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Original contribution

Anesthesia care in a medium-developed country: a nationwide survey of Mongolia☆,☆☆

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Abstract

Study Objective: To evaluate the current status of anesthesia and its allied disciplines in Mongolia.

Design: Nationwide questionnaire survey.

Setting: Two university hospitals.

Measurements: A total of 44 hospitals that include a department of surgery and that were registered at the Mongolian Ministry of Health were queried. The questionnaire included 44 questions in two sections. The first section consisted of 6 general questions about the hospital, and the second section included 40 questions on anesthesia and perioperative patient care. The Mann-Whitney *U*-test, Chi^2-tests, and a bivariate correlation analysis were used for statistical analysis.

Main Results: 44 (100%) questionnaires were returned. Twenty-two (50%) hospitals were located in the capital city of Ulaanbaatar. Nine hundred (median; interquartile range: 413-1,468) surgical interventions were performed annually in the study hospitals. Physician anesthesiologists delivered anesthesia in all hospitals. Techniques for general anesthesia included endotracheal intubation (95.5%), laryngeal mask ventilation (13.6%), mask ventilation (27.3%), dissociative ketamine anesthesia (84.1%), and combined general/regional anesthesia (63.6%). Regional anesthetic techniques included spinal (97.7%), epidural (43.2%), axillary plexus (40.9%), peripheral nerve (13.6%), and local anesthesia (15.9%). The most frequently used hypnotics were ketamine (86.4%) and thiopental sodium (70.5%). Halothane was

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☆☆ None of the authors has a financial competing interest regarding issues discussed in this manuscript. All authors work or have worked as anesthetists in Mongolia and are interested in improving the situation of anesthesia and its allied disciplines in Mongolia and other developing countries.

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available in all hospitals. Oxygen was available during anesthesia in 95.5% of hospitals. The most widely available intraoperative monitoring equipment were a stethoscope (84.1%), oximeter (81.8%), and sphygmomanometer (84.1%). A recovery room was available in 22 (50%) hospitals.
Conclusions: Anesthesia is an underdeveloped and under-resourced medical specialty in Mongolia.

1. Introduction

In recent years, growing scientific evidence has established that the status of anesthesia care in the developing world is precarious [1-4]. It may be assumed that thousands of patients, including many young, healthy, or pregnant patients, annually die because of unsafe or inappropriate anesthesia care worldwide [5]. To improve the situation of surgical and critically ill patients outside of the industrialized world, detailed reports outlining problems and needs of anesthesia in these countries are urgently needed [6]. Such information may be used to estimate required improvements by local health care facilities, national institutions, or international aid programs.

While reports on the situation of anesthesia in the least developed regions, such as Sub-Saharan Africa, recently have been published [2,3], there are still scarce data on the situation of anesthesia in medium-developed countries. Given the steady economic growth in several medium-developed nations, it is imaginable that health care – and anesthesia – has different needs and requires other steps to improve its quality than in the least developed regions. In view of the fact that 80% of health care equipment in developing countries is funded by international donors or foreign governments [7], more data on the situation of anesthesia in medium and lesser-developed countries are necessary to coordinate national and international aid programs and prevent misdirected donations [7].

Using a nationwide, questionnaire-based survey, this study evaluated the current status of anesthesia care in Mongolia, a medium-developed central Asian country. Our hypothesis was that anesthesia care and perioperative patient safety were insufficient in Mongolian hospitals that offered surgical services.

2. Materials and methods

This study was performed as a nationwide questionnaire survey. The protocol and questionnaire were approved by the Institutional Review Board of the Mongolian Medical University in Ulaanbaatar and supported by the Mongolian Ministry of Health. In September 2007, questionnaires were sent via the postal service from the country's capital, Ulaanbaatar, to anesthesiologists in charge of 44 hospitals that were registered at the Mongolian Ministry of Health as having a department of surgery. After 6 months, questionnaires were sent again to hospitals that had not responded by that time.

Furthermore, the anesthesiologists in charge of these hospitals were contacted and asked to participate in the survey. Completed questionnaires were collected at the Central State University Hospital in Ulaanbaatar until June 2008, then taken to the study center in Innsbruck, Austria, for statistical analysis.

2.1. Study questionnaire

The questionnaire in the current study was used successfully in a nationwide survey conducted in the Republic of Zambia/Africa in 2006 [3]. The questionnaire was refined by the authors' experience and knowledge of the working conditions for anesthesiologists in Mongolia so as to maintain good comparability with anesthesia data collected in the Republic of Zambia. The questionnaire was translated from English **[Appendix]** into the Mongolian language by a native Mongolian speaker, who worked as a medical assistant, but who was neither involved in the design nor analysis of this study. Linguistic corrections and testing of the study questionnaire for respondent comprehension, as well as time consumption, was performed by all Mongolian co-authors. In addition, all authors separately assessed the questionnaire for adequacy of length and format.

The study questionnaire included 44 questions, divided into two sections **[Appendix]**. The first section consisted of 6 general questions about the hospital. The second section asked 38 questions about anesthesia care and perioperative management. Free text comments were requested of respondents to report the 5 most common surgical interventions and the 5 most common complications of general and regional anesthesia. Finally, respondents were asked for suggestions for improvements of the anesthesia service at their hospital. For statistical analysis, free text comments were grouped and transformed into a numerical code.

2.2. Study endpoints

The main study endpoint was to evaluate the current situation of anesthesia care in Mongolia. Secondary endpoints were to investigate whether anesthesia care differs between hospitals located in or outside of Ulaanbaatar, and to evaluate whether anesthesia services were correlated with the number of hospital beds.

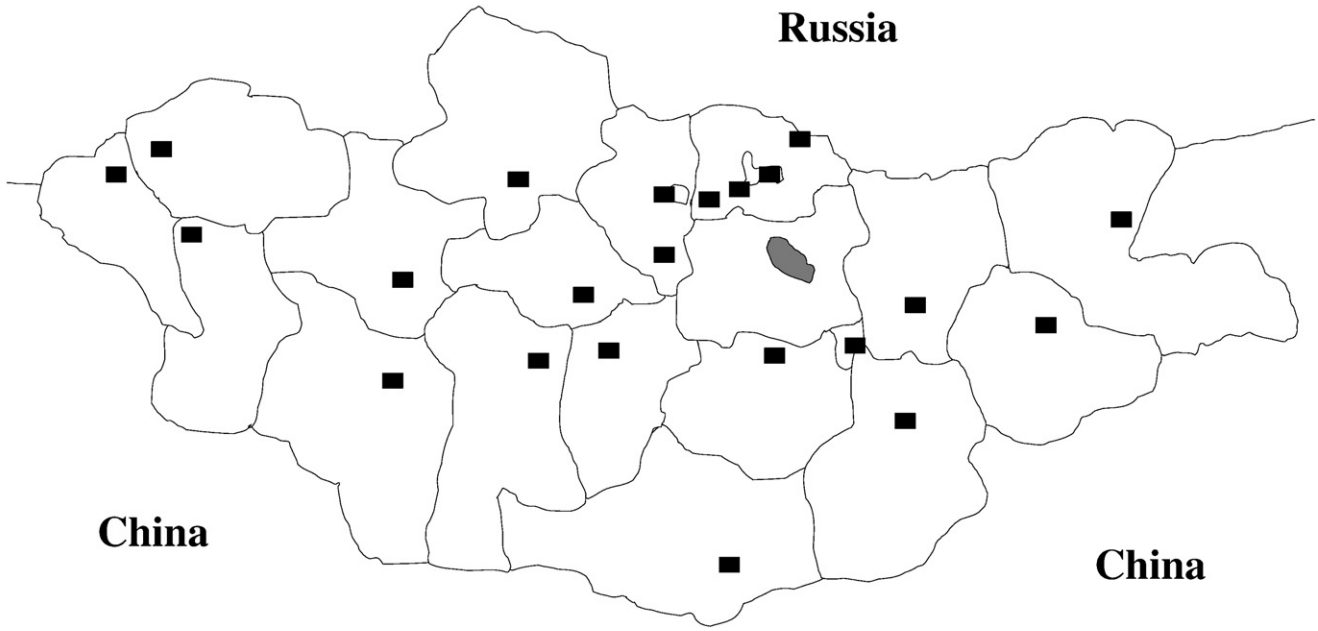

Fig. 1 Map of Mongolia showing the location of the 22 responding hospitals. The hospitals (50%) are located in the capital city of Ulaanbaatar, which is marked in grey. All remaining hospitals are marked by black squares.

2.3. Statistical analysis

SPSS software was used for statistical analysis (SPSS 15.0.; SPSS, Inc., Chicago, IL, USA). Normality distribution of study variables was tested with Lillieforts tests. Mann-Whitney *U*-test and *Chi²*-tests were used to compare data between hospitals in and outside of the Mongolian capital. The relationship between anesthesia care and the number of hospital beds was assessed by bivariate Spearman's *Rho* correlation coefficient (SRCC) analysis. *P*-values < 0.05 were considered to indicate statistical significance. Continuous data are median values and interquartile ranges (IQR), while categorical data are absolute numbers and percentages.

3. Results

Questionnaires from 44 hospitals were returned [response rate 100%, (Fig. 1)]. Twenty-two hospitals (50%) were located in the capital city (Table 1). Details of anesthesia practice are summarized in Tables 2-5. The median number of physician-anesthesiologists in each department was three (IQR, 2-5; $n = 43$). Spinal anesthesia was all respondents' anesthetic technique of choice for cesarean section (n=39). Preanesthetic examinations ($n = 43$) included past medical history (97.7%), electrocardiography (ECG); (83.7%), laboratory investigations (97.7%), and a chest radiography (62.8%). Vital parameters (100%), drugs, and fluids administered (97.7%) were documented intraoperatively ($n = 44$). Monitoring equipment in the recovery room ($n = 22$) included an ECG monitor (63.6%), a non-invasive blood pressure monitor (40.9%), and an oximeter (77.3%). Invasive blood pressure (BP) or end-tidal carbon dioxide

Table 1 Characteristics of participating hospitals

Number of responding hospitals	*n* (%)	44 (100)
Beds	*n*	200 (100-253)
Physicians/100 beds	*n*	27 (22-31)
Physician present in the hospital over 24 hours	*n* (%)	33 (75)
Operation rooms	*n*	3 (2-3.8)
Surgical interventions per year	*n*	900 (413-1468)
Five most common surgical interventions [a]	*n* (%)	
Elective abdominal surgery		39 (88.6)
Gynecology/obstetrical surgery		26 (59.1)
Trauma/orthopedic surgery		15 (34.1)
Surgery for acute abdomen		14 (31.8)
Ear-nose-throat surgery		7 (15.9)
Radiography available in the hospital	*n* (%)	31 (70.5)
Sonography available in the hospital	*n* (%)	30 (68.2)
Source of financial support [b]	*n* (%)	
Government		36 (81.8)
Private		7 (15.9)
Military		1 (2.3)
Mission		0 (0)

Data are given as *n* (%) or median values and IQR.
[a] Open-ended question with free text comments.
[b] Multiple answers possible.

Table 2 Details of anesthesia practice: part I

Anesthesia cases performed per year, *n* = 42	*n* (%)	
< 100 cases		3 (7.1)
100-250 cases		4 (9.5)
250-500 cases		12 (28.6)
> 500 cases		23 (54.8)
Number of general anesthesia cases per year, *n* = 43	*n*	275 (85-293)
Techniques used for general anesthesia[a], *n* = 44	*n* (%)	
General anesthesia with intubation		42 (95.5)
General anesthesia with Laryngeal Mask Airway		6 (13.6)
General anesthesia with mask		12 (27.3)
Dissociative ketamine anesthesia		37 (84.1)
Combined general and regional anesthesia		28 (63.6)
Number of regional anesthesia cases per year, *n* = 36	*n*	325 (123-572)
Techniques used for regional anesthesia[a], *n* =44	*n* (%)	
Spinal anesthesia		43 (97.7)
Peridural anesthesia		19 (43.2)
Axillary plexus anesthesia		18 (40.9)
Peripheral nerve blocks		6 (13.6)
Local anesthesia		7 (15.9)
Commonly used intravenous hypnotic agent[b], *n* = 44	*n* (%)	
Ketamine		38 (86.4)
Thiopental sodium		31 (70.5)
Benzodiazepines		10 (22.7)
None available		0 (0)
Commonly used volatile anesthetic agent[b], *n* = 44	*n* (%)	
Halothane		44 (100)
Nitrous oxide		5 (11.4)
Ether		1 (2.3)
Commonly used analgesic agent[b], *n*=44	*n* (%)	
Fentanyl		28 (63.6)
Morphine		4 (9.1)
Others (e.g. metamizole, paracetamol, diclofenac)		38 (86.4)
None available		0 (0)
Commonly used muscle relaxant[b], *n*=44	*n* (%)	
Atracurium		43 (97.7)
Succinylcholine		27 (61.4)
Pancuronium		3 (6.8)
None available		1 (2.3)
Commonly used local anesthetic[b], *n*=42	*n* (%)	
Bupivacaine		31 (73.8)
Lidocaine		24 (57.1)
Procaine		1 (2.4)
None available		0 (0)

n after bold subheadings reflects the number of completed questions and is considered 100%.
Data are given as *n* (%) or median values and IQR.
[a] Multiple answers possible.
[b] Open-ended question with free text comments.

Table 3 Details of anesthesia practice: part II

Type of intravenous fluids available, *n* = 44	*n* (%)	
Crystalloids		62 (100)
Colloids		2 (46)
Qualification of individual performing anesthesia[a], n =44	*n* (%)	
Physician anesthesiologist		44 (100)
Trained nurse (3 yrs state-registered nursing school+anesthesia training)		23 (52.3)
Nurse (3 yrs state-registered nursing school)		2 (4.5)
Nurse's aide without state-registered training		3 (6.8)
External training over the last 5 years, *n* = 44	*n* (%)	25 (56.8)
Contemporary anesthesia textbook available, *n* = 44	*n* (%)	18 (40.9)
Availability of an anesthesia machine, *n* =44	*n* (%)	40 (90.9)
Availability of oxygen during anesthesia, *n* = 44	*n* (%)	42 (95.5)
Type of oxygen supply[a], *n* =44		
oxygen cylinder		32 (72.7)
compressed gas/oxygen system		l3 (29.5)
oxygen concentrator		4 (9.1)
Monitoring equipment for anesthesia, *n* = 44	*n* (%)	
Stethoscope		37 (84.1)
Sphygmomanometer		37 (84.1)
Electrocardiogram		34 (77.3)
Oscillatory non-invasive blood pressure monitor		31 (70.5)
Availability of invasive blood pressure monitoring		4 (9.1)
Pulse oximeter		36 (81.8)
Capnography/capnometry		7 (15.9)
Availability of a suction machine, *n* = 44	*n* (%)	42 (95.5)
Protocolling during anesthesia, *n* = 41	*n* (%)	41 (100)
Preanesthetic examination, *n* = 39	*n* (%)	39 (100)
Written, informed consent, *n* = 43	*n* (%)	37 (86)
Blood bank in the hospital, *n* = 44	*n* (%)	28 (63.6)
Types of blood recruitment[a], *n* = 36	*n* (%)	
Blood from regularly tested donors		31 (86.1)
Blood from relatives		7 (15.9
Recovery room, *n* = 44	*n* (%)	22 (50)
Patients treated at recovery room, *n* = 21	%	80 (15-100)

n after bold subheadings reflects the number of completed questions and is considered 100%.
Data are given as *n* (%) or median values and IQR.
[a] Multiple answers possible.

Table 4 Complications during general and regional anesthesia

Five most frequent complications during general anesthesia, *n* = 40	*n* (%)
Cardiovascular instability	23 (57.5)
Tachycardia and/or arrhythmias	16 (40)
Laryngospasm	15 (37.5)
Difficult airway	12 (30)
Hypoxia	8 (20)
Five most frequent complications during regional anesthesia, *n* = 41	*n* (%)
Cardiovascular instability	34 (82.9)
Postdural headache	18 (43.9)
Insufficient anesthesia	11 (26.8)
Tachycardia and/or arrhythmias	8 (19.5)
Total spinal anesthesia	5 (12.2)

Questions were open-ended, requiring free text comments of the respondents.
n after bold subheadings reflects the number of completed questions and is considered 100%.

($ETCO_2$) monitoring was not available in the recovery room at any hospital.

Respondents from hospitals in Ulaanbaatar reported a higher number of physician anesthesiologists per department [3.5 (2-7.3) *vs.* 2 (1.5-3); $P = 0.02$], more frequent use of Laryngeal Mask Airways (LMAs; 26.3% *vs.* 4%; $P = 0.03$), higher availability of intraoperative ECG (94.7% *vs.* 64%; $P = 0.02$), and invasive BP monitoring (21.1% *vs.* 0%; $P = 0.02$), availability of a contemporary anesthesia textbook (57.9% *vs.* 28%; $P = 0.04$), and recovery room (84.2% *vs.* 24%; $P < 0.001$), but also less frequent use of dissociative ketamine anesthesia for general anesthesia [12% (5-26.3%) *vs.* 34% (15.5-30.5%); $P = 0.03$] than did respondents from hospitals other than in the capital city. The number of hospital beds was correlated with the number of physician anesthesiologists per department (SRCC, 0.575; $P < 0.001$), annual number of surgical interventions (SRCC, 0.791; $P < 0.001$), general anesthesia (SRCC, 0.589; $P < 0.001$) and regional anesthesia (SRCC, 0.477; $P = 0.003$), use of endotracheal intubation (SRCC, 0.329; $P = 0.03$) and ketamine (SRCC, -0.338; $P = 0.03$) during general anesthesia, use of epidural (SRCC, 0.496; $P = 0.001$) and local anesthesia (SRCC, -0.35; $P = 0.02$), availability of colloid fluids (SRCC, 0.386; $P = 0.01$), preanesthetic written, informed consent (SRCC, -0.232; $P = 0.04$), and availability of a blood bank (SRCC, 0.431; $P = 0.004$).

Table 5 Suggestions to improve anesthesia services [a,b]

Anesthesia, *n* = 39	*n* (%)
Technical equipment (e.g. monitors, anaesthesia machine)	35 (89.7)
Training and education	13 (33.3)
Better supply of drugs	9 (23.1)
Constant and reliable oxygen supply	8 (20.5)
Recovery	6 (15.4)

n after bold subheadings reflects the number of completed questions and is considered 100%.
All respondents stated that they were willing to cooperate with anesthesia departments of industrialized nations (n = 44, 100%).
[a] Open-ended questions with free text comments.
[b] Multiple suggestions possible.

4. Discussion

Mongolia is a landlocked country in Central Asia with an area of 1.6 million/(million/km(2)) km^2 (604,000 square miles) and a population of approximately 2.6 million people. It is among the poorest countries in Asia [8] and ranks 114th in the Human Development Report of the United Nations [9]. After its release from Communist rule in 1990, and despite an ongoing economic boom, Mongolia has substantial political, social, and health care problems. In 2005, the average life-expectancy at birth was 65 years, with cardiovascular disease, liver cancer, and ischemic heart disease being the main causes of death [8]. The maternal mortality rate was 0.1% in 2000, and the infant < 5-year mortality rate was 3.9% in 2005 [10]. With the government's annual per capita expense of $24.80 (U.S. dollars), the country spends about 50 times less on public health care than does an average industrialized nation [8].

Anesthesia training in Mongolia comprises a one-and-a-half year postgraduate training program at one or more university teaching hospitals. All of these hospitals are located in the capital city of Ulaanbaatar. During their training program, residents deliver anesthesia under the supervision of a trained anesthesiologist. Depending on the surgical spectrum of the university teaching hospital where they undergo training, residents are taught to deliver anesthesia for general surgical, ear-nose-throat, urological, and gynecological/obstetrical cases. Training in anesthesia care for orthopedic, neurosurgical, vascular, thoracic, and pediatric surgical interventions is heterogeneous. Due to a nationwide shortage of anesthesiologists, in 2008 the Mongolian Ministry of Health temporarily reduced the duration of training for anesthesiologists to 6 months.

Based on the results of our survey, anesthesia in Mongolia appears to be underdeveloped and under-resourced, particularly in small-sized hospitals and those located outside of the capital city. Although basic drugs to perform anesthesia are available, their supply seems inconsistent and unavailable to all hospitals. Accordingly, one fourth of the respondents suggested that an improved drug supply would help to enhance the quality of anesthesia care at their hospital. Similarly, equipment to monitor vital organ functions are only intermittently available and usually not for all patients. Strikingly, some anesthesia departments in Mongolia still have no regular oxygen supply whatsoever.

While our survey primarily evaluated the current practice of anesthesia care in Mongolia, it did not comprehensively assess the availability of certain consumables. One may hypothesize that, for example, the low rate of general

anesthesia performed with a LMA to secure the airway may be due to restricted availability of LMAs in the responding anesthesia departments.

The lack of an oximeter in approximately 20% of anesthesia departments may contribute considerably to unsafe anesthesia in Mongolia. Despite the fact that one study found no major benefit of intraoperative oximeter monitoring on patient mortality [11], oximeters are widely accepted as reliable first-warning devices and may prevent hypoxia and myocardial ischemia [12]. It is the major priority of the Safety and Quality of Practice Committee of the World Federation of the Societies of Anaesthesiologists and the Global Oximetry Initiative [13] to promote oximeter availability worldwide, particularly in developing countries. As in Mongolia, where other monitoring equipment is only intermittently available, the unrestricted availability of oximeters during anesthesia may be of even greater benefit.

Although the current situation of anesthesia in Mongolia is one of numerous limitations and far from being comparable to anesthesia care in industrialized nations, it appears to be better than in the least developed countries. Whereas, for example, only 22% of persons administering anesthesia in the Republic of Zambia are physician anesthesiologists [3], a medically graduated anesthesiologist is present in all anesthesia departments in Mongolia. This finding could be one of the reasons that endotracheal intubation and spinal anesthesia are performed in almost all Mongolian hospitals but only in 10% and 30%, respectively, of Zambian hospitals [3]. The wider use of regional anesthesia, particularly epidural and plexus anesthesia, in Mongolia versus Zambia or other African countries may also reflect better training of anesthesiologists and a comparatively better supply of local anesthetics and consumables such as needles or epidural catheters [14]. The regular use of spinal anesthesia for cesarean section, in contrast to practice in Zambia, may contribute to the lower maternal mortality rate seen in Mongolia [15]. Perioperative monitoring equipment is more regularly available in Mongolia than in African countries [1-4,16] and even sophisticated monitoring techniques such as invasive pressure or $ETCO_2$ monitoring are used in selected hospitals. Although less so than in Zambia [3], dissociative ketamine anesthesia is frequently delivered in rural Monoglia's hospitals, while it has mostly been replaced by general anesthetic techniques using endotracheal intubation or the LMA in Ulaanbaatar. The use of halothane as the first-choice inhalational anesthetic is comparable between Mongolia and the least developed countries [3].

Respondents' suggestions for improving anesthesia and intensive care unit services at their hospitals are supported by our survey. More equipment, better training, and a regular supply of oxygen and drugs for anesthesia may help to improve anesthesia care. Still, our data cannot prove whether these factors could indeed beneficially affect perioperative patient care and safety. Based on our results, anesthesia equipment is more frequently available in Mongolia than, for example, Sub-Saharan Africa [2,3]. The wide-ranging availability of electricity or compressed gas and oxygen systems in at least some hospitals is an important prerequisite for equipment such as modern anesthesia machines or mechanical ventilators [1,7,17]. Furthermore, the universal presence of physician anesthesiologists with at least some experience with this equipment may help to insure that donated equipment is used correctly to improve patient care [1,7,17]. Still, common problems associated with donation of anesthesia equipment (eg, suitability for use in the heat, cold, and dust of certain climates; the need for spare parts or consumables that locally are impossible to obtain; facilities that can guarantee local maintenance or repair) must be considered [1,7,17].

Although all hospitals with a surgical department in Mongolia could be included in this nationwide survey, it is known to the authors that anesthesia is also administered in other Mongolian hospitals (eg, emergency cesarean section). The situation of anesthetic care in these hospitals that are located in mostly rural or remote areas was not evaluated and may be even worse than that in the surveyed hospitals. Other limitations of this analysis include the possibility that some respondents may have based the information given on estimates rather than statistical data. Questions regarding the availability of medical equipment or drugs may have been affected less so than patient-related data. Second, our survey evaluated only data on the situation of anesthesia and did not investigate the situation of other specialties closely involved in perioperative patient care (eg, surgery, radiology) [18]. Third, the results of this study may not be extrapolated to other medium-developed countries, particularly those outside of Central Asia. Finally, although open-ended questions prevent respondents from restricting their answers to predefined statements, *post-hoc* coding of free text comments bears the risk that single statements were grouped on the basis of the investigators' viewpoint and thus could have been changed from their original meaning.

In conclusion, anesthesia is an underdeveloped and underresourced medical specialty in Mongolia.

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References

[1] Dünser MW, Baelani I, Ganbold L. A review and analysis of intensive care medicine in the least developed countries. Crit Care Med 2006;34: 1234-42.

[2] Hodges SC, Mijumbi C, Okello M, McCormick BA, Walker IA, Wilson IH. Anaesthesia services in developing countries: defining the problems. Anaesthesia 2007;62:4-11.

[3] Jochberger S, Ismailova F, Lederer W, et al; and the "Helfen Berührt" Study Team. Anesthesia and its allied disciplines in the developing world: a nationwide survey of the Republic of Zambia. Anesth Analg 2008;106:942-8.
[4] Glenshaw M, Madzimbamuto FD. Anaesthesia associated mortality in a district hospital in Zimbabwe: 1994 to 2001. Cent Afr J Med 2005;51: 39-44.
[5] Walker IA, Wilson IH. Anaesthesia in developing countries – a risk for patients. Lancet 2008;371(9617):968-9.
[6] Bogod DG. One day for Africa: anaesthesia in Uganda and beyond. Anaesthesia 2007;62:1-3.
[7] Gatrad AR, Gatrad S, Gatrad A. Equipment donation to developing countries. Anaesthesia 2007;62(Suppl 1):90-5.
[8] WHO Country Fact Sheet Mongolia 2006. Available at: http://www.who.int/whosis/database. Accessed December 23, 2008.
[9] The Human Development Report 2007/2008. Available at: http://hdr.undp.org. Accessed December 23, 2008.
[10] Maternal Mortality in 2005. Available at: http://www.who.int/whosis/mme_2005.pdf. Accessed December 23, 2008.
[11] Moller JT, Pedersen T, Rasmussen LS, et al. Randomized evaluation of pulse oximetry in 20,802 patients: I. Design, demography, pulse oximetry failure rate, and overall complication rate. Anesthesiology 1994;78:436-44.
[12] Moller JT, Johannessen NW, Espersen K, et al. Randomized evaluation of pulse oximetry in 20,802 patients: II. Perioperative events and postoperative complications. Anesthesiology 1994;78:445-53.
[13] Thoms GM, McHugh GA, O'Sullivan E. The global oximetry initiative. Anaesthesia 2007;62(Suppl 1):75-7.
[14] Schnittger T. Regional anaesthesia in developing countries. Anaesthesia 2007;62(Suppl 1):44-7.
[15] Clyburn P, Morris S, Hall J. Anaesthesia and safe motherhood. Anaesthesia 2007;62(Suppl 1):21-5.
[16] Hansen D, Gausi SC, Merikebu M. Anaesthesia in Malawi: complications and death. Trop Doct 2000;30:146-9.
[17] McCormick BA, Eltringham RJ. Anaesthesia equipment for resource-poor environments. Anaesthesia 2007;62(Suppl 1):54-60.
[18] Wright IG, Walker IA, Yacoub MH. Specialist surgery in the developing world: luxury or necessity? Anaesthesia 2007;62(Suppl 1):84-9.