



# The Open Public Health Journal

Content list available at: <https://openpublichealthjournal.com>



## RESEARCH ARTICLE

### Current Status of Obstetric Anaesthesia Services (OASIS); A Cross-sectional Survey of Public Hospitals in Khartoum State, Sudan

Sohel M G Ahmed<sup>\*,1</sup>, Amna Mustafa Ali<sup>2,3</sup>, Tayseer Salih Mohamed<sup>4</sup>, Mohamed Sayed M Hajnour<sup>5,6</sup>, Hayat O. Elfil<sup>1</sup>, Samahir F M Hussein<sup>2,3</sup>, Dalia Abdelrahman<sup>7</sup>, Abdelrahman Elteгани<sup>8,9</sup>, Ahmed M A A Abusalab<sup>2</sup>, Aala F Elhadi<sup>10</sup>, Amna Eljak<sup>11,12</sup> and Hadab Ahmed Mohamed<sup>13,14</sup>

<sup>1</sup>Hamad General Hospital, Hamad Medical Corporation, Doha, Qatar

<sup>2</sup>Department of Anaesthesia, University of Khartoum, Khartoum, Sudan

<sup>3</sup>Soba University Hospital, Khartoum, Sudan

<sup>4</sup>Saad Abu Alela Hospital, Khartoum, Sudan.

<sup>5</sup>King Khalid University Hospital, Riyadh, KSA

<sup>6</sup>King Saud University, Riyadh, KSA

<sup>7</sup>Rotunda Maternity Hospital, Dublin, Ireland

<sup>8</sup>Alzaaiem Alazhary University, Khartoum, Sudan

<sup>9</sup>Alshaab Teaching Hospital, Khartoum, Sudan

<sup>10</sup>Rashid Trauma Centre, Dubai, UAE

<sup>11</sup>Khartoum Academy Charity Hospital, Khartoum, Sudan

<sup>12</sup>University of Technology and Medical Science, Khartoum, Sudan

<sup>13</sup>Faculty of Medicine, University of Khartoum, Khartoum, Sudan

<sup>14</sup>Department of Anaesthesia, The National Centre for Neurological Sciences (NCNS), Khartoum, Sudan

#### Abstract:

##### Background:

Medical services in general, and anaesthetic services in particular, in Sudan have been vulnerable to changes secondary to the socio-economic factors over the last few decades.

##### Objective:

This cross-state survey aims to identify the current set up of obstetric anaesthesia services in 19 hospitals - representing all public hospitals in Khartoum State with maternity units- and audit them against internationally set standards.

##### Methodology:

This is a cross-sectional descriptive non-interventional study. Questionnaires- based on the World Federation of Societies of Anaesthesiologists (WFSA) Safe Anaesthesia Standards- were distributed to Anaesthetic departments' heads at the time of the study (first to fourteenth of May 2016) of 19 public hospitals. This is the total number of public hospitals delivering obstetric services in Khartoum State. All filled out questionnaires were returned (response rate 100%). Collected information/data provided were subsequently entered into an Excel sheet and analysed. Results were tabulated.

##### Results:

There was a considerable variation in the capacity of the surveyed hospitals in terms of human resources, caseload and set up. Improper utilisation of already deficient anaesthesiologist in covering high load obstetrics services was also noticed. All the hospitals fell short of recommendations for minimum standards set by the World Federation of Societies of Anaesthesiologists (WFSA).

##### Conclusion:

There is a vast gap between international set standards and the current set up of obstetric anaesthesia in Khartoum State public hospitals. Necessary concerted efforts from governmental, non-governmental and professional bodies are warranted to improve obstetric anaesthetic services in Khartoum State.

**Keywords:** Obstetrics, Anaesthesia, Setup, State, Hospitals, Khartoum.

#### Article History

Received: February 12, 2019

Revised: May 21, 2019

Accepted: June 14, 2019

## 1. INTRODUCTION

In 2015, the WHO estimated that over 303,000 women died of complications in childbirth [1]. The maternal mortality rate in Sudan in the same year was calculated to be 311 per 100,000 live births, ranking it the 40<sup>th</sup> worst place globally [1]. Ninety-nine percent of maternal deaths occurs in resource-poor countries [2] where access to family planning, antenatal care and emergency obstetric services is limited.

In many developing countries, especially sub-Saharan Africa, there is a critical shortage of healthcare providers and minimal resources [3]. Sudan is no exception. Decades of “brain drain”, insecurity and the economic toll of long-term conflicts impacted negatively the country’s development in general and healthcare, in particular [4].

Anaesthesia services have not been immune to these factors. Nationally, there are too few physician anaesthetists. At the time of this survey, the number of consultant anaesthetists registered with the Sudan Medical Council (SMC) was 378, not all of these are currently practising in Sudan, and some of them passed away in recent years [5]. This led to frequent delivery of anaesthesia by non-physicians (technicians and assistants). Anaesthetic technicians are high school graduates who proceed to receive four years of training in college. Anaesthetic assistants, on the other hand, are nurses who receive further two years training in anaesthesia. Throughout Sub-Saharan Africa, anaesthesia services are deemed by many, including senior healthcare management, as a low priority specialty and often lacks the voice to demand additional resources [6].

To our knowledge, there has been no survey, to date, that quantifies and describes challenges faced by anaesthetists delivering obstetric services in Khartoum State. We believe this is an essential step in planning comprehensive and optimum service delivery, and in effective utilisation of current resources, in addition to adopting a training curriculum which matches the needs and is based on local settings.

## 2. METHODOLOGY

The study was a cross-sectional survey conducted in Khartoum State from the first until the fourteenth of May 2016. All public hospitals providing obstetric anaesthesia in Khartoum State were included in the survey. The list of the hospitals was provided by the Khartoum State Ministry of Health. We developed a survey tool based on WFSA safe standards and the WHO Safety Checklist [16, 7]. We also assessed other parameters, such as the number and experience of service providers, equipment availability and medications. Data was collected in a pre-set questionnaire filled by anaesthesia head department in each enrolled hospital (Annex A). All the questionnaires were filled and returned (response rate 100%). The data was entered into an Excel sheet and analysed by one of the investigators (TSM). As this survey was non-interventional and did not include human subjects, the need for ethical approval was waived away by the Ethics and

Research Committee of the State Ministry of Health, Khartoum State.

## 3. RESULTS

There are nineteen public state hospitals which currently deliver obstetric services. Their names and locations were provided by the State Ministry of Health (Table 1). Hospitals affiliated to armed forces (police, military, internal security forces) and privately-owned hospitals were not included in this study, as they enjoy different set of governing systems, financial revenues, set-up and staffing levels. We could not establish how many deliveries occur in these facilities.

There was a huge variation in the capacity of the studied hospitals. Three of the hospitals (TRK, OMH and SAU, all being stand-alone obstetric hospitals) accounted for 66.3% of all in-hospital deliveries. Some units were much smaller with less than 1000 deliveries per annum. One particular hospital (JBT) had only 40 births in 2015. The majority of the obstetric units had a delivery rate between 2000 and 4000 (Table 1).

The number of senior physicians available varied significantly across these units so did the availability of junior doctors and non-physician staff (Table 1). While all the hospitals had one or more consultant obstetricians among its staff, five of these hospitals had no consultant anaesthetists affiliated to them, head departments in these institutions were either anaesthetic technicians or assistants or had none. There was also considerable variation in the ratio of consultant physicians to deliveries, indicating that human resources were probably not uniformly distributed throughout the state. Only six of these hospitals were allocated anaesthetic trainees.

Availability of anaesthetic equipment was uniformly deficient throughout the different hospitals. While almost all the hospitals had an anaesthetic machine per room, the obstetric hospital with the highest case load (OMH) reported that none of their 12 machines was fit for purpose. The caesarean section rate in OMH is around 30% [8]. Accordingly, there are more than 10,000 caesarean deliveries per annum without adequate anaesthesia resources. Six of the hospitals had no ventilators, indicating that lung ventilation was carried out *via* manual bagging. Fifty-two out of the fifty-eight operating rooms (ORs) designated for obstetric surgeries had one or more pulse oximeters. 12 of the 19 hospitals had a ready access to a defibrillator. Five of the investigated hospitals had no facilities to ensure ECG monitoring intraoperatively, while another three reported the occasional presence of same.

Only three anaesthetic departments were equipped with a difficult airway setup; however, 6 of the other departments did not have necessary airway adjuncts, such as bougies and stylets. Suction apparatus was available in all ORs albeit on-demand basis in some of them.

The setup for neuraxial anaesthesia seemed to be better established. All the anaesthetic departments studied had access to spinal needles. Four hospitals, however, reported using size 23G and larger size needles. These needles are associated with higher incidences of post-dural puncture headaches (PDPH), and their routine use is discouraged [9]. Both lignocaine and bupivacaine were observed to be equally available. However,

\* Address correspondence to this author at the Hamad General Hospital, Hamad Medical Corporation, PO Box 11340, Doha, Qatar; Tel: +97450586481; Email: sohelm@yahoo.com

**Table 1. Distribution of health care staff and equipment in the surveyed hospitals.**

	<b>Group A Hospitals with deliveries =/ &gt; 4000 per annum</b>	<b>Group B Hospitals with deliveries between &gt; 1000 &lt;4000 per annum</b>	<b>Group C Hospitals with 100 deliveries or less per annum</b>
Hospitals and abbreviations	Turkish Hospital (TRK), Omdurman Maternity H. (OMH), Ibrahim Malik Hospital (IMH), Soba University Hospital (STH), Chinese Friendship Hospital (CFH), Saudi Hospital (SH)	Ali Abdelfattah H. (AAF), Bahri Teaching Hospital (BTH), Saad Abu AlEla Hospital (SAH), Academy Charity Hospital (KAH), Bashayir Hospital (BH), Haj Elsafi Hospital (HGH), Al-Ban Jadeed Hospital (ABJ)	Garri Hospital (GAR), Al-Jazeera Slang Hospital (AJS), Jebail Al-Tena Hospital (JTH), Um-Dawan Ban H. (UDB), Jabl Awleya Hospital (JTH), Umbadda Hospital (UBH)
No of Obstetric Operating Rooms (OR) Median (range)	3 (1-12)	2 (1-3)	2
Deliveries per annum Median (range)	6885 (4000- 36000)	2700 (1600-3860)	162 (65-700)
No of Consultant Obstetricians per facility Median (range)	14 (9-18)	4 (2-10)	2 (1-5)
No of Consultant Anaesthetists per facility Median (range)	4 (3-13)	4 (1-5)	0 (0-1)
No of anaesthetic machines in the hospital Median (range)	3 (1-12)	2 (1-3)	2 (1-3)
No of pulse oximeters in OR Median (range)	1 (1-4)	2 (1-3)	1 (1-2)

ephedrine was the main vasoconstrictor used, as phenylephrine has not been licensed in Sudan [10].

Most anaesthetic departments had emergency medications available. Only three, however, believed that access to blood and blood products was consistent and reliable. WHO regional analysis of maternal mortality in Africa identified haemorrhage, along with hypertensive disorders, sepsis, and pulmonary embolism as the predominant ailments [11].

None of the hospitals investigated had an incubator to transfer neonates in place, only two had a Post-Anesthetic Care Unit (PACU), and six had an Intensive Care Unit (ICU) within the premises.

#### 4. DISCUSSION

To our knowledge, this is the first survey that analysed obstetric anaesthesia services in Khartoum state. The reason we only included Khartoum state in this study was that it is the most populated state in Sudan. The population census conducted in 2008 showed that over 5 million inhabited the capital [12], many believe that this number has doubled in recent years [13, 14].

In 2010, the World Federation of Societies of Anaesthesiologists (WFSA) described a list of essential equipment and drugs requirements for delivery of safe anaesthesia [7]. Recommendations specific to the delivery of safe obstetric anaesthesia was endorsed by the Anaesthetists Association of Great Britain and Ireland (AAGBI) [15] and the American Society of Anesthesiologists (ASA) [16]. In 2018, the WHO and WFSA published an updated version regarding the safe practice of anaesthesia [17].

For caesarean section, the most common obstetric surgery, the requirement was to be able to safely provide adult general anaesthesia and spinal anaesthesia, and to have access to blood transfusion and drugs for the treatment of common obstetric problems such as haemorrhage, pre-eclampsia and eclampsia [18].

Effective obstetric anaesthesia services are closely related to maternal well-being and pregnancy outcomes. In setting its safety standards, the WFSA recommends that facilities providing caesarean sections, have to be able to provide adult general anaesthesia and spinal anaesthesia safely and should provide access to blood transfusion and drugs for the treatment of common obstetric problems such as haemorrhage, pre-eclampsia and eclampsia [3, 7, 18].

Women fertility in Sudan is estimated by the World Bank to be around 4.4 per woman [19]; this, in addition to the exponentially growing urban population resulting from rural to city migration, puts a burden on an already overextended service. When it comes to deliveries, only 18% of births in Sudan are delivered in a healthcare facility, and only 13.2% are delivered in a public hospital [20].

Human resources are the backbone of any service. In this study, anaesthetic, and human resources are both insufficient and ill-distributed (Table 1). Currently, a significant portion of obstetric anaesthetic services is delivered by anaesthetic assistants (nurses with 2-year training in anaesthesia) and the newly introduced anaesthetic technicians. This is deemed by many as an unsafe practice; national anaesthetic and perioperative organisations recommend that they are “to be supervised at all times” [21, 22]. The presence of a trained anaesthesiologist is a cornerstone in patient safety. Anaesthetic

technicians' job plan and scope of responsibilities remain to be clearly defined by the Ministry of Health in Sudan [10]. Clear obligatory regulations should be released by the health authorities to limit the unsupervised practice of anaesthetic assistants in locations privileged by physician-anaesthetist-based service

Sudan has preserved the model of stand-alone obstetric hospital it inherited from colonial Great Britain and is found nationwide. Safety and efficiency of such a model have undergone immense criticism with more countries moving away from it [23 - 25].

Another point worth mentioning is that some health facilities had a limited number of deliveries per annum (Table 1), with one as low as 40 deliveries in total in 2015. A recent study in East Africa concluded that Hospitals with less than 1000 deliveries per year are a significant concern, as the caseloads are too low to enable the acquisition or maintenance of skills for safe operative services [26]. Small volume centres are associated with worse outcomes, and we believe that the redirection of services towards high volume centres would be more resource efficient and safer practise. It has to be taken into consideration, however, that Khartoum State extends over an area of more than twenty-two thousand kilometers square. Infrastructure such as paved roads and rail service is poorly developed, with some regions partially accessible during the rainy season. For these, the presence of healthcare units in their area is of paramount importance.

Huge safety leaps in anaesthesia were only witnessed in the second half of the twentieth century and the beginning of the twenty-first. This was promoted primarily *via* advances in technology, such as anaesthetic delivery systems, monitoring devices and medications. Most hospitals in this study have shown critical shortages in all above mentioned domains of health care. No anaesthetic should be delivered without a fully functioning anaesthetic machine. The practise of manual bagging an anaesthetised patient is hazardous and -in the combined absence of capnography - may lead to detrimental effects secondary to hypercarbia, hypocarbia and possible barotrauma. Inadequate setup and improper application of safety measurements when utilizing regional anaesthesia, such as hand hygiene and aseptic techniques in neuraxial blocks, may have severe sequelae. Perioperative support systems, e.g. neonatal ICU backup, is a necessity if best outcomes are sought.

## CONCLUSION

Obstetric anaesthesia services in Khartoum are inadequate and are unable to deliver safe service to a large portion of pregnant ladies. Substandard care remains a leading avoidable factor in many maternal deaths, particularly those due to anaesthesia, the majority of which are associated with a lack of skills in basic anaesthesia and resuscitation [27]. An urgent national review by bodies responsible for health services in the country is warranted. As Hodges and Mujambi of Uganda nicely summarised in their article “ (studies) are the first step to quantifying and describing the problems faced by anaesthetists in developing countries, and one that can be used by national anaesthesia societies and governments in developing countries

to improve management and planning of anaesthesia services, target education and enable limited resources to be used effectively” [26]. Professional bodies, such as the Sudan Society of Anaesthesiologists, need to make their voices heard. Minimum standards on safe service delivery need to be agreed upon and audited regularly. This cannot and should not wait. This should happen now.

## AUTHORS' CONTRIBUTIONS

- SMGA helped to design the study, conduct the study and write the manuscript, seen the original study data, reviewed the analysis of the data, approved the final manuscript
- AMA helped to design the study, conduct the study and write the manuscript, collected the original study data, reviewed the analysis of the data and approved the final manuscript.
- TSM helped to design the study, conduct the study and write the manuscript, collected the original study data, reviewed the analysis of the data, approved the final manuscript and is the author responsible for archiving the study files.
- MSMH helped to design the study, conduct the study and write the manuscript, has seen the original study data, reviewed the analysis of the data, approved the final manuscript.
- HOE helped to design the study, conduct the study and write the manuscript, seen the original study data, reviewed the analysis of the data, approved the final manuscript.
- SFMH helped to design the study, conduct the study and write the manuscript, collected the original study data, reviewed the analysis of the data and approved the final manuscript.
- DOA helped to design the study, conduct the study and write the manuscript, seen the original study data, reviewed the analysis of the data, approved the final manuscript.
- AE helped to design the study, conduct the study and write the manuscript, collected the original study data, reviewed the analysis of the data and approved the final manuscript.
- AMAAA helped to design the study, conduct the study and write the manuscript, collected the original study data, reviewed the analysis of the data and approved the final manuscript.
- AFE helped to design the study, conduct the study and write the manuscript, has seen the original study data, reviewed the analysis of the data, approved the final manuscript.
- AFE helped to design the study, conduct the study and write the manuscript, collected the original study data, reviewed the analysis of the data and approved the final manuscript.
- HAM helped to design the study, conduct the study and write the manuscript, collected the original study data, reviewed the analysis of the data and approved the final manuscript.

**ETHICS APPROVAL AND CONSENT TO PARTICIPATE**

As this survey was non-interventional and did not include human subjects, the need for ethical approval was waived away by the Ethics and Research Committee of the State Ministry of Health, Khartoum State.

**HUMAN AND ANIMAL RIGHTS**

No animals/ humans were used in the study that is basis of this research.

**CONSENT FOR PUBLICATION**

Not applicable.

**AVAILABILITY OF DATA AND MATERIALS**

The data supporting the findings of the article is available in a secured file password protected in the main investigator's computer.

**FUNDING**

None.

**CONFLICT OF INTEREST**

The authors declare no conflict of interest, financial or otherwise.

**ACKNOWLEDGEMENTS**

Declared none.

**ANNEX (A) HOSPITAL DATA COLLECTION SHEET**

- [1] Name of hospital .....
- [2] Number of operating theatres in hospital .....
- [3] Number of operating rooms delivering obstetric services .....
- [4] Number of consultant obstetricians affiliated to the hospital .....
- [5] Number of consultant anaesthetists affiliated to the hospital.....
- [6] Number of anaesthetic registrars .....
- [7] Number of anaesthetic technicians .....
- [8] Number of anaesthetic assistants .....
- [9] Number of maternal deliveries in 2015 .....
- [10] Number of beds in labour ward .....

**Are the following equipment and monitors available in your institution for obstetric surgeries around the clock?**

<i>Item</i>	<i>Always</i>	<i>Sometimes</i>	<i>Never</i>	<i>Remarks</i>
Functioning anaesthetic machines				no. of machines
ventilators				No of vent
Pulse oximeter				No. of devices
Capnography				
BP measuring devices				
ECG monitoring				
Arterial lines (invasive BP monitoring)				
Central lines				
Laryngoscopes				
Disposable endotracheal tubes				
Buggies/stylets				
LMAs				
Difficult intubation aids (iLMA, McCoy blades, videoscopes)				Commonest available
Suction apparatus				
Operating table with tilting capabilities				
Equipped Neonatal incubator				
defibrillators				No in theatres
Sterile gloves				
Spinal needles				Commonest size
Epidural needles				
bupivacaine				
Lignocaine				
IV anaesthetic drugs (thio, propofol, ketamine)				Commonest used in CS
Suxmethonium				
Anaesthetic vapour				Commonest available
Air cylinders				
N2O cylinders				
Atropine				
Ephedrine				
phenylephrine				

(Annex) contd.....

Item	Always	Sometimes	Never	Remarks
adrenaline				
Blood products				
Uterotonics (oxytocin, ergo, etc)				Commonest available
Magnesium Sulphate				
Recovery area				No of spaces
HDU				No of beds
ICU				No of beds

## REFERENCES

- [1] Global health Observatory (GHO) Data, WHO [online] accessed 29th July 2016 [http://www.who.int/gho/maternal\\_health/mortality/maternal/en/](http://www.who.int/gho/maternal_health/mortality/maternal/en/)
- [2] WHO. (2010) Trends in Maternal Mortality: 1990 to 2008. Geneva: World Health Organization [online]. Accessed 29th July 2016 [https://apps.who.int/iris/bitstream/handle/10665/44423/9789241500265\\_eng.pdf](https://apps.who.int/iris/bitstream/handle/10665/44423/9789241500265_eng.pdf)
- [3] WHO. <https://www.who.int/whr/2006/en/> Working together for health. The World Health Report 2006 [online] accessed on 29th July 2016
- [4] Isam Mohammed Abdel-Maged. Isam Mohammed Abdel-Maged, Brain drain in the Sudan: pros and cons [Online]. accessed 31 December 2016. <https://www.researchgate.net/publication/287196399>
- [5] Personal communication with Sudan Medical council (SMC).
- [6] Bharati Sachidanand Jee, Chowdhury Tumul, Gupta Nishkarsh, *et al.* Nigerian Medical Journal. Anaesthesia in underdeveloped world: Present scenario and future challenges. 2014 Jan-Feb; 55(1): 1-8
- [7] Merry AF, Cooper JB, Soyannwo O, Wilson IH, Eichhorn JH. International Standards for a Safe Practice of Anesthesia 2010. *Can J Anaesth* 2010; 57(11): 1027-34. [<http://dx.doi.org/10.1007/s12630-010-9381-6>] [PMID: 20857254]
- [8] Carlson VM, Omer MI, Ibrahim SA, *et al.* Fifty years of Sudanese hospital-based obstetric outcomes and an international partnership. *BJOG* 2011; 118(13): 1608-16. [<http://dx.doi.org/10.1111/j.1471-0528.2011.03092.x>] [PMID: 21917111]
- [9] Reynolds F. Dural puncture and headache. *BMJ* 1993; 306(6882): 874-6. [<http://dx.doi.org/10.1136/bmj.306.6882.874>] [PMID: 8490408]
- [10] National Medical Supplies Fund. <http://nmsf.gov.sd/prices/medicines> Accessed 13 February 2017
- [11] Khan KS, Wojdyla D, Say L, Gülmezoglu AM, Van Look PF. WHO analysis of causes of maternal death: a systematic review. *Lancet* 2006; 367(9516): 1066-74. [[http://dx.doi.org/10.1016/S0140-6736\(06\)68397-9](http://dx.doi.org/10.1016/S0140-6736(06)68397-9)] [PMID: 16581405]
- [12] Central Bureau of Statistics (Sudan). 5th Sudan population and housing census - 2008 - Priority results, 26 April 2009 [online]. Accessed 8th February 2017
- [13] World Population Review. <http://world-population-review.com/countries/sudan-population> Accessed on 8th February 2017
- [14] World Health Organization (WHO). Working together for health. The World Health Report 2006. [Online]. //http://www.who.int/whr/en Accessed on 01/02/2017
- [15] Association of Anaesthetists of Great Britain and Ireland (AAGBI) Online..
- [16] American Society of Anaesthesiologists (ASA). <https://www.asahq.org/about-asa/newsroom/news-releases/2009/03/asa-supports-ihisprint-action-day-for-who-surgical-safety-checklist> Retrieved on 10th February 2016
- [17] Adrian W. Gelb, MBChB, FRCPC • Wayne W. Morriss, MBChB, FANZCA • Walter Johnson, MD. World Health Organization-World Federation of Societies of Anaesthesiologists (WHO-WFSA) International Standards for a Safe Practice of Anesthesia. *Canadian Journal of Anesthesiology* 2018; 65(6): 698-708. [<http://dx.doi.org/10.1007/s12630-018-1111-5>]
- [18] Anonymous . International standards for a safe practice of anaesthesia. *Eur J Anaesthesiol* 1993; 10: 12-5.
- [19] World Bank. <http://data.worldbank.org/indicator/SP.DYN.TFRT.IN> Accessed on 25/01/2017.
- [20] World Health Organization. 2017. Sudan: Country Profile. Geneva: Department of Making Pregnancy Safer, 2011. Online. [www.who.int/making\\_pregnancy\\_safer/countries/sud.pdf](http://www.who.int/making_pregnancy_safer/countries/sud.pdf) Accessed on 25/01/2017
- [21] Royal College of Anaesthetists (UK). Joint statement from the RCoA and AAGBI on the Scope of Practice of Physicians' Assistants (Anaesthesia). 18 April 2016
- [22] Medical Sciences Council of New Zealand. Guideline for the professional relationship between anaesthesia technicians and anaesthetist. August 2014
- [23] Ministry of Health. Review of the quality, Safety and Management of Maternal services in the Wellington Area. [Online] <https://www.health.govt.nz/system/files/documents/publications/maternal-services-review-oct08-v2.pdf>
- [24] National Health Services (NHS) UK. 2017. . Better Births, Improving Outcomes of Maternity Services in England. [Online]. <https://www.england.nhs.uk/wp-content/uploads/2016/02/national-maternity-review-report.pdf> Accessed on 27/01/2017
- [25] Oireachtas Committee on Health and Children. 2017. Republic of Ireland. <https://www.oireachtas.ie/parliament/media/committees/healthandchildren/health2015/Opening-Statement-by-Dr.-Sam-Coulter-Smith,-Master,-Rotunda-Hospital.pdf> [Online]. Accessed on 27/01/2017
- [26] Hodges SC, Mijumbi C, Okello M, McCormick BA, Walker IA, Wilson IH. Anaesthesia services in developing countries: defining the problems. *Anaesthesia* 2007; 62(1): 4-11. [<http://dx.doi.org/10.1111/j.1365-2044.2006.04907.x>] [PMID: 17156220]
- [27] Thompson JP, Mahajan RP. Monitoring the monitors--beyond risk management. *Br J Anaesth* 2006; 97(1): 1-3. [<http://dx.doi.org/10.1093/bja/ael139>] [PMID: 16769701]