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Editorial

Welcoming the "Metaverse" in Integrative and Complementary Medicine: Introductory Overview

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Special Issue: Welcoming the "Metaverse" in Integrative and Complementary Medicine

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Abstract

The digital transformation of healthcare is accelerating. At the forefront of this revolution is the development of the "metaverse." This multidimensional digital universe, where virtual and physical realities converge, is reshaping the potential of integrative and complementary medicine. In this special edition journal series, we explore how metaverse technologies such as virtual reality, augmented reality, avatars, digital twins, blockchain smart contracts, and more, are poised to revolutionize holistic healthcare. This article serves as a brief introduction to concepts, domains, and technologies of the metaverse, with scope for integrative and complementary medicine applications. It provides a groundwork and invitation for scholars to join this transformative frontier in healthcare, where the metaverse and integrative medicine unite to offer new dimensions for holistic well-being. Together, we explore the endless possibilities of "Welcoming the Metaverse in Integrative and Complementary Medicine," bridging the gap between the digital and the holistic for a more inclusive, diverse, and interconnected future of healthcare and wellbeing.

Keywords

Metaverse; augmented/virtual reality; telemedicine/telehealth; digital contracts; artificial intelligence; integrative medicine

1. Introduction

In the rapidly evolving landscape of healthcare, the "metaverse" digital revolution is building momentum. Originally emerging from the realms of science fiction as a kind of technological dream [1], the metaverse is no longer a distant concept but a tangible reality that is reshaping the way we approach wellness and healthcare [2]. Metaverse technologies in healthcare are estimated to be a 11.3 billion-dollar market by 2030 [3]. The ethos of integrative and complementary medicine is accessible whole-person wellbeing that encompasses optimal health of individuals, communities, and populations across multiple interconnected biological, behavioral, social, and environmental domains [4]. Thus, the metaverse promises particular utility to this expanding medical specialty. Here, we initiate a special edition journal series that invites an exploration of this technological new world, where the boundaries between the digital and the physical collide, and holistic well-being forms entirely new dimensions.

2. Defining the Metaverse

For the uninitiated, the metaverse represents a digital, inter/hyper-connected universe where virtual and physical realities converge and collaborate to create highly immersive, expansive, and interactive experiences that incorporate elements of the virtual world with physical material existence [2]. In this multidimensional space, individuals can experience, learn, heal, and thrive in ways previously unimagined.

3. Metaverse Technologies

Central to this paradigm shift are various technologies that underpin the metaverse, each with its unique potential to revolutionize integrative and complementary medicine. The expansion of metaverse-related technologies, such as Virtual Reality (VR) [5], Augmented Reality (AR) [6, 7], Mixed Reality (MR) [8, 9], Haptic Biofeedback [10, 11], Digital Twins [12], Avatars [13], Smart Contracts [14], Telemedicine and Telehealth [15, 16], Blockchain Technology [17], Artificial Intelligence (AI) [18], Spatial Computing [19], and 3D Modeling and Simulation [20, 21], are already significantly enriching systems in business and healthcare that will shift how patients/providers interact and experience wellness.

3.1 Virtual Reality (VR)

VR technology transports individuals to entirely new dimensions, generated by algorithmic scenarios which provide an immersive backdrop for holistic therapies and wellness practices. VR can offer relief to patients with chronic pain conditions like fibromyalgia, who can interact with the technology to absorb themselves in therapeutic virtual environments and/or experience the body (and bodily pain) differently [13], that may aid reduction in pain perception and improve well-being. The use of immersive virtual, augmented, and/or mixed reality technologies are redefining physical therapies/massage treatments as the need for physical proximity becomes redundant. Remote healing sessions with practitioners from anywhere in the world will be possible where patients can

participate in physical therapy, massage, energy healing, acupuncture, and other holistic treatments from the comfort of their homes. Such innovation promises to extend outreach and accessibility to broader clinical communities for personalized integrative and complementary medicine.

3.2 Augmented Reality (AR) and Mixed Reality (MR)

Whilst virtual reality (VR) immerses patients in entirely digital environments, augmented reality (AR) and mixed reality (MR) overlay/infuse digital elements into one's physical surroundings providing real-time information [22]. Such tools may enrich guidance during integrative therapies and wellness routines, i.e. during physical rehabilitation patients can wear AR devices that provide real-time feedback on exercise form, bodily alignment, and muscle expenditure, reducing injury risk and expediting recovery. Moreover, AR/MR enhances the physical therapy experience for patients recovering from serious injuries, such as post-stroke rehabilitation. Real-time feedback and interactive exercises can aid patients in regaining mobility and independence.

3.3 Haptic Feedback

Haptic feedback recreates tactile/touch sensations in the metaverse [23], enabling traditional physical therapies, like acupuncture and massage, to become real-world digital applications. Practitioners may use haptic gloves to provide remote acupuncture sessions with precise, real-time feedback, optimizing needle placement and patient comfort. This metaverse-technology has potential to enhance the realism of remote therapeutic interventions for patients with chronic conditions like neuropathic pain, osteoarthritis, and motor neuron diseases. Patients may receive virtual treatments with authentic sensations, providing pain relief, improved joint mobility, enhanced muscular co-ordination, and muscle/fascia manipulations.

3.4 Digital Twins

Personalized digital representations of individuals enable practitioners to visualize and assess biologic patterns, anatomy, and physiological states, towards tailored holistic interventions. Digital twins allow patients to explore their own bodies in intricate detail by engaging in a virtual representation of their physiology [24] towards gaining a deeper understanding of the mind-body connection. Patients may visualize how stress affects their systems, explore the impact of meditation/mindfulness and yoga (for example), and engage in guided visualizations to promote healing and wellness towards personalized wellness plans. This can be invaluable for chronic conditions (i.e. diabetes, cancer, cardiovascular disease, and mental health disorders), where digital twins can monitor patients' physiological states to customize holistic treatment plans as they unfold for optimal disease management.

3.5 Avatars

Whilst digital twins serve as personalized physiological representations of an individual patient for visualization, analysis, and assessment; digital avatars are virtual personas in the metaverse that can simulate external worlds and internal (bodily) states [13]. Such realistic simulations can be advantageous for patients to interact with guided integrative and complementary medicine interventions, or engage in altered bodily/cognitive experiences for therapeutic purposes. One

example would be avatars that can lead patients through customized yoga routines, adjusting poses based on individual needs and physical conditions. Digital avatars may also play a crucial role in providing personalized support to individuals with chronic mental health conditions such as depression, anxiety, and schizophrenia [25, 26], where avatars can guide patients through social interactions, interventions, and symptom management protocols during "triggers".

3.6 Telemedicine and Telehealth

While telemedicine and telehealth are not new technologies themselves [15, 27], their integration within the metaverse represents an innovative approach to expanding healthcare services in engaging virtual environments. This extends the reach of integrative and complementary medicine by enabling remote consultations and therapeutic sessions, making holistic care truly global. Such technology opens up the world for patients with rare chronic diseases to specialized care otherwise not accessible in their local regions. Patients can consult with experts worldwide through telemedicine, improving diagnosis, treatment options, and clinical outcomes.

3.7 Blockchain Technology

Blockchain technology is a decentralized and distributed ledger system that securely records and verifies transactions across a (preferably vast) network of computers [17]. It has a multitude of potential applications in healthcare, including secure patient record management, pharmaceutical supply chain verification, streamlined telemedicine services, transparent clinical trials, accelerated medical research, efficient medical billing, controlled prescription drug distribution, simplified health insurance processes, reliable medical credential verification, and improved organ transplant traceability. Ensuring the security and privacy of patient data, decentralized blockchain technology plays a critical role in maintaining trust within the metaverse. For individuals with chronic autoimmune disorders like rheumatoid arthritis, cancer, and HIV/AIDS, blockchain technology guarantees the security and privacy of treatment data. Patients can securely share their health records with multiple practitioners, ensuring comprehensive care while maintaining data integrity and ownership.

3.8 Smart Contracts

Smart contracts utilize the decentralized, secure, and transparent nature of blockchain technology to automatically execute and enforce agreements/transactions when specific conditions are met, eliminating the need for intermediaries and enhancing efficiency and trust in healthcare and supply chain management. Streamlining administrative processes, digital contracts automate appointment scheduling, payment processing, and insurance claims, enhancing the efficiency of integrative healthcare practices, and reducing human error. By automating administrative processes through smart contracts, practitioners can focus more on patient care, and certain costs can be tempered at the patients' end.

3.9 Artificial Intelligence (AI)

As previously mentioned, digital twins, digital avatars, and VR/AR/MR technologies enhance immersive experiences [13]. However, Artificial Intelligence (AI) stands apart in its core function as

a powerful analytical tool that dynamically processes real-time data through algorithms and machine learning [18] to provide personalized interventions, predictive insights, and proactive healthcare management. AI-powered virtual practitioners can provide real-time guidance, personalized treatment plans, and data-driven insights for holistic wellness. AI-driven virtual practitioners empower patients with chronic cardiovascular conditions like hypertension to manage their health proactively. AI analyzes real-time data, providing tailored lifestyle recommendations, individualized prompting to ensure clinical adherence, and can anticipate clinical events before they occur alerting patients and medical providers.

3.10 Spatial Computing

Fosters the creation of kinetic interactive 3D environments where users can engage in therapeutic practices to cultivate deeper mind-body connection. Patients can have access to interactive mindfulness exercises, virtually explore anatomical structures, or participate in dynamic rehabilitation programs; all of which augment holistic care for a wide range of chronic conditions, such as neurorehabilitation for stroke patients, pain management, and mental health support. It empowers patients to actively participate in their healing trajectory within a visually engaging and immersive virtual world. While spatial computing shares some similarities of digital twins in terms of digital representation, their primary purpose/application are distinct in that spatial computing is optimal for creating immersive 3D environments for real-time user interaction, while digital twins create digital representations of real-world entities for monitoring, analysis, and simulation.

3.11 3D Modeling and Simulation

Within the realm of metaverse technologies, 3D modeling and simulation are advanced techniques that excel at producing highly realistic virtual wellness spaces. Such tools enable visual access to intricate physiological processes and anatomical structures [20]. Unlike spatial computing, which emphasizes real-time user interaction, 3D modeling and simulation focuses on visual representation. Within an educational context, this technology offers insights to patients with various chronic conditions, allowing them to gain a deep understanding of the anatomical, bio-psycho-social, and interactive factors contributing to their symptomatology. Such visual comprehension empowers patients to explore and engage with complementary treatments more effectively, offering an orthogonal dimension of experiential learning to that of spatial computing or digital twins.

4. Domains of Metaverse Integration

Section 3 introduced the essential metaverse technologies underpinning healthcare transformation. This section provides a brief overview of the diverse domains where such technologies may augment the delivery of integrative and complementary medicine. Here, we explore how the metaverse's immersive potential and state-of-science tools may be applied to various facets of healthcare, revolutionizing the patient experience and expanding horizons of holistic wellness. The metaverse's integration into integrative and complementary medicine opens a multitude of avenues for holistic healthcare across several discrete domains:

4.1 Virtual Wellness Spaces

Offer a unique departure from reality that have considerable therapeutic potential. Particularly patients with chronic conditions and those in need of rehabilitation, can use these virtual environments to manage primary symptoms, reduce stress, and improve secondary mental well-being [28, 29]. Virtual wellness spaces allow the development of diverse therapeutic experiences, including immersive integrative therapy sessions, stress-reduction programs, interactive relaxation techniques, trauma rehabilitation, interventions that facilitate joint flexibility and reduce inflammation, among many others.

4.2 Personalized Therapies

Tailored treatments, involving massage, acupuncture, mindfulness/yoga, and energy healing, are delivered through avatars and digital simulations, addressing individual needs. Patients with chronic neurological conditions, such as epilepsy, multiple sclerosis, Parkinson's disease, and Alzheimer's disease, may benefit from personalized therapies in the metaverse. Virtual therapists create customized sessions that focus on specific integrative medicine techniques which are essential for targeted symptom management.

4.3 Physical Rehabilitation

Virtual physical therapy sessions with haptic feedback devices offer guidance and support for those recovering from injuries, particularly in isolated circumstances or severely impaired mobility. Chronic conditions like muscular dystrophy require ongoing physical rehabilitation. In the metaverse, patients can access specialized virtual physical therapy programs that adapt to their changing needs, maintaining muscle strength, biomechanical health and function over time.

4.4 Mind-Body Connection

The metaverse helps individuals explore the intricacies of the mind-body connection through interactive experiences and guided visualizations. For example, patients with chronic gastrointestinal disorders such as Crohn's disease, irritable bowel syndrome, and ulcerative colitis can experience their mind-gut connection in completely new ways. Interactive experiences delve into stress reduction techniques and dietary interventions, helping patients manage symptoms and improve digestive health.

4.5 Holistic Education

Immersive educational resources and training programs empower both practitioners and patients in a wide range of areas critical for holistic health. These include mind-body dynamics, nutrition, lifestyle practices, ethics, stress reduction techniques, mindfulness, and meditation. Patients suffering with chronic autoimmune diseases such as multiple sclerosis, rheumatoid arthritis, or lupus can benefit significantly from metaverse-based holistic education. These immersive experiences not only provide insights into adaptive nutrition but also offer essential tools for managing symptoms, enhancing overall quality of life, and promoting holistic well-being.

4.6 Remote Consultations

Telemedicine services in the metaverse enable individuals to access integrative care from any location, eliminating geographical barriers. Patients with a range of chronic conditions, such as chronic obstructive pulmonary disease/COPD, asthma, and rare lung diseases like pulmonary fibrosis, may find solace in metaverse consultations. Beyond medical advice, these consultations provide access to virtual pulmonary rehabilitation programs, empowering patients to maintain lung function, independence, and vital social support.

4.7 Community Building

Whereas virtual wellness spaces primarily offer individual therapeutic experiences within immersive environments, the community building domain revolves around connecting individuals in overlapping clinical cohorts. Virtual holistic health communities foster support, information sharing, and a sense of belonging. Such communities within the metaverse are lifelines for patients experiencing chronic mental health conditions such as schizophrenia or social anxiety. These communities not only offer support but also provide tailored peer-led group therapy sessions, promoting social engagement and symptom management.

4.8 Energy Healing

Remote energy healing sessions and therapies, including Reiki, sound therapy, crystal healing, and biofield therapies [30], become accessible through digital twins and virtual environments. These therapies offer potential relief for a wide range of chronic conditions, including fibromyalgia, neuropathic pain, chronic fatigue syndrome, and various autoimmune disorders. Within the metaverse, energy healers employ digital twins to remotely investigate energy blockages, balance chakras, explore individualized energetic dynamics, and harmonize the body's subtle biofield energies to address specific health concerns.

4.9 Stress Management

In addition to gamified stress management and biofeedback mechanisms, the metaverse promises a wide scope for targeted stress-relief techniques. For individuals dealing with chronic heart conditions like congestive heart failure, virtual stress-reduction programs play a pivotal role in improving cardiac function and overall health. Moreover, metaverse-based stress management extends its benefits to patients with chronic respiratory conditions such as chronic obstructive pulmonary disease/COPD, helping them manage anxiety and breathlessness effectively. Patients experiencing chronic pain conditions, like osteoarthritis and fibromyalgia, can find relief through personalized metaverse-guided stress management techniques, which contribute to their holistic well-being. Guided mindfulness and meditation sessions, immersive relaxation techniques, specialized breathing exercises, and other approaches address discrete clinical needs, ensuring a holistic approach to stress management in the metaverse.

4.10 Fiscal Efficiency

Blockchain technology significantly enhances fiscal efficiency in healthcare by streamlining data management, ensuring data integrity, promoting interoperability, automating processes through smart contracts, reducing fraud, empowering patients with data ownership, offering cost transparency, and optimizing supply chain management. Through its secure and transparent ledger system, blockchain minimizes administrative overhead, billing errors, and fraudulent activities. It facilitates seamless data sharing across healthcare systems, reducing redundancy and enabling prompt, accurate payments to healthcare providers. Patients and clinicians/practitioners benefit from real-time cost visibility, informed decision-making, and more cost-effective care options. Additionally, blockchain aids the procurement of integrative medical devices and supplies, preventing counterfeits and supply chain disruptions. Combined, these advantages make blockchain technology a powerful tool for improving fiscal efficiency in the integrative and complementary medicine sector.

5. Ethical Considerations

The assimilation of the metaverse into integrative and complementary medicine offers an appealing frontier for enhancing healthcare practices and patient well-being. Albeit, it is imperative that ethical considerations remain at the forefront of this evolution. Privacy, data security, informed consent, and the potential for digital health disparities are open questions that require deeper exploration as this space develops. Practitioners, researchers, and policymakers must be mindful to ensure that holistic metaverse healthcare remains equitable, safe, and patient-centric. Ethical guidelines and regulatory frameworks should be continually refined to align with the rapid dynamic nature of the metaverse. The integration of the metaverse into integrative and holistic healthcare presents a host of considerations that merit careful examination and responsible implementation:

5.1 Data Privacy and Security

One of the foremost concerns is the safeguarding of patient data within the metaverse. As healthcare interactions increasingly occur in virtual environments, robust measures for data privacy and security must be established. The integration of blockchain technology and advanced encryption methods can help protect patients' sensitive health information. Furthermore, transparent data-sharing agreements and informed consent processes should be developed, granting patients control over their data and its use.

5.2 Digital Divide

While the metaverse holds immense potential, there is a risk of exacerbating existing disparities in healthcare access. Ensuring that all patients, regardless of their socioeconomic status or technological literacy, have the opportunity to benefit from metaverse-based healthcare services is paramount. Initiatives must be put in place to bridge the digital divide and provide access to marginalized populations, thereby promoting health equity.

5.3 Informed Consent

In the metaverse, patients engage in novel forms of therapies and consultations. It is incumbent upon healthcare providers to obtain informed consent from patients, ensuring that they have a comprehensive understanding of the nature of virtual treatments, potential benefits, and associated risks. Patients should also be made aware of the limitations of virtual interventions, possible "hype", and offered alternatives when necessary.

5.4 Avatar Ethics

Avatars and digital twins are integral components of the metaverse healthcare experience. However, their creation and use should adhere to ethical principles. Practitioners must avoid the creation of avatars that mislead patients or provide false information. Patients engaging with avatars should always be aware that they are interacting with digital representations and not human counterparts. The long-term implications of replacing real human social interaction with highly immersive human-AI, has not been fully unpacked at present.

5.5 Therapist-Patient Relationship

The metaverse introduces unique challenges to the traditional clinician-patient relationship. To ensure ethical practice, clear guidelines must be established for maintaining professional boundaries and preventing any misuse of the virtual environment. The paramount concern should always be the well-being of the patient.

5.6 Cultural Sensitivity

The metaverse is a global platform, making cultural sensitivity a vital consideration in holistic healthcare. Integrative practitioners must be attuned to the cultural backgrounds, beliefs, and practices of their patients to provide respectful and inclusive care, avoiding any actions or interventions that could be perceived as culturally insensitive.

5.7 Medical Licensing and Regulation

The expansion of metaverse-based healthcare services may necessitate new considerations regarding medical licensing and regulation. Clear guidelines and regulatory frameworks must be established to ensure that healthcare providers delivering services within the metaverse adhere to established standards of care and ethical conduct.

5.8 Bias and Fairness

As AI-technology becomes more sophisticated and ubiquitous, AI-driven virtual practitioners within the metaverse must be programmed to avoid bias and discrimination. Ethical AI algorithms may be developed to provide fair and equitable healthcare recommendations and treatments, regardless of patients' cultural and socio-economic backgrounds, ensuring that the integrative medicine metaverse remains a space of unbiased care.

5.9 Patient Empowerment

An interesting trajectory of the metaverse in healthcare is that it tips the power differential away from the clinician/medical professional as an 'all-knowing messiah' and provides patient autonomy and access to vast amounts of specialist information. Patients should be empowered to make informed decisions about their care within virtual environments. Transparency regarding treatment options, risks, and expected outcomes is essential. Discontinuing/modifying metaverse-based treatments should be easily implemented by patients if they are dissatisfied or uncomfortable with sessions/experiences.

5.10 Research Ethics

In addition to the usual ethical considerations for any research study, metaverse-based research within integrative and complementary medicine entails unique factors. Researchers must ensure that participants have a clear understanding of the virtual nature of the environment and potential sensory experiences during informed consent. Safeguarding the privacy of avatars and digital personas becomes vital, necessitating advanced data protection measures. Additionally, researchers must consider the potential influence of metaverse-specific variables, such as the immersive nature of virtual spaces on self-report, behavioral, and clinical outcomes. These factors, along with upholding general ethical research principles, are crucial to responsible metaverse research in healthcare. By following specific ethical guidelines, researchers may contribute to advance the broader understanding of how transformative metaverse technology can enrich integrative medicine whilst maintaining human protections and well-being of participants.

5.11 Guarding Against Technological Misuse

As with any technology, there is potential for misuse within metaverse-related healthcare. The anonymous and immersive nature of virtual environments can create opportunities for deception, such as Munchausen's syndrome, digital identity fraud, or propagation of harmful pseudoscientific health information. Vigilance and proactive monitoring/reporting systems are crucial to deter such activity.

6. Call for Contributions

The aforementioned sections represent a "popcorn" overview of metaverse technologies, domains, and potential ethical considerations. This special edition journal series serves as a call to action, inviting researchers, clinicians/practitioners, and patients/clients, to share their deeper insights, research findings, and visions for this rapidly developing frontier. It aims to explore the use of metaverse-related technology, such as avatars, digital twins, physical therapies, fiscal innovations, and more, in the unification and promotion of holistic health for all. We examine the endless possibilities of "Welcoming the Metaverse in Integrative and Complementary Medicine," where the convergence of digital and holistic wellness paves the way for a technologically-infused, diverse, inclusive, and interconnected future.

Author Contributions

The author did all the research work of this study.

Competing Interests

The author has declared that no competing interests exist.

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