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OPINION

The future - challenges and opportunities for universities and health care

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Gaisford Harrison Memorial Lecture
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Introduction

I dedicate this lecture to our dear friend and colleague, Professor Bongani Mayosi, who passed away earlier this year. Bongani's death is a devastating loss on various levels. He was a personal friend and we had worked closely together as colleagues. I had the greatest respect for him as a top cardiologist and leading scientist. And he was an important figure in higher education – in our country and further afield.

His tragic death highlights the extreme pressure experienced in South Africa's higher-education sector the past few years. His passing makes us reflect anew on depression as an illness, and also on how we, as stakeholders in academia, interact with one another. It reminds us of the importance of respect, care, collegiality and professionalism in our relationships.

My thoughts are with Bongani's loved ones and colleagues, who are no doubt still coming to terms with his loss.

One of the ways we can honour his legacy is to build the best possible higher education and health-care systems for the future. So, that is what I want to look at: The future – challenges and opportunities for universities and health care.

The university

Universities are some of society's most enduring institutions, dating back to the Middle Ages and even earlier. Yet the world is changing fast, and all kinds of pressures are mounting on universities that are likely to affect their on-going existence. Technological advances, economic forces, demographic shifts and various other social factors mean universities are "ripe for disruption" (Christensen & Eyring, 2011:vii; 5).

But for that to happen, universities must think deeply about their continued existence and make major changes in order to adapt to new circumstances.

The problem is, institutional transformation and innovation is not easy, even though it is absolutely crucial if we want to achieve systemic sustainability. Deep and extensive change creates uncertainties and places high demands on all involved.

I shall explore some of the challenges facing universities at this point in the 21st century, and also look at the inherent opportunities for innovation and growth. Universities may be ripe for disruption but they are also well placed to be ready for innovation. The challenges we face can be turned into opportunities.

The "technologies that now threaten to disrupt traditional universities … can also reinvigorate them to the benefit of so many people" (Christensen & Eyring, 2011: xiii).

Key trends

Understanding the ecosystem in which we operate is important. So let me highlight seven key trends affecting universities going into the future (de Villiers, 2017).

Complexity and contingency

We live in a changeable, contestable and therefore negotiable world. University managements have to employ flexible and responsive planning frameworks (Lange, 2010).

Agility, adaptability and responsiveness are required in our complex era. Universities should be involved in "pattern detection" and "scenario building" (Kinghorn, 2011).

The characteristics of an organisation that is attuned to the knowledge economy of the 21st century includes complexity awareness, creativity, agility and continuous learning (Kinghorn, 2011).

To accommodate the complexities we need responsible leadership in higher education. Responsible leadership entails five aspects that are important for the 21st century (Vogtlin, 2017). These are:

- being able to make informed ethical judgments;
- displaying moral courage and aspiring to positive change;
- engaging in long-term thinking and getting perspective on the future;
- communicating effectively with stakeholders; and
- participating in collective problem-solving.

The knowledge economy and collaborative knowledge production

Knowledge has become the "key strategic resource necessary for prosperity" (Duderstadt, 2000).

Universities have a crucial role to play in the knowledge economy. However, specialised, disciplinary knowledge has limited capacity to explain and solve complex problems. Complex times call for collaboration across different sets of boundaries: between and across disciplines, across institutional and national borders and between universities and other sites of knowledge generation.

Collaboration around knowledge projects and co-production of knowledge is viable and sensible. The massive increase in the availability of knowledge online and the mass expansion of access to university markets mean a fundamental change in the role of universities as originators and keepers of knowledge (Ernst & Young, 2012).

Collaborative learning

The current, dominant model of pedagogy (teacher-centred lectures) is obsolete. The focus should be more on how students learn than what they learn (Tapscott and Williams, 2010).

New technology makes it possible to embrace collaborative learning models. It facilitates a change in the relationship between students and teachers in the learning process.

Collaborative learning provides the basis for the university to be a learning organisation – an organisation characterised by a shared vision, team learning, systems thinking, mental models, and personal mastery (Senge, 2006; 2014)

Innovation

Methods of investigation that move away from what has been seen, to the creation of what has never been seen, are needed (Kinghorn, 2011). Creativity and innovation can create unusual products and processes to solve complex problems of our time.

Network society

Formal and informal networks are a feature of the 21st century (Lange, 2010). The primacy of relationships is confirmed in a time of resource scarcity and complexity. Institutions have to team up with others with similar goals and objectives to pool resources. Because of complexity and increasing globalisation, universities find that they must collaborate with others – increasingly in networks – to address different aspects of the challenges that are experienced.

Internationalisation

An "international market place, not only for conventional products, but also for knowledge professionals, research and educations services" has emerged (Duderstadt, 2000).

Individual institutions are part of a worldwide higher education system. Student and staff exchanges, global big science collaborations, international joint ventures, research teams and partnerships are integral parts of the current worldwide higher education environment.

Global mobility is growing for students, academics and university brands and this is creating global partnerships and broader access for students and academics (Klopper, 2018).

The Fourth Industrial Revolution (4IR) and technology

In the Industrial Age, which began with the Industrial Revolution in Britain around 1760, the advanced technology of the day was machinery, and the most valuable resources physical commodities such as iron ore and coal.

The creation of computer technology in the second half of the 20th century – the Digital Revolution – has since led to the Information Age. Now the most valuable resource is knowledge.

The birth of computer networks – in the form of the internet and the World Wide Web – has greatly aided and accelerated the development of an information society. Knowledge is being created and shared at a greater pace than ever before in human history.

Universities worldwide have been arguing for many years that the digital revolution will substantially challenge the way universities function (Tapscott and Williams, 2010).

It has been said that "a new generation of students requires a different model of higher education" (ibid.). Weiss et al (2002) indicated that classrooms are transformed from spaces of delivery to spaces of active inquiry, authorship and ownership.

Big data and AI/ML

So, I have highlighted seven key trends affecting universities. What an exciting time to be alive!

Let me now turn in more detail to aspects that I have mentioned, but not unpacked. I am referring to big data, artificial intelligence, machine learning – in the context of health care in general, and anaesthesia in particular.

We are seeing an "explosion the use of machine learning (ML)" – as artificial intelligence (AI) is increasingly called – particularly in health care (Mira, 2017).

"All clinicians, including anaesthesiologists and nurse anaesthetists, are likely to find themselves incorporating machine learning tools and capabilities into their practices in the not-too-distant future" (ibid.).

But what are its "strengths and limitations"? What are the "pitfalls" and which "strategies" should we pursue to avoid them? Whatever the case, we should gear up because experts say "the era of ML has arrived".

Three factors are fuelling this trend, according to Steve Ranger on ZDnet (cited by Mira, 2017):

The rise of big data

Vast amounts of data are being generated, and it is doubling every two years. "The role of big data has become increasingly

prominent in the constantly evolving world of medicine" (Simpao, Ahumada and Rehman, 2015).

ML is needed to keep track of all this data, being generated by, amongst others, electronic health record systems (EHRs), which have enabled hospitals to collect and store a rapidly increasing volume and variety of patient data.

"Interest in population-level, epidemiological anaesthesia-related research has led to the creation of large anaesthesiology-specific databases" (ibid.).

Advances in computer hardware and software

The second factor driving the rise of ML/AI, is advances in computer hardware and software: continuous improvements in computing power though parallel computing and simulating neural networks.

The key is analytics – "methods such as mathematical and algorithmic-based data processing, text mining, and natural language processing" are being used "to analyse and derive insight from data across a wide spectrum of healthcare fields" (ibid.).

There are many benefits offered by health analytics, but the main one is improving patient care. Through the use of powerful analytic tools that used big data in clinical decision support (CDS) systems, anaesthetists and other clinicians can make more personalised, evidence based decisions informed by real-time insights (ibid.).

The 'cloud'

The third factor fuelling the age of ML, is cloud business models: "Before the cloud, most AI (artificial intelligence) work was isolated and relatively high cost, but the economics of the cloud mean machine learning … will be cheap and easy to use", writes Ranger (cited by Mira, 2017).

Machine learning

What is ML? It is defined (on WhatIs.com) as "computers with the ability to learn without being explicitly programmed … computer programmes that can change when exposed to human data".

If that sounds human-like, it is supposed to. That is the goal of artificial intelligence. To replicated human thinking but to do it faster and bigger.

So, if machines can do that, will they replace humans? More to the point, will ML take over the work of physicians? Let's leave that open for the moment. Let's first look at the abilities of machine learning.

IBM's AI platform, Watson Health, was tested at Memorial Sloan Kettering Cancer Center in the US – and it was found that the software was capable of predicting lung cancer with 90% accuracy, compared to human rates of 50% (Mira, 2017).

This is possible because the software is able to synthesise and apply massive amounts of data – in this case 600 000 medical findings, 1,5 million patient records and 2 million pages of medical journals. This level of information absorption surpasses human capacity (ibid.).

However, oncologists were still needed to take responsibility, and to explain why certain decisions were taken. So, the role of ML or AI is to be a decision support tool – albeit a very powerful one. But it does not replace the clinician.

So, what can machines do with AI/ML? According to Bertalan Mesco (ibid.), AI will be applied in health care to mine medical records, design treatment plans, perform repetitive tasks, support consultations, help manage medications and provide health assistance, help patients make healthier choices and decisions, develop or medicines, and facilitate precision medicine.

That sounds good, but there are also concerns regarding the implementation of real-time clinical decision support systems (Simpao, Ahumada and Rehman, 2015): loss of autonomy of clinicians, risk to patient privacy, and potentially basing recommendations on faulty so-called 'real-life' data.

For the last point, there is a great term in computer science – GIGO, which stands for "garbage in, garbage out" – i.e. where flawed, or nonsense input data produces nonsense output or 'garbage'. The principle also applies more generally to all analysis and logic, in that arguments are unsound if their premises are flawed (Wikipedia, 2018).

So the validation of data quality is very important – which can be a huge task taking in the world of big data, but AI is also being used to check data before it is used as input in decision support.

Looking ahead

Simpao, Ahumada and Rehman (2015) argue that the future of anaesthesia and healthcare analytics will involve ever-increasing demand for and application of sophisticated analytics methods and tools … to explore and analyse data with the goals of improving patient care, increasing efficiency, optimising resource utilisation and allocation, and enhancing decision making at both clinical and enterprise levels. And this will "increase the demand for anaesthetists who can bridge the gap between the medical and information sciences".

How do we do that? In two ways – by producing good clinicians, and by preparing now for the future of AI/ML. I will expand briefly on each aspect:

Good clinicians

Nathan (2005) lists ten commandments (all starting with "C") for the young translational clinical researcher (patient-oriented translational clinical investigator, or POTCI), as outlined below.

i. Clinical focus:
   - Must be primarily interested in a particular disease and patients who suffer from it
   - May lead to basic biological inquiry

- Driving force is the patient

ii. Collaboration:
- Must collaborate with basic scientists and full-time clinicians
- Published results of collaborative efforts may be problematic – honest evaluation of an author's real contribution
- Should train medical students in clinical research
- Rarely successful translational clinician scientists who had not been bitten by laboratory/research bug in medical school
- Basic science – clinical experience

iii. Courage:
- To learn new techniques and new approaches
- Do not slavishly adhere to a set of painfully learned techniques
- "Paralysed academic investigator's disease syndrome"

iv. Critical awareness of literature and field:
- Absolute requirement
- Emerging "hot" new information

v. Constructive infrastructure:
- Support staff
- Core labs

vi. Cooperative partners:
- Costly travel
- Encroachment on family life
- Child rearing responsibilities
- Day care centres

vii. Consent to participate:
- Detailed notes in chart
- Conversation in normal terms with patient and documentation

viii. Conflict of interest:
- Deadly bacillus
- Personal compensation or ownership of stock

ix. Chronophage:
- Well-meaning supervisors/chairs who ask eager-to-please young people to perform extraneous tasks that eat their time
- Women and novices are particularly vulnerable

x. Caring mentors:
- Availability
- Steer investigator into most productive areas, away from barren/overworked soil
- Solve inevitable conflicts and jealousies
- Help find collaborating experts

Preparing for the future

Now to the second thing to do in order to bridge the gap between the medical and information sciences: we need to pay attention to data science and prepare for it, and by preparing now for the future of AI/ML.

Fatima Paruk (cited in Mira, 2017) of Allscripts advises health systems and clinicians to "prepare now by establishing data governance, infrastructure and strategy".

Lisa Suennen (ibid.) of GE Ventures encourages clinicians to learn about AI's inherent strengths and weaknesses. "… it's an excellent time to invest in education".

And anaesthesiologist Arthur Atchabahian (ibid.) of New York University says, "We cannot resist technological advances. Our role is to manage those advances to best benefit patients but also to avoid disappearing – like travel agents and bank tellers, who were displaced by the internet".

It seems the ball is in our court, and we should play it. Big data and artificial intelligence will fundamentally change not only the 'world of work', but also *our* world as 'knowledge workers' at universities.

That is why I have been driving the establishment of a school for data science and computational thinking at Stellenbosch University – watch this space …

"The time to embrace ML is now, suggests an article in Healthcare IT News" (Mira, 2017).

And the Gartner Group warns, "the risk of investing too late in smart machines is likely greater than the risk of investing too soon".

Conclusion

Jeffrey Buller (2015) points out that higher education does not handle change particularly well. Ironically, "the very institutions that exist to develop innovative ideas and question traditional ways of doing things" seem to be "so resistant to change that they often stifle it".

He says that to an extent all organisations resist change because by their nature they want to "act in ways that are regular, consistent and predictable".

Yet universities seem particularly resistant to even modest change, a phenomenon captured by a comment attributed to various figures: "It is easier to change the course of history than it is to change a history course."

Why is this the case? Because universities are examples of what Buller calls "distributed organisations" – i.e. power is shared among various individuals or groups within the organisation. Distributed organisations fall between hierarchical organisations where all decisions are taken at the top, and decentralised organisations, where each member of the institution possesses power equal to that of every other member.

Buller argues that in a university's culture of shared governance, faculty and other staff members do not view change just as an issue affecting the organisation; they tend to view it as an indictment of them. If they are told they need to change, they take it personally. They infer that they are doing something wrong, which is an affront to their sense of independence and academic freedom.

This is a problem because the "choice in higher education today isn't whether we should change but how … Change is already

here. The issue is what we're going to do about it and what type of change we want for our … universities" (Buller 2015:55).

Therefore, the challenge becomes "how university personnel can work together constructively to produce an academic culture that responds well to each new challenge or opportunity, capitalise on evolving possibilities when times are good and demonstrate resilience when times are bad".

Buller calls for "a truly transformative approach – one that guides us to think differently about change and move from trying to manage it to leading it". He says the "most important task for change leaders in higher education is not to announce a specific goal but rather to spend their time creating a culture of innovation and continuous learning".

But whom is he addressing? VCs and DVC? Deans and Departmental Chairs? Yes, all of these. But also, because the university is a distributed organisation where governance is shared, everyone has a responsibility to lead change.

You can begin to affect the culture of your institution no matter what your job description may be. All it takes is a recognition that meaningful change is all about the culture and that the culture is all about the people. Trust the people you work with, empower them, and recognise their efforts to be creative, and the change that will result will be far more spectacular than can be possible with even the [best] strategic plan.

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