

# Learning from the MBRRACE Maternal Mortality Report UK

**Dr Bharati N Rajdev**

Anaesthetics Registrar, Burton Hospitals NHS Foundation Trust, UK

**Dr B Das**

Anaesthetic Consultant, Burton Hospitals NHS Foundation Trust, UK

Edited by:

**Dr James Brown and Dr Richard Hughes**

Correspondence to [atotw@wfsahq.org](mailto:atotw@wfsahq.org)



**ANAESTHESIA**  
TUTORIAL OF THE WEEK

[www.wfsahq.org](http://www.wfsahq.org)

20<sup>th</sup> APRIL 2016

## QUESTIONS

Before continuing, try to answer the following questions. The answers can be found at the end of the article, together with an explanation. **Please answer True or False:**

### 1. Regarding causes of maternal death in the MBRRACE-UK report:

- Direct maternal deaths have halved since 2003-2005
- There has been a significant change in the indirect maternal death rate, compared with the 2006-08 report
- Thromboembolism is the leading cause for direct maternal deaths
- Cardiac disease is the biggest cause of maternal death
- Death rates from hypertensive disorders of pregnancy are increasing

### 2. Regarding sepsis:

- Deaths due to genital tract sepsis are classified as direct maternal deaths
- There has been an increase in mortality rate from genital tract sepsis
- Coliforms are the most prevalent causative organism of genital tract sepsis
- Influenza was responsible for 43% of sepsis-associated deaths
- 75% of those women who died from influenza had H1N1 strain

### 3. Regarding the following statements:

- General anaesthetic is required for perimortem caesarean section
- Massive haemorrhage protocol should be activated for all perimortem caesarean sections
- Fetal viability should be confirmed before perimortem caesarean section
- Hypotension is a late sign in massive haemorrhage
- Paradoxical bradycardia can develop with massive bleeding

## Key Points

- Maternal mortality rate in UK has been steadily decreasing in past decade, mainly due to reduction in direct maternal deaths.
- Cardiac disease remains the greatest single cause of maternal deaths.
- Thromboembolic disease is the leading cause of direct deaths.
- Specific lessons for anaesthesia include thorough investigation and follow-up of patients diagnosed with post-dural puncture headache, standardised monitoring of the parturients and institution of practice drills for peri-operative airway crises management.

## INTRODUCTION

MBRRACE-UK (Mothers and Babies Reducing Risk through Audits and Confidential Enquiries across the UK) was published in Dec 2014, it replaces the previous triennial maternal mortality report by the Centre for Maternal and Child Enquiries (CEMACE)<sup>1</sup>. Important changes have been made in how maternal mortality in the UK is reported.

- MBRRACE covers surveillance data for maternal deaths for a four year period (2009-12), compared to the traditional three-year period
- Cases from Ireland are included for the first time
- Learning from "near-misses" as well as deaths are included. Near-misses are identified through the UK Obstetric Surveillance System (UKOSS)
- Moving forward maternal mortality data will be reported annually. Each annual report will concentrate on specific review topics and each review topic will be revisited every three years
- Topics presented in the 2014 report were sepsis, haemorrhage, amniotic fluid embolism (AFE), anaesthesia, neurological, and other indirect causes.

Subscribe to ATOTW tutorials by visiting [www.wfsahq.org/resources/anaesthesia-tutorial-of-the-week](http://www.wfsahq.org/resources/anaesthesia-tutorial-of-the-week)

This tutorial summarises the main findings from the MBRRACE report and key lessons gained from the reviewed topics, with special focus on anaesthesia.

## Definitions of maternal deaths (World Health Organisation, 2010)

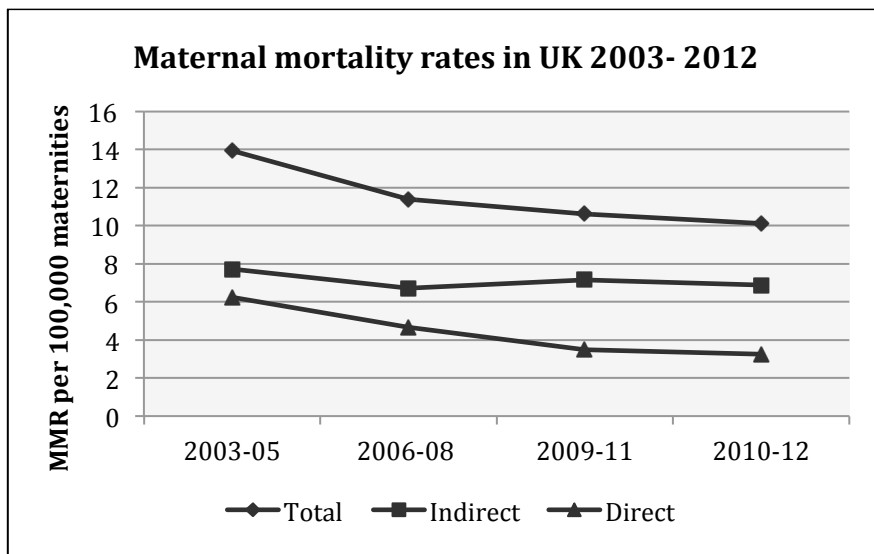
MBRRACE categorises maternal deaths in the following way:

- **Maternal death:** Death of a woman while pregnant or within 42 days of the end of the pregnancy from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.
- **Direct:** Deaths resulting from obstetric complications of the pregnant state (pregnancy, labour and puerperium), from interventions, omissions, incorrect treatment or from a chain of events resulting from any of the above.
- **Indirect:** Deaths resulting from previous existing disease, or disease that developed during pregnancy and which was not the result of direct obstetric causes, but which was aggravated by the physiological effects of pregnancy.
- **Late:** Deaths occurring between 42 days and one year after the end of pregnancy that are the result of Direct or Indirect causes.
- **Coincidental:** Deaths from unrelated causes, which happen to occur during pregnancy or the puerperium.

## CAUSES AND TRENDS

There were 357 maternal deaths in UK and Ireland in 2009-2012. The trends and causes are summarised in Figure 1 and 2. To allow for comparison with previous reporting periods of three years, data is presented for 2009-2011 and 2010-2012.

- 2010-12: 10.12 deaths per 100,000 maternities (n=243)
- 2009-11: 10.63 deaths per 100,000 maternities (n=253)
- 2006-08: 11.39 deaths per 100,000 maternities
- 2003-05: 13.95 deaths per 100,000 maternities.
- This is a statistically significant reduction.
- The reduction is despite an increase in maternities, obesity, immigrants and mothers of advanced age.



**Figure 1:** Falling maternal mortality rate in the UK from 2003 to 2012. Direct maternal deaths have halved whereas indirect maternal death rate has remained unchanged in past decade

### Direct maternal deaths:

- Direct maternal deaths have halved since 2003-2005.
- Thromboembolic disease is the major cause of direct maternal deaths.
- Deaths due to eclampsia, acute fatty liver of pregnancy and HELLP syndrome are at the lowest recorded rate.
- There is statistical significant reduction in deaths due to genital tract sepsis.

### Indirect maternal deaths:

- There is no significant change in the rate of indirect maternal deaths.
- Indirect causes are responsible for twice as many deaths as direct causes.
- “Other indirect causes” groups together a range of causes, including influenza and non-genital tract sepsis. This group was the greatest contributor to indirect deaths.
- 29 deaths occurred due to influenza, 50% of these were considered preventable through vaccination.
- There has been no significant change in death rates from cardiac, psychiatric and neurological causes.
- Cardiac disease continues to be the greatest single cause of maternal deaths.

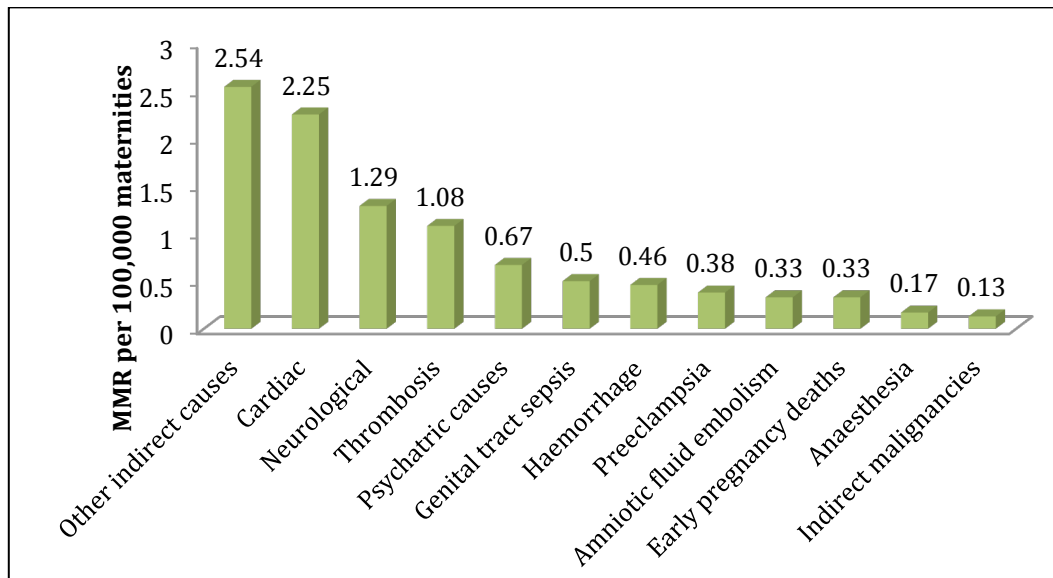


Figure 2: Chart showing maternal mortality by cause from 2010-12

## KEY REVIEW TOPICS


### 1) Sepsis

Sepsis is a major cause of maternal mortality and morbidity. Maternal mortality rate from infectious causes in 2009-12 was 2.04 per 100,000 maternities. 83 women died from sepsis, 20 of these were genital tract sepsis. The causative organisms were Group A Streptococcus in 12 of the cases and, coliform in 6. In two cases no organisms were isolated.

Influenza was implicated in the death of 36 women which accounts for 43% of the sepsis deaths. 75% of these had H1N1 strain. None of the women who died from influenza had been vaccinated. Antiviral and ECMO therapy were considered underutilised.

#### Lessons

- Early recognition and management of sepsis. Detailed history and examination should be performed.
- Assess vital signs regularly and screen for signs of systemic inflammatory response syndrome (SIRS). Any derangement should trigger appropriate action. (Figure 3)
- A patient is septic if she meets criteria for SIRS and has a known infection.
- Use “Sepsis Six” care bundle (Figure 3) when managing septic patients.<sup>2,3</sup>
- A senior anaesthetist should be involved.
- Critical care support should be available.
- Offer influenza vaccine to all pregnant women.
- Repeated presentations to health care providers should be considered a “red flag”

Screening for SIRS	Evaluation for Red Flag Sepsis
<p><b>SIRS is confirmed if ANY TWO of the following are present:</b></p> <ul style="list-style-type: none"> <li>• New onset of confusion or altered mental state</li> <li>• Temperature &gt; 38.3° C or &lt; 36° C</li> <li>• Heart rate &gt;90 beats/min*</li> <li>• Respiratory rate &gt;20 breaths/min</li> </ul> <p><b>Point of care test</b></p> <ul style="list-style-type: none"> <li>• Blood glucose &gt;7.7mmol/L in the absence of known diabetes</li> <li>• White cell count &gt;12 or &lt;4 x10<sup>9</sup>/l</li> </ul>	<p><b>Act immediately if ANY ONE of the following are present:</b></p> <ul style="list-style-type: none"> <li>•Systolic BP &lt; 90mmHg (or &gt;40mmHg fall from baseline)</li> <li>• Heart rate &gt;130 per minute</li> <li>• Oxygen saturations &lt;91%</li> <li>• Respiratory rate &gt;25 breaths/min</li> <li>• Responds only to voice or pain or is unresponsive</li> </ul> <p><b>Point of care test</b></p> <ul style="list-style-type: none"> <li>• Lactate &gt;2.0mmol/L</li> </ul>
	
<p><b>In the presence of documented or presumed infection, use Sepsis Six care bundle (UK Sepsis Trust 2013) <sup>5</sup></b></p> <ul style="list-style-type: none"> <li>• Take an arterial blood gas and give high flow oxygen if required</li> <li>• Take blood cultures</li> <li>• Commence intravenous antibiotics</li> <li>• Start intravenous fluid resuscitation</li> <li>• Take blood for haemoglobin and lactate levels</li> <li>• Measure the urine output hourly</li> </ul>	

\*Guidelines are not specific for pregnancy. Royal College of Obstetricians and Gynaecologists (RCOG) guidance suggests using a threshold of 100 beats/min.<sup>2</sup>

**Figure 3:** SIRS screening and evaluation for Red Flag Sepsis (UK Sepsis Trust 2014) <sup>4</sup>

## 2) Haemorrhage

Haemorrhage was the third most common cause of direct maternal death. During the period of the report, there were 17 maternal deaths due to obstetric haemorrhage. Seven were considered associated with uterine atony, seven with genital tract trauma, two with placental abruptions and one with placenta percreta. Two cases involved were Jehovah's Witnesses.

### Lessons

- Good communication and teamwork is essential for improving outcomes.
- Investigate and treat antenatal anaemia.
- Early recognition of severity is essential.
- Pre-emptive management helps prevent metabolic acidosis, coagulopathy and anaemia.
- All abnormal observations should be acted upon: hypotension is a late sign; paradoxical bradycardia can develop in massive bleeding.
- Start early resuscitation with warm intravenous fluids.
- Haemoglobin level can give false reassurance during a massive haemorrhage because values do not change from normal until redistribution of interstitial fluid into the blood plasma occurs.
- Consideration should be given to using blood products early, before coagulation tests deteriorate. Ideally as part of a massive haemorrhage protocol.
- Early control of source of bleeding.
- Careful usage of uterotonics.
- Hysterectomy should not be deferred until the woman is in extremis.

## 3) Amniotic fluid embolism (AFE)

AFE is rare but often fatal; the fifth leading cause of direct maternal deaths. There were 11 maternal deaths reported due to AFE; seven intrapartum, one post and three during caesarean section.

### Lessons

- Good resuscitation is essential for survival of the women with AFE.
- In maternal collapse advanced life support should be initiated promptly. AFE is a clinical diagnosis. Reversible causes should be considered (*BEAU-CHOPS*) (Figure 4).
- Aim to perform perimortem caesarean section within five minutes of cardiac arrest.<sup>6</sup>
- Anaesthetic is not necessary for perimortem section
- Haemorrhage should be anticipated in a perimortem section and it is suggested to activate the massive haemorrhage protocol.

Causes of maternal collapse: BEAU-CHOPS
<b>B</b> leeding-DIC
<b>E</b> mbolism- coronary, pulmonary, amniotic fluid
<b>A</b> naesthetic complications
<b>U</b> terine atony
<b>C</b> ardiac disease – MI, ischaemia, aortic dissection, cardiomyopathy
<b>H</b> ypertension, pre-eclampsia, eclampsia
<b>O</b> ther (4 Hs & Ts from ALS guidelines) <sup>7</sup>
<b>P</b> lacenta abruption/previa
<b>S</b> epsis

**Figure 4:** Mnemonic for causes of maternal collapse

#### 4) Anaesthesia

There has been a reduction in deaths due to anaesthesia in last 30 years. In this report there were four deaths directly related to anaesthesia.

##### **Neuraxial anaesthesia:**

Two women died following unintentional dural puncture during epidural insertion. One patient was treated conservatively, the other received an epidural blood patch. Neither had follow-up arranged. They both had a persistent headache and re-presented as emergencies. One had a subdural haematoma and the other cerebral venous thrombosis. Despite a reduced level of consciousness, one woman was transferred to a neurosurgical unit without an appropriately skilled escort.

##### **Lessons**

- In women who suffer a dural puncture headache, their GP should be notified and routine hospital follow-up arranged.
- In women diagnosed with post-dural puncture headache, other intracranial causes such as subdural haematoma and cerebral venous thrombosis should be considered.
- Women (in pregnancy or in postpartum period) with serious neurological symptoms should be urgently referred to a neurological unit. Appropriate medical (usually anaesthetic) personnel should be involved in transferring parturients with a reduced level of consciousness.

##### **General anaesthesia:**

Two deaths occurred under general anaesthetic. Both had an elevated BMI. One woman suffered prolonged hypoventilation during general anaesthesia, possibly due to severe undiagnosed bronchospasm. In this case ventilation was not possible following tracheal intubation and fixation on malposition of the endotracheal tube (ET) as a cause for this resulted in repeated removal and re-siting of the ET. This fixation error probably resulted in failure to consider other causes of difficult ventilation such as severe bronchospasm.

A second patient suffered prolonged hypoventilation post extubation following anaesthesia for management of postpartum haemorrhage. In this case, patient monitoring during the post-operative period was judged to have been inadequate.

##### **Lessons**

- Simulation should be used to practice management of intraoperative airway crises (e.g. severe bronchospasm, difficult intubation).
- Training should include specific attention to human factors (e.g. fixation error).
- Monitoring standards in recovery must be same for parturients as for non-pregnant women.

##### **Collapse after anaesthesia:**

One woman collapsed after epidural-top-up and one woman after local anaesthetic infiltration at the end of caesarean section. Efficient CPR was performed in both cases including the administration of intralipid even though local anaesthetic toxicity was uncertain. The deaths were not attributed to anaesthesia.

##### **Lessons**

- Anaesthetists must be able to deal with adverse effects of local anaesthetics.
- Restrict the use of higher concentrations of local anaesthetics.
- Intralipid must be immediately available.
- There is a broad differential diagnosis for collapse in the peripartum period (Figure 4).

### **Hyperkalaemia:**

A pre-eclamptic woman with mild renal impairment, who had an elective caesarean section, received diclofenac rectally for postoperative analgesia. She developed hyperkalaemia with deteriorating renal function, which was not promptly treated: she subsequently had a cardiac arrest and died.

### **Lessons**

- Diclofenac (NSAIDs) should be avoided in patients with renal dysfunction.
- Hyperkalaemia should be treated promptly.

### **Other lessons specific to anaesthetists:**

- All maternity units should provide training for team working.
- Ambulance services must provide training regarding left uterine displacement in the management of maternal collapse.
- Care should be taken with induction agents in critically ill patients (especially thiopentone due to its relative unfamiliarity).
- Temperature monitoring and appropriate measures to prevent intraoperative hypothermia should be used, especially during prolonged cases and those with significant bleeding.
- Senior advice should be sought for women requiring parental opioids for severe abdominal pain.
- Anaesthetists must be involved in system reviews of adverse events or serious incidents in maternity care.
- Parturients should have regular monitoring and appropriate responses should be triggered if observations are abnormal. This practice should be audited regularly.

## **5) Neurological complications**

In the period 2009-12, there were 14 maternal deaths associated with seizures, a rate of 0.40 per 100,000 maternities. Sudden unexpected death in epilepsy (SUDEP) was the most common cause of death. Intracerebral haemorrhage was the cause of death in 26 women in 2009-12, 13 of these had subarachnoid bleeds.

### **Lessons**

- All women with a diagnosis of epilepsy should receive pre-pregnancy counselling and an agreed treatment plan made with respect to antiepileptic medications.
- According to National Institute for Health and Care Excellence (NICE) guidelines<sup>8</sup> women with epilepsy should not be admitted in single rooms because they could have unwitnessed seizures and SUDEP.
- Guidelines for the management of pregnant women with epilepsy are required.
- All pregnant women with new onset headache, or who demonstrate aberrant features, should have a neurological examination and assessment for neck stiffness.
- Hypertensive women should not receive ergometrine for management of the third stage of labour.
- Outcomes in women with subarachnoid bleed are improved by close communication between obstetric, neurology and neurosurgical teams.

## **6) Medical disorders**

There were 10 deaths from respiratory disease (excluding influenza), three due to asthma. Other causes of maternal death included: connective tissue disorders, liver disease, endocrine, haematological, and gastroenterological disorders

### **Lessons**

- Pre-pregnancy advice should be given to women with pre-existing medical disorders.
- Women with medical conditions should have individualised care plans formulated with multidisciplinary input.
- Anaesthetists and physicians should be involved promptly in the care of pregnant women with acute respiratory compromise.
- There should be a low threshold to admit pregnant women with acute exacerbation of asthma

### Summary of key points from MBRRACE-UK:

- There has been a statistical significant decline in the maternal mortality rate.
- **Decrease is due to reduction in direct maternal deaths:** a result of pregnancy related complications e.g. thrombosis, genital tract sepsis, haemorrhage. These have halved over last 10 years.
- There has been no change in the indirect maternal death rate: pre-existing or new medical problems not a result of pregnancy e.g. heart disease, epilepsy. **Indirect causes are now responsible for twice as many deaths as direct causes.**
- **Cardiac disease** continues as the greatest single cause of maternal deaths.
- **Thromboembolic disease** is the leading cause of direct deaths.
- “Other indirect causes” are the leading cause of indirect maternal deaths, including influenza and non-genital tract sepsis. Nearly a quarter of deaths were related to sepsis.
- Deaths directly attributed to anaesthesia have declined over the last 30 years. Four were reported in MBRRACE. Two deaths occurred under general anaesthetic. Two women died following unintentional dural puncture during epidural insertion.

### Key lessons for anaesthesia:

- Importance of communication to GP and outpatient follow-up of women with post-dural puncture headache.
- Consider other intracranial causes in women with post-dural puncture headache
- Anaesthetists should practice drills for managing peri-operative airway crises
- Monitoring standards in recovery must be same for parturients as for non-pregnant women



## Answers to questions

1.

- a. **True.** Direct maternal deaths have halved since 2003-2005.(6.24 per 100,000) maternities in 2003-2005 and 3.25 per 100,000 maternities in 2010-2012)
- b. **False.** For indirect maternal deaths there has been no statistically significant change.
- c. **True.** This is thought to be related to increasing obesity.
- d. **True.** Cardiac disease remains the largest single cause of indirect maternal deaths. There was no significant change in the maternal mortality rate from cardiac disease between 2006-08 and 2010-2.
- e. **False.** Deaths from pre-eclampsia, eclampsia and HELLP syndrome are at their lowest ever recorded rate.

2.

- a. **True.** Deaths due to genital tract sepsis are classified as direct maternal deaths and deaths due to other infections are classified as indirect maternal deaths.
- b. **False.** There is a statistically significant reduction in deaths due to genital tract sepsis.
- c. **False.** Group A Streptococcus is most common.
- d. **True.** 36 women died from influenza which accounts for 43% of deaths associated with sepsis.
- e. **True.** 27 of the 36 women had confirmed H1N1.

3.

- a. **False.** Anaesthesia is not required before commencing a peri-mortem caesarean section.
- b. **True.** It is suggested that massive haemorrhage protocol should be activated
- c. **False.** Perimortem caesarean section is carried out for the benefit of the woman; there is no need to confirm fetal viability. Doing so leads to loss of valuable time.
- d. **True.** Hypotension is a late sign in haemorrhage.
- e. **True.** Tachycardia most common, but paradoxical bradycardia can develop.

## References:

1. Knight M, Kenyon S, Brocklehurst P, Neilson J, Shakespeare J, Kurinczuk JJ, editors, on behalf of MBRRACE-UK. Saving lives, improving mothers' care-lessons learned to inform future maternity care from the UK and Ireland confidential enquiries into Maternal deaths and Morbidity 2009-12. Oxford: National Perinatal Epidemiology Unit. University of Oxford, 2014
2. Royal College of Obstetricians and Gynaecologists. (2012a). "Green-top Guideline No. 64a. Bacterial Sepsis in Pregnancy." from <http://www.rcog.org.uk/files/rcogcorp/25.4.12GTG64a.pdf>
3. Royal College of Obstetricians and Gynaecologists. (2012b). "Green-top Guideline No. 64b. Bacterial Sepsis following Pregnancy." from <http://www.rcog.org.uk/files/rcog-corp/25.4.12GTG64a.pdf>.
4. UK Sepsis Trust. (2014). "Primary Care Toolkit." from [http://sepsistrust.org/wp-content/files\\_mf/1409322498GPtoolkit2014.pdf](http://sepsistrust.org/wp-content/files_mf/1409322498GPtoolkit2014.pdf).
5. UK Sepsis Trust. (2013). "Clinical Tools." from <http://sepsistrust.org/info-for-professionals/clinical-tools/>.
6. Royal College of Obstetricians and Gynaecologists. (2011c). "Green-top Guideline 56. Maternal Collapse in Pregnancy and the Puerperium." from <http://www.rcog.org.uk/womens-health/clinical-guidance/maternalcollapse-pregnancy-and-puerperium-green-top-56>.
7. Resuscitation Council (UK). [Adult advanced life support](https://www.resus.org.uk/resuscitation-guidelines/adult-advanced-life-support/) guidelines from <https://www.resus.org.uk/resuscitation-guidelines/adult-advanced-life-support/>
8. National Institute for Health and Care Excellence. (2012). "CG137. The epilepsies: the diagnosis and management of the epilepsies in adults and children in primary and secondary care." from <http://www.nice.org.uk/guidance/CG137>.

**Acknowledgement:** We thank Dr Mohan Sathyamoorthy, Anaesthetics Registrar Queens Hospital, Burton, for suggesting this topic.



This work is licensed under the Creative Commons Attribution-NonCommercial 3.0 Unported License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc/3.0/>