apgar score <4, skeletal fracture other than of the clavicle, facial nerve palsy, brachial plexus palsy, subgaleal haemorrhage, ventilator support, hypoxic ischemic encephalopathy, stillbirth after hospital admission, or neonatal death) – This indicator is frequent enough and vary sufficiently among hospitals so that it could be recommended as a useful outcome measure. However, it is significantly related to multiple patient characteristics. Risk adjustment is necessary for meaningful comparisons of obstetric outcomes between institutions. (Bailit et al. 2013.)

Continuous support for women in the delivery room – This indicator was considered applicable, understandable and acceptable by Kesmodel & Jølving (2011). According to them the definition of this indicator must be based on staff already working in the delivery departments.

Delivery of a healthy child after uncomplicated delivery – The indicator is defined as first time vaginal deliveries without Caesarean section, vacuum extraction or forceps, episiotomy, third or fourth degree lacerations, post-partum haemorrhage ⩾1000ml and Apgar score ⩾9/5/all first-time intended vaginal deliveries. According to Kesmodel & Jølving (2011) this indicator is applicable, understandable and generally acceptable.

Elective delivery before 39 weeks – This is a promising quality indicator because it is a measure that can reduce risks of iatrogenic near-term prematurity. Its limitation is that it requires specific data collection of gestation. (Janakiraman & Ecker 2010.)

Failed instrumental delivery leading to caesarean section – There is a lack of availability or robustness of data for this indicator (Sibanda et al. 2013).

Failure-to-rescue rate – The failure-to-rescue rate is a nurse-sensitive measure of care quality which can be applied with modifications for the obstetric population (Simpson 2005). It is defined as the inability of clinicians to save the life of a hospitalized patient when she experiences a complication or a condition not present on admission or, more simply, the failure to diagnose and treat on time. Simpson (2005) sees that it is essential to systematically evaluate the perinatal team's response by using the key components of the concept of failure-to-rescue process (expectations for careful monitoring, timely identification, appropriate interventions, and roles of perinatal team members) as outcome measures. Further modification of the measurement of the concept is, however, necessary. (Simpson 2005.)

Fetal mortality and stillbirth rate – National data on fetal mortality and stillbirths are available for all countries, but vary in their definitions (Buitendijk et al. 2003). The lack of common criteria can distort comparisons between countries (Zeitlin et al. 2003).

Frequency of episiotomy –Kesmodel and Jølving (2011) say that while there is evidence that restrictive use of episiotomy compared to routine use reduces the risk of serious perineal lacerations, healing problems and the need for suturing, the ideal or standard frequency for episiotomy remains unknown (Kesmodel & Jølving 2011).

Frequency of seizure prophylaxis not given to women with severe pre-eclampsia – This could be a useful indicator because it is proven to be associated with adverse patient outcome and because it could produce improvements in patient care (Grobman et al. 2006).

Infant mortality – At the moment only few countries in Europe can report infant mortality rates (mortality during the first year of life) by birth weight and gestational age (Buitendijk et al. 2003) or by cause of death (Gissler et al. 2010).

Intrapartum group B streptococci prophylaxis – While there is well-founded evidence of the benefits of this indicator, there may be little room for improvement because compliance rates are already high. (Janakiraman & Ecker 2010.)

Intrapartum stillbirth rate – Deaths occurring during childbirth – This indicator reflects reasonably well the quality of obstetric care in a country. It is also more closely related to various measures of obstetric care than the antepartum stillbirth rate. Percentage of births by Caesarean section are more strongly associated with intrapartum stillbirths than other measures of care, suggesting that access to this intervention may play an important role in decreasing intrapartum stillbirths. (Goldenberg et al. 2007.)

Percentage of newborns breastfed at birth – There is a lack of information, and definitions vary significantly between countries concerning, for example, exclusive/mixed breastfeeding and timing of breastfeeding (Wildman et al. 2003).

Perinatal mortality rate – Perinatal mortality, particularly in developed countries, is a rare and extreme event, and under-registration is known to be as high as 20% of perinatal deaths. The crude perinatal mortality rate cannot be taken at face value and certainly not for international comparisons. The rate depends on a number of factors (such as definitions, reliability of registration procedures and practises, congenital abnormalities and the effectiveness of antenatal screening, risk factors, as well as quality of antenatal and perinatal care) and is constructed through several important determinants that need to be assessed separately before reaching final conclusions. Perinatal mortality figures should be corrected according to known risk factors, and common definitions should be used. The perinatal mortality rate can, then, serve as reasonable indicator for the quality of antenatal and perinatal care; however, morbidity generally is considered a more meaningful outcome indicator for the quality of perinatal care. (Richardus et al. 1998.)

Postoperative haemorrhage or haematoma - The measure is feasible, and it varies widely and demonstrates considerable opportunity for improvement. Multiple clinical strategies, such as avoiding prolonged second stage, can affect the prevalence of this indicator. This indicator does not require a case-mix adjustment. (Gregory et al. 2013.)

Postpartum hospital stay – This measure is too easily influenced by non-medical factors, such hospital or national policy (Chalmers & Porter 2001).

Postpartum hysterectomy – The indicator has received low scores in studies (Sibanda et al. 2013).

Prevalence of cerebral palsy – There are complex requirements for collecting data for this indicator (Buitendijk et al. 2003).

Prevalence of hypoxic-ischemic encephalopathy – Only a few countries can provide information on this indicator (Buitendijk et al. 2003).

Prophylactic use of oxytocin in the third stage of labour – According to Kesmodel & Jølving (2011), it is an indicator for good clinical practice, but since the measure has already been routinely implemented in all obstetric departments there is no room for real improvement in quality (Kesmodel & Jølving 2011).

Proportion of newborns still hospitalized 7 days after delivery – This measure may reflect the centralization of high-risk deliveries into larger, non-university units, as well as significant differences in treatment cultures dependent on hospital size, or both. According to Pyykönen et al. (2014), newborns were less likely to be treated for long periods in small units than in large units, and the proportion of newborns still hospitalized at the age of 7 days was slightly higher, indicating higher morbidity of newborns in these units. Alternatively, this might also be a sign of overtreatment. (Pyykönen et al. 2014.)

Respirator treatment – This measure indicates the centralization of high-risk deliveries into larger, non-university units, as well as significant differences in treatment cultures dependent on hospital size, or both (Pyykönen et al. 2014).

Shoulder dystocia leading to brachial plexus injury (BPI) – There is a lack of availability or robustness of data for this indicator (Sibanda et al. 2013).

Severe fetal hypoxia – This indicator was considered applicable, understandable and generally acceptable, and it relates to an important aspect of patient safety. The original suggestion for an indicator included SBE (low-standard base excess), but because many delivery units do not routinely measure SBE, the indicator was considered impossible to implement. (Kesmodel & Jølving 2011.)

Systematic assessment of cardiotocography (CTG) – There is a lack of evidence of important aspects of the indicator, and it is impossible to define a proper standard (Kesmodel & Jølving 2011).

Bologna Score – The instrument is useful as a quality indicator for intrapartum care. Writers consider that the validity of the instrument has been shown. It is easy to use and gives a good overview of how care is given at the participating maternity units. The Bologna Score tool consists of three indicators: 1) the percentage of women with planned vaginal birth attended by a skilled attendant in labour, 2) the percentage of women with induced labour or undergoing elective Caesarean section, and 3) the actual Bologna Score (presence of a woman's companion during birth, use of partogram during birth, absence of augmentation, use of non-supine position during birth, skin-to-skin contact between mother and baby at least 30 minutes during the first hour after birth). (Sandin-Bojö & Kvist 2008.)

Thromboembolic prophylaxis in women undergoing Caesarean delivery – While there is theoretic evidence of the benefits of this indicator in preventing serious conditions, there are no large randomized trials showing benefit compared with early ambulation. (Janakiraman & Ecker 2010).

Time of initiation of breastfeeding – According to Chalmers & Porter (2001), this indicator is more likely to be a measure of neonatal well-being than maternal health and may be poorly related to the provision of appropriately managed normal labour

.

Vaginal birth after Caesarean delivery (VBAC) rate – This is a poor marker for hospital and physician quality due to various controversies, such as risks and decision-making in the actual care of the patients (Bailit 2007). Jones et al. (1993), however, argue that attempted vaginal birth after Caesarean and successful VBAC were among the most useful indicators.

Venous thromboembolism – This occurs too infrequently for meaningful assessment (Bailit et al. 2013).

5 Discussion

5.1 Reflection on obstetric quality and patient safety indicators

There is a variety of different indicators that try to capture the quality and patient safety in obstetrics. These indicators vary from one country, region or organization to another. The existing indicators have been created with the extensive efforts of the various different expert panels, but still there is ongoing debate about these indicators. There is no common consensus on a single uniform set of indicators that could be used in most countries or obstetric settings. It seems that researchers and experts still disagree about which indicators best reflect obstetric quality and patient safety. For example, the five indicators perceived to be the best indicators in the Santos et al. (2013) study were: neonatal mortality rate by gestational age, birth weight and plurality, prevalence of severe maternal morbidity, percentage of highly preterm babies delivered in units without an NICU, severe neonatal morbidity among babies at high risk, and prevalence of hypoxic-ischemic encephalopathy. Results in their study showed that views of European physicians working in the perinatal field were not necessarily in agreement with other recommendations, such as EURO-PERISTAT. (Santos et al. 2013.)

There are also different kinds of problems associated with several obstetric quality indicators. Some of the existing obstetric quality indicators, such as intact lower genital tract (Baghurst 2010), do not have sufficiently precise definitions. It makes the practical specification of cases difficult, which in turn affects how these cases are recorded. Even some of the most well-known indicators, such as the maternal mortality ratio, the neonatal mortality rate and the Caesarean section rate, are to some extent problematic as quality indicators in obstetric care.

There are also some promising obstetric quality indicators, although these may still need some additional adjustment before wide-scale application. Indicators such as Adverse Outcome Index, severe maternal morbidity or near miss, women in the perinatal period, and women's satisfaction with perinatal health care are among such indicators. It is also apparent that some obstetric quality indicators are perceived to be more useful than others, because the former have precise definitions and are easily accessible from data sources such as hospital discharge registers (indicators such as NSTV CB). Other reasons for their perceived usefulness are the expected clinical importance and the possibility to affect the indicator with clinical practices (indicator such as postpartum haemorrhage). Opinions on the usefulness of these obstetric quality indicators vary greatly, however.

Problems associated with obstetric quality indicators are not limited to differing views on their usefulness. The number of indicators in use is enormous, and the related terms and definitions vary greatly. It is therefore necessary to study closely how an indicator is defined in a particular context. For example, there are a number of different names and definitions for obstetric trauma, including obstetric trauma, serious lacerations, third or fourth degree lacerations, perineal tearing/tears, perineal trauma or obstetric anal sphincter injury. Usually obstetric trauma is defined as third or fourth degree anal sphincter injury in vaginal delivery, but it could also mean only third or only fourth degree of lacerations. Moreover, it could mean the overall rate for obstetric trauma, but it could also be further divided into primiparas, singleton deliveries, instrumental deliveries, deliveries without instrument or deliveries with or without episiotomy. Precise definitions are important in order to avoid conceptual confusion, and definitions should, therefore, be the same everywhere.

International work on recommended indicators is valuable. Creating common indicators on quality and patient safety in obstetric care, especially at the Nordic level, is one attempt to address the problem of not having common indicators. Not only could internationally accepted, common indicators enable national and international comparisons, but they could also improve clinical practices.

Common indicators may help to identify areas for improvement. They may help to recognize and prevent adverse events in obstetric care. Guidelines and practices can be developed later on the basis of the information obtained with the help of indicators. The ultimate aim with developing indicators is to improve the health of pregnant women and their babies. This will be done by giving appropriate and effective care. (EURO-PERISTAT 2010, RANZCOG/ACHS 2013.)

Precise statistics concerning maternal deaths and complications are, however, not sufficient to point out which way the maternity services should be developed. Each case has its story to be told. Adverse events or other tragedies should never happen repeatedly. WHO suggests different possible approaches to maternal death enquiries that are adaptable at any level and in any country: facility and community death reviews, confidential enquiries into maternal deaths, near-miss reviews and clinical audits (WHO 2004).

Confidential enquiries have a long history in the UK in making the maternity services safer (CMACE). This method has also been adapted to France (Saucedo et al. 2013). Recently, a study in Norway collected data on maternal deaths over several years. One of the notions was that maternal deaths were underreported to the registers. Moreover, the study revealed that there was room for improvement in medical care in 12 out of 24 cases (Vangen et al. 2014). A successful nationwide effort to collect data on near-misses has reached an impressive coverage with a response rate of more than 90% in the UK (Knight et al. 2013).

5.2 Reflection on the literature review process

A review is always a retrospective study because it collects and summarizes existing data reports. That is why the observations and conclusions must be interpreted within the limitations of a retrospective nature of the review. (Clarke 2008, Feldstein 2005.) This review included articles from the years 1993–2014, mostly from the 2000s.

According to Yuan & Hunt (2009), literature reviews can be misleading if the data are inappropriately handled. To increase the reliability of any review, it is necessary to demonstrate a link between the results and the data. In this study there was a genuine attempt to avoid any bias. The whole process from study identification and data collection to data analysis is clearly described. This has increased the reliability of this review. Unfortunately, it was not possible to have more than one researcher to conduct the indicator evaluation.

As any review is as good as the individual study included in it, it is important to estimate the quality of the studies included (Feldstein 2005, Clarke 2008.) All the articles in this review have been published in highly qualified academic journals, which themselves have certain inclusion criteria for publishing studies. There was no time to do critical evaluation of the chosen articles. All the references are listed below and, where necessary, the reader can study all the articles in detail. It should also be noted that it was decided not to go through all the references in the selected literature due to lack of time and resources. This may cause a selection bias, because all the possible literature should be taken into account when making a proper literature review (Feldstein 2005, Clarke 2008).

Moreover, it should be noted that only 14 existing sets of indicators were investigated in detail although there are many more published sets of indicators. The Mamelle et al. (2001) article, for example, about indicators and evaluation tools for perinatal care networks in France lists several obstetric indicators. Also the Haller et al. (2010) article presents some obstetric indicators which a group of experts considered to be highly representative of safety during obstetric care. It was not possible to include these articles in this review, but these articles are highly recommended for future reading and reference. It should also be noted that the same indicators can be found in most of the published sets of indicators. Therefore, it remained unclear how many additional indicators even a more rigorous overview on the existing indicators would have generated.

6 Nordic expert group

The work on obstetric indicators was led by Mika Gissler, Research Professor, and Petri Volmanen, Chief Medical Officer at the National Institute for Health and Welfare (THL). The literature review was done by Sirpa Manninen, Midwife, as a part of her Master of Health Sciences at the University of Tampere.

All the Nordic countries nominated from one to three experts to participate in the work. The expert group met once in Helsinki (26 May 2014) and held one telephone meetings (13 March 2015).

The following persons participated in the expert group:

Denmark:
- Paul D. Bartels, The Danish Clinical Registries (RKKP), Aarhus
- Ulrik Kesmodel, University of Aarhus
- Jens Langhoff-Roos, Rigshospitalet, Copenhagen

Finland:
- Mika Gissler, National Institute for Health and Welfare, Helsinki
- Sirpa Manninen, University of Tampere
- Anna-Maija Tapper, Helsinki University and HUS Hyvinkää Hospital
- Petri Volmanen, National Institute for Health and Welfare, Helsinki

Iceland
- Ragnheiður Inga Bjarnadóttir, National University Hospital, Reykjavík

Norway
- Bjørn Backe, St. Olav University Hospital, Trondheim
- Kari Klungsøyr, Norwegian Institute for Public Health, Medical Birth Register, Bergen
- Svein Rasmussen, Haukeland University Hospital, Bergen

Sweden
- Charlotta Grünewald, Karolinska University Hospital, Stockholm
- Karin Gottvall, National Board of Health and Welfare, Stockholm
- Olof Stephansson, Karolinska University Hospital, Stockholm

The expert group proposed a preliminary set of indicators on May 2014 after a thorough discussion on the literature review and on the existing indicators and their feasibility. These were piloted by using existing routine data sources, mainly the National Medical Birth Registers for the years 2008–2012. The following proposal was formulated based on the pilot data collection.

7 Proposal for Nordic Quality and Patient Safety Indicators in Obstetrics with results of pilot data collection

The selected indicators were categorized into three groups:

1. Process and structural indicators
2. Outcome indicators for maternal health
3. Outcome indicators for newborn health

For each group, the selected indicators are presented with the pilot data from all five Nordic countries. Only indicators which measure patient safety and quality are included. In the final inclusion, also the current and future availability of indicators in the National Health Information Systems were taken into account. In principle the indicator should be available now or in the near future for at least three of the five Nordic countries to be included in the core indicator list.

7.1 Process and structural indicators

Unplanned out-of-hospital deliveries

Rationale: To measure the function and quality of care, such as the centralization of childbirth, access and distance to delivery ward, coordination of resources, availability of hospital beds and transportation, as well as the quality of information given to the parturients.

Definition: The number of deliveries that occur outside hospitals, including transport deliveries, per 1000 deliveries. Planned home deliveries and miscarriages are excluded.

- Nominator: Unplanned out-of-hospital deliveries. ICD-10 code: Z38.1.
- Denominator: Number of all deliveries (per women).

Note:

- No data available for Denmark.

	Denmark		Finland		Iceland		Norway		Sweden	
	Unplanned	Total	Unplanned	Total	Unplanned	Total	Unplanned	Total	Unplanned	Total
2008	..	..	126	58 925	..	4 783	377	60 368	149	106 679
2009	..	..	139	59 918	..	4 939	376	61 884	152	107 809
2010	..	..	138	60 422	..	4 834	393	61 542	173	113 339
2011	..	..	143	59 385	1	4 480	311	60 318	153	108 212
2012	..	..	126	59 038	3	4 517	327	60 319	159	108 312
Per 1000										
2008	..		2.1		..		6.2		1.4	
2009	..		2.3		..		6.1		1.4	
2010	..		2.3		..		6.4		1.5	
2011	..		2.4		0.2		5.2		1.4	
2012	..		2.1		0.7		5.4		1.5	

Caesarean section in general anaesthesia

Rationale: To describe clinical practices of Caesarean sections.

Definition: The number of Caesarean sections performed in general anaesthesia per 100 Caesarean sections. Vaginal deliveries are excluded.

- Nominator: Sections in general anaesthesia. NCSP codes: WX400, WX404, WX408, WX419.
- Denominator: Number of all sections (per women).

Notes:

- No data available for Denmark.
- The Finnish data are taken from the Hospital Discharge Register data, and it seems not to be comparable with other countries.

	Denmark		Finland		Iceland		Norway		Sweden	
	General anaesthesia	Sections	General anaesthesia	Sections	General anaesthesia	Sections	General anaesthesia	Sections	General anaesthesia	Sections
2008	..	..	114	9 821	87	784	1 264	10 057	2 678	18 307
2009	..	..	118	9 526	104	813	1 205	10 155	2 506	18 827
2010	..	..	490	9 860	81	704	1 186	10 189	2 647	19 203
2011	..	..	383	9 715	90	661	1 095	9 955	2 548	18 360
2012	..	..	377	9 647	71	685	1 110	9 789	2 436	18 455
Per 100										
2008	..		1.2		11.1		12.6		14.6	
2009	..		1.2		12.8		11.9		13.3	
2010	..		5.0		11.5		11.6		13.8	
2011	..		3.9		13.6		11.0		13.9	
2012	..		3.9		10.4		11.3		13.2	

Blood transfusion rate (all parturients)

Rationale: The indicator is used as a proxy of blood loss, which is a major obstetric complication.

Definition: The number parturients who are given blood during the delivery per 100 deliveries, separately given for sections and vaginal deliveries.

- Nominator: Any blood transfusion in delivery.
- Denominator: Number of all deliveries (per women).

Notes:

- This indicator should be replaced with one measuring the amount of blood loss, after this information is collected for all countries. The definition of massive blood loss should be agreed before the indicator can be taken into use.
- No data available for Denmark.

Section	Denmark		Finland		Iceland		Norway		Sweden	
	Trans-fusions	Sections	Trans-fusions	Sections	Trans-fusions	Sections	Trans-fusions	Sections	Trans-fusions	Sections
2008	..	..	404	9 821	25	784	326	10 057	377	18 307
2009	..	..	397	9 526	31	813	320	10 155	389	18 827
2010	..	..	395	9 860	17	704	337	10 189	453	19 203
2011	..	..	385	9 715	33	661	369	9 955	447	18 360
2012	..	..	388	9 647	21	685	451	9 789	312	18 455
Per 100										
2008	..		4.1		3.1		3.2		2.1	
2009	..		4.2		3.8		3.2		2.1	
2010	..		4.0		2.4		3.3		2.4	
2011	..		4.0		4.9		3.7		2.4	
2012	..		4.0		3.1		4.6		1.7	

Vaginal deliveries	Denmark		Finland		Iceland		Norway		Sweden	
	Trans-fusions	Vaginal births	Trans-fusions	Vaginal births	Trans-fusions	Vaginal births	Trans-fusions	Vaginal births	Trans-fusions	Vaginal births
2008	..	..	932	49 102	47	3 999	811	50 311	789	88 372
2009	..	..	992	50 397	49	4 126	755	51 729	819	88 982
2010	..	..	977	50 576	40	4 130	920	51 353	970	94 136
2011	..	..	1 016	49 678	74	3 760	879	50 363	971	89 852
2012	..	..	1 063	49 401	68	3 765	1 096	50 530	651	89 857
Per 100										
2008	..		1.9		1.2		1.6		0.9	
2009	..		2.0		1.2		1.5		0.9	
2010	..		1.9		1.0		1.8		1.0	
2011	..		2.0		2.0		1.7		1.1	
2012	..		2.2		1.8		2.2		0.7	

Third or fourth degree perineal tears

Rationale: To measure the quality of care in vaginal delivery.

Definition: The number of third or fourth degree perineal tears, separately given for non-instrumental and instrumental deliveries (vacuum extractor or forceps) per 100 vaginal deliveries.

- Nominator: Third or fourth degree perineal tears. ICD-10 codes: O70.2 or O70.3.
- Denominator: Number of vaginal deliveries (per women).

Notes:

- Indicator collected by OECD as a Health Care Quality Indicator and by NOMBIR (the Nordic Collaboration of the Medical Birth Registers).
- No data available for Denmark.

Instrumental	Denmark		Finland		Iceland		Norway		Sweden	
deliveries	Tears	Deliveries	Tears	Deliveries	Tears	Deliveries	Tears	Deliveries	Tears	Deliveries
2008	..	..	162	4 987	69	350	474	5 616	984	8 055
2009	..	..	178	5 115	65	354	513	5 831	911	7 993
2010	..	..	195	5 275	49	318	419	6 064	1 054	8 301
2011	..	..	175	5 109	46	323	369	6 000	976	7 673
2012	..	..	208	5 151	47	383	339	5 928	910	7 507

Per 100

2008	..	3.2	19.7	8.4	12.2
2009	..	3.5	18.4	8.8	11.4
2010	..	3.7	15.4	6.9	12.7
2011	..	3.4	14.2	6.2	12.7
2012	..	4.0	12.3	5.7	12.1

Without	Denmark		Finland		Iceland		Norway		Sweden	
instrument	Tears	Deliveries	Tears	Deliveries	Tears	Deliveries	Tears	Deliveries	Tears	Deliveries
2008	..	..	275	44 138	164	3 656	842	44 696	1 943	80 317
2009	..	..	325	45 307	140	3 774	793	45 898	1 917	80 989
2010	..	..	339	45 327	153	3 820	742	45 289	2 209	85 835
2011	..	..	301	44 596	122	3 448	679	44 363	2 087	82 179
2012	..	..	392	44 283	100	3 397	719	44 602	2 105	82 350

Per 100

2008	..	0.6	4.5	1.9	2.4
2009	..	0.7	3.7	1.7	2.4
2010	..	0.7	4.0	1.6	2.6
2011	..	0.7	3.5	1.5	2.5
2012	..	0.9	2.9	1.6	2.6

Fourth degree perineal tears

Rationale: To measure the quality of care in vaginal delivery.

Definition: The number fourth degree perineal tears, separately given for non-instrumental and instrumental deliveries (vacuum extractor or forceps) per 100 vaginal deliveries.

- Nominator: Fourth degree perineal tears. ICD-10 code: O70.3.
- Denominator: Number of vaginal deliveries (per women).

Notes:

- No data available for Denmark. The data for Iceland and Norway will be available later.

Instrumental	Denmark		Finland		Iceland		Norway		Sweden	
deliveries	Tears	Deliveries	Tears	Deliveries	Tears	Deliveries	Tears	Deliveries	Tears	Deliveries
2008	..	..	19	4 987	26	350	..	..	96	8 055
2009	..	..	21	5 115	19	354	..	..	78	7 993
2010	..	..	25	5 275	14	318	..	..	99	8 301
2011	..	..	21	5 109	9	323	..	..	108	7 673
2012	..	..	20	5 151	12	383	..	..	92	7 507

Per 100

2008	..	0.4	7.4	..	1.2
2009	..	0.4	5.4	..	1.0
2010	..	0.5	4.4	..	1.2
2011	..	0.4	2.8	..	1.4
2012	..	0.4	3.1	..	1.2

Without instrument	Tears	Deliveries	Tears	Deliveries	Tears	Deliveries	Tears	Deliveries	Tears	Deliveries
2008	..	..	36	44 138	..	..	..	..	167	80 317
2009	..	..	54	45 307	..	..	..	..	143	80 989
2010	..	..	46	45 327	..	..	..	..	196	85 835
2011	..	..	40	44 596	..	..	..	..	194	82 179
2012	..	..	48	44 283	..	..	..	..	200	82 350

Per 100

2008	..	0.1	..	..	0.2
2009	..	0.1	..	..	0.2
2010	..	0.1	..	..	0.2
2011	..	0.1	..	..	0.2
2012	..	0.1	..	..	0.2

Acute re-admissions for inpatient care after delivery within 30 days postpartum

Rationale: To measure the need for unplanned re-admission leading to hospitalization for obstetric reasons after delivery as a quality measure for delivery care. This is increasingly important since the average stay of length has shortened substantially.

Definition: The number of acute re-admission for inpatient care with an ICD-code from O00 to O99 as the main diagnoses within 30 days after delivery per 100 deliveries.

- Nominator: Maternal diagnoses in inpatient care (mainly obstetrics and gynaecology departments within 30 days after delivery.
- Denominator: Number of deliveries (per women).

Notes:

- Information on mean hospital stay should be collected, either on total average length of stay or after the delivery.
- No data available for Iceland.
- The Swedish data for 2012 exclude deliveries in the Värmland district.

	Denmark		Finland		Iceland		Norway		Sweden	
	Re-admissions	Deli-veries	Re-admissions	Deli-veries	Re-admissions	Deli-veries	Re-admissions	Deli-veries	Re-admissions	Deli-veries
2008	..	..	805	58 925	..	..	566	59 198	991	106 679
2009	..	..	789	59 918	..	..	579	60 616	1 175	107 809
2010	..	..	702	60 422	..	..	593	60 797	1 423	113 339
2011	..	..	901	59 385	..	..	582	59 364	1 795	108 212
2012	..	..	854	59 038	..	..	683	59 265	1 886	108 312
Per 100										
2008	..		1.4		..		1.0		0.9	
2009	..		1.3		..		1.0		1.1	
2010	..		1.2		..		1.0		1.3	
2011	..		1.5		..		1.0		1.7	
2012	..		1.4		..		1.2		1.7	

Proportion of newborns with umbilical cord pH taken

Rationale: To measure the routine clinical practices in indicating asphyxia.

Definition: The number of children with umbilical cord pH taken in paired sample per 100 live births.

- Nominator: Low umbilical cord pH taken in paired sample.
- Denominator: Number of live births.

Notes:

- Only hospitals with routine taking and systematic recording should be included in the statistics.
- The data are currently available for Finland only.
- Data for Norway are available soon. Data from Sweden are available in the Quality Register covering the Stockholm metropolitan area.

	Denmark Sample taken	Live births	Finland Sample taken	Live births	Iceland Sample taken	Live births	Norway Sample taken	Live births	Sweden Sample taken	Live births
2008	..	..	46 033	59 607	..	..	..	..	..	..
2009	..	..	47 669	60 583	..	..	..	..	..	..
2010	..	..	49 546	61 192	..	..	..	..	..	..
2011	..	..	48 892	60 094	..	..	..	..	..	..
2012	..	..	48 675	59 693	..	..	..	..	..	..

Per 100										
2008	..		77.2		..		..		..	
2009	..		78.7		..		..		..	
2010	..		81.0		..		..		..	
2011	..		81.4		..		..		..	
2012	..		81.5		..		..		..	

7.2 Outcome indicators for maternal health

Maternal mortality ratio

Rationale: To measure the occurrence of severe obstetric complication.

Definition: Maternal death is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes. The numbers are related to 100 000 live births.

- Nominator: Maternal deaths.
- Denominator: Number of live births.

Notes:

- Data taken from the WHO Health for all –statistical database.
- Recommendation: Make an audit, do not count the numbers only (Nordic lessons-learned sessions).
- Finland and Norway provided data on linked data showing underreporting: In Finland from a specific study on pregnancy-related deaths in 2001–2012 and in Norway an audit study with linkage of registers in 1996–2011.

	Denmark		Finland		Iceland		Norway		Sweden	
	Deaths	Live births	Deaths	Live births	Deaths	Live births	Deaths	Live births	Deaths	Live births
2008	4	65 308	5	59 607	0	4 835	3	61 177	6	109 301
2009	4	63 156	1	60 583	0	5 027	1	62 746	6	111 801
2010	2	63 697	3	61 192	0	4 907	3	62 347	3	115 641
2011	2	62 440	0	60 094	1	4 492	3	61 093	1	111 770
2012	1	58 277	2	59 693	0	4 533	0	61 141	5	113 177
2008-2012	13	312 878	11	301 169	1	23 794	10	308 504	21	561 690
Per 100 000	4.2		3.7		4.2		3.2		3.7	

		2008-2012		1996-2011	
Linked data	..	4.0	..	7.3	..

Peripartum hysterectomy

Rationale: To measure the occurrence of a severe obstetric complication.

Definition: The number of peripartum hysterectomies within seven days after delivery per 1000 deliveries.

- Nominator: Peripartum hysterectomies. The number of women with hysterectomies per 1000 deliveries. NCSP codes MCA30, MCA33, LCD10 and LCD00, ICD-10 code: O82.2
- Denominator: Number of deliveries.

Note:

- The data are taken from the Medical Birth Register and the Hospital Discharge Register.

	Denmark		Finland		Iceland		Norway		Sweden	
	Cases	Deliveries	Cases	Deliveries	Cases	Deliveries	Cases	Deliveries	Cases	Deliveries
2008	..	..	48	58 925	1	4 783	22	60 368	18	106 793
2009	..	..	30	59 918	0	4 939	23	61 884	20	108 194
2010	..	..	29	60 422	0	4 834	20	61 542	27	113 504
2011	..	..	29	59 385	0	4 421	26	60 318	31	109 765
2012	..	..	30	59 038	1	4 450	20	60 319	25	110 754
Per 1000										
2008	..		0.8		0.2		0.4		0.2	
2009	..		0.5		0.0		0.4		0.2	
2010	..		0.5		0.0		0.3		0.2	
2011	..		0.5		0.0		0.4		0.3	
2012	..		0.5		0.2		0.3		0.2	

Uterus rupture during labour

Rationale: To measure the occurrence of a severe obstetric complication.

Definition: The number of complete uterine ruptures before or during labour per 1000 deliveries.

- Nominator: Complete uterine ruptures before or during labour, ICD-10 code: O71.1.
- Denominator: Number of deliveries.

Note:

- The data are taken from the Medical Birth Register and the Hospital Discharge Register.

	Denmark		Finland		Iceland		Norway		Sweden	
	Cases	Deliveries	Cases	Deliveries	Cases	Deliveries	Cases	Deliveries	Cases	Deliveries
2008	..	..	48	58 925	4	4 783	48	60 368	82	106 793
2009	..	..	51	59 918	5	4 939	43	61 884	87	108 194
2010	..	..	78	60 422	5	4 834	47	61 542	95	113 504
2011	..	..	55	59 385	6	4 421	56	60 318	101	109 765
2012	..	..	71	59 038	2	4 450	37	60 319	97	110 754

Per 1000

2008	..	0.8	0.8	0.8
2009	..	0.9	1.0	0.7	0.8
2010	..	1.3	1.0	0.7	0.8
2011	..	0.9	1.4	0.9	0.9
2012	..	1.2	0.4	0.6	0.9

Post-partum bleeding with coagulation defects

Rationale: To measure the occurrence of a severe obstetric complication.

Definition: The number of women with post-partum bleeding with coagulation defects per 1000 deliveries.

- Nominator: The number of women with post-partum bleeding with coagulation defects. ICD-10 code: O72.3
- Denominator: Number of deliveries.

Notes:

- The exact definition of coagulation defects remains unknown. The ICD code is given on clinical impression, which should be the same in all countries. Clinical use of this indicator should be explored.
- The Finnish data are taken from the Medical Birth Register and the Hospital Discharge Register.
- The Norwegian data are from the Norwegian Patient Registry.

	Denmark		Finland		Iceland		Norway		Sweden	
	Cases	Deliveries	Cases	Deliveries	Cases	Deliveries	Cases	Deliveries	Cases	Deliveries
2008	..	..	14	58 925	1	4 783	1	60 368	24	106 793
2009	..	..	15	59 918	5	4 939	25	61 884	24	108 194
2010	..	..	7	60 422	1	4 834	16	61 542	42	113 504
2011	..	..	22	59 385	2	4 421	10	60 318	30	109 765
2012	..	..	21	59 038	1	4 450	20	60 319	50	110 754

Per 1000

2008	..	0.2	0.2	0.2	0.2
2009	..	0.3	1.0	0.4	0.2
2010	..	0.1	0.2	0.3	0.4
2011	..	0.4	0.5	0.2	0.3
2012	..	0.4	0.2	0.3	0.5

7.3 Outcome indicators for newborn health

Perinatal mortality

Rationale: To measure the quality of obstetric and neonatal care.

Definition: Stillbirths and early neonatal deaths (0–6 days) per 1000 newborns, separately given for all stillbirths, stillbirths during labour, early neonatal deaths, and all perinatal deaths. Excluding stillbirths and live births with major congenital anomaly according to EUROCAT definition.

- Nominator: Stillbirths from 22 gestational weeks and early neonatal deaths (0–6 days). Late pregnancy terminations are excluded.
- Denominator: Number of live births and stillbirths from 22 gestational weeks. The number of live births can be found under ‘Low umbilical artery pH’.

Notes:

- Information on cases excluding congenital anomalies is not available from Denmark and Iceland.

	Stillbirths - all					Excluding major congenital anomalies				
	Denmark	Finland	Iceland	Norway	Sweden	Denmark	Finland	Iceland	Norway	Sweden
2008	..	194	11	270	387	..	162	..	256	379
2009	..	207	21	248	444	..	173	..	227	436
2010	..	180	17	246	425	..	138	..	228	412
2011	..	164	7	228	437	..	131	..	200	425
2012	..	163	11	227	431	..	159	..	206	423

Per 1000

2008	..	3.2	2.3	4.4	3.6	..	2.8	..	4.3	3.6
2009	..	3.4	4.2	3.9	4.1	..	3.0	..	3.7	4.1
2010	..	2.9	3.5	3.9	3.7	..	2.4	..	3.7	3.7
2011	..	2.7	1.6	3.7	4.0	..	2.3	..	3.3	4.0
2012	..	2.7	2.4	3.7	3.9	..	2.8	..	3.4	4.0

	Stillbirths during labour					Excluding major congenital anomalies				
	Denmark	Finland	Iceland	Norway	Sweden	Denmark	Finland	Iceland	Norway	Sweden
2008	..	8	0	29	23	..	8	..	28	21
2009	..	13	0	17	35	..	10	..	17	35
2010	..	9	1	24	38	..	5	..	21	37
2011	..	3	0	18	42	..	2	..	13	40
2012	..	5	0	9	25	..	5	..	7	25
Per 1000										
2008	..	0.1	0.0	0.5	0.2	..	0.1	..	0.5	0.2
2009	..	0.2	0.0	0.3	0.3	..	0.2	..	0.3	0.3
2010	..	0.1	0.2	0.4	0.3	..	0.1	..	0.3	0.3
2011	..	0.0	0.0	0.3	0.4	..	0.0	..	0.2	0.4
2012	..	0.1	0.0	0.1	0.2	..	0.1	..	0.1	0.2

	Early neonatal deaths					Excluding major congenital anomalies				
	Denmark	Finland	Iceland	Norway	Sweden	Denmark	Finland	Iceland	Norway	Sweden
2008	..	96	8	82	128	..	55	..	61	98
2009	..	94	4	106	128	..	58	..	75	88
2010	..	68	5	71	132	..	40	..	50	105
2011	..	78	2	76	93	..	37	..	54	77
2012	..	71	2	79	102	..	45	..	51	78
Per 1000										
2008	..	1.6	1.6	1.3	1.2	..	1.0	..	1.0	0.9
2009	..	1.5	0.8	1.7	1.2	..	1.0	..	1.2	0.8
2010	..	1.1	1.0	1.1	1.1	..	0.7	..	0.8	0.9
2011	..	1.3	0.4	1.2	0.8	..	0.6	..	0.9	0.7
2012	..	1.2	0.4	1.3	0.9	..	0.8	..	0.9	0.7

	All perinatal deaths					Excluding major congenital anomalies				
	Denmark	Finland	Iceland	Norway	Sweden	Denmark	Finland	Iceland	Norway	Sweden
2008	..	290	19	352	515	..	217	..	317	477
2009	..	301	25	354	572	..	231	..	302	524
2010	..	248	22	317	557	..	178	..	278	517
2011	..	242	9	304	530	..	168	..	254	502
2012	..	234	13	306	533	..	204	..	257	501
Per 1000										
2008	..	4.8	3.9	5.7	4.8	..	3.8	..	5.3	4.6
2009	..	5.0	5.0	5.6	5.2	..	4.0	..	4.9	5.0
2010	..	4.0	4.5	5.1	4.8	..	3.0	..	4.6	4.7
2011	..	4.0	2.0	5.0	4.8	..	2.9	..	4.2	4.7
2012	..	3.9	2.9	5.0	4.9	..	3.6	..	4.3	4.7

Low umbilical artery pH

Rationale: To estimate the incidence of asphyxia.

Definition: Number of live births with umbilical artery pH below 7.05 per 1000 live births with measurement of pH.

- Nominator: Number of live births with umbilical artery pH below 7.05.
- Denominator: Number of live births with measurement of pH in umbilical artery and vein (difference more than 0.03), or single measurement excluding live births without pH result.

Notes:

- Only hospitals with routine taking and systematic recording should be included in the statistics.
- The data are currently available for Finland only.
- Data for Norway are available soon.
- Data from Sweden are available in the Quality Register covering the Stockholm metropolitan area.

	Denmark		Finland		Iceland		Norway		Sweden	
	Cases	Live births	Cases	Live births	Cases	Live births	Cases	Live births	Cases	Live births
2008	..	..	584	46 033	..	..	..	..	..	..
2009	..	..	624	47 669	..	..	..	..	..	..
2010	..	..	618	49 546	..	..	..	..	..	..
2011	..	..	618	48 892	..	..	..	..	..	..
2012	..	..	654	48 675	..	..	..	..	..	..

Per 1000

2008	..	12.7	..	..	..
2009	..	13.1	..	..	..
2010	..	12.5	..	..	..
2011	..	12.6	..	..	..
2012	..	13.4	..	..	..

5-minute Apgar score 0–6

Rationale: To measure newborn health in general.

Definition: Live births with 5-minute Apgar score 0–6 per 1000 live births.

- Nominator: Live births with 5-minute Apgar score 0–6.
- Denominator: Number of live births with known Apgar scores.

Notes:

- The data on Apgar scores 0–3 may be more comparable.
- The Icelandic instructions had a translation problem, which has now been corrected.
- The Finnish instructions on Apgar score are outdated.

	Denmark		Finland		Iceland		Norway		Sweden	
	Cases	Live births	Cases	Live births	Cases	Live births	Cases	Live births	Cases	Live births
2008	516	65 380	1 137	59 607	112	4 835	853	61 177	1 283	107 300
2009	461	63 257	1 193	60 583	109	4 973	902	62 746	1 301	108 454
2010	550	63 749	1 237	61 192	97	4 869	836	62 347	1 423	113 985
2011	545	59 391	1 159	60 094	91	4 466	883	61 093	1 370	108 923
2012	537	58 291	1 265	59 693	104	4 495	908	61 141	1 413	108 928

Per 1000

2008	7.9	19.1	23.1	13.9	12.0
2009	7.3	19.7	21.9	14.4	12.0
2010	8.6	20.2	19.9	13.4	12.5
2011	9.2	19.3	20.4	14.5	12.6
2012	9.2	21.2	23.1	14.9	13.0

5-minute Apgar score 0–3

Rationale: To measure newborn health in general.

Definition: Live births with 5-minute Apgar score 0–3 per 1000 live births.

- Nominator: Live births with 5-minute Apgar score 0–3.
- Denominator: Number of live births with known Apgar scores.

	Denmark		Finland		Iceland		Norway		Sweden	
	Cases	Live births	Cases	Live births	Cases	Live births	Cases	Live births	Cases	Live births
2008	179	65 380	222	59 607	21	4 835	248	61 177	260	107 300
2009	137	63 257	216	60 583	11	4 973	218	62 746	253	108 454
2010	195	63 749	215	61 192	16	4 869	210	62 347	295	113 985
2011	199	59 391	207	60 094	11	4 466	185	61 093	276	108 923
2012	206	58 291	227	59 693	9	4 495	219	61 141	306	108 928

Per 1000

2008	2.7	3.7	4.3	4.1	2.4
2009	2.2	3.6	2.2	3.5	2.3
2010	3.1	3.5	3.3	3.4	2.6
2011	3.4	3.4	2.5	3.0	2.5
2012	3.5	3.8	2.0	3.6	2.8

Umbilical artery pH below 7.05, or when umbilical artery pH is missing, 5-minute Apgar score 0–6

Rationale: To estimate the incidence of asphyxia.
Definition: Number of live births with umbilical artery pH below 7.05 or, when this data are not available, live births with 5-minute Apgar score 0–6 minutes per 100 live births with measurement of pH.

- Nominator: Number of live births with umbilical artery pH below 7.05 or, when this data are not available, live births with 5-minute Apgar score 0–6
- Denominator: Number of live births

Notes:

- Only hospitals with routine taking and systematic recording should be included in the statistics.
- The data are currently available for Finland only.
- Data for Norway are available soon.
- Data from Sweden are available in the Quality Register covering the Stockholm metropolitan area.

	Denmark		Finland		Iceland		Norway		Sweden	
	Cases	Live births	Cases	Live births	Cases	Live births	Cases	Live births	Cases	Live births
2008	..	..	151	46 033	..	..	..	..	..	..
2009	..	..	131	47 669	..	..	..	..	..	..
2010	..	..	166	49 546	..	..	..	..	..	..
2011	..	..	133	48 892	..	..	..	..	..	..
2012	..	..	148	48 675	..	..	..	..	..	..

Per 1000

2008	..	3.3	..	..	..
2009	..	2.7	..	..	..
2010	..	3.4	..	..	..
2011	..	2.7	..	..	..
2012	..	3.0	..	..	..

The group also discussed the need to get information on neonatal care. Neonatologists should be consulted before adopting the two indicators below.

1. Respiratory treatment

Definition: The number of live births with respiratory treatment in early neonatal period (0–6 days) per 100 live births.

- Nominator: Live births with respiratory treatment in early neonatal period.
- Denominator: Number of live births.

2. Brain cooling among infants with low Apgar scores

Definition: The number of live births with brain cooling under early neonatal period (0–6 days) per 100 live births with low 5-minute Apgar scores (0–6).

- Nominator: Live births with brain cooling under early neonatal period.
- Denominator: Number of live births with low 5-minute Apgar scores.

8 Conclusions

The Nordic Medical Birth Registers collect substantial data on obstetric and neonatal care and outcomes. Most of the proposed indicators are already collected and disseminated nationally. Also their quality is shown to be good for most variables. We observed some uncertain or incomplete data, for example, the low percentage of general anaesthesia in Caesarean section in Finland. As only reliable indicator values should be published, it is important that prior release all indicator values are validated by national experts.

The pilot data collection showed comparable values for most of the indicators, e.g. maternal mortality ratio, perinatal mortality rates and the proportion of newborns with low Apgar scores 0–3. There were, however, clear variations in some indicators. The pilot study suggests that these outliers are real, and they were found in all of the Nordic countries. Finland had increased rates for blood transfusions, peripartum hysterectomies and uterine ruptures, as well as low 5-minute Apgar scores 0–6. Iceland recorded high rates of third or fourth degree ruptures and low 5-minute Apgar scores 0–6. Norway reported high rates of unplanned out-of-hospital births as well as blood transfusions. Sweden reported high rates of third or fourth degree ruptures in vaginal deliveries.

Data on umbilical artery pH are not collected into all of the Nordic Medical Birth Registers. The same is true for the estimated blood loss during delivery. Therefore, the expert group proposes an indicator on blood transfusion until the indicator on blood loss is operationalized and available in at least three Nordic countries. The indicators on neonatal outcome have to be discussed and finalized with neonatologists.

9 Perspectives, including from measuring to improvement

Benchmarking and health care quality indicators have been shown to be in improving the quality of health care services both locally and nationally. A Norwegian example shows that the rate of third and fourth degree ruptures in vaginal deliveries could be halved after introducing a national programme with local training (Hals et al. 2010, Stedenfeldt et al. 2014). The publishing of Nordic patient safety indicators should encourage all Nordic countries to compare their own data with their peers and identify areas with possibilities for improvement.

One of the key issues is that only indicators with reliable information should be published. The quality of any register should be validated regularly. In general, the Medical Birth Registers have high completeness and validity, but some studies have shown that registration of rare outcomes, such as severe maternal complication, may not be complete (Colmorn et al. 2015, Jakobsson et al. 2015). Routine data linkages between Medical Birth Registers and Hospital Discharge Registers may improve the quality of data on rare outcomes. Data linkages and confidential enquires also tend to improve the data on maternal deaths, as has been shown by linkage studies in Finland and Norway. No register data are good, if the registration of diagnoses and interventions done by clinicians in hospitals is not complete and reliable. The registration process should be simple and clear, and information should be recorded only once in a common electronic patient record in a structural format.

References

ACOG 2000. The American College of Obstetricians and Gynecologists. Evaluation of Caesarean delivery. Washington (DC); http://archive.poughkeepsiejournal.com/assets/pdf/bk15725757.pdf [last accessed 01.05.2014]

AHRQ Quality Indicators 2002. Guide to Inpatient Quality Indicators: Quality of Care in Hospitals – Volume, Mortality, and Utilization. Department of Health and Human Services Agency for Healthcare Research and Quality; http://www.qualityindicators.ahrq.gov [last accessed 24.02.2014]

AHRQ Quality Indicators. 2003. Guide to Patient Safety Indicators. Department of Health and Human Services Agency for Healthcare Research and Quality; http://www.qualityindicators.ahrq.gov [last accessed 10.03.2014]

Baghurst P. 2010. The trouble with clinical indicators: Intact lower genital tract following childbirth in NSW Hospitals, 2003–2005. Australian and New Zealand Journal of Obstetrics and Gynaecology 2010; 50: 45–50.

Baghurst P. 2013. The case for retaining severe perineal tears as an indicator of the quality of obstetric care. Australian and New Zealand Journal of Obstetrics and Gynaecology 2013; 53: 3–8.

Bailit J, Love T, Dawson N. 2006. Quality of obstetric care and risk-adjusted primary Caesarean delivery rates. American Journal of Obstetrics and Gynecology (2006) 194: 402–407.

Bailit J. 2007. Measuring the Quality of Inpatient Obstetrical Care. Obstetrical and Gynecological Survey, 62 (3): 207-213.

Bailit J, Grobman W, Rice M, Spong C, Wapner R, Varner R, Thorp J, Leveno K, Caritis S, Shubert B, Tita A, Saade G, Sorokin Y, Rouse D, Blackwell S, Tolosa J, Van Dorsten P. 2013.Risk-adjusted models for adverse obstetric outcomes and variation in risk-adjusted outcomes across hospitals. Americal Journal of Obstetrics, Gynecology 2013;209: 446: 1-30.

Boulkenid R, Sibony O, Goffinet F, Fauconnier A, Branger B. 2013. Quality Indicators for Continuous Monitoring to Improve Maternal and Infant Health in Maternity Departments: A Modified Delphi Survey of an International Multidisciplinary Panel. PLos ONE 8 (4): e60663.

Brace V, Penney G, Hall M. 2004. Quantifying severe maternal morbidity: a Scottish population study. BJOG: an International Journal of Obstetrics and Gynaecology. 2004 (111); 481–484.

Buitendijk S, Zeitlin J, Cuttini M, Langhoff-Roos J, Bottu J. 2003. Indicators of fetal and infant health outcomes. European Journal of Obstetrics & Gynecology and Reproductive Biology 111 (2003): 66–77.

Casey M, Moscovice I, Klingner J, Shailendra P. 2013. Rural Relevant Quality Measures for Critical Access Hospitals. The Journal of Rural Health 29; 159–171.

Chalmers B, Porter R. 2001. Assessing Effective Care in Normal Labor: The Bologna Score. Birth 28(2); 79-83.

Clarke M. 2008. Overview of Methods, in Reviewing Research Evidence for Nursing Practice: Systematic Reviews (eds C. Webb and B. Roe), Blackwell Publishing Ltd, Oxford, UK. doi: 10.1002/9780470692127.ch1

CMACE. Centre for Maternal and Child Enquiries. Saving Mothers' Lives. Reviewing maternal deaths to make motherhood safer: 2006–2008. The Eight Report on Confidential Enquiries into Maternal Deaths in the United Kingdom. British Journal of Obstetrics and Gynecology 2011; 118 (suppl. 1): 1-203.

Colmorn LB, Petersen KB, Jakobsson M, Lindqvist PG, Klungsøyr K, Källen K, Bjarnadottir RI, Tapper AM, Børdahl PE, Gottvall K, Thurn L, Gissler M, Krebs L, Langhoff-Roos J. 2015. The Nordic Obstetric Surveillance Study – NOSS: A study of complete uterine rupture, abnormally invasive placenta, peripartum hysterectomy and severe blood loss at delivery. Acta Obstet Gynecol Scand 94(7):734-44.

EURO-PERISTAT 2010. European Perinatal Health Report. Health and Care of Pregnant Women and Babies in Europe in 2010; http://www.europeristat.com/reports/european-perinatal-health-report-2010.html [last accessed 06.02.2014]

EURO-PERISTAT 2012. List of indicators, updated 2012; http://www.europeristat.com/our-indicators/indicators-of-perinatal-health.html [last accessed 26.02.2014]

Feldstein D.A. 2005. Clinician's Guide to Systematic Reviews and meta-Analyses. Wisconsin Medical Journal 104 (3), 25-29.

Geller S.E, Rosenberg D, Cox S, Brown M, Simonson L, Kilpatric R. 2004. A scoring system identified near-miss maternal morbidity during pregnancy. Journal of Clinical Epidemiology 57 (7), 716-720.

Geraedts, M, Neumann, M. 2004. Evaluation geburtshilflicher Qualitätsindikatoren - Studie im Auftrag der BQS Bundesgeschäftsstelle Qualitätssicherung gGmbH. Geburtshilfe und Frauenheilkunde. 64 (4); 375-380.

Gissler M, Mohangoo A, Blondel B, Chalmers J, Macfarlane A, Gaizauskiene A, Gatt M, Lack N, Sakkeus L, Zeitlin J for the EURO-PERISTAT group. 2010. Perinatal health monitoring in Europe: results from the EURO-PERISTAT project. Informatics for Social and Health Care 35 (2); 64-79.

Goldenberg R, McClure E, Bann C. 2007. The relationship of intrapartum and antepartum stillbirth rates to measures of obstetric care in developed and developing countries. Acta Obstetricia et Gynecologica. 86: 1303-1309.

Gregory K.D, Korst L.M,Lu M.C, Fridman N. 2013. AHRQ patient safety indicators: time to include hemorrhage and infection during childbirth. Joint Commission Journal on Quality and Patient Safety 39 (3),114-122.

Grobman W, Joe Feinglass J, Murthy S. 2006. Are the Agency for Healthcare Research and Quality obstetric trauma indicators valid measures of hospital safety? American Journal of Obstetrics and Gynecology. 195; 868–74.

Haller G, Camparini-Righini N, Kern C, Pfister RE, Morales M, Berner M, Clergue F, Irion O. 2010. Patient safety indicators for obstetrics: a Delphi based study. J Gynecol Obstet Biol Reprod. Paris 39 (5):371-8A.

Hals E, Øian P, Pirhonen P, Gissler M, Hjelle S, Berge Nielsen E, Severinsen A M, Solsletten C, Hartgill T, Pirhonen 2010. Multicenter interventional study to reduce the incidence of anal sphincter tears. Obstetrics and Gynecology 116; (4): 901-908.

Jakobsson M, Tapper A-M, Berdiin Colmorn L, Lindqvist P, Klungsøyr K, Krebs L, Børdahl P, Gottvall K, Källén K, Bjarnadóttir R, Langhoff-Roos J, Gissler M and the NOSS study group 2015. Emergency peripartum hysterectomy: Results from the prospective Nordic Obstetric Surveillance Study (NOSS). Acta Obstetricia et Gynecologica Scandinavica. doi: 10.1111/aogs.12644.

Janakiraman V, Ecker J. 2010. Quality in Obstetric Care: Measuring What Matters. Obstetrics & Gynecology. 116 (3); 728-732.

Johansen K.S., Hod M. 1999. Special communication. Quality development in perinatal care ─ the OBSQID project. International Journal of Gynecology & Obstetrics 64 (1999); 167-172.

Johnson C, Handberg E, Dobalian A, Gurol N, Pearson V. 2005. Improving Perinatal and Neonatal Patient Safety. The AHRQ Patient Safety Indicators. Journal of Perinatal & Neonatal Nursing. 19 (1); 15–23.

Jones L, LoGerfo J, Shy K, Connell F, Holt V, Parrish K, McCandless K. 1993. StORQS: Washington's Statewide obstetrical Review and Quality System: overview and provider Evaluation. QRB: Quality Review Bulletin 19 (4);110-118.

Kesmodel U. S, Jølving L.R. 2011. Measuring and improving quality in obstetrics – the implementation of national indicators in Denmark. Acta Obstetricia et Gynecologica Scandinavica 90; 295–304.

Knight H, Cromwell D, Van der Meulen J, Gurol-Urganci I, Richmond D, Mahmood T, Templeton A, Dougall A, Johnson S. 2013. Patterns of Maternity Care in English NHS Hospitals 2011/12. The Royal College of Obstetricians and Gynaecologists; www.rcog.org.uk [last accessed 09.03.2014]

Knight M, Workman M, Fitzpatrick K, Acosta C, Peirsegaele P, Mistry V, Kurinczuk JJ. UKOSS Annual Report 2013. Oxford: National Perinatal Epidemiology Unit (2013).

Korst L.M, . Gornbein J.A, Gregory K.D. 2005. Rethinking the Caesarean Rate. How Pregnancy Complications May Affect Interhospital Comparisons. Medical Care. 43 (3); 237-245.

Kritchevsky S.B, Braun B, Gross P, Newcomb C, Kelleher C.A, Simmons B. 1999. Definition and adjustment of Caesarean section rates and assessments of hospital performance. International Journal for Quality in Health Care, 11 (4); 283–291.

Lobis S, Fry D, Paxton A. 2005. Averting maternal death and disability. Program note: applying the UN process indicators for emergency obstetric care to the United States. International Journal of Gynecology and Obstetrics. 88; 203—207.

Mamelle N, David S, Lombrail P, Roze JC. 2001. College National des Gynecologues et Obstetriciens Francais, Federation Nationale des Pediatres Neonatologistes. Journal de Gynecologie, Obstetrique et Biologie de la Reproduction 30 (7):641.

Main E.K, Moore D, Farrell B, Schimmel L.D, Altman R, Abrahams C, Bliss C, Polivy L, Sterling J. 2006. Is there a useful Caesarean birth measure? Assessment of the nulliparous term singleton vertex Caesarean birth rate as a tool for obstetric quality improvement. American Journal of Obstetrics and Gynecology 194; 1644–1652.

Mann S, Pratt S, Gluck P, Nielsen P, Risser D, Greenberg P, Marcus R, Goldman M, Shapiro D, Pearlman M, Sachs B. 2006. Performance Measures. Assessing Quality in Obstetrical care: Development of standardized Measures. Joint Commission Journal on Quality and Patient Safety. 32(9), 497-505.

OECD 2010. Improving Value in Health Care: Measuring Quality. Forum on Quality of Care, Paris, 7-8 October 2010. http://www.oecd.org/health/ministerial/46098506.pdf [last accessed 09.03.2014]

OECD 2013. Health at a Glance 2013: OECD Indicators, OECD Publishing; http://dx.doi.org/10.1787/health_glance-2013-en [last accessed 09.03.2014]

ORYX -initiative. Perinatal Care Core Measure Set; http://www.jointcommission.org/perinatal_care/ [last accessed 26.02.2014]

Pasternak D.P, Pine M, Nolan K, French R. 1999. Risk-Adjusted Measurement of primary Caesarean Sections: Reliable Assessment of the Quality of Obstetrical Services. Quality management in Health Care 8(1); 47-54.

Pyykönen A, Gissler M, Jakobsson M, Lehtonen L, Tapper A-M. 2013. The rate of obstetric anal sphincter injuries in Finnish obstetric units as a patient safety indicator. European Journal of Obstetrics & Gynecology and Reproductive Biology 169;33–38.

Pyykönen A, Gissler M, Jakobsson M, Petäjä, J, Tapper A-M. 2014. Determining obstetric patient safety indicators: the differences in neonatal outcome measures between different-sized delivery units. British Journal of Obstetrics and Gynecology121:430–437.

RANZCOG/ACHS 2013. Obstetrics indicators. Clinical Indicator User Manual for data collected in 2H2013; http://www.ranzcog.edu.au/fellows/pracrm/ranzcogachs-clinical-indicators.html [last accessed 06.02.2014]

Richardus, J. H, Graafmans, W.C., Verloove-Vanhorick, S. P., Mackenbach, J. P. 1998. The Perinatal Mortality Rate as an Indicator of Quality of Care in International Comparisons. Medical Care. 36 (1); 54-66.

Robson MS 2001. Classification of caesarean sections. Fetal and Maternal Medicine Review 12: 23–39.

Sandin-Bojö A.K, Kvist L. 2008. Care in Labor: A Swedish Survey Using the Bologna Score. Birth 35(4); 321-328.

Santos J, Correia C, Cabral F, Bernardes J, Costa-Pereira A, Freitas A. 2013. Should European perinatal indicators be revisited?

European Journal of Obstetrics & Gynecology and Reproductive Biology 170 : 85–89.

Saucedo M, Deneux-Tharaux C, Bouvier-Colle MH; Le Comité national d'experts sur la mortalité maternelle. [Maternal mortality in France, 2007-2009]. Journal of Gynecology, Obstetrics and Reproductive Biology (Paris). 2013 Nov;42(7):613-27.

Sibanda T, Fox R, Draycott, T. Mahmood T, Richmond D, Simms R. 2013. Intrapartum care quality indicators. a systematic approach for achieving consensus. European Journal of Obstetrics & Gynecology and Reproductive Biology. 166; 23-29.

Simpson K. 2005. Failure to Rescue. Implications for Evaluating Quality of Care During Labor and Birth. Journal of Perinatal and Neonatal Nursing. 19 (1); 24–34.

Singh R, Trivedi A. N. 2011. Is the caesarean section rate a performance indicator of an obstetric unit? Journal of Maternal-Fetal and Neonatal Medicine 24 (2): 204–207.

Socialstyrelsen och Sveriges Kommun och Landsting. Öppna jämförelser 2014. Hälso- och sjukvård. Jämförelser mellan landsting. Beskrivning av indikatorer. Bilaga 1. http://www.socialstyrelsen.se/SiteCollectionDocuments/2014-12-1-bilaga-1.pdf (in Swedish).

Srinivas S.K, Fager C, Lorch S.A. 2010. Evaluating Risk-Adjusted Caesarean Delivery Rate as a Measure of Obstetric Quality. Obstetrics & Gynecology. 115 (5); 1007-1013.

Stedenfeldt M, Øian P, Gissler M, Blix E, Pirhonen J. 2014. Risk Factors for Obstetric Anal Sphincter Injury after a Successful Multicenter Intervention Program. British Journal of Obstetrics and Gynecology 121 (1); 83-91.

Tapper A-M. 2013. Synnytyksiin liittyvät riskit, in book: Potilasturvallisuuden perusteet (eds Aaltonen L-M, Rosenberg P), Duodecim, Helsinki (in Finnish).

TemaNord 2010. Nordisk kvalitetsmåling i sundhedsvaesenet. TemaNord 2010:572 (in Scandinavian languages).

The Joint Commission. Specifications Manual for Joint Commission National Quality Core Measures; http://manual.jointcommission.org/releases/TJC2014A/rsrc/Manual/TableOfContentsTJC/PC_2014A.pdf [last accessed 26.02.2014]

The National Board of Health and Welfare in Sweden. 2014 Indicator registry (Indikatorbiblioteket) http://www.socialstyrelsen.se/indikatorer/sokiindikatorbibliotek et?search=graviditet&#listing Accessed [26.03.2014]

THL 2012. Sairastavuustilastoinnin kehittäminen ja OECD:n laatuindikaattorit Suomessa. Raportti 42/2012 (in Finnish).

Troop P, Goldacre M, Mason A, Cleary R (eds). 1999. Health Outcome Indicators: Normal Pregnancy and Childbirth. Report of a working group to the Department of Health. Oxford: National Centre for Health Outcomes Development, 1999. http://nchod.uhce.ox.ac.uk/pregnancy.pdf [last accessed 26.3.2014]

Vangen S, Ellingsen L, Andersgaard AB, Jacobsen AF, Lorentzen B, Nyfløt LT,Rygh AB, Skulstad SM, Tappert C, Øian P 2014. Maternal deaths in Norway 2005-2009.Tidsskr Nor Laegeforen 134(8):836-839.

Walker S, Strandjord T.P, Benedetti T. J. 2010. In search of perinatal quality outcome measures: 1 hospital's in-depth analysis of the Adverse Outcomes Index. American Journal of Obstetrics Gynecolology 2010, 203 (336), 1-7.

WHO Indicator Registry. http://www.who.int/gho/indicator_registry/en/ Accessed [16.03.2014]

WHO 2004. Beyond the Numbers. Reviewing maternal deaths and complications to make pregnancy safer. World Health Organization, Geneva.

Wildman K, Blondel B, Nijhuis J, Defoort P, Bakoula C. 2003. European indicators of health care during pregnancy, delivery and the postpartum period. European Journal of Obstetrics & Gynecology and Reproductive Biology 111; 53–65.

Wildman K, Bouvier-Colle M-H. 2004. Maternal mortality as an indicator of obstetric care in Europe. British Journal of Obstetrics and Gyncology111; 164–169.

Yuan Y, Hunt R.H. 2009. Systematic Reviews: The good, the Bad, and the Ugly. The American Journal of Gastroenterology 104, 1086-1092.

Zeitlin J, Wildman K, Bréart G, Alexander S, Barros H, Blondel B, Buitendijk S, Gissler M, MacFarlane A, the PERISTAT scientific advisory committee. 2003. PERISTAT Indicators for monitoring and evaluating perinatal health in Europe. European Journal of Public Health 13 (3 supplement); 29-37.

Appendix 1. Search strategies

Cinahl

S4 S1 AND S2 AND S3 (64)

S3 TI ((obstetric* or childbirth or birth or perinatal or intrapartum)) OR MH (childbirth or "delivery, obstetric" or "obstretric care" or "intrapartum care" or "perinatal care" or "pregnancy outcomes") (35,618)

S2 TI indicator* OR MH ("clinical indicators" OR "health status indicators") (15,753)

S1 TI ((quality or safety)) OR MH ("quality of health care" or "quality of nursing care" or "obstretric standards" or "obstretric service standards" or "quality of health care methods" or "patient safety") (114,418)

Cochrane Database of Systematic Reviews 2005 to December 2013

(obstetric* or childbirth or birth or perinatal or intrapartum).ti. and (quality or safety).ti,ab. and indicator*.mp. [mp=title, short title, abstract, full text, keywords, caption text] (10)

Ovid MEDLINE(R) In-Process & Other Non-Index Citations and Ovid MEDLINE(R) 1946 to Present, Ovid MEDLINE(R) Daily Update February 13, 2014

1 (obstetric* or childbirth or birth or perinatal or intrapartum).ti. (93784)

2 exp *"Delivery, obstetric"/ (36032)

3 exp *"Perinatal Care"/ (3588)

4 or/1-3 (126038)

5 (quality or safety).ti. (196835)

6 exp "patient safety"/ (4107)

7 exp "Quality of health care"/ (4804195)

8 exp "Outcome assessment (health care)"/ (668291)

9 or/5-8 (4886157)

10 exp "Quality Indicators"/ (12305)

11 indicator*.ti. (28759)

12 4 and 10 (198)

13 4 and 9 and 11 (181)

14 12 or 13 (346)

15 limit 14 to yr="1990 -Current" (323)

16 limit 15 to (Danish or English or Finnish or French or German or Icelandic or Norwegian or Spanish or Swedish) (307)

Appendix 1. Search strategy (continued)

ProQuest Health Management

S4 OR S7 (15)

S7 S1 AND S2 AND S6 (10)

S6 S3 OR S5 (5779)

S5 TI(indicator*) (4789)

S4 S1 AND S3 (13)

S3 SU("Quality Indicators" OR "Performance indicators") (1096)

S2 TI(quality OR safety) OR SU("Outcome assessment (health care)" OR "patient safety" OR "safety, hospital & patient" OR "quality of health care" OR "quality of care" OR "quality of service") (78890)

S1 TI(obstetric* or childbirth or birth or perinatal or intrapartum) OR SU(births OR obstetrics OR "Delivery, obstetric" OR "Perinatal care") (20434)

PubMed

(obstetric*[Title] or childbirth[Title] or birth[Title] or perinatal[Title] or intrapartum[Title]) AND (quality[Title] OR safety[Title]) AND indicator* AND pubstatusaheadofprint (2)

Web of Science

TI=(obstetric* or childbirth or birth or perinatal or intrapartum) AND TI=(quality OR safety) AND TS=(indicator*) *Indexes=SCI-EXPANDED, SSCI, A&HCI Timespan=1990-2014* (67)

Appendix 2. Some of the existing, published sets of obstetric indicators

Information included in these tables is directly extracted from the reports and articles given below each table. These tables aim to present the essential information in a compact form.

AHRQ: The Agency for Healthcare Research and Quality

Indicator set	Indicators and description	Nominator and Denominator or calculation	Rationale	Comments on the use of indicator (if mentioned)
AHRQ Selected Quality and Patient Safety Indicators	**Caesarean Delivery Rate** (IQI 21) Provider-level number of Caesarean deliveries per 100 deliveries.	**Nominator:** Number of Caesarean deliveries, identified by DRG, or by ICD-9-CM procedure codes if they are reported without a 7491 hysterotomy procedure, among cases meeting the inclusion and exclusion rules for the denominator. **Denominator:** All deliveries. Exclude cases: abnormal presentation, preterm, fetal death, multiple gestation diagnosis codes, breech procedure codes	The most common operative procedure performed in the United States. Is associated with higher costs than vaginal delivery. Has been identified as an overused procedure. As such, lower rates represent better quality. The Caesarean delivery rate can be decreased by decreasing the primary Caesarean delivery rate or increasing the VBAC rate.	Empirical analyses demonstrate that Caesarean delivery rate is measured with good precision. Risk adjustment affects the outlier status and rankings of as many as 25% of hospitals. Hospital rankings may change after risk adjustment. Providers may want to examine the clinical characteristics of their populations when interpreting the results of this indicator. Clinical characteristics such as prior Caesarean, parity, breech presentation, placental or cord complications, sexually transmitted diseases (STDs), infections, and birth weight have been shown to explain substantial variation in Caesarean delivery rates. Additional bias may result from clinical differences not identifiable in administrative data. Supplemental risk adjustment with linked birth records or other clinical data may be desirable. Relative to other indicators, a higher percentage of the variation occurs at the provider level rather than the discharge level. The overall Caesarean delivery rate cannot determine appropriate use, but the variation in rates across institutions and regions may, if the variations do not merely reflect variations in patient disease severity and comorbidities.
	Primary Caesarean Delivery Rate (IQI 33) Provider-level number of Caesarean deliveries per 100 deliveries.	**Nominator:** Number of Caesarean deliveries, identified by DRG, or by ICD-9-CM procedure codes if they are reported without a hysterectomy procedure, among cases meeting the inclusion and exclusion rules for the denominator.	Same as above	Same as above

		Denominator: All deliveries. Exclude cases: abnormal presentation, preterm, fetal death, multiple gestation diagnosis codes, breech procedure codes, previous Caesarean delivery diagnosis in any diagnosis field.		
	Vaginal Birth after Caesarean Rate, Uncomplicated (IQI 22) Provider-level vaginal births per 100 discharges with a diagnosis of previous Caesarean delivery.	**Nominator:** Number of vaginal births in women among cases meeting the inclusion and exclusion rules for the denominator. **Denominator:** All deliveries with a previous Caesarean delivery diagnosis in any diagnosis field. Exclude cases: abnormal presentation, preterm, fetal death, multiple gestation diagnosis codes, breech procedure codes	VBAC has been identified as a potentially underused procedure and as such higher rates of VBAC represent better quality.	Is measured with very good precision. It is likely that the observed differences represent true differences in provider performance rather than random variation. Some clinical factors such as previous classic Caesarean delivery may contraindicate VBAC, and this indicator should be risk-adjusted for these factors. Because these clinical factors may not be available in administrative data, linkage to birth records may provide for better risk adjustment. The best rate for VBAC has not been established. This indicator should be used in conjunction with area rates, national rates, and complication rates (maternal uterine rupture and length of stay, neonatal length of stay) to assess whether a rate is truly too high or too low. Selection bias due to patient preferences and other factors may impact performance on this indicator. Supplemental adjustment with linked birth records or other clinical data may be desirable to address bias from clinical differences not identifiable in administrative data. Relative to other indicators, a higher percentage of the variation occurs at the provider level rather than the discharge level. The signal ratio* is high, at 83.1%. This indicates that the observed differences in provider performance likely represent true differences, although some of the observed difference is due to patient characteristics.
	Vaginal Birth after Caesarean Rate, All (IQI 34) Provider-level vaginal births per 100 discharges with a diagnosis of previous Caesarean delivery.	**Nominator:** Number of vaginal births in women among cases meeting the inclusion and exclusion rules for the denominator. **Denominator:** All deliveries with a previous Caesarean delivery diagnosis in any diagnosis field	–	Same as above
	Birth Trauma - Injury to Neonate (PSI 17) Cases of birth trauma, injury to neonate, per 1000 live born births.	**Nominator:** Discharges among cases meeting the inclusion and exclusion rules for the denominator with ICD-9-CM code for birth trauma in any diagnosis field. Exclude infants with a subdural or cerebral haemorrhage and any diagnosis code of pre-term infant (birth weight of less than 2500 grams and less than 37 weeks gestation or 34	Sometimes newborns can suffer injury to for example to the head, neck, or shoulder. This indicator is intended to flag cases of birth trauma for infants born alive in a hospital.	Birth Trauma indicator generally performs well on several different dimensions, including reliability, relatedness of indicators, and persistence over time. The overall usefulness of this indicator was rated as favourable by panellists. But the project team was unable to find other evidence on the validity of this indicator.

		weeks gestation or less), with injury to skeleton and any diagnosis code of osteogenesis imperfecta. **Denominator:** All live born births (newborns). The definition of newborn is any neonate with either an ICD-9-CM diagnosis code for an in-hospital live born birth or an admission type of newborn , age in days at admission equal to zero, and not an ICD-9-CM diagnosis code for an out-of-hospital birth. A neonate is defined as any discharge with age in days at admission between zero and 28 days (inclusive). If age in days is missing, then a neonate is defined as any DRG in MDC 15, an admission type of newborn or an ICD-9-CM diagnosis code for an in-hospital live born birth.		Reliability of the indicator - The signal ratio is high relative to other indicators, at 97.0%, suggesting that observed differences in risk-adjusted rates reflect true differences across hospitals. The signal standard deviation for this indicator is also high, relative to other indicators, indicating that the systematic differences (signal) among hospitals is high and more likely associated with hospital characteristics.
	Obstetric Trauma - Vaginal Delivery with Instrument (PSI 18) Cases of obstetric trauma (3rd or 4th degree lacerations) per 1000 instrument assisted vaginal deliveries.	**Nominator:** Discharges among cases meeting the inclusion and exclusion rules for the denominator with ICD-9-CM code for 3rd and 4th degree obstetric trauma in any diagnosis or procedure field. **Denominator:** All vaginal delivery discharges with any procedure code for instrument-assisted delivery.	Potentially preventable trauma during vaginal delivery with instrument may occur.	This indicator generally performs well on several different dimensions, including reliability, relatedness of indicators, and persistence over time. The overall usefulness of this indicator was rated as favourable by panellists. Reliability of the indicator - The signal ratio* is moderately high, relative to other indicators, at 69.9%, suggesting that observed differences in risk-adjusted rates likely reflect true differences across hospitals. The signal standard deviation for this indicator is also high, indicating that the systematic differences (signal) among hospitals is high and more likely associated with hospital characteristics.
	Obstetric Trauma - Vaginal Delivery without Instrument (PSI 19) Cases of obstetric trauma (3rd or 4th degree lacerations) per 1000 vaginal deliveries without instrument assistance.	**Nominator**: Discharges among cases meeting the inclusion and exclusion rules for the denominator with ICD-9-CM code for 3rd and 4th degree obstetric trauma in any diagnosis or procedure field. **Denominator:** All vaginal delivery discharges. Exclude cases with instrument-assisted delivery.	Potentially preventable trauma during vaginal delivery without instrument may occur.	This indicator generally performs well on several different dimensions, including reliability, relatedness of indicators, and persistence over time. The overall usefulness of this indicator was rated as favorable by panellists. Reliability of the indicator - The signal ratio* is high, relative to other indicators, at 86.4%, suggesting that observed differences in risk-adjusted rates reflect true differences across hospitals. The signal standard deviation for this indicator is also high, relative to other indicators indicating that the systematic

				differences (signal) among hospitals is high and more likely associated with hospital characteristics. The signal share** is lower than many other indicators. The lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).
	Obstetric Trauma - Caesarean Delivery (PSI 20) Cases of obstetric trauma (3rd or 4th degree lacerations) per 1000 Caesarean deliveries.	**Nominator:** Discharges among cases meeting the inclusion and exclusion rules for the denominator with ICD-9-CM code for obstetric trauma in any diagnosis or procedure field. **Denominator:** All Caesarean delivery discharges.	There may be potentially preventable trauma.	This indicator generally performs well on several different dimensions, including reliability, relatedness of indicators, and persistence over time. The overall usefulness of this indicator was rated as favourable by panellists. Reliability of the indicator - The signal ratio is lower than many indicators, at 45.9%, suggesting that observed differences in risk-adjusted rates may not reflect true differences across hospitals. The signal standard deviation for this indicator is also lower than many indicators, indicating that the systematic differences (signal) among hospitals is low and less likely associated with hospital characteristics. The signal share** is lower than many indicators.

* The signal ratio - the proportion of the total variation across providers that is truly related to systematic differences (signal) in provider performance rather than random variation (noise).

** The signal share is a measure of the share of total variation (hospital and patient) accounted for by hospitals; the lower the share, the less important the hospital in accounting for the rate and the more important other potential factors (e.g., patient characteristics).

AHRQ Quality Indicators 2002. Guide to Inpatient Quality Indicators: Quality of Care in Hospitals – Volume, Mortality, and Utilization. Department of Health and Human Services Agency for Healthcare Research and Quality; http://www.qualityindicators.ahrq.gov [last accessed 24.02.2014]

AHRQ Quality Indicators. 2003. Guide to Patient Safety Indicators. Department of Health and Human Services Agency for Healthcare Research and Quality; http://www.qualityindicators.ahrq.gov [last accessed 10.03.2014]

Boulkenid et al. (2013) list of quality indicators

Indicator set	Indicator and description	Nominator and Denominator or calculation	Rationale	Comments on the use of indicator (if mentioned)
List of quality indicators for obstetric care chosen by expert panel (Boulkenid et al. 2013)	**Nuchal translucency measurement during the first trimester of pregnancy**	**Nominator:** Number of women with nuchal translucency measurement during the first trimester of pregnancy. **Denominator:** Total number of women delivered	–	–
	Three-marker screening performed during the first trimester of pregnancy	**Nominator:** Number of women with three-marker screening during the first trimester. **Denominator:** Total number of women delivered.	–	–
	Vaginal sampling in the 9th month to screen for Streptococcus group B carriage	**Nominator:** Number of women who underwent vaginal sampling in the 9th month to screen for Streptococcus group B carriage. **Denominator:** Total number of women delivered.	–	–
	Epidural analgesia use	**Nominator:** Number of women with epidural analgesia use. **Denominator:** Total number of women who delivered vaginally	–	–
	Caesarean section before labour	**Nominator:** Number of caesarean sections before labour. **Denominator:** Total number of women delivered.	–	Indicator is clearly defined, easily collectible, and relevant to efforts aimed at decreasing maternal morbidity and healthcare costs. In the overall population, caesarean section rates depend chiefly on the case-mix in the maternity centre and may consequently vary across centres. In low-risk women, very low adverse event rates are expected and the caesarean section rates therefore show little variation across centres, allowing comparisons of different centres.
	Caesarean section during labour	**Nominator:** Number of caesarean sections during labour. **Denominator:** Total number of women	–	Same as above

		delivered.		
	Third/fourth-degree perineal tear (full-thickness tears)	**Nominator**: Number of women with third/fourth-degree perineal tears. **Denominator:** Total number of women who delivered vaginally.	Reflects severe morbidity related to pregnancy	–
	Uterine rupture	**Nominator:** Number of women with uterine rupture. **Denominator:** Total number of women delivered.	Reflects severe morbidity related to pregnancy	–
	Intact perineum	**Nominator:** Number of women with intact perineum. **Denominator:** Total number of women who delivered vaginally.	An important goal to maximize patient comfort, minimise pain, and ensure the absence of residual discomfort due to scarring.	Reflects not only absence of third/fourth-degree tears, but also absence of less severe tears during instrumental vaginal delivery and absence of episiotomy.
	Nosocomial infection of surgical site	**Nominator:** Number of women with nosocomial infections. **Denominator:** Number of women who had surgery.	–	–
	Blood transfusion during and/or after delivery	**Nominator:** Number of women given blood transfusions during and/or after delivery (delivery related blood loss >1500 ml). **Denominator:** Total number of women delivered.	–	–
	Maternal ICU transfer and/or admission	**Nominator:** Number of women transferred and/or admitted to the intensive care unit (ICU). **Denominator:** Total number of women delivered.	Reflects severe morbidity related to pregnancy	–
	Decision to breastfeed at discharge	**Nominator:** Number of women who decided to breastfeed at discharge. **Denominator:** Total number of women discharged home with a live baby.	Breastfeeding has numerous short- and long-term positive health effects for the infant. Breastfeeding has been associated with neurodevelopmental advantages, lower rates of obesity, and a lower incidence of atopic disorders.	Routine recording of data on breastfeeding may be difficult to achieve, as some mothers do not return to the maternity centre after delivery. A decision by the mother to breastfeed, taken at discharge from the maternity ward, seems to be a reasonable surrogate for actual breastfeeding after discharge.

	Caesarean section before labour in low-risk woman	**Nominator:** Number of caesarean sections before labour in low-risk women. **Denominator:** Women aged between 18 and 40 years with a singleton pregnancy, cephalic presentation, and no underlying comorbidities during the pregnancy (e.g., diabetes or hypertension, uterine scarring, admission before 37 weeks' gestational age), no aspirin use during pregnancy, and no non-routine investigations such as foetal imaging by magnetic resonance imaging or computed tomography.	–	–
	Caesarean section during labour in low-risk woman	**Nominator:** Number of caesarean sections during labour in low-risk women. **Denominator:** Women aged between 18 and 40 years with a singleton pregnancy, cephalic presentation, and no underlying comorbidities during the pregnancy (e.g., diabetes or hypertension, uterine scarring, admission before 37 weeks' gestational age), no aspirin use during pregnancy, and no non-routine investigations such as foetal imaging by magnetic resonance imaging or computed tomography.	–	–
	Instrumental vaginal delivery	**Nominator:** Number of neonates delivered by instrumental extraction (using obstetric forceps or vacuum extractor). **Denominator:** Total number of vaginally births (all live born neonates including those with birth defects).	A decrease in the instrumental vaginal delivery rate is widely accepted as indicating an improvement in the quality of care. Instrumental vaginal delivery is associated with several neonatal adverse effects such as extra- and intracranial haemorrhage and cephalhaematoma. Instrumental vaginal delivery significantly increases the risk of third or fourth degree perineal tears and of vaginal and cervical lacerations compared with spontaneous vaginal delivery.	–
	Rate of non-low-birth-weight neonates admitted to the NICU	**Nominator:** Number of admissions to Neonatal intensive care unit (NICU) of neonates >2500 g without birth defects. **Denominator:** Total number of neonates (all live born neonates including those with birth	–	–

		defects).		
	Birth ≥ 37 weeks with Apgar, < 7 at 5 min	**Nominator:** Number of births ≥ 37 weeks with Apgar < 7 at 5 min. **Denominator:** Total number of births ≥ 37 weeks (weeks of amenorrhoea).	–	The panellists agreed that an Apgar score <7 after 5 minutes was a valid indicator in neonates born at or after 37 weeks' gestational age. This indicator was not considered relevant for babies born before 32 weeks' gestational age, in keeping with studies showing that immaturity may lead to a low Apgar score in preterm neonates who are relatively healthy.

Boulkenid R, Sibony O, Goffinet F, Fauconnier A & Branger B. 2013. Quality Indicators for Continuous Monitoring to Improve Maternal and Infant Health in Maternity Departments: A Modified Delphi Survey of an International Multidisciplinary Panel. PLos ONE 8 (4): e60663

Danish National Indicator Project

Indicator set	Indicator and description	Nominator and Denominator or calculation	Rationale	Comments on the use of indicator (if mentioned)
Danish National Indicator Project	**Anaesthesia/ pain relief** - Proportion of birth epidural/birth spinal given within one hour from prescription.	**Nominator:** Birth epidural and birth spinal given within one hour. **Denominator:** all birth epidurals and birth spinals given and requested for women with intended vaginal delivery.	Many women feel pain during delivery. Most of women want to have some kind of pain relief. Epidural analgesia is effective method for relieving the pain during delivery. When it is used the need for additional pain relief during delivery is reduced. But it increases the duration of the expulsion phase as well as the need for oxytocin stimulation. Increased risk of instrumental delivery, hypotension and urine retention has been described when epidural is used.	Indicator was considered applicable and understandable. Evidence level 5*.
	Continuous support for women in the delivery room - Proportion of women who have a healthcare professional continuously in the delivery room.	**Nominator:** Women with healthcare professional continuously present in the delivery room. **Denominator:** all women with intended vaginal delivery.	Continuous support during labour reduces duration of labour. Increases the chance of spontaneous vaginal delivery. Reduces the risk of instrumental delivery, Caesarean section and the need for medical pain relief. There may be better satisfaction with the overall birth experience if support is given.	Indicator was considered applicable, understandable and acceptable. Indicator relates to patient safety, as less intervention is expected. The definition of this indicator must be based on staff already working in the delivery departments. Evidence level 1a*.
	Lacerations, 3rd or 4th degree - Proportion of women with first time-deliveries having 3rd or 4th degree lacerations.	**Nominator:** Women with 3rd or 4th degree lacerations at first time deliveries. **Denominator:** all first time vaginal deliveries.	Rupture of the anal sphincter increases the risk of anal incontinence.	This indicator is considered applicable, understandable and generally acceptable. Evidence level 2b*.
	Caesarean section, grade 1 (life threatening situation for mother and/or fetus) - Proportion of birthing women giving birth with Caesarean section degree 1 <15 minutes from decision to delivery	**Nominator:** Caesarean section, grade 1 with delivery within 15 minutes **Denominator:** all ordinated grade 1 Caesarean sections	In relation to the newborn, delivery >30 minutes after time from decision to time of delivery (DTD) has been associated with low umbilical cord pH and increased risk of admission to NICU. Delivery <30 minutes after DTD has been associated with increased risk of intubation and of umbilical cord pH <7.00. The latter finding may be due to selection bias.	Indicator is applicable, understandable and generally acceptable. Indicator relates to an important aspect of patient safety. Evidence level 5*.
	Caesarean section, grade 2 (mother and/or fetus in danger, but situation not life-	**Nominator:** Caesarean section, grade 2 with delivery within 30 minutes.	Same as above	Same as above

	threatening) - Proportion of birthing women giving birth with Caesarean section degree 2 <30 minutes from decision to delivery	**Denominator:** all ordinated grade 2 Caesarean sections.		
	Postpartum haemorrhage - Proportion of women with post-partum haemorrhage ≥1000ml (within two hours post-partum)	**Nominator:** Women with post-partum haemorrhage ≥1000ml (within two hours post-partum) **Denominator:** all deliveries	Incidence of post-partum haemorrhage is increasing. This is an important cause of maternal morbidity and mortality.	Relates to an important aspect of patient safety. Is applicable, understandable and generally acceptable. Definition prescribes that blood loss, if possible, should be measured by weighing of sheets etc. Blood loss >500ml during parturition is often underestimated when blood loss is estimated rather than measured objectively. Evidence level 2b*.
	Establishment of skin-to-skin contact between mother and the newborn infant - Proportion of births where close contact between the mother and the newborn child is established immediately after the birth.	**Nominator:** Deliveries where skin-to-skin contact between mother and the newborn child is established (live, singleton births with Apgar score ≥ 9). **Denominator:** all deliveries (live, singleton births with Apgar score ≥ 9).	Early skin-to-skin contact has a strong positive effect for example on breastfeeding. It has also positive effect on infants body temperature after birth and infants blood glucose levels.	Is applicable, understandable and generally acceptable. Evidence level 1a*.
	Severe fetal hypoxia - Proportion of live born children with neonatal hypoxia.	**Nominator:** Live born children with severe neonatal hypoxia. **Denominator:** all deliveries. (Severe hypoxia is defined as: cb-pH <7.0. Both arterial and venous pHs are registered. The difference between the two measurements must be ≥0.03, the arterial pH being the lower. If only one measure is obtained it will usually be the venous sample, and if <7.0, the child is categorized as having severe hypoxia. If only one measure is obtained and if >7.0, the measurement is not included in the calculation. If no cb-pH is reported, Apgar score <7 at 5 minutes is considered severe hypoxia)	Cord blood-pH (cb-pH) <7.00 is associated with increased risk of neonatal death and unexplained convulsions. Convulsion risk increases with declining cb-pH <7.00. Low standard base excess (SBE) <–15mmol/l has been associated with convulsions, cardiopulmonary resuscitation, hypoxic–ischemic encephalopathy, intubation and intrauterine growth retardation. SBE shows stronger associations with the above adverse outcomes than low cb-pH.	Indicator relates to an important aspect of patient safety. Indicator was considered applicable, understandable and generally acceptable. The original suggestion for an indicator included SBE, but because many delivery units do not routinely measure SBE, it was considered impossible to implement. Evidence level 2b*.
	Delivery of a healthy child after uncomplicated delivery - Proportion of uncomplicated deliveries	**Nominator:** First time vaginal deliveries without caesarean section, vacuum extraction or forceps, episiotomy, 3rd or 4th degree lacerations, post-partum Haemorrhage ≥1000ml and Apgar score	Measuring what is normal or optimal.	Indicator is applicable, understandable and generally acceptable. The indices that have been developed internationally do not appear to be immediately transferable to Danish delivery

	with birth of a healthy child.	≥9/5. **Denominator:** all first time intended vaginal deliveries.		departments. Solution would be to measure only what is already routinely registered in connection with delivery. Later on modification of the indicator may be based on the development of a new, useful, applicable and well documented index. Evidence level 5*, but based on evidence levels 1a-5 for individual parameters.

*Group of experts assigned a level of evidence to all articles and reports based on the evidence levels suggested by the Oxford Centre for Evidence-based Medicine. These levels reach from 1-5.

Kesmodel U. S & Jølving L.R. 2011. Measuring and improving quality in obstetrics – the implementation of national indicators in Denmark. Acta Obstetricia et Gynecologica Scandinavica 90; 295–304.

EURO-PERISTAT

Indicator set	Indicators and description	Nominator and Denominator or calculation	Rationale	Comments on the use of indicator (if mentioned)
EURO-PERISTAT (updated list 2012)	C1 **Fetal mortality rate** by gestational age, birth weight, plurality	The fetal mortality rate is defined as the number of fetal deaths at or after 22 completed weeks of gestation in a given year, expressed per 1000 live births and stillbirths that same year. When gestational age is missing, Euro-Peristat requests that fetal deaths be included if they have a birth weight of 500 g or more, but not if both gestational age and birth weight are missing.	Half of all deaths in the perinatal period are fetal deaths, also called stillbirths. The causes of fetal death are multiple and include congenital anomalies, FGR, abruption associated with placental pathologies, preterm birth, and other maternal complications of pregnancy, as well as infections. Between 30 and 50% of fetal deaths remain unexplained.	Misclassification of stillbirths and neonatal deaths make it difficult to compare mortality at these early gestations. Using a lower limit of 28 weeks for the fetal mortality rate reduces the impact of terminations on reporting differences, since terminations are very rare in most countries after that point. Countries have different rules about the lower limits for gestational age and birth weight for recording fetal deaths and this complicates international comparisons. Differences in European legislation governing the lower limit for inclusion of fetal deaths make it difficult to compare rates at lower gestational ages. Computing rates by gestational age and birth weight is therefore necessary to derive valid comparable indicators when registration practices diverge. It is essential to improve information systems in Europe by developing common guidelines for recording these births and deaths.
	C2 **Neonatal mortality rate** by gestational age, birth weight, plurality	Annual and cohort deaths are of interest.. The annual neonatal mortality rate is defined as the number of deaths during the neonatal period (up to 28 completed days after birth) after live birth at or after 22 completed weeks of gestation in 2010, expressed per 1000 live births that year. If gestational-age data were missing, deaths are included if baby had a birth weight of at least 500 g. If both gestational age and birth weight were missing, the deaths were not included.	The neonatal mortality rate is a key measure of health and care during pregnancy and delivery. The principal causes of neonatal death in high income countries are congenital anomalies and complications related to very preterm birth. Babies from multiple pregnancies have neonatal mortality rates 4-6 times higher than singletons.	Comparisons of neonatal mortality rates at early gestational ages must be combined with an analysis of fetal mortality rates, because early neonatal deaths may be recorded as fetal deaths. Some data recording systems impose a lower limit of 500 g for registration of births, which can create limitations in comparing neonatal mortality rates at low gestational ages. Methodological issues related to registration are less problematic for neonatal than for fetal mortality rates. The inclusion criteria of 500g or 24 weeks used in some countries may results in lower neonatal mortality rates than in countries where there is no limit for inclusion. Differences in ethical and clinical decisions about babies born very preterm may also contribute to the disparities observed.
	C3 **Infant mortality rate** by gestational age, birth weight, plurality	Data on annual and cohort infant deaths by gestational age, birth weight, and plurality is presented per 1000 live births. The annual infant mortality rate is defined as the number of infant deaths (days 0-364) after live birth at or after 22 completed weeks of gestation in a specific year, expressed per 1000 live births in that same	The infant mortality rate, when presented by gestational age and birth weight, measures the longer-term consequences of perinatal morbidity for high-risk groups, such as very preterm and growth-restricted babies. While most infant deaths due to perinatal causes occur soon after birth, high-risk babies hospitalised in neonatal units after birth can die after the neonatal period. The principal causes of death in	Most countries provided data on infant mortality by gestational age, birth weight, and plurality, which makes it possible to monitor outcomes of high-risk births in the first year of life. Only one third of Euro-Peristat participants were able to provide data on cohort infant deaths. Routine linkage of medical birth statistics with cause-of-

		year.	the post-neonatal period include accidents and infections, which are often preventable, and the post-neonatal mortality rate is more highly correlated with social factors than is the neonatal mortality rate. Indicator serves as a measure of the quality of medical care and of preventive services.	death statistics is necessary to study outcomes of high-risk infants at the European level.
	C4 **Birth weight distribution** by vital status, gestational age, plurality	Indicator is defined as the number of births within each defined birth weight interval, expressed as a proportion of all registered live births and stillbirths. It is computed by vital status at birth, gestational age, and plurality. The indicators selected for inclusion in this summary are live births weighing less than 1500 and 2500 g.	Low birth weight is associated with 2 distinct complications of pregnancy: preterm birth and FGR. Babies with a low birth weight are at higher risk of poor perinatal outcome and of long-term cognitive and motor impairments. Macrosomia or high birth weight (4500 g and over) is also associated with pregnancy complications.	The existence of physiological variation in birth weight in Europe must be taken into consideration when interpreting differences between countries. A common European approach should be developed to distinguish between constitutionally small babies and those with growth restriction.
	C5 **Gestational age distribution** by vital status, plurality	Indicator is defined as the number of live births and fetal deaths at each completed week of gestation (starting from 22 weeks), expressed as a proportion of all live births and stillbirths. This distribution is presented as follows: 22-36 weeks of gestation (preterm births); 37-41 weeks (term births); 42 or more weeks (post-term). Preterm births can be subdivided as 22-27 weeks (extremely preterm), 28-31 weeks (very preterm), and 32-36 weeks (moderately preterm). This indicator is computed by vital status at birth and plurality.	Babies born preterm, defined as before 37 completed weeks of gestation, are at higher risk of mortality, morbidity, and impaired motor and cognitive development in childhood than infants born at term. Being born preterm predisposes children to higher risks of chronic diseases and mortality later in life. Post-term births are also associated with poor outcomes, and wide variations in rates in Europe illustrate differences in approaches to the management of prolonged pregnancies.	Gestational age is an essential indicator of perinatal health but is still not currently included in international data sets, although the data are available almost everywhere and should be routinely reported. The method of determining gestational age can influence the reported gestational age distribution; use of ultrasound estimates tends to shift the distribution to the left and increase the reported preterm birth rate, although not all studies have found this to be the case.
	C6 **Maternal mortality ratio** by age, mode of delivery	Maternal death is defined as the death of a woman while pregnant or within 42 days of the termination of pregnancy, irrespective of the duration and site of the pregnancy, for any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes. The MMR is thus the number of all maternal deaths from direct and indirect obstetric causes per 100 000 live births.	Maternal mortality is a major marker of health system performance, and overall each year from 335 to 1000 women die in Europe during and because of pregnancy or delivery. Results from severe obstetric complications and conditions that occur more frequently but without such catastrophic results. Maternal mortality ratio in Europe is low. But almost half the maternal deaths are associated with	Maternal deaths are generally under-reported. The small numbers of maternal deaths recorded result in statistical variation. To address the difficulties related to the low numbers of deaths, maternal mortality ratios may be calculated with data for the 5 years. There may also be differences in inclusion criteria, especially for indirect and late maternal deaths. Confidential enquiries and record linkage are recommended to obtain complete data on pregnancy-related deaths and also to make it possible to understand how these deaths happened and to make

			substandard care.	recommendations to prevent the recurrence of those that could have been prevented.
	C7 **Multiple birth rate** by number of foetuses	Shows the rates of twin and triplet and higher order births, expressed as numbers of women with twin and with triplet or higher-order births per 1000 women giving birth to one or more fetuses.	Compared with singletons, babies from multiple births have much higher rates of stillbirth, neonatal mortality, infant mortality, preterm birth, low birth weight, congenital anomalies, and subsequent developmental problems.	There may be variations in how multiple births in which one or more babies die before birth or registration are included in the civil registration. Multiple births are rare events and in small populations year-to-year variation and confidence intervals are relatively wide.
	C8 **Distribution of maternal age**	Distribution of age in years at delivery for women delivering a live born or stillborn baby. The recommended presentation is: 10-14, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45 and older. This summary presentation focuses on the extremes of the childbearing distribution, defined as younger than 20 years and as 35 years and older.	Both early and late childbearing are associated with higher than average rates of preterm birth, growth restriction, perinatal mortality, and congenital anomalies.	This indicator is relatively easy to access. All countries were able to provide this indicator. Some civil registration systems record the age the mother reaches during the year of birth and not her age at delivery. In some situations, age may be recorded during antenatal visits but not updated at delivery.
	C9 **Distribution of parity**	Parity is defined as the number of previous total live births and stillbirths (0, 1, 2, or 3+ births). Distribution of parity can be shown as a percentage of women with live births and stillbirths.	The incidence of maternal conditions such as hypertension and preeclampsia differs by parity, as do use of services and interventions during pregnancy, labour, and delivery, as well as health behaviour. Primiparous women are at above average risk of adverse outcomes compared with multiparous women. Risks are also higher for women of higher parity who have had many previous births (grand multiparous women).	Most countries were able to provide data on parity. But different countries may have different ways of collected data on parity. Many civil registration systems do not count previous stillbirths as a birth in the computation of parity. Attention should also be paid to the recording of previous multiple births.
	C10 **Distribution of births** by mode of delivery by parity, plurality, fetal presentation, previous caesarean section	The percentage distribution of all births, live born and stillborn, by method of delivery for all women and then subdivided by parity, previous caesarean section, presentation, and plurality. Data were also requested for caesarean sections as a percentage of births at grouped weeks of gestational age.	Rise in obstetric interventions causes concern. Consequences of the rise in caesarean rates in both high and middle income countries include elevated risks of placenta accreta, placenta praevia, placental abruption, and stillbirth in subsequent pregnancies. Countries also vary in their use of operative vaginal delivery, either with forceps or vacuum extraction. In addition to wide variations between countries, operative delivery rates also vary by parity, previous caesarean section, presentation, and plurality, so comparisons of methods of delivery according to each of these factors can be informative. In some specific situations, the need for intervention is clear. For others there is ongoing debate, for example, about the use	Method of delivery was available for everywhere except Greece. Countries differ in the ways that they classify caesarean sections. Some countries subdivide them according to whether they were undertaken before or during labour. Others use the subdivision into elective caesarean sections, which include all those planned before the onset of labour and thus include a few that take place after labour has started, and emergency or unplanned caesarean sections. In some countries cases are reported per woman and multiple births to one woman are counted only once.

			of caesarean section for breech presentation, multiple births, and women with a previous caesarean section. This lack of consensus means it is useful to highlight differences in practices.	
	R1 **Prevalence of selected congenital anomalies**	Congenital anomalies diagnosed prenatally, at birth, or within the first year of life. The Euro-Peristat indicators include 3 congenital anomaly subgroups: cleft lip (with or without palate), spina bifida, and Down syndrome.	Congenital anomalies have an important public health impact for example in terms of their effect on the quality of life of affected children and adults and their families and their contribution to fetal and infant mortality. There is a need to improve primary prevention policies to reduce environmental risk factors in the pre- and periconceptional period.	Obtaining accurate and comprehensive data on this indicator requires specific systems for ascertainment and harmonisation of definitions.
	R2 **Distribution of APGAR score at 5 minutes**	Distribution of the Apgar score for all live births at or after 22 completed weeks of gestation. There are 2 cut-off points, less than 4 and less than 7.	Both term and preterm babies with an Apgar score of 0 to 3 have a higher risk of early neonatal death. The value of the Apgar score at 5 minutes is highly correlated with neonatal mortality and provides the best predictive value for subsequent mortality.	Data were available in 70% or more of all countries providing complete or partial data. The proportion of missing values was 1% or less in most countries, excluding Finland (15.2%) where 5-minute Apgar scores are not routinely given and/or recorded if the scores at 1 minute are high. Although the Apgar score is supposed to be a standardized measure, there can be some subjectivity and differences between countries in the value recorded for each element of the Apgar score. Another difficulty is due to the counting of missing values: missing values should not be coded as 0 and then classified in the group of values of 0-3.
	R3 **Fetal and neonatal deaths due to congenital anomalies**	The percentage of fetal deaths and early neonatal deaths attributed to congenital anomalies.	Congenital anomalies are a leading cause of fetal and neonatal deaths. There are wide international variations in antenatal screening policies, regulations regarding the termination of pregnancies and its timing, and medical attitudes towards children born alive with a severe anomaly. Differences in these policies and clinical practices affect fetal and neonatal mortality rates as well as the proportion of deaths due to congenital anomalies.	The main problem is verifying that the cause of death has been attributed in the same way in all cases and that a congenital anomaly is not only present but is the underlying cause of death. Another factor that can influence the detection of an anomaly is whether an autopsy was conducted after death. In general, more deaths are attributed to this category when autopsies are performed. Some of the variation between countries may be due to differences in policies for antenatal screening and terminations for congenital anomalies. If anomalies are detected and terminated before 22 weeks of pregnancy, this should reduce the number of fetal and neonatal deaths attributed to congenital anomalies. In countries that allow terminations after 22 weeks of gestation, this policy may increase the percentage of fetal deaths due to congenital anomalies.
	R4 **Prevalence of cerebral palsy**	—	CP is the most common motor impairment in childhood. Affecting one child in 500, it is responsible for permanent lifelong activity limitations and participation	Routinely collected data on child health present many difficulties. One of the most important challenges is that systems usually are not standardised. Data stored for each child in each health system vary, not only by type, but also in

			restrictions.	quality. Obtaining accurate and comprehensive data on this indicator requires specific systems for ascertainment and harmonization of definitions.
	R5 **Maternal mortality ratio by cause of death**	Number of deaths attributed to each category of causes as a percentage of total maternal deaths. Number of deaths corresponded to the ICD-10 codes for the following causes: abortions, ectopic pregnancy, hypertension, haemorrhages, chorioamnionitis/sepsis, amniotic fluid embolisms, other thromboembolic causes, anaesthesia complications, uterine ruptures, other direct obstetrical causes, indirect circulatory causes, other indirect obstetrical causes, and unknown causes.	Patterns of causes and timing of maternal death as well as age-specific mortality ratios vary between countries with different levels of MMR. In countries with higher MMRs, a higher proportion of deaths resulted from haemorrhages and infections, whereas hypertensive disease and indirect obstetric deaths formed a higher proportion of the deaths in countries with lower MMRs. Deaths from infections and haemorrhages were more often associated with substandard care.	Data were available in 70% or more of all countries providing complete or partial data. But there are 2 sorts of limitations: firstly, the under-reporting of deaths associated with pregnancy described above and, secondly, a specific problem of application of the coding rules recommended by the WHO in the ICD. A maternal death is usually the consequence of a series of unexpected obstetric complications and possibly also adverse social circumstances that in combination lead to the death of a woman who is generally young and in good health. As a result, the choice of the underlying cause and therefore its coding to the appropriate digit code of the ICD is not easy and differs from one country to another. Better and more uniform coding and recording of the causes of maternal deaths in European countries would facilitate comparisons between countries and improve our understanding of the sequences of events that can lead to maternal death.
	R6 **Prevalence of severe maternal morbidity**	Number of women experiencing any one of eclamptic seizures, caesarean hysterectomy, embolisation, blood transfusion, or a stay of more than 24 hours in an intensive care unit as a percentage of all women with live born and stillborn babies.	The rarity of maternal death in developed countries does not mean that pregnancy is a safe condition. For every maternal death, there are many serious, even life-threatening episodes of pregnancy complications. Severe maternal morbidity occurs in approximately 1% of all deliveries.	Eclampsia and hysterectomy were the 2 complications most frequently reported by countries. There are concerns about the accuracy of the data provided. Data on the chosen complications is not at the moment routinely available from most of hospital discharge or other routine sources. Data collecting systems require further development before a comparable measure of maternal morbidity can be included in routine reporting at a European level.
	R7 **Prevalence of tears to the perineum**	Percentage of women who delivered vaginally and had a tear, by its degree of severity.	Vaginal births can be associated with some form of trauma to the genital tract, either as a consequence of tears or of episiotomy. The morbidity associated with perineal trauma is significant in the case of third- and fourth-degree tears. Although techniques have been developed to prevent third- and fourth-degree tears, the issues involved are complex, as factors including birthing positions, individual tissue quality, and the speed of labour all play a part. Higher rates of tears are associated with operative vaginal delivery, compared	There were differences between countries in the percentage of women reported to have tears. These differences should be interpreted with caution as they are likely to be a consequence of variations in completeness of recording of tears, especially for first- and second-degree tears.

			to spontaneous vaginal delivery.	
	R8 **Percentage of women who smoke during pregnancy**	Proportion of women who smoked during pregnancy among those with live born or stillborn babies. When possible, data were collected for 2 time periods: an earlier (ideally, first trimester) and a later (ideally, third trimester) phase.	Maternal smoking may be considered the most important preventable factor associated with adverse pregnancy outcomes. It can impair normal fetal growth and development and thus increase the risk of low birth weight, preterm birth, intrauterine growth restriction, and some congenital anomalies.	Not all of the countries could provide data on smoking. In many countries, the quality of data needs still to be improved.
	R9 **Distribution of mothers' education**	ISCED classification was further grouped into 3 basic categories: Primary school completed or started or no formal education (levels 0, 1), Any secondary (levels 2, 3), Any postsecondary (levels 4, 5, 6) of education.	Social disadvantage remains a major determinant of poor perinatal outcome and requires effective action. Many perinatal health indicators, including maternal mortality, preterm birth, congenital anomalies, and duration of breast feeding, are inversely related to variables that are proxy measures of social disadvantage, such as the mother's level of education and the parents' parents' occupational classification.	Many countries cannot provide data on mothers' educational levels. Further research will be required into the possibility of effectively comparing measures of education level and occupational class as it seems unlikely that the countries that do not record mothers' educational levels will do so in the near future..
	R10 **Distribution of households' occupational classification**	–	Same as above	Further research will be required into the possibility of effectively comparing measures of education level and occupational class.
	R11 **Distribution of mothers' country of origin**	Mother's country of origin should be presented in 2 ways: (1) geographic regions, classified according to the UN list of world macro regions and components, with Europe further subdivided into EU27 and other than EU27 countries, and (2) regions grouped by income level, as classified by the World Bank.	International migration to Europe may be accompanied by health disparities in perinatal outcomes between migrants and women born in receiving countries and also between groups of migrants.	Data are available in many countries to permit an analysis of health outcomes by mothers' countries or regions of birth.
	R12 **Distribution of mothers' body mass index (BMI)**	Percentage of women delivering live births or stillbirths by their pre-pregnancy body mass index (BMI). This distribution is presented as follows: <18.5 (underweight), 18.5-24.9 (normal), ≥25.0 (overweight and obese). Overweight and obese women can be subdivided as pre-obese (BMI 25.0-29.9), obese class I (BMI 30.0-34.9), obese class II (BMI 35.0-39.9), and obese class III (BMI ≥40.0).	Maternal weight before and during pregnancy can affect the course of pregnancy, its outcome, and the offspring's lifelong health. Both underweight and overweight women experience higher rates of adverse outcomes.	BMI before pregnancy is not available in most European countries. When data are reported directly from women, BMI may be underestimated, as women tend to report their weight as being lower than it actually is. This indicator should be monitored in more European countries in view of the possible changes in proportions of underweight, overweight, and obese women in the upcoming generations of women in childbearing age and the impact of these changes on perinatal health outcomes and long-term health.

	R13 **Percentage of all pregnancies following subfertility treatment**	Women with live births or stillbirths after ART can be presented as a percentage of all women with live born or stillborn babies. ART are defined as: ovulation induction, intrauterine insemination with or without ovulation induction; or in vitro fertilisation (IVF), which may include intracytoplasmic sperm injection, in vitro maturation, and frozen embryo transfer.	Children conceived using ART have a higher risk of some adverse outcomes compared with children conceived spontaneously. They tend to have higher rates of perinatal death, preterm birth, low birth weight, and congenital anomalies. These techniques are also more likely to result in multiple pregnancies, unless single embryo transfer is used.	Data were limited or could not be provided based on the Euro-Peristat definitions. The major problem with this indicator is that it is difficult to know whether the relevant information is systematically collected for all pregnancies or is noted only when the birth attendants are aware that ART were used. This problem is particularly acute for the less invasive procedures, such as ovulation induction or intrauterine insemination, because the midwife or the obstetrician managing the delivery is less likely to be aware of them.
	R14 **Distribution of timing of 1st antenatal visit**	Distribution of the trimester of the first antenatal visit can be shown per 100 women with live born or stillborn babies; the distribution also includes women who received no antenatal care.	Using this indicator in conjunction with mothers' educational level and country of birth could provide a useful basis for comparing the ability of healthcare systems to provide access to care for all pregnant women.	It is difficult to collect data about the first antenatal visit with medical birth registers because of the potential confusion between the first consultation with a health professional and the first visit to a hospital or maternity unit. Whether these first visits are recorded may also depend on the organisation of maternity care in the country. There are also differences in how timing of antenatal care is recorded.
	R15 **Distribution of births by mode of onset of labour**	Numbers of babies (per 100 live births and stillbirths) born after spontaneous onset of labour, induced labour, and caesarean section, either planned or undertaken before labour.	The high rates of obstetric intervention cause concern. There is also growing pressure by women to avoid unnecessary interventions. There is no evidence that a high rate of induction of labour increases the risk of delivery by caesarean section, either among term or post-term deliveries, provided, however, that they are undertaken in accordance with good practice guidelines. Data about the onset of labour are essential to the interpretation of data about mode of delivery.	Data were available in most of the countries, 70% or more of all countries providing complete or partial data. The definition of induction may vary between countries or even between maternity units within the same country, according to the use and timing of the procedures. These differences may have a significant impact on rates. Countries differ also in the ways that they classify caesarean sections. Some countries subdivide them according to whether they were undertaken before or during labour. Others use the subdivision into elective caesarean sections, which include all those planned before the onset of labour and thus include a few that take place after labour has started, and emergency or unplanned caesareans. The definition of induction must be harmonised within and across countries, and induction and augmentation should be clearly distinguished to improve the rigour of comparisons between countries.
	R16 **Distribution of place of birth by volume of deliveries**	Number of births occurring at home or in maternity units of various sizes and is defined by the total number of births in the same year at home, and in hospitals that had a total number of births in 2010 of less than 300, 300-499, 500-999, 1000-1499, 1500-1999, 2000-2999, 3000-3999, 4000-4999, or 5000 and over. It was also possible to include births in another category, which some countries used to classify births that	Differences in the size of populations and population density affect the organisation of maternity services. There is also an ongoing debate about the association between the size of maternity units and quality of care.	Data for this indicator are available in most countries and can thus be used to monitor trends over time, but other contextual information is needed to interpret data about births in small units. When data collection systems are hospital-based, home births may not be included, so they may be undercounted. In some countries private maternity units do not contribute to data

		take place in different types of settings, such as midwife-led units.		collection systems. Where systems cover the entire population, this indicator should be readily available and of good quality but must be interpreted, within the context of the referral system and levels of care, which are specific to each country.
	R17 **Percentage of very preterm infants delivered in units without a NICU**	Proportion of all births (live born and stillborn) between 22 and 31 weeks of gestation delivered in units without an on-site NICU.	About 1 to 1.5% of all births are very preterm, but these infants account for one third to one half of all neonatal deaths; between 5 and 10% of survivors develop cerebral palsy, and babies without severe disabilities face risks of developmental, cognitive, and behavioural difficulties in childhood at least twice as high as babies born at or closer to term. The delivery of these infants in maternity units with on-site neonatal intensive care is associated with lower mortality.	The principal difficulty in interpreting this indicator is the absence of a common definition of levels of neonatal care.. There is no common definition of on-site NICU etc. While it is easy to agree on what constitutes a tertiary or regional centre with full neonatal intensive care facilities, many countries have intermediate levels of care which provide care to many, but not all, high-risk infants. It would be useful to develop a common European classification for maternity and neonatal units to facilitate monitoring the care of these high-risk babies.
	R18 **Episiotomy rate**	Percentage of women who delivered vaginally and had an episiotomy.	The aim of an episiotomy is to prevent severe perineal tears. There have been policies of routine episiotomy instituted in some settings. Restrictive episiotomy policies can have a number of benefits compared to its routine use.	Data were available in most of the countries. Many countries have no missing data, but some data providers noted that it is not possible to distinguish between missing information and no episiotomy. The wide variation in the use of episiotomy illustrates the variability in medical practices that exists between the countries in Europe and raises questions how scientific evidence is integrated into clinical decisions.
	R19 **Births without obstetric intervention**	–	–	–
	R20 **Percentage of infants breastfed at birth**	Babies breast fed in the first 48 hours after birth are defined as: 1) the number of newborn babies who are exclusively breast fed (baby receives breast milk and is allowed to receive drops and syrups) or (2) the number of newborn babies who receive mixed food (baby receives breast milk and is allowed any food or liquid including non-human milk), or it can be defined as its opposite (3) the number of newborns who are not breast fed throughout the first 48 hours of age as a percentage of all newborn babies. Breast feeding in the first 48 hours after birth is presented as a percentage of all newborns.	Breast feeding provides benefits for babies including important nutritional advantages and improved resistance to infections.	Data were available in 19 countries or regions. Data collection in every country and greater precision and consistency in defining the modes of breast feeding are necessary to assess the efficacy of national policies and to know to what extent the recommendations to promote it are achieved.

	F1 **Severe neonatal morbidity among high risk infants**	–	–	–
	F2 **Prevalence of neonatal encephalopathy**	–	–	–
	F3 **Causes of fetal and neonatal death other than CA**	–	–	–
	F4 **Neonatal screening policies**	–	For some anomalies, antenatal diagnosis leads to better preparation of families and health services for an affected baby and can improve the care provided. For other anomalies, antenatal diagnosis is commonly followed by the option of termination of pregnancy for fetal anomaly.	Congenital anomaly screening differs across Europe.
	F5 **Content of antenatal care**	–	–	–

EURO-PERISTAT 2010. European perinatal health report. Health and Care of Pregnant Women and Babies in Europe in 2010; http://www.europeristat.com/reports/european-perinatal-health-report-2010.html [last accessed 06.02.2014]

EURO-PERISTAT 2012. List of indicators, updated 2012; http://www.europeristat.com/our-indicators/indicators-of-perinatal-health.html [last accessed 26.02.2014]

German Agency for Quality Assurance (BQS Bundesgeschäftsställe Qualitätssicherung gGmbH)

Indicator set	Indicators and description	Nominator and Denominator or calculation	Rationale	Comments on the use of indicator (if mentioned)
BQS Bundes-geschäftsställe Qualitäts-sicherung gGmbH	**Micro blood sample of fetus taken if CTG is pathological, singletons**	–	–	The definition is inaccurate. Evidence: not reported.
	Micro-blood sample taken if CTG is pathological, singletons, CS	–	–	The definition is inaccurate. Evidence: not reported.
	Presence of a pediatrician in births before 32 completed weeks	–	–	The definition is inaccurate. Evidence: not reported.
	Arterial blood gas sampling taken	–	–	The definition is accurate. Evidence: not reported.
	Acidosis in full term singletons	–	–	The definition is accurate. Evidence: not reported.
	3th or 4th degree tear in vaginal delivery, singletons	–	–	The definition is (accurate). Evidence is based on reliable data sources such as reviews on Cochrane, DARE, Clinical Evidence and on internet based sources such as ASMF, ACOG, RAND, RCOG, CDC.
	3th or 4th degree tear in vaginal delivery with episiotomy, singletons	–	–	The definition is accurate. Evidence is based on reliable data sources such as reviews on Cochrane, DARE, Clinical Evidence and on internet based sources such as ASMF, ACOG, RAND, RCOG, CDC.
	Wound complication in spontaneous vaginal delivery, singletons	–	–	The definition is accurate, but there are some data quality problems. Evidence:no.
	Wound complication in instrumental vaginal delivery, singletons	–	–	The definition is accurate* Evidence: no.

	Wound complication in Caesarean delivery, singletons	–	–	The definition is accurate, but there are some data quality problems. Evidence is based on reliable data sources such as reviews on Cochrane, DARE, Clinical Evidence and on internet based sources such as ASMF, ACOG, RAND, RCOG, CDC.
	Birth of a premature newborn with a birth weight less than 1500 g in a maternity ward without a pediatric unit	–	–	The definition is inaccurate. Evidence is based on reliable data sources such as reviews on Cochrane, DARE, Clinical Evidence and on internet based sources such as ASMF, ACOG, RAND, RCOG, CDC.

Geraedts, M & Neumann, M. 2004. Evaluation geburtshilflicher Qualitätsindikatoren - Studie im Auftrag der BQS Bundesgeschäftsstelle Qualitätssicherung gGmbH. Geburtshilfe und Frauenheilkunde. 64 (4); 375-380.

National Centre for Health Outcomes Development (NCHOD) indicators

Indicator set	Indicators and description	Nominator and Denominator or calculation	Rationale	Comments on the use of indicator (if mentioned)
NCHOD Health Outcome Indicators: Normal Pregnancy and Childbirth	1: **General health status of mother after delivery**	Summary scores from a multi-dimensional general health status instrument, modified for the population, administered at a specified time after delivery.	The use of general measures, encompassing a relatively broad conception of health status would allow a greater opportunity for the impact of childbirth to be assessed on a basis that incorporates the values of the women concerned. This contrasts with an approach based on the assessment of a necessarily limited number of specific problems, the selection of which may reflect primarily clinical concerns.	Modified versions of standard instruments such as established general health status measure may be effective, but such measures have not yet been established in a post-partum population. There are possible confounders. These are a range of demographic and socio-economic variables. Conclusion made on the indicator: This indicator needs to be further developed because indicator specification is incomplete.
	2: **Incidence of post-natal depression**	The number of women who are identified as suffering from post-natal depression, divided by total number of women. The resulting fraction should be expressed as a percentage and reported with its Nominator and denominator, with scope to subdivide by women's age.	It is estimated that around 10-15% of mothers experience a marked non-psychotic depressive illness in the early months following childbirth. Both anti-depressant drug therapy and cognitive-behavioural counselling have been shown to be effective in reducing such post-natal depression	This indicator can only provide an estimate of the true incidence of post-natal depression. Any comparisons based on this indicator will require cautious interpretation and knowledge of social factors applying in the populations under consideration. There are confounding variables, which are significantly associated with the proposed operational definition of post-natal depression: unplanned pregnancy; a lack of breastfeeding at six weeks; unemployment of the mother prior to pregnancy and/or of the head of household. The influence of these and similar variables on later Edinburgh Post-natal Depression Scale (EPDS) scores is unknown. It is proposed that post-natal depression be operationally defined with reference to the Edinburgh Post-natal Depression Scale (EPDS). Self-completion of the EDPS instrument can cause response bias because depressed women may be less likely to respond. Also the exclusion from self-completion surveys of women with visual or cognitive disabilities, or who are not English speaking, may have a systematic effect on aggregate data. Conclusion made on the indicator: To be further developed because indicator specification is incomplete, in that further work is needed on the compilation of the indicator from

				screening instruments.
	3: **Smoking among pregnant women**	A) the number of women who report smoking in the year before they became pregnant, divided by the total number of women B) the number of women smokers (as defined above) who report giving up smoking during their pregnancy, divided by the number of women who reported smoking at the start of their pregnancy C) the number of women smokers (as defined above) who report both giving up smoking during their pregnancy and not smoking at two months post-partum, divided by the number of women who reported smoking at the start of their pregnancy.	The association between smoking and adverse outcomes of pregnancy has been well established. In particular, it is a factor in intra-uterine growth retardation and is associated with the risk of miscarriage, prematurity and haemorrhage from the placenta. A recent review of pre-natal smoking cessation interventions suggests that they can be effective both in increasing smoking cessation and reducing the incidence of low birthweight	There are possible confounders and that is why proposed indicator should be made available by age and social class - most readily defined by the occupation of the woman's husband or partner. There is strong evidence that those in lower socio-economic groups are much more likely to smoke during pregnancy and find it harder to give up. A reliance on self-report has the obvious disadvantage that respondents who are smokers may be motivated to deny their habit. However, other methods, such as biomedical testing, for assessing smoking behaviour are neither practical nor ethical. Conclusions: Should be implemented where local circumstances allow by periodic survey or to be implemented generally by periodic survey.
	4: **Weekly alcohol consumption among pregnant women**	The number of women who fall within a given alcohol consumption category (defined below), divided by the total number of women.	There is general agreement that women should not drink excessively during pregnancy. However, while there is no evidence of fetal harm at levels equivalent to less than eight units per week, there is little consensus as to whether a 'safe' limit should be set and if so, at what level. Relatively simple advisory interventions may have some influence over the minority of women who drink heavily.	Socio-economic factors can influence this indicator. Socio-economic variables are likely to have a significant role in explaining variations in alcohol consumption among pregnant women. Data in collected by surveys and respondents may under-report their consumption. The resulting bias may be less important in comparative reports across similar populations. Still the reliability of self-reports of drinking during pregnancy needs to be established. Additional indicators of change in alcohol consumption during and after pregnancy would be of value. Conclusion: Should be implemented where local circumstances allow by periodic survey or to be implemented generally by periodic survey.
	5: **Illegal drug misuse among pregnant women**	The number of women who fall within a given category of illegal drug misuse (discussed below), divided by the total number of women.	Pregnant women who misuse drugs experience a wide range health problems, either specifically due to the misuse or stemming from a background of multiple social problems exacerbated by drug use The impact of drug use on maternal health can encompass infection, over-dosage, poor nutrition, and a variety of obstetric complications. The babies of mothers who have misused drugs during pregnancy may suffer withdrawal symptoms ranging from	The prevalence of drug misuse is confounded with socio-economic factors and the causal interrelationships between deprivation and drug use will complicate the interpretation of population based comparisons. Data collection in the sensitive area of illegal drug misuse is likely to present significant difficulties. Simple questionnaire-based methods are unlikely to yield accurate data in view of the illicit nature of the activities of interest. Further work is required and definition of the categories of

			mild irritability to convulsions. Additionally, maternal drug misuse is associated with an increased incidence of pre-term delivery, low birthweight and babies which are small for gestational age	illegal drug misuse is of interest. There is no available validated measurement tool and one should be developed as a matter of urgency. Development and testing of a data collection methodology need still more work. Conclusion: This indicator needs to be further developed because indicator specification is incomplete.
	6: **Incidence of domestic violence associated with pregnancy and childbirth**	The number of women who are identified as suffering domestic violence associated with pregnancy, divided by the total number of women.	Pregnancy as a trigger for violent attacks on women by their husbands or partners has been highlighted recently. In pregnancy, domestic violence endangers the health and safety of both the mother and the fetus.	There may be several different social and demographic factors that may be associated with the risk of domestic violence associated with pregnancy and the neonatal period. These are possible confounders. It is to be expected that self-reports of domestic violence will be strongly influenced by the nature of the screening process - who is asking, in what context, at what point in the pregnancy etc. The indicator specified here proposes an aggregation of data derived from a process of screening individual women. Screening for domestic violence without the provision of social support is ethically unacceptable. Further work is required in development of an operational definition of domestic violence in pregnancy and childbirth and in development of practical screening methods. Conclusion: This indicator needs to be further developed because indicator specification is incomplete.
	7: **Incidence and duration of breast-feeding**	The cumulative number of babies born within the survey period who were wholly or partially breast-fed: – to four months old – to six weeks old – to two weeks old – to one week old – initially (i.e. all babies who were put to the breast at all, even if this was on one	The benefits of breast-feeding are widely recognised, and the good evidence of its association with improved health for the baby covers a wide range of potential illness, including gastroenteritis, respiratory infection, and diabetes mellitus. Mothers should be encouraged to breast-feed, preferably for at least four months	Socio-economic variables such as social class are associated with the prevalence of breast-feeding. The use of standard descriptors of social class, duration of education and provide information about confounders. The Infant Feeding Survey obtains response rates approaching 75%, although these are achieved using up to three postal reminders. The reliability of self-reports of breast-feeding during pregnancy need still to be established. Conclusion: This indicator needs to be implemented where local circumstances allow by periodic survey or to be implemented generally by periodic survey.

		occasion only).		
	8: **Maternal mortality rate**	The number of direct, indirect and late maternal deaths per 100 000 total births.	Although the rate of maternal mortality in the UK has fallen to 9.8 per 100 000 total births for the period 1991-1996, its importance as an adverse outcome remains. Enquiry reveals that the proportion of deaths in which sub-standard care was considered a factor is substantial, implying that the rate could be reduced still further.	It is unknown whether case ascertainment is complete, depending as it does on the diagnosis of pregnancy, and the reporting of the death. However of the deaths known is possible in a very high proportion of cases. Conclusion: This indicator should be implemented generally on a routine basis.
	9: **Stillbirth, neonatal and post-neonatal mortality rates**	Number of stillbirths (fetal deaths occurring at or after 24 completed weeks' gestation) per 1000 total live and stillbirths Number of neonatal deaths (deaths of infants aged less than 28 completed days) per 1000 live births Number of post-neonatal deaths (deaths of infants aged 28 days to 365 completed days) per 1000 live births. Figures must be available in such a way that they can be tabulated by birthweight intervals of 500g; i.e. < 500g; 500-999g; 1000-1499g, etc., and by cause of death groups.	Stillbirth and infant mortality rates reflect some of the most serious adverse outcomes of childbirth. The importance of birthweight in the interpretation of perinatal mortality has been seen to be important. Also tabulation by cause of death groups will allow more detailed analysis, enabling, for example separate consideration of deaths associated with congenital abnormalities.	The risks of stillbirth, neonatal and post-neonatal deaths are influenced by a wide range of maternal factors such as age, parity, socio-economic status, ethnicity, as well as by improvements in obstetric care. These are possible confounders. Data for these indicators can be obtained from the registers. Registration data are likely to be of good quality and completeness. But it has been noted that variations in the recording of viability at birth may influence the extent of registration of live births and also neonatal mortality rates, particularly within the < 500g birthweight category. It is essential that birthweight groupings are used in the tabulation and interpretation of these indicators. Conclusion: This indicator should be implemented generally on a routine basis.
	10: **Incidence of eclampsia**	The number of women with eclampsia (both pre and post-delivery) delivering in the given year, divided by the total number of women delivering in the year. Should be expressed as a rate per 1000 women.	Eclampsia is a rare but serious complication of pregnancy. One aim of antenatal care is to detect pre-eclampsia, in the hope that the onset of serious complications (including eclampsia) can be delayed or prevented.	Possible confounders are: parity and the occurrence of multiple pregnancies. The validity of comparisons based on this indicator will be dependent on the reliability of the clinical diagnosis of eclampsia. The rarity of the event means that missing even small numbers of cases via the routine coding of diagnostic information can have a large impact on the indicator results. It may be that a dedicated 'adverse event' recording system would more easily achieve the required levels of case ascertainment. Conclusion: this indicator should be further developed

				because link with effectiveness is not clear.
	11: **Incidence of severe post-partum haemorrhage**	The number of women delivering in the given year, who suffered a major post-partum haemorrhage (PPH), divided by the number of women who delivered in the given year. The resulting fraction should be expressed as a rate per 1000.	Post-partum haemorrhage is associated with maternal morbidity and mortality, not only through the direct effects of bleeding and its consequences (e.g. acute anaemia), but also as a result of the interventions a major haemorrhage may necessitate (e.g. general anaesthesia, manual removal of the placenta or hysterectomy). The risks of post-partum haemorrhage may be influenced both by the management of the third stage of labour and the manner in which the placenta is removed following Caesarean section.	Case ascertainment is critically dependent on the completeness of routine PPH diagnostic coding. This indicator will also be influenced by the accuracy of the clinical note regarding the severity of haemorrhage. This is why a definition of 'severe' PPH needs to be developed and tested with respect to the practicality and utility of the resulting indicator. Conclusion: this indicators needs to be further developed because the indicator definition is incomplete. An operational definition of post-partum haemorrhage should be developed and tested before an indicator can be implemented.
	12: **Perineal trauma and episiotomy rates**	The number of women, delivering vaginally in the given year, experiencing a perineal tear and/or episiotomy, divided by the number of women delivering vaginally in the given year. The following classification should be used: intact perineum: no episiotomy or tear, first degree tear, second degree tear, third or fourth degree tear, episiotomy (including those to facilitate an instrumental delivery).	Perineal wounds, whether traumatic or surgical, are associated with a variety of adverse outcomes including pain, oedema, infection, and sexual dysfunction. The benefits and risks of episiotomy as a means of avoiding more severe damage to the perineum and possible cranial trauma to the neonate are still matters of research and debate.	Parity may be a possible confounder that could influence this indicator , primarily as a proxy for previous perineal trauma or episiotomy. This indicator is critically dependent on the quality of the general coding process. Furthermore the distinctions between tears of different degrees may be uncertain due to unreliability in either the clinical record or the coding process. In particular, the differentiation between third and fourth degree tears is believed to be unreliable, and the indicator definition avoids this issue by aggregating the data across this distinction. Conclusion: This indicator should be implemented generally on a routine basis.
	13: **Pain during labour and delivery**	The distribution of responses from women, delivering within the survey period, across the self-report categories of pain (a) in labour and (b) during delivery, given below.	Indicator identifies those cases where pain was not an issue because of effective intervention and also allows the derivation of a simply defined adverse outcome: a failure to prevent 'unbearable' pain. It is anticipated that the distinction between high levels of pain that are bearable as opposed to unbearable may be sensitive to interventions that seek to inform women's' expectations of pain in childbirth, and help them to develop strategies to cope with such pain.	Parity and socio-economic factors may be possible confounders that may influence this indicator. It will be important for this indicator to be analysed alongside other indicators of the mother's perception of labour, delivery and the immediate postnatal period. Conclusion: This indicator should be further developed because further work is needed on the methods of measurement. Following this further development to be implemented generally by periodic survey.

	14: **Incidence of post-natal urinary incontinence**	The number of women, delivering in the given survey period, suffering urinary incontinence at the given follow-up period post-partum, divided by the number of women delivering in the survey period. (Indicator should be presented by parity)	Urinary incontinence is a distressing and disabling condition with implications for the social, psychological, occupational, domestic and sexual lives of those it affects.	Multiparity is a possible confounder and it should be included in the indicator's definition. The validity of the indicator will depend on the quality of the GP practice data which is unlikely to be uniformly high. The source relies on a correspondence between other related services and the GP. GP´s may also have different definitions of incontinence, which will consequently effect the extent to which a problem is recorded as part of the notes. Currently there is no standard document to record this information nationally, and so local data collection systems would be required. Little information is currently available and this indicator would allow the extent of the problem to be quantified in a systematic way. Conclusion: this indicator should be implemented where local circumstances allow by periodic survey. Could possibly be recorded routinely if health visitor data collection proved to be feasible.
	15: **Incidence of post-natal faecal incontinence**	The number of women, delivering vaginally in the survey period, suffering faecal incontinence at the given follow-up period post-partum, divided by the number of women delivering vaginally in the survey period.	Faecal incontinence affects about 4% of women post-partum. Faecal incontinence can lead to significant social disablement. Among vaginal deliveries, instrumental delivery (forceps or vacuum) was the only significant obstetric risk factor identified. The prevention of faecal incontinence and the effectiveness of its treatment are additional concerns.	Parity may be a possible confounder, because it may be that subsequent vaginal delivery may exacerbate faecal incontinence due to previous anal sphincter trauma. Data capture for this indicator will require a specific survey, presumably of a sample of the relevant obstetric population. The extremely sensitive nature of the subject makes a postal survey, or other method based on a self-completed questionnaire, inappropriate. Conclusion: Development and piloting of practical data collection methods still need to be done. This indicator should be further developed because the indicator definition is incomplete. Before this indicator can be implemented, work needs to be done on developing appropriate data collection methods for this sensitive information.
	16: **Gestational age**	The distribution of gestational age within the given year, across the following categories: – extremely pre-term: gestation < 28 completed weeks	Preterm birth represents a major factor in perinatal and infant mortality. Delaying birth and prolonging gestational age may improve newborn's chances of survival and reduce the risk of subsequent morbidity. The indicator reflects the extent	A wide variety of factors are possible confounders. These factors are associated with pre-term birth, including maternal socio-demographic factors, medical complications and obstetric history. The accuracy of the routine recording of gestational age may

		– very pre-term: 28 GW ≤gestation < 32 GW – pre-term: 32 GW ≤ gestation < 37 GW – term: 37 GW (259 days) ≤ gestation < 42 GW – post-term: gestation ≤ 42 GW The resulting fractions should be expressed as percentages and reported, with their Nominators and denominators, separately for single and multiple births. In line with the WHO definition, gestational age should be measured from the first day of the last normal menstrual period.	to which the goal of term pregnancies has been achieved.	be compromised by a failure to comply with the definition of completed weeks. There is evidence that a proportion of units do not complete the gestation and the number of babies in the fields of the minimum data set for admitted patient care. Conclusion: This indicator should be implemented generally on a routine basis.
	17: **Birthweight**	The distribution of birthweight within the given year, tabulated by intervals of 500g; i.e. < 500g; 500-999g; 1000-1499g, etc. The figures should be expressed per 1000 births and reported, with their denominators, separately for single and multiple births	Many maternal behavioural and biological factors contribute to low birthweight, which in turn can increase infants' likelihood of disease and death. As an outcome statistic, the indicator reflects the extent to which the avoidance of low birthweight has been achieved.	There are possible confounders; a wide variety of factors are associated with low birthweight, including maternal socio-demographic factors such as ethnicity, medical complications and obstetric history. Birth registration data are likely to be of good quality. There is evidence that a proportion of units do not complete the gestation and the number of babies in the fields of the minimum data set for admitted patient care. Conclusion: This indicator should be implemented generally on a routine basis.
	18: **Maternal admissions to ICU**	The number of women delivering within the given year, who are admitted, for any reason related to pregnancy/childbirth, to an intensive care unit (ICU), divided by the number of women delivering within the given year. Three admission periods are relevant to this indicator are: antenatal (at any gestation), post-natal (within six weeks of the delivery), late post-natal (between six weeks and one year after the delivery).	–	There are possible confounders; a wide range of maternal and fetal predisposing factors will influence the risks faced in any given case. Cases in which a particularly high risk of complications is anticipated are likely to be over-represented among women under the care of maternity units with ready access to ICU facilities. The local availability of facilities may also influence the admission thresholds. As not all admissions within these periods will reflect such obstetric complications (e.g. admissions following a road traffic accident), individual cases will require review to exclude irrelevant admissions. Conclusion: This indicator needs to be further developed because further work is needed on the methods of measurement. Problems exist with identifying pregnancy-related admissions. Data collection methods will need to be developed to ensure all relevant admissions are captured.
	19: **Use of antenatal**	The number of women delivering in the	A policy of administering corticosteroids	The accuracy of the indicator will depend on the

	corticosteroids to enhance pulmonary maturity	given year at between 24 and 36 completed weeks (168 and 252 days) gestation who receive ante-natal corticosteroids, divided by the number of women delivering in the given year at between 24 and 36 completed weeks gestation.	to women who are expected to deliver preterm can achieve substantial reductions in neonatal morbidity and mortality.	completeness of clinical notes with respect to relevant indications, contra-indications and details of corticosteroid administration. Conclusion: This indicator should be implemented generally by periodic survey.
	20: **Mode of delivery rates**	The number of deliveries associated with each of the following modes: – spontaneous – assisted – caesarean undertaken before or at onset of labour – caesarean undertaken during labour Each of these divided by the total number of deliveries. Fractions should be expressed as percentages (with associated Nominators and denominators), and the results should be reported both for the whole population as well as by parity and separately for cephalic and breech presentations. Assisted deliveries for cephalic presentations should be further broken down between ventouse and forceps deliveries.	The mode of delivery has a potentially wide range of effects on the outcome for both mother and infant. Units with an atypical distribution of cases across delivery modes may use this fact as a starting point for the further investigation of their management of labour and delivery.	A wide range of maternal and fetal risk factors will be associated with mode of delivery. The validity of inter unit comparisons of obstetric practice with respect to delivery methods could be improved by reporting the indicator within risk factor defined case-mix groups such as the 'standard primipara'. It should be recognised that the personal preferences of the women served by a given maternity unit may also have some influence on its practice with respect to delivery method. Such preferences may vary systematically with socio-demographic variables. There is evidence that some units do not properly fill in the data set for admitted patient care. Data quality considerations make it prudent to begin data collection with a relatively crude classification, adding detail as information systems begin to demonstrate competence. Conclusion: This indicator should be implemented generally on a routine basis.
	21: **Neonatal admissions to (a) intensive and (b) special care**	The number of babies of at least 37 completed weeks (259 days) gestation who are born within the given year and admitted within seven days of birth to a special or neonatal intensive care unit for at least 48 hours, divided by the number of babies of at least 37 completed weeks (259 days) gestation born within the given year.	A high rate of admission of term babies to special care, relative to other units with a similar case-mix, may reflect suboptimal intra-partum or neonatal care.	Local provision and availability of special care facilities are likely to influence admission and discharge thresholds, and thereby the number of cases meeting the operational definition of an admission to special care. Tertiary units will have antenatal transfers of cases of congenital malformations who are likely to require neonatal unit admission. They may also take postnatal transfers of asphyxiated term babies who should not be included within these statistics. Information about admission to neonatal intensive care is adequately collected and an indicator based on it can be recommended for general implementation. Admission to special care is only recommended for implementation in local circumstances where its recording is known to be good because in many places its recording is known to be very variable Conclusion: For neonatal admissions to intensive care (21a) – this indicator should be implemented generally on a routine basis. For admissions to special care (21b) – this indicator

				should be implemented where local circumstances allow on a routine basis.
	22: **Emergency post-natal admission of mother**	The number of women delivering within the given year and subsequently admitted to hospital as emergencies, within the specified period post-partum, divided by the number of women delivering within the given year. Two follow-up periods are suggested, although others may also be relevant: – seven days post-partum – six weeks post-partum.	Unplanned re-admissions may reflect an adverse outcome of antecedent health care and/or the development of complications. With appropriate consideration of patient risk factors, re-admission rates may draw attention to aspects of the planning, organisation and delivery of care which require review.	A wide range of maternal risk factors are likely to influence the postnatal emergency admission rate. Additionally, those units with relatively long average lengths of stay for delivery episodes may have reduced re-admission rates, as complications have a greater opportunity to become apparent prior to discharge. Many questions remain about the validity and utility of this indicator and it cannot be recommended for implementation in advance of pilot testing. Conclusion: This indicator should be further developed because link with effectiveness is not clear.
	23: **Detection and treatment of rhesus iso-immunisation in pregnancy**	*Detection:* Number of women booked within the survey period for pregnancy care, who have their Rh group determined antenatally, divided by the number of women booked within the survey period for pregnancy care Number of women who are rhesus negative booked within the survey period for pregnancy care and who are screened for antibodies between 28-36 weeks gestation, divided by the number of women booked within the survey period for pregnancy care who are rhesus negative. *Treatment:* Number of women booked within the survey period for pregnancy care and who meet the criteria for anti-D immunoglobulin treatment and are so treated, divided by the number of women booked within the survey period for pregnancy care and who meet the criteria for anti-D immunoglobulin treatment.	Without prophylaxis a significant proportion of RhD-negative women who give birth to a RhD-positive baby will develop immune anti-D as a result of feto-maternal haemorrhage. The recommended practice of administering anti-D IgG postnatally in such cases, as well as following miscarriage and a range of ante-natal events associated with feto-maternal haemorrhage, has contributed to a substantial fall in deaths attributed to haemolytic disease of the newborn.	The accuracy of the indicator will depend on the completeness of clinical notes with respect to screening, its results and the administration of anti-D IgG. Conclusion: This indicator should be implemented generally by periodic survey.
	24: **Women's experience of maternity services**	A summary of women's responses to a standard questionnaire assessing their experiences of / satisfaction with the maternity services they received. Summary scores should be presented for individual parts of the maternity services,	Surveys of users' satisfaction with the services provided to them represent one practical and potentially valuable method of monitoring service and providing a basis for modifying the service. Comparisons between services or for the same service over time can be used to	A variety of socio-demographic and other factors related to obstetric history are likely to influence women's reports of their experience of maternity services. While inter-unit comparisons, particularly against norms derived from peer group units (e.g. inner city, non-teaching) may be useful, comparisons should be treated with caution.

		together with details of sampling and response rates.	highlight problem areas and guide more detailed local investigations.	The exclusion from postal surveys of women with visual or cognitive disabilities, literacy problems or who are not English speaking, for example, may have a systematic effect on results. These factors underline the need to supplement standard postal surveys with other forms of data collection. Data should be collected with a survey five to six weeks post-partum. On the basis of previous experience with the instruments discussed above, response rates of around 70% can be expected. Data on women's experience of, and satisfaction with, services are not a suitable basis for a simplistic 'league table' approach to comparisons. Conclusion: This indicator should be implemented generally by periodic survey.

Troop P, Goldacre M, Mason A, Cleary R (eds). 1999. Health Outcome Indicators: Normal Pregnancy and Childbirth. Report of a working group to the Department of Health. Oxford: National Centre for Health Outcomes Development, 1999. http://nchod.uhce.ox.ac.uk/pregnancy.pdf [last accessed 26.3.2014]

OECD – Patient safety indicators (obstetric)

Indicator set	Indicators and description	Nominator and Denominator or calculation	Rationale	Comments on the use of indicator (if mentioned)
OECD – patient safety indicators (obstetric)	**Obstetric trauma, vaginal delivery with instrument**. "Obstetric trauma with instrument" refers to deliveries using forceps or vacuum extraction **Obstetric trauma, vaginal delivery without instrument**	The two obstetric trauma indicators are defined as the proportion of instrument assisted/non-assisted vaginal deliveries with third- and fourth-degree obstetric trauma codes in any diagnosis and procedure field. Any differences in the definition of principal and secondary diagnoses have no influence on the calculated rates.	Patient safety during childbirth can be assessed by looking at potentially avoidable tearing of the perineum during vaginal delivery. Such tears extend to the perineal muscles and bowel wall and require surgery. These types of tears are not possible to prevent in all cases but can be reduced by employing appropriate labour management and high quality obstetric care.	Obstetric trauma indicators are considered as relatively reliable and comparable across countries. Differences in the consistency with which obstetric units report these complications may complicate international comparison. There may be under-reporting in the fear of litigation. Differences in data reporting across countries may influence the calculated rates of obstetric patient safety indicators. These relate primarily to differences in coding practice and data sources. Some countries report obstetric trauma rates based on administrative hospital data and others based on obstetric register.

OECD 2013. Health at a Glance 2013: OECD Indicators, OECD Publishing; http://dx.doi.org/10.1787/health_glance-2013-en [last accesses 09.03.0214]

ORYX-initiative

Indicator set	Indicators and description	Nominator and Denominator or calculation	Rationale	Comments on the use of indicator (if mentioned)
ORYX - initiative Perinatal Care Core Measure Set	PC-01 **Elective delivery** Patients with elective vaginal deliveries or elective Caesarean sections at ≥37 and < 39 weeks of gestation completed	**Nominator:** Patients with elective deliveries **Denominator**: Patients delivering newborns with ≥ 37 and < 39 weeks of gestation completed	Elective deliveries may result in significant short term neonatal morbidity. Elective inductions also result in more Caesarean deliveries and longer maternal length of stay. Elective inductions can also double the Caesarean delivery rate. Repeat elective Caesarean sections before 39 weeks gestation also result in higher rates of adverse respiratory outcomes, mechanical ventilation, sepsis and hypoglycemia for the newborns.	Variation may exist in the assignment of ICD-9-CM codes; therefore, coding practices may require evaluation to ensure consistency. In order to identify areas for improvement, hospitals may want to review results based on specific ICD-9 codes or patient populations. Data could be analysed further to determine specific patterns or trends to help reduce elective deliveries.
	PC-02 **Caesarean section** Nulliparous women with a term, singleton baby in a vertex position delivered by Caesarean section	**Nominator:** Patients with Caesarean sections **Denominator:** Nulliparous patients delivered of a live term singleton newborn in vertex presentation	There are no data that high CS rates improve any maternal or infant outcomes. This measure seeks to focus attention on the most variable portion of the CS epidemic, the term labour CS in nulliparous women. This population segment accounts for the large majority of the variable portion of the CS rate, and is the area most affected by subjectivity.	Variation may exist in the assignment of ICD-9-CM codes; therefore, coding practices may require evaluation to ensure consistency. In order to identify areas for improvement, hospitals may want to review results based on specific ICD-9 codes or patient populations. Data could then be analysed further determine specific patterns or trends to help reduce Caesarean sections.
	PC-03 **Antenatal steroids** Patients at risk of preterm delivery at ≥24 and <32 weeks gestation receiving antenatal steroids prior to delivering preterm newborns	**Nominator:** Patients with antenatal steroid therapy initiated prior to delivering preterm newborns. **Denominator:** Patients delivering live preterm newborns with ≥24 and <32 weeks gestation completed	There is a (National Institutes of Health 1994 recommendation to) to give a full course of corticosteroids to all pregnant women between 24 weeks and 34 weeks of gestation who are at risk of preterm delivery. A full course of antenatal corticosteroids should be administered to women with premature rupture of membranes (PROM) before 32 weeks of gestation. Corticosteroids could reduce the risks of respiratory distress syndrome, prenatal mortality, and other morbidities.	Variation may exist in the assignment of ICD-9-CM codes; therefore, coding practices may require evaluation to ensure consistency. It could be good to document reasons for corticosteroids given to patients in order to identify areas for improvement in antenatal steroid administration rates. Education efforts can be targeted based on the specific reasons identified.
	PC-04 **Healthcare-associated bloodstream infections in neonates** Health Care-Associated Bloodstream Infections in Newborns, like Staphylococcal and gram	**Nominator:** Newborns with septicemia or bacteremia. **Denominator:** Live born newborns	Health care-associated bacteremia is significant problem for infants admitted into neonatal intensive care units (NICUs) and other hospital units. This is especially true for very low birth weight infants who are at high risk for these infections due to their immature immune systems. Many different effective preventive measures can be taken in order to reduce these	Variation may exist in the assignment of ICD-9-CM codes; therefore, coding practices may require evaluation to ensure consistency. Discrepancies can occur between birth weights obtained from labour and delivery vs. nursery departments. Organizations should determine the most reliable source for this data

	negative septicemias or bacteremias in high-risk newborns.		infections.	element value and consistently obtain it from that source. It is important to ensure that all weight conversions from pounds and ounces to grams are accurate and concise. In order to identify areas for improvement, hospitals may want to review results based on specific ICD-9 codes or patient populations. Data could then be analysed further determine specific patterns or trends to help reduce bloodstream infections.
	PC-05 **Exclusive breast-milk feeding** Exclusive breast milk feeding during the newborn's entire hospitalization	**Nominator:** Newborns that were fed breast milk only since birth **Denominator:** Single term newborns discharged alive from the hospital	Exclusive breast milk feeding for the first 6 months of neonatal life has long been the expressed goal of World Health Organization (WHO) and it has been seen to have benefits for newborn babies.	Variation may exist in the assignment of ICD-9-CM codes; therefore, coding practices may require evaluation to ensure consistency. In order to identify areas for improvement in breast milk feeding rates, hospitals may wish to review documentation for reasons. Education efforts can be targeted based on the specific reasons identified.
	PC-05a **Exclusive breast milk feeding considering mother's choice** Exclusive breast milk feeding during the newborn's entire hospitalization considering mother's choice	**Nominator:** Newborns that were fed breast milk only since birth **Denominator:** Single term newborns discharged alive from the hospital excluding those whose mothers chose not to exclusively feed breast milk	Same as above	Same as above.

ORYX -initiative. Perinatal Care Core Measure Set; http://www.jointcommission.org/perinatal_care/ [last accessed 26.02.2014]

The Joint Commission. Specifications Manual for Joint Commission National Quality Core Measures; http://manual.jointcommission.org/releases/TJC2014A/rsrc/Manual/TableOfContentsTJC/PC_2014A.pdf [last accessed 26.02.2014]

RANZCOG/ACHS (Royal Australian and New Zealand College of Obstetricians and Gynaecologists/ and the Australian Council on Healthcare Standards

Indicator set	Indicators and description	Nominator and Denominator or calculation	Rationale	Comments on the use of indicator (if mentioned)
RANZCOG/ ACHS	Indicator 1: **Outcome of selected primipara** In the indicators 1.1 – 1.4 selected primipara is defined as a woman who is: 20 to 34 years of age at the time of giving birth, giving birth for the first time at ≥20 weeks of gestation, Singleton pregnancy, Cephalic presentation, At gestation 37 weeks to 40 weeks and 6 days.	–	The selected primipara represents pregnancies where intervention and complication rates should be low and consistent across hospitals.	Use of the selected primipara (rather than all women giving birth) as the basis for inter-hospital comparison of maternity care controls for differences in casemix and increases the validity of those comparisons.
	1.1 **Selected primipara - Spontaneous vaginal birth.** Spontaneous vaginal birth is defined as a vaginal birth (regardless of onset of labour) that is not assisted by forceps or vacuum and is not a vaginal breech delivery	**Nominator:** Number of selected primipara who have a spontaneous vaginal birth. **Denominator:** Number of selected primipara who give birth	–	–
	1.2 **Selected primipara - Induction of labour** Induction of labour is defined as surgical and / or medical induction (for more details look RANZCOG/ACHS manual).	**Nominator:** Number of selected primipara who undergo induction of labour **Denominator:** Number of selected primipara who give birth.	–	–
	1.3 **Selected primipara - Instrumental vaginal birth** Instrumental vaginal birth is defined as forceps or vacuum.	**Nominator:** Number of selected primipara who undergo an instrumental vaginal birth **Denominator:** Number of selected primipara who give birth.	–	–

	1.4 **Selected primipara - Caesarean section**	**Nominator:** Number of selected primipara undergoing caesarean section. **Denominator:** Number of selected primipara who give birth.	–	–
	Indicator 2: **Vaginal delivery following caesarean section (VBAC)**	–	With the rising caesarean section rates the issue of whether it is safe to have a vaginal birth after caesarean section (VBAC) is of high importance. Repeated caesarean section can be associated with significant morbidity for women but VBAC carries also risks, such as increased risks for the baby when compared with repeat elective caesarean section.	Rates of VBAC vary between hospitals. Research on why such variations occur and how to better select women for VBAC would be worthwhile.
	2.1 Vaginal delivery following previous birth of caesarean section	**Nominator:** Number of women delivering vaginally who have had only one previous birth ≥20 weeks gestation and that birth was by caesarean section **Denominator:** Number of women delivering by any route who have had only one previous birth ≥ 20.0 weeks gestation and that birth was by caesarean section	–	–
	Indicator 3: **Major perineal tears & surgical repair of the perineum in primipara** For the purpose of Indicators 3.1 – 3.6 the selected primipara is defined as: A woman who is 20 to 34 years of age at the time of giving birth, Giving birth for the first time at ≥20 weeks of gestation, Singleton pregnancy, Cephalic presentation , At gestation 37 weeks to 40 weeks and 6 days	–	Vaginal birth is a common cause of anal sphincter injuries in women and as such obstetric anal sphincter injury is considered a major complication of vaginal birth. It is a complication that can have a significant impact on a woman's quality of life.	–
	3.1 **Selected primipara - Intact perineum or unsutured perineal tear**	**Nominator:** Number of selected primipara with no tears within the vulva, vagina, or perineum (other than superficial grazes) **Denominator:** Number of selected	–	–

		primipara delivering vaginally		
	3.2 **Selected primipara - Episiotomy & NO perineal tear** Include all tears in the anterior and posterior compartments whether or not they are sutured and exclude superficial grazes	**Nominator :** Number of selected primipara undergoing episiotomy (as defined in the manual) and NO tears within the vulva, vagina, or perineum (other than superficial grazes) **Denominator:** Number of selected primipara delivering vaginally	–	–
	3.3 **Selected primipara - Perineal tear and NO episiotomy** Include all tears in the anterior and posterior compartments whether or not they are sutured and exclude superficial grazes. Any degree of perineal tear is included.	**Nominator:** Number of selected primipara sustaining a tear within the vulva, vagina, or perineum (other than superficial grazes) and NO episiotomy **Denominator:** Number of selected primipara delivering vaginally	–	–
	3.4 **Selected primipara - Episiotomy AND perineal tear** Include all tears in the anterior and posterior compartments whether or not they are sutured and exclude superficial grazes. Any degree of perineal tear is included.	**Nominator:** Number of selected primipara undergoing episiotomy AND sustaining a tear within the vulva, vagina, or perineum (other than superficial grazes) **Denominator:** Number of selected primipara delivering vaginally	–	–
	3.5 **Selected primipara - Third degree tear** Surgical repair is defined as suture of the perineum following delivery	**Nominator:** Number of selected primipara undergoing surgical repair of the perineum for third degree tear **Denominator:** Number of selected primipara delivering vaginally	–	–
	3.6 **Selected primipara - Fourth degree tear** Surgical repair is defined as suture of the perineum	**Nominator:** Number of selected primipara undergoing surgical repair of the perineum for fourth degree tear **Denominator:** Number of selected	–	–

	following delivery	primipara delivering vaginally		
	Indicator 4: General anaesthesia for caesarean section General anaesthetic includes women undergoing a primary general anaesthetic and includes conversions from regional to general anaesthetic where intubation is required to control the airway	–	Women who are having a caesarean section should be offered regional anaesthesia rather than general anaesthesia because it is safer and results in less maternal and neonatal morbidity.	–
	4.1 **General anaesthesia for caesarean section**	**Nominator:** Number of women having a general anaesthetic (as defined in the manual) for a caesarean section. **Denominator:** Number of women having a caesarean section.	–	–
	Indicator 5: **Antibiotic prophylaxis at the time of caesarean section**	–	An appropriate prophylactic antibiotic at the time of caesarean section, both elective and emergency, significantly reduces maternal post-operative infectious morbidity. Surgical prophylaxis should be administered even if the patient is receiving antibiotics for prolonged rupture of the membrane.	–
	5.1 **Appropriate prophylactic antibiotic at time of caesarean section** An appropriate prophylactic regimen refers to correct medication choice, route of administration and dosing schedule	**Nominator:** Number of women who receive an appropriate prophylactic antibiotic at the time of caesarean section. **Denominator:** Number of women undergoing caesarean section.	–	–
	Indicator 6: Pharmacological thromboprophylaxis & caesarean section 6.1-6.2: Planned caesarean includes all women who are ≥37 weeks gestation and the decision for delivery by	–	Thromboembolism is a major cause of maternal morbidity. Pregnancy is a risk factor for VTE (venous thrombo-embolism) and the risk is higher if the birth is by caesarean section, especially emergency (non-elective) caesarean section	The rate for this indicator will not be 100% as there will be some women where the clinician does not deem it appropriate for the patient to receive pharmacological thromboprophyl-axis. These guidelines are consensus guidelines as there is a paucity of adequately conducted trials on which to base recommendations.

	caesarean section was made prior to the onset of labour or rupture of membranes, and the principle indication for delivery by caesarean section is unchanged. All other deliveries by caesarean section are to be considered unplanned. Appropriate pharmacologic thrombo-prophylaxis means prophylaxis that is concordant with the recommendations in locally agreed guidelines			
	6.1 **Unplanned LSCS (lower uterine segment caesarean section) - pharmacological thromboprophylaxis**	**Nominator:** Number of women undergoing an unplanned lower uterine segment caesarean section who receive appropriate pharmacological thromboprophylaxis **Denominator:** Number of women undergoing an unplanned lower uterine segment caesarean section	–	–
	6.2 **Planned LSCS - pharmacological thromboprophylaxis**	**Nominator:** Number of women undergoing a planned lower uterine segment caesarean section who receive appropriate pharmacological thromboprophylaxis. **Denominator:** Number of women undergoing a planned lower uterine segment caesarean section	–	–
	Indicator 7: Postpartum haemorrhage/blood transfusion	–	Postpartum haemorrhage (PPH) is a potentially life threatening complication of birth that occurs in about 3-5% of vaginal births and it remains a leading cause of maternal morbidity and mortality.	–
	7.1 **Women requiring blood transfusion after vaginal delivery**	**Nominator:** Number of women who give birth vaginally who receive a blood transfusion during the same admission. **Denominator:** Number of women who give birth vaginally.	–	–
	7.2 **Women requiring blood transfusion after**	**Nominator:** Number of women who undergo caesarean section who receive a blood transfusion during the same	–	–

	caesarean section	admission. **Denominator:** Number of women who undergo caesarean section.		
	Indicator 8: Intrauterine growth restriction (IUGR) (birth weight < 2750 g at 40weeks gestation or beyond)	—	Severe IUGR is a major cause of perinatal mortality and morbidity with mortality increasing with IUGR in late pregnancy.	Birth weight varies with maternal height, weight, parity, ethnicity and foetal sex and it is why that is impractical to collect at present. A surrogate measure of birth weight less than 2750 grams after 40 weeks gestation is used.
	8.1 **Babies - birth weight <2,750 g at 40 weeks gestation or beyond**	**Nominator:** Number of babies born with birth weight less than 2750g at 40weeks gestation or beyond. **Denominator:** Number of babies born at 40 weeks gestation or beyond.	—	—
	Indicator 9: Apgar score < 7 at 5 min after delivery in term babies	—	Apgar score gives an understanding on the condition of the infant at specific time after the baby is born. The five minute Apgar score measures how well the infant is adapting to the new environment and is an assessment of how the baby responds to possible resuscitation.	—
	9.1 **Term babies - Apgar score of <7 at 5 minutes post-delivery** Term refers to gestation equal to or greater than 37 weeks gestation. Note: Stillbirths are excluded	**Nominator:** Number of live born term babies with an Apgar score of less than 7 at five minutes post delivery **Denominator:** Number of live born term babies born	—	—
	Indicator 10: All admissions of a term baby to special care nursery or neonatal intensive care nursery	—	Inborn term babies without birth defects are not normally expected to be admitted to a SCN (Special Care Nursery) or NICN (Neonatal Intensive Care Nursery). This indicator is included to determine whether the rate of admission of inborn term infants to SCN or NICN for reasons other than birth defects is principally due to non-avoidable factors such as adverse events.	Admissions due to congenital abnormality are excluded. Clarification from clinicians should be sought if difficulty is encountered in determining congenital abnormality.
	10.1 **Term babies - transferred or admitted to NICN or SCN**	**Nominator:** Number of inborn term babies transferred / admitted to a neonatal intensive care nursery or special care nursery (as defined above) for reasons other than	—	—

	Term refers to gestation of equal to or greater than 370 weeks gestation. Inborn baby is defined as an infant born at the reporting hospital. Note: Admissions due to congenital abnormality are excluded	congenital abnormality. **Denominator:** Number of inborn term live babies.		
	Indicator 11: **Peer review of serious adverse events**	–	Serious adverse events occur in healthcare and these may result in maternal or perinatal mortality or morbidity. A peer review process ensures that these incidents will be reviewed and the outcome evaluated with the aim of improving the safety and quality of obstetric care because it is possible to learn from serious adverse events. It would be good if serious adverse events within a healthcare would be analyzed through a formal peer review and clinical audit process to facilitate identification and introduction of any necessary improvements in safety.	–
	11.1 **Serious adverse events addressed within peer review process**	**Nominator:** Number of serious adverse events that are addressed within a peer review process. **Denominator:** Number of serious adverse events.	–	–

RANZCOG/ACHS 2013. Obstetrics indicators. Clinical Indicator User Manual for data collected in 2H2013; http://www.ranzcog.edu.au/fellows/pracrm/ranzcogachs-clinical-indicators.html [last accessed 06.02.2014]

Royal College of Obstetrics and Gynaecology

Indicator set	Indicators and description	Nominator and Denominator or calculation	Rationale	Comments on the use of indicator (if mentioned)
RCOG –clinical indicators	**Induction of labour rate -** the proportion of labours that are medically or surgically induced)	**Nominator:** induced labour is defined using the delivery onset field in the HES maternity tail. Failed induction (ICD-10 code O61) is also included in the Nominator 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.	Labour induction may be associated with poorer outcomes for women and their babies including an increased risk of emergency caesarean section when used in primiparous women at term. Concerns have also been raised about the increasing costs and the lack of attributable health benefits	Coding inconsistencies. There may be 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. Coding practices should be standardised between hospitals. There may be inadequate adjustment for case mix. 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. There may be variations as a result of clinical uncertainty and inconsistent clinical management policies between units.
	Percentage of induced labours resulting in emergency caesarean section - The proportion of women with induced labours who deliver by emergency caesarean section	**Nominator:** emergency caesarean section is defined using OPCS codes R18 and R25.1. Where OPCS delivery codes are missing (< 1% of records), the delivery method field from the maternity tail is used instead. **Denominator:** induced labours, excluding women with premature rupture of membranes (ICD-10 code O42).	Same as above	Same as above
	Percentage of spontaneous labours resulting in emergency caesarean section - the proportion of women with spontaneous onset of labour who go on to deliver by emergency caesarean section	**Nominator:** emergency caesarean section is defined using OPCS code R18 and R25.1. Where OPCS delivery codes are missing (<1% of deliveries), the delivery method 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.	Caesarean section increases the risk of maternal complications such as haemorrhage, infection, thrombosis and also the risk of uterine rupture, placenta praevia and placenta accreta in subsequent pregnancies. Neonatal complications after delivery by caesarean section include fetal respiratory distress syndrome, pulmonary hypertension, iatrogenic prematurity, and difficulty with bonding and breastfeeding. But there is also a threshold below which the caesarean delivery rate is too low and both maternal and neonatal health is compromised.	Mode of delivery is well recorded. Good-quality data were available for 152/164 hospitals. 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. 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.
	Elective caesarean section rate - percentage of all deliveries carried out by elective caesarean section	**Nominator:** elective caesarean section is defined using OPCS code R17. Where OPCS delivery codes are missing (< 1% of deliveries), the delivery method field from the maternity tail is used. **Denominator:** all deliveries	Same as above	Good-quality data were available for 147/164 hospitals. 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 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.
	Elective caesarean section performed before 39 weeks of gestation without clinical indication - the proportion of elective caesarean sections performed at less than 39 weeks.	**Nominator:** elective caesarean sections performed at less than 39 completed weeks of gestation. **Denominator:** elective caesarean sections without clinical indication. 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	Same as above	Same as above
	Instrumental delivery rate - the proportion of deliveries in which forceps or vacuum cups were used.	**Nominator:** instrumental delivery with forceps or vacuum. **Denominator:** all deliveries, excluding: elective caesarean section and emergency caesarean section before the onset of labour.	Outcomes following instrumental delivery include an increased risk of maternal pelvic floor injuries and birth trauma compared with unassisted vaginal deliveries. 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.	Indicator show widespread variation in instrumental delivery rates between hospitals even after adjustment for differences in maternal age, ethnicity, socio-economic deprivation and clinical risk factors.

	Percentage of instrumental deliveries carried out by vacuum extraction - The proportion of instrumental deliveries carried out by vacuum extraction)	**Nominator:** vacuum extraction **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.	Same as above	Indicator showed large variation in the ratio of vacuum extraction/ forceps deliveries among hospitals. 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.
	Percentage of attempted instrumental deliveries resulting in emergency caesarean section - proportion of attempted instrumental deliveries which result in emergency caesarean section	**Nominator**: failed instrumental deliveries resulting in emergency caesarean section. Failed instrumental delivery is defined using ICD-10 code O66.5. **Denominator:** all attempted instrumental deliveries (successful and failed).	Same as above	Indicator showed 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. The failed instrumental delivery rate is probably best interpreted in the context of additional data. A hospital's failed instrumental delivery rate is 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
	Rate of third and fourth degree tears among unassisted vaginal deliveries - The proportion of women with a third or fourth degree perineal tear after unassisted vaginal delivery	**Nominator:** 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.	Third and fourth degree perineal tears during vaginal delivery extend to the perineal muscles, anal sphincter and bowel wall and require surgical repair after birth. Possible complications include anal incontinence after repair as well as poorer overall quality of life. These types of tears are not possible to prevent entirely, but their likelihood can be reduced by employing appropriate labour management and care standards	The proportion of deliveries involving higher degree lacerations can be a useful indicator of the quality of obstetric care. 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. 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. 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 anesthesia and episiotomy rates
	Rate of third and fourth degree tears among instrumental vaginal deliveries as above after assisted (instrumental) vaginal delivery	**Nominator:** As above. **Denominator:** all assisted vaginal deliveries, defined using OPCS codes R21 and R22.	Same as above	Same as above The variation that can be seen 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.
	Emergency maternal readmission within 30 days of delivery - The proportion of women who are readmitted to hospital as an emergency within 30 days of delivery	**Nominator:** 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.	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. Monitoring and publishing readmission rates may highlight performance indicators that units may not be aware of.	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. Hospitals should examine their admission method coding to ensure that this indicator can be reliably calculated in future. Conflicting interpretations about the results of the indicator challenge the validity of this indicator as a measure of quality.

Knight H, Cromwell D, Van der Meulen J, Gurol-Urganci I, Richmond D, Mahmood T, Templeton A, Dougall A, Johnson S. 2013. Patterns of Maternity Care in English NHS Hospitals 2011/12. The Royal College of Obstetricians and Gynaecologists. www.rcog.org.uk [last accessed 09.03.2014]

Sweden – selected indicators from The National Board of Health and Welfare (Socialstyrelsen)

Indicator set	Indicators and description	Nominator and Denominator	Rationale	Comments on the use of indicator (if mentioned)
The National Board of Health and Welfare (Sweden) – selected indicators	**Third and fourth degree tears in primiparas** The proportion of perineal tears of grade III and IV in vaginal deliveries among first-time mothers (instrumental and non-instrumental deliveries).	**Nominator:** Number of perineal tears of third or fourth degree in the vaginal birth divided into instrumental and non-instrumental deliveries. **Denominator**: Total number of vaginal deliveries among first-time mothers.	–	Data exists and data sources are: The Swedish Medical Birth Registry at the National Board of Health and Welfare. Shortfall in reporting to the Medical Birth Registry is estimated at between 0.5 and 3 percent per year.
	Stillborn Number of stillbirths per 1000 births	**Nominator:** Number of stillbirths. **Denominator:** All children born	–	Data exists and data sources are: The Swedish Medical Birth Registry at the National Board of Health and Welfare. Shortfall in reporting to the Medical Birth Registry is estimated at between 0.5 and 3 percent per year, but is slightly higher for children who die in infancy.
	Caesarean sections among first-time mothers - Proportion of caesarean in primipara (Robson 1 and Robson 1 and 2)	**Nominator**: Number of caesarean section (Robson 1 - nullipara, singleton cephalic, ≥ 37 weeks, spontaneous labour) Number of caesarean section (Robson 1 and 2 - nullipara, singleton cephalic, ≥ 37 weeks, spontaneous labour or induced or caesarean section before labour) **Denominator**: The total number of births according to Robson 1 The total number of births according to Robson 1 and 2	–	Data exists and data sources are: The Swedish Medical Birth Registry at the National Board of Health and Welfare. Shortfall in reporting to the Medical Birth Registry is estimated at between 0.5 and 3
	Low Apgar scores - Percentage of newborns with low Apgar scores at five minutes	**Nominator:** Number of children with low Apgar score five minutes after birth. **Denominator:** Total number of live births.	–	Same as above
	Neonatal deaths - Number of infant deaths within 28	**Nominator:** Number of neonatal deaths. **Denominator:** Number of live births.	–	Same as above

	days per 1 000 live births.			
	Tobacco habits during pregnancy	**Nominator:** Number of pregnant women who smoked and / or sniffed at gestation week 30-32. **Denominator:** All pregnant women who have information on tobacco habits.	–	Data exists and data sources are: The Swedish Medical Birth Registry at the National Board of Health and Welfare. Shortfall in reporting to the Medical Birth Registry is estimated at between 0.5 and 3 percent per year. Missing data for antenatal care records, with a particular tobacco habits collected, is slightly larger (about 7%)
	Screening for risky alcohol consumption during pregnancy	**Nominator:** Number of women who were screened with the AUDIT form. **Denominator:** Number of women who gave birth during the measurement period.	The indicator is important to measure because of alcohol during pregnancy can damage the fetus.	Data exists and data sources are: National Quality register, Pregnancy registry for antenatal care. Low coverage in certain counties.
	Healthcare-associated infections in children in neonatal care - Number of infection episodes per 100 children cared for in neonatal care. Includes infection cases among both living and deceased. children.	**Nominator:** Number of confirmed or suspected infection episodes. **Denominator:** Number of children cared for (100 -number)	Different infections in newborns can quickly lead to life-threatening conditions, the indicator is important to follow.	Data exists and data sources are: National Quality register, SNQ – Swedish neonatal Quality register. There are a quite low proportion of children with infections in Sweden and it means that statistical uncertainty is high. There may also be different routines in it that to how different care units take infection tests. Loss of data can affect the reported results.
	Perinatal mortality and intrauterine death - Proportion of perinatal mortality and intrauterine death	**Nominator 1:** Perinatal mortality and intrauterine fetal death (number of cases) in diabetes (type 1 or type 2) **Denominator 1:** All children born to women with diabetes **Nominator 2:** Perinatal mortality and intrauterine fetal death (total number of cases). **Denominator 2:** All babies (singletons)	A very good glucose control during pregnancy reduces the risk of perinatal mortality and intrauterine fetal death in diabetes.	Data exists and data sources are: the Swedish Medical Birth Register and drug registry.

Above mentioned indicators are free translations from Swedish

The National Board of Health and Welfare in Sweden. 2014 Indicator registry (Indikatorbiblioteket) http://www.socialstyrelsen.se/indikatorer/sokiindikatorbiblioteket?search=graviditet&#listing [last accessed 26.03.2014]

WHO (selected indicators extracted from published databases)

Indicator set	Indicators and description	Nominator and Denominator	Rationale	Comments on the use of indicator (if mentioned)
WHO (selected indicators)	**Births attended by skilled health personnel** (%) - Number of births attended by skilled health personnel (%)	**Nominator:** The number of births attended by skilled health personnel (doctors, nurses or midwives) trained in providing lifesaving obstetric care, including giving the necessary supervision, care and advice to women during pregnancy, childbirth and the post-partum period; to conduct deliveries on their own; and to care for newborns. **Denominator:** The total number of live births in the same period.	All women should have access to skilled care during pregnancy and childbirth to ensure prevention, detection and management of complications. Assistance by properly trained health personnel with adequate equipment is key to lowering maternal deaths. The indicator is a measure of a health system's ability to provide adequate care for pregnant women.	Concerns have been expressed that the term skilled attendant may not adequately capture women's access to good quality care, particularly when complications arise. Standardization of the definition of skilled health personnel is sometimes difficult because of differences in training of health personnel in different countries.
	Births by caesarean section (%) - Percentage of births by caesarean section among all live births in a given time period.	**Nominator:** the number of women having given birth by caesarean section **Denominator:** numbers of live births.	The percentage of births by caesarean section is an indicator of access to and use of health care during childbirth. An approximate figure of less than 5% indicates that all women who are in need may not be receiving caesarean section at birth.	This indicator does not provide information on the reason for undergoing caesarean section, and includes caesarean sections that were performed without a clinical indication as well as those that were medically indicated. The extent to which caesarean sections are performed according to clinical need, therefore, is not possible to determine.
	Maternal mortality ratio - The maternal mortality ratio (MMR) is the annual number of female deaths from any cause related to or aggravated by pregnancy or its management, per 100,000 live births, for a specified year.	**Nominator:** Number of maternal deaths (excluding accidental or incidental causes) during pregnancy and childbirth or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy **Denominator:** Number of live births	Complications during pregnancy and childbirth are a leading cause of death and disability among women of reproductive age in developing countries. The maternal mortality ratio represents the risk associated with each pregnancy, i.e. the obstetric risk. It is also a Millennium Development Goal Indicator for monitoring Goal 5, improving maternal health. The indicator monitors deaths related to pregnancy and childbirth. It reflects the capacity of the health systems to provide effective health care in preventing and addressing the complications occurring during pregnancy and childbirth.	Currently, only about one third of all countries/territories have reliable data available. There are often data quality problems, particularly related to the underreporting and misclassification of maternal deaths. Therefore, data are often adjusted in order to take into account these data quality issues. Adjustments for underreporting and misclassification of deaths and model-based estimates should be made in the cases where data are not reliable. Maternal mortality is difficult to measure. Vital registration and health information systems in most developing countries are weak, and thus, cannot provide an accurate assessment of maternal mortality. Even estimates derived from complete vital registration systems, such as those in developed countries; suffer from misclassification and underreporting of maternal deaths. Because maternal mortality is a relatively rare event, large sample sizes are needed if household surveys are used. This is very costly and may still result in estimates with large confidence intervals, limiting the usefulness for cross-

				country or overtime comparisons.
	Neonatal mortality rate	Number of deaths during the first 28 completed days of life per 1000 live births in a given year or other period.	Mortality during the neonatal period accounts for a large proportion of child deaths, and is considered to be a useful indicator of maternal and newborn neonatal health and care.	The reliability of estimates of neonatal mortality depends on the accuracy and completeness of reporting and recording of births and deaths. Underreporting and misclassification are common, especially for deaths occurring early in life.
	Infant deaths - Number of infant deaths (thousands)	Number of infant deaths is the count of deaths occurring to an infant, before reaching the age of one.	Number of infant deaths measures the magnitude of child mortality.	–
	Stillbirth rate - Stillbirth rate per 1000 total births	**Nominator:** the number of stillbirths (for international comparison purposes, stillbirths are defined as third trimester fetal deaths ≥ 1000 grams or ≥28 weeks). **Denominator:** the number of total births.	Stillbirths occur antepartum or intrapartum. In many cases, stillbirths reflect inadequacies in antenatal care coverage or good quality intrapartum care.	The reliability of estimates of stillbirths depends on the accuracy and completeness of reporting and recording of births and deaths. Underreporting of stillbirths is common.
	Early initiation of breastfeeding (%) - Proportion of children born in the last 24 months who were put to the breast within one hour of birth.	**Nominator:** Children born in the last 24 months who were put to the breast within one hour of birth **Denominator:** Children born in the last 24 months	Early initiation of breastfeeding, within one hour of birth, protects the newborn from acquiring infection and reduces newborn mortality. This indicator facilitates emotional bonding of the mother and the baby and has a positive impact on duration of exclusive breastfeeding.	–
	Density of nursing and midwifery personnel per 10000 population	Number of nursing and midwifery personnel per 10000 population.	There are no gold standards for assessing the sufficiency of the health workforce to address the health care needs of a given population. It has been estimated in the World Health Report 2006 that countries with fewer than 23 physicians, nurses and midwives per 10000 population generally fail to achieve adequate coverage rates for selected primary health care interventions as prioritized by the Millennium Development Goals framework.	The method of estimation for number of nursing and midwifery personnel depends on the nature of the original data source. While much effort has been made to harmonize the data to enhance comparability, the diversity of sources means that considerable variability remains across countries and over time in the coverage and quality of the original data. Some figures may be underestimated or overestimated
	Density of physicians per 10000 population	Number of medical doctors, including generalist and specialist medical practitioners per 10000 population.	Same as above	While much effort has been made to harmonize the data to enhance cross-national comparability, the diversity of sources means that considerable variability remains across countries in the coverage, quality and reference year of the original data. Some figures may be underestimated or overestimated.

WHO indicator registry. http://www.who.int/gho/indicator_registry/en/ [last accessed 16.03.2014]

WHO OBSQID (Obstetrical Quality Indicators and Data Collection)

Indicator set	Indicators and description	Nominator and Denominator	Rationale	Comments on the use of indicator (if mentioned)
WHO OBSQID	**Intrauterine deaths** (22-27 completed weeks)	–	–	–
	Antenatal deaths (>27 completed weeks)	–	–	–
	Fetal deaths during delivery	–	–	–
	Early neonatal death (0-6 days)	–	–	–
	Late neonatal death (7-27 days)	–	–	–
	Preterm birth (<32 completed weeks)	–	–	–
	Major congenital malformations	–	–	–
	Lethal congenital malformations	–	–	–
	Apgar < 6 in 5 minutes (>31 completed weeks)	–	–	–
	Infants with RDS	–	–	–
	Neonatal seizures within 7 days	–	–	–
	Maternal deaths within 42 days	–	–	–
	Hysterectomy within 48 hours	–	–	–
	Women with blood transfusion	–	–	–

	Eclampsia (during pregnancy – 10days after delivery)	–	–	–
	Women with multiple pregnancies	–	–	–
	Multiple pregnancies detected before delivery	–	–	–
	Parturients with no prenatal visits before birth	–	–	–
	Births unattended by health care provider	–	–	–
	Caesarean sections	–	–	–
	Forceps extractions	–	–	–
	Vacuum extractions	–	–	–
	Insulin dependent diabetes mellitus	–	–	–
	Non-insulin dependent diabetes mellitus	–	–	–
	Gestational diabetes mellitus	–	–	–

Johansen K.S. & Hod M. 1999. Special communication. Quality development in perinatal care – the OBSQID project. International Journal of Gynecology & Obstetrics 64 (1999); 167-172.

Appendix 3. List of indicators

- Absence of augmentation (including external mechanical pressure on the fundus) or emergency Caesarean section
- Adverse Outcome Index (AOI)
- Anaesthesia/ pain relief
  - Anaesthesia and/or pain relief
  - Epidural analgesia use
  - General anaesthesia for caesarean section
  - Non-pharmacological (vs pharmacological) means of pain management
- Antenatal care
  - Distribution of timing of first antenatal visit
  - Content of antenatal care
- Antenatal deaths
  - Antenatal deaths (>27 completed weeks)
  - Antepartum stillbirth rate
- Antenatal steroids
- Antibiotics given after pre-labor rupture of membranes (PROM)
- Apgar score
  - Apgar < 6 in 5 minutes (>31 completed weeks)
  - Apgar 5 <7 for bodyweight ≥2500 g
  - Apgar score <5in neonates <1500g
  - Apgar score at 5 minutes distribution of
  - Apgar score of <7 at 5 minutes post-delivery in term babies
  - Apgar Score of greater than 7 at 10 minutes after delivery
- Arterial blood gas sampling taken
- Asphyxia rate
- Availability of EmOC
- Babies with a birth weight <2750 g at 40 weeks gestation or beyond
- Birth Trauma - injury to Neonate (includes major bone and organ injuries, excludes brachial plexus injuries)
- Birth weight distribution
  - Birth weight
  - Birth weight distribution by vital status, gestational age, plurality
- Births attended by skilled health personnel (%)

  - Percentage of women attended by a skilled attendant in labour
  - Percentage of women with planned vaginal birth attended by a skilled attendant in labour
- Births unattended by health care provider
- Births without obstetric intervention
- Blood transfusion
  - Blood transfusion during and/or after delivery / Women with blood transfusion / Maternal blood loss requiring transfusion
  - Blood transfusion after caesarean section
  - Blood transfusion after vaginal delivery
- Brachial plexus palsy
  - Erb's paralysis rate of
  - SD leading to BPI (shoulder dystocia leading to brachial plexus injury)
- Breastfeeding
  - Breastfeeding - decision to breastfeed at discharge
  - Breastfeeding - exclusive breast milk feeding considering mother's choice, Exclusive breast-milk feeding, Exclusive breastfeeding during birth hospitalization
  - Breastfeeding - early initiation of breastfeeding (%), Percentage of infants breast fed at birth
  - Breastfeeding – incidence and duration of breast-feeding
- Caesarean section
  - Acute Caesarean section, Caesarean section during labour
  - Caesarean section before labour
  - Caesarean section before labour in low-risk woman
  - Caesarean section during labour in low-risk woman
  - Caesarean section in selected primipara / C-section rate for low-risk first birth women / Caesarean sections among first-time mothers
  - Caesarean section rate, Total Caesarean deliveries (percentage of all deliveries), Caesarean delivery rates, Caesarean section rate, Caesarean deliveries as a proportion of all births, Births by caesarean section (%)
  - Caesarean section, grade 1 (grade 1 - life-threatening situation for mother and/or fetus)
  - Caesarean section, grade 2 (grade 2 - mother and/or fetus in danger, but situation not life-threatening)
  - Delivery of an infant <2500g following planned repeat Caesarean delivery (percentage of all planned repeat Caesarean deliveries)
  - Elective caesarean section performed before 39 weeks of gestation without clinical indication / Elective caesarean section rate
  - Nulliparous term singleton vertex (NTSV) Caesarean birth rate / Nulliparous term singleton vertex Caesarean birth (NTSV CB)
  - Percentage of spontaneous labours resulting in emergency caesarean section
  - Previous Caesarean section
  - Primary Caesarean delivery for failure to progress (percentage of primary Caesarean deliveries)

  - Primary Caesarean Delivery Rate / Primary Caesarean sections (percentage of deliveries without previous Caesarean)
  - Risk-adjusted Caesarean delivery rate
  - Risk-adjusted primary Caesarean rates, Risk-adjusted primary Caesarean delivery rates
- Case fatality rate in maternal deaths
- Causes of fetal and neonatal death other than CA (congenital anomalies)
- Causes of perinatal death
- Cerebral palsy prevalence of
- Complications of anesthesia
- Composite neonatal adverse outcome
- Congenital malformations
  - Lethal congenital malformations, Major congenital malformations
  - Prevalence of selected congenital anomalies
- Death in low-mortality diagnosis-related groups
- Delivery of a healthy child after uncomplicated delivery
- Density of nursing and midwifery personnel (per 10 000 population)
- Density of physicians (per 10 000 population)
- Detection and treatment of rhesus iso-immunization in pregnancy
- Distribution of place of birth
- Domestic violence associated with pregnancy and childbirth incidence of
- Early neonatal death (0-6 days) / Early neonatal mortality
- Eclampsia
- Elective delivery (elective vaginal deliveries or elective Caesarean sections) / Elective delivery prior to 39 weeks gestation
- Emergency postnatal admission of mother
  - Emergency maternal readmission within 30 days of delivery
  - Maternal ICU transfer and/or admission
  - Unplanned maternal return to operating room or labour and delivery
- Episiotomy
  - Episiotomy & NO perineal tear in selected primipara
  - Episiotomy AND perineal tear in selected primipara
  - Episiotomy rate
- Failure to rescue (Failure to rescue is defined as the inability of clinicians to save a hospitalized patient's life when he or she experiences a complication or a condition not present on admission or, more simply, the failure to diagnose and treat in time)
- Fetal and neonatal deaths due to congenital anomalies
- Fetal deaths

  - Fetal mortality rate (percentage of live births plus fetal deaths)
  - Fetal mortality rate by gestational age, birth weight, plurality
  - Intrauterine deaths (22-27 completed weeks)
- Fetal heart rate distribution
- Foreign body left during obstetrical procedure
- General health status of mother after delivery
- Gestational age distribution
  - Gestational age distribution
  - Gestational age distribution by vital status and plurality
- Healthcare-associated bloodstream infections in neonates / Healthcare-associated infections in children in neonatal care
- Households' occupational classification distribution of
- Hypoxic-ischemic encephalopathy prevalence of
- Hysterectomy
  - Hysterectomy within 48 hours
  - Postpartum hysterectomy rate
- Induction
  - Induced labour or elective Caesarean section, percentage of women Percentage of women with induced labour or undergoing elective Caesarean section
  - Induced labours resulting in emergency caesarean section (percentage of)
  - Induction of labour
  - Induction of labour in selected primipara
  - Delivery of an infant <2500g following induction of labor without a listed medical indication (percentage of deliveries induced without listed medical indications)
- Infant deaths
  - Infant mortality rate
  - Infant mortality rate by gestational age, birth weight, plurality
- Infants with RDS
- Instrumental deliveries
  - Forceps extractions
  - Instrumental deliveries resulting in emergency caesarean section / Failed instrumental delivery leading to CS
  - Instrumental vaginal birth in selected primipara
  - Instrumental vaginal deliveries / Rate of medically assisted deliveries / Forceps or vacuum assisted delivery
  - Vacuum extractions
- Intact perineum
  - Intact lower genital tract (ILGT)

- Intact perineum or unsutured perineal tear in selected primipara

- Intrapartum group B streptococci prophylaxis
- Intrapartum neonatal deaths
  - Intrapartum neonatal death ≥2500 g
  - Intrapartum stillbirth rate / Fetal deaths during delivery
- Long term outcome of the high risk infants
- Maternal age distribution
- Maternal death
  - Maternal mortality ratio (MMR) / Maternal deaths within 42 days
  - Maternal mortality ratio by age, mode of delivery
  - Maternal mortality ratio by cause of death
- Maternal satisfaction
  - Women's satisfaction with perinatal health care
  - Women's experience of maternity services
- Maternal social-cultural background distribution
- Maternal support
  - Continuous support for women in the delivery room
  - Maternal support - support to women in the perinatal period which includes (1) emotional support, including intimacy, reassurance and the ability to confide in or rely on another, (2) informational support, that is, providing information and advice and (3) instrumental support, involving aid and services that can include gifts, financial assistance, household help.
  - Presence of a companion at birth
- Maternal use/abuse of drugs or alcohol
  - Illegal drug misuse among pregnant women
  - Weekly alcohol consumption among pregnant women
- Met need for emergency obstetric care. Emergency obstetric care (EmOC) refers to the functions necessary to save lives. These functions include: parenteral antibiotics, parenteral oxytocic drugs, parenteral anticonvulsants for pre-eclampsia and eclampsia, manual removal of placenta, removal of retained products, assisted vaginal delivery, surgery, blood transfusions
- Micro blood sample of fetus
  - Micro blood sample of fetus taken if CTG is pathological, singletons
  - Micro-blood sample taken if CTG is pathological, singletons, CS
- Mode of delivery rates
- Mother with diabetes
  - Gestational diabetes mellitus
  - Insulin dependent diabetes mellitus
  - Non-insulin dependent diabetes mellitus
- Mother's education / Distribution of mothers' education

- Mothers body mass index / Distribution of mothers' body mass index (BMI)
- Mothers' country of origin /Distribution of mother's country of origin
- Multiple birth rate
  - Women with multiple pregnancies
  - Multiple birth rate by number of fetuses
  - Multiple pregnancies detected before delivery
- Near miss / Severe maternal morbidity
- Neonatal deaths
  - Late neonatal death (7-27 days)
  - Neonatal mortality /Neonatal mortality rate
  - Neonatal deaths (750-999g)
  - Neonatal mortality rate by gestational age, birth weight, plurality
- Neonatal encephalopathy prevalence of
  - Neonatal encephalopathy prevalence
  - Term infants with diagnosis of hypoxic encephalopathy or seizure (percentage of term infants)
- Neonatal screening policies
- Neonatal seizures within 7 days
- Neonates with massive aspiration syndrome (percentage of all neonates)
- Newborns still hospitalized 7 days after delivery
- NICU admissions
  - Admission to neonatal intensive care unit > 1 day, bodyweight ≥2500 g and gestational age ≥37 wks
  - Neonates transferred from a non- NICU hospital
  - Neonatal admissions to intensive care
  - Neonatal admissions to special care
  - Rate of non-low-birth-weight neonates admitted to the NICU
  - Term babies - transferred or admitted to NICN or SCN
  - Term infant admitted to NICU excluding infants with major congenital anomalies
- Nosocomial infection of surgical site
- Nuchal translucency measurement during the first trimester of pregnancy
- Number of caregivers involved in prenatal and natal care (number of midwives, residents, GP's and obstetricians.
- Obstetric trauma
  - Fourth degree tears in selected primipara
  - Obstetric trauma (3^{rd} or 4^{th} degree lacerations) - vaginal delivery without instrument

- Obstetric trauma (3rd or 4th degree lacerations) - vaginal delivery with instrument /Rate of third and fourth degree tears among instrumental vaginal deliveries
- Obstetric Trauma (3rd or 4th degree lacerations) - Caesarean Delivery
- Perineal tear and NO episiotomy (selected primipara)
- Perineal trauma and episiotomy rates
- Rate of third and fourth degree tears among unassisted vaginal deliveries
- Third and fourth degree tears in primiparas
- Third degree tears in selected primipara
- Third or fourth tear in vaginal delivery in singletons
- Lacerations 3rd or 4th degree (percentage of vaginal deliveries) / Prevalence of tears to the perineum / Third- and fourth-degree perineal laceration / Severe perineal tears / Severe perineal laceration / Prevalence of trauma to the perineum / Obstetric trauma / Proportion of births with third or fourth-degree lacerations / Obstetric anal sphincter injuries (OASIS)
- Third or fourth degree tear in vaginal deliver where episiotomy has been used

- Obstructed labour
- Onset of labour
  - Distribution of births by mode of onset of labour
- Pain during labour and delivery
- Parity
  - Distribution of parity
- Parturients with no prenatal visits before birth
- Peer review of serious adverse events
- Perinatal deaths (percentage of live births plus fetal deaths)
  - Perinatal mortality rate
  - Perinatal deaths due to congenital anomalies
- Peripartum infection
- Postnatal depression incidence
- Postnatal faecal incontinence incidence
- Postnatal urinary incontinence incidence
- Postoperative haemorrhage or hematoma
- Postoperative Sepsis
- Postpartum haemorrhage
  - Postpartum haemorrhage
  - Postpartum haemorrhage ≥ 1000 ml / Incidence of severe postpartum haemorrhage
- Postpartum hospital stay
- Post-term deliveries (gestational age beyond 42 weeks)

- Preeclampsia rate
- Preterm birth
  - Preterm birth (<32 completed weeks)
  - Preterm births (Women delivered ≤37 and ≥34 weeks)
- Preterm deliveries in units without NICU
  - Infants < 1800g delivered in a non-NICU hospital
  - Very preterm infants delivered in units without a NICU
  - Birth of a premature newborn with a birth weight less than 1500 g in a maternity ward without a pediatric unit
- Prophylactic antibiotics for Caesarean delivery / Appropriate prophylactic antibiotic at time of caesarean section
- Prophylactic use of oxytocin in the third stage of labour
- Proportion of all births in emergency obstetric care (EmOC) facilities
- Respirator treatment
- Selected infections due to medical care
- Severe fetal hypoxia
  - Severe fetal hypoxia rate
  - Arterial cord pH
  - Acidosis in full term singletons
- Severe maternal morbidity
- Severe neonatal morbidity among high risk infants
- Severity index (SI) describes the severity of the outcomes.
- Skin-to-skin contact
  - Skin-to-skin contact of mother and baby for at least 30 minutes within the first hour after birth
  - Establishment of skin-to-skin contact between mother and newborn infant
- Smoking during pregnancy
  - Percentage of women who smoke during pregnancy
  - Smoking Tobacco habits during pregnancy
- Spontaneous vaginal birth (selected primipara)
- Stillbirth rate
  - Total stillbirths /Stillborn
  - Term intrapartum stillbirths
- Sub-fertility treatment
- Systematic assessment of cardiotocography (CTG)
- Three-marker screening performed during the first trimester of pregnancy
- Thromboembolic prophylaxis in women undergoing Caesarean delivery

    - Pharmacological thromboprophylaxis in unplanned LSCS (lower uterine segment caesarean section)
    - Planned LSCS - pharmacological thromboprophylaxis
- Transfusion reaction
- Umbilical artery pulsatile index
- Use of a non-supine position for birth
- Use of a partogram
- Uterine rupture
- Vaginal birth after Caesarean delivery (VBAC)
    - Vaginal Birth after Caesarean Rate, All
    - Vaginal Birth after Caesarean Rate, Uncomplicated
- Vaginal sampling in the 9th month to screen for Streptococcus group B carriage
- Venous thromboembolism rate
- Weighted Adverse Outcome Score. WAOS describes the adverse event score per delivery
- Wound complication
    - Wound complication in Caesarean delivery, singletons
    - Wound complication in instrumental vaginal delivery, singletons
    - Wound complication in the spontaneous vaginal delivery, singletons