Intensive Care Medicine in Mongolia's Three Largest Cities: Outlining The Needs

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ABSTRACT

Purpose: To evaluate intensive care resources, support and personnel available in Mongolia's three largest cities.

Materials and Methods: This prospective study was performed as a questionnaire-based survey evaluating intensive care units (ICUs) in Mongolia's three main cities.

Results: Twenty-one of 31 ICUs participated in the survey. The median number of beds per ICU was seven (interquartile ranges, 6-10) with 0.7 (0.6-0.9) physicians and 1.5 (0.6-1.8) nurses/bed. A 24-hr physician service was available in 61.9% of the participating ICUs. A median number of 359 patients (250-500) with an average age of 39 (30-49) years were treated annually. Oxygen was available in all ICUs, but only for 60% (17-75) of beds. Pressurized air was available in 33% of the ICUs for 24% (0-15) of beds. Of the ICUs 52.4% had a lung ventilator serving 20% (0-23) of beds. The most common admission diagnoses were sepsis, stroke, cardiac disease, postoperative or postpartum hemorrhage and intoxication. Availability of medical equipment, disposables and drugs was inadequate in all ICUs.

Conclusions: Intensive care medicine in Mongolia's three largest cities is an under-resourced and underdeveloped medical specialty. The main problems encountered are insufficient training of staff as well as lack of medical equipment, disposables and drugs.

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INTRODUCTION

Since its beginnings in the 1950s (1), intensive care medicine has grown to a comprehensive medical specialty (2). Industrialized nations spend approximately USD 1,500 (average exchange rate) annually on healthcare *per* capita (3). The share spent on intensive care medicine varies and has been reported to be 13.3% of hospital costs and 4.2% of total national health expenditures in the United States (4). However, considering that only one-quarter of the world's population lives in industrialized nations (5), it is a matter of fact that most critically ill patients are treated in medium- or least developed regions. Few data exist, but clearly indicate that intensive care medicine in these countries is either grossly underdeveloped or even nonexistent (6, 7). While up to ~€ 10,000 are occasionally spent on innovative therapies for individual critically ill patients in industrialized nations (*e.g.* recombinant Factor VIIa or activated protein C treatment course) (8), annual healthcare expenses *per* person are almost 50-500fold lower in less developed countries (4).

Mongolia is a Central Asian country that is home to ~2.6 Mio people and ranks 114th in the 2007/2008 Human Development Report of the United Nations (5). After its release from communist rule in 1990 and despite an ongoing economic boom, Mongolia faces substantial political, social and healthcare 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 (3). The maternal mortality rate was 0.1% in 2000, and the under five mortality 3.9% in 2005 (3). With the government's annual *per* capita expense being USD 24.8, Mongolia spends approximately 50times less money on healthcare than does an average industrialized nation (5).

This survey evaluates the current status of intensive care medicine in Mongolia's three largest cities.

MATERIALS AND METHODS

This prospective study was performed as a questionnaire-based survey. The institutional review board of the Mongolian Medical University in Ulaanbaatar approved the study protocol and questionnaire. The study was conducted at the end of a one-week educational course in intensive care medicine in Ulaanbaatar, to which the 31 intensive care units (ICUs) in Mongolia's three largest cities were invited (Ulaanbaatar: ~ 1.2 Mio inhabitants, 29 ICUs; Darchant: 95.000 inhabitants, 1 ICU; Erdenet: 74.000 inhabitants, 1 ICU). On the last day of the course, the questionnaires in Mongolian language were distributed to one physician from each participating ICU, preferentially the intensivist in charge. A first version of the study questionnaire was integrated into a nationwide survey conducted in the Republic of Zambia/Africa (9). Thereafter, the questionnaire was refined based on the authors' experience and knowledge gained from working in Mongolian intensive care units. The questionnaire was translated from English into Mongolian by a native Mongolian speaker, who works as a medical assistant but was neither involved in the design nor analysis of this study. Linguistic correction and testing of the study questionnaire for respondent comprehension and time consumption was done by all Mongolian co-authors. Furthermore, all authors separately assessed the questionnaire for adequacy of length and format. While the questionnaires were being completed, the study coordinators were present to answer questions, address ambiguities, check the adequacy of questionnaire completion and collect any pending information. After survey completion, no efforts were launched to recruit more ICUs.

The study questionnaire consisted of two parts and 89 questions in total (for English version, see Electronic Supplemental Material). The first part collected general information about the hospital and the ICU's relevant back-up disciplines (22 questions). The second part was divided into six sections on basic supplies (7 questions), patient-related data (18 questions), staff-related data (10 questions), financial issues (3 questions), education and

training (8 questions), as well as the availability of medical equipment, disposables and drugs (21 questions). Free text comments were requested to assess the five most frequent causes of ICU admission, the five most frequent causes of death at the ICU, the three most common causes of sepsis, and the five most common surgical interventions requiring postoperative ICU care. Finally, respondents were asked to suggest how to improve intensive care medicine at their hospital. For statistical analysis, free text comments were grouped and converted into numerical codes after the survey was completed.

Statistical Analysis

Descriptive statistical methods were applied to present results of individual sections and questions (SPSS 12.0.1.; SPSS Inc, Chicago, IL). Data are given as median values and interquartile ranges (IQR), if not indicated otherwise.

RESULTS

Of the 31 ICUs invited to the course, one physician from each of the 21 attending ICUs completed the questionnaire giving relative and absolute return rates of 100 and 67.7%, respectively. Of the twelve ICUs in the tertiary, university teaching hospitals in Mongolia, eight (75%) were evaluated in the survey. Of the ten ICUs not included in this survey four were located in a tertiary and six in a secondary hospital. Five were multidisciplinary ICUs, and five were specialized (pediatric, *n*=1; infection, *n*=1; burns, *n*=1; neurosurgery, *n*=1; cardiac surgery, *n*=1).

Except for one, all respondents (20, 95.2%) replied that they kept annual statistics on their ICU population. Treatment costs were covered by the hospital and state health insurance carrier in thirteen hospitals (61.9%). In six hospitals (28.6%), patients paid at least part of their treatment costs themselves. Two hospitals (9.5%) were private and relied entirely on their patients for payment. Certain diagnostic procedures (*e.g.* computed tomography, magnetic resonance imaging, angiography) or therapeutic interventions (interventional endoscopy or cardiology) were not covered by state health insurance but had to be paid for by the patient or his family in every hospital (Table 1).

Eleven ICUs (52.4%) reported being multidisciplinary, whereas ten (47.6%) were specialized (obstetric, *n*=4; pediatric, *n*=4; trauma, *n*=1; toxicology, *n*=1). Ten respondents (47.6%) stated that they transferred very sick patients to tertiary centers. All ICUs had running water and electric power, but an emergency generator was available in only eleven ICUs (52.4%). Power failures occurred at a median frequency of two per month (IQR, 1-2) (Table 2). Eighteen (85.7%), two (9.5%) and one ICU (4.8%) were staffed by anesthetists, internists and pediatricians, respectively. Nine ICUs (42.9%) reported having full-time intensivists (Table 3). Thirteen ICUs (61.9%) had 24-hr physician presence. A specific educational program for physicians working at the ICU existed at six ICUs (28.6%); duration of training at these ICUs ranged from three days to 1.5 years. Twelve respondents (57.1%)

claimed that nurses at their ICU also had duties outside the ICU (*e.g.* emergency or anesthesia department) during their ICU working hours.

Regular maintenance of medical equipment by technical personnel was possible at ten (47.6%) hospitals; basic equipment repairs were possible at eleven ICUs (52.4%) (Table 4). All respondents reported that ureidopenicillins, carbapenems, vancomycin, intravenous acyclovir, dobutamine, midazolam, terlipressin, any intravenous thrombolytic or anti-aggregatory drug other than aspirin or dipyridamol were not available at their hospital.

DISCUSSION

The results of this questionnaire based-survey indicate that intensive care medicine in Mongolia's three largest cities is an albeit established, but under-resourced and underdeveloped medical specialty. ICUs lack adequate financing and support from back-up disciplines (*e.g.* radiology, endoscopy, or cardiology); they are understaffed and ICU personnel is inadequately trained, while medical equipment, disposables and drugs are inadequate. Similar data and problems have been reported from ICUs in other less developed countries (9-15). The results of this survey show the situation of intensive care medicine in Mongolia's three largest cities to apparently be worse than in Eastern European countries (10, 11), India (12), Sri Lanka (13), or Latin America (14). However, in view of the uniform availability of basic supplies (*e.g.* electricity, running water) and some medical equipment, intensive care medicine in Mongolia can be considered to be better resourced than in sub-Saharan Africa (6, 7, 9, 15).

This study used a questionnaire consisting of two parts with a total of 89 questions. The major weakness of the survey instrument is that it was not independently validated and it is not certain whether it reliably assesses all aspects related to the situation of intensive care medicine in a developing country. The lack of “don’t know” choices throughout the questionnaire may have lead to unnoticed misunderstandings among the participants and could have introduced an unknown random error to our study results. Although open-ended questions in the questionnaire prevented respondents from restricting their answers to predefined statements, *post hoc* coding of free text comments bears the risk that single comments were grouped on the basis of the investigators’ viewpoint and may have thus been changed from their original sense.

According to information from the Mongolian Ministry of Health, ICUs are only sporadically available in hospitals outside the three main cities. Nonetheless, investigating only ICUs in these cities may have subjected our study to a relevant selection bias. Since it is

very likely that the situation of ICUs in the remote areas of Mongolia is even worse than suggested by this survey, the true situation and actual needs of intensive care medicine in Mongolia may have been underestimated. Moreover, it must be assumed that ICUs outside Mongolia's three largest cities might need still different improvements. Although two-thirds of the Mongolia's major ICUs and three-quarters of the ICUs in the tertiary hospitals of Ulaanbaatar were included in our survey, interpretation of the survey results is limited by the fact that ten eligible ICUs could not be evaluated.

The main ICU admission diagnoses given in this study are more similar to the diseases encountered in the ICUs of North America and Europe (16, 17) than to those so far reported from other less developed nations (6, 7, 9-15). This observation may be caused by the fact that the majority of the latter countries lie in subtropical or tropical regions and face an additional spectrum of tropical diseases. Nonetheless, it is astonishing that, unlike in reports from industrialized nations (16), postoperative patient care was not among the five main ICU admission diagnoses in our survey. Given the fact that almost all ICUs were located in hospitals with a surgical department and a median number of 2,235 annual surgical interventions, it must be assumed that most surgical patients are not treated in an ICU during the immediate postoperative period. One of the most frequent causes of ICU admission, on the other hand, was sepsis with the three most common septic foci being the wound, abdomen and lungs in decreasing order. Simultaneously, sepsis was also the most frequent cause of death at the ICU. Delayed admission (6), irregular supply of antibiotics and unavailability of specific antimicrobial agents despite a high incidence of resistant bacteria (unpublished data, Central State University Hospital, Ulaanbaatar, Mongolia) could well explain this finding.

Together with sepsis, stroke was the most common ICU admission diagnosis and also cause of death in critically ill patients. Comparable to Northern China (18), hemorrhagic stroke is highly prevalent in Mongolia, most probably due to inconsistent and irregular control of chronic arterial hypertension (19). Insufficient basic medical treatment probably also

contributes to a high rate of ICU admissions because of cardiovascular diseases (20). Particularly for patients with acute coronary syndromes significant therapeutic problems exist. Currently, only one center in Mongolia can perform percutaneous coronary revascularization but its routine activities are substantially limited by a shortage of supply materials and anti-aggregation drugs. Moreover, the nonavailability of any intravenous thrombolytic agent also precludes pharmacological coronary revascularization. A similar therapeutic dilemma is faced by Mongolian physicians in the treatment of upper gastrointestinal hemorrhage. Since interventional endoscopy can be performed only in a minority of hospitals and terlipressin is not available at any ICU, conservative therapy and emergency surgery are frequently the only therapeutic options. Accordingly, gastrointestinal hemorrhage was reported to be one of the most frequent causes of ICU death in this survey.

Perhaps the most important problem facing critical care practice as suggested by this survey was inadequate ICU staffing and personnel training. Compared to industrialized nations (21), the number of ICU physicians and nurses observed *per* bed in this survey is low. Additionally, low salaries that do not cover the rent for an average apartment and the living expenses for an average family force many ICU workers to take on extra jobs in or outside the hospital. This not only forces ICU staff to work excessively long hours and promotes low job morale, but may also be the reason why ~40% of the responding ICUs fail to have a physician on duty around the clock. These staff-related and educational problems may be reflected in the unacceptably high mortality rate of severely ill patients, such as those requiring mechanical ventilation >24 hrs.

As suggested by Bastos *et al.*, the lack of adequate and consistent patient monitoring further contributes to insufficient patient care in the ICUs of less developed countries (22). Particularly the local lack of technical personnel who can maintain or repair the small contingent of medical equipment further limits the alarmingly low number of functional

apparatus in Mongolian ICUs. Similar data have been reported from other less developed countries (6, 23, 24).

Low government *per capita* spending on healthcare as well as ineffective insurance payments to hospitals (~USD100/patient/hospital stay irrespective of pathology, disease severity or length of stay) obviously cause deficient hospital budgets and inadequate supply of disposables and drugs to ICUs. The observation made by this survey that a ventilation bag with mask is available in merely two-thirds of the evaluated ICUs is particularly striking. All these problems make it clear why a significant portion of treatment costs must be covered by the patients or their relatives.

When interpreting the results of this study important limitations need to be considered. Although 95.2% of the respondents claimed to keep annual statistics, we cannot exclude that some answers are based on estimates rather than statistical data. Questions regarding the availability of medical equipment, disposables or drugs may have been affected less than patient-related data. Particularly, statements about ICU mortality seem to have suffered from a substantial responder bias, since nine (42.9%) physicians stated that their ICU mortality was 0-2%. After all, this observation could reflect a certain unwillingness on the part of some Mongolian intensivists to face up to true mortality rates and lacking quality control at their ICU. Another limitation of our study is its descriptive design, which may well identify the situation and needs of intensive care medicine, but does not allow clear strategies for improving the situation of intensive care medicine in Mongolia or other less developed countries to be drawn from the results.

CONCLUSIONS

Intensive care medicine in Mongolia's three largest cities is an under-resourced and underdeveloped medical specialty. The main problems encountered are insufficient training of staff as well as lack of medical equipment, disposables and drugs.

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Table 1. Characteristics of Hospitals

n		21
Beds	*n*	274 (121-400)
Physicians	*n*	93 (25-109)
Surgery Department	*n (%)*	19 (90.5)
Surgical Interventions/Year	*n*	2235 (350-2750)
Emergency Department	*n (%)*	16 (76.2)
Laboratory	*n (%)*	20 (95.2)
24-hr Service	*n (%)*	13 (61.9)
Bacteriologic Laboratory	*n (%)*	14 (66.7)
X-ray	*n (%)*	18 (85.7)
Computed Tomography	*n (%)*	4 (19)
Magnetic Resonance Imaging	*n (%)*	2 (9.5)
Angiography	*n (%)*	2 (9.5)
Sonography	*n (%)*	21 (100)
Echocardiography	*n (%)*	20 (95.2)
Endoscopy	*n (%)*	12 (57.1)
Interventional Endoscopy	*n (%)*	4 (19)
Hemodialysis	*n (%)*	3 (14.3)
Interventional Cardiology	*n (%)*	1 (4.8)

Variables are given as median and inter-quartile range or as number and percentage of all.

Table 2. Characteristics of Intensive Care Units

n		21
Beds	*n*	7 (6-10)
Physiotherapeutic Service at ICU	*n (%)*	3 (14.3)
Documentation of Vital Signs	*n (%)*	20 (95.2)
Availability of Oxygen	*n (%)*	21 (100)
Beds with Oxygen Supply	*%*	60 (17-75)
Source of Oxygen Supply	*n (%)*	
Oxygen Cylinder		11 (52.4)
Oxygen System		8 (38.1)
Oxygen Concentrator		2 (9.5)
Availability of Pressurized Air	*n (%)*	7 (33.3)
Beds with Pressurized Air	*%*	24 (0-15)
Availability of a Lung Ventilator	*n (%)*	11 (52.4)
Beds with Mechanical Ventilator	*%*	20 (0-23)
Availability of Mobile X-Ray Machine	*n (%)*	5 (23.8)
Patients Treated per Year	*n*	359 (250-500)
Five Most Common ICU Admission Diagnoses	*n (%)*	
Sepsis		11 (52.4)
Stroke		11 (52.4)
Cardiac Diseases		10 (47.6)
Postoperative or Postpartum Hemorrhage		8 (38.1)
Intoxication		6 (28.6)
Five Most Common Surgical ICU Admission Diagnoses	*n (%)*	
Abdominal Surgery		14 (66.7)
Thoracic Surgery		9 (42.9)
Obstetric/Gynecologic Surgery		8 (38.1)
Trauma/Orthopedic Surgery		5 (23.8)
Urologic Surgery		5 (23.8)
Average Patient Age	*yrs*	39 (30-49)
Average Length of ICU Stay	*days*	4 (4-5)
Estimated ICU Mortality	*%*	10 (1-13.5)
Estimated ICU Mortality for Patients on MV >24 hrs	*%*	50 (15-89)
Five Most Common Causes of Death at the ICU	*n (%)*	
Sepsis		11 (52.4)
Stroke		11 (52.4)
Cardiac Diseases		9 (42.9)
Hemorrhage		8 (38.1)
Gastrointestinal Hemorrhage		7 (33.3)
Withdrawal of Therapy in an End of Life Decision	*%*	5 (0-2)

ICU, intensive care unit; MV, mechanical ventilation.
Data are given as median values and IQR, if not indicated otherwise.

Table 3. Data on ICU Staff, Education and Monthly Salary

Physicians/ICU Bed	*n*	0.7 (0.6-0.9)
Nurses/ICU Bed	*n*	1.5 (0.6-1.8)
Nurses with Special ICU Training	*n (%)*	0 (0)
Availability of an uptodate Critical Care Textbook at ICU	*n (%)*	13 (61.9)
Availability of Internet Access in Hospital or ICU	*n (%)*	13 (61.9)
Access to International Critical Care Journals	*n (%)*	7 (33.3)
Cooperation with Foreign Hospitals/Universities	*n (%)*	6 (28.6)
Willingness to Cooperate with Foreign Hospitals/Universities	*n (%)*	21 (100)
Monthly Salary of ICU Physician	*USD*	116 (100-125)
Monthly Salary of ICU Nurse	*USD*	76 (70-85)
Price One Loaf of Bread*	*USD*	~0.5
Price One Kg of Rice*	*USD*	~1
Price One Kg of Meat*	*USD*	~2
Monthly Rent Medium Class Apartment*	*USD*	150-200

ICU, intensive care unit.
*, prices Ulaanbaatar November 2007.
Data are given as median values and IQR, if not indicated otherwise.

Table 4. Availability of Monitoring Facilities.

	>75% of Beds	**50-75% of Beds**	**<50% of Beds**	**Not Available**
ECG	4 (19)	1 (4.8)	12 (57.2)	4 (19)
Noninvasive ABP	6 (28.6)	2 (9.5)	6 (28.6)	7 (30.3)
SpO_2	3 (14.3)	3 (14.3)	8 (38.1)	7 (33.3)
Temperature	7 (33.3)	2 (9.5)	4 (19)	8 (38.1)
Endtidal CO_2	1 (4.8)	0 (0)	2 (9.5)	18 (85.8)
Invasive ABP	1 (4.8)	0 (0)	0 (0)	20 (95.2)
CO Measurement	0 (0)	0 (0)	0 (0)	0 (0)
ICP Measurement	0 (0)	0 (0)	0 (0)	0 (0)

ECG, electrocardiogram; ABP, arterial blood pressure; SpO_2, plethysmographic oxygen saturation monitor; CO_2, carbon dioxyde; CO, cardiac output; ICP, intracranial pressure.
All data are given as n (%).

Table 5. Availability of Disposables.

	Always	Sometimes	Never
ECG Stickers	5 (23.8)	16 (76.2)	0 (0)
Peripheral iv Lines	11 (52.4)	10 (47.6)	0 (0)
Cannulas	17 (81)	4 (19)	0 (0)
Syringes	19 (90.5)	2 (9.5)	0 (0)
50 mL Syringes	5 (23.8)	8 (38.1)	8 (38.1)
Infusion Systems	21 (100)	0 (0)	0 (0)
Central Venous Catheters	8 (38.1)	11 (52.4)	2 (9.5)
Endotracheal Tubes	17 (81)	2 (9.5)	2 (9.5)
Ventilation Bag with Mask	14 (66.7)	4 (19)	3 (14.3)
Sterile Suction Catheter	13 (61.9)	7 (33.3)	1 (4.8)
Urinary Catheter	15 (71.4)	6 (28.6)	0 (0)
Sterile Gloves	18 (85.7)	3 (14.3)	0 (0)
Examination Gloves	19 (90.5)	2 (9.5)	0 (0)
Hand Disinfectant	7 (33.3)	12 (57.1)	2 (9.5)

ECG, electrocardiogram.
Data are given as n (%).

Table 6. Availability of Fluids and Drugs.

	Always	Sometimes	Never	Don't Know
Crystalloid Fluids	18 (85.7)	3 (14.3)	0 (0)	0 (0)
Colloid Fluids	12 (57.1)	8 (38.1)	1 (4.8)	0 (0)
Parenteral Nutrition	1 (4.8)	15 (71.4)	5 (23.8)	0 (0)
Intravenous Electrolytes	17 (81)	3 (14.3)	1 (4.8)	0 (0)
Penicillin	20 (95.2)	1 (4.8)	0 (0)	0 (0)
3rd Generation Cephalosporine	10 (47.6)	10 (47.6)	1 (4.8)	0 (0)
Aminoglycoside	14 (66.7)	7 (33.3)	0 (0)	0 (0)
Chinolone	6 (28.6)	11 (52.4)	3 (14.3)	1 (4.8)
Metronidazole	14 (66.7)	7 (33.3)	0 (0)	0 (0)
Antifungal Agent	4 (19)	14 (66.7)	3 (14.3)	0 (0)
Dopamine	17 (81)	4 (19)	0 (0)	0 (0)
Epinephrine	20 (95.2)	1 (4.8)	0 (0)	0 (0)
Norepinephrine	0 (0)	9 (42.8)	11 (52.4)	1 (4.8)
Thiopentone	20 (95.2)	0 (0)	1 (4.8)	0 (0)
Ketamine	19 (90.5)	1 (4.8)	1 (4.8)	0 (0)
Diazepame	19 (90.5)	2 (9.5)	0 (0)	0 (0)
Fentanyl	20 (95.2)	1 (4.8)	0 (0)	0 (0)
Morphine	18 (85.7)	3 (14.3)	0 (0)	0 (0)
Nondepolarizing MR	18 (85.7)	1 (4.8)	2 (9.5)	0 (0)
NSAID	17 (81)	4 (19)	0 (0)	0 (0)
Unfractionated Heparin	20 (95.2)	1 (4.8)	0 (0)	0 (0)

MR, muscle relaxant; NSAID, non-steroidal antiinflammatory drug.
Data are given as n (%).

Table 7. Suggestions How to Improve ICU Services*.

Enhanced Availability of Monitoring Equipment	18 (85.7)
Better Education and Training	10 (47.6)
Improved Laboratory Facilities	5 (23.8)
Broader and Consistent Drug Supply	4 (19)
Increase ICU Staff	3 (14.3)
Broader and Consistent Availability of Supply Materials	2 (9.5)
Installation of Internet Access at Hospital or ICU	1 (4.8)

ICU, intensive care unit; *, multiple answers possible.
Data are given as n (%).