# Rise of the machines: Is the future of health care human?

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In recent times, whenever I meet surgical colleagues and friends practising in New Zealand (where I did almost all my medical and surgical training) it seems the first question I get asked, after pleasantries are out of the way, is 'how many robotic operations are you doing?'. The reason for this is simple: surgeons are understandably preoccupied with technical advances, and robotic assisted platforms are now in common use in Australia and most of the developed world. Penetration is lower in New Zealand, but that is a temporary situation. Make no mistake, the robots are coming soon and the expectation is that eventually they will be embedded in every operating theatre in the country.

In this issue of the journal, Shah and colleagues outline an approach where physical tasks were developed to facilitate robotic training on a retired robotic system (REF). Most current da Vinci robotic systems (made by Intuitive Surgical Inc., Sunnyvale, California) already incorporate software that allows training in a virtual environment while sitting on the console. In fact, training on these simulators is a prerequisite to accreditation, and is mandated by the company manufacturing the device along with either an accredited robotic fellowship or an intensive program of workshops and proctoring for established surgeons. Currently, almost all robotic training (prior to patient contact) is managed and regulated by industry, with the move to clinician control of this process yet to materialise, but expected soon.[1]

The current generation of robotic technology is being pushed largely by industry and enthusiastic surgeons, not only for financial gain, but also because they have the potential to make difficult operations (such as rectal cancer surgery) easier for the operating surgeon.[2] Do these robots improve patient outcomes? The answer is that they do not yet.[3-6] This is likely because the exent of tissue damage is not different when robotic operations are compared to other minimally invasive techniques (i.e. there is no meaningful reduction in incision size or intra-abdominal injury). In addition, claims that patients are demanding their operations to be performed robotically are also misleading in my opinion, and the technology is also not currently cost-effective by any stretch of the imagination (or creative accounting).[7] So why the relentless worldwide march to embrace robotics then? The real truth is that the current technology is simply a first step towards a longer-term future where machines initially augment human surgical ability, and ultimately replace it (or at least components of it).[8] This is happening in virtually every industry, and to think that medicine or surgery is immune, would be naïve. The forthcoming generation of robots are considerably more advanced, with flexible single port systems, true haptic feedback, and augmented reality overlaid directly to the operating surgeon's field of view, all imminent. The advent of these new technologies will not only be able to address some of the current limitations, but also reduce the capital and consumable costs through innovation and competition to drive down prices. Further cost reduction is also likely once there is critical mass, with purchasing economies of scale and improvement in operating team efficiency reducing the real dollar cost of any given operation.

The future is even closer (and more career threatening) on the software side of the coin. Artificial intelligence, specifically deep learning technology, is already able to replicate certain tasks that do not require specific social contact with patients, namely: imaging interpretation, histological analysis, and risk prediction.[9-11] The combination of widespread electronic medical records (big data), and the ability of specialised software to analyse these (artificial intelligence), has created the potential for unprecedented computer learning ability. Unlike with robotics, there is no cost barrier, with the software expected to be much cheaper than the humans it will eventually replace. The only real question that remains is: who/what will be replaced and when. That is more difficult to answer. The main obstacles to adoption are likely to be patient and doctor acceptance, rather than weaknesses or delays in the technology itself. However, as we have seen with autopilot systems in airplanes and self-driving cars, perceptions will slowly change until a new normal is accepted. There will be major regulatory barriers too. How will the Royal Australasian College of (insert specialty here) react, accredit, and implement potential doctor-replacing systems? There is no part two exam for robots yet.

The overall theme of this issue of the journal centres around the future of health care in New Zealand. If I were a medical student right now, I would be seriously considering the impact that robotics and artificial intelligence will have on medical practice and patient care. The challenge will be to select specialties that are at lower risk of being made redundant, and perhaps more importantly, to lead from the front when it comes to adoption. It is imperative that as the technology develops, clinician and research-led programmes drive safe implementation with a patient-centred approach. The future is both exciting and uncertain, but that is always the case, and all you can do is embrace it.

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