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Editorial

The Metaverse and Oncology

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The metaverse as a concept was coined by Neal Stephenson in his 1992 novel *Snow crash* as a blend of the words 'meta' and 'universe' [1]. Today it is a rather amorphous concept, but generally refers to either an alternative parallel virtual reality world (or worlds) or a blending between the real and virtual worlds. In recent years, this term has gained traction as the technology industry pursues virtual and augmented reality applications (more broadly termed XR). The impetus for this 'second coming' of virtual reality [2] can be traced back to the purchase of Oculus VR in 2014 by Facebook for around $2 billion. Since then, interest in virtual and augmented reality applications and the wider concept of the 'metaverse' has exploded. Indeed, Facebook have now rebranded their company as 'Meta', staking their future on this vision of a blended world.

If one is to believe the hype, which surrounding the metaverse is substantial [3], the metaverse will allow a revolution in social, commercial, educational and medical sectors (and beyond). It will be an integral part of our everyday lives. Life in absence of the metaverse will be difficult to define. So, what, from the perspective of medicine and in particular oncology, will this add to our current practice?

Let us imagine a fictional scenario:

> Whilst taking out the trash, I got a notification floating in front of me reminding me of my consultation. I washed my hands, went through to my living room, sat on my couch and said that I was ready to start the appointment. The doctor appeared in front of me as if they were really there. We both inhabited the same 'space', but this was a blend between each of our experienced surroundings. It was, however, indistinguishable from 'real life'. This put me at ease immediately, I have always hated hospitals – so impersonal and sterile.
>
> An interactive scan of my tissues hovering over my coffee table and the doctor walked me through where the cancer was, my diagnosis, and my treatment options. The doctor reached out with their hand, haptically interacting with the scan, feeling the texture of the disease. I was able to do the same. 'As you can see, the tumour feels hard, no diffuse edge, our current understanding suggests this shows the tumour is likely contained in this location. This is good news for your treatment'.
>
> Seeing everything in this blended world and being able to actually feel the cancer gave me a true sense of where the cancer was in my body and how we were going to tackle it through treatment. Using the doctor's AI, we were able to visualise, over time, various treatment scenarios – the cancer morphing and shrinking before our eyes. Together we agreed on the best treatment plan.
>
> Later in the appointment the world changed around me, I was no longer in my living room, but instead was standing in the radiotherapy room in which I would receive my treatment. Me in my living room, the doctor in their office, but both of us able to walk around the room in which I would receive my treatment together. It was so reassuring to see where this crazy big noisy machine would target my cancer.

The future is hard to predict at the best of times, but the previous description gives some hints as to how oncology might be influenced by the metaverse.

Patient appointments could happen in the metaverse, with patients consulted by doctors from anywhere in the world. This is particularly important regarding specialists in rare conditions and disease. Virtual consultations would not be limited to impersonal telephone or video calls (as we have experienced in the COVID-19 pandemic). Rather, they would be 'virtual in-person consultations', blurring the boundaries of reality and offering a far more natural way of

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interacting, for example, reaching out to feel the texture of your cancer compared with surrounding tissue.

Hospitals can often be busy, daunting and confusing experiences for patients, making it hard to absorb complex treatment information. The metaverse could offer a way in which to ease and enhance the patient's experience. Patients could be put at ease with the logistics of treatment, such as the large noisy unfamiliar equipment needed for radiotherapy, by having a virtual metaverse visit to the hospital site where they will receive treatment and meet the clinical team in the metaverse prior to in person. Training for more complex techniques, for example, breath-hold techniques, could be carried out in the metaverse, sparing clinical resources for those having treatment and allowing the patient to get familiar with the exercises in their own home.

Clinicians could have an enhanced ability to view and manipulate medical data, for example imaging information, to come to better diagnoses and treatment plans. They would be able to communicate complex information to patients regarding their treatment options. For example, doctors and patients could collaboratively view treatment scenarios in a shared immersive environment. This interaction could be enhanced using a digital twin [4] of the patient, allowing visualisation of potential disease progression and how this could be tackled by alternative treatment options.

On the face of it, this seems a wining scenario for the benefits of the metaverse. However, there are substantial issues that will need to be resolved to ensure fair and equitable access for all individuals.

The most pertinent of these is privacy and data ownership. Companies such as Facebook (now Meta) have a chequered history regarding exploiting users' personal data for financial gain. For example, the Cambridge Analytica scandal, where the personal data of millions of users were collected, without consent, and used for targeted political advertising. This becomes critical when the data are not just your network of friends and preferences for different products or political parties, but instead detailed personal medical data.

We have already seen the Royal Free Hospital in London hand over personal data of 1.6 million patients to Google Deep Mind to create a healthcare application for acute kidney injury. The Information Commissioner's office concluded: 'Patients would not have reasonably expected their information to have been used in this way, and the Trust could and should have been far more transparent with patients as to what was happening' [5]. It is unlikely that the medical sector can develop its own metaverse, but will need the expertise of third-party companies. There is a need to develop secure, trusted environments to host patient data within the metaverse, with transparent governance and accountability for data safety. These concerns will only be magnified with the extent of the information required so that the metaverse will achieve its full potential. Extensive and clear guidelines for trusted environments are provided in the recent Goldacre report: 'Better, broader, safer: using health data for research and analysis' [6]. These recommendations form an ideal foundation for building a secure metaverse.

The metaverse may act to magnify, or create new, socioeconomic divides. Accessing the metaverse may be prohibitively costly and technically challenging to groups such as the elderly, those from low socioeconomic backgrounds and those who struggle to engage with technology. The Office for National Statistics estimated in 2018 that 8% of the UK population had zero digital literacy skills and a further 12% were estimated to only have limited digital abilities [7]. It is likely that the initial digital skill levels required to access and utilise the metaverse will further magnify these statistics. If accessibility to the metaverse is not at the forefront of considerations as we develop medical use cases, then we risk creating new under-represented groups who will not benefit. To avoid this potential bias, engagement with all stakeholder groups, hospitals, clinicians and patients, needs to identify barriers for adoption to ensure the metaverse(s) developed is fit for purpose.

The adoption of new technologies inevitably results in new working practices and the need to re-think applications. This will create new job roles within healthcare and the need to upskill staff groups. It may be the functionality of the metaverse will provide surprising opportunities – you could 'feel' the edge of a tumour. Is there any benefit to this? Would patients prefer to have consultations where they feel comfortable and safe, for example at home, and not the sterile and impersonal environment of the hospital? Tasks that seem routine now will need to be reconsidered. The metaverse will provide opportunities that are impossible currently and these need to be explored and evaluated systematically with patient benefit at the core.

We need to learn from fast-paced technical developments of other fields. A current example is the speed of technical development of medical artificial intelligence tools, which has outpaced ethical considerations, reporting recommendations and engagement from clinicians and patients [8]. This has resulted in a multitude of artificial intelligence tools that are not validated and not fit for purpose. To fully enable all that the metaverse offers, this engagement and discussions need to start now. Only by doing so will the hype of the metaverse be realised, building trust in this technology and enabling benefits for medical professionals, patients and society.

Conflicts of Interests

The authors declare no conflicts of interest.

Author Contributions

Both authors contributed equally to the manuscript.

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