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The Bare Minimum: The Reality of Global Anaesthesia and Patient Safety

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Abstract

Introduction Current guidelines for the provision of safe anaesthesia from the World Health Organization and the World Federation of Societies of Anaesthesiologists (WFSA) are unachievable in a majority of low and middle-income countries (LMICs) worldwide.

Methods Current guidelines for anaesthesia and patient safety provisions from the WHO and WFSA are compared with local ability to achieve these recommendations in LMICs.

Conclusions Influential international organizations have historically published anaesthesia guidelines, but for the most part, without impacting substantial documentable changes or outcomes in low-income environments. This analysis, and subsequent recommendations, reviews the effectiveness of existing strategies for international guidelines, and proposes practical, step-wise implementation of patient safety approaches for LMICs.

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Introduction

Patient safety is the legacy of modern anaesthesia [1, 2]. The success of patient safety initiatives in high-income countries is indisputable [3, 4]. Unfortunately, many low and middle-income countries (LMICs) have not yet benefited from either a culture of patient safety or an investment in standards [3]. Years of poverty and competition for scarce resources have resulted in a long-term lack of infrastructure, equipment, and clinical capacity [5–13]. The infrastructure gap between high-income and low-income countries unfortunately translates into a patient safety gap, and anaesthesia and surgical outcomes reveal the tragic reality [13–19]. Patient outcomes parallel a society's positioning on the human development index (HDI) [3, 20].

The lack of anaesthesia providers, essential medicines and safety monitoring in LMICs has not gone unnoticed. Efforts to assist anaesthesia providers through education and training [21–27], as well as to improve the availability of appropriate equipment through cost-effective design and donation, have

Table 1 Guidelines and standards from international organizations

	WHO Guidelines 2009 WFSA Guidelines 2010		American Society of Anesthesiology Guidelines 2011
	Level 1—Highly Recommended (WFSA) Rural Center (WHO)	Level 2—Highly Recommended (WFSA) District Hospital (WHO)	
Equipment capital outlay	Continuous SpO_2 Constant O_2 availability Noninvasive BP monitoring Adult and paediatric self inflating bags Suction Availability of temp monitoring Stethoscope Laryngoscope, bougie Tracheal tubes, airways Anaesthesia vapourizers[a]	Continuous SpO_2 Constant O_2 availability ECG monitoring Noninvasive BP monitoring Continuous et CO_2 monitoring Adult and paediatric self inflating bags Suction Availability of temp monitoring Defibrillator Stethoscope Laryngoscope, bougie Tracheal tubes, airways Anaesthesia vapourizers	Standard 1: Qualified anesthesia personnel shall be present in the room throughout the conduct of all general anesthetics, regional anesthetics and monitored anesthesia care Standard 2: During all anesthetics, the patient's oxygenation, ventilation, circulation and temperature shall be continually evaluated Required monitors include: Continuous $Sp0_2$, ECG, BP, End-tidal $C0_2$, Tempurature
Essential medicines for anaesthesia	Oxygen Ketamine Lidocaine 1 %, 2 % Diazepam Pethidine Morphine Epinephrine Atropine Anaesthesia vapourizers[a] Inhalational anaesthetics[a]	Oxygen Ketamine Lidocaine 1 %, 2 % Diazepam Pethidine Morphine Epinephrine Atropine Anaesthesia vapourizers Thiopental Suxamethonium Neostigmine Pancuronium Inhalational anaesthetics[a] Lidocaine 5 % heavy spinal solution Bupivicaine .5 % heavy/plain Furosemide Hydralazine Dextrose 50 % Aminophylline Ephedrine Hydrocortisone	

[a] indicates optional

been common during the past 50 years [28–31]. Guidelines for practitioners, hospitals and governments (as in Table 1) have been written and revised, with the belief and hope that such stratified lists and recommendations would be embraced by both practitioners and governments, and would support progress toward improved patient outcomes [2, 32–35].

In the developed world, guidelines from organizations such as the American Society of Anesthesiologists (ASA) have been very successful in encouraging anaesthesia providers to utilize appropriate safety monitors, and to ensure the availability of airway equipment and rescue medications. These guidelines and related actions have improved patient safety and outcomes, have saved lives, and have been endorsed by hospitals, insurers and the legal profession. And so, many guidelines, including those of the ASA have transitioned into standards of care.

Similar to country-specific guidelines in high-income countries (HIC's), international guidelines comprise basic

lists of essential monitoring, medications and equipment which are ranked for patient safety, with the intent that providers, governments and healthcare systems would mandate the availability and use of such resources. These are strong recommendations that have been available for many years and have been regularly updated, and they are readily available on the WFSA and WHO organizational websites [2, 32].

Tragically, well-meaning international guidelines are aspirational for a majority of low-income countries and, for the most part, have not steered ministries of health or healthcare systems in LMICs to commit to investments in capital purchases, or to enact strategies for ensuring essential medicine or disposable supply availability [8, 9, 12]. Therefore, the guidelines are largely unobtainable, and to date have had little benefit to practicing providers in the poorest settings.

In acknowledging the realities of what can be achieved safely with the bare minimum, there is a risk that Governments will invest even less. However, the hope is that they invest less in high tech solutions that continue to fail, and more in "real" development for the practitioners struggling to provide safe anaesthesia. This will entail focusing on education within financial and cultural confines, empowering safe practice through vigilance and hands on monitoring, and local engagement.

The process of assessing the reality of anaesthesia care in LMICs has identified enormous challenges for patients and providers. The spectrum of needs for safe patient care includes training, education and credentialing of anaesthesia providers, airway and other anaesthesia equipment, safety monitors, and sustained procurement of medications and disposable supplies. Many hospitals providing emergency and essential surgery in LMICs provide anaesthesia without much of what is considered essential in HIC's. The patients receiving care in these settings have few options, and the anaesthesia providers are tasked with providing the best possible care under the circumstances [7, 13, 36–38].

Anaesthesia in low- and middle-income countries

In 85 LMICs, few hospitals can reach the anaesthesia guidelines provided by the WHO [32] or the WFSA [2, 13, 39, 40]. Effective guidelines ought to provide practical guidance and a realistic benchmark of patient safety, against which local standards and improvements can be compared. Sadly, guidelines that are not achievable may simply engender a sense of nihilism and defeatism. The reality is that responsible and lifesaving clinical care can be administered in environments of intense austerity, and standards should be generated that are inclusive of and helpful for providers who labour in such circumstances [19]. With new focus on the role of surgery and safe anaesthesia in global health [41, 42], a change from idealist highest standards to practically improving patient safety within the reality that exists, while simultaneously working for a higher standard, is timely. Surgery must often be undertaken in the most austere settings, and the articulation of a *bare* minimum for safe anaesthesia may improve outcomes and empower providers to educated vigilance and quality.

More than 2 billion patients around the world—children, pregnant women, young trauma victims, and many cancer patients in LICs, receive surgery and anaesthesia in austere environments and in less than safe circumstances [39]. Millions of patients are receiving anaesthesia without a critical monitor and often without oxygen or a qualified anaesthesia provider [13, 19]. Until recently, little was known about the true practice conditions faced in these environments, and even less is known about the resulting outcomes and complications.

Estimates of anaesthesia-related death rates in these grim settings are staggering, and surgical death rates are widely unknown. In spite of this, for many—especially those with obstructed labour, post-partum haemorrhage, and trauma—surgery and anaesthesia at the district hospital level represent their only chance at survival [19]. Despite the paucity of concrete data, it is imperative to begin global action to improve patient safety in low-income settings. While global effect and prioritization are needed, this must be achieved through pragmatic local action.

Safety initiatives

The surgical safety checklist and the evolving universal use of a pulse oximeter are clear progress for global patient safety [43–46]. These efforts are to be commended, supported and reinforced. However, much work remains to be done. In the majority of operative settings in LICs, there is no reliable source of oxygen. Perhaps the introduction of pulse oximetry, with related education, to the tens of thousands of ORs and PACUs around the world will encourage hospital systems and ministries of health to also insure availability of oxygen. But historical lessons from donation programmes encourage no assumption [47–49]. The global health community must expand the current initiatives to include cost-effective strategies, including oxygen and a culture of vigilance, in tandem with pulse oximetry and checklists, to insure a future of global patient safety and improved outcomes.

Guidelines and standards

Properly implemented clinical guidelines, standards and checklists have become standard tools in assisting the management of health care. Essential to these processes,

however, is the ability to practically implement the suggestions, including gaining buy-in from those required to perform the tasks and processes. The latter has proven challenging even in countries that have benefited from the direction for decades [47–49]. Crippling poverty is central to implementing the aspirational guidelines, but an absent culture of vigilance and lack of empowerment to improve are also contributors.

The usual expectation is that national organizations, with the assistance of international organizations, will organize the implementation of international guidelines at the local level. Unfortunately, the historical reality is that the poorest countries have not had the capacity or resources to institute their own context sensitive protocols, and therefore lag far behind both in terms of outcomes and process.

In LICs, as in HIC's, the hospital level determines not only the types of services available, but also the quality and availability of equipment, disposables, medications and personnel. A rural hospital in a HIC may not have an MRI and a neurosurgeon, but there will also be a reliable and efficient transport and communication service in place for patient referral. In contrast, in the case of a small district hospital in an LIC, the capacity for patient transport is always problematic and district (first level) hospitals are generally the only real refuge for patients, and for most conditions [19]. Unhappily, in LICs, the best of support and trained professionals are usually concentrated in regional and referral hospitals. District hospitals are left to manage as they can, without support or meaningful guidance.

Advances in technology have frequently preempted effective traditional anaesthesia skills and methods. For example, in the absence of ECG monitoring, use of the pre-cordial stethoscope and vigilant tracking of the pulse is essential. In reality, this simple, universally available approach provides even more information than the ECG alone. The trained ear can detect arrhythmias, volume status, respiratory rates and breath sounds. The trained finger is sensitive enough to detect changes in rhythm and blood pressure [50].

As mentioned, supplies of oxygen in austere environments are tenuous, and anaesthesia in the presence of room air is a reality [36, 38, 51]. Of course there are many options for improving oxygenation on room air, and these clinical actions must be considered in global guidelines [38, 52].

In situations where mechanical ventilation is not an option, manual ventilation is an obvious choice. With no ventilator back up and very limited availability of reversal agents, the risks and benefits of non-depolarizing muscle relaxants are questions worth considering [53]. Practical and ethical issues, such as these, which may no longer be of great relevance to the developed world, remain critical elsewhere.

It is absolutely essential that the poorest countries are empowered and encouraged to set their own benchmarks and standards, and that they begin tracking outcomes and improvements.

The bare minimum for realistic patient safety

The bare minimum that exists in the poorest countries, and in remote hospitals far from the capital, must be acknowledged and safe options for practice offered. These minimums must be recognized as part of a continuum, and must be taught to and benchmarked. While the developed world and international organizations may be hesitant to acknowledge these realities and to teach for them, this is of basic import to creating global anaesthesia safety. There is no compromise in recognizing the bare minimum.

Anaesthesia safety was originally and fundamentally based on vigilance, and regardless of the environment, the ability to be vigilant remains the foundation of the specialty. Technology may have enabled a relative de-emphasis on continuous auscultation and the continuous finger on the pulse for many of today's HIC anaesthesia practitioners, but we must refocus on the clinical abilities of looking listening and touching in an austere environment.

In LIC settings, where technology is sparse and options are limited, presence, clinical ability and vigilance must be focused upon and taught [2, 53, 54]. Figure 1 illustrates an approach to patient safety in austere and LIC settings. It is not enough to benchmark the ideal for patient safety in anaesthesia. We must acknowledge the reality, and provide guidance, education and

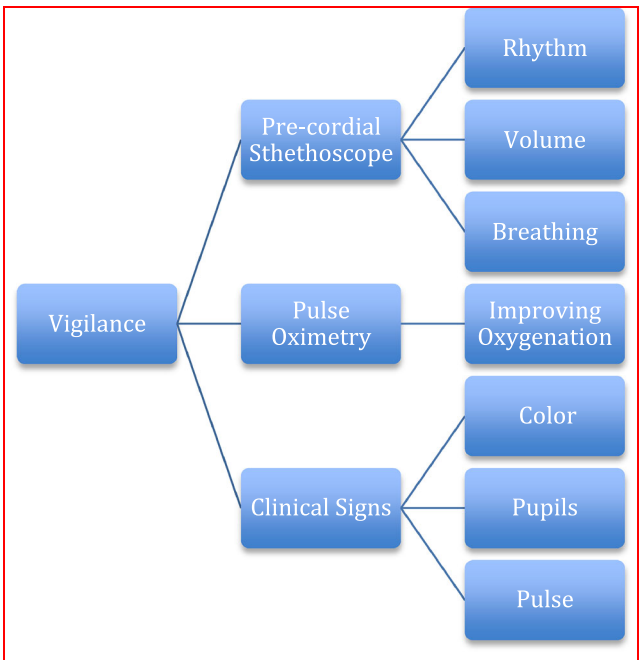

Fig. 1 Essentials of safe patient care during anaesthesia in any setting

Table 2 Infrastructure, anaesthesia techniques, drugs, monitoring by facility type

Levels of care	Level 1				Level 2
	[A] Health Clinic	[B] Rural Hospital 1	[C] Rural Hospital 2	[D] First Referral Hospital	[E] Regional Hospital
Infrastructure	No running water, no electricity, no oxygen	Running water, intermittent electricity, no oxygen	Running water, occasionally without electricity, oxygen sometimes available	Running water, electricity, oxygen often available	Water, electricity, oxygen mostly available
Anaesthesia Technique(s)	Local anaesthesia	Local anaesthesia Ketamine general anaesthesia	Local anaesthesia Ketamine general anaesthesia Spinal anaesthesia	Local anaesthesia Ketamine general anaesthesia Spinal anaesthesia Drawover inhalational anaesthesia	Local anaesthesia Ketamine general anaesthesia Spinal anaesthesia Drawover inhalational anaesthesia Plenum anaesthesia (Boyles type machine)
Drugs	Lignocaine 1 %, 2 %	Lignocaine 1 %, 2 % Ketamine 50 mg/ml Atropine 0.6 mg/ml Diazepam 5 mg/ml, 2 ml or Midazolam 1 mg/ml, 5 ml	Lignocaine 1 %, 2 % Ketamine 50 mg/ml Atropine 0.6 mg/ml Diazepam 5 mg/ml, 2 ml or Midazolam 1 mg/ml, 5 ml Bupivacaine 0.5 % heavy or plain, 4 ml Ephedrine 30/50 mg ampoules Analgesia drugs Oxygen cylinders or oxygen concentrators	Lignocaine 1 %, 2 % Ketamine 50 mg/ml Atropine 0.6 mg/ml Diazepam 5 mg/ml, 2 ml or Midazolam 1 mg/ml, 5 ml Bupivacaine 0.5 % heavy or plain, 4 ml Ephedrine 30/50 mg ampoules Analgesia drugs e.g. opioids Oxygen cylinders or oxygen concentrators Halothane or other volatile agent Induction agent, thiopentone, propofol Muscle Relaxant & reversal drugs	Lignocaine 1 %, 2 % Ketamine 50 mg/ml Atropine 0.6 mg/ml Diazepam 5 mg/ml, 2 ml or Midazolam 1 mg/ml, 5 ml Bupivacaine 0.5 % heavy or plain, 4 ml Ephedrine 30/50 mg ampoules Analgesia drugs e.g. opioids Oxygen cylinders or oxygen concentrators Halothane or other volatile agent Induction agent, thiopentone, propofol Muscle Relaxant & reversal drugs
Monitoring	Simple observation Finger on pulse Temperature	Simple observation Finger on pulse Temperature Blood pressure Measurement Stethoscope	Simple observation Finger on pulse Temperature Blood pressure Measurement Stethoscope Pulse oximeter	Simple observation Finger on pulse Temperature Blood pressure Measurement Stethoscope Pulse oximeter ECG desirable	Simple observation Finger on pulse Temperature Blood pressure Measurement Stethoscope Pulse oximeter ECG High circuit pressure Relief necessary with High disconnect alarm Essential if mechanical Ventilation oxygen Analyzer, oxygen failure Alarm essential Capnography desirable

Table 2 Infrastructure, anaesthesia techniques, drugs, monitoring by facility type

Levels of care	Level 1				Level 2
	[A] Health Clinic	[B] Rural Hospital 1	[C] Rural Hospital 2	[D] First Referral Hospital	[E] Regional Hospital
Comments	Limited surgery possible with local anaesthesia Major constraints are infrastructure and surgical skills available	Trained anaesthesia provider essential Wide range of surgery possible with Ketamine GA Therapeutic possibilities of improving oxygenation limited without oxygen	Increased training required for anaesthesia provider Intra-abdominal surgery below umbilicus possible with both spinal and Ketamine Pulse oximeter very useful in medical and paediatric wards	Significant training necessary for anaesthesia provider Inhalational anaesthesia with muscle relaxant drugs allows a wide range of peripheral and body cavity surgery Drawover inhalational anaesthesia can be provided by drawover vaporiser and circuit Many Rural hospitals are equipped with Boyles type machines, often inoperative	More complicated surgery dictates a higher level of anaesthesia training Most District or Provincial hospitals are equipped with Boyles type machines requiring high pressure oxygen Nitrous oxide is rarely available and no longer regarded as a necessary drug Drawover anaesthesia can be provided by drawover "machines" e.g. Glostavent, Universal Anaesthesia Machine

support for the most basic of circumstances. Table 2 offers suggestions for such an initiation. These efforts will provide universal patient safety and will save lives.

As mentioned earlier, this paper in no way argues against the suitability and usefulness of the WHO and WFSA guidelines in assisting many middle and some low-income countries in credible negotiations with their governments over essential infrastructure and support. What this paper argues is that there needs to be relevant guidelines and counsel for those very poor countries that cannot provide for consistent oxygen, water, electricity and the most basic medications.

The *bare minimum* will not encourage those with more resources to do less; rather practical and realistic guidelines will empower those with only the bare minimum to do what they are doing more safely. The *bare minimum* will not guide governments to spend less for safe surgery and anaesthesia, in fact most of them likely could not spend much less than they currently spend and still support any surgery. In fact, this real minimum would have to be taken seriously by ministries of health and hospital systems in the lowest resource regions, because the *bare minimum* is achievable, cost effective, and sustainable.

Recommendations

1. Encourage every LMIC to outline realistic goals for anaesthesia provider training and credentialing with the goal of improved patient safety.
2. Encourage maximum use of established practices known to improve patient safety (Fig. 1), and the routine documentation and reporting of outcomes.
3. Raise awareness on the limited availability of oxygen in many LMICs, and encourage cost-effective solutions for improving routine access to oxygen.
4. Standardize the use of the Surgical Safety Checklist.
5. Increase availability of a functional pulse oximeter.
6. Emphasize the essential role of surgery and anaesthesia to every healthcare system, and encourage collective planning between surgery and anaesthesia to optimize quality surgical care, including patient selection, optimization, choice of anaesthetic and surgical approach, postoperative observation and pain control.
7. Focus on the prevention and treatment of the major anaesthesia risks: hypoxemia and hypotension.
8. Acknowledge the cost effective and safe use of Ketamine as a sole anaesthetic [55].
9. Adhere to minimum practical standards for
   a. Ketamine.
   b. Spinal Anaesthesia.
   c. Recovery of the Anaesthetized Patient.
   d. Acute Pain Management.
10. Emphasize the absolute importance of educated vigilance in anaesthesia care.

Conclusions

Improving anaesthesia patient safety globally should be a public health priority. As the burden of surgical disease increases, and the role of emergency and essential surgery expands, the provision of safe anaesthesia must be

acknowledged and supported. The role of international organizations to support the lowest common anaesthesia denominator is novel and requires expansion of existing standards and guidelines.

Best practice in LMICs will be improved upon by encouraging a bare minimum for patient safety, and acknowledging that aspirational guidelines must remain as a gold standard for which ministries of health and hospitals should aim. Educated vigilance must be emphasized in every operative setting. Vigilance, an educated and credentialed provider, pre-cordial stethoscope, oxygen and a pulse oximeter will provide safety for a majority of patients worldwide.

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