MetaHealth - How will the Metaverse Change Health Care?

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Abstract—**We are living in a digital age, and the Pandemic has accelerated innovation in health care and has surfaced new business models and opportunities for health. Beyond the applications in telehealth, supply chain, payments, secure data sharing, and remote monitoring are also essential innovations in Blockchain and Non Fungible Tokens (NFTs) that allow people to exchange value on a decentralized network. Futurists and technologists are also exploring how the Metaverse can play a role in different sectors. This Commentary aims to explore how the Metaverse may be used in the future to change, enhance, and possibly transform health care. The five covered areas are collaborative working, education; clinical care, wellness, and monetization.**

Keywords—GameFi, tokenization, Blockchain, health care, virtual reality, augmented reality

I. INTRODUCTION

We have long been aware that the health care system is unsustainable, with the pressure of long-term, chronic disease, rising costs, aging populations, insufficient health workforce, and limited resources. It is necessary to find models that move health care from the hospital to the living room.

Digital Health is revolutionizing care directly and becoming a critical enabler of change in the pharmaceutical and biotechnology sectors. The Covid-19 pandemic also encouraged innovators and health workers to find ways to enable patients to be managed out of hospitals and remotely. The increasing coverage of smartphones and greater use of wearable devices have also been enablers.

Earlier in 2021 [1], I predicted three significant shifts in the global health landscape, the move of the big tech companies into healthcare, the monetization of consumer data, the creation of health data marketplaces, and the growth of Asia as a leader in digital health.

We are now moving fast to a Metaverse age. The World Economic Forum [2] already predicted that the introduction of digital services would be one of the most critical factors in transforming health care over the next decade.

The combination of Blockchain and gamification is enabling tokenized incentivization in virtual worlds. Futurists and technologists explore how the Metaverse can play a role in different sectors. One of the boldest to date has been the announcement by the city of Seoul [3], Korea, which plans to create a Metaverse for its municipal administration, including economic, cultural, tourism, educational and civic service. Bardi [6] highlights that while the entertainment industry has been the first to embrace extended reality, increasingly such advancements are being used to enhance building and construction, communications, health care, and emergency response training.

Outlier Ventures [4] suggest the defining characteristic of a true Metaverse is that it has its own economy and currencies native to it, where value can be earned, spent, lent, borrowed, or invested interchangeably in both a physical or virtual sense, without the need for a government. The Metaverse is a combination of DeFi, NFTs, decentralized governance, decentralized cloud services, and self-sovereign identity and can enable the exchange of physical, economic, and content assets.

In this Commentary, I explore how the Metaverse may be used in the future to change, enhance and possibly transform health care. I will discuss the five areas: collaborative working, education, clinical care, wellness, and monetization.

II. COLLABORATIVE WORKING

The COVID-19 pandemic has dramatically changed social interactions. Social distancing policies, lockdowns, and mandatory quarantines have accelerated the technological mediation of communication on an unprecedented scale. Many physical activities such as office work, education, and conferences have moved to the online space through social media apps, the Metaverse, or mobile phones.

During the pandemic, we saw social networks accelerating and platforms becoming more immersive [5]. Manalova [6] describes the emergence of a brand-new internet minute, which creates fundamental dependence and emotional investment into digital solutions as a bridge between families, friends, communities, and societies.

In the Metaverse, 3D avatars of health workers will have space to collaborate with tools such as digital whiteboards, and they will be able to meet face-to-face without any complex conferencing equipment. Machines, systems, and procedures will be safely tested via digital twins to detect faults and vulnerabilities before carrying them out in a physical environment.

Samia Rizk [7] gives the example that a health care application could include creating a digital copy of a hospital process, such as in-patient flow, then applying advanced analytics and running millions of potential scenarios to identify the root cause and test different interventions before using them.

The Metaverse can also encourage and enable collaboration. New EdTech platforms like Studyum [8] with Metaverse on-ramps create spaces to organize collaborative activities. Learners can be ranked according to their activity and performance and put together to form groups with similar levels of accomplishment. The intra-community collaboration will be incentivized with tokens.

In veterinary science, Neethirajan [9] describes how data augmentation, using digital twins, and digital avatars or Metaverse offers a timely way of exploring the subtle nuances of animal behavior and cognition in enhancing farm animal welfare.

Çöltekin et al., [10] describe how geo-visualization allows information exploration and sensemaking, where scientists design and use visual-spatial displays to explore data, generate hypotheses, develop problem solutions and construct knowledge. The Metaverse provides a space where it is possible to 3D-model virtually anything, and real-world specifications can be replicated via digital twin technology.

III. EDUCATION

The use of AR (Augmented Reality) and VR (Virtual Reality) will change medical education [11] and training as well as processes and procedures. VR allows students to literally enter the human body, providing a comprehensive view and allowing the replication of actual procedures. AR is also being introduced to give students hands-on learning, such as simulating patient and surgical encounters, allowing medical students to visualize and practice new techniques. Even more immersive experiences could be recreated from real surgery where students can experience the surgery as if they were the surgeon themselves.

Studyum [12] is an example of gamified learning in practice. Users are rewarded with tokens for every class attended, every video watched, every assignment completed, and some will be rewarded with NFT crypto collectibles. Augmented Reality allows AI (Artificial Intelligence) instructors to show learners how to stand, sing, and appear more confident. Using these techniques, people will be able to learn from a completely game-like setting, using celebrity coaches to demonstrate particular skills. This could be a "celebrity surgeon," the surgeon gets rewarded for his teaching, and the students get rewarded for their learning.

Sin-nosuke et al [13] explore a learning system for analyzing devices in a virtual world and demonstrate its significance for research collaboration and collaboration without borders. They describe this as a response to enable collaboration among remote organizations and countries. They present a concept for the learning system in the Metaverse.

Education will be transformed into an immersive experience where learning is fun, success is rewarded and data analytics target precision learning.

IV. CLINICAL CARE

Medicine has always been a hands-on personal encounter, where doctors can detect physical as well as emotional responses. However, the pandemic has forced a rapid acceleration of remote care technologies. For example, before the pandemic, 43% of healthcare facilities were capable of providing telehealth, but that percentage rose to 95% in 2020 [14].

Tufts University, in a study on the impact of Covid-19 on clinical research, found the increased adoption of electronic informed consent was the second-largest emerging trend behind the use of telehealth delivery [15]. These and other advancements have opened the exploration of remote and digital technologies.

There is immense scope for the Metaverse to be used in clinical care. Using immersive experiences recreated from surgery, real-time guidance can be provided in the surgeon's field of view. AR will allow access to the information within the sterile field of the operating room, which will improve surgical precision and flexibility. The Metaverse will allow simultaneous education, training, and planning as well as collaborative medical procedures.

Combined with AI, this can empower clinical decision-making and ensure more precise interventions which are tailored to each individual patient. An example is Veyond Metaverse (https://www.veyondMetaverse.com) which is creating a future Healthcare Metaverse ecosystem. It aims to improve education, training through a collaborative platform for simultaneous education, training, and planning as well as collaborative medical procedures.

Initially, the Metaverse will be used for surgical simulations, diagnostic imaging, patient care management, rehabilitation, and health management [16]. For patients, these technologies can expedite education about conditions or treatment plans. In a clinical setting, AR and VR can help care teams at the point of care. When combined with radiology, AR can provide clinicians with the ability to project medical images, such as CT (Computed Tomography) scans, directly onto the patient and in alignment with the patient's body, even as the person moves, to provide clinicians with clearer lines of sight into internal anatomy.

This can potentially improve patient experience, for example, intravenous injections can benefit from technologies like that from Accuvein (https://www.accuvein.com) which can project a map of the patient's veins on the skin. Medtronic acquired Digital Surgery, and Zimmer Biomet announced OptiVu™ Mixed Reality [17] which will use Microsoft HoloLens to create a merger of the real and digital worlds. Avatars will mimic realistic consultations, personalized care, treatment, and diagnosis through data interconnectivity.

Extended reality headsets are also being used as a way to alter the psychological experiences of users for the treatment of addictions and phobias [18].

V. WELLNESS

Gamification is a new way of connecting healthcare providers and patients, especially in wellness and fitness, where AR can deliver smarter workouts with guidance from virtual instructors. In another new concept, "move-to-earn", players are incentivized to be active. For example, in Genopets [19], using data from smartphones and wearables,

players can get rewarded for walking, dancing, running a daily run, or just getting up and going about life.

Medical schools are beginning to incorporate AR into the curriculum to provide students with valuable hands-on learning opportunities. With AR, programs can simulate patient and surgical encounters, allowing medical students to visualize and practice techniques during training.

VI. MONETIZATION THROUGH GAMIFICATION

The monetization of health data will create new economic opportunities. 'Play to earn', 'learn to earn' and 'move to earn' could become a primary income for millions of people.

We will witness the consumerization of healthcare. Combining data and blockchain will enable data owners to monetize their data. Self-sovereign identity will enable individuals to monetize their health data in the future and consumer-focused health care driven by data will change the institutional models of the past. Harnessing technology will also give consumers a better ability to proactively manage their own health and wellness and to make better, more informed decisions.

New platforms that are also creating ways that people can "learn to earn" can be integrated into healthcare. This may be for wellness, or for community collaboration, or medical education. Non Fungible Tokens (NFTs) will play an important role in value exchange.

Interoperability is essential to digital healthcare. Blockchain and token economies will allow both the secure sharing as well as the monetization of data and intellectual value

VII. ETHICS

Digital ethics are not different from conventional ethics but there is huge potential for inadvertent or deliberate automation of unethical conduct at scale. Given the potential scale of impact, it is important to start exploring ethical questions for health in the Metaverse. Recently, I had posed these ten questions [20]:

1) Should we have an open or closed Metaverse?

2) How much open-source is open? If you create in the Metaverse, who owns it?

3) Should avatars have agency?

4) If you share biometric data in the Metaverse, what data security, privacy, and rights should you have?

5) Should consumers be protected in the Metaverse?

6) Should we mitigate the physical and mental health impacts of the Metaverse?

7) How will informed consent be possible in the Metaverse?

8) Should children be allowed in the Metaverse?

9) Should we create an equitable, inclusive, and truly decentralized Metaverse?

10) How do we maximize the incredible economic and social possibilities and minimize harm?

Samia Rizk [21] recommends that the convergence of digital solutions will require an additional set of standards and approaches as new applications arise. In particular, the risk of bias amplification in AI needs to be addressed by market players involved in the development of XR (Extended Reality) solutions. Likewise, the challenges for ethics will expand as the areas of digital convergence grow and the scenarios diverge to reflect individual use scenarios.

Research is needed on all aspects of health in the Metaverse. Examining prospectively, how the new decentralized architecture is being developed, how blockchain token economies and GameFi is being applied, and the impacts and benefits. Ethical questions and implications need to continue to be explored and new ways of automating ethics in the technology stack and applications.

VIII. CONCLUSION

In this commentary, the ways in which the Metaverse may be used in the future to change, enhance, and possibly transform health care are explored. The five areas discussed are collaborative working; education; clinical care, wellness, and monetization. There are no doubt risks, but the opportunities are immense. The power to harness the digitally literate young population to take control of their health care and be incentivized to learn, follow wellness, and educate their peers in a safe social virtual setting is a powerful thought. Innovators are revolutionizing health education into immersive micro modules that can be taught online to anyone, anywhere. The precision possibilities for clinicians, collaborating around the world and using augmented reality to assist them, opens possibilities to overcome health worker shortages. The ability for the community, patients, and experts to be rewarded for their efforts to improve health opens a whole new economy and earning opportunities.

This is a new world that is advancing daily, and our knowledge grows with the innovators who are building these new Metaverses. It is possible to create a sustainable and affordable paradigm in health care, and health leaders need to be part of its creation. It is time to lean in and see just what the possibilities are.

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