

ISSUES IN MEDICINE

COVID-19: The role of artificial intelligence in empowering the healthcare sector and enhancing social distancing measures during a pandemic

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Indiscriminatory in its spread, COVID-19 has engulfed communities from all social backgrounds throughout the world. While healthcare professionals work tirelessly testing for the virus and caring for patients, they too have become casualties of the pandemic. Currently the best way to attempt to curb the spread of the virus, echoed by almost all nation leaders, is to distance ourselves from one another socially or physically. However ideal this may seem, social distancing is not always practical in densely populated lower-income countries with many citizens below the breadline. With the majority of South Africans living in poverty, communities in overcrowded households are unable to distance themselves from one another appropriately. In addition, as a nation we struggle with high HIV and tuberculosis rates, malnutrition and an already overburdened healthcare system, emphasising the extreme vulnerability of our people. These factors, coupled with the fact that many of our healthcare professionals lack the necessary personal protective equipment to prevent them from contracting the virus themselves, highlight the gravity of the damaging repercussions that we may face in the coming months, after the complete national lockdown in force at the time of writing is lifted and we move towards a partial lockdown state. Nationally, there needs to be a shift in mindset towards exploring alternative technology-based preventive measures that may empower the healthcare sector in the long term and enhance social distancing.

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The world was unprepared for COVID-19 and the rapid rate at which it spreads. However, while some other countries took a more relaxed approach, South Africa (SA) acted quickly and declared a national State of Disaster on 15 March 2020, despite having a very low rate of infected individuals and no deaths at that stage. This swift action by government, together with the national lockdown, accounts for the relatively controlled pace at which the virus is spreading in SA. At the time of writing, the global infection rate had already exceeded 2.6 million, with over 180 000 deaths reported.^[1] The much-needed lockdown in SA, which has practically paralysed the economy and left many citizens unemployed, is expected to flatten the curve to an extent. However, this does not mean that we should be complacent in our approach towards mitigating the effects of the virus once lockdown ends. In fact, infections are now only expected to peak in September.^[2] The true test will come after we enter a partial lockdown phase, as individuals' behaviour will directly determine whether the virus can be contained effectively or not. Currently, the best method of doing this, echoed equally by almost all nation leaders, is to distance ourselves from one another socially or physically in an attempt to curb the spread of the virus. However ideal this may seem, social distancing is not always practical in densely populated lower-income countries with many citizens below the breadline. With the majority of South Africans living in abject poverty, communities in overcrowded households are unable to distance themselves from one another appropriately. In addition, as a nation we struggle with high HIV and tuberculosis rates, malnutrition^[3] and an already overburdened healthcare system, which emphasises the extreme vulnerability of our society. These factors, coupled with the fact that many of our medical professionals do not have the necessary personal protective equipment (PPE) to prevent them from contracting the virus themselves, highlight the gravity of

the damaging repercussions that we may face in the coming months after the complete lockdown is lifted and we move towards a partial lockdown state. Nationally, there needs to be a shift in mindset towards exploring alternative technology-based preventive measures that may empower the healthcare sector in the long term and enhance social distancing. It is clear that mitigating the effects of COVID-19 will be a reality for SA for some time to come.

The role of artificial intelligence in curbing the spread of COVID-19

Identifying emerging risks

In general, artificial intelligence (AI) has a definite role to play in the healthcare sector.^[4] However, its importance in the face of a pandemic is even more significant. Through the use of AI, pandemics may be better predicted and societies warned ahead of time, allowing governments to better prepare.^[5] For example, BlueDot, a global AI database company that uses outbreak risk software, combined their health and medical expertise with advanced data analytics to build solutions that track, contextualise and anticipate infectious disease risks.^[6] BlueDot was one of the first companies in the world to identify the emerging risk from COVID-19 and warn its clients to avoid Wuhan province. This warning came almost 10 days prior to the warning sent out by the World Health Organization (WHO).^[5] According to BlueDot, the projected annual global cost of COVID-19 is one trillion dollars.^[6] If the BlueDot warning message had resonated around the globe 10 days before the official warning from the WHO, governments could have started implementing preventive measures earlier. With the devastating effects that COVID-19 has already had on countries across the world, and as is apparent with any pandemic, reaction time is always of the essence.

Initiating drug discovery

AI can also be used to initiate drug discovery and fast-track drug development. Chinese scientists successfully sequenced the COVID-19 genome in just 1 month, an accomplishment which would usually take up to several months to achieve.^[7] Without the genome, scientists would not have been able to conclusively diagnose the virus or begin working towards a vaccine or antibody test.^[8] In addition, Australian researchers created a laboratory-grown copy of the virus, the first copy outside China, which enabled scientists to determine whether a future vaccine would be effective.^[5] Insilico Medicine, a biotechnology company based in the USA, was able to use their integrated AI-based drug discovery pipeline to generate new drug compounds against COVID-19. The results revealed a novel method of developing new treatments against COVID-19, while also demonstrating cost-effectiveness and time efficiency.^[9] Through the use of AI technology, the company was able to categorise thousands of molecules for potential medications in only 4 days, and these data were then made available for free to researchers. AI not only laid the foundation for potential new drugs against the virus, but also fuelled the widespread sharing of information among researchers across the world.

Enhancement of social distancing measures

Physical distancing from one another is a critical part of ensuring that the virus does not spread. However, this cannot always be maintained in densely populated countries, where access to basic resources is already a daily matter of life and death. AI is able to provide enhancements to social distancing and could also assist SA's already overburdened healthcare system. For example, China's sophisticated surveillance technology uses facial recognition and body temperature to identify whether an individual has a fever and therefore may be a carrier of the virus.^[10] Although debatable, this method allows for early intervention before an individual begins to display noticeable symptoms of infection. An AI-based computer vision camera system has been used in the UK to monitor adherence by individuals to social distancing measures, and, more controversially, Israel's cyber-monitoring system enables its security services to identify and quarantine people who may be infected.^[11] In China, robots that are typically used in the catering industry are used to clean, sterilise, and deliver food and medicines in order to reduce human contact.^[12] Similarly, drones are used for aerial spray and disinfection, transfer of samples and delivery of consumer goods.^[13] Then there is also the use of applications and big data, which can identify and assess risk based on an individual's history, how much time they have spent in virus hotspots, and potential exposure to people carrying the virus. Individuals are assigned a red, yellow, or green colour code that can be accessed through popular apps, that indicate whether they should be quarantined or if it is safe for them to be allowed in public.^[10] Taiwan is one of the countries that succeeded by using AI, big data and analytics to track and manage the virus, coupled with proactive testing.^[14] Despite its close proximity to Wuhan Province, Taiwan has a very low infection rate and has managed to avert a public health crisis.^[15]

Offering alternative methods to assist healthcare professionals

Healthcare professionals are confronted with the risk of contracting the virus on a daily basis. They are the true heroes, attending to community needs, risking their lives and exposing themselves and their loved ones to danger, and all possible measures that may assist in ensuring their safety should be investigated. A number of healthcare workers have already tested positive for the virus across South Africa's provinces, with certain facilities being forced to

close temporarily.^[16-18] Healthcare workers have to be protected in order to provide patients with the necessary care. With shortages in appropriate PPE a reality, AI may offer an alternative solution and decrease the risk of exposure. The use of AI technologies should not attempt to replace healthcare professionals entirely, but rather assist to improve and fast-track diagnosis while alleviating bottlenecks in our healthcare system.

The use of robotics in delicate surgical procedures is not new to SA. The Urology Hospital in Pretoria was the first to offer robotic surgery for prostatectomy, with patients reporting quicker healing times due to the minimally invasive nature of the surgery, and shorter hospital stays.^[19] In addition, the first robotic-arm knee replacement operation in Africa was performed using the state-of-the-art Mako robotic-assisted surgery system at Linksfield Hospital in Johannesburg.^[20] The introduction of AI-powered medical imaging systems or 'robot doctors' may be a route to consider for further development in the future. One such 'robot doctor', developed in China, even took and passed the Chinese medical exams.^[21] An AI-powered imaging system was also found to automatically and accurately detect COVID-19 and calculate the disease burden in patients.^[22] It is possible for AI to be as accurate as humans, provide quicker diagnoses to patients, and offer a more cost-effective solution than standard tests for COVID-19.^[11] This type of technology could offer alternative support to our healthcare professionals and assist with mass screening in our communities. It could also decrease their risk of exposure and track the development of the disease. Some SA provinces announced drastic measures in an attempt to limit the spread of the virus. For example, the KwaZulu-Natal government controversially suggested that people who tested positive would no longer be able to self-isolate, but would be forcibly moved to quarantine facilities. This rule would have applied equally to healthcare workers who tested positive for the virus, adding to the stress that they are under due to no fault of their own.^[23] However, questions remain around the suitability and 'buy in' of the SA public where AI in healthcare is concerned. To a degree we are already using AI technology to inform, educate and assist our communities through online apps and virtual interaction with medical professionals.

Pitfalls to AI as a preventive measure: Ethical and legal concerns

New technologies can only be successfully implemented if communities trust the motives behind them. If communities believe that the human element has been removed from their care, they may automatically resist, mistrust the technology, or become suspicious of its intentions. SA society is community orientated rather than individualistic.^[24] However, the aim of any new technology should not be to replace the human element entirely, rely on independent computer intelligence or promote individualism.^[4] The objective, especially when a nation finds itself in a state of disaster tackling a pandemic, should be to assist the resource distribution system using a combination of human and device interaction. Humans are key to providing context and interpreting data output.^[11] There are also valid concerns of loss of employment due to AI, as specific acts that would traditionally require human function may be replaced with technology. However, this concern should be weighed against the fact that many of our citizens have already lost their jobs or face the impending threat of being retrenched because of the negative impact of the virus on our economy through the national lockdown. With most sectors at a standstill, there is no predicted recovery rate for the SA economy, or any guarantees that those who have lost their employment will regain a space in the workforce. AI poses added concerns of quality control, data bias, financial complexities and

threats to data security. For AI systems to work effectively, there must be sufficient data to establish trends or patterns that can then be used to aid prediction tools. Unfortunately, the lack of historical, unbiased and precise data that can be accurately collected from reliable platforms remains a problem, especially in pandemic situations where the characteristics of a virus are completely new.^[11] In addition, the ethical and legal complications are debated.^[4] AI systems could potentially discriminate against and stigmatise communities if they are not effectively tailored to properly reflect characteristics specific to SA society. In addition, individuals in a community may become stigmatised or discriminated against for accepting services from devices. Furthermore, devices may be stolen for financial gain, or if citizens are suspicious about their motives, they may even be destroyed by communities. However, it is important that the public is educated about the benefits that AI has to offer, specifically in pandemic situations where the availability to access essential resources freely is threatened.

The moral status of artificial agents as human persons also raises debatable complexities.^[25] Then there is the question of who is essentially in control of the technology, which has no clear answer. This lack of clarity has an implication for legal liability should an error occur or if a patient is incorrectly diagnosed, misinformed or harmed by a device. The patient may have a claim against the state, his/her legal practitioner, and the creator of the AI. There is currently no universally accepted definition of AI, which affects how legislation is interpreted when considering its use. SA does not have any regulatory framework in place to govern AI in healthcare, and an ethicolegal hiatus exists in this regard. Privacy concerns around the misuse of personal data are pertinent in the debate regarding how AI should be regulated. Whenever there is a need to collect large sets of data, apprehension exists around its potential mismanagement. Section 71 of the Protection of Personal Information Act No. 4 of 2013 (POPIA)^[26] prevents a person from being subject to a decision which results in legal consequences, that is based solely on the automated processing of personal information intended to provide a profile of such person, unless specific conditions are met. The type of data that an AI system can process could reveal specific personal information about an individual that they do not want shared, posing a significant challenge when anonymising data may not be guaranteed. Specific to disaster situations, there are fears that social control measures using thermal and facial recognition software that infringe on a person's right to privacy will not be restored once a pandemic ends, and that governments may abuse the use of such technology.^[11] It is crucial that the public is aware of the potential uses of their information – although this could prove difficult when potential uses may not be fully contemplated. As AI is currently not catered for in our ethical or legal systems, laws would probably have to be amended, policy and guideline documents updated, and possibly a new framework developed to incorporate the use of AI in our healthcare system. Nevertheless, with job losses a reality, our vulnerable population already starving,^[27] the dire economic situation we find ourselves in, healthcare workers at risk, the healthcare system stretched beyond capacity and corruption still rife in the midst of the pandemic,^[27,28] AI needs to be considered as a reasonable long-term intervention. Should the virus overcome our nation, as it has in many other parts of the world, we will surely move from a national State of Disaster to a State of Emergency as declared under section 37(4) of the SA Constitution.^[29] This is the last measure that the government uses to restore order, and should a State of Emergency be endorsed, legislation enacted under section 37 may derogate from the Bill of Rights, with only certain exceptions including the rights to life and human dignity.^[29,30]

Conclusions

'Our country and the world we live in will never be the same'.^[31] Much depends on public behaviour as we move towards a partial lockdown state. As health facilities across the world grapple with trying to find a 'cure' for the virus, more infections are being detected every day. It is clear that the virus has engulfed every aspect of our daily lives, socially, economically, financially and politically, with the poor and vulnerable being the hardest hit. It is also clear that COVID-19 will remain part of our lives for some time to come, and it may not be the only pandemic to drastically affect our nation. It is time to embrace AI more seriously in an attempt to aid our healthcare and resource systems and better prepare for the impact of the next disaster. Carefully crafted technology that speaks to the ethical and legal requirements of SA and respects African societies and value systems should not be underestimated. The use of AI in the fight against COVID-19 has proved successful in certain countries. The current State of Disaster that SA finds itself in can only be assisted by the correct use of AI and big data. In a country where social distancing is difficult to achieve, AI cannot solve all the issues surrounding it, but could be used to enhance these measures. With the government re-prioritising its expenditure to cater for the most vulnerable in our population who have been adversely affected by the lockdown, funding cutting-edge technology may not be considered as an immediate necessity. However, President Ramaphosa's implementation of technology-based solutions to assist with the distribution of basic resources^[31] indicates that now, more than ever, it is crucial to carefully consider the implications of the use of AI in SA in pandemic situations. There should be more effort placed in developing appropriately regulated technology that speaks to the needs of all our citizens while offering protections to our healthcare workers during times of crisis.

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