

Anaesthesia in underdeveloped world: Present scenario and future challenges

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SUMMARY

The overall mortality and morbidity in underdeveloped countries are still unchanged and preventable risks factors constitute the main burden. Among these, anaesthesia-related mortality is largely preventable. Various contributory factors related to human resources, technical resources, education/teaching system and other utilities needs further attention in poor income group countries. Therefore, we have made an attempt to address all these issues in this educational article and have given special reference to those factors that might gain importance in (near) future. Proper understanding of anaesthesia-related resources, their overall impact on health care system and their improvisation methods should be thoroughly evaluated for providing safer anaesthesia care in these countries which would certainly direct better outcome and consequently influence mortality.

Keywords: Anaesthesia, mortality, outcome, resources, underdeveloped

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INTRODUCTION

The morbidity and mortality in developed world have decreased in the past few years; however, the overall outcome is still not changed substantially in the developing countries.¹⁻⁴ These can be attributed to various preventable as well as non-modifiable contributing factors. In this regard, strikingly, most of the anaesthesia-related mortality is preventable.^{1,2} Anaesthesia being an essential part of secondary healthcare services is now not merely limited to operating room (OR) but also involves the services related to emergency room, intensive care unit, angiography-catheterisation laboratory, magnetic resonance imaging (MRI) suite, pain clinics, resuscitative rooms, electroconvulsive therapy (ECT) room, and other life-saving hospital services. Thus the anaesthesia-related services constitute one of the important health-related systems which often found to be severely deficient in the underdeveloped world. Therefore, these deficiencies create unsafe

perioperative environment and contribute to increase in morbidity and mortality in these countries.¹⁻³

Proper understanding of anaesthesia-related resources, their overall impact on health care system and their improvisation methods should be thoroughly evaluated for providing safer anaesthesia care in these developing countries. Therefore, we have made an attempt to address all these issues in this educational article.

We have performed a Pub Med search [1 January 2001-31 December 2012] using search terms including "Anaesthesia", "Developing", "underdeveloped", "country" and "world". All papers in the English language that specifically discussed the relevant issues are included.

MAGNITUDE OF PROBLEM AND SOLUTION

Total perioperative mortality decreased progressively over the decades, from 10,603 per million before the 1970s, to 4533 per million in the 1970s-80s, and 1176 per million in the 1990s-2000s.

Although there is significant reduction in anaesthesia-related perioperative mortality during the last 50 years, patients undergoing surgery in low-income group countries still have two to three times increased mortality risk compared with high-income group countries.¹ Therefore, it is obvious that growth in every area of health care sectors across

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the world is not uniformly distributed due to various factors related to human resources, technical resources, education system, and other utilities; hence needs further attention especially in poor income group countries.³⁻⁶ In developing countries, there always exist a big gap between growing population and there health care need, it becomes even more important to utilize the limited resources with greatest efficiency and judiciously, at the same time; however, it is still long way to go for developing countries to improve and implement the safe anaesthesia services for all its patients [Table 1].

Human resource

Even in the era of patient safety, majority of population in developing world, do not have access to safe anaesthesia services.^{1,3,7} There are still no strategic measures of assessing the safe anaesthesia services, particularly in the rural and underprivileged areas of developing world. In most of the developing countries, health care system is usually overburdened by patients load; majorities are contributed by various infectious diseases, trauma-related injuries and non-communicable diseases. In some of the underdeveloped country, surgical disease imposes

highest mortality than infectious diseases; hence signifies the established anaesthesia care services for the overall management in these areas.^{8,9}

Majority of trained residents would like to work in major cities, thus, making the resource even more unevenly distributed.⁵ Some of the residents or staffs, who acquired their speciality training outside the country, usually stay at western countries.⁵ The main reasons behind are mainly lack of good earnings and proper facilities in these under developing countries. Study on anaesthesia services in one of the African countries showed that the majority of anaesthesia procedures were administered by non-physicians. Even the anesthesiologist was not involved in pain as well as emergency services.^{7,10} The other survey further highlighted that there was serious crunch in the entire anaesthesia services. Even the anaesthesia at the University teaching hospital was found to have severe shortage in manpower and the other resources as well.¹¹ Currently, there is wide disparity between urban and rural areas in developing countries, mostly because of sufficient human resources on physician in such developing countries. Despite all efforts, there is therefore lack of safe anaesthesia services to majority of population in rural areas. In another survey, the numbers of anaesthesia providers per capita of population in developing countries were found to be significantly less in comparison to developed world.¹²

Table 1: Magnitude of problems related to anaesthesia in underdeveloped countries

Type of Problem	Related Problems
Population and Disease	Tremendous growing population
Socioeconomic problem	Increasing disparity between urban and rural areas
	Increasing number of communicable and non communicable diseases
Human Resources	Illiteracy, Poverty
	Religious factors
	Poor remunerations for anesthesiologists
Technical Resources	Insufficient number of trained Anesthesiologist
	Lack of trained technician and trained nurse anesthetist
	Shortage of teaching staffs in medical colleges
	Brain drain problems
	Lack of operation theatre infrastructure
Educational resources	Shortage of centralized gas pipeline, pulse oximetry, other monitoring services
	Shortage of high dependency unit and intensive care unit
	Unavailability of equipments, life saving drugs and anesthetic agents
	Lack of well developed pediatric, obstetrical and pain services
	Lack of structured residency curriculum
Other utilities	Non popularity of anesthesia as speciality
	Lack of proper audits, research, publications
	Lack of ACLS/BLS/ATLS training
	Lack of standardized guidelines
	Inadequate water, electricity, generators, oxygen and blood banks
	Shortage of ambulances, lack of proper transportation methods

Nurse anesthetists serve essential role in anaesthesia providing services in western world; however, this requires a proper curriculum-based training and skill development modules for these personals. In developing countries, such delegation of physician`s work, would have an important role, but there is lack of proper education for nurse anaesthetist in developing countries and there is no such structured programme for them.¹³ In addition, the teaching staffs to train these persons are themselves not properly trained.

In a study of 1543 patients in a developing sub-Saharan country, no significant difference in mortality was observed during operations performed by two different groups (local versus expatriates) of surgeons, thus re-emphasized the importance of locally adapted skills and knowledge in these situations.¹⁴ Similarly, the effect of local anaesthetic practices cannot be ignored; however, continuous education/teaching and retraining with newer technologies can certainly play a crucial role for future outcome. Thus, overall there is not only acute shortage of properly trained anesthesiologists, but also of those who could do delegated work, like nurse anaesthetists and technicians, in the most of the developing world. This shortage is found to be even worse in rural areas of these countries.

Technical resource

The safety of anaesthesia does not only depend upon the trained staff but also rely on the monitors used during

perioperative period. In this regard, the commonest monitor is pulse oximetry; however, in some developing countries (Uganda), it is still not available in most of the hospitals.¹⁵ This mainly depends upon the cost of equipment. Survey (WHO based) of 44 hospitals of a sub-Saharan country (Rwanda) showed that there was significant lack in technical resources including electricity, water and generators in 8 hospitals and no pulse oximeter was in 19 hospitals.¹⁶ In fact, more than 19% of operation theaters worldwide have no pulse oximeter.¹⁷ There is acute shortage of proper functional operation theaters. In addition, there is also lack of resuscitative equipments, airways carts, suction devices and other intraoperative monitoring methods. The anaesthetic drugs are also limited. Most of the poor income countries only have ether or halothane vaporizers. Narcotic agents and other analgesics are not in proper quantity nor widely available. Besides having these basic technologies then it is important for the individuals using them to know and have the means of maintaining the service to these monitors. Therefore, due to presence of limited financial and logistic resources, anaesthesiologists are bound to give the same anaesthetic agents irrespective of type of surgical procedures which may sometimes increase in anaesthetic-related morbidity and mortality and also affect surgical outcome as well.

To provide general anaesthesia, there is lack of proper equipments and monitors. Thus, use of spinal anaesthesia is usually the choice in most of the surgical cases where it is feasible. The distinct advantage of regional anaesthesia in preventing airway-related complications and its cost effectiveness are now well established. In poor-resource countries, more focus over spinal anaesthesia seems to be reasonable.¹⁸ Although relatively safe, the lack of resuscitative equipments in these countries can pose the maternal as well as fetal risk during regional anaesthesia.

Education

The lack of proper education in anaesthesia in most of the developing countries is another area of great concerns. The important issue in some of the developing countries is non-availability of the teaching staff. Thus, due to shortage of teaching staff, the training for others including residents, medical students and nurses cannot be properly imparted. Therefore, a lot of physicians perform a part or their even whole anaesthetic training abroad. However, these physicians also later face problem associated with enormous differences between their training environment (with reliable power, sources of compressed oxygen and other gases, sophisticated machines and modern drugs) and the area at which they are imparting training. In addition they work within a different resource environment. Easy adaptability and proper utilisation of available resources are essential features desired for the anaesthesiologists working in developing countries.¹⁹⁻²² Language barrier is another problem which usually presents most of the time,

warrants translator services. Even in a country, there is also wide prevalence of local languages and no officially accepted uniform national language. Therefore at present, some of the courses have been introduced which serves these mentors to prepare and acclimatise them before going to serve.

There is substantial lack of proper curriculum-based residency training in anaesthesia in many underdeveloped countries. Even the countries, in which, anaesthesia is a part of post-graduation training, residents use to opt anaesthesia as the last choice. The methods such as audits and quality improvement database are some of the other crucial factors which are poorly utilised in these countries.¹⁹ They can provide the information of morbidity and mortality in the community and in turn may help to improvise the overall health care facilities. The publications in journals may be the crude measurement of education, teaching, research and healthcare status and was found to be contributed only 0.3% by low income countries.²³ There is also lack of standard and uniform guidelines among various hospitals. In addition, local practices are also variable.

Role of simulation can be of utmost importance in this regard. This is a relatively newer field of anaesthesia which now a days has gained popularity. In this, the situation (case or adverse event) is created and one has to act accordingly to manage the case and thus the person can be prepared for future to cope up with actual situation. The role of simulation becomes even more important in skill-demanding part of anaesthesia like obstetrical and paediatric anaesthesia. The mannequin-based resuscitative training is one of the essential parts of simulation based anaesthesia and found to be very effective.²⁴⁻²⁷ These techniques are already being used in some underdeveloped countries to train and teach the residents, medical students and other medical personals. However, a wider spread of such facilities would help to increase and maintain medical education in developing countries.

Obstetrical anaesthesia services

Anaesthesia was defined as 'safe' when anaesthesiologist had access to all the minimum facilities which are usually required for managing the particular group of the patients. The prerequisites are availability of trained anaesthesiologist, proper equipments and drugs to administer general and regional anaesthesia as well, used to have facility for safe blood transfusion services and setup to manage the expected emergencies. Apart from the safe drugs and advance monitoring methods, simulation based anaesthesia training and process improvement checklists were also incorporated into anaesthesia practice as safety measure.²⁸⁻³⁰ Obstetrical anaesthesia is rapidly growing subspecialty of anaesthesia. However, in developing world still the mortality and morbidity related to anaesthesia is not changed significantly. In a large data base of 16,697

deliveries, incidence of anaesthetic-related complications in parturient was 35.9: 10,000. Four common anaesthetic-related adverse events in Caesarean section were found to be associated with desaturation, cardiac arrest, awareness and death.^{31,32} To fill the gap in trained anaesthesiologist, some of the countries have initiated various training programmes [Life Saving Anesthetic Skills (LSAS) for Emergency Obstetric Care (EMOC)] training programme for medical officers and found to be effective method.³³ Pregnant patients often present as difficult airway condition during general anaesthesia and impose great risks for both mother and the foetus. Therefore, it is useful to plan regional anaesthesia for caesarean deliveries. This can significantly reduce airway-related complications.

Paediatric anaesthesia services

Paediatric anaesthesia in western world is a separate sub-specialty of anaesthesia and often involves trained physicians from this field. However, in developing world, paediatric anaesthesia is almost non-existence as a separate entity and majority of non-physicians are involved to deliver the paediatric anaesthesia services. There is lack of monitors, equipments for resuscitation, poor control of infection and hemorrhage, and no supplies of basic utilities.³⁴ The United Nations' Millennium Development Goal 4 is to reduce the global under-five mortality rate by two-thirds by 2015.³⁵ However, the perioperative paediatric mortality rates have increased over the past decades in all over the world. In this, developing countries have been found to have worse mortality rates. The most common anaesthesia method is general anaesthesia with manual ventilation or spontaneous breathing.³⁶ The majority of paediatric-related mortality is due to airway-related complications.^{37,38} In addition, cardiac arrest-related deaths are found to be very high in these countries.³⁸ Hence signifies the role of trained anaesthesiologist with good resuscitative skills in this situation. The training in newborn resuscitation in developing countries has been shown to reduce mortality significantly and thus highlights the effectiveness of training for this vulnerable group.³⁹ Most of the anaesthesia-related cardiac events are preventable (medication errors, airway related).⁴⁰ Therefore, proper labelling of medications and provision of resuscitation equipments including difficult airway carts can certainly decrease these cardiac events. A fact that is not paid sufficient attention in most developing countries. On the other hand, nurses also play the important role in paediatric anaesthesia surgeries because of lack of sufficient trained anaesthesiologists as well as other anaesthesia provider personnel. However, study on nurses' knowledge, sensitivity and attitudes about pain in children in developing country (India) highlighted the severe lacunae in this aspect too.⁴¹

Intensive care

There is severe deficiency in the ICU care settings and total intensive care beds. Recent article highlighted

the importance of ICU in developing countries mainly sub-Saharan. On contrary to USA, most of the younger population need ICU care and they usually require ICU for the curable/preventable acute diseases (intestinal obstruction, etc.) because of surgical causes.⁴² The need for proper education and training is highly desirable in this field;⁴³ not only in anaesthesia but also in surgical specialties. The initiatives from developed world in form of on line teaching forums, various journals contribution for free articles for developing countries and centralized ICU registry system may be helpful to upgrade the critical care settings in developing world.⁴³ The other area of great concern is antimicrobial prescription in ICUs. In most of the developing world, the use of antimicrobial therapy is not based on culture and sensitivity nor is the therapy given according to standard guidelines.^{44,45} These can produce serious threat for patient care as well as may contribute to greater antimicrobial resistance, especially of low-cost antibiotics.⁴⁶ Therefore, warrants proper monitoring and proper prescription.

Other utilities

The other factors which have significant impact on anaesthesia as well as surgical services are the lack or unreliable supply of basic utilities including electricity, water, oxygen and blood bank.⁴⁵ The increasing trend of corruption and neglect is also a contributory factor for the crippled healthcare systems in these countries.⁴⁵ Hypoxaemia is commonly associated with death in developing countries. The availability of oxygen systems is of paramount importance in this regard.⁴⁸ There is lack of adequate supply of oxygen in most of the developing world. Thus there is need of oxygen concentrators to full fill this demand. According to millennium development programme (Goal-4), oxygen supply and pulse oximeter should be provided to every healthcare facilities especially involving paediatric age.⁴⁹

Transportation methods including adequate ambulances, road conditions, traffic controls, etc., are also found to be insufficient in most of the part of these underdeveloped countries. In addition, there is lack of physician assisted transport and also scarcity of fully equipped ambulances to transfer the patients.⁵⁰ In addition the referral summary given by medical staffs during shifting coupled with vitals recordings were also found to be inadequate.⁵⁰

ROLE OF DEVELOPED COUNTRIES AND VARIOUS ORGANIZATIONS

Over the last decade, anaesthesia practices are being improved a lot due to the inclusion of advance technologies, equipments, safe drugs and the structured training of anaesthesiologists. In the last few years, various organizations have also come into existence and are continuously working to upgrade the health care facilities of the developing countries. In addition, support from

the developed world have also played a crucial role to improve the anaesthesia-related services including teaching, training, exchange of students, donations, cheaper technology innovations and researches [Table 2].

To ensure the safety and to establish standard care for every patient, World Federation of Societies of Anesthesiologists (WFSA) laid down certain guidelines for safe anaesthesia practice.⁵¹ Similar standard guidelines were also formulated by many esteemed societies including Anesthesia Patient Safety Foundation (USA), the Australian Incident Monitoring System, and the Safety Committee of the Association of Anesthetists of Great Britain and Ireland.^{29,30,52} After its inception in 1955, WFSA is working with an objective to improve the standards of

anaesthesia worldwide, with an emphasis in developing countries. Till 2007, 120 national societies are working together under WFSA. The WFSA has suggested that safe anaesthesia practice can be standardised through exchange of scientific information, by recommending standards of training, encouraging research into all aspects of anaesthesiology, establishing patient safety measures including standardization of equipment and by providing information regarding opportunities for postgraduate training and research.^{29,30,51,52} The significant improvement in perioperative mortality over time in developed world is due to implementation of non-expensive process improvement, apart from increased healthcare investment in the technologies, techniques, and training necessary to improve patient safety.⁵³⁻⁵⁵ The simple example of process improvement is WHO patient checklist used in Safe Surgery Saves Lives Study.⁵³ It has been found that 30-day mortality in patients undergoing non-cardiac surgery was decreased from 1.5% to 0.8% after introduction of the checklist. Therefore, these checklists should be incorporate in to the perioperative care services in underdeveloped countries.

Many institutes in North-America have successfully developed and run the global health care/Anaesthesia fellowships which involve structured curriculum for the motivated physicians and found to have good impact in the development of the anaesthesia in the developing countries. With the help and guidance by Canadian [Canadian Anesthesiologists' Society International Education Fund (CASIEF)] and American [American Society of Anesthesiologists Overseas Teaching Programme (ASAOTP)] societies, speciality training in anaesthesia could be initiated in some developing countries (Rwanda) so that they can produce sufficient number of anaesthesiologists.²⁰ In addition, international nurse anaesthesia continuing education project was framed and it would impart standardised training to nurse anaesthetists in the developing countries so that these can be formed as important arm for safe anaesthesia care.¹³ Such initiatives are needed to substantially and sustained improve the situation in developing countries. Another approach is to teach the medical personal directly in their countries.⁵⁶

The biggest hurdle in the healthcare system is the cost; therefore, it is imperative to include relatively inexpensive and simple yet effective methods to improvise the standard anaesthesia care in developing world.⁵⁷ Through the generous contributions from its members, Canadian Anesthesiologist Society (CAS) have played a crucial role, for example, in providing Life box pulse oximeters to sub-Saharan countries. In these countries, mobile is very cheap option of communication thus few centres are trying to incorporate new anaesthesia technologies like pulse oximetry in to the mobile system and therefore, would be able to provide some of the standard monitors in very cheap price.¹⁵ In addition, some oximeters are also being designed for obstetrical emergencies. This would incorporate blood pressure, oxygen

Table 2: Improvement methods for anaesthesia development in underdeveloped countries

Sectors	Improvement Methods
Human Resources	Local resource utilization (nurses, technician, anesthesiologists) Increasing number of trained anesthesiologists Policy to rotate and serve in rural areas Strengthening collateral system (nurse anesthetist and paramedics) Continued medical education and updating of knowledge and skill Better salary and incentives for anesthesiologists
Technical resource	Availability of monitoring system mainly pulse oximetry Provision of anesthetic drugs, equipments, anesthesia workstation Provision of emergency drugs and equipments Availability of blood banks and safe mother and child care services Inclusion of check lists, data/record keeping, audits
Education	Uniform teaching curriculum and evidence based training Proper record keeping and developing a national database Standard guidelines and protocols and inclusion of the local needs Simulation based training and telemedicine Community awareness programs
Global Initiatives	Global anesthesia fellowship Delegates to train the anesthesiologist and other medical staffs, Donations and Involvement in administrative services Integrated research, Provision for free books/journals and publications
Other utilities	Provision for basic amenities of electricity, safe drinking water Strengthening patient transfer and transport services Fire safety measures in the hospital premises

saturation, maternal and gestational age. Finally, it will give a score which would predict the outcome.¹⁵ The requirement of ICU/anaesthesia machine ventilator is an important issue; however, due to limited supply of oxygen and frequent interruptions in electricity warrants alternate method. Thus gas driven (Glostavent) ventilators were developed. These are found to be equally efficient and cost-effective.⁵⁸ These examples show that such impressive efforts are needed to further improve the equipment investment in such countries.

CHALLENGES AHEAD IN DEVELOPING COUNTRIES

Anaesthesia services in developing countries are going through a phase of transition. There is a paradigm shift in the involvement of anaesthesiologist from intraoperative management of a case to perioperative management, to care of patients in the intensive care units, to resuscitation in emergency department to shifting of critically ill patient. This change is also reflected in the standard of care from one place to another; it varies from primitive anaesthesia to world class perioperative care. But these services are not available to majority of population because of poverty, growing population, limited resources, cost of treatment, disparity and non-uniformity of available healthcare services, increasing burden of non-communicable diseases along with communicable disease and increasing needs of aging population. The need for non-physician anaesthetists cannot be overlooked particularly in areas where properly trained anaesthesiologists are lacking.¹⁰ However, standard training of these non-physicians should be ensured. The involvement of local resources would be easier and cheaper option in this regard. In addition, anaesthesia education curriculum should therefore be developed to generate good anaesthesiologist who would know the cutting edge technology but also could be able to utilise and modulate the local available resources. The anaesthesia curriculum should also develop for non-anaesthesia personnel as well so that they can also be utilized in underserved areas or area of need.^{10,19,20} Basic medical education should comprise of basic life support, advance cardiac life support, ventilation/intubation skills and other emergency treatment of common catastrophic situations. Bainbridge and colleagues have played a crucial part in confirming disparities in perioperative health care between developed and developing countries and in showing that drastic improvements in outcomes are feasible. Their findings should inspire us to apply perioperative practices with demonstrable effectiveness to under-resourced settings. Moreover, these findings must be taken into a broader context to improve anaesthesia practice in developing countries and not compare it with what has been attained by developed countries.

As occurrence of any complication within 30 days of surgery is the strongest determinant of overall mortality, perioperative anaesthesia practice can probably improve

postoperative outcome by: preoperative optimisation; evidence-based safety protocols like checklists, appropriate patient monitoring, sterile procedures technique, safe transfusions practice; proper intraoperative care of the patient such as temperature regulation, blood pressure and heart rate control, judicious hydration, maintenance of homeostasis; multimodal pain management; and improving postoperative patient care.^{1,59}

Future of anaesthesia in developing countries would certainly remain in the hand of the natives of the particular countries and utmost requirement is to make anaesthesia speciality interesting among medical graduates and to realize its importance among other medical professionals and patients as well. There are some important consideration in this regard and should include anaesthesia rotation during medical graduation, structured curriculum of anaesthesia residency, inclusion of continuous professional development programme (CPD) and combined medical education with particular attention to anaesthesia speciality. Anaesthesiologists should also be included in administrative posts in health care planning. There should be strict audit for the release of the government funds for the purchase of the surgical as well as anaesthetic equipments/drugs. Apart from this, the salary structures should also be improved and there should be provision for additional bonuses or incentives for the anaesthesiologist working in the underserved areas.

DISCUSSION

The magnitude of problems including human, technical, investment and educational resources are the main factors to be considered before developing safe anaesthesia care services in to these underdeveloped countries. In fact the existing resources are poorly utilized and one of the important factors needs more focus. Involvement of local resources would be the best way to deal with the problems. However, this require involvement of substantial involvement of local and central government agencies and importantly, there should be proper monitoring and surveillance methods to check for the money expenditure and utilizations. The need for timely audits is of utmost importance. Involvement of local as well as international NGOs would be of great help for providing many facilities for the perioperative care services including man power, equipments, education and donations. Telemedicine should and must play a pivotal role in such initiatives also in anaesthesia.⁴⁴ This is particularly useful for those sub-disciplines where there are no or not sufficient trained personnel; a method that is also widely used in leading Universities in Europe and North America. When it comes to anaesthesia, this is also helpful in strengthening teaching processes and also improves quality of service-giving activity.

There should be proper communication between anaesthesiologists or anaesthesia providers and patients.

This would provide basic understanding and importance of anaesthesia to the patients and community which could in turn help in developing anaesthesia as separate speciality in near future. Proper education should be imparted to residents, nurses, technicians and other anaesthesia providers. Role of simulation could be another method besides telemedicine which can have substantial impact on the education and training of these personnel. Proper curriculum-based training should be programmed for residents, nurses and anaesthesia providers. It is not the choice of anaesthesia is important for safe practices, the provision to deal with complications associated with it, should be of paramount importance. However, the need of development of regional anaesthesia in certain group of patients such as obstetrical patients in these underdeveloped areas have certain benefits, but need for proper training and equipment for resuscitation cannot be ignored. The global approach should focus on the development of educational strategies, provide basic anaesthetic agents and equipments, involvement of international experts to educate the people and importantly should involve as active member for development of health services. The frequent surveys and educational audits should be emphasized and international committee should provide the anaesthesia-related educational materials (books, journals) with minimal costs.

The different training institutes at local universities in developing countries should develop to a good research centre for both local and international researchers, especially but not only for epidemiological studies. Also the clinical experiences in developing countries are important for the scientific community. Having a research institute dealing with local prevailing disease conditions and treatment options has great impact in devising our own disease prevention and treatment strategies on a scientific basis by developing countries.

CONCLUSIONS

Considering the current state of anaesthesia services in the underdeveloped countries, a lot of efforts have to be put for the improvement in the safe anaesthesia practice. To fill the gap of inequity in anaesthesia services in this part of world, efforts should be made to improve it regardless of country and social status by the assessment of the problem within region specific and country, population-based need and risk stratification; setting standard as per resource poor environment. Newer (educational) technologies like telemedicine and simulation would help to further increase education and learning in anaesthesia not only in first world but also especially in developing countries. Global priority should be given to reducing total perioperative and anaesthetic-related mortality with evidence-based best practice in developing countries to reduce the disparity in mortality compared with developed countries.

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