

# Towards an Ethics for the Healthcare Metaverse

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**Abstract**—Harnessing the metaverse for medical and healthcare purposes is currently heralded as the “next frontier in healthcare.” However, to ensure the “amazing possibilities” of the so-called “healthcare metaverse” can be fully realized, it’s vital to proactively identify and address potential challenges, especially those of an ethical nature. This paper aims to spotlight these ethical challenges within the healthcare metaverse and chart a course for confronting these issues and cultivating an ethics framework for this emerging field. We will demonstrate that the ethical quandaries within the healthcare metaverse bear striking similarities to those seen in digital medicine, an arena that grapples with vast quantities of data and the application of artificial intelligence. Reflecting on these parallels, we explore how six central ethical challenges in digital medicine – 1) accessibility, 2) fairness, 3) discrimination and bias, 4) responsibility, 5) privacy, data safety and security, and data ownership, as well as 6) environmental issues – unfold within the healthcare metaverse’s virtual boundaries and show that the metaverse’s immersive nature further intensifies these ethical challenges. In view of this, we advocate that the next phase in forging ethics for the healthcare metaverse involves a nuanced reconsideration of current ethical methods and principles in digital medicine, with an emphasis on the immersive element of the metaverse. We foresee the concept of embodiment within virtual settings to be at the heart of this immersion-focused reassessment.

**Keywords**—Virtual Reality, Medicine, Bioethics, Artificial Intelligence, Challenges

## I. INTRODUCTION

For a long time, the possibilities of the metaverse were primarily explored in fiction, through novels like William Gibson’s *Neuromancer* or Vasilii Mahanenko’s *Survival Quest* series, movies like *Ready Player One* or series like *Black Mirror*. Nowadays, the utilization of the metaverse for educational, advertising, commercial, and other purposes is gaining increased attention in real life. Its potential for healthcare is estimated to be particularly great [1] – with the metaverse already heralded as the “next technological step in the healthcare sector” [2] and the “next frontier in healthcare” [3]. Numerous researchers discuss the “amazing possibilities”

[4] of the so-called “healthcare metaverse” and promise that it will make healthcare smarter, more accessible, and more efficient [5], contributing to a “revolution of the healthcare sector” [6] or, even more sensationally, a “revolution in health” [7].

Yet, beyond mere euphemistic statements, a rich tapestry of research has emerged surrounding the metaverse for healthcare purposes. On the technological front, researchers are probing the technical capabilities, striving to weave health data more seamlessly into the metaverse, and actively working to transform the metaverse into a full-fledged healthcare environment [8-10]. From the medical angle, the multifaceted applications of the metaverse are under exploration for diagnostic utility, treatment of a wide array of mental [11, 12] and physical conditions, preventative measures, and continuous patient monitoring [1, 13]. These applications span various developmental stages, encompassing everything from initial conceptual designs to practical trials [1]. Viewing from a social science lens, studies are being conducted to gauge how individuals perceive the potentials of a healthcare metaverse and their attitudes towards it. Similarly, educational initiatives are emerging that delve into the metaverse’s capabilities for training medical practitioners [14, 15] or as a tool for public health communication and education [16, 17].

From an ethical standpoint, various studies have engaged with the ethics of immersive environments or the metaverse more broadly [18-20]. However, specific research focusing on the ethics of a healthcare metaverse remains notably scant. Aside from a few tentative approaches to the topic [21-23], there has been minimal exploration explicitly targeting the ethics of a healthcare metaverse. To ensure that the healthcare metaverse can fully realize its potential, a focused examination of this subject is not only necessary but essential. Investigating these ethical challenges and proactively addressing them will lay a strong foundation. This proactive approach can create safeguards that ensure the metaverse operates within the healthcare community in a manner that is both responsible and ethically sound, ultimately optimizing its efficacy and impact.



We will pinpoint and address this existing gap by exploring the ethical challenges that the healthcare metaverse presents. In doing this, we will adhere to the conceptual framework laid out by Caitlin Curtis and Claire E. Brolan [24]. They portray the healthcare metaverse as an extension of the increasingly data-driven and AI-centric field of digital medicine. The healthcare metaverse not only builds upon but also broadens the trends and technologies of digital medicine by infusing the aspect of immersion [1]. In view of this context, we argue that the ethical challenges faced in the healthcare metaverse are comparable to those of “digital medicine”, i.e., medicine that utilizes data and AI. However, the immersive nature of the metaverse magnifies several of these challenges, increasing the urgency to address them. Hence, to effectively address the ethical issues of the healthcare metaverse, we argue that it is crucial to reconsider or extend previous approaches to the ethics of digital medicine, taking into account the aspect of immersion.

## II. METHODS

To bolster our argument, we employ a mixed-methods approach that pragmatically combines conceptual analyses, comparative methods, and ethical reflections. First, we elucidate the concept of the “metaverse” and explore the opportunities it offers within healthcare. Second, in a comparative depiction, we demonstrate the benefits the healthcare metaverse has over other forms of telemedicine. These elucidations are rooted in an intensive examination and thorough literature review on the subject of the metaverse and healthcare, deepening the insights into the current research landscape on the subject of the metaverse in healthcare that were given above.

Against this conceptual background and building on the similarities between digital medicine and the immersive healthcare environments presented above [24], we proceed to identify and delineate the principal ethical challenges specific to the healthcare metaverse. We identify the key ethical challenges of the healthcare metaverse by considering scientific reviews that pinpoint the core ethical issues of digital medicine [25-27]. Among the many issues these three papers indicate, we select those that are particularly relevant to the context of the healthcare metaverse by critically assessing which of the challenges highlighted in the reviews are of particular significance in the context of immersive healthcare environments. This leads us to identify six core ethical issues: 1) *accessibility*, 2) *fairness*, 3) *discrimination and bias*, 4) *responsibility*, and 5) *privacy, data safety and security, and data ownership*, as well as 6) *environmental issues*. We then engage in conceptual ethical reasoning to illustrate how these ethical issues manifest themselves within the immersive environment of a healthcare metaverse.

In the *Discussion* chapter, we critically reflect on these insights. We initially conclude that the path towards an ethics of the healthcare metaverse starts with reimagining the ethics of digital medicine, aligning approaches and motives with the perspective of immersivity. In this context, we argue that embodiment is central for an ethics of the healthcare metaverse and propose a preliminary framework for further exploration in this direction. Then, we address the limitations of our

reflections and pinpoint areas for additional research. Finally, we will synthesize our findings in a conclusion.

## III. WHAT IS THE METAVERSE AND HOW CAN IT BE USED FOR HEALTHCARE?

Before we can explore the ethical challenges of a healthcare metaverse, we need to clarify what the metaverse is and how it can be utilized for healthcare purposes.

Following Matthew Ball, the “metaverse” can be understood as “[a] *massively scaled and interoperable network of real-time rendered 3D virtual worlds that can be experienced synchronously and persistently by an effectively unlimited number of users with an individual sense of presence, and with continuity of data*, such as identity, history, entitlements, objects, communications, and payments.” [28] To unpack this dense definition, the term “metaverse” typically refers to a virtual universe filled with various worlds that individuals can enter as avatars or virtual representations of themselves, engaging and interacting in real-time with their virtual environment, other users, or artificial characters [29]. Virtual worlds in the metaverse can be created and hosted by users themselves, private-sector companies, or non-profit organizations, and range from replicas of real-world settings to fantastical worlds. Unlike regular video games or movies, which are viewed on a monitor, the optical “immersion” in the metaverse usually takes place via head-mounted displays. This increases the immersivity of virtual worlds and allows users to experience their digital environment and interactions with other characters as very lifelike [30]. The avatar is controlled either via handheld controllers, via sensors attached directly to the body that determine the position of certain body parts and transmit them to the avatar in-game, or a combination of both. While the metaverse has primarily been used for gaming and entertainment purposes for a long time, its application for healthcare has recently garnered significant attention [4].

One of the most significant opportunities of the metaverse for healthcare is the establishment of so-called “virtual hospitals” [31], i.e., virtual environments resembling real clinics or medical practices that individuals can “enter” for diagnosis, medical care, or health education. According to Patel and Shokouhi [32], virtual hospitals can serve as substitutes for traditional medical practices and clinics, allowing individuals to receive medical care and advice in a virtual environment. This is especially beneficial for those who face challenges in visiting a physical doctor or clinic, such as those living in remote locations or with limited mobility. Virtual clinics employ both human and AI doctors, with the latter handling routine diagnoses, thereby reducing wait times for patients and allowing “real” doctors to focus on more complex cases. This enables a smaller number of human doctors to care for a larger number of virtual patients, alleviating the burden on real-life hospitals and emergency rooms – as people who would otherwise have visited for a diagnosis can now be diagnosed in the metaverse and are only referred to a “real” clinic if a virtual diagnosis is inconclusive or if a serious illness is suspected.

It is also possible to perform certain treatments in virtual environments. Particularly significant potential is emerging in the treatment of mental illnesses such as body dysmorphism symptoms, anxiety disorders, or social deficits [11, 12]. For

example, it is possible to expose patients to virtual stress situations and, under professional supervision, train them to cope with them. Additionally, there is further potential for rehabilitation measures [33], such as professionally instructing people to perform specific physical rehabilitation exercises and tracking and evaluating their progress – has the patient’s mobility or physical endurance improved or deteriorated? – in real time using sensors [4]. Treatments like these can be administered and supervised equally by medical experts or by specialized AI.

Moreover, the metaverse offers new avenues for health communication [16, 17] and medical education [14, 15, 34]. For instance, aspiring doctors can utilize immersive simulations to gain a deeper understanding of human anatomy and various organs [35]. They can also practice making diagnoses and performing treatments using both real and simulated patients. Furthermore, patients can be educated about various health conditions and preventive measures through virtual representations, empowering them to make more informed decisions about their wellbeing [16]. Altogether, this can lead to a better educated and empowered patient population, and a more skilled and efficient healthcare workforce.

Last but not least, the potential to provide easier access to medical services significantly broadens its scope, a development that could profoundly influence the entire healthcare system, including public health concerns [36]. This opens exciting possibilities for preventive health initiatives such as stress reduction, burnout prevention, and rehabilitation outside of traditional healthcare settings, like physiotherapy. This potential for widespread health care accessibility signifies a promising leap toward comprehensive and inclusive health care.

#### IV. WHAT IS THE ADVANTAGE OF A HEALTHCARE METAVERSE COMPARED TO OTHER FORMS OF TELEMEDICINE?

The benefits of a healthcare metaverse seem to be numerous, but one might ask why we need it. Telemedicine can be conducted over the phone or through videochat, and collaboration among specialists, consultation with AI, creation of stress scenarios for training purposes, and instruction and assessment of rehabilitation exercises can also be achieved through more traditional communication channels. Neither medical education nor health communication necessarily require immersion in virtual environments. So, if all these things can be accomplished without the metaverse, what are its unique advantages and its “amazing possibilities” [4]?

Admittedly, diagnoses do not work any better in the metaverse than via telephone or video calls. After all, you do not need an immersive environment to describe symptoms to doctors. If patients want to ask their doctors about physical abnormalities they are concerned about, this might even work better via webcam than with an avatar in the metaverse, as questionable abnormalities can be shown via webcam, but not on the avatar. And for diagnoses that require physical examinations, all these media are equally useless.

However, when it comes to virtual treatments, medical education or health communication, the metaverse can unfold great potentials thanks to its immersive nature as well as the

extremely vivid experiences and more direct interactions of the persons with their virtual environment and characters that it allows [37]. Simulated stress or anxiety situations in the metaverse can appear much more real and engaging than “experiencing” them on a screen or imagining them in one’s mind. As a result, treatment sessions can be more “lifelike”, and patients may have a greater chance of success in learning to deal with such challenging situations [4]. Virtual rehabilitation measures can also benefit from the metaverse’s immersivity. A more engaging environment and intensive interaction with a counterpart or training partner can increase motivation and spur patients to perform physical exercises more effectively, as some may have experienced in real-life gym situations. Something similar is true for medical training and health communication, which can also benefit from the immersive nature of the metaverse and its enhanced visualization techniques [38]. In medical education, the improved visualization techniques of the metaverse can expose future physicians to lifelike situations similar to their later everyday work [39], providing them with “practical experience” and bridging the theory-practice gap that exists between theoretical training in medical school and its application in practice. The immersive nature of the metaverse can also aid in health communication. In addition to contributing to better understanding, providing vivid demonstrations of the consequences of compliance or non-compliance with preventive measures, patients may be more likely to implement these measures consistently [16].

In summary, while the metaverse may not open up entirely new possibilities, it has the potential to significantly improve the effectiveness of various telecare, medical education, and healthcare communications. Key to this is the metaverse’s strong immersive capabilities, that are enabled by combining advanced communications, data processing, AI, and visualization technologies [8].

#### V. WHAT ARE THE ETHICAL CHALLENGES OF A HEALTHCARE METAVERSE?

For the healthcare metaverse to operate effectively, it requires a large software and hardware ecosystem, including virtual worlds and servers for hosting, end-user devices for controlling avatars, and significant computing power and fast internet connectivity [8]. Only when these components are available and integrated can the healthcare metaverse unfold its full potential [8]. However, in addition to the technical and associated financial, social, and coordination challenges, as well as the legal challenges [40], the healthcare metaverse also presents ethical challenges. As highlighted in a scoping review by Petrigna and Musumeci [41], little has been written about these.

As mentioned in the previous section, the healthcare metaverse closely aligns with various advances in digital medicine, including telemedicine and the application of medical data and AI tools. A new aspect added to the metaverse is that of immersivity. As the healthcare metaverse can be seen as an extension of digital medicine [24], it seems plausible that its ethical challenges would also manifest as expansions of the ethical challenges inherent in digital medicine. Thus, to identify the ethical challenges of the healthcare metaverse, we will examine the key ethical

challenges of digital medicine and explore how these challenges manifest themselves within the context of an immersive healthcare setting.<sup>1</sup>

In order to identify the key ethical challenges of digital medicine, we engaged with systematic reviews that were specifically concerned with these central ethical issues [25-27]. By critically assessing which of the issues highlighted in the reviews are of particular significance in the context of the healthcare metaverse, we pinpointed the key ethical concerns. Though there are undoubtedly more ethical challenges associated with digital medicine, we recognized the following six as being fundamental to our analysis: 1) *accessibility*, 2) *fairness*, 3) *discrimination and bias*, 4) *responsibility*, and 5) *privacy, data safety and security, and data ownership*, as well as 6) *environmental issues*.

#### A. Accessibility

The healthcare metaverse promises to make medical care more accessible, especially for people who cannot physically visit hospitals or doctor's offices due to illness or old age. However, comprehensive use of the healthcare metaverse and receiving high-quality virtual medical care require expensive software and hardware, such as head-up displays and controllers, a powerful computer, a fast Internet connection, and ideally, additional sensors [38]. These requirements are currently quite costly [4]. Additionally, there is still a digital divide, and many older people struggle to use the necessary technologies and navigate virtual worlds. These factors are problematic, as the healthcare metaverse is intended to provide high-quality healthcare to older individuals and those with lower socioeconomic status. While these accessibility issues may not directly relate to immersivity itself, they are related to the prerequisites necessary for immersivity.

#### B. Fairness

Although the healthcare metaverse allows doctors to diagnose and treat more patients efficiently, it does not guarantee that every patient will be seen immediately. Even in virtual hospitals, patients may have to wait for a human doctor's appointment, sometimes for several hours [32]. Alternatively, patients may choose to schedule an appointment with an AI-doctor, which raises the question of how access to doctors is fairly coordinated in the healthcare metaverse. Specifically, there is a concern that some patients may pay for premium access to skip the digital queues, while others have to wait for extended periods or settle for AI doctors [8]. Although these issues also exist in the "real-world", they become more acute in the metaverse. In real hospitals, patients can detect preferential treatment and lodge complaints when others who came after them are "served" first, or when they only interact with AI doctors. However, in the metaverse, it is challenging to track who waits for how long or who receives priority. It is also difficult to differentiate between "real" and AI-doctors.

#### C. Discrimination and bias

Discrimination and bias are a risk wherever data are analyzed, particularly when done with the help of AI [42]. There is a danger that certain groups of people are over- or under-represented in the training data, which can lead to biased or one-sided results [24, 43]. For example, if self-learning algorithms are primarily fed with data from white males, this can produce biased or worse results for women, people of color, and especially women of color [44]. In face-to-face situations, physicians have the possibility to recognize and address such biases and discrimination. If a Black person, for example, is in front of them and they know that Black persons may be underrepresented in the AI's training data, they can critically examine the results and recommendations to uncover any biases and false results. However, in the healthcare metaverse, physical cues do not exist. A person with female genetics can give themselves a male avatar, and someone with darker skin can assume a white avatar [45]. This lack of cues can prevent doctors from being particularly sensitive to potential biases and can lead to discrimination going undetected.

#### D. Responsibility

Extensive discussions on AI ethics have highlighted that whenever AI is used, there is a risk of "responsibility gaps" [46] or "responsibility diffusion" [47]. This means that it is almost impossible to clearly identify who can be held morally responsible and legally accountable for the outcomes of a decision made with the help of AI. This proves particularly problematic in the medical context, and even more challenging when AI is used in the healthcare metaverse. For instance, if an AI-assisted diagnosis made in the healthcare metaverse is found to be incorrect, it can be more difficult than in real life to determine who is responsible for the error and whether it is due to a technical deficiency or lack of safeguards in the virtual environment, or human error. Human errors, such as incorrect diagnoses by physicians or retrospective unwise decisions by patients, are an inherent part of healthcare. However, distinguishing the source of these errors can be complex. For instance, if a medical misdiagnosis is apparent, it is necessary to ascertain whether the doctors made an erroneous decision despite having accurate data or if the data they were given was faulty, ambiguous, or skewed in the first place. In the former scenario, the responsibility would lie with the physicians for misinterpreting data, even if it was generated by an AI system [48]. However, in the latter scenario, the physicians would be absolved of blame. This is because, within the metaverse, they must rely on the data they receive without any means to validate its veracity or confirm the positioning of the sensors that recorded it. In cases where a patient's decision leads to a negative outcome, it can be challenging to determine the role of the virtual environment in the wrong decision, and whether the patient would have made a different decision in a real-world setting. These complexities underscore how much the virtual environment of the healthcare metaverse can make the attribution of responsibility more difficult.

<sup>1</sup> Alternatively, we could adopt a reverse approach, starting with the metaverse's ethical challenges and examining their implications for healthcare. However, since new ethical questions frequently arise in healthcare, we

believe it's more effective to begin with the ethical challenges of digital medicine and investigate how they are transformed when the metaverse's immersive dimension is introduced.

E. Privacy, data safety and security, and data ownership

The generation of data, particularly medical data, invariably raises issues concerning privacy, data security, and ownership. Key questions that emerge include who owns the data, who has the authority to control and use it, and for what reasons – be it treatment, research, advertising, or monetization [23, 41, 49]. How effectively is this data shielded, and to what extent is user privacy safeguarded against invasive attempts and malicious hacking [24, 31]?

As the healthcare metaverse generates and transmits medical data extensively [22], and patients may be more predisposed to divulging sensitive details such as personal health records, medical history, treatment preferences, or even financial information due to the perceived trust and intimacy within the virtual environment, these concerns become increasingly urgent [50].

TABLE I. ETHICAL CHALLENGES OF THE HEALTHCARE METAVERSE

Challenges	A comparison of the ethical challenges of digital medicine and the healthcare metaverse.	
	Ethical challenges of digital medicine	Ethical challenges of the healthcare metaverse
Accessibility	Access to quality medical care, encompassing state of the art medical devices and digital applications, should ideally be universal [25-27]. Nevertheless, the high cost of specialized medical equipment often restricts its availability to limited locations. This scarcity poses a particular challenge for individuals who are rendered immobile due to illness or the natural aging process, hindering their ability to access specially equipped medical facilities [38].	The healthcare metaverse proposes to bolster accessibility by enabling individuals to attend virtual clinics or engage in virtual medical consultations from anywhere in the world. However, utilizing the healthcare metaverse entails having the necessary hardware and software, as well as the technical proficiency to operate them [38]. First, these requirements can prove to be prohibitively expensive [4]. Second, it's often the case that older individuals find it particularly challenging to navigate such technologies [38]. This can exacerbate accessibility issues – especially for those already grappling with them.
Fairness	The principle of equal access to high-quality medical care is a fundamental one [25-27]. Yet, in practice, disparities often exist where individuals with greater financial resources receive preferential medical treatment. This can manifest as shorter waiting times or access to better facilities and cutting-edge equipment.	The healthcare metaverse promises to enhance fairness in healthcare provision. It allows for patients to immediately book appointments with AI doctors, who, by design, treat all patients impartially. However, the availability of human doctors within the healthcare metaverse remains limited [32]. There's a looming risk that wealthier individuals might purchase premium access, thereby receiving preferential treatment [8]. This form of preferential treatment in the metaverse is less noticeable and overall, lacks transparency.
Discrimination and bias	Medical algorithms are often skewed, as they are trained predominantly on data from white males [24, 42, 43]. This bias in data collection can result in AI diagnoses and treatment suggestions that are less accurate and less effective for, e.g., women and people of color [44].	The use of virtual environments and fictional avatars in the metaverse can make it more challenging for doctors to discern their patients' gender or ethnicity [45]. While this could potentially mitigate human biases and discrimination [45], it simultaneously complicates the recognition of any biases and discrimination present in AI diagnoses or treatment recommendations. The reason being, doctors might be less sensitized to the fact that their patient belongs to a group underrepresented in the training data used for AI.
Responsibility	When AI comes into play for making medical diagnoses or suggesting treatments, the landscape of responsibility can become muddled. It grows unclear who – be it the doctor, the AI, or other involved parties – holds moral responsibility for certain decisions and who is legally liable for any resultant consequences [46, 47].	Within the realm of the healthcare metaverse, these blurred lines of responsibility intensify. Added to the puzzle of determining responsibility – whether it falls on the doctor, the AI, or other parties – is the question of whether the same decisions would have been made by doctors in a real-world setting [48]. The degree to which the virtuality of their environment influences their decisions introduces yet another layer of complexity.
Privacy, data safety and security, and data ownership	Digital medicine operates with vast quantities of data, some of which are particularly sensitive. This triggers pressing questions about who rightfully owns this data, how well it's protected, and who has the authority to utilize and dictate its use [23, 24, 31, 41, 49].	In the metaverse, issues concerning data safety and security, privacy, and ownership become even more heightened. This amplification results from two primary factors. First, the metaverse creates a higher volume of data compared to traditional digital medicine [22]. Second, the perceived level of trust and intimacy within the virtual environment might encourage patients to share more sensitive information [50].
Environmental issue	Digital medical tools, particularly those involving AI applications, demand extensive computational resources and produce enormous volumes of data [55]. This process is intrinsically linked to a high level of energy consumption, resulting in the substantial emission of greenhouse gases.	The process of creating the virtual environments for the healthcare metaverse, and coordinating them across multiple devices in real-time, demands an even greater level of computational power and generates even more data than traditional digital medicine. This leads to a corresponding increase in the emission of greenhouse gases [56]. Additionally, the VR devices raise concerns about their recyclability and the potential for electronic waste [57].

Table 1. Overview of the ethical challenges of the healthcare metaverse (right column) in direct comparison to the ethical challenges of digital medicine (left column).

Another crucial challenge to address in this context is: how to utilize the collected data for collective benefit – such as

enhancing existing systems – while ensuring individuals retain control over their personal data. Navigating this delicate

balance between communal progress and personal autonomy is a central task in the burgeoning field of virtual healthcare [51, 52].

#### F. Environmental issues

From an environmental standpoint, the digital transformation of medicine emerges as a double-edged sword. On the one hand, digitalization enables the execution of virtual meetings, including medical consultations or check-ups, thereby reducing travel and, in turn, cutting significant greenhouse gas emissions. Some optimistic studies even posit that the incorporation of digital and AI tools might lower the global healthcare carbon footprint by up to 80% [53]. With the advent of the healthcare metaverse, the possibilities for telemedical diagnoses, treatments, and continuous monitoring will grow further, potentially yielding additional savings in greenhouse gas emissions [54].

On the other hand, digital medical instruments themselves consume vast amounts of energy, consequently generating an immense volume of greenhouse gases. The training and deployment of medical AI systems, which manipulate extensive data and therefore necessitate multiple servers and robust computing capacities, are especially energy-hungry [55]. While no specific figures or projections are available at present, it seems plausible to assume that the healthcare sector's carbon emissions will experience a substantial surge with the advent of a healthcare metaverse. Crafting virtual environments demands high-powered processors and GPUs, producing copious data that must be transmitted globally and updated on multiple devices at millisecond intervals, both of which consume significant energy resources [56].

Beyond the extraordinary energy needs and the resultant greenhouse gas emissions, end devices, such as smart glasses and high-performance equipment, require a plethora of rare resources. Their extraction often involves intensive energy and water usage. Moreover, questions loom regarding the recyclability of VR devices. Will they, like much other electronic waste, ultimately find their way into landfills or other parts of the environment? [57] The answer remains uncertain, adding yet another layer to the complex environmental equation of the healthcare metaverse.

#### G. Summary

To elucidate the ethical challenges of the healthcare metaverse, we will condense the insights from this chapter into a table. Table I will serve to succinctly outline the ethical challenges unique to the healthcare metaverse, drawing clear parallels with corresponding challenges found in digital medicine. By doing so, we aim to underscore how the immersive nature of the healthcare metaverse amplifies existing ethical dilemmas within digital medicine, rendering them even more urgent and demanding of our attention.

Table I's rows list the individual ethical challenges that have been addressed in this chapter. In the columns, these issues are contextualized, showing how they manifest in digital medicine (in the left column) and in the context of the healthcare metaverse (in the right column). Content-wise, the table doesn't introduce any new insights – instead, it serves to succinctly summarize the material explored in this chapter, making it more accessible and easily digestible.

## VI. DISCUSSION

Having now provided an overview of the central ethical challenges of the healthcare metaverse, we wish to discuss these insights a little bit further. First, we will consider how one might address these challenges and propose next steps towards developing a convincing ethics of the healthcare metaverse. Then, we will identify some limitations of our investigation.

### A. Next steps towards an ethics for the healthcare metaverse

In the preceding chapter, we conducted an examination of the ethical challenges pertinent to the healthcare metaverse. Our investigation was founded on two key premises: first, that the ethical challenges encountered within the healthcare metaverse parallel those found in digital medicine; and second, that the metaverse's element of immersivity intensifies the urgency of these challenges. What do these findings mean for the next steps toward an ethics for the healthcare metaverse?

If the ethical challenges of the healthcare metaverse parallel those of digital medicine, only amplified by the metaverse's immersivity, it seems logical to approach ethics for the healthcare metaverse from the perspective of digital medicine. Consequently, we should reevaluate approaches and principles from the ethics of digital medicine, such as data sovereignty [58, 59], explainability [60], or meaningful human control [61-63], in light of the immersive aspect.

The journey towards crafting a comprehensive ethics of the healthcare metaverse commences by grounding it in the ethical principles and approaches of digital medicine, and then reexamining and reshaping them against the backdrop of the metaverse's immersive nature. Thus, the next step is to cultivate a nuanced understanding of the metaverse's immersive characteristics. As emphasized by Liam Jarvis in his seminal work *Immersive Embodiment* [64], the concept of embodiment within immersive environments is set to play a pivotal role.

Indeed, as alluded to earlier, immersion promotes a sense of disembodiment, liberating individuals to explore places, execute actions, and interact without leaving the comfort of their home, involving themselves in strenuous movements, or engaging in direct face-to-face encounters. Nonetheless, the physical body retains a critical role in this new frontier, serving a dual purpose: first, in controlling the avatar, and second, as a driving force propelling individuals to venture into the healthcare metaverse. After all, the motivation behind seeking virtual clinics is not for the welfare of the virtual avatar, but rather for the health of the user's physical body.

Recognizing this, it becomes clear that the physical experience within these immersive technologies warrants significant attention. In the future, it will be particularly important to study this empirically. Such investigation can help us to better understand the user's embodied experience within the virtual space and to broaden our ethical considerations around these issues. This focus on the physical within the virtual could potentially redefine our approach to immersive healthcare technologies.

Once we have fostered a robust understanding of embodiment in immersive environments and, as a result, gained insights into the nature of immersivity,<sup>2</sup> we can leverage this knowledge to revisit the ethics of digital medicine and its fundamental approaches and principles. Consequently, we will be well-equipped to formulate a robust and meaningful ethics of the healthcare metaverse, one that is aptly tailored to address the ethical challenges presented by immersive environments.

### B. Limitations of this study

In closing, it is crucial to identify two significant limitations that form the foundation of this study.

First, the considerations that we have presented in this work are largely conceptual. However, when aligning with contemporary ethical concepts such as embedded ethics or the wide reflective equilibrium, these emphasize the importance of engaging theoretical considerations with empirical data, thereby lending additional evidence to one's conclusions. We have referred to empirical data or studies at key points in the text. Nevertheless, it would be beneficial to further emphasize empirical aspects in subsequent research, for instance, by delineating the views, attitudes, and hopes of key stakeholders concerning the healthcare metaverse, or by assessing the actual state of the metaverse's accessibility on a population level.

Second, we have articulated in our conclusions that a deeper engagement with the concept of embodiment could be a valuable starting point for the ethics of the healthcare metaverse. However, we have alluded to this rather than fully elaborating on it. There remains a need for further research in this area, both on theoretical and empirical levels. Theoretically, it needs to be more clearly outlined what role embodiment should play for ethics concerned with the healthcare metaverse and how embodiment should be conceived in virtual environments. Empirically, investigations must be conducted to understand how individuals perceive embodiment in virtual versus real environments, how these altered body-experiences change their interactions with others, and what implications this has for healthcare within the metaverse.

These limitations, while integral to the current discourse, also serve as beacons guiding future scholarly inquiry and experimentation in this multifaceted and rapidly progressing field. They underscore the complexity of the subject matter and signal uncharted territories that beckon further exploration and understanding.

## VII. CONCLUSION

In this article, we have endeavored to identify the ethical challenges associated with the healthcare metaverse and to take a significant step toward formulating an ethics specific to the Healthcare Metaverse. We began with an introductory overview of the metaverse itself and its potential applications within healthcare, providing a snapshot of the current research landscape concerning the intersection of metaverse and

healthcare. Following this, we delineated the unique advantages that the healthcare metaverse may hold over other forms of telemedicine.

Our central inquiry led us to a deep exploration of the ethical challenges particular to the healthcare metaverse. Recognizing that this metaverse can be seen as an extension of digital medicine – with its increasing reliance on data-driven and AI-centric approaches – we posited that the ethical considerations in the healthcare metaverse must inherently parallel those found in digital medicine. A defining distinction, however, lies in the immersive aspect of the healthcare metaverse. Subsequently, we identified and thoroughly examined six key ethical challenges specific to digital medicine – 1) *accessibility*, 2) *fairness*, 3) *discrimination and bias*, 4) *responsibility*, and 5) *privacy, data safety and security, and data ownership*, as well as 6) *environmental issues* – and analyzed how these are manifested within the virtual confines of the healthcare metaverse. It became apparent that the metaverse's immersive nature further intensifies these ethical challenges.

In our discussion, we briefly outlined the limitations of our study, showing possibilities for future research, and contemplated the future trajectory for developing an ethics framework tailored for the healthcare metaverse. We concluded that the next logical steps must involve careful consideration of the concept of embodiment within immersive environments. By leveraging these insights, there is an opportunity to advance existing ethical principles in digital medicine, including but not limited to sovereignty [58, 59], explainability [60], or meaningful human control [61-63].

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### AUTHORS` CONTRIBUTIONS

All authors have participated in drafting the manuscript. All authors read and approved the final version of the

<sup>2</sup> To cultivate this understanding of immersive embodiment, we can draw on valuable insights from a diverse range of disciplines including dance studies [65], theatre and performance studies [66], or video game studies [67, 68], neuro- and cognitive sciences [69, 70], philosophy [71-73] or

phenomenology [74], sociology [75], critical race studies [45, 76], queer studies [77, 78], or theology [75, 79].

manuscript. All authors contributed equally to the manuscript and read and approved the final version of the manuscript.

## CONFLICT OF INTEREST

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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