



**Centre for Maternal and Child Enquiries**

*Improving the health of mothers, babies and children*



# **The CEMACH/OAA Diabetes Project: A national audit of anaesthetic records and care for women with type 1 or type 2 diabetes undergoing caesarean section**

**A joint report of CMACE and the OAA**

**June 2010**

Issued as part of the Confidential Enquiry into Maternal and Child Health (CEMACH) Programme

## **CMACE Mission statement**

Our aim is to improve the health of mothers, babies and children by carrying out confidential enquiries and related work on a nationwide basis and by widely disseminating our findings and recommendations.

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The findings contained in this report represent the views of CMACE. They were arrived at after a careful consideration of the available evidence. They do not override healthcare professionals' individual responsibility to make appropriate decisions in the circumstances of the individual patient, in consultation with the patient and/or guardian or carer.

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# Contents

<b>Abbreviations</b>	<b>ii</b>
<b>Glossary of terms</b>	<b>iii</b>
<b>Foreword</b>	<b>viii</b>
<b>Acknowledgements</b>	<b>ix</b>
<b>1 Introduction</b>	<b>1</b>
<b>2 Key findings</b>	<b>2</b>
<b>3 Key recommendations</b>	<b>4</b>
<b>4 Methodology</b>	<b>5</b>
<b>5 Description of women and babies in project</b>	<b>7</b>
<b>6 Pre-operative record</b>	<b>9</b>
<b>7 Intra-operative record</b>	<b>18</b>
<b>8 Post-operative record</b>	<b>28</b>
<b>9 Overall qualitative assessment</b>	<b>29</b>
<b>10 Conclusions</b>	<b>30</b>
<b>References</b>	<b>32</b>
<b>Appendix 1: Assessment questionnaire</b>	<b>35</b>
<b>Appendix 2: Contemporary anaesthetic standards</b>	<b>40</b>
<b>Appendix 3: CEMACH/OAA committee, co-ordinators, reviewers and assessors</b>	<b>42</b>
<b>Appendix 4: Standardisation policy</b>	<b>44</b>
<b>Appendix 5: Management of intubation</b>	<b>46</b>

## Abbreviations

AAGBI	Association of Anaesthetists of Great Britain and Ireland
ASA	American Society of Anesthesiologists
BMI	Body Mass Index
CEMACH	Confidential Enquiries into Maternal and Child Health (now CMACE)
CEMD	Confidential Enquiries into Maternal Deaths
CMACE	Centre for Maternal and Child Health Enquiries
CSE	Combined spinal and epidural anaesthesia
ECG	Electrocardiogram
GA	General Anaesthesia
GMC	General Medical Council
HES	Hospital Episode Statistics
IDDM	Insulin dependent diabetes mellitus
IQR	Interquartile range
NCEPOD	National Confidential Enquiries into Peri-operative Deaths
NHS IT	National Health Service Information Technology
NOAD	National Obstetric Anaesthetic Database
OAA	Obstetric Anaesthetists' Association
RCA	Royal College of Anaesthetists
RCOG	Royal College of Obstetricians and Gynaecologists

# Glossary of terms

<b>Acidosis</b>	Increased blood or tissue acidity
<b>Adrenaline</b>	A drug that constricts blood vessels; it is used to support the circulation or to reduce local anaesthetic absorption
<b>Airway pressure</b>	The pressure of air in the lungs
<b>Alfentanil</b>	An opioid analgesic (See Opioid/opiate)
<b>Anaesthetic vapour</b>	A general anaesthetic (see volatile anaesthetic agent)
<b>Antacid</b>	A drug that neutralises stomach acidity
<b>Antiemetic</b>	A drug that may stop vomiting
<b>Aortocaval occlusion</b>	This describes the occluding effect of the pressure of the uterus and baby on the major blood vessels in the abdomen
<b>Arterial blood gas</b>	A blood sample taken from an artery is used to determine the acidity of the blood, the levels of carbon dioxide, oxygen, and bicarbonate
<b>ASA score</b>	A medical risk grading system for anaesthesia <sup>25</sup>
<b>Atracurium</b>	A neuromuscular blocking drug (see Neuromuscular block)
<b>Base excess</b>	Base excess and base deficit refer to an excess or deficit, respectively, of the amount of base present in the blood. The value is usually reported as a concentration in units of mEq/L, with positive numbers indicating an excess of base
<b>Bicarbonate</b>	One of the important chemical buffers necessary to maintain normal acid-base balance in the body
<b>Body Mass Index</b>	An individual's weight in kilograms divided by the square of their height in metres, used in the assessment of obesity
<b>Bradycardia</b>	A slow heart rate
<b>Capnography</b>	Monitoring of the concentration of carbon dioxide (CO <sub>2</sub> ) in the respiratory gases
<b>Carboprost (Hemabate)</b>	A prostaglandin which stimulates the uterus to contract, used to treat excessive uterine bleeding
<b>Central line</b>	A central venous line is a catheter placed into a large vein in the neck, chest or groin. It is used to administer medication or fluids, obtain blood samples and directly measure the central venous pressure
<b>Central venous pressure</b>	See Central line
<b>Citrate</b>	A chemical that reduces stomach acidity

<b>Colloid</b>	Colloid intravenous solutions contain suspended particles that stay in the blood stream for longer than crystalloid solutions
<b>Congenital anomaly</b>	A physical or biochemical malformation which is present at birth
<b>Coronary heart disease</b>	Narrowing of the small blood vessels that supply blood and oxygen to the heart muscle (myocardium)
<b>Cricoid pressure</b>	This manoeuvre may prevent regurgitation during endotracheal intubation. Pressure is applied to the part of the windpipe known as the cricoid cartilage
<b>Crystalloid</b>	Water-based intravenous solutions of mineral salts or other water-soluble molecules, designed to match the blood plasma
<b>Diastolic blood pressure</b>	See Systolic blood pressure
<b>Diazepam</b>	A drug to relieve anxiety
<b>Dysrhythmia</b>	An irregular heart rate
<b>Electrocardiography</b>	A noninvasive trans-thoracic interpretation of the electrical activity of the heart over time captured and externally recorded by skin electrodes
<b>Ephedrine</b>	An adrenaline-like drug to treat a low blood pressure associated with anaesthesia
<b>Epidural anaesthesia</b>	An injection and/or infusion into the epidural space (outside the dura mater, the outer most of the membranes which ensheath the spinal cord) using a needle or plastic catheter
<b>Ergometrine</b>	A drug that stimulates the uterus to contract. It is used to treat excessive bleeding after childbirth
<b>Essential hypertension</b>	High blood pressure for which no specific cause can be found
<b>Extubation</b>	Extubation is the removal of the orotracheal tube
<b>Fentanyl</b>	An opioid analgesic (See Opioid/opiate)
<b>Fresh frozen plasma</b>	The fluid portion of human blood that has been centrifuged, separated, and frozen to preserve clotting factors
<b>Gelofusin</b>	A type of colloid solution (see Colloid)
<b>General anaesthesia</b>	A variety of drugs are given to the patient that have different effects with the overall aim of ensuring unconsciousness, reducing nervous reflexes and muscle movements and pain relief
<b>H<sub>2</sub> antagonist</b>	A group of drugs that act as antacids
<b>Hartmann's solution</b>	A type of crystalloid solution (see Crystalloid)
<b>High dependency unit</b>	A place in hospital where critical care is given without artificial respiration

<b>Hydrocortisone</b>	A steroid drug
<b>Hypersensitivity reaction</b>	An inappropriate and excessive reaction by the body's immune system to a substance perceived as foreign
<b>Ileostomy</b>	A surgical opening constructed by bringing the end or loop of small bowel out onto the surface of the skin
<b>Incisor gap</b>	See Interdental distance
<b>Insulin sliding scale</b>	Intravenous insulin and dextrose infusions with a set of instructions for adjusting the dose of insulin on the basis of blood glucose test results
<b>Intensive care unit</b>	A place in hospital where critical care is given and which can support artificial respiration
<b>Interdental distance</b>	The distance between the front teeth with the mouth fully open, also known as the incisor gap
<b>Interquartile range (IQR)</b>	The spread of a set of values between which 25% (25 <sup>th</sup> centile) and 75% (75 <sup>th</sup> centile) of these values lie
<b>Intubation/endo-tracheal intubation</b>	Tracheal intubation is the placement of a flexible plastic tube into the trachea (windpipe) to protect the patient's airway and provide a means of mechanical ventilation. Orotracheal intubation is preferred in obstetrics where, with the assistance of a laryngoscope, an endotracheal tube is passed through the mouth, larynx, and vocal cords, into the trachea. A bulb is then inflated near the distal tip of the tube to help secure it in place and protect the airway from blood, vomit, and secretions
<b>Isoflurane</b>	An inhaled volatile anaesthetic drug
<b>Laryngoscopy</b>	A view of the larynx and vocal cords (voicebox) through which the windpipe may be intubated (see above for tracheal intubation)
<b>Median</b>	The value of the middle term of a series when the items are arranged in numerical order
<b>Metoclopramide</b>	A drug to prevent vomiting
<b>Myocardial ischaemia</b>	Lack of oxygen in the myocardium (see coronary heart disease)
<b>Nasogastric tube</b>	Used in nasogastric intubation, involving the insertion of a plastic tube through the nose, past the throat, and down into the stomach
<b>Neonatal death</b>	Death of a live born baby before 28 completed days after birth
<b>Nephropathy</b>	A disease affecting the kidneys
<b>Neuromuscular block</b>	Neuromuscular blocking drugs block neuromuscular transmission at the neuromuscular junction, causing paralysis of muscles
<b>Neuropathy</b>	Any pathology or disorder of the peripheral nerves
<b>Normoglycaemia</b>	A normal blood glucose concentration

<b>Opioid/opiate</b>	A drug, used in medicine for reducing pain (opiates are derived from opium)
<b>Orogastric tube</b>	An orogastric tube is used in orogastric intubation involving the insertion of a plastic tube through the mouth, past the throat, and down into the stomach
<b>Oxygen saturation</b>	Oxygen saturation, commonly referred to as "sats", measures the percentage of haemoglobin binding sites in the bloodstream occupied by oxygen. Healthy individuals usually exhibit oxygen saturation values between 97% and 99%
<b>Pharynx</b>	The pharynx is the part of the neck and throat situated immediately behind the mouth
<b>Phenylephrine</b>	An adrenaline-like drug; one of its uses is to treat low blood pressure associated with anaesthesia
<b>Placental abruption</b>	A condition where all or part of the placenta has separated from the uterine wall, disrupting the flow of blood and oxygen to the fetus
<b>Pre-eclampsia</b>	A condition characterised by hypertension and proteinuria (protein in the urine) presenting for the first time after 20 weeks pregnancy
<b>Pre-oxygenation</b>	A patient is given oxygen to breathe before general anaesthesia in order to fill the lungs with oxygen
<b>Propofol</b>	A drug given intravenously for general anaesthesia
<b>Proton pump inhibitor</b>	A group of drugs that act as antacids
<b>Pulse oximetry</b>	A non-invasive method of measuring the oxygen saturation of arterial blood
<b>Range</b>	The difference or interval between the smallest and largest values in a frequency distribution
<b>Ranitidine</b>	An antacid
<b>Rapid sequence induction</b>	This procedure is designed to be used during intubation of the trachea. It is generally used for patients who have an increased risk of inhaling stomach contents into the lungs and necessitates cricoid pressure
<b>Regional block/regional anaesthesia</b>	Anaesthesia characterised by the loss of sensation in a circumscribed region of the body, produced by the application of a regional anaesthetic, usually by injection. The techniques include epidural anaesthesia and spinal anaesthesia
<b>Salbutamol</b>	Used to dilate the bronchioles in the lungs, also relaxes the uterine muscle

<b>Spinal anaesthesia</b>	Spinal anaesthesia involves injecting a local anaesthetic, commonly with other drugs such as opioids, into the cerebrospinal fluid through the dura mater (see Epidural anaesthesia)
<b>Stillbirth</b>	Legal definition: a child that has issued forth from its mother after the 24 <sup>th</sup> week of pregnancy and which did not at any time after being completely expelled from its mother breathe or show any other signs of life (Section 41 of the Births and Deaths Registration Act 1953 as amended by the Stillbirth Definition Act 1992)
<b>Suxamethonium</b>	A neuromuscular blocking drug (see Neuromuscular block)
<b>Syntocinon</b>	A synthetic form of oxytocin that stimulates the uterine muscle to contract
<b>Systolic blood pressure</b>	Blood pressure is a force exerted by circulating blood on the walls of blood vessels. It varies between a maximum (systolic) and a minimum (diastolic) pressure
<b>Thiopentone</b>	A drug given intravenously for general anaesthesia
<b>Thyromental distance</b>	The distance between the thyroid cartilage and the mental prominence
<b>Tracheostomy</b>	A tracheostomy opens a direct airway through an incision in the neck into the windpipe
<b>Type 1 diabetes</b>	There is an absolute deficiency of insulin production, due to autoimmune destruction of the insulin-producing beta cells in the islets of Langerhans in the pancreas. It accounts for 5 – 15% of all people with diabetes
<b>Type 2 diabetes</b>	There is a relative deficiency of insulin production, and/or the insulin produced is not effective (insulin resistance). It accounts for 85% - 95% of all people with diabetes
<b>Ulcerative colitis</b>	A form of inflammatory bowel disease
<b>Vital signs</b>	Measures of various physiological statistics, usually including pulse rate, blood pressure, respiratory rate and body temperature
<b>Volatile anaesthetic agent</b>	A drug that is vapourised to pass into the lungs and produce general anaesthesia

# Foreword

Diabetes mellitus affects a large and growing number of women of childbearing age. Diabetic pregnancies are of importance to anaesthetists for a variety of reasons, not least because of the increased likelihood of requiring anaesthetic intervention at delivery. The multisystem nature of the disorder requires careful evaluation of the impact of co-morbidities such as hypertension, myocardial ischaemia, neuropathies and obesity. In addition to the usual considerations for mother and baby, the anaesthetist needs to pay particular attention to the maintenance of normoglycaemia. Meticulous anaesthesia is the cornerstone of a successful outcome.

The CEMACH enquiry<sup>1</sup> into diabetic pregnancies in 2002/03 identified over 3,800 pregnancies. This showed that 36% of diabetic women were delivered preterm and 67% were delivered by caesarean section. The data collected for this present enquiry provides a wealth of information about the anaesthetic management of mothers with diabetes. This publication concentrates on the standards of documentation of anaesthesia for caesarean section. This cohort has become the largest national audit of anaesthetic records and is based on professional guidelines from the Royal College of Anaesthetists, the Association of Anaesthetists of Great Britain and Ireland and the Obstetric Anaesthetists' Association (OAA). It reflects 2002 practice. In order to close the audit loop it could be re-assessed in 2012. The findings are equally relevant to documentation of anaesthetic processes for all specialties and highlight the need for improvement.

The work of CEMACH is enthusiastically followed by obstetric anaesthetists. The widened remit from purely dealing with deaths to dealing with health issues and its liaison with professional societies, in this case the OAA, is greatly welcomed. The involvement of Academic Foundation doctors (Dr Katharine Medlow) is also refreshing. Nevertheless the voluntary time and expertise given by so many professionals to undertake assessments and contribute to committees is a great testament to the standing of CEMACH. In common with other CEMACH publications the use of vignettes brings home the messages in a memorable way, making objective data illustrative of the clinical situation.

The output of this project will be a useful reference for future studies; it identifies what parts of the record were considered of value by anaesthetists, what standards were kept and what needs to be improved. The standard of record-keeping for elective caesarean section, where there is time for adequate assessment and preparation, was below that expected and this may be the first area on which to focus for improvements. Although good care may have been delivered its documentation is important for communication between professionals and for review at a later date, be it for a future pregnancy or medico-legal purposes.

It is surprising that there is currently a dearth of evidence for the management of diabetes at caesarean section on which anaesthetists can base their practice. For this reason a wide variety of approaches to glycaemic control were found, varying from control and monitoring carried out entirely by the mother to that involving intravenous insulin and dextrose regimes managed by medical staff. The occurrence of diabetic ketoacidosis highlights the dilemma of whether to prioritise resuscitation or delivery.

The findings of this report reach beyond obstetric anaesthetists. Research funding bodies and patient interest groups are obvious targets because of the need for a wider evidence-base in this area. Others who would benefit from reading the report outside the anaesthetic profession include the Department of Health, NHS IT, obstetricians, Chief Executives in the NHS and patient organisations, operating department technicians, pre & post-operative staff and midwives.

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### **Reference**

1. *Confidential Enquiry into Maternal and Child Health: Pregnancy in Women with Type 1 and Type 2 Diabetes in 2002-03, England, Wales and Northern Ireland*. London: CEMACH; 2005

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# 1 Introduction

In 2002 the Confidential Enquiry into Stillbirths and Deaths in Infancy (CESDI), one of the two predecessor organisations of the Confidential Enquiry into Maternal and Child Health (CEMACH), agreed to collaborate with the Obstetric Anaesthetists' Association (OAA) to evaluate standards of anaesthetic care of women with type 1 or type 2 diabetes undergoing caesarean section who had been identified during the national CEMACH Diabetes Programme.

The principal aim of the project was to assess standards of care pertaining to the anaesthetic management of women with type 1 or type 2 diabetes whose delivery method was by caesarean section, by quantitative and qualitative assessment of the anaesthetic records to determine anaesthetic management against generic professional guidelines for anaesthetic records.<sup>1-6</sup> Revised guidelines have since been published but there have been no significant changes relevant specifically to caesarean section in women with type 1 or type 2 diabetes.<sup>7,8</sup>

No specific anaesthetic standards existed in 2002 for anaesthetic management or anaesthetic records of women with type 1 or type 2 diabetes during caesarean section. These women are in a high risk category and also have a high caesarean section rate, so it was deemed important to examine their care.

Patients with type 1 or type 2 diabetes are recognised to have specific medical risk factors for anaesthesia, such as nephropathy, neuropathy and coronary heart disease.<sup>9</sup> The project included an assessment of the degree to which these risk factors were anticipated by anaesthetists, and the effect of risk factors in this project on outcome.

Links were made between the data collected in the project and previously collected CESDI and CEMACH Diabetes Programme data to provide additional maternal and neonatal information including outcome.

In focussing not only on aspects of diabetes care but also on generic standards of anaesthetic care, many of the findings of this project have broader implications for obstetric anaesthetic management in general such as airway assessments, maternal and fetal monitoring and tests for regional nerve blockade.

In July 2009, CEMACH became an independent charity, with the new name "Centre for Maternal and Child Enquiries" (CMACE). CMACE's remit continues to be the improvement of maternal and child health. It continues to carry out national maternal and perinatal mortality surveillance and confidential enquiries as part of CEMACH programme. This is funded by the National Patient Safety Agency (NPSA) for England and Wales, the Department of Health, Social Services, Public Safety of Northern Ireland and the States of Jersey and Guernsey. Since the inception of this work, National Health Service Quality Improvement Scotland (NHS-QIS) has become a full participant in the maternal enquiry and the Isle of Man in the CEMACH programme.

## 2 Key findings

These findings relate to the anaesthetic records of 1282 women with type 1 or type 2 diabetes undergoing caesarean section in England, Wales and Northern Ireland between 1<sup>st</sup> March 2002 and 28<sup>th</sup> February 2003.

### 2.1 General

- Sixteen percent (201/1282) of caesarean sections did not have the grade of urgency recorded.
- American Society of Anesthesiologists' (ASA) score was documented in 61% (785/1282) of cases.

### 2.2 Choice of anaesthetic technique

- Spinal anaesthesia was the most commonly planned and administered form of anaesthesia for caesarean section.
- Almost all epidural anaesthetic techniques occurred in emergency caesarean sections, probably due to previous insertion of epidural anaesthesia for labour.
- General anaesthesia was used for 18% (118/658) of emergency and 7% (31/423) of elective caesarean sections.
- Five percent (58/1166) of regional anaesthetics were converted to general anaesthesia.
- Only 41% (71/173) of general anaesthetics administered were identified as planned pre-operatively to be the intended anaesthetic technique.

### 2.3 Preparation for general anaesthesia

- There was wide variation in the standard of documented pre-operative airway assessments, with 33% (428/1282) having no documented assessments.
- Intubation aids were used in 16% (27/173) of cases.
- There was widespread lack of documented use of preparations to prevent pulmonary aspiration of stomach contents.

### 2.4 Management of Diabetes

The anaesthetic record included documentation of:

- Type of diabetes for 42% (523/1234) of women documented as having diabetes
- Pre-operative blood glucose measurements for 33% (423/1282) of women
- Intra-operative blood glucose monitoring for 29% (373/1282) of women
- Intra-operative administration of intravenous insulin for 28% (365/1282) of women (of these, 45% (165/365) had intra-operative blood glucose monitoring).

### 2.5 Intra-operative assessment and monitoring

- Level of block was tested in 74% (864/1166) of caesarean sections where a regional block was carried out.
- Capnography was not documented in one general anaesthetic record.
- Oxygen saturation levels were recorded in 93% (1198/1282) of all anaesthetic records.

## **2.6 Post-operative care**

- Fifty four percent (698/1282) of anaesthetic records for women with type 1 or type 2 diabetes undergoing caesarean section included instructions for post-operative care.
- Of the postoperative care records 64% (445/698) included post-operative instructions specific for patients with type 1 or type 2 diabetes.

## **2.7 Documentation and medical assessment overall**

Reviewing anaesthetic records as a proxy for standards of anaesthetic care, the assessors considered that:

- anaesthetic documentation was substandard overall in 31% (399/1282) of records
- medical assessment (including diabetes assessment) was substandard in 52% (669/1282) of cases
- cases demonstrating substandard assessment of anaesthetic documentation frequently demonstrated other unacceptable features, for example 13% (50/399) had no record of intra-operative oxygen saturations and 91% (362/399) were assessed as having overall substandard medical assessment.

## 3 Key recommendations

### Documentation on Anaesthetic Records

3.1 Anaesthetists should adhere to published standards for anaesthetic documentation, including those published by:

- The Royal College of Anaesthetists
- The Association of Anaesthetists of Great Britain & Ireland
- The Obstetric Anaesthetists' Association.

### Design of Anaesthetic Record Forms

#### Specific for diabetes

3.2 Printed or electronic documentation should record the specific needs and risk assessment of anaesthesia for pregnant women with type 1 or type 2 diabetes and their babies, including:

- Pre-operative blood glucose level
- Insulin and dextrose infusions
- Blood glucose monitoring
- Instructions for post-operative management of diabetic mother and baby.

#### General for anaesthesia

3.3 Printed anaesthetic record forms should be designed to enable full documentation including:

- specific prompts for key information, such as age, body mass index, blood pressure, fetal heart rate, ASA (American Society of Anesthesiologists) grade and preparations for anaesthesia, including tracheal intubation
- a prompt for urgency of caesarean section
- sufficient space for freehand recording of the anaesthetist's pre-operative medical assessment
- instructions for post-operative care developed by multidisciplinary teams.

#### Electronic anaesthetic records

3.4 Electronic anaesthetic records should be designed to:

- allow pre-population of anaesthetic records in order to increase the accuracy of documentation and decrease anaesthetic workload
- have built in flexibility so they can be adapted for non-standard operations and patients with specific medical requirements
- provide tailored templates for
  - caesarean section operations
  - pre-, intra- and post-operative care of patients with specific co-morbidities
- be printed on standard sized paper matching other hospital records in order to facilitate filing of important clinical information and clinical audit.

## 4 Methodology

The CEMACH/OAA Diabetes Project is a national clinical audit of anaesthetic records for caesarean section in women with type 1 or type 2 diabetes. It included all women identified as having type 1 or type 2 diabetes in the CEMACH Diabetes Programme database who delivered by caesarean section between 1<sup>st</sup> March 2002 and 28<sup>th</sup> February 2003 inclusive.

A feasibility study was undertaken in the CEMACH North East Region in 2004 to determine how best to obtain the anaesthetic records for each woman in the project. The records were obtained by an obstetric anaesthetic consultant and collated by the regional CEMACH office.

A questionnaire (Appendix 1) was developed through piloting<sup>10</sup> to enable standardised assessment of the anaesthetic records based on predefined anaesthetic standards of care (Appendix 2). The questionnaire contained specific questions on pre-operative care, intra-operative management and post-operative instructions as well as qualitative questions on the overall record. In the light of recommendations in CEMACH's Saving Mothers' Lives 2003-2005 report, specific questions relating to maternal weight and body mass index were included.<sup>11</sup>

The OAA appointed 15 obstetric anaesthetic consultants (Appendix 3) as regional anaesthetic co-ordinators, who were responsible for retrieving anaesthetic records for the 11 CEMACH regions. Five obstetric anaesthetic consultants formed a central administrative email-based committee.

The regional anaesthetic co-ordinators liaised with NHS trusts' obstetric anaesthetic departments to retrieve the medical notes, photocopy anaesthetic records, forward the photocopied records to the CEMACH regional manager and follow up all missing cases. The prescription sheet was not requested. Only the anaesthetic record and the print-out of any electronic anaesthetic monitoring system were part of the assessment. The CEMACH regional manager supplied the regional anaesthetic co-ordinator with a list of all relevant cases in the region and, when anaesthetic records were obtained, removed identifiable data. Wherever possible the grade of anaesthetist and obstetrician for the caesarean section were retained when their names were removed.

The CEMACH central office collated all anaesthetic records, each of which had a unique identifier in order to allow linkage with the CEMACH Diabetes Programme database. Thirty-one obstetric anaesthetic assessors (at consultant, staff and associate specialist and specialist registrar grades) were recruited nationally through OAA mailings and provided with written instructions on methodology for the assessment. On first review of the records the CEMACH central office sent between 20 and 70 records to each assessor over a period of six months.

The records were then reviewed by a central team of five obstetric anaesthetic consultants and junior doctors, working in pairs, who reviewed the photocopied records together with the original assessor's questionnaire results. More than one central assessor scored each case and made the qualitative assessments. The central assessors represented all grades of anaesthetists. In order to reduce transcription errors, the data for each record was entered directly onto an ACCESS computer database at the time of re-review. CEMACH prepared the ACCESS database form and linked the tabulated data to the CEMACH Diabetes Programme database. Data analysis was performed using Queries to the ACCESS database.

### **Standards for questionnaire assessment**

The generic anaesthetic standards used for this project were contemporary standards published by the Royal College of Anaesthetists (RCA), the Association of Anaesthetists of Great Britain & Ireland (AAGBI) and the OAA.<sup>1-6</sup> These standards are summarised in Appendix 2.

The standard of the anaesthetic records were considered as a surrogate for actual standards of care, rather than purely an assessment of record keeping per se, as commonly used by the General Medical Council (GMC) when assessing performance.

### **Limitations of the study**

Anaesthetic records for each woman were reviewed but not the full medical records or prescription charts, due to time and financial constraints of the project. It is recognised that a retrospective review of the anaesthetic record without access to full medical notes may not give a fully accurate picture of the actual standard of care. In order to achieve maximum objectivity, the questionnaire was designed so that the majority of items were from quantifiable data and it was only in the overall quality assessment of the record that subjective items were measured.

Where there were a number of different entries by anaesthetists that indicated a positive response to an item, none was excluded e.g. obesity was accepted as recorded where there was a record of actual weight or body mass index or simply the word 'obese'. This lack of precision was inevitable because anaesthetic records are not standardised.

Following the first review of records, some sections of the project questionnaire were found to be incomplete and in some instances information was recorded that the data input manager could not interpret. Additionally there were some errors of data input noted during data analysis. In order to overcome these limitations the anaesthetic record was re-reviewed and data entered directly into the database.

During the assessment process it was noted that specific information may have been recorded by the anaesthetist at the time but the relevant part of the anaesthetic record had not been supplied to the assessors. For example, within a group of similar anaesthetic records, a few had missing pages; in other cases print-outs (often slips of paper) of electronic monitoring systems referred to in the record were not provided. In scoring the latter it was considered that full monitoring had probably been used, although specific parameters were only recorded as monitored where there was definite evidence of this. Furthermore, during the re-review of all records a standardisation policy was adopted. The policy is set out in Appendix 4.

### **Process of developing recommendations**

The central administrative committee developed draft recommendations based on the findings of the project. These were sent out to the anaesthetic assessors for feedback and then finalised by the central committee.

## 5 Description of women and babies in project

The CEMACH Diabetes Programme identified an overall caesarean section rate of 67% in women with type 1 or type 2 diabetes.<sup>12, 13</sup> The OAA project focussed on women delivering between 1<sup>st</sup> March 2002 and 28<sup>th</sup> February 2003. During this period 1533 women with type 1 or type 2 diabetes in England, Wales and Northern Ireland had a caesarean section. The CEMACH/OAA Diabetes Project collected data on 1282 of 1533 eligible cases (84% response rate). Difficulty with retrieval of anaesthetic records was the main cause of missing data and this varied between regions. Some hospitals failed to locate medical records while others submitted records from other operations or submitted an incomplete record.

Of the women included within the CEMACH/OAA Diabetes Project, 75% (965/1282) of women were identified from the CEMACH Diabetes Programme database as having type 1 diabetes and 25% (317/1282) of women as having type 2 diabetes. These proportions were comparable with the full CEMACH Diabetes Programme cohort of 3,733 women with type 1 or type 2 diabetes in which 73% were identified as having type 1 diabetes and 27% as having type 2 diabetes.<sup>12,13</sup>

Table 1 shows the ages for women with type 1 or type 2 diabetes in the CEMACH/OAA Diabetes Project compared with all women undergoing caesarean section in the general maternity population.<sup>14,15</sup> The median (interquartile [range]) age for the women in the project was 31 (27, 35 [16-48]) years (Table 1). While the age distribution of women with type 1 diabetes undergoing caesarean section was similar to the general maternity population, there was a higher proportion of women with type 2 diabetes over 35 years compared to the general maternity population. This is consistent with the full cohort of 3733 women in the CEMACH Diabetes Programme where women with type 2 diabetes tended to be older than women with type 1 diabetes.<sup>12</sup> Higher maternal age is associated with an increased risk of essential hypertension, pre-eclampsia and placental abruption<sup>16, 17</sup> and previous reports by CEMACH and one of its predecessor organisations, the Confidential Enquiry into Maternal Deaths (CEMD), have shown increasing maternal mortality with maternal age.<sup>18, 19</sup>

**Table 1. Age of women with type 1 or type 2 diabetes undergoing caesarean section compared to women undergoing caesarean section in the general maternity population**

Age (years)	CEMACH/OAA Diabetes Project		General Maternity Population	
	Type 1 diabetes N=965 n (%)	Type 2 diabetes N=317 n (%)	RCOG <sup>a</sup> 2001 <sup>14</sup> N=156025 (3 month period)%	NOAD <sup>b</sup> 2003 <sup>15</sup> N=7794 %
<20	45 (5)	1 (<1)	7	7
20-24	121 (13)	13 (4)	17	} 88
25-29	255 (26)	48 (15)	28	
30-34	338 (35)	110 (35)	30	
35-39	162 (17)	109 (34)	14	
40+	43 (4)	36 (11)	2	5
Data not available	1 (<1)	0 (0)		

<sup>a</sup> Royal College of Obstetricians and Gynaecologists Clinical Effectiveness Support Unit

<sup>b</sup> National Obstetric Anaesthetic Database

Twenty-nine percent (369/1282) of women were primigravid. This compares with 40% (1507/3808) in the full CEMACH Diabetes Programme cohort.<sup>12</sup> Two percent (32/1282) of women had multiple births. There were no maternal deaths in the CEMACH/OAA Diabetes Project.

The ethnicity of women with type 1 or type 2 diabetes in the CEMACH/OAA Diabetes Project was 83% White, 4% Black, 10% South Asian, <1% Chinese and 3% 'Other' or 'Not known'. This compares with proportions of 80%, 6%, 10%, <1% and 3% respectively in the full CEMACH Diabetes Programme cohort.

A total of 7.0% (90/1316) of babies had a confirmed congenital anomaly, 1.3% (17/1316) were stillbirths and 1.0% (13/1316) were neonatal deaths. This compares to rates of 4.2%, 2.7% and 4.1% for congenital anomalies, stillbirths and neonatal deaths respectively for women in the full CEMACH Diabetes Programme cohort who gave birth during the same period, and to rates in the general maternity population during 2002-03 of 2.1%, 0.6% and 1.2% respectively.<sup>12, 20, 21</sup> The differences seen in babies in the project are likely to be due to differences in clinical circumstances: babies with a congenital anomaly may be more likely to require caesarean section, while caesarean would not normally be carried out for babies diagnosed to have died in utero, and babies dying in the neonatal period are likely to include very preterm gestations following spontaneous preterm labour.

## 6 Pre-operative record

The questionnaire sought evidence of compliance with pre-operative professional standards as listed below and in Appendix 2<sup>1,3</sup>

“It is particularly important to record complete information during a Caesarean section in a clear and rational way. This is because medical and legal enquiry following this procedure is more common than for many other procedures and the exact timing of events may be critical.”  
Royal College of Anaesthetists 2000<sup>1</sup>

Assessment of risk factors should include documentation of the following: date of assessment, assessor, weight (height optional), basal vital signs, medication, allergies, addiction, previous general anaesthetics, family history, potential airway problems, prostheses, teeth, crowns, investigations, cardio respiratory fitness, other problems, ASA grade ± comment...and anaesthetic checks e.g. nil by mouth, consent, premedication  
Association of Anaesthetists of Great Britain and Ireland 1998<sup>3</sup>

### 6.1 Recording urgency of caesarean section

A 4-point grading system to classify urgency of caesarean section was published in 2000<sup>22</sup> and this was adopted by the Royal College of Obstetricians and Gynaecologists in 2001.<sup>14</sup> In 2002 these grades had not been consistently adopted by all maternity units, and the older more commonly used system of ‘elective’ and ‘emergency’ grades of urgency was therefore used for this project. Where the new grades were recorded on the anaesthetic record, Grade 4 was scored as elective and Grades 1-3 as emergency. In addition some charts recorded urgency according to the NCEPOD definitions (from ‘emergency’ to ‘scheduled’); for consistency this was also converted to an elective or emergency grade (see Appendix 4).<sup>23</sup>

#### Box 1 Urgency classification of caesarean section<sup>22</sup>

Grade 1	Immediate threat to life of woman or fetus
Grade 2	Maternal or fetal compromise which is not immediately life-threatening
Grade 3	Needing early delivery but no maternal or fetal compromise
Grade 4	At a time to suit the patient and maternity team

In 16% (201/1282) of caesareans, the urgency of the procedure was not recorded. Sixty one percent (658/1081) of caesareans with a degree of urgency recorded were emergency and 39% (423/1081) were elective (Table 2). These proportions are comparable with those recorded in the CEMACH Diabetes Programme<sup>12</sup> and to the general maternity population.<sup>24</sup>

**Table 2. Recorded urgency of caesarean section in women with type 1 or type 2 diabetes compared to general maternity population**

Grade of Urgency	Women with type 1 or type 2 diabetes		General maternity population		
	CEMACH/OAA Diabetes Project N=1282 n (%)	CEMACH Diabetes Programme <sup>12</sup> N=2340 n (%)	HES England & Wales 2002-03 <sup>24</sup> N=120600 n (%)	RCOG 2001 <sup>14</sup> N=33579 n (%)	NOAD 2003 <sup>15</sup> N= 8900 n (%)
Emergency	658 (51)	1305 (56)	69600 (58)	20984 (62)	5414 (61)
Elective	423 (33)	1035 (44)	51000 (42)	12564 (37)	3476 (39)
Unknown grade	201 (16)	0 (0)	0 (0)	33 (<1)	10 (<1)

### 6.2 ASA scores (medical risk for anaesthesia)

Women presenting for caesarean section were graded according to medical risk for anaesthesia using the American Society of Anesthesiology (ASA) grading system.<sup>25</sup> The ASA grade is a composite summary of data based on the patient's notes and clinical examination and hence may reflect a more detailed medical assessment than that documented on the paper record.

#### Box 2 ASA scores for assessing risk in women with type 1 or type 2 diabetes

Grade 1	a fit healthy person who has no medical conditions e.g. pregnant women without type 1 or type 2 diabetes
Grade 2	a mild disorder e.g. treated type 1 or type 2 diabetes without complications
Grade 3	type 1 or type 2 diabetes with moderately severe diabetic complications
Grade 4	identifies serious medical risks
Grade 5	describes a patient who is moribund

The ASA score was recorded in 61% (785/1282) of cases. Of these, 5% (38/785) were recorded as ASA 1. Since these were all women with type 1 or type 2 diabetes, this scoring was incorrect. Seventy eight percent (613/785) of cases were recorded as ASA 2, 17% (132/785) as ASA 3 and <1% (2/785) as ASA 4 (described as Case Reports 1 and 2). No women were recorded as ASA Grade 5.

#### Reports of ASA Grade 4 cases

##### Case 1

An obese (140kg) woman with type 2 diabetes presented at 37 weeks gestation for an emergency caesarean section because of necrotising fasciitis of the abdominal wall. Her temperature was 37.1°C and she was recorded as being 'acidotic'. A pre-operative maternal arterial blood gas showed a pH of 7.203 and base excess of -14.3mmol/l. Her creatinine was recorded as raised. The planned management recorded general anaesthesia, surgery in main theatres and intensive care treatment to follow. The airway assessment was a 'tick' written against the word teeth. A central line was in situ. Two consultants and two specialist registrars were involved in pre-oxygenation and a rapid sequence induction with cricoid pressure and endotracheal intubation. The patient was positioned to the left with a wedge under the right buttock and active warming was commenced. Full monitoring was recorded including temperature, central venous pressure and invasive arterial blood pressure. The surgeons proceeded with excision of abdominal wall and caesarean section. After an hour syntocinon was administered (presumably at the time of delivery) as well as carboprost (Hemabate) and calcium chloride. Blood loss was not recorded on

the anaesthetic chart but 5 units of packed blood cells were given and one unit of fresh frozen plasma. The systolic blood pressure was recorded as above 100mmHg at all times. There was no recording of blood glucose before or during the operative period. Neither dextrose nor insulin administration was recorded on the anaesthetic chart.

*The assessment scores of standards of care for this patient based on the scoring system described below in "Overall Qualitative Assessment" and Appendix 1 where 1 = excellent care and 6 = appalling care were:*

- 2 for anaesthetic documentation (question 22)
- 3 for medical assessment (question 23).

#### *Case 2*

A gravida 14 woman with type 1 diabetes recorded as having 'multiple medical problems' presented for a 'scheduled' caesarean section. She had insulin dependent diabetes, asthma, epilepsy and a body mass index of 35 kg/m<sup>2</sup>. She had a tracheostomy in situ. A consultant with two junior anaesthetists planned a spinal anaesthetic. Intravenous access was described as 'appalling' and central venous access failed despite using ultrasound. Two 18G cannulae were placed. There were two attempts at spinal anaesthesia with success using a 27G needle. The level of regional nerve blockade was not recorded. The patient was placed supine with monitoring and supplemental oxygen administered. Systolic blood pressure varied between 100 and 200 mmHg and heart rate was above 140 beats/min except for a bradycardia of 35 after 400 mcgs of phenylephrine. This episode was recorded as a critical incident. An intra-operative blood glucose was recorded as 6.1 mmol/l and an infusion of human actrapid was running at 1u/h together with gelofusin and normal saline. No dextrose infusion was recorded. Post-operative instructions asked for non-invasive blood pressure, oxygen saturation, blood glucose monitoring and high dependency unit care.

*The assessment scores of standards of care for this patient based on the scoring system described below in "Overall Qualitative Assessment" and Appendix 1 where 1 = excellent care and 6 = appalling care were:*

- 4 for anaesthetic documentation (question 22)
- 5 for medical assessment (question 23)

### **6.3 Seniority of staff**

In this cohort of women with type 1 or type 2 diabetes, the lack of documentation of grade of anaesthetist prevented us from reliably establishing the seniority of anaesthetists caring for women of ASA Grade 3 or 4. The appropriate use of staff skills and seniority should be considered at all levels of patient care based on medical and anaesthetic risk.

### **6.4 Pre-operative history and investigations**

Assessors sought evidence of attention to history and investigations during pre-operative assessment. In particular, assessors sought records of type of diabetes, blood pressure, body mass index (BMI), weight or obesity, biochemistry, blood glucose and diabetes complications. Recording of this data is detailed in Tables 3a and 3b.

Ninety-six percent (1234/1282) of cases were recorded on the anaesthetic chart as having diabetes. Of these, 42% (523/1234) had the type of diabetes recorded. It is important to note that there are different potential co-morbidities associated with each type of diabetes which may be relevant to the anaesthetic care planned e.g. neurological dysfunction with type 1 and obesity with type 2 diabetes.

Only nine percent (115/1282) of women with type 1 or type 2 diabetes having a caesarean section had their electrolyte results noted and only 33% (423/1282) had a blood glucose concentration recorded pre-operatively on the anaesthetic chart. In 26% (339/1282) of records a designated prompt for one or more electrolyte results was printed on the form, but the results were not recorded. Pre-operative insulin administration (regular medications or a pre-operative sliding scale) was recorded in 89% (1140/1282) of women. It was noted that five records recorded the diabetes as 'diet controlled'.

**Table 3a. Pre-operative assessment charted on anaesthetic record of women with type 1 or type 2 diabetes undergoing caesarean section**

<b>Women with type 1 or type 2 diabetes undergoing caesarean section (N=1282)</b>				
	<b>Documented</b>	<b>Not documented and prompt box left blank</b>	<b>Not documented and no prompt box</b>	<b>Data not available</b>
	<b>n (%)</b>	<b>n (%)</b>	<b>n (%)</b>	<b>n (%)</b>
<b>Physical Characteristics</b>				
Blood Pressure	315 (25)	671 (52)	290 (23)	6 (<1)
Body mass index or weight	235 (18)	776 (61)	265 (21)	6 (<1)
Obesity noted (if body mass index or weight not recorded)	80 (8% of remaining 1047)	22 (2% of 1047)	901 (86% of 1047)	44 (4% of 1047)
<b>Biochemistry</b>				
Biochemistry recorded	115 (9)	339 <sup>a</sup> (26)	819 (64)	9 (<1)
Potassium	105 (8)	337 (26)	818 (64)	22 (2)
Urea	94 (7)	305 (24)	861 (67)	22 (2)
Creatinine	98 (8)	305 (24)	857 (67)	22 (2)
Bicarbonate or base excess	10 (<1)	22 (2)	1241 (97)	9 (<1)
<b>Blood Glucose</b>	423 (33)	105 (8)	743 (58)	11 (<1)

<sup>a</sup> One or more prompt boxes left blank

Obesity is a known risk factor for anaesthesia.<sup>11, 26, 27</sup> Contemporary professional standards required weight to be recorded prior to anaesthesia.<sup>3</sup> However, only 25% (315/1282) of women either had their weight or BMI recorded, or it was recorded that they were obese.

Diabetes complications sought were limited to recognised complications with a possible impact on anaesthetic management. Overall 12% (151/1282) of women had complications specific to diabetes documented on the anaesthetic record. In a further 7% (84/1282) of women the anaesthetist had sought specific diabetes complications, found none and recorded this.

**Table 3b. Diabetes and specific diabetes complications charted on anaesthetic record of women with type 1 or type 2 diabetes undergoing caesarean section**

Women with type 1 or type 2 diabetes undergoing caesarean section N=1282 n (%)	
<b>Record of Diabetes</b>	
Diabetes recorded	1234 (96)
<i>Type of diabetes recorded</i>	523/1234 (42)
<b>Diabetes Complications</b>	
Complications recorded	151 (12)
Nephropathy	29 (2)
Neuropathy	7 (<1)
Of which, autonomic neuropathy	1 (<1)
Retinopathy	38 (3)
Poor glycaemic control	92 (7)
Coronary artery disease	0 (0)
Other <sup>a</sup>	15 (1)
Recorded that there were no complications	78 (6)

<sup>a</sup> Other diabetes complications recorded included history of diabetic ketoacidosis, pyelonephritis, leg ulcer, peripheral vascular disease, pericardial effusion (secondary to nephrotic syndrome) and cataracts.

### 6.5 Airway assessment

Airway assessment is especially important in individuals with diabetes as they may develop 'stiff joint' syndrome that can affect the atlanto-axial joint limiting neck extension and so causing difficulty with tracheal intubation.<sup>28</sup> Regional techniques may need to be converted to general anaesthesia, so airway assessment is important even if a regional technique, with the mother awake, is planned. In the CEMACH/OAA Diabetes Project 5% (58/1166) of regional anaesthetics were converted to a general anaesthetic. Mallampati described a simple airway assessment test which is graded according to the amount of pharynx visible (1 being the most and 4 being the least).<sup>29</sup> Whilst not perfect as a predictor of expected difficult intubation it is a reasonable guide and will help alert the anaesthetist to be prepared for difficulty. Airway assessment is particularly important in pregnancy as the Mallampati score tends to increase<sup>30, 31</sup> and there is a reported increase (of eightfold) in difficulties or failure to intubate the trachea for a caesarean section.<sup>32</sup>

Despite the potential need for conversion of regional to general anaesthesia for caesarean section, only 44% (558/1282) of records charted a Mallampati score of the oropharynx despite a further 84 records having a prompt box in which to write the score left blank. The scores are shown in Table 4a. Overall, 66% (847/1282) of records charted one or more airway assessments, mainly teeth (Table 4b). Of all women who were administered general anaesthesia a Mallampati score was charted in 46% (80/173), and other airway assessments were charted in 64% (111/173). These figures include 41% (71/173) who had both a Mallampati score and another airway assessment charted.

For elective cases where general anaesthesia was administered, a Mallampati score was charted in 65% (11/17) for general anaesthesia alone and in 36% (5/14) where regional anaesthesia was converted to general anaesthesia. Other airway assessments were charted in

71% (12/17) who had general anaesthesia alone and 79% (11/14) whose regional anaesthesia was converted to general anaesthesia.

For emergency cases a Mallampati score was charted in 41% (35/85) for general anaesthesia alone and 45% (15/33) of cases where regional anaesthesia was converted to general anaesthesia. Other airway assessments were recorded in 64% (54/85) who had general anaesthesia alone and 61% (20/33) whose regional anaesthesia was converted to general anaesthesia.

For cases where the urgency of caesarean section was not recorded, a Mallampati score was charted in 62% (8/13) of cases where general anaesthesia was the initial procedure and 55% (6/11) of cases where regional anaesthesia was converted to general anaesthesia. Other airway assessments were recorded in 62% (8/13) who had general anaesthesia alone and 55% (6/11) whose regional anaesthesia was converted to general anaesthesia.

**Table 4a. Mallampati score of women with type 1 or type 2 diabetes undergoing caesarean section who had a recorded Mallampati score**

Mallampati score	Women with type 1 or type 2 diabetes undergoing caesarean section with a recorded Mallampati score (N=558) n (%)
Class 1	255 (46)
Class 2	232 (42)
Class 3	58 (10)
Class 4 <sup>a</sup>	9 (2)
Mallampati assessed but class not recorded or illegible	4 (<1)

<sup>a</sup> No Mallampati Class 4 patients had general anaesthesia

**Table 4b. Type of airway assessment in women with type 1 or type 2 diabetes undergoing caesarean section**

Assessment of airway <sup>a</sup>	Women with type 1 or type 2 diabetes undergoing caesarean section with a recorded airway assessment	
	With Mallampati score N = 558 n(%) <sup>b</sup>	Without Mallampati score N = 289 n(%) <sup>b</sup>
Teeth	410 (73)	241 (83)
Neck (movements/short)	189 (34)	36 (12)
Jaw (protrusion/ temporomandibular joint movement)	78 (14)	23 (8)
Mouth opening (incisor gap/interdental distance)	71 (13)	12 (4)
Thyromental distance	57 (10)	4 (1)
Only recorded that an airway problem was or was not anticipated	7 (1)	44 (15)
Other assessments <sup>c</sup>	5 (1)	5 (2)

**Comment [RD1]:** Hi Jo – was unsure what you meant by moving the score to the 1<sup>st</sup> line – sorry

<sup>a</sup> Seven records could not be assessed, for example because of poor photocopying or writing

<sup>b</sup> Percentages add up to more than 100% as some women had more than one type of airway assessment.

<sup>c</sup> Other assessments included Wilson score, previous grade of intubation or difficult or failed intubation, tracheal stenosis, tracheostomy, obstructive sleep apnoea and tongue studs.

## **6.6 Discussion of anaesthetic options with the woman**

Anaesthetic techniques should be discussed with patients before surgery, to facilitate informed consent and enable appropriate preparations to be made. The actual intra-operative anaesthetic techniques used are shown in Table 8. In 71% (916/1282) of cases a pre-operative discussion was recorded. This applied to 80% (338/423) of those recorded as elective cases and 66% (434/658) of those recorded as emergency cases (Table 5).

The anaesthetic technique eventually used may not be the technique originally planned. A discussion of the actual anaesthetic technique is included in section 7.2.

A regional technique was recorded as the intended anaesthetic technique in 66% (842/1282) of cases. Of these, five of the caesarean sections were recorded as Grade 1 urgency, although others may have been Grade 1 urgency and not recorded as such. In one urgent case where a previous intubation had been difficult, general anaesthesia was recorded as the intended option, with regional anaesthesia planned as a back up in the event of failure to successfully intubate the patient.

General anaesthesia was recorded as an option in 6% (72/1282) of cases. In addition, two records documented both regional and general anaesthesia as options. Of the 74 cases, 71 had a general anaesthetic (41% of all general anaesthetics, 71/173). The remaining 59% (102/173) of general anaesthetics that were given were not recorded as the intended option at the outset.

A Grade 1 urgency caesarean section may preclude full anaesthetic assessment and thus may increase risk. Thirty-two percent (8/25) of Grade 1 urgency cases were administered general anaesthesia which had been recorded as an option, and a further 44% (11/25) were administered general anaesthesia that had not been recorded as an option. Twenty percent (5/25) of Grade 1 urgency cases were recorded as having planned regional anaesthesia, one of whom was converted to general anaesthesia. Four women of Grade 1 urgency (two of whom were converted to general anaesthesia) were administered regional anaesthesia that had not been recorded as the anaesthetic option prior to caesarean.

Spinal anaesthesia was the most common option documented for all urgency categories of caesarean section, (58% (490/842) of all cases where regional anaesthesia was discussed as an option). For emergency caesarean section, an extension of existing epidural analgesia was documented as an option for 27% (105/385) of cases, compared with elective procedures, where only one epidural was planned. The higher rate of epidural use in emergency surgery reflects prior insertion of an epidural catheter for labour analgesia.

**Table 5. Anaesthetic options discussed with women with type 1 or type 2 diabetes undergoing caesarean section.**

Anaesthetic option	Emergency CS N=658 n (%)	Of which Grade 1 Urgency N=25 n (%)	Elective CS N=423 n (%)	Urgency not specified N=201 n (%)	Total N=1282 n (%)
<b>Regional Anaesthesia only</b>	<b>385 (59)</b>	<b>5 (20)</b>	<b>324 (77)</b>	<b>133 (66)</b>	<b>842 (66)</b>
CSE <sup>a</sup>	18 (3)	0 (0)	57 (13) <sup>b, c</sup>	18 (9)	93 (7)
Epidural	106 (16) <sup>b, d</sup>	2 (8)	1 (<1)	0 (0)	107 (8)
Spinal	196 (30)	1 (4)	202 (48)	92 (46)	490 (38)
Regional technique not specified	65 (10)	2 (8)	64 (15)	23 (11)	152 (12)
<b>General anaesthesia only</b>	<b>47 (7)</b>	<b>8 (32)</b>	<b>14 (3)</b>	<b>11 (5)</b>	<b>72 (6)</b>
<b>Both regional and general anaesthesia given as a possible option</b>	<b>1 (&lt;1)</b>	<b>0 (0)</b>	<b>1 (&lt;1)</b>	<b>0 (0)</b>	<b>2 (&lt;1)</b>

<sup>a</sup> Combined spinal and epidural anaesthesia

<sup>b</sup> In one case in this group it was not possible to tell whether general anaesthesia was also planned

<sup>c</sup> In one woman a CSE was planned for an elective caesarean section. This later became an emergency for which she required a general anaesthetic.

<sup>d</sup> In 105 cases an epidural inserted previously for labour was extended.

### 6.7 Anaesthetic interventions prior to caesarean

Anaesthetic interventions in preparation for caesarean section include identifying last oral intake, prescribing an intravenous insulin regime (insulin sliding scale and glucose infusion) and prescribing antacid and antiemetic medication as recommended in contemporary professional guidelines and CEMACH recommendations.<sup>1, 3, 19, 33</sup> The pre-operative interventions documented for women are shown in Table 6. Twenty-eight percent (364/1282) of women did not have any pre-operative interventions documented on the anaesthetic record. Seventy three percent (932/1282) of women did not have a record of antacid medication (citrate) and 63% (812/1282) did not have a record of ranitidine medication or other H<sub>2</sub> antagonist. Aspiration of gastric contents following failure to achieve tracheal intubation after induction of anaesthesia for caesarean section is a well documented cause of maternal death.<sup>19, 33</sup> However, it is possible that this area of suboptimal care has been overestimated, as midwifery records and prescription charts provided by some obstetric units in addition to the requested anaesthetic record, showed that pre-operative medication may be more frequent than was possible to assess from the anaesthetic records.

Table 6 shows that of the 409 women documented as having an insulin sliding scale only 137 were documented as having a glucose infusion. For the remainder it is likely that a glucose infusion was implied when an insulin sliding scale regime was documented or that the infusion was documented elsewhere, for example on a dedicated insulin sliding scale chart.

**Table 6. Pre-operative anaesthetic interventions documented for women with type 1 or type 2 diabetes undergoing caesarean section**

<b>Documented anaesthetic intervention</b>	<b>Emergency CS N=658 n (%)</b>	<b><i>Of which Grade 1 Urgency CS</i> N=25 n (%)</b>	<b>Elective CS N=423 n (%)</b>	<b>Urgency of CS not specified N=201 n (%)</b>	<b>Total N=1282 n (%)</b>
<b>Oral intake</b>					
Last oral intake identified	207 (31)	5 (20)	96 (23)	50 (25)	<b>353 (28)</b>
<b>Intravenous medication</b>					
Sliding scale insulin	209 (32)	6 (24)	143 (34)	57 (28)	<b>409 (32)</b>
Glucose infusion	81 (12)	0 (0)	54 (13)	18 (9)	<b>153 (12)</b>
<b>Pre-medication</b>					
H <sub>2</sub> antagonist	225 (34)	2 (8)	169 (40)	61 (30)	<b>455 (35)</b>
Citrate	205 (31)	8 (32)	89 (21)	41 (20)	<b>335 (26)</b>
Metoclopramide	109 (17)	4 (16)	84 (20)	32 (16)	<b>225 (18)</b>
Proton pump inhibitor	2 (<1)	0 (0)	2 (<1)	1 (<1)	<b>5 (&lt;1)</b>

## 7 Intra-operative record

This section of the report discusses information gained from the intra-operative part of the anaesthetic record, including grade of anaesthetist, anaesthetic technique used, intra-operative monitoring and intra-operative cardiovascular, respiratory and blood glucose stability.

### 7.1 Grade of anaesthetist present

In many cases the grade of the anaesthetist was unknown either because there were no names recorded or the transcription from name to grade was not made during anonymisation of the anaesthetic record. However, at least 20% (253/1282) of caesarean sections had a consultant anaesthetist present (Table 7). The record's format often did not allow conclusions as to which grade of anaesthetist completed the pre-operative assessment and who actually delivered the anaesthetic, unless the handwriting was the same.

**Table 7. Grade of anaesthetist reported on record of caesarean section for women with type 1 or type 2 diabetes**

Grade of most senior anaesthetist	Women with type 1 or type 2 diabetes undergoing caesarean section (N=1282)						Total (N)
	Alone (N)	With another anaesthetist					
		Consultant (n)	Specialist Registrar (n)	Staff & Associate Specialist (n)	Senior House Officer (n)	Grade not available (n)	
Consultant <sup>a</sup>	122	3 <sup>b</sup>	59 <sup>c</sup>	11	56 <sup>d</sup>	2	253
Specialist Registrar <sup>a</sup>	194	-	10	-	15 <sup>e</sup>	1	220
Staff and Associate Specialist <sup>a</sup>	76	-	-	9	-	1	86
Senior House Officer <sup>a</sup>	54	-	-	-	-	1	55
Grade not available	f	-	-	-	-	f	668

<sup>a</sup> Where anaesthetists of two seniorities worked together the case is recorded in the more senior anaesthetist's row only.

<sup>b</sup> One with two other consultants and one with consultant and specialist registrar

<sup>c</sup> Two with two specialist registrars and four with specialist registrar and senior house officer

<sup>d</sup> Two with two senior house officers

<sup>e</sup> One with two senior house officers

<sup>f</sup> Where the grade was not available it was not possible to assess whether or not the anaesthetist was working alone.

### 7.2 Actual Anaesthetic Technique used

Professional standards require the recording of the anaesthetic technique.<sup>3</sup> Overall, general anaesthesia was administered in 13% (173/1282) of patients, including 5% (58 /1282) of cases where regional anaesthesia was converted to general anaesthesia. The corresponding rates in the general population are shown in Table 8.<sup>15, 24</sup>

The anaesthetic option recorded may not have been the actual technique used. For example, in 842 cases where a regional anaesthetic was given as the anaesthetic option, 6% (47/842) recorded the administration of general anaesthesia. In many cases the indication for conversion to general anaesthesia was failed regional anaesthesia.

The anaesthetic techniques recorded as used are listed in Table 8 by grade of urgency. General anaesthesia (general or general plus regional) was given in 76% (19/25) of women recorded as having a Grade 1 urgency caesarean section and in 18% (118/658) of all recorded emergency caesarean sections. Seven percent (31/423) of women with type 1 or type 2 diabetes had general anaesthesia for an elective caesarean section compared with 3.5% for all women in NOAD data.<sup>15</sup>

Six percent (33/572) of regional anaesthetics attempted for an emergency caesarean section had to be converted to general anaesthesia; three percent (14/406) of regional anaesthetics attempted for elective caesarean sections were converted to general anaesthesia (one reason for this result may be the reported lack of testing the level of regional nerve blockade, see section 7.4). This compares with conversion rates of 4.9% for emergency and 0.8% for elective caesarean sections reported for all women in one UK hospital from 1999-2004.<sup>34</sup> The Royal College of Anaesthetists' guidelines recommend that conversion to general anaesthesia from regional anaesthesia for emergency and elective caesarean section should not be higher than 3% and 1% respectively.<sup>35</sup>

**Table 8. Anaesthetic technique recorded for caesarean section in women with and without type 1 or type 2 diabetes**

	Women with type 1 or type 2 diabetes undergoing caesarean section					All Women undergoing caesarean section	
	Women in CEMACH/OAA Diabetes Project N=1282					HES England & Wales 2002-03 <sup>24</sup> N=122000	NOAD 2003 <sup>15</sup> N=8900
Urgency of Caesarean Section	All Emergency N=658	Of which Grade 1 N=25	Elective N=423	Urgency not recorded N=201	Total n (%)	Total n (%)	Total n (%)
<b>Epidural</b>	156 <sup>a</sup>	4	1	1	<b>158 (12)</b>	25800 (21)	2030 (23)
<b>Spinal</b>	339	2	297	144	<b>780 (61)</b>	55720 (46)	5402 (61)
<b>CSE<sup>b</sup></b>	35	0	82	27	<b>144 (11)</b>	8490 (7)	481 (5)
<b>All GA</b>	118	19	31	24	<b>173 (13)</b>	14340 (12)	937 (11)
<i>General alone</i>	85	16	17	13	115 (9)	11210 (9)	693 (8)
<i>General converted from regional</i>	33	3	14	11	58 (5)	3130 (3)	244 (3)
<b>More than one type of Regional</b>	9	0	12	5	<b>26 (2)</b>	No data	41 (<1)
<b>Not recorded</b>	1	0	0	0	<b>1 (&lt;1)</b>	No data	9 (<1)

<sup>a</sup> 155 cases were extensions of an existing epidural sited for labour and 1 epidural was sited specifically for caesarean in a woman with pre-eclampsia

<sup>b</sup> Combined Spinal Epidural: spinal and epidural anaesthesia used in combination in one or more spaces

### 7.3 Monitoring of maternal and fetal status

Intra-operative professional standards include records of drugs and fluids, patient position, fetal heart rate and timing of events. General monitoring during induction and maintenance of anaesthesia includes pulse oximetry, blood pressure, electrocardiography and additional monitoring where applicable such as biochemical variables. For general anaesthesia monitoring of the airway, breathing systems, anaesthetic vapour and carbon dioxide are required plus a nerve stimulator if a muscle relaxant is used

Royal College of Anaesthetists 2000, Association of Anaesthetists 1998, 2000<sup>1, 3, 4, 5</sup>

Contemporary anaesthetic standards required the recording of specified maternal and fetal data. Some data applied to only regional or general anaesthesia and other data applied to both. Tables 9a, 9b and 9c record the intra-operative documentation of maternal and fetal data.

For 59 records a print out from an electronic monitoring system was supplied on varying sizes of paper and a further 16 records referred to a print out which was not supplied to the assessors. In a few cases an electronic print out was the only intra-operative anaesthetic record supplied. For all cases the electronic print out appeared to be from a bespoke software system not connected with any other electronic hospital record.

Only 29% (373/1282) of women had a blood glucose result recorded on the intra-operative record. Of these 165 were recorded as receiving an insulin/glucose sliding scale regime. An additional 200 women who did not have a record of intra-operative blood glucose monitoring were administered insulin intra-operatively. Every effort was made to collect data on intra-operative monitoring of the intravenous insulin regime and blood glucose records; however there is a possibility that this information may have been recorded elsewhere in the records, for example in the maternity notes. During a caesarean section there may be little time for recording of intra-operative blood glucose levels, but it is important, particularly during general anaesthesia where changes in the level of consciousness cannot be assessed and where the mother is unable to convey symptoms of hypoglycaemia. Blood glucose levels were recorded intra-operatively in only 27% (47/173) of women undergoing general anaesthesia.

Fetal heart rate was documented in 1% (13/1282) of records; however, this frequency is likely to be higher because the midwife should keep the relevant record in the maternity notes.

**Table 9a. Documentation of intra-operative monitoring for women with type 1 or type 2 diabetes undergoing caesarean section**

Care documented	General anaesthesia (alone or converted from regional anaesthesia) N = 173 n (%)	Regional anaesthesia only N = 1108 n (%)	Total N =1282 <sup>a</sup> n (%)
Blood pressure	171 (99)	1097 (99)	<b>1269 (99)</b>
ECG	170 (98)	1092 (99)	<b>1263 (99)</b>
Anaesthetic timescale	168 (97)	1076 (97)	<b>1245 (97)</b>
Maternal heart rate	168 (97)	1076 (97)	<b>1245 (97)</b>
Oxygen saturation <sup>b</sup>	168 (97)	1029 (93)	<b>1198 (93)</b>
Delivery time	89 (51)	666 (60)	<b>755 (59)</b>
Wedge/tilt used	60 (35)	415 (37)	<b>476 (37)</b>
Blood glucose <sup>c</sup>	47 (27)	325 (29)	<b>373 (29)</b>
Fetal heart rate	4 (2)	9 (<1)	<b>13 (1)</b>

<sup>a</sup> One chart did not record anaesthetic technique

<sup>b</sup> An additional 1 general anaesthetic case and 17 regional cases recorded that oxygen saturations were monitored but did not record any values. A further 2 general anaesthetic cases and 8 regional cases referred to a print out, not supplied to us, which may have recorded oxygen saturations, and in a further 2 regional cases the record was poorly photocopied and may have contained a record of oxygen saturations.

<sup>c</sup> There were an additional 200 women who received an insulin regime intra-operatively without documented evidence of intra-operative glucose monitoring although this may have been documented elsewhere on a sliding scale chart.

The most frequently recorded type of monitoring was that of blood pressure. In thirteen patients (two having general anaesthesia) blood pressure was not recorded, although in nine of these cases (including the two having general anaesthesia) an electronic print out of monitoring was referred to in the record but not supplied to us and this may also have been the case for the remaining four cases.

There was no record of oxygen saturations in seven percent (84/1282) of cases, although some records were poorly photocopied or incomplete (see Table 9a) so this data may have been recorded but not supplied to us. This result is disconcerting due to potential maternal morbidity and mortality associated with inadequate ventilation.<sup>19, 36</sup>

## 7.4 Monitoring in regional anaesthesia

Table 9b details the documented care provided to women with type 1 or type 2 diabetes receiving regional anaesthesia for caesarean section.

**Table 9b. Documentation of intra-operative care specific for regional anaesthesia in women with type 1 or type 2 diabetes undergoing caesarean section**

Care documented	Women with type 1 or type 2 diabetes having regional anaesthesia <sup>a</sup> for caesarean section N=1166 n (%)
Level of block tested	864 (74)
Top tested only	678 (78% of 864)
Top and bottom tested	166 (19% of 864)
Level tested not recorded	12 <sup>b</sup> (1% of 864)
Conversion to GA required	58 (5)
Poor nerve block <sup>c</sup>	72 (6% of 1108)
High nerve block	5 (<1)

<sup>a</sup> regional anaesthesia, including converted to general anaesthesia

<sup>b</sup> in two cases it was not possible to determine the level tested due to illegibility or poor photocopying

<sup>c</sup> excluding cases converted to general anaesthesia

The identification of a poor nerve block was based on pharmacological supplementation usually by fentanyl or alfentanil and/or on a written account within the anaesthetic record. Conversion to general anaesthesia may also be an indication of an inadequate nerve blockade but this is separately itemised. Thus more than 1 in 10 women may have had a less than complete nerve blockade. Recognition of an inadequate nerve block is best achieved prior to surgery in order to reduce maternal or anaesthetic adverse events but there is no standardised method to do this. The anaesthetic records did report tests of the top of the nerve block in almost all women where testing was documented. A high nerve block was identified by reported sensory and motor changes in 5 women's arms but no specific intervention was recorded. Testing the sacral segments was less frequent and may reflect a reliance on a lack of sensations from the insertion of a urinary catheter.

## 7.5 Monitoring in general anaesthesia

Table 9c details the documented care provided to women with type 1 or type 2 diabetes receiving general anaesthesia for caesarean section.

**Table 9c. Documentation of intra-operative care specific for general anaesthesia in women with type 1 or type 2 diabetes undergoing caesarean section**

Care documented	Women with type 1 or type 2 diabetes having general anaesthesia for caesarean section N=173 n (%)
Capnography	171 (99) <sup>a</sup>
Endotracheal tube size	156 (90) <sup>b</sup>
Volatile anaesthetic agent monitor	151 (87)
Cricoid pressure	143 (83)
Preoxygenation	129 (75)
Grade of intubation	126 (73)
Ventilation monitor	115 (66)
Intubation aids used <sup>c</sup>	27 (16)
Neuromuscular monitoring	14 (8)
Oro- or nasogastric tube	2 (1) <sup>d</sup>
Failed intubation	1 (<1) <sup>e</sup>

<sup>a</sup> In one case capnography was not recorded, although this was a Grade 1 urgency case and no tick box for capnography was printed on the form, so capnography may have been used but not recorded. In a second case a tick box for capnography was present on similar charts, but a full photocopy of the record in question was not supplied.

<sup>b</sup> In one additional case a laryngeal mask airway was used, although no details of a failed intubation were recorded

<sup>c</sup> Cases where intubation aids were used are detailed in Appendix 5.

<sup>d</sup> The cases where gastric catheterisation occurred are described in detail in Case Reports 4 and 5.

<sup>e</sup> The case is described in detail in Case Report 3.

Confirmation of correct endotracheal tube placement by monitoring expired carbon dioxide level was required by contemporary professional guidelines, as noted in The Sixth Report of the Confidential Enquiries into Maternal Deaths in the United Kingdom because failure to monitor can lead to maternal morbidity or mortality.<sup>4,19</sup> One percent (2/173) of general anaesthetic records did not chart monitoring of expired carbon dioxide level. However, one of these cases may have used capnography but not recorded it; in the other there was more uncertainty because the tick box was missed off the photocopy.

Use of intubation aids was reported for 16% (27/173) of women having general anaesthesia. Appendix 5 sets out further details of cases where intubation aids were used, including Mallampati class, grade of intubation and whether oxygen desaturation was recorded during intubation.

### Report of attempted intubation

#### Case 3

A type 2 diabetic patient on insulin during pregnancy presented for an emergency caesarean section. The indication for caesarean section was not recorded. She was noted as obese, an asthmatic, a smoker and needle phobic. She had had a twin pregnancy 10 years previously when she had been delivered by caesarean section under general anaesthesia. She was adamant that she wanted a general anaesthetic.

Her airway was not recorded as assessed. No pre-medication was charted. The patient's position was not recorded. She had a grade 1 laryngoscopy after a rapid sequence induction but no end tidal CO<sub>2</sub> was recorded and airway pressures were greater than 40 cmH<sub>2</sub>O. A second intubation attempt produced similar conditions and a hypersensitivity reaction was considered the most likely cause. A size 4 laryngeal mask was placed and patient was allowed to spontaneously breathe oxygen and sevoflurane. Adrenaline 1:10000 20mls, ephedrine 60mgs, hydrocortisone 500mg and salbutamol 5mgs were given intravenously. The lowest systolic blood pressure was 42 mmHg for 2 minutes and oxygen saturation recordings were extremely variable from <80% early in the record to 97% at the time of hypotension. The recorded monitoring was supplied on a trend print out for 90 minutes. Intra-operative airway pressures and respiratory rate were not recorded. No blood glucose was recorded. No anaesthetic drugs were charted on the graphic anaesthetic record, only fluids and blood loss (700ml). The patient was transferred awake to intensive care.

A separate event summary was supplied for critical incident review. This contained details of the pre-medication, ranitidine, and induction agents, thiopentone and suxamethonium.

*The assessment scores of standards of care for this patient based on the scoring system described below in "Overall Qualitative Assessment" and Appendix 1 where 1 = excellent care and 6 = appalling care were:*

- 5 for anaesthetic documentation (question 22)
- 5 for medical assessment (question 23)

Despite the intubation (and extubation) risks in pregnant women being well known through the published literature including maternal mortality reports, there was a paucity of information about monitoring of neuromuscular blocking drugs (recorded in 8% (14/173) of cases) and ventilation (recorded in 66% (115/173) of cases). Past confidential enquiry reports have included cases of maternal death due to lack of monitoring after extubation.<sup>37</sup> The reports also mention failure to adequately reverse a neuromuscular block.<sup>37, 38</sup> Patient awareness during caesarean section is also a well recognised complication<sup>39</sup> but in only 87% (151/173) of general anaesthesia cases in this project was monitoring of volatile anaesthetic agents recorded.

#### **Reports of women who had gastric catheterization during general anaesthesia**

(NB The review of Case 5's records was restricted to the records collected for the CEMACH/OAA Diabetes Project. Additional records would be expected to explain the events after surgery)

##### *Case 4*

A 25 year old woman with type 1 diabetes at 31 weeks gestation presented as an emergency for caesarean section for fetal distress. She had had a previous general anaesthetic for an ileostomy secondary to ulcerative colitis. She had no airway assessments recorded. Assessment of her teeth was left blank. She was given metoclopramide, a H<sub>2</sub> antagonist and antacid (both unnamed) in preparation for anaesthesia. After pre-oxygenation, a rapid sequence induction with cricoid pressure was followed by a grade 1 laryngoscopy and endotracheal intubation. The time of delivery of a live baby was recorded, but no other times were recorded. There was only one set of recordings for oxygen saturation, inspired oxygen, and end tidal CO<sub>2</sub> and isoflurane. There was no pre-operative or intra-operative recording of blood glucose. No insulin or dextrose was recorded as given. A nasogastric tube was placed at the end of surgery. Post-operative instructions were left blank.

*The assessment scores of standards of care for this patient based on the scoring system described below in "Overall Qualitative Assessment" and Appendix 1 where 1 = excellent care and 6 = appalling care were:*

- 4 for anaesthetic documentation (question 22)
- 6 for medical assessment (question 23)

##### *Case 5*

A 25 year old woman with type 1 diabetes presented for an emergency caesarean section following two convulsions. She was originally admitted because of chest pain and subsequently fitted on the day of surgery with a blood glucose of 4 mmol/l. She was noted to be oedematous but had no record of

hypertension (space on the form for blood pressure was left blank) or proteinuria. A further prolonged convulsion seven hours later at 09.15 am was resolved by airway management and intravenous diazepam (10mg). Her blood glucose was 14 mmol/l. She was pre-medicated with ranitidine and metoclopramide but not sodium citrate because she was in a post-ictal state. She had an 'easy' tracheal intubation (space on the form for grade of intubation was left blank) following a rapid sequence induction at 09.45 am. She had an arterial line placed and orogastric tube inserted. The baby was delivered 5 minutes later. Pre-operative blood results were noted and further blood samples taken. No intra-operative blood glucose was recorded nor administration of dextrose or insulin infusions. An infusion of magnesium was maintained after the second convulsion and her systolic blood pressure was stable at 100-110mmHg. Urinary output was noted to be 10ml/ hour after anaesthesia commenced and she received 1.7 litres of crystalloid. At the end of surgery her respiratory rate was 23 breaths per minute, the atracurium was not reversed and after a blank period without cardiovascular monitoring records for 30 minutes, the patient was 'transferred' at 11.30 am using a propofol infusion and atracurium bolus.

*The assessment scores of standards of care for this patient based on the scoring system described below in "Overall Qualitative Assessment" and Appendix 1 where 1 = excellent care and 6 = appalling care were:*

- 3 for anaesthetic documentation (question 22)
- 5 for medical assessment (question 23)

### **7.6 Non-anaesthetic drug administration**

An intra-operative record of drug administration was identified in over 99% (1275/1282) of cases. Eighty-seven percent (1117/1282) received antibiotics, 96% (1231/1282) received oxytocin (Syntocinon) and 93% (1197/1282) received intravenous fluids. Only 28% (365/1282) were documented as having received insulin of whom 45% (165/365) had intra-operative glucose monitoring.

### **7.7 Qualitative assessments of intra-operative cardiovascular, respiratory and glucose stability and related therapies**

Due to the potential metabolic effects of alterations in blood pressure control and acid base balance as a consequence of cardiovascular and respiratory complications of anaesthesia, cardiovascular and respiratory stability were evaluated. Questions were asked about the record in relation to stability of blood pressure and oxygen saturation, heart rhythm irregularities and blood glucose stability (Tables 10a and 10b). Anaesthetic assessors were not given definitions of stability or prescribed limits but were asked to use their professional judgement of abnormality. The main reasons for this approach were the lack of pre-operative or baseline values and to permit flexibility in interpretation of electronic records (when a probe may have been displaced). In the analysis more than one assessor's judgement was required for a positive report of instability. During assessment, oxygen saturations reported as abnormal varied from 58% to 95% and blood glucose instability was always outside the limits of 4-8mmol/l.

**Table 10a. Reported incidence of cardiovascular, respiratory and glucose instability during caesarean section in women with type 1 or type 2 diabetes**

	<b>General anaesthesia (alone or converted from regional anaesthesia)</b> <b>N=173</b> <b>n (%)</b>	<b>Regional anaesthesia only</b> <b>N=1108</b> <b>n (%)</b>
Cardiovascular/respiratory instability evident from record	61 (35)	335 (30)
Specifically:		
• Blood pressure	53 (31)	312 (28)
• Oxygen saturation <sup>a</sup>	16 (9)	11 (<1)
• Dysrhythmias/heart rate	13 (8)	82 (7)
• Other <sup>b</sup>	4 (2)	0 (0)
Blood glucose instability evident from record	15 (9)	82 (7)

<sup>a</sup> In one case the saturation improved when the endotracheal tube was withdrawn slightly.

<sup>b</sup> Other forms of instability included bronchospasm (2 cases: one in association with a history of mild asthma where oxygen desaturations of 91 and 90% were recorded on 100% oxygen; see Case Report 3 for other case), ST segment depression in association with hypotension after delivery (1 case) and low urine output (1 case).

**Table 10b. Qualitative assessment of duration of intra-operative cardiovascular, respiratory and glucose instability in women with type 1 or type 2 diabetes undergoing caesarean section**

	<b>General anaesthesia (alone or converted from regional anaesthesia)</b> <b>N=173</b> <b>n (%)</b>	<b>Regional anaesthesia only</b> <b>N=1108</b> <b>n (%)</b>
Stable	108 (62)	729 (66)
Brief, clinically insignificant instability	19 (11)	154 (14)
Brief, clinically significant instability	20 (12)	133 (12)
Prolonged disturbance	22 (13)	71 (6)
Totally unstable <sup>a</sup>	1 (<1)	2 (<1)
Insufficient data to comment	3 (2)	19 (2)

<sup>a</sup> See Case Reports 3, 6 and 7

In the assessment, when drugs or other clinical factors given to support an unstable state were identified, it was not possible to determine whether these were given prophylactically e.g. ephedrine and colloid used to maintain blood pressure. Pharmacological support, mainly ephedrine, was administered to 57% (735/1282) of women. Brief instability was common. Thirty-one percent (397/1282) of women had cardiovascular or respiratory instability reported and of these 92% (365/397) included alterations in blood pressure, 24% (95/397) included changes in heart rate and dysrhythmias and 7% (27/397) included changes in oxygen saturation (including 9% (16/173) of women undergoing general anaesthesia). Changes in blood pressure were accompanied by heart rate changes in 18% (73/397) of women with cardiovascular or respiratory instability, by changes in oxygen saturation in 5% (19/397) and by changes in both pulse rate and oxygen saturation in 1% (5/397).

The glucose control was recorded as unstable in 8% (97/1282) of women.

Three cases were qualitatively assessed by two or more assessors as “totally unstable”. Details of these cases are set out in Case Reports 3 (in section 7.5), 6 and 7. These cases demonstrated aspects of substandard care not brought to light by other parts of the study.

#### Reports of “totally unstable” cases

##### Case 6

An ASA 2 type 1 diabetic woman with pre-eclampsia presented for an emergency caesarean section. She was on an insulin sliding scale, nil by mouth and her haemoglobin was 10.5g/dl with platelets  $272 \times 10^9/L$ . Spinal anaesthesia produced a bilateral nerve block to T4. The first recorded blood pressure was 190/110mmHg and this decreased to 110/65mmHg prior to delivery with a pulse rate of 95 beats/min. Ephedrine 6mg intravenously was given. After delivery of the baby 10 units of syntocinon were administered and then an infusion of 40 units in 500mls. However, vaginal blood loss was noted in association with a blood pressure of 110/65mmHg. The syntocinon infusion was then given ‘stat’ and a further infusion set up. The haemoglobin was recorded as ‘6’ and the pulse rate 130 beats/min. At some stage both external jugular and subclavian cannulations were performed on opposite sides, and a further anaesthetist was called with a consultant obstetrician in attendance. Ergometrine was given as well as 3 litres of Hartmanns’ solution, 1litre of Gelofusin, one unit of O negative blood and 5 units of cross matched blood bringing the haemoglobin to ‘7.8’. The blood pressure was recorded as 170/90mmHg and pulse rate of 105 beats/min prior to transfer to a high dependency unit.

*The assessment scores of standards of care for this patient based on the scoring system described below in “Overall Qualitative Assessment” and Appendix 1 where 1 = excellent care and 6 = appalling care were:*

- 3 for anaesthetic documentation (question 22)
- 4 for medical assessment (question 23)

##### Case 7

A woman with type 1 diabetes woman of 46 years presented for an emergency caesarean section including tubal ligation in the evening time. The written anaesthetic assessment briefly recorded that she was ASA 2, was a Jehovah’s Witness, had no allergies or a cold and had consented to regional anaesthesia. No drug therapies were recorded. A spinal anaesthetic was recorded on the written record with a bilateral nerve block to T4. The print out contained a record of the intra-operative monitoring and following an initial blood pressure of 130/70mmHg all subsequent systolic pressures were less than 100mmHg. The blood pressures were taken every 3 minutes and show a gradual trend over 15 minutes to 50/30mmHg and a bradycardia of 40 beats/min developed after an initial heart rate of 100 beats/min. At this time the oxygen saturation changed from >95% to <80%, possibly due to disconnection because it immediately recovered. The cardiovascular monitoring then became unstable with transient increases in heart rate to 70 beats/min dipping again to 40 beats/min with blood pressures of 60/40mmHg for 20 minutes. The last blood pressure was 70/40mmHg. An attached graphic chart recorded the baby delivered and drugs given during this period of prolonged instability. The drugs included ephedrine, atropine and 10% glucose. A ‘BM’ (blood glucose level) of 5.1 was recorded at the start of anaesthesia and 8.9 after the glucose. The fluids given included 2 litres of Hartmann’s solution and 1 litre of Gelofusine. The blood loss was recorded as about 1 litre and post-operative blood pressure only reached 100mmHg in the nursing record 30 minutes after the end of the printed record. Written post-operative instructions were ‘routine’, ‘analgesia’, ‘BM’ and ‘sliding scale’.

*The assessment scores of standards of care for this patient based on the scoring systems described below in “Overall Qualitative Assessment” were*

- 4 for anaesthetic documentation (question 22)
- 5 for medical assessment (question 23)

## 8 Post-operative record

Post-operative professional standards require the anaesthetic record to include a record of drugs given including analgesics and specific instructions for airway management and monitoring.  
Association of Anaesthetists of Great Britain and Ireland 1998<sup>3</sup>

Fifty-four per-cent (698/1282) of records contained written post-operative instructions. There was a designated space for post-operative instructions on the anaesthetic record in 81% (1019/1262) of cases where a full anaesthetic record was provided. Post-operative instructions were written in 66% (673/1019) of cases where a designated space was provided, in the remainder it was left blank. In 10% (25/243) of cases where no specific area was designated, post-operative instructions were nonetheless written.

Of the 698 post-operative instructions written, 64% (445/698) included instructions specific for diabetes and 90% (628/698) included instructions for other factors of post-operative management. Fifty four percent (375/698) of written post-operative instructions were both for diabetes and other aspects of management.

Roles and responsibilities overlap in the post-operative period. There may have been other plans written in the patient's main medical record by the anaesthetist or other medical staff or given verbally to nursing staff. The overall system of written plans for post-operative management may need to be reviewed by anaesthetic, obstetric and midwifery teams to ensure that items are not omitted, do not conflict, are unambiguous and are accessible to the staff providing post-operative care.

## 9 Overall qualitative assessment

The anaesthetic record was scored by the regional anaesthetic assessors and the central team on a six point scale for both the anaesthetic documentation and the assessment of medical fitness for anaesthesia of a woman with type 1 or type 2 diabetes (Table 11). Records awarded scores of '1' or '2' were above average, scores of '3' or '4' were acceptable and scores of '5' or '6' were considered unacceptable.

Assessment of the anaesthetic records was intended as a surrogate for actual standards of anaesthetic care. In the analysis, oxygen saturation was not documented in 13% (50/399) of records with scores of 5 and 6 for anaesthetic documentation compared with almost half this figure overall.

**Table 11. Overall quality of anaesthetic documentation and medical assessment for women with type 1 or type 2 diabetes undergoing caesarean section**

Anaesthetic records in CEMACH/OAA Diabetes Project N=1282			
Assessment of overall quality		Anaesthetic documentation n (%)	Medical assessment n (%)
<b>Above average</b>	<b>1 (Excellent)</b>	20 (2)	14 (1)
	<b>2</b>	122 (10)	77 (6)
<b>Acceptable</b>	<b>3</b>	286 (22)	171 (13)
	<b>4</b>	455 (35)	350 (27)
<b>Unacceptable</b>	<b>5</b>	329 (26)	489 (38)
	<b>6 (Appalling)</b>	70 (5)	180 (14)
<b>Unable to assess</b>		0 (0)	1 (<1)

Of the 423 elective caesarean section records, 28% of anaesthetic documentation and 50% of medical assessments fell below acceptable standards, that is the standard of documentation fell seriously below standard even when surgery and anaesthesia were planned in advance and non-urgent.

Assessment was wholly or partly incomplete in 2% (31/1282) of records because of illegibility, although in five cases this was due to poor photocopying. Those who scored '5' or '6' on anaesthetic documentation often also had substandard scores on medical assessment; of the records with a score of '5' or '6' for anaesthetic documentation 91% (362/399) also scored a '5' or '6' for medical assessment.

## 10 Conclusions

The information available for assessment was the anaesthetic record and print outs of any electronic monitoring system. In the operating theatre this record stays near to the anaesthetist while the patient's notes may not always be physically present. However, it was recognised that where information was not available on the anaesthetic record the information may have been recorded by the anaesthetist or other members of the multidisciplinary team in the patient's notes and been available to or known by the anaesthetist. The fact that some records were incomplete should therefore not be judged as a clinical governance issue but, provided the relevant information was recorded elsewhere in the patient's notes, as an appropriate alternative method of working. For example, exact weight was often not recorded even where obesity was noted, although the weight may have been recorded elsewhere by maternity staff. The anaesthetic record and electronic print out therefore represent a minimum record of the information available to the anaesthetist during surgery.

At least twenty percent (253/1282) of women were anaesthetised with a consultant anaesthetist present. Despite this apparent senior level of staffing, the actual records were often lacking in many critical areas. For example, many records did not include preparations expected in the management of a diabetic mother prior to major surgery. Indeed, 3% (42/1282) of women were not recorded as having diabetes at all.

The information provided about pre-operative assessment was often limited and did not demonstrate a structured medical approach to diabetic care. The qualitative scores showed that those who provided less than adequate medical assessments (scored '5' or '6') also tended to display substandard records in other parts of the study, for example not recording oxygen saturation or having a poor qualitative score for anaesthetic documentation.

Since this study, the NICE guideline on diabetes in pregnancy recommends that diabetic women with co-morbidities such as obesity or autonomic neuropathy should be offered an anaesthetic assessment in the third trimester of pregnancy.<sup>40</sup>

In women with type 1 or type 2 diabetes there is a high rate of caesarean section and in this cohort of women there was also a high rate of general anaesthesia. General anaesthetics were administered more than twice as often as they were planned as the initial anaesthetic technique. It is in the nature of obstetric anaesthesia that anaesthesia may need to be given with rapidity and that an inadequate regional block may result in the need for general anaesthesia. The fact that conversion to general anaesthesia was required in approximately 1 in 20 occasions in this cohort underlines the need for being prepared by prior airway assessment and ensuring that processes have been followed to minimise the risk of aspiration of stomach contents, even if regional anaesthesia alone is planned.

Blood pressure during caesarean section is known to be labile, due to aorto-caval occlusion and sympathetic nerve blockade. Also, maternal blood glucose can decrease rapidly on delivery of the placenta leading to maternal hypoglycaemia unless insulin administration is suitably adjusted. In this audit blood glucose monitoring and insulin administration appeared unrelated because 55% (200/365) of women received an intravenous insulin regime during the operation but without documented evidence of blood glucose monitoring. It is difficult to be sure whether blood glucose measurements were recorded on separate charts, but we suggest they should also be included on the anaesthetic record if time permits, particularly if insulin administration is charted. Neglecting maternal blood glucose monitoring may be to the detriment of the baby who may be born hyperglycaemic and acidotic if maternal glucose is high, with post-delivery hypoglycaemia.<sup>41</sup> The recent NICE guideline on diabetes in pregnancy recommends that blood glucose should be monitored every 30 minutes during general anaesthesia for caesarean section.<sup>40</sup> This documentation should be part of the anaesthetic record.

The value of capnography in confirming correct endotracheal tube placement has been emphasised in confidential enquiry reports.<sup>19</sup> Capnography for general anaesthesia was definitely not recorded in one of the 173 general anaesthetic cases.

Overall 31% (399/1282) of anaesthetic records were qualitatively considered by the assessors to have poor documentation. Just over half (52%, 669/1282) of medical assessments were qualitatively considered to be inadequate for women with type 1 or type 2 diabetes. Some of the case study examples illustrate in more detail why assessors scored records poorly. Hence a wide professional evaluation considered that a satisfactory level of care was delivered to less than one half of diabetic women at caesarean section.

Given the potential opportunity for preassessment of patients having elective surgery either on the day of surgery or at a predetermined time before surgery, we anticipated that documentation and medical assessments for elective caesarean section would meet contemporary professional standards. In practice half of recorded medical assessments for elective procedures were below published standards. Current recommended standards in medical records may assist improvements in future anaesthetic documentation.<sup>42</sup>

Quality of anaesthetic record design, whilst not formally assessed, was noted to vary considerably. Anaesthetic records with appropriate box prompts, but also adequate space for free text entries, were considered to act as an important aide-memoire. For example, post-operative management plans were recorded in 66% (673/1019) when space for the instructions was designated on the chart compared with 10% (25/243) where there was no designated space. The facility to enter free text comments, particularly for pre-operative assessment, was also considered important by assessors in stand-alone electronic anaesthetic records.

The CEMACH/OAA Diabetes Project has raised a number of concerns regarding the recording of pre-operative assessment, preparation for general anaesthesia, intra-operative monitoring and other aspects of anaesthetic record keeping for women with type 1 or type 2 diabetes undergoing caesarean section. A number of recommendations have been made in response to these findings and it is hoped that these will be useful in considering how changes can be implemented to improve standards of care.

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# Appendix 1: Assessment questionnaire

## CEMACH/OAA diabetes project

### PREASSESSMENT

- Q1 Category of caesarean section  
(please see background information and definitions)
- |         |                          |                      |                          |                 |                          |
|---------|--------------------------|----------------------|--------------------------|-----------------|--------------------------|
| Grade 1 | <input type="checkbox"/> | Grade 2              | <input type="checkbox"/> | Grade 3         | <input type="checkbox"/> |
| Grade 4 | <input type="checkbox"/> | Charted as emergency | <input type="checkbox"/> | Grade not given | <input type="checkbox"/> |
- 
- Q2 Reason(s) given for caesarean section?
- |     |                          |    |                          |
|-----|--------------------------|----|--------------------------|
| Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
|-----|--------------------------|----|--------------------------|
- If yes, please give reason(s)
- 
- Q3 ASA grade  
(please see background information and definitions)
- |         |                          |         |                          |                 |                          |
|---------|--------------------------|---------|--------------------------|-----------------|--------------------------|
| Grade 1 | <input type="checkbox"/> | Grade 2 | <input type="checkbox"/> | Grade 3         | <input type="checkbox"/> |
| Grade 4 | <input type="checkbox"/> | Grade 5 | <input type="checkbox"/> | Grade not given | <input type="checkbox"/> |
- 
- Q4 a) Was the medical condition of diabetes recorded on the anaesthetic record?
- |     |                          |    |                          |
|-----|--------------------------|----|--------------------------|
| Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
|-----|--------------------------|----|--------------------------|
- b) Was the type of diabetes recorded? (i.e. type 1 or type 2)
- |     |                          |    |                          |
|-----|--------------------------|----|--------------------------|
| Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
|-----|--------------------------|----|--------------------------|
- 
- Q5 Were these basic clinical details of relevance to diabetes documented pre-operatively:
- a) Blood pressure? Yes  No
- b) Weight and/or BMI? Yes  No
- If no:
- c) was the patient charted as obese? Yes  No
- 
- Q6 Were the following pre-operative biochemical results documented:
- a) Potassium? Yes  No
- b) Urea? Yes  No
- c) Creatinine? Yes  No
- d) Bicarbonate? Yes  No
- e) Glucose? Yes  No
- 
- Q7 Was pre-operative drug therapy recorded?
- a) Insulin? Yes  No
- b) Other? Yes  No
- 
- Q8 Were complications of diabetes mentioned in the pre-operative assessment (either as present or not present)?
- |     |                          |    |                          |
|-----|--------------------------|----|--------------------------|
| Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
|-----|--------------------------|----|--------------------------|
- If yes, were the following complications documented:

- |                             |     |                          |    |                          |
|-----------------------------|-----|--------------------------|----|--------------------------|
| a) Nephropathy?             | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| b) Neuropathy?              | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| If yes, was it autonomic    | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| c) Retinopathy?             | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| d) Poor glucose control?    | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| e) Coronary artery disease? | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| f) Other complications?     | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |

If yes, please state

---

- Q9 a) Was airway assessment charted as Mallampati score?
- |     |                          |    |                          |
|-----|--------------------------|----|--------------------------|
| Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
|-----|--------------------------|----|--------------------------|

If yes, please give class

*(please see background information and definitions)*

- |         |                          |         |                          |
|---------|--------------------------|---------|--------------------------|
| Class 1 | <input type="checkbox"/> | Class 2 | <input type="checkbox"/> |
| Class 3 | <input type="checkbox"/> | Class 4 | <input type="checkbox"/> |

- b) Were other pre-operative airway assessments charted?

*(please see background information and definitions)*

- |     |                          |    |                          |
|-----|--------------------------|----|--------------------------|
| Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
|-----|--------------------------|----|--------------------------|

If yes, please state

---

- Q10 a) Was a regional technique discussed and/or planned in pre-operative assessment?
- |     |                          |    |                          |
|-----|--------------------------|----|--------------------------|
| Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
|-----|--------------------------|----|--------------------------|

If yes, was it:

- |                                |                          |                       |                          |
|--------------------------------|--------------------------|-----------------------|--------------------------|
| CS grade 4 (elective) CSE      | <input type="checkbox"/> | CS grade 1-3 CSE      | <input type="checkbox"/> |
| CS grade 4 (elective) epidural | <input type="checkbox"/> | CS grade 1-3 epidural | <input type="checkbox"/> |
| CS grade 4 (elective) spinal   | <input type="checkbox"/> | CS grade 1-3 spinal   | <input type="checkbox"/> |

Other (please state): \_\_\_\_\_

- b) Was a general anaesthetic recorded as planned?
- |     |                          |    |                          |
|-----|--------------------------|----|--------------------------|
| Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
|-----|--------------------------|----|--------------------------|

- Q11 Were the following preparations for anaesthesia documented:

- |                                    |     |                          |    |                          |
|------------------------------------|-----|--------------------------|----|--------------------------|
| a) Last oral intake?               | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| b) Infusion of iv glucose?         | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| c) Sliding scale insulin infusion? | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| d) Proton pump inhibitor?          | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| e) H2 antagonist?                  | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| f) Metoclopramide (prokinetic)?    | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| g) Citrate use?                    | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |

h) Other (please state): \_\_\_\_\_

## ANAESTHESIA

Q12 What anaesthetic technique was used?

- |                                  |                          |                     |                          |
|----------------------------------|--------------------------|---------------------|--------------------------|
| Epidural                         | <input type="checkbox"/> | Spinal              | <input type="checkbox"/> |
| CSE (1 or more spaces)           | <input type="checkbox"/> | General anaesthetic | <input type="checkbox"/> |
| General anaesthetic and regional | <input type="checkbox"/> | Multiple regional   | <input type="checkbox"/> |

Other (please state): \_\_\_\_\_

Q13 Please state the grades of the anaesthetist(s) present at surgery

Grade	1 <sup>st</sup> anaesthetist	2 <sup>nd</sup> anaesthetist	3 <sup>rd</sup> anaesthetist
Consultant			
SpR			
SHO			
NCCG			
Other			
Grade not known			

Q14 Please state the grades of the obstetrician(s) present at surgery

Grade	1 <sup>st</sup> obstetrician	2 <sup>nd</sup> obstetrician	3 <sup>rd</sup> obstetrician
Consultant			
SpR			
SHO			
NCCG			
Other			
Grade not known			

Q15 Were the following recorded:

- |   |     |                          |    |                          |
|---|-----|--------------------------|----|--------------------------|
| a) Anaesthetic times?                                     | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| b) Time anaesthetist first informed (for category 1-3 CS) | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| c) Delivery time?   | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| d) Was wedge/tilt used?                                   | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| e) Fetal heart rate (at any time)?                        | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| f) Blood glucose?   | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| g) Blood pressure?  | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| h) Oxygen saturation?                                     | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| i) ECG?   | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| j) Pulse (derived)?                                       | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |

Q16 Regional anaesthesia only

a) Was the level of block tested and documented?

If yes, how was it tested

- |                 |                          |                    |                          |
|-----------------|--------------------------|--------------------|--------------------------|
| Top tested only | <input type="checkbox"/> | Bottom tested only | <input type="checkbox"/> |
|-----------------|--------------------------|--------------------|--------------------------|

Other (please state): \_\_\_\_\_

b) Did a regional nerve block require conversion to general anaesthetic?

- |     |                          |    |                          |
|-----|--------------------------|----|--------------------------|
| Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
|-----|--------------------------|----|--------------------------|

c) Did a poor block require any pharmacological supplementation?

- |     |                          |    |                          |
|-----|--------------------------|----|--------------------------|
| Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
|-----|--------------------------|----|--------------------------|

d) Did a high block need any specific intervention?

- |  |     |                          |    |                          |
|--|-----|--------------------------|----|--------------------------|
|  | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
|--|-----|--------------------------|----|--------------------------|
- Q17 General anaesthesia only  
Were the following documented:
- |   |     |                          |    |                          |
|---|-----|--------------------------|----|--------------------------|
| a) Preoxygenation?                            | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| b) Cricoid pressure/RSI?                      | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| c) Grade of intubation?                       | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| d) Tube size used?                            | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| e) Aids used/difficulties?                    | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| f) Failed intubation?                         | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| g) Capnography?                               | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| h) N/M monitoring?                            | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| i) Agent monitor?                             | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| j) Ventilation monitor?                       | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| k) Oro/nasogastric tube passed and aspirated? | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
- Q18 a) Were there signs of cardiovascular or respiratory instability?  
Yes  No
- If yes, how was this documented
- |                               |     |                          |    |                          |
|-------------------------------|-----|--------------------------|----|--------------------------|
| i) Blood pressure?            | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| ii) Oxygen saturation?        | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| iii) Dysrhythmias/heart rate? | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
- iv) Other (please state):  
\_\_\_\_\_
- |   |     |                          |    |                          |
|---|-----|--------------------------|----|--------------------------|
| b) Was there instability in glucose control?                          | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| c) Was any pharmacological or other support required for instability? | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
- If yes, please state:  
\_\_\_\_\_
- Q19 Were the following non-anaesthetic drugs given:
- |                 |     |                          |    |                          |
|-----------------|-----|--------------------------|----|--------------------------|
| a) Antibiotics? | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| b) Syntocinon?  | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
- If yes, please state dose:  
\_\_\_\_\_
- |               |     |                          |    |                          |
|---------------|-----|--------------------------|----|--------------------------|
| c) Insulin?   | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| d) IV fluids? | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
- If yes, please state type:  
\_\_\_\_\_
- e) Other (please state):  
\_\_\_\_\_
- Q20 a) Was there designated space on the anaesthetic chart for post-operative instructions?  
Yes  No
- |  |     |                          |    |                          |
|--|-----|--------------------------|----|--------------------------|
| i) If yes, were these completed?                               | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
| ii) If no, were appropriate instructions written nevertheless? | Yes | <input type="checkbox"/> | No | <input type="checkbox"/> |
- b) Were there specific instructions related to diabetes?  
Yes  No

c) Were there routine or specific instructions relating to other aspects of management?  
 Yes  No

Q21 Were the following obstetric complications documented?

a) Pre-eclampsia?	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>
b) Polyhydramnios?	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>
c) Antenatal haemorrhage?	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>
d) Intrapartum haemorrhage?	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>
e) Postpartum haemorrhage?	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>
f) Other (please state):	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>

---

g) No complications documented

**OVERALL QUALITATIVE ASSESSMENT**

Q22 What was your overall qualitative assessment of the anaesthetic documentation?  
 Excellent      Appalling   
 1 2 3 4 5 6

*Record was illegible*

Q23 What was your overall qualitative assessment of the medical assessment?  
 Excellent      Appalling   
 1 2 3 4 5 6

*Record was illegible*

Q24 What was your overall qualitative assessment of homeostasis during anaesthesia (based on definitions and support therapies given)?

Stable	<input type="checkbox"/>
Brief, clinically insignificant instability	<input type="checkbox"/>
Brief, clinically significant instability	<input type="checkbox"/>
Prolonged disturbance (corrected eventually)	<input type="checkbox"/>
Totally unstable (requiring ongoing post operative resuscitation or support)	<input type="checkbox"/>

Please add any additional comments in the box below. Please continue on the reverse of this sheet if you require additional space.

## Appendix 2: Contemporary anaesthetic standards

The following excerpts from professional guidance have been used as the basis for the CEMACH/OAA Project:

“The anaesthetist is uniquely qualified to assess anaesthetic risk”<sup>2</sup>

“The aim in assessing patients before anaesthesia and surgery is to improve outcome”<sup>2</sup>

“...there should be early involvement of consultant anaesthetists in the management of complex deliveries”<sup>5</sup>

“It is particularly important to record complete information during a Caesarean section in a clear and rational way. This is because medical and legal enquiry following this procedure is more common than for many other procedures and the exact timing of events may be critical.”<sup>1</sup>

### Anaesthetic Records

The maintenance of meticulous anaesthetic records is vital. Suggestions for the recommended content of an anaesthetic record have been published (*see below*). Drug doses (including inhalational agents) should be documented as well as physiological parameters and intra-operative events. Automated printouts from anaesthetic machines may form part of the record.”<sup>3</sup>

The following has been abbreviated:

### Anaesthetic Record Set (suggestions as to a reasonable content)

#### PRE-OPERATIVE INFORMATION

##### Assessment and risk factors

Date of assessment

Assessor

Weight (height optional)

Basal vital signs

Medication

Allergies

Addiction

Previous general anaesthetics, family history

Potential airway problems

Prostheses, teeth, crowns

Investigations

Cardiorespiratory fitness

Other problems

ASA± comment

##### Checks

Nil by mouth

Consent

Pre-medication

#### OPERATION

##### Vital signs recording

##### Drugs and Fluids

##### Airway and breathing system

##### Regional anaesthesia

Block performed

##### Patient position

## POST-OPERATIVE INSTRUCTIONS

Drugs

Analgesic techniques

Special airway instructions

Monitoring<sup>3</sup>

The following has been abbreviated:

### “MONITORING THE PATIENT

#### Induction of anaesthesia

Pulse oximeter

Non-invasive blood pressure monitor

Electrocardiogram

Capnograph

The following must also be available

A nerve stimulator where a muscle relaxant is used

A means of measuring the patient's temperature

#### Maintenance of anaesthesia

Pulse oximeter

Non-invasive blood pressure monitor

Electrocardiograph

Capnograph

Vapour analyser

The following must also be immediately available

A nerve stimulator where a muscle relaxant is used

A means of measuring the patient's temperature

#### Regional techniques

Pulse oximeter

Non-invasive blood pressure monitor

Electrocardiography

#### Additional monitoring

Biochemical variables<sup>4</sup>

#### Specific for obstetric anaesthesia

“The fetal heart rate should be recorded during initiation of regional nerve block and until the abdominal skin preparation is begun in emergency Caesarean section.”<sup>5</sup>

“...include the following: ... strict recording of the time of skin incision, uterine incision and delivery”<sup>1</sup>

“For operative delivery under regional nerve block, continuous pulse oximetry, non-invasive blood pressure capable of automatic one minute cycles (preferably with print out) and continuous ECG monitoring are required during induction, maintenance and recovery.”<sup>5</sup>

Specific data to be recorded for diabetes in obstetrics

- “Usual diabetic treatment regime
- Level of pre-operative control
- Perioperative regime
- Results of blood sugar
- Frequency of blood sugar checks..”<sup>1</sup>

### Appendix 3: CEMACH/OAA committee, co-ordinators, reviewers and assessors

#### OAA Central Administrative Email-based Committee:

Anita Holdcroft  
 Anne May  
 Geraldine O'Sullivan  
 Gordon Lyons  
 Rowan Wilson (Questionnaire Assessment Organiser)

<b>CEMACH Region</b>	<b>CEMACH Regional Manager</b>	<b>OAA Consultant Anaesthetist Co-ordinator(s)</b>
<b>North East (NE)</b>	Marjorie Renwick <i>(to October 2009)</i>	Val Bythell
<b>Yorkshire and Humberside (YH)</b>	Lesley Anson <i>(to March 2006)</i>	Rowan Wilson
<b>East Midlands (EM)</b>	Sue Wood	Susan Coley
<b>East of England (EE)</b>	Carol Hay	James Broadway
<b>London (LO)</b>	Stephanie Roberts <i>(to June 2004)</i>	Phillipa Groves Vanessa Skelton
<b>South East (SE)</b>	Melanie Gompels <i>(to February 2007)</i>	Geetha Dissanayake Mark Sinden David Uncles
<b>South West (SW)</b>	Rosie Thompson	Stephen Michael Kinsella Mike Wee
<b>West Midlands (WM)</b>	Donna Drinkall <i>(to 2004)</i>	Peter Millns
<b>North West (NW)</b>	Julie Maddocks	Lesley Horsman
<b>Wales (WA)</b>	Jane Stewart <i>(to August 2005)</i>	Rachel Walpole
<b>Northern Ireland (NI)</b>	Maureen Scott <i>(to March 2005)</i>	David Hill

**Central team of OAA reviewers**

Anita Holdcroft  
Anne May  
Katharine Medlow  
Seosoon Seah  
Aneesul Shakir

**Regional OAA assessors (details correct for January 2006)**

J W L Ackers	SW	Rotherham General Hospital
Sunita Agarwal	LO	Enfield
Janet Barrie	NW	Royal Oldham Hospital
Deborah Browne	EE	Norfolk and Norwich University Hospital
Jeremy Charlton	YH	Harrogate District Hospital
Susan Coley	EM	Leicester General Hospital
Pushkar Dadarkar	SE	Wexham Park Hospital
Geetha Dissanayake	LO	Darent Valley Hospital
Fiona Donald	SW	Southmead Hospital
Ruth W Eustace	EM	Critical Care Directorate
Emma Evans	LO	Livingstone Park
W R Harvey	SW	Royal Cornwall Hospitals Trust (Treliske) Truro
Moothedath Hariprasad	NW	Manchester Royal Infirmary
Stephen Kinsella	SW	St Michael's Hospital
Nuala Lucas	LO	Northwick Park Hospital
Sola Makinde	LO	The Anaesthetic Department
Hamish McClure	YH	St James University Hospital
Brendan McGrath	NW	Hope Hospital (Salford)
Julian McDonough	YH	Department of Anaesthetics
Bernard Munro	LO	Chase Farm Hospital NHS Trust
Deborah Phillips	EE	Lincoln County Hospital
Anthea Pinder	EE	Northampton General Hospital NHS Trust
Felicity Plaat	LO	Hammersmith Hospital
Javaid Rashid	YH	Doncaster Royal Infirmary
Ted Rees	WM	Cheltenham General Hospital
Bhaskar Saha	NW	Royal Oldham Hospital
Mark Sinden	SE	Kent & Sussex Hospital
Christine Thomas	EE	Great Notley
Jenny Tuckey	SW	Royal United Hospital
Sonia Verma	SE	Medway Maritime Hospital
R C Wilson	YH	St James's University Hospital

## Appendix 4: Standardisation policy

### Pre-operative Records

1. Classification of caesarean sections according to the four point classification system recommended by Lucas et al (2000)<sup>22</sup> was sought. Many anaesthetic record forms had pre-printed boxes for classification according to the NCEPOD four point classification system.<sup>23</sup> NCEPOD category 4 (elective) was accepted as corresponding to a caesarean section category 4 (elective). All other NCEPOD categories were accepted as recording that the caesarean section was an emergency, as well as 'failure to progress', 'fetal distress' or use of 'top up of epidural' inserted for labour. 'Crash' or 'stat' was accepted as category 1 (immediate threat to life), as well as 'severe fetal distress' and 'cord prolapse'.
2. Where a space was allocated on the chart for entry of information listed on the questionnaire but was not filled in the item was recorded as "left blank".
3. Records of insulin administration (pre- or since admission) and of regular blood glucose monitoring were accepted as a record of the condition of diabetes.
4. As oral hypoglycaemics are contraindicated in pregnancy, a record of "IDDM" was not accepted as a record of type 1 diabetes unless the patient was recorded as having had IDDM for in excess of 8 years.
5. A record of "diet controlled diabetes" was accepted as a record of type 2 diabetes.
6. A record of "high BMI" was accepted as a record of obesity.
7. A record of "U&Es normal" was not accepted as a record of electrolyte results, but was noted as a free text comment. A blank box or prompt on the form for "U&Es" resulted in an assessment of "left blank" for potassium, urea and creatinine levels, but not for bicarbonate or glucose.
8. A blood gas result including a record of base excess was accepted in place of a formal record of bicarbonate level.
9. A record of insulin administration was accepted whether the insulin was recorded as a pre-operative medication or as an insulin sliding scale.
10. Records were accepted as having a record of whether or not the patient was on "other medication" if any medication was recorded in a box designated for medication history.
11. A record was accepted as assessing diabetic complications where specific complications were documented but also where specific or general diabetic complications were recorded as being absent.
12. In some cases both regional and general anaesthesia were discussed with the patient during the pre-operative assessment. In this case the anaesthetic technique planned to be attempted first was recorded as the planned anaesthetic option.
13. Various eponymous "regimes" were referred to. It was assumed that these were glucose/insulin regimes.
14. A record of a "sliding scale" was assumed to be a record of an insulin sliding scale.
15. Some forms recorded "antacid" pre-medication. This was recorded as "other pre-medication" but not as any particular class of antacid pre-medication.

16. Where the anaesthetic technique used was an epidural top-up this was specifically noted on the database.
17. Where given, grades of anaesthetist were recorded in the order recorded on the anaesthetic chart.

#### **Intra-operative Records**

18. An intra-operative record of pulse rate was accepted as a record of an ECG having been recorded in the absence of ECG monitoring being identified.
19. Where a spinal anaesthetic was attempted but did not proceed and general anaesthesia was subsequently administered the anaesthetic technique was recorded as "GA and regional" and the case was recorded as regional anaesthesia converted to general anaesthesia. However, whether the remainder of the regional anaesthesia section of the questionnaire was completed depended on how far the regional technique had progressed. For example in some cases the technique was abandoned prior to injection of drugs, due to patient distress or inability to site the needle rather than due to inadequate block.
20. Poor blocks and high blocks were recorded, regardless of whether or not specific steps were taken in response to them.
21. Where no intra-operative blood glucose was recorded the question "glucose instability?" was marked "left blank" as it was considered that spare lines are almost always present on an intra-operative record which could be used for recording blood glucose levels.
22. Pharmacological agents designed to treat cardiovascular instability were recorded as given even where they appeared to have been given prophylactically rather than in response to recorded instability.

#### **Post-operative Records**

23. Any post-operative instruction was accepted as an appropriate response for post-operative instructions, even though in many cases only one instruction was charted, e.g. 'BM' or 'oxygen'.

#### **Qualitative Assessments**

24. "Overall qualitative assessment of medical assessment" was interpreted as specifically referring to diabetic care in addition to any other recorded medical problems.
25. "Overall qualitative assessment of homeostasis" was interpreted as referring to pre- and intra-operative glucose stability (where recorded) in addition to intra-operative cardiovascular and respiratory stability.

#### **Other Comments**

26. Values for blood glucose, weight/BMI and pre-operative blood pressure were recorded in the "additional comments" box.

## Appendix 5 : Management of intubation

### (a) Cases where aids to intubation were used

#### Bougie alone used

Case	Grade of Intubation	Mallampati Score	Oxygen desaturation recorded
1	1	1	No
2	1	2	No
3	1	Not recorded	No
4	2	1	No
5	2	2	No
6	2	2	No
7	2	2	No
8	2	2	No
9	2	3	No
10	2	Not recorded	No
11	2	Not recorded	No
12	2	Not recorded	No
13	2	Not recorded	No
14	3	2	No
15	3	3	No
16	3	Not recorded	No
17	3	Not recorded	No
18	4 <sup>a</sup>	Not recorded	No
19	Not recorded	3	No
20	Not recorded	Not recorded	No

<sup>a</sup> Grade not formally recorded, but recorded that larynx not seen

#### Special blade used with or without bougie

Case	Aids used	Grade of Intubation	Mallampati Score	Oxygen Desaturation recorded
1	Long blade	1	2	No
2	Polio blade	1	3	No
3	Short handle, long blade	1	3	No
4	McCoy and bougie	3	3	No
5	McCoy and bougie	3	Not recorded	Yes

**(b) Difficult intubation recorded but no aids used**

<b>Case</b>	<b>Grade of Intubation</b>	<b>Mallampati Score</b>	<b>Oxygen Desaturation recorded</b>
1	2	Not recorded	No
2	1	Not recorded	No





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