

Medical Student Essay Prize Runner-up

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What will anaesthesia look like in the next 25 years?

'The distinction between past, present and future is only a stubbornly persistent illusion.'
Albert Einstein, 1955

When thinking about the growth of any field, be it in science or the arts, I believe it is important to remember that this development is a continuum. We cannot begin to estimate how far we will go without first judging how far we have come.

Looking back upon the time of Enlightenment and its discovery of Nitrous Oxide, we can see the beginning of a discipline that resembles anaesthesia today [1]. However, since this origin, anaesthesia's course has been far from unwavering. Despite William Morton's demonstration of ether for the painless operation in 1846 [2] public perception of the discipline was still tentative. It took the royal seal of approval from Queen Victoria when she used anaesthesia during labour in 1853 and 1857 to finally quash lingering hesitations over this new era of medicine [3].

Jump forwards to 2017 and the calculated, exact, safety-centred speciality of anaesthesia may be unrecognisable to its early pioneers. The question is, will we be able to recognise it over the next 25 years?

The Role of the Anaesthetist

We all take differently to the various epoch-defining buzzwords that circulate through the medical profession: 'reflection' and 'resilience' are just two from current trends. Even from my position outside the profession, I have become aware of such a phenomenon occurring within anaesthetics that has the potential for significant change.

The era of the Perioperative Physician may be dawning, and if so could have major implications for the specialty. The role of the anaesthetist could be changing dramatically, taking responsibility for more general aspects of patient care before, during and after the operation. There are concerns from within the profession about what this will look like, what the definition of the perioperative physician is and even where the perioperative period starts and ends [4]. However, others advocate that this new role could see the speciality grow into a new light, where our clinical scope expands to strive for better patient care and surgical outcomes [5].

The design and implementation of a new perioperative medicine pathway will influence anaesthetics training in the UK [6], it looks set for the role of the anaesthetist to change. In the next 25 years we could therefore see the 'unmet needs' of variation in surgical morbidity and mortality

greatly reduced [4], partially by the growth and development of anaesthesia for enhancing patient care.

The Human Factor

The profession of anaesthetics wears the case of Elaine Bromiley like a badge, an emblem to strive to increase patient safety. Thanks to the work of her incredibly understanding husband we have seen the advent of the Clinical Human Factors Group and the dawn of a new type of innovation in patient care.

Anaesthesia is one of the specialities leading the way in enrolment of human factors within their training, professional role, guidelines and protocols [7]. The next 25 years could see anaesthesia playing a key role in the further dissemination of human factors training across medical specialities. The profession's affiliation with simulation training could prove essential in the development of new scenario-based training to propel itself forward into a new era of non-technical skills [8].

With 25 more years of research, training and understanding of human factors we could see medical errors reduced to negligible levels. The 'Swiss Cheese Model' [9] could become an archaic remnant from a time we look back on and marvel at how we worked blind without human factors as a guide. Of course this evolution in practice would not only benefit anaesthetics, but also the wider medical profession. If other specialities took human factors into the core of their professional role, as we see them starting to now, the profession could shake off the low-level distrust from the public it is experiencing in relation to medical errors [10].

Pharmacogenetics

It would be naïve to write about the future of any medical profession without the mention of the role of genetic medicine. Since the Human Genome Project, the scope to individually map and therefore tailor medical treatment or interventions to a patient's genome has grown exponentially [11]. This has exciting connotations for anaesthesia where pharmacogenetic differences can have significant effect on anaesthetic practice [12].

We have already seen that within anaesthesia better research and understanding of the genetic nature of conditions is helping us manage them. For example, identification of genetic components of Familial Malignant Hyperthermia (FMH) is allowing further ways to screen for patients susceptible to this anaesthetic emergency in order to help manage them [13]. Although still in its infancy, over the next 25 years we could see the genetic guidance for FMH management evolve into the identification of highly sensitive and specific genetic tests which allow anaesthetists to give individually tailored volatile anaesthetics to these patients without risk.

The role of pharmacogenetics could influence not only the management and avoidance of anaesthetic disasters such as FMH, but also the day-to-day, patient-to-patient delivery of anaesthetics to everyone who enters the anaesthetic room. No two patients will ever react in the same way to the same drug, to the point where drug-response variability can be thought of 'as the

rule, rather than the exception' [14]. However with future pharmacogenetic research and application to routine screening we could end up in a position where genetically tailored types and doses of anaesthetic agents are calculated in preoperative assessment. This could allow tighter, more stable control of anaesthesia for all patients, with better prediction of drug response. The knock-on effects of this could be numerous, from more efficient use of theatre and recovery room space through to fewer and less severe complications of anaesthesia.

Technology

Technology, throughout history, has been a crucial factor in all forms of humanity's development [15]. It follows then that inevitably, anaesthesia will develop alongside and be shaped by technology.

The word 'Nanotechnology' may still take some readers on a *Fantastic Voyage* filled with microscopic submarines [16]. However, the profession of anaesthetics needs to be ready to harness its future role. Research has already shown that nanotechnology could play a significant result in reducing the adverse effects of some propofol emulsions [17]. With further application of nanotechnology we could find ourselves on the precipice of virtually eradicating anaesthetic drug adverse reactions. Nanorobots could deliver a drug so specifically to the desired receptor that only the sought response would be possible [18]. The potential for a synergistic effect between pharmacogenetically calculated anaesthetics and nanorobotic delivery systems could leave us in a world where complications of anaesthesia (of any magnitude) are a thing of the past.

There are areas of technological advance some may find more approachable that also show a lot of promise for the future of anaesthesia. In a world seeking to automate everything around us, from predictive text to self-driving cars, it is no wonder that an attempt at self-automated anaesthesia has been made. The success of a device in controlling the depth of anaesthesia by interpreting the patient's bispectral index is an exciting development in the world of anaesthetics [19]. It could be a springboard for the future research and development of automated systems within the profession. Despite a very human tendency to develop suspicion towards automatic systems such as this, they present an exciting prospect for the future of anaesthetics. Automatic control of basic parameters within the delivery and monitoring of anaesthesia could leave the anaesthetist free to take control of aspects of care in more precise ways, further enhancing patient safety and outcomes.

The Money Issue

One can only write about the medical profession for so long before the 'M word' has to be mentioned. Economic instability and the funding of healthcare has been identified as a key uncertainty for the medical profession [20], and this by no means exempts anaesthesia. An aging population, increasing expectations and more complex healthcare needs of patients will demand that anaesthesia continues to deliver the highest quality of care efficiently.

As we all have heard, 'necessity is the mother of invention' and so whilst endless, demoralising budget cuts threaten patient care and the profession of anaesthetics it must also be thought of as a driving force for innovation.

Conclusion

When looking ahead, towards the horizon of scientific advancement that will inevitably propel anaesthesia on a forward trajectory, it is impossible to say where it will land. Any number of advances in our understanding of anaesthesia could see the profession evolve immeasurably, many of which we will probably be oblivious to until their time comes.

There are a few 'certainties' we can hope to rely on though, which I have tried to comment on. The role of the anaesthetist will surely grow, expand and take on more responsibility; whether this permeates through to changing the public's perception of what an anaesthetist actually does is another matter altogether. The profession's assimilation of the discipline of human factors will continue, become more deeply rooted and hopefully appear more broadly across all medical specialities. Genetic medicine will have a profound effect on the medications anaesthetists use. This, coupled with the role of technological advances in diagnostics, procedural tools and therapeutics will help bring us into a new light of patient safety. All of this must of course occur within a practical world, which in our western society is chiefly governed by budgets and their targets.

Over the course of writing this essay, and the reading it has brought my way, one thing has become explicitly clear. The question itself is limited: talking about the future of anaesthesia as a lone entity does no justice to the science and art of the profession. This is because advances in anaesthesia ultimately not only progresses the speciality itself, but also allows progression in any other surgical (or medical by extension) speciality. Creation of better, safer surgical conditions on more extensive patient groups who were previously thought to carry too much risk, allows the development of new surgical techniques, and the treatment of patients previously thought untreatable.

Therefore, I believe the future of anaesthesia is a bright one, and sheds its light on medicine as a whole and all those who benefit from its care.

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