PERSPECTIVE

Exploring the intersection of the medical metaverse and healthcare ethics: future considerations and caveats

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ABSTRACT

The medical metaverse and digital twin are set to revolutionise healthcare. Like all emerging technologies their benefits must be weighed against their ethical and social, impacts. If we consider the advances of medical technology as an expression of our values, such as the pursuit of knowledge, cures and healing, an ethical study allows us to align our values and steer the technology towards an agreed goal. However, to appreciate the long-term consequents of a technology, those consequences must be considered in the context of a society already shaped by that technology. This paper identifies the technologies currently shaping society and considers the ethical, and social consequences of the medical metaverse and digital twin in that future society.

1. Introduction

The rate of innovation in HealthTech has been impressive; the worlds of InfoTech and BioTech are fusing, and we are beginning to see the emergence of the medical metaverse and its systemic relation, the medical digital twin. Futurists, entrepreneurs, and healthcare practitioners alike are speculating on what this means and how we can revolutionise the delivery of healthcare. Enabled by Industry 4.0[1] and made viable by the coronavirus disease 2019 pandemic,[2] the metaverse is impacting healthcare and a broad range of other industries.[3] It is estimated that the metaverse's market value will reach between USD 250 and 400 billion by 2025,[4] with the healthcare metaverse market reaching USD 79.6 billion by 2028.[5] Given these estimates, industry incumbents and MedTech entrepreneurs are in a race to become market leaders. In 2021, the world's first two medical metaverses were launched,[6,7] the number of journal articles listed on PubMed with "metaverse" in their title jumped from 4 in 2021 to 107 in 2022, and it was informally suggested that 2022 should be named the "year of the metaverse in medicine".[2]

There is sound technical rationale associated with the integration of these emerging technologies into medicine. A review of the applications of the digital twin and the metaverse in medicine thus far gives us good reason to be optimistic.[8] However, we must recognise that not everything that is possible from a technological perspective is acceptable from an ethical, social, or legal perspective. Human beings are both the beneficiaries and victims of science and technology, therefore there is

a need to balance our current optimism against current (and perceived future) cultural norms, religious beliefs, and the preservation of human dignity.[9] As the medical metaverse and medical digital twin becomes the norm we run the risk that this technical rationale overrides our value driven systems, changing what we consider rational, inevitably expanding, thereby changing the fabric of healthcare. This is why we are asking questions and having ethical discussions in the nascent stages of the technologies. In what directions should they expand? Should we limit their expansion? Who makes these decisions?

2. The metaverse

Generically speaking, it can be described as a convergence of the real and digital worlds,[10] a continuum of digital worlds, realities and business models,[11] and a societal transition where the "information ecosystem shifts from a flat media viewed in the third person to an immersive media experienced in the first person".[12]

Conceptually, the metaverse (Fig. 1) is a convergence of worlds: our real world with real hospitals, real patients, and real healthcare workers. The mirrored world (a digital twin of the real world) with its replicated structures/systems/people etc. The native virtual world: our minds, imagination, and creativity projected into cyberspace. Finally, the augmented real world where the mirrored and native virtual worlds are either viewed or projected into the real world through extended reality technology. A Web 3 based Metaverse is a metaverse built on
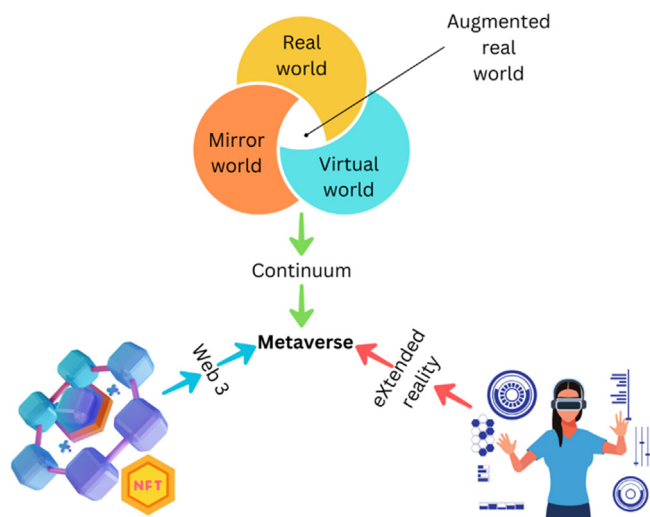
Fig. 1. The metaverse explained.[4]

top of the blockchain; this affords patients, healthcare professionals and healthcare facilities ownership of digital assets and information. For example, a type of smart contract unique to the blockchain called a non-fungible token (NFT) allows patients to own, securely store, and share their DNA profile on the blockchain. These bio-NFT's satisfy the strict data provisions of the European Union general data protection regulation and the California Consumer Privacy Act.[13]

3. Old paradigms

In reviewing previous ethics papers on this topic, it is clear that ex ante issues such as data collection, informed consent, AI data sets and training, etc., have been well covered.[14–17] While ex ante questions are clearly relevant for a Web 3 ethical debate, they were equally relevant and similar in substance to Web 2 debates, therefore presumed to be very well covered. This paper will have a greater focus on *ex post* practical and consequential moral questions. Issues that arise later in a technologies lifecycle and are sometimes considered second-order consequences. However, in considering *ex post* ethical, social, and legal issues we do so in the correct societal and cultural context. It is important that we avoid a "Jetsons fallacy" and understand the technology in the context of a future society. Although a children's cartoon, the Jetsons is an example of how we humans project current culture and society into the future and attempt to analyse future technology in that context. Launched in the early 1960's and set way into the future, the Jetsons were an all-American nuclear family in a world of flying cars, autonomous robots, and holograms. Yet despite this technology, George went to work to push a button all day long. Sixty years later, and cars do not fly, AI is fledgling, pushing buttons is automated, the structures of society and the family have changed.[18] Technology does not progress in parallel to culture and society; it is systemically interwoven. Technology is ever altering our culture and society and in turn is in turn altered by them. Context is everything; therefore, in this paper, we will briefly look at some of the technologies that will impact our culture and society (which I posit will be big). As technical rationality will likely manifest itself through these technologies, it is important that we consider future ethical, social, and legal consequences in the correct context.

4. A new perspective—technologies shaping society

4.1. Blockchain and the V-Form hospital

I hypothesise that the blockchain with radically alter the structures of a hospital, reducing it from both a physical structure and hierarchal in-

stitution and distribute it across a network of services. The shape of this new type of institution has been called a V-Form institution. A V-Form institution is "an outsourced, vertically integrated organisation tied together not by management and corporate hierarchy but by distributed ledger technology (i.e., a blockchain)"[19,20]

Institutions as we know them, including the hospital as an institution, developed organically within society. To understand why they will disappear, we must comprehend why they developed. Nobel Laureate Ronald Coase had asked the question: why does such a governance structure exist despite the prevailing wisdom, as suggested by Adam Smith, that the market mechanism was sufficient to govern an economy? Coase concluded that there was a cost to doing business in the economy.[21] These "transaction costs" or the "cost of trust" were in response to the opportunistic and dishonest nature of humans. Institutions are an attempt to mitigate the effects of dishonesty and ensure trust; the size of the institution is determined by the relative costs of trust. Fellow Nobel Laureate Oliver Williamson expanded on this theory, stating the greater the specificity in the assets required, the more the market preferred the hierarchy.[22] Medicine and a medical specialist's knowledge have high asset specificity; therefore, hospitals as an institution developed.

The ledger is the foundation of institutional trust,[19] and a hospital like any institution is a series of ledgers. A ledger ties the identities of staff with credentials, it grants staff certain privileges and authorities such as who can do what procedure, who supervises whom etc. They maintain a record of who did what task, patient records, theatre records etc. These ledgers are costly to maintain (the cost of trust) and are fraught with error. The blockchain is a distributed ledger that industrialises trust and produces it at scale,[19] it provides better and more cost-efficient trust than the institution. The hierarchy therefore becomes redundant. The digital twin (a ledger spliced with AI) compounds the effects of blockchain. The digital twin reduces diagnostic uncertainty and assists in preventative health. Eliminating the need for face-to-face interactions and reducing hospital presentations.

The institutional hospital will scale down to core services such as trauma or maternity, other specialities will fragment into a network of services. The nascent medical metaverses are already linking patients, specialists, insurance, pharmacy, universities, research etc. from around the world and are an early example of the V-Form hospital or health service. In assessing the potential impacts of the medical metaverse and digital twin on the health service, we need to imagine the future as not having hospitals, or any kind of hierarchal institution, but a network of services.

4.2. The emergence of synthetic agency and the metasphere

538 million years ago, the world went through an evolutionary phenomenon: the sudden appearance of skeletal remains, with marked variability, suggested that there was a "quantum evolution with an explosive phase". This phenomenon was called the Cambrian explosion.[23] Single-celled organisms became multicellular animals with intelligence, capable of sensing and acting on the world around them.[24] The actions that humans would have on the world (the apex animal that emerged from this radically altered biosphere) was to create the anthroposphere, developed through the course of human history, it is that part of the environment that has been made by humans.[25]

The world is again on the cusp on a Cambrian-like explosion; however, it will not alter the biosphere. The explosion will alter the anthroposphere, and being similar in magnitude to the first, it will radically change it. Human carbon-based intelligence will merge with new silicon-based intelligences. We will acquire new forms of sentience and subsequently new ways of seeing, understanding, and acting on the world around us.[24] As human action forged the anthroposphere, I hypothesise that the action of these new agencies will forge a new sphere, call it the metasphere.

A metasphere is distinct from a metaverse, the metaverse forming part of the architecture of the metasphere. The reason this distinction is

made is that we tend to think of the metaverse as being the imaginary world or beyond the res extensa. The metasphere, like any of the other spheres of the earth, is very real. We may not see the agencies that we will interact with in the future, but they will exist, and as this existence is normalised humans will have a different understanding of what is "normal".

5. Discussion consequential moral issues

5.1. Human enhancement and transhumanism

Performance enhancement is an obvious and acceptable use case for the engineering digital twin; however, in healthcare, there are socio-ethical considerations to overcome. It may be argued that by providing each human with the same baseline functioning, enhancement will level the playing field, ensuring equality and inclusion. However, a market driven medical digital twin may exacerbate the rich poor divide, particularly if the enhancement is beyond what is considered typical or normal for humans (if there is some definition of normal that we can all agree on). Will an entirely new class of superhumans be introduced to society? What effect will this have on our society and our ability to regulate it?

Future issues we may face can depend on which direction enhancement and transhumanism will take, although they may take many. Ultra humanism may harness advanced prosthetics, somatic and germline gene editing to make humans a stronger, smarter, faster, USD 6 million "bionic man", capable of transcending human capabilities and perhaps surviving in alternate atmospheres. As the natural extension of the humanism movement, the aim is to push individual freedoms and human autonomy to the highest possible scale.[26] In a future two tear society of humans and transhumans, the challenge for social institutions is to balance rights? If transhumanism becomes the zeitgeist of future times, how can we respect the dignity of "normal" humans and not view their perceived vulnerabilities as something that needs to be cured?

5.1.1. The post-human and life in the metasphere

Maybe we could abandon our physical bodies altogether. If our digital twin accurately represents the information structures of our brain, can it "upload" us or become us? This might enable life without a physical body, existing virtually within an avatar or in a bodyless state. But would this really represent freedom and autonomy? Advising us to look up the etymology of the word "cybernetics" Lawrence Lessig cautioned us about seeking freedom in cyberspace. He used the term "code is law" to describe code as the architecture of cyberspace (metaverse) and, therefore, a form of regulation.[27] A recent analysis of the developing metaverses identified different "control models" emerging.[28] What will be allowed in a particular metaverse will be controlled by what the developers' goals are.

If we are to consider the human as something that needs to be cured and extend the use of the digital twin and metaverse to achieving this, are we responsible for the welfare and rights of those who upload into the structures of the metasphere? While this discussion may seem fanciful, it must be noted that transhumanism is not a fringe movement and has emerged in several diverse thinkers worldwide.[29] A study from the University of Queensland in 2009 identified transhumanist thought within a cross-section of the community.[30] The transhumanist movement has their own Web 3 cryptocurrency, which they use to fund transhumanist projects worldwide.[31]

5.1.2. Genetic enhancement

The advances in molecular medicine and AI bring genetic enhancement to the forefront. Complexities such as gene pleiotropy are current obstacles, but the value proposition of the digital twin is mitigating this complexity and providing us with useful information. Aided by AI's recent decoding of the remaining 13% of the human genome, and clustered regularly interspaced short palindromic repeats technology

increasing the velocity at which we can experiment, we find ourselves in a scenario where laws may be no longer capable of guiding the technology or the actions of entrepreneurs.

When introducing surrogate motherhood, entrepreneurs confronted the established institutional and legal paradigms and forced a shift in the interpretation of motherhood and procreation, this resulted in the acceptance and regulation of surrogacy.[32] Perhaps the actions of entrepreneurs, repugnant or otherwise, will shift the interpretation and judgement of "natural humans" and pave the way for human enhancement and transhumanism.

In the future V-Form health service, challenges of peer supervision and review will be exacerbated. It is also plausible that much of this research will take place within the metasphere, away from the interference of regulators. AI and digital twin transparency will face challenges, similar to regulation in the dark net or even the high seas. I would argue that difficulties in oversight coupled with the prevalence of medical tourism, and the efforts of synthetic agency, make the reality of the genetically enhanced human far more likely than unlikely.

5.2. Health and autonomy in Attention Economy 2.0

It is well known that the tech giants behind Attention Economy 2.0 have entered Web 3 and the metaverse, and some of those have entered healthcare.[33] Both digital twins and the Attention Economy 2.0 depend on large scale data collection and the super crunching of this data. If these tech giants develop digital twins or partner with companies that already have, then there is a clear conflict of interest and ethical concern about the use of our data. Will we be sold individualised medicine, individualised advertisement, or both? The social impact of tech giants developing the medical metaverse and digital twins should not be underestimated. Will their products be available to doctors, insurance companies, and the health service, or will they replace them? In such a scenario, what scope would government have to shape health policy?

Consider these potential conflicts of interest occurring in the context of an authoritarian government; state control and influence would extend well beyond that of nudge economics. Similarly, when we reach the point of technical singularity, what if the digital twin no longer acted in the human's best interest and instead acted in their own interest? Being under the influence of imitation would we even recognise the takeover; this raises clear concerns about the potential impacts on human freedom and agency.

5.3. Metaverse, digital twins and the doctor patient relationship

As the medical metaverse increases the physical distance between the doctor and the patient, there is a risk of prioritising data over patient care, where the digital twin becomes the standard to which the human must conform. Heidegger's philosophy of technology did not extend into the field of medicine; however, he had an interest in how medicine was practiced and delivered. In a series of lectures that he gave to doctors in the 1960′s he emphasised the phenomenological way in which the patient experienced the world, experienced their diseases, their pain, sorrow etc. Critical of how the scientific method developed in the 17th century offered a mechanistic view of the body. To Heidegger, the human body represented a unique way of "being in the world". If a doctor is to help their patient, then they should understand the "lived body". Heidegger advocated for doctors to remain thinking practitioners and not yield their practice to medical technology or technologists.[29]

If we were to borrow an analogy from ethnology on how to understand cultural phenomena. Like language, cultural phenomena is made up of signs which individually have no meaning but forms a system of signs. The internal coherence of this system of signs is what gives a culture its individuality. Therefore, "meaning must be sought from where it resides and not elsewhere". To permeate life with meaning, humans have devised these systems of signs and position it between themselves and reality itself. At times confusing the system with the actual reality.[34]

When consulting with a patient, it is therefore the role of the physician to decipher the clinical signs to discover the root cause of symptoms and to decipher the system of signs that lies between the physician's reality and that of the individual's reality. Armed with the understanding of the phenomenological way in which the patient is experiencing the world and their disease, the physician can deliver a more holistic treatment. We can call this the "art of medicine".

The art of medicine, in many respects, represents the "facework" that has been described by Giddens,[35] facework that creates trust in the doctor and beyond the doctor into the abstract system that the doctor represents. While the blockchain and digital twin may replace the type of trust provided by the hospital, the medical metaverse, having the potential to make the health system more abstract to the patient, must ensure there is ongoing trust in that abstract system.

6. Conclusion

In evaluating some of the potential ethical, social, and legal challenges of the metaverse and digital twins, this paper has considered some of the worst-case scenarios. However, it must be acknowledged that not all would agree with this approach. It has been pointed out that there is a large gap between our perceptions and the reality of what these technologies can achieve. Unless there is a rational debate with respect to these capabilities then we risk losing out on their immense benefits.[36]

While we should remain positive about the benefits that the metaverse and digital twin will bring, we must proceed with caution. The rate of innovation in emerging technologies has meant that regulators cannot keep pace,[37] therefore who is representing the public interest and balancing the potential risks against these benefits? Previously, medical technology assessments had the luxury of time and were able to develop "metatechnologies",[38] where the technology and its developers were considered one entity. A metatechnology weighted the pros and cons from the perspective of the public interest.

Consider the current ethical and regulatory debate surrounding the development of AI. The Future of Life Institute has called for a six month pause in AI development to allow the regulators catch up,[39] this call has been rejected by the industry, which have decided to proceed with industry led regulation through Non-Governmental Organizations such as the Partnership on AI.[40] It seems that we have gone full circle and returned to the pre metatechnology era where industry is yet again making the rules.

Medical technology is an expression of our values,[41] the pursuit of knowledge, the pursuit of healing, and we can broadly describe ethics as the "art of human course correction",[24] in other words, we steer our values and have a say in which direction the technology goes. However, as innovation accelerates, our ability for course correction is limited, and we find ourselves in a situation where our values are being decided for us. While the perspective offered in this paper was not intended to be cynical, it was intended to make us think. We will soon reach a stage where we can no longer correct the course of these technologies, a point in time called "ethical singularity".[42] Ethical singularity is approaching, and the other side of singularity is a health service that we can no longer shape.

7. Limitations

Ethics are everywhere, and the more we look the more we see. In an ever-pluralistic society ethics can be conflicting; like all wicked problems not all arguments and counter arguments can be addressed within the boundaries of a manuscript.

Competing interests

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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