While it is tempting to imagine that 2030 is in the distant future, it is actually only 12 years away. While we may all hope that safe and timely access to anesthesia will soon be universally available, we should also accept that this problem will not likely be solved in just over a decade. Indeed, it does those who will need safe anesthesia in the future a disservice by unrealistically overestimating the improvements that could be achieved. It is also tempting to imagine that little has changed during the past 12 years since 2006. Nevertheless, aspirations are important. Bearing in mind that the first iPhone was only released in 2007, it is worth remembering that rapid change is achievable.

The need for surgery and anesthesia in low-income countries (LICs) and middle-income countries (MICs) is enormous and growing. In all likelihood, the capacity for the health systems of LICs and MICs to provide safe surgery and anesthesia will continue to be outstripped by this ever-increasing demand for anesthesia and surgery.

The future is difficult to predict, and any prediction made is likely to be subject to significant error. It is reasonable to assume, however, that in 12 years time, the global surgical and anesthesia community will still be looking for novel and ever less expensive ways to maintain an effective anesthesia workforce, embrace new technology, and keep patients safe.

People in different regions differ in many ways—genetics, socioeconomic status, population density, and exposure to microbial and occupational hazards are all affected by geography. So too is the practice of anesthesia.

In preparing for this article, it became clear that we are attempting to predict the evolution of anesthesia as a medical specialty in 2 different worlds. In high-income countries (HICs) and perhaps some upper MICs, progress is much more likely to focus on the greater application of technology to improve efficiency and safety, new drugs with fewer side effects and more predictable pharmacology, and ways to adapt practice to increasing health costs in an aging population.

Simultaneously, in LICs and lower MICs (LMICs), the changes needed are more modest but have the potential to make enormous differences to the practice of anesthesia and the safety of surgery. In the next 12 years, 5 billion people will need access to safe surgery and anesthesia to address the inequality that now exists.

By 2030, addressing the workforce gap in many LICs and LMICs, improving emergency care, and grappling with the burden of noncommunicable disease (much of which is treatable with surgery) will necessarily remain the key focus of anesthesia providers, health policymakers, and advocates of safe surgery. Understanding how anesthesia could evolve by 2030 hinges in part on understanding how our world could similarly evolve. Access to safe anesthesia is affected as much by geopolitics as by the development of new equipment or access to medications. The interaction of our evolving world with the technological advances of our specialty will determine how different (or not) global anesthesia will be in the future.

So bear with us in a thought experiment, and fast forward now to 2030...

Our world is more industrialized and technologically connected than at any other time in human history. With ready access to cheap, high-speed Internet and almost 1 smartphone per adult, advanced, intuitive social media platforms have overtaken phone calls and e-mail to become the principal form of personal communication.

Artificial intelligence–enabled devices (which can provide instant, context-sensitive text and speech translations) have largely removed the language barrier from international communication. Now, the ability of people in LICs to instantly connect and communicate with friends in HICs has improved access to, and sharing of, information like never before. However, it has also highlighted the persistent depth of inequality that exists between those who have and those who have not.

Massive infrastructure projects throughout Asia, Africa, and South America were the theme of the 2020s. In 2025, after nearly a decade of introspection and isolation, a resurgent United States lifted the shutters on trade and imports and declared itself open for bilateral trade once again. China, India, and Brazil continue to compete to be the global leader in manufacturing, accessing resources to satisfy the world’s insatiable appetite for ever more material things, and to cement their place as superpowers in the reinvigorated global economy.

These infrastructure projects—mostly in LICs and LMICs—led to more road networks well outside of
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traditional urban boundaries, more motor vehicles, and more road trauma. United Nations predictions from 2015 proved to be conservative, and by 2025, road traffic injuries were the 7th leading cause of death globally—5 years sooner than predicted.4,5

Unlike earlier predictions, however, the vast majority of road trauma now occurs in LICs and LMICs because that is where almost all of the cars are now—discarded from HICs, where self-driving cars and ridesharing technology have rendered the personal motor vehicle a thing of the past.

Consequently, in HICs, the burden of road trauma has fallen dramatically. Now, aside from the occasional malfunction, road trauma is rarely seen in vehicle occupants and is now mostly seen in vulnerable road users such as pedestrians and cyclists—and even then it is rare.

Also in 2025, the United Nations released its key report—Ten Years of Sustainable Development Goals: Quo vadis? In it, and prompted largely by the increasing burden of trauma and noncommunicable disease in LICs, the World Health Assembly formally amended Sustainable Development Goal (SDG) 3® to refer specifically to developing surgical and anesthesia capacity.

The amendment was driven by a consortium led by China and India. Having learned from their successes transitioning from centralized to market economies and building on programs to reduce maternal mortality and improve access to timely obstetric care in the prior decades, the key players presented a clear and simple message: addressing trauma will be impossible without surgery—and surgery is impossible without safe anesthesia.7 Their action was a welcome albeit symbolic gesture, but with time it proved to be game changing. Amending SDG 3 briefly increased mainstream publicity of the need to build surgical and anesthesia capacity in LICs and LMICs.

This short period of heightened awareness was enough to gain traction with some policymakers, especially in China but also in a number of other Asian, African, and South American nations. There is now a renewed political will to view surgical and anesthesia capacity as a nation-building priority.

These shifting patterns of disease burdens had different consequences in various parts of the world. In LICs and LMICs, health systems were stressed, whereas in HICs, anesthesia entered a golden age of science. During the mid- to late 2020s, advances in laboratory techniques and technology enabled analysis and modeling of receptors and cell signaling pathways to a level of detail not previously possible. These advances inevitably led to the development of new drugs engineered to act specifically at particular receptor subtypes, thereby providing more of the desired effects and fewer adverse effects.

New hypnotic agents began appearing on the market in HICs. After several delays in production, Phaxan was released in mid-2024. As a reformulated, aqueous version of alphaxalone, it has all the benefits of cardiovascular stability with none of the immunogenic problems of previous Cremophor EL solutions.

At roughly the same time, ABP-700® was released and proved popular in Europe, the United States, and New Zealand, where etomidate had continued to be used. Also known as cyclopropyl-methoxy-carbonyl-methyl-etomidate, it is an etomidate analogue without the adrenocortical suppression that made etomidate less than ideal. The appearance of these newer hypnotics did not render propofol obsolete. Instead, it prompted a realignment of the place of propofol in anesthesia practice as the mainstay of anesthesia maintenance.

By the late 2020s, total intravenous anesthesia (TIVA) had overtaken volatile anesthesia as the most common means of maintaining general anesthesia. This shift was stimulated in 2026 by the release into the markets of HICs of a proprietary reversal agent for propofol based on work done in Canada showing that physostigmine could reverse the effects of propofol.9 Interest in the intravenous agents had been buoyed by renewed and growing pressure on regulatory authorities to ban volatile agents and gases known to cause greenhouse effects, harm the ozone layer, and damage the environment. Stopofol appeared in response to the renewed competition with newer hypnotics and added a layer of safety to an already safe drug for infusion. This development helped tip the balance in favor of TIVA based on a new propofol formulation associated with neither pain on injection nor the propofol infusion syndrome.

Alongside the shift to TIVA was an improvement in accuracy of depth of anesthesia monitors. The monitors now available are able to judge whether consciousness is present by assessing electroencephalogram signals at 2 sites—frontal and parietal—to determine the presence or absence of the communication between these sites, which is necessary for the “binding” of different sensory perceptions into a conscious experience. Multiple manufacturers began large-scale production of equivalent monitors, and therefore cheaper, hand-held, smartphone-based alternatives appeared on the market.

As volatile anesthesia use decreased, the imperative to improve TIVA administration for all age groups increased. TIVA is now common in children of all ages, using target-controlled infusion (TCI) technology to administer propofol and remifentanil due to the successful validation of universal TCI algorithms suitable for pediatric use.10 The availability of these algorithms has helped to reduce the incidence of drug errors since the same model is used for adults and children. In addition, these TIVA models automatically compensate for the differences in pharmacokinetics in different patient populations, reducing the complexity of TIVA for clinicians.

The source codes for these models were made freely available by the researchers.10 The control algorithms needed to implement the models, interact with the user, and control the TCI pumps had also been freely available for several years. Manufacturers were able to provide users in LICs and MICs with affordable versions of this TCI technology. With the cost of propofol reduced globally, TIVA became increasingly common in LICs and LMICs—even without ready access to the still expensive Stopofol.

Along with hypnotics, new nonaddictive opioids appeared on the market11 and have now almost completely replaced “traditional” opiates. Most anesthesia trainees in HICs have never administered morphine to a patient. Morphine and fentanyl have now been relegated to the occasionally used list of old drugs.
Anesthesia: The View From 2030

Ketamine continued to cause controversy during the 2020s. Despite China’s positive role as a leader in raising the profile of surgical and anesthetic capacity, it unfortunately renewed its campaign to have ketamine banned. Ultimately, this was again unsuccessful due to effective lobbying by the World Federation of Societies of Anaesthesiologists (WFSA) to the World Health Organization through a strong data-driven information campaign. In the most underresourced parts of the globe, particularly in parts of sub-Saharan Africa, ketamine remains the mainstay of anesthesia practice and an essential bare-minimum drug.

As the bare-minimum standards for anesthesia continued to slowly improve in low-resource settings, anesthesia technology enjoyed a period of major advancement in HICs. With the spread of minimally invasive endovascular and interventional radiology cases, anesthesia provision moved ever further away from the operating room. In response, small and ultraportable diagnostic machines developed to allow anesthetists to provide advanced point-of-care testing for patients regardless of the location of care. The “lab on a chip” approach to portable diagnostics means that chemical pathology, hematological, coagulation, and blood gas testing are all immediately and cheaply available. Similarly, anesthesia work stations have been revolutionized. Fully wireless monitoring systems, integrated artificial intelligence-enabled ultrasound machines, and automatic electronic anesthesia records with secure cloud storage have allowed routine tasks to be partly automated. The anesthetist is now less defined by the technical aspects of care and more by their role as intraoperative crisis decision makers and perioperative physicians.

As automation and technological integration prevailed throughout the 2020s in HICs, in LICs and LMICs, the focus remained more on improving basic access to safe anesthesia. In that context, legislation was introduced in a number of countries in Asia and Africa to encourage new approaches to increasing surgical and anesthesia capacity down to the district hospital level. Uniquely, in an attempt to reduce their reliance on foreign government aid, this included tax concessions for foreign businesses that invested in improving responses to trauma and surgical capacity in areas where they worked—and in some countries a levy on foreign businesses. Some of this so-called “trauma tax” was used to establish scholarships in medical schools to increase the number of medically trained anesthetists. Simultaneously, nursing graduates were elicited with state-sponsored, rurally bonded scholarships to train as independent anesthesia providers via technical programs based in hospitals and endorsed by local colleges. On completion of their training, these various graduates were compelled to work in district-level hospitals for a period of time. The WFSA, via national associations, was integral to ensuring the academic integrity of the training programs and maintained a close relationship with the training sites.

In the past, efforts to address the anesthesia workforce challenges had often failed because there simply was not the money to pay providers’ salaries. Inevitably, the pressures of working in underresourced and ill-equipped district hospitals were severe. Providers would resign their posts to work in private practice (where it existed), emigrate to HICs in search of better opportunities, or completely stop practicing anesthesia. These programs were critically different from previous attempts. They were linked to SDG 3, and now, for the first time, addressing the anesthesia workforce was being tackled by some of the world’s most successful businesses. Flowing from the publicity that came from amending SDG 3, Tesla and Volvo partnered with a number of government programs aimed to improve access to trauma care.

As pioneers of car safety, both Volvo and Tesla saw a natural fit to extend their interest to bridging the gap of safe trauma care, now that human-driven cars were almost exclusively a LIC and MIC problem. Tesla and Volvo, having been extensively lobbied by the WFSA, became convinced that solving the workforce challenge was a problem worth taking on and aligned with both companies’ visions of corporate social responsibility.

Tesla and Volvo applied the same cost-effectiveness analyses that had made them successful businesses to the problem of safe surgery, reminiscent of the successful Bill and Melinda Gates Foundation’s approach to communicable disease. This step led them inexorably to the problem of anesthesia capacity, and they set about contributing to the solution of both problems by focusing initially on solving the anesthesia workforce issue.

Indeed, several of the workforce lessons learned in LMICs were carried over to solve the increasing demand being placed on anesthesia services in HICs. With an aging population and ever-increasing appetite for life-extending procedures in the chronically unwell and elderly, medically trained anesthetists are much more likely to be found anesthetizing high-risk patients or managing these patients’ perioperative medical needs. In turn, independent nurse–anesthetists were introduced in almost all HICs by the late 2020s to reduce waitlist times for elective surgery. It is now more likely than not that a low-risk patient undergoing elective surgery will be anesthetized by a nurse practitioner supervised distantly by a physician anesthetist.

Of course not all workforce issues were solvable. Many LICs and MICs were not meaningfully able to improve the safety and quality of basic surgical care. Years of protracted insurgent conflict and political stagnation destroyed almost all critical infrastructure in a number of nations in the Middle East, leaving them without personnel, equipment, or expertise. These failed states were nearly completely dependent on foreign aid, emergency relief organizations, and the military. Not surprisingly, safe surgery and anesthesia was seen as a low policy priority in these places.

Similarly, many sub-Saharan African nations remained desperately poor and underresourced. In the aftermath of the second major Ebola outbreak in 2022 and with worsening extreme drug-resistant tuberculosis, the resources and working-age populations of many nations were decimated. In circumstances such as these, surgery continued to proceed as it had for the decades before—sometimes with skilled anesthesia providers and sometimes without. While some trickle-down effects occurred in terms of access to second-hand equipment, many countries relied on the dedication and hard work of 1 or 2 key individuals. These local physician anesthesiologists, surgeons, and nurses

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often kept the pressure on local politicians and international groups to ensure that they were not completely forgotten.17,18

For countries such as these that had not flourished as much as others in the 2020s, Lifeboxx9 and the WFSA remained crucial links to improving the safety of their populations. By 2024, it was rare not to see a Lifebox oximeter in even the most remote of district hospitals. Having been successful at distributing and training key personnel in the use of pulse oximeters, Lifebox turned their attention to end-tidal carbon dioxide monitors.

In 2030, 2 years after the Lifebox Gasman was released, there remain approximately 40,000 operating theaters around the world where end-tidal carbon dioxide monitoring is not available. When the distribution started, 90,000 operating theaters provided general anesthesia to patients without this essential monitor,20 so again things are improving.

Looking ahead to 2042, it is difficult to predict what anesthesia across the globe will look like—but some promising signs indicate that each year it gets a little bit safer for people needing surgery.

Advancing the science of anesthesia while reducing the inequality of access remains the essential challenge to make safe surgery truly global. ✪

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