VIEWPOINT

The Artificial Intelligence (AI) 'Genie' is out of the 'Bottle': Considering the Potential Impacts of AI on Public Health from a Climate Change and One Health Perspective

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Abstract

Artificial Intelligence (AI) offers significant potential to improve health, medical and social care. It equally offers substantial opportunities in improving the education and training of health, medical and social care professionals. However, AI training and development, as well as AI use into the future requires considerable electrical power. In our anthropocene world already experiencing the negative impacts of global warming and climate change the increased burden of additional power production should not be taken lightly. It is recommended that all AI developments in the fields of health and social care and education be matched with equivalent or better reductions in carbon production.

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Generative Artificial Intelligence, often simply referred to as AI, has proven to be a transformative force in a variety of industries, and its potential for positive change in health and social care shows equal promise. There are already emerging uses of AI in many health and social care settings, including real-time integrated diagnostic care outside of a hospital (1), early detection of cancers (2), and assistive robotic technology in settings as varied as operating theatres and the kitchen of a person's home (3). As technology inevitably advances, the interplay between AI and human compassion, skill and knowledge will radically change how we provide care and support for people.

One example of an area where AI has the potential to make a significant impact is that of loss, grief and bereavement care. Bereavement is universally regarded as one of the most stressful life events (4), and significant research underscores its negative impact on physical and mental health (5-7). When used sensitively and effectively, the integration of AI into bereavement and grief support could improve the overall well-being of individuals who are experiencing loss.

For those seeking information and support, AI can provide immediate and accessible information to help normalise the grief experience for most people. For example, AI-driven chatbots can engage in empathetic conversations, adapting language and tone based on the user's emotional state, cultural and demographic indicators and their request for assistance or guidance (8). An AI system could offer small pieces of information to help slowly improve an individual's grief literacy levels, providing recognition that grieving is normal and individualised, and helping them to feel more in control of the bereavement experience. This type of service delivery is more flexible than a pamphlet or a website, in which the information provided remains mostly static and potentially outdated once published. This fluid personalisation of information could be very helpful for someone seeking compassion, a listening ear and possible signposting to more advanced grief support prior to connecting with a bereavement service volunteer or therapeutic professional.

By using predictive analysis algorithms, AI triage systems can facilitate the detection of individuals experiencing prolonged grief disorder who may need immediate assistance through face-to-face counselling or more intensive supports (9). An AI-supported assessment and intake process could allow for more time for interaction with the counsellor, social worker or psychotherapist in individual or group sessions (10). Virtual reality (VR) and AI technologies can create immersive environments in which individuals can confront and process their grief in a controlled and supportive setting. The use of AI to anonymise and aggregate data from system interactions could also expand opportunities for data-driven research, contributing to a better understanding of grief-related challenges and effective intervention strategies for bereavement professionals (11). In the context of grief and bereavement, as in other health and social care fields, AI has the power to provide personalized, accessible, and timely support to individuals who find themselves navigating grief.

However, potential challenges in incorporating AI into human therapeutic and care services do exist, and must be attended to. To use AI well, there is a vital need for ongoing training and support for staff, especially for those who might resist its incorporation into their practice. Some care professionals may have a lack of expertise or ease around technology, with little pre-service educational experience in using it. From the perspective of both the therapeutic professional and the person seeking help, there may be a low-level but potent fear around AI completely replacing human contact and eliminating the need for person-to-person care. Recent research suggests that even when there is successful use of AI within the care sector, both managers and care staff underestimate the time needed for human assessment of data and system maintenance and development (12). To reach its full potential as part of health and social care offerings, AI needs to be engaged and experimented with, interrogated, and embedded in services over time as part of an ever-adjusting reflexive process, much like the art of caring itself.

The potential for uses and abuses of disruptive technologies, in the form of AI developments is generating a great deal of interest in academic contexts and is being widely embraced to help teach health professionals (13), as well as in academia more widely (14). A variety of software tools have already been harnessed to manage administrative tasks in education, for example, timetabling. In addition, the potential for AI generated assessment and marking is also being developed. For example, Pearson and other commercial education organisations are now marketing assessment tools driven by AI (15).

Technology supported learning is by no means a new phenomenon in education. Recent developments in AI build on so called 'mastery' approaches which date back to the 1960s (16). These approaches have long been identified as having the potential to provide individualised teaching programmes which allow students to assess their current knowledge and build on it with a computer-generated individualised learning route. AI technologies have significantly enhanced the capabilities of such instruments and the development of AI assisted learning tools has been extensive and influential. For example, *Squirrel*, a Chinese company which breaks down learning into the smallest conceptual units and uses an individualised learning approach, has raised €180 million in funding, and was recently valued at €1 billion (17).

While there is concern about ensuring deeper learning and critical thinking skills among students, Hao argues that the collaboration between instructors and students using AI driven learning platforms will take on a different form in the future: teaching roles will provide supplementary discussion and exploration of interpersonal, ethical, and critical thinking dimensions learned via AI technology and allow for a more personalised approach to teaching and learning (17).

Meskó *et al*. argue that, while there are ethical issues to address, AI has the potential to solve the human resources problems that currently exist in healthcare (18). The integration of disruptive technologies using AI capabilities into graduate and postgraduate training programmes, they claim, is essential. These tools are already being used in healthcare workplaces, a practice which will only increase over time. In medicine, for example, Wartman & Combs argue that a 'reboot' of medical education, which takes account of evidence from psychology about human computer interface, is essential so that teaching can keep pace with the changing ways in which medicine will be administered in the context of AI generated diagnostic and symptom management development and capacities (19). Similar calls have been made in social work (20); nursing (21) and education (22). Indeed, a recent scoping of academic literature exploring AI use for educating healthcare professionals found that programmes using AI have been developed in cognitive, psychomotor, and affective domains using delivery formats as diverse as workshop, case-based activities, discussions, experiential learning, and web-based activities (13). It would seem then, that AI is here to stay in terms of educating our future workforce of health and social care professionals and in their participation in it.

Despite the significant advantages that AI offers in relation to medical, health and social care its use is not without potential dangers. Some of the original researchers that have helped drive the development of superintelligent AIs have recently called for global regulation to '*protect humanity'* from what has dramatically been described as '*the risk of accidentally creating something with the power to destroy it*' (23). In a similar vein The European Union (EU) has recently passed the EU AI Act, which aims to ensure that '*AI systems used in the EU are safe, transparent, traceable, non-discriminatory and environmentally friendly*' (24).

The final point is particularly important, as well as potentially highly problematic. AI training and maintenance involves significant and largescale processing time and therefore uses considerable electricity to power the GPU hardware involved. To a lesser extent, AI use (called inference) also involves significant power use. The increased electrical power required to run AI software, particularly in the short-term must be acknowledged as a given (25,26).

However, the increased use is undoubtedly more than many members of the public assume. Current forecasts indicate that global AI training, inference, and model maintenance activities may use as much electricity as the Netherlands (25,27). It has been suggested that Google's AI could alone even potentially use as much electricity as Ireland (25). Even in circumstances in which more efficient processors are installed in data centres with limited local power supplies, such developments themselves equally incur an environmental cost based on raw material extraction, refining, manufacturing, shipping and installation (28).

Some authors have suggested that AI electricity use will in time plateau and then shrink (26). However, there are two issues with such projections. Firstly, it is important to note the Jevons' Paradox which suggests that increased efficiencies can lead to higher, rather than reduced demand, leading to net increases in usage (25). The second factor is the global impact of such increased electricity use, and hence electricity production, even in the short-term. Recent evidence suggests for example that estimates of ice sheet loss in Greenland may have significantly underestimated the scale of the loss. It is now thought that Greenland alone is losing over 250 billion tonnes of ice per year. This equates to 30 million tonnes per hour from just that location (29,30). AI electricity use may only be high in the short-term, however, the question must be asked, can we even afford increased electricity production impacts over even a limited time?

There can be little dispute that we are now living in the anthropocene geological age (31,32). Humans have significantly altered the Earth's environment and climate in what is comparably an extremely short timeframe. The impacts of these changes have been dramatic and look set to continue. Global temperatures are now estimated to have risen by an average of 0.06 C per decade since 1850. However, the increase is not constant. Since 1982 the warming rate has increased threefold to 0.20 C per decade (33).

The One Health approach is an extremely useful perspective through which to explore the impacts of climate change and rising temperatures (34). The US Centers for Disease Control & Prevention

(CDC) define One Health as '*a collaborative, multisectoral, and transdisciplinary approach — working at the local, regional, national, and global levels — with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment'* (35).

The effects of this warming will be felt across the entire planet as entire ecosystems are impacted by rising temperatures. The impacts of climate change are dramatic and already becoming painfully visible. Heatwaves, droughts and wildfires are already becoming more common. Alongside these we can anticipate increased ferocity and frequency of severe storms and flooding (36). The impacts on human health directly of increased temperatures and heatwaves will include increased mortality and morbidity from heat stress, as well as air pollution based effects on asthma, respiratory and cardiovascular disease (36). However, the wider system impacts of forced migration due to flooding or desertification will be compounded by hunger, civil instability and warfare.

Patz & Hahn have outlined five mechanisms through which they suggest climate change will disrupt biological systems and which will in turn adversely impact human populations. These processes are: *'Modifications in Vector, Reservoir, and Pathogen Lifecycles; Diseases of Domestic and Wild Animals and Plants; Disruption of Synchrony Between Interacting Species; Trophic Cascades; and Alteration or Destruction of Habitat'* (37). Each of these factors represents a significant threat to our increasingly interconnected and vulnerable world often based on fragile global supply lines.

It is undoubtedly true that AI offers significant potential for health and social gain into the future. However, the impacts on electricity usage and consequentially on global warming may be significant. Thus, negative climate impacts on health and wellbeing may almost be seen, in small part at least, as iatrogenic results of AI health promoting technologies. The use of AI for health promotion, diagnostic, teaching and health research purposes will undoubtedly serve to improve population health on a net basis, even when balancing the detrimental impacts of global warming.

However, two crucial concerns remain. The first concern relates to the exponential growth in AI in the global North. Outlined above are potential positive applications of AI in health, medicine, and social care and in the education and training of health, medical and social care professionals. However, the AI 'genie' is now out of the 'bottle' and it is already being used across a plethora of industries, including media, entertainment, advertising and sales. Therefore, the potential AI impacts on health, medical and social care are likely to only constitute a marginal fraction of all AI driven electricity usage. In the context of global warming, this raises serious questions about the net benefits of AI.

The second serious concern over the growth in AI use relates to social justice. From a social justice perspective it is crucial to remember that the developments in AI are predominantly the efforts of more affluent and more industrialised economies. The increased electricity usage caused by AI development and use will inevitably result in increased power generation, part of which will undoubtedly be fuelled by fossil fuels. The negative impacts of the associated continuing increases in global warming are not being shared equally. The AI developments in the global North will exacerbate global warming and climate change that are most immediately impacting impoverished island nations that are disappearing due to rising sea-levels, as well as those experiencing drought, famine and desertification. The benefits of AI will probably be felt in the global North, while its negative impacts will probably be most acutely felt in the global South.

It is strongly recommended that all applications of AI in the health, medical and social care field, including education and training should incorporate firm steps to reduce the carbon footprint of such activities the through energy and carbon offset mechanisms by a matched or greater amount. This can include the retrofitting of existing facilities to improve energy efficiencies, as well as carbon sink development, and investment in renewable energy sources such as solar, wind or hydro power generation.

The potential of AI to improve the health status of the population seems certain. However, there are potential downsides of such developments that cannot afford to be ignored. The increases in electrical power use forecast through the future use of AI are considerable. The impacts of global warming are not distributed evenly and are most likely to be felt in vulnerable communities and countries. The One Health perspective is a useful lens through which to adopt a more robust and integrated view of climate change developments. It is recommended that all health-related AI initiatives include matched reductions in electricity use.

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