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# Incidence of hypoxia and related events detected by pulse oximeters provided by the Lifebox Foundation in the maternity unit at Sylvanus Olympio University Teaching Hospital, Togo

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**Abstract** In recent decades anesthesia safety has not been improved in low-income countries. This prospective audit describes the incidence of hypoxia and related events detected among a cohort of patients undergoing surgery in the maternity unit at Sylvanus Olympio University Teaching Hospital, Togo, West Africa, by using pulse oximeters donated by the Lifebox Foundation. The Lifebox oximeter enables early detection of hypoxia for patients undergoing surgery before irreversible damage occurs. Pulse oximetry is cost-effective intervention and should be more accessible in all operating rooms of this type.

**Keywords** Pulse oximeter · Hypoxia · Anesthesia · Mortality · Lifebox Foundation · Low-income · Togo

Perioperative and anesthetic-related mortality has improved in the past 50 years, but these improvements have not been observed in the poorer parts of the world [1]. The 68th World Health Assembly agreed a resolution in May 2015 to improve access to emergency and essential surgical care and anesthesia in low and middle-income countries, and stressed the need to improve the safety and quality of existing services [2].

Togo is a low-income country, current population 6.8 M, in West Africa [3]. In 2005 we reported avoidable anesthetic mortality (AMR) of 0.75 % in Lomé, with 50 % of the deaths being of previously healthy obstetric patients, mainly as a result of cardiorespiratory complications [4]. We performed a needs analysis of the 2 university teaching hospitals and 24 district hospitals in Togo; 15 hospitals did not have a pulse oximeter, 16 did not have an ECG for perioperative monitoring, and capnography was not available in any hospital [5].

Pulse oximetry is a standard of care recommended by the World Health Organization and the World Federation of Societies of Anesthesiologists [6]. The Lifebox Foundation ([www.lifebox.org](http://www.lifebox.org)) is a charity registered in the UK and USA working to improve access to pulse oximetry for patients in low and middle-income countries. The Lifebox oximeter is a high-quality medical grade oximeter, manufactured by Acare Technology, Taiwan, suitable for use in the operating theater, available at low-cost to providers in low and middle-income countries through the Lifebox Foundation [7]. In November 2012, the National Association of Anesthesiologists of Togo delivered training in surgical and anesthesia safety to 179 anesthesia providers from all the regions of Togo, and the Lifebox Foundation donated 140 Lifebox oximeters to anesthesia providers who did not have access to one, including anesthesia providers working in the maternity unit of Sylvanus Olympio University Teaching Hospital in Lomé, Togo.

This prospective audit describes the incidence of hypoxia and related events detected by use of the Lifebox pulse oximeter among a cohort of patients undergoing surgery in the two operating theaters of the maternity unit at Sylvanus Olympio University Teaching Hospital from 1st January to 31 March 2014.

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Fifteen anaesthesia providers were working in the maternity unit, and each had his or her own pulse oximeter. Blood pressure monitoring was available, but capnography equipment was not available. All women who received anaesthesia in the maternity unit were monitored with a pulse oximeter pre and postoperatively, and a logbook entry completed for each patient included ASA score, anaesthesia technique, lowest saturation recorded, the abnormality detected, and intervention undertaken to correct hypoxia.

Five hundred and forty procedures were performed during the audit period: cesarean section 378 (70 %), myomectomy 54 (10 %), salpingectomy 38 (7 %), hysterectomy 32 (6 %), cystectomy 22 (4 %), and laparotomy for peritonitis 16 (3 %). One hundred and forty cases (26 %) were planned intervention and 440 (74 %) were emergencies. Twenty percent of cases were under general anaesthesia and 80 % received regional anaesthesia (spinal anaesthesia 85.7 %, epidural analgesia 14.3 %).

In 21 cases (4 %)  $\text{SpO}_2 < 90\%$  was recorded (Table 1). There were ten maternal deaths during the three-month audit (Table 2). There were three “anesthetic” deaths: one cardiac arrest, one aspiration pneumonia, and a case of hypoxic brain injury that had occurred before admission. In two instances of cardiac arrest as a result of hypoxia the mother was successfully resuscitated. There were no technical problems with the oximeters, and all anesthesia providers reported that the oximeter was essential for the delivery of safe anesthesia.

Our survey shows that the Lifebox pulse oximeter enabled detection of hypoxia among patients undergoing surgery in the maternity unit at Sylvanus Olympio University

**Table 1** Causes of  $\text{SpO}_2 < 90\%$  detected by use of the Lifebox pulse oximeter

Cause	No of cases
Hypotension	4
Hypovolemia	2
Difficult intubation	2
Breathing circuit leak	2
Pulmonary aspiration	1
Bronchospasm	1
Esophageal intubation	1
Hypoventilation	1
Pulmonary edema	1
Cardiac arrhythmia	1
Hypothermia	1
Deep anesthesia	1
High spinal block	1
Tracheal tube disconnection	1
Anesthesia machine defective	1
Total	21

**Table 2** Maternal deaths at Sylvanus Olympio University Teaching Hospital 1 January to 31 March 2014

Cause of maternal death	No of all causes	No of anaesthesia-related
Hemorrhage	2	
Eclampsia	2	
Sepsis	2	
Embolism	1	
Anaesthesia complications	3	
Unresuscitated cardiac arrest		1
Aspiration pneumonia		1
Post-anoxic coma		1
Total	10	3

Teaching Hospital Togo, and enabled most anaesthetic mishaps to be managed appropriately before irreversible damage occurred. The incidence of desaturation in the audit was similar to that reported in other studies [8].

The 2014 Cochrane review of randomized controlled studies performed in high-income settings stated that the value of oximetry was questionable, but stated that was possible that pulse oximetry may have a greater effect on outcomes in areas with less comprehensive provision of health care [9]. We suggest that in settings in which perioperative monitoring is limited and capnography is not available, routine use of pulse oximetry saves lives. Peri-operative pulse oximetry has recently been shown to be cost-effective intervention in low-income settings [10]. When scaled to all anesthesia providers, introduction of pulse oximetry and training is likely to make an important contribution to anesthesia safety. However, the maternal death rate recorded in this audit remains high, in part because of the high acuity of patients admitted to the hospital; this should be the focus of future intervention to improve the quality and safety of anesthesia services in Togo.

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#### Compliance with ethical standards

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