Journal of Community Pharmacy Practice
Vol: 03, No. 01, Jan-June 2023
ISSN: 2799-1199, DOI: 10.55529/jcpp.31.1.11

Research Paper

A review on: metaverse in health care and pharma

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Article Info

Article History:
Received: 25 August 2022
Revised: 11 November 2022
Accepted: 19 November 2022
Published: 04 January 2023

Keywords:
Metaverse
Virtual Reality
Augmented Reality
Digital Twins
Telepresence
Blockchain

ABSTRACT

Background: The metaverse can be seen as a new kind of Internet. It goes beyond the usual text and images. In this idea, real life and online life meet in one space. This shift is linked to several tools working together. AI helps the system react. AR and VR bring in layered views and shared places. Fast networks, like 5G, help data move quickly. Compared with older online services, the metaverse is meant to feel more present. It is not only watching a screen.
Objective: This review looks at how the metaverse could affect health care and pharma. It also checks which tools make this change possible. At the same time, it notes the ethical issues that come with those tools.
Method: For the method, a narrative review was used. The focus was on three tech areas that matter for health care. First is telepresence. Second is digital twinning. Third is blockchain. The goal is to bring together what is known about how these tools may alter care delivery.
Result: The results suggest that combining telepresence, digital twinning, and blockchain could open new options for health care. It may support new forms of treatment. It may also lower some costs. It may help patient results improve. Together, these tools can back care models that feel more connected and more driven by data.
Conclusion: The metaverse could help digital health in real ways. It may support new forms of care that are immersive and easier for more people to use. Still, it is not something to rush into without thought. There are key concerns that must be addressed. These include privacy, data safety, and fair access.

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Journal of Community Pharmacy Practice (JCPP)

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1. INTRODUCTION

Neal Stephenson first used the word "metaverse" in his science fiction book Snow Crash in 1992. It comprises of the stem "verse," which means "world and universe," and the prefix "meta," which stands for "transcendence and virtuality." In three-dimensional, real-time virtual worlds known as metaverses, many users can engage in social, economic, and cultural activities and communicate with one another through avatars and their surroundings without being physically present. The healthcare sector, among many others, has reacted to the metaverse phenomenon in 2021. The widespread use of digital assistants in the health sector has been made more effective by [1] a number of technical advances, including Artificial intelligence, machine learning, blockchain, and personal big data·



Figure 1. Metaverse in Healthcare

1.1 Metaverse

On the internet, there is a virtual realm called the Metaverse. It is a location where users can communicate with each other as well as artificially created characters and items. Additionally, there are virtual items and services for sale and purchase in the Metaverse.

1.2 Metaverse in Relation to the Healthcare Industry

Three significant technology trends discussed below have come together to form the metaverse in the field of healthcare.

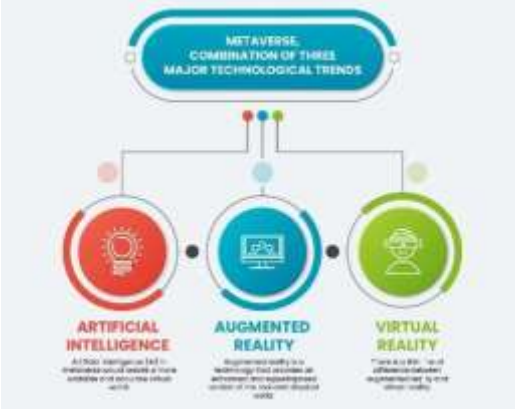


Figure 2. Core Technological Pillars of the Metaverse: AI, AR, and VR

1.3 Artificial Intelligence

Metaverse would provide a more realistic and scalable virtual reality with artificial intelligence (AI). Artificial intelligence (AI) in the healthcare sector can be used to comb through and process in real time the massive amount of data that is constantly given by [2] client activities in the organization's metaverse, as well as to enable various use cases. It will all remain intact with the help of this. It will be possible to interact in the metaverse openly thanks to the use of artificial intelligence in this field. Artificial intelligence can separate common dialects, like English, and reconfigure them so that they are understandable to computers.

According to data from Data Bridge Market Research, during the projected period of 2022–2029, the artificial intelligence in healthcare market is anticipated to see a CAGR of 51.37%. This suggests that by 2029, the market value, which was $6.35 billion in 2021, would have risen to $175.22 billion. Due to an increase in product launches, the availability of a larger patient pool, and developments in medical technology, "Patients" dominates the end-user segment of the Artificial intelligence in healthcare market.

1.4 Augmented Reality

A technology known as augmented reality offers a better and overlay image of the real and physical world. One of the most crucial elements of the metaverse is augmented reality, which makes it easier to mimic real-world events. Augmented reality can be used by [3] healthcare organisations to market their services and goods, launch successful marketing and awareness initiatives, and gather unique customer data.

1.5 Virtual Reality

Between augmented reality and virtual reality, there is a fine line. While virtual reality is an immersive experience that completely replaces the real world with the virtual one, augmented reality is based on real-world settings. The term "virtual reality" refers to a 3D and PC-produced virtual world that is either intended to replicate the real world or a made-up universe and is created by a combination of realistic sounds, images, and other sensations using tools like virtual reality headsets/protective caps, gloves, and body locators with sensors Within this virtual environment, anyone can talk and interact without any difficulties. In any case, as it does not accurately reflect the user's true physical environment, it is advised that users only utilise virtual reality technology in public areas to avoid accidentally injuring themselves or others by coming into touch with objects from the real world.

Together with the previously mentioned three technologies, as well as other technologies like mixed reality, blockchain technology, and social media, metaverse will offer a new the way for the development of new drug delivery and treatment channels, improve patient outcomes with regard to healthcare, and significantly reduce the cost of medical treatments. Following consistency would make it possible to detect and cure illnesses, diseases, illnesses, disorders, and medical conditions more effectively, according to the checking of patient movement in the metaverse.

1.6 Uses of Metaverse in Health Care

- Education
- Telemedicine
- Surgical Operations
- Digital Twins
- Fitness, wellness and quality of life
- Blockchain

1.7 Education

As parts of the metaverse, augmented reality (AR) and virtual reality (VR) will change how medical education and training are delivered on a massive technical scale. (AR) would make it possible for students to engage in hands-on learning by utilizing medical instruments, carrying out medical and surgical operations, and allowing the students to visualize and practice emerging medical technology. (VR) would

expose pupils to a virtual environment including operating rooms and theatres. Medical students and enthusiasts can enjoy simulating a real-world environment and virtually entering the human body in the virtual reality world.

Users could take use of a fully realized gaming environment by utilizing these methods and technology. Additionally, celebrity coaches might be hired for a more engaging and enjoyable learning experience. The purpose of using the metaverse for clinical and educational purposes is to create an augmented reality environment for studying the human body's vital processes in a research center setting.



Figure 3. Smart Medical with Augmented and Virtual Reality Technology Concept, Medical Student use AR and VR for Practice the Surgery (4) Smart Medical with Augmented and Virtual Reality Technology Concept, Medical Student Use AR and VR for Practice the Surgery



Figure 4. Young Teacher Using Virtual Reality Glasses and 3D Presentation to Teach Students in Chemistry Class, Education, VR, Tutoring

At the moment, augmented reality is accepted in teaching programmes for medical schools and has been shown to benefit treatment. For instance, Novarad Corp., a provider of clinical imaging software, recently announced the release of their augmented reality educational software.

The future of clinical education and training will also see a significant expansion thanks to a combination of these two technologies (augmented reality and virtual reality), known as the metaverse. Clinical educators can make use of this invention to help students with problemsolving, project completion, creativity stimulation, and creating a learning environment for all students.

1.8 Medical Services

In the medical services industry, which is a crucial step in the delivery of healthcare, doctors are acknowledged as a professional group with competence. The more practicefocused medical education there is, the more effective doctors will be at treating patients. Virtual reality facilities are used in the education of medical students, and their application in the production of healthcare services is seen to be one of the variables that can raise the level of patient happiness and service quality. There are many good outcomes that can be observed, including quicker interventional procedure times, sensible and optimal patient examination times, and lower patient wait times



Figure 5. Group of Multiethnic Students with Professor Learn Medicine or Scientific Project with VR Glasses in Modern Laboratory

1.9 Telemedicine

The 2D healthcare systems and solutions suffered a disaster during the pandemic phase. This was a result of the limitations and requirements placed on people's freedom of movement. The global rollout of the lockdown protocol made the situation for 2D healthcare systems even worse. Prior to the COVID-19 pandemic, only 43% of all healthcare facilities were successful in providing patients with remote therapy and treatment. But COVID-19 has had a beneficial effect on the telemedicine industry. Currently, the 43% market share has increased to 95%. Additionally, as the metaverse develops, telemedicine will spread more widely on a worldwide scale.

Metaverse's virtual office, where patients and doctors can meet in a 3D space or another setting, will improve telemedicine encounters. This is expected to essentially improve the client experience for teleconsultation benefits. The metaverse in medical services can enable strong inundation through the use of virtual reality because it delivers an incredibly higher sense of "being there" than other virtual settings like websites, informational apps, or online entertainment. This implies that a patient in India who requires medical advice and treatment from a specialist in New York can do so easily by using headphones. Scans and tests can be performed in one area, and the information or data can be sent from there to any other healthcare facility in the world. By pushing and supplying a better doctor-patient contact interface/platform, Metaverse has done nothing but improve access to telehealth solutions. As a result of increased digitalization, particularly in emerging nations, 2D healthcare systems are being rapidly replaced with 3D and virtual healthcare systems and solutions.



Figure 6. Doctor with Virtual Reality Glasses Working with A Remote Doctor on A Virtual Reality Interface Screen

1.10 Surgical Operations

Healthcare facilities all over the world are currently heavily utilizing cutting-edge technology like virtual reality, augmented reality, and artificial intelligence. Universities and other educational institutions also make use of these technologies to provide students access to 3D views of patients' bodies and to prepare them for surgical procedures. These technologies do, however, come with a unique set of technological difficulties, such as:

- Building real, physical items and thoughtful connection points inside a PC-created environment
- Creating surgical interfaces within a PC-created environment
- Addressing interactions between medical equipment

- Interpreting signs for uncertain situations during medical procedures

At top hospitals and clinics, the use of technology like augmented reality (AR), virtual reality (VR), robotics, 3D printing, and minimally invasive surgery is on the rise. For instance, Kankakee's Riverside Healthcare was the first hospital to offer AR spine surgery in March 2021. A surgeon wears a headset that displays the information onto their retina and superimposes the surgical equipment's position over the patient's CT scan, enabling a doctor to browse data and examine the patient.



Figure 7. Doctor Use Augmented Reality While Surgery in Operation Theatre

1.11 Digital Twins

The goal of the digital twin technology is to learn more about, analyze, investigate, and make judgments based on virtual representations of real-world and real-time things. With the aid of metaverse, digital twins can take the form of anything, even actual patients or medical equipment. The technology of the digital twin will become more efficient and effective thanks to metaverse by:

- Identification of certain risk factors
- Enabling quicker and more accurate diagnosis
- Predicting responses to the treatments
- Enabling shorter, safer, and more efficient clinical trial
- improving the effectiveness of the medical facilities



Figure 8. Digital Twin of Immune System

The use of digital twin's technology is a primary goal for numerous sizable medical technology companies, including Siemens Healthineers and GE Healthcare. These groups will need fundamental resources, including enormous amounts of patient information, to achieve their goal. With the aid of metaverse, it is anticipated that in the future, patients, researchers, medical practitioners, scientists, and medication developers will use digital twins as "test dummy technology." This suggests that the usage of digital twins and the metaverse will be combined to comprehend and forecast how a patient will recover from surgery, deal with a particular ailment, or respond to medication. As the accuracy of each person's genetic makeup increases, this will help the mapping and comprehension processes. By testing the medication virtually, this combination would reduce the number of animal tests even more. Additionally, it

would monitor the patient's health and search for any indications of pharmaceutical side effects while recommending the best course of treatment for the person experiencing one or more medical conditions. However, widespread implementation and execution are necessary to turn a digital twin's potential into reality. This includes integrating the technology into the clinical daily routine on a large scale, improving crucial clinical cycles with cutting-edge simulations, and working to improve medical care**.**

1.12 Fitness, Wellness and Quality of Life

Gamification will be quite important in this aspect. Gamification will give more advanced and creative ways for patients and healthcare professionals to interact with one another. The number of fitness and health-related applications will expand thanks to metaverse. With the aid of virtual instructors, health and fitness programmes are currently delivered via augmented reality and virtual reality. Celebrity instructors can be employed here as well, as was previously noted. Bringing together and establishing connections between patients and healthcare providers is the main goal of the application of gamification. In this regard, platforms like Roblox have served as stepping stones. Due to these platforms' accessibility, a growing number of users (patients and healthcare professionals) are connecting, working together, and communicating on a daily basis. On these services, individuals can create and have fun using metaverse. Through the use of virtual trainers and coaches, it would be possible to give consumers with smarter training using metaverse. Virtual reality, on the other hand, can raise a patient's quality of life.

Exercises based in virtual reality are becoming more and more well-liked in emerging markets as well. Virtual reality has been found to be even more engaging, interactive, and enjoyable by people. Virtual and augmented reality will establish themselves as the individual therapists for people as metaverse moves ahead of people. This is because metaverse has a wider potential and horizon than conventional kinds of exercise or conventional methods of preserving health and fitness.

1.13 Blockchain

Blockchain will revolutionise the healthcare sector and is an essential part of the metaverse. The fact that it considers decentralised networks managed by clever contracts, as well as a record of computerised "proprietorship" of environment or even items in the contemporary digital world, is widely acknowledged by large businesspeople and scholars. The most prominent application of blockchain in the healthcare sector is the management and protection of extremely crucial healthcare-related data and information. Currently, a lot of the time is spent moving or exchanging information between numerous businesses in an ineffective, wasteful, inefficient, and foggy manner. Data providers largely concur that there are differences in how critical healthcare information is shared and traded. Health records are increasingly vulnerable to fraud and virus since they are frequently kept and centralized utilizing computer networks. In our digital age, one of the most pervasive unethical behaviors is data theft. All of this suggests that blockchain, as a metaverse component, would enable the storing of data and other important information in a very centralized and safe manner, enabling protection against data thefts and other types of unethical actions. Many people think of blockchain technology as being related to cryptocurrency. Blockchain, on the other hand, is a technological database that makes it possible to store and transmit medical data securely, with the only person with the ability to alter it being the data owner. Additionally, blockchain may "transparentize" governmental, medical, and installment/payment procedures. The risk of deception and the regulatory burden on the data owner-the insurer as well as the healthcare provider-are reduced. In addition, it would secure matters for both the payer and the insured.

The traditional methods of storing data or information are being replaced by the blockchain technology, which eliminates the time-consuming and ineffective processes that they currently employ. Blockchain's auditability, transparency, stability, and encryption provide more efficient, effective, secure, and constant systems for managing credentials. In essence, blockchain innovation gives the patient or client complete control and independence over their information.

1.14 Metaverse in Pharma

The Metaverse in Pharma is a potent tool that can assist pharmaceutical businesses in accelerating the drug discovery process, enhancing communication and teamwork between various departments, and lowering the cost of clinical trials.

1.15 Uses of Metaverse in the Pharma Industry

- **Patient Communities:** Purposefully constructed patient communities in the metaverse can facilitate connections, interaction, and experience sharing among patients from around the globe. With the aid of smart contract creation technologies, rules and laws governing these communities may be carefully designed while keeping data security security and safety in mind.
- **Rep-HCP Virtual Interactions:** Up to 20% of rep encounters are virtual or remote conversations, and this number has significantly climbed over the past few years, largely because of the epidemic. For Reps, the metaverse can open up new avenues for natural virtual interactions with HCP and the development of online connections.
- **Brand Interactions and Events:** Medical training, disease cure programmes, educational programmes, and specialised drug advantages in connected conditions can all be considered as some of the greatest and first use cases of a metaverse in the pharmaceutical industry. Pharma businesses and brands can arrange virtual industry events for HCPs, patients, and even the general public through user-friendly metaverse platforms.
- **Brand Marketing:** Pharma businesses can reach new audiences and patients by utilising innovative marketing opportunities including sponsored content, virtual billboards, virtual games, and digital conferences in the metaverse.
- **Telemedicine:** The strength of artificial intelligence and machine learning combined with body scanning, vitals tracking, and haptic touch within the virtual environment have the potential to drastically transform telemedicine and make digital HCP consultations more hyper-realistic, personalized, and humanlike. Without a doubt, telemedicine will open up new possibilities for providing distant care.9
- **Drug Development in the Metaverse:** The average amount needed to get a new drug to market is $1.4 billion USD, according to a 2020 Journal of the American Medical Association (JAMA) research. The planning, staffing, and management of clinical trials is one of the most expensive and time-consuming phases of drug research. A novel treatment's development expenses may account for as much as 60% of the total. To find enough clinical trial participants with the necessary disease, genetic, gender, age, and other characteristic profiles for a clinical trial, it requires a lot of effort and money.

The incredible potential of using digital twins to drastically cut the expense and time needed to conduct valid clinical trials is made possible by the metaverse. A virtual model known as a "digital twin" is created to faithfully represent actual physical things, procedures, or even people. To explore numerous processes, digital twins "may perform any number of valuable simulations." The experiment or trial might be carried out and studied much more swiftly and safely if a digital twin were used. The Metaverse would also provide an immersive or augmented reality (AR) visual portrayal of the effects of the suggested therapy on a digital twin, which might be a full person or just certain organs and systems. This is in contrast to a standard data analytics programme. Such a visual three-dimensional and interactive representation would be more user-friendly and likely more informative to a clinical researcher.

Pharmaceutical corporations are eagerly investigating this technology, despite the fact that it has not yet been developed enough to construct a perfect digital twin of a human person. When that technology is implemented, pharmaceutical companies will be able to finish clinical studies in a matter of weeks rather than months or years, and at a fraction of the expense.

2. CONCLUSION

The metaverse presents both chances and difficulties, like a coin with two sides. In spite of the hazards involved, there are undoubtedly more opportunities. The idea is compelling in a safe and secure

social virtual environment, we can encourage the educated young population to take control of their medical services and be encouraged to study, improve welfare, and teach their peers. Researchers are changing healthcare into colourful mini-modules that can be taught online to anybody, anywhere, and anytime. The precision chances for doctors, working together globally and using augmented and virtual reality to aid them, opens prospects to get over the difficulty of a shortage of trained medical experts in a certain geographic area.

The ability to reward the community, patients, and specialists for their efforts to advance health in the future opens up a completely new market and set of prospects. It is possible to create a controllable and realistic paradigm for medical care, but only with the involvement of healthcare professionals. The time has come to lean in and explore just what effects the metaverse can bring about.

The metaverse's virtual reality and augmented reality elements will aid students in their training and education in the medical field. A simulation of the real world environment might be created using virtual reality and augmented reality, and real-world physical medical devices may be made available for training and practical applications. In this regard, Data Bridge Market Research did a thorough analysis of the market for surgical and spinal implants around the world.

According to Data Bridge Market Research, the market is projected to reach USD 16.20 billion by 2028 and increase at a CAGR of 5.50% during the forecast period. There are, nevertheless, several obstacles and limitations facing the market. The market for spinal implants and surgical equipment will face significant challenges from a lack of experienced workers and an unfavorable reimbursement environment. Additionally, the market for surgical devices and spinal implants may be constrained by the high expense of the process.

Acknowledgments

The authors have no specific acknowledgments to make for this research.

Funding Information

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Author Contributions Statement

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
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Gururaj S Kulkarni	✓	✓	✓			✓	✓	✓		✓	✓		✓	
Rakesh Babu SN		✓	✓	✓			✓	✓				✓	✓	✓
Padma M Paarakh	✓	✓			✓	✓		✓	✓	✓			✓	✓

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Informed Consent

All participants were informed about the purpose of the study, and their voluntary consent was obtained prior to data collection.

Ethical Approval

The study was conducted in compliance with the ethical principles outlined in the Declaration of Helsinki and approved by the relevant institutional authorities.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

REFERENCES

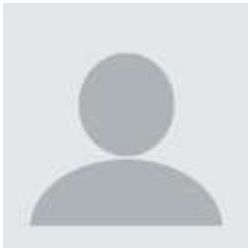
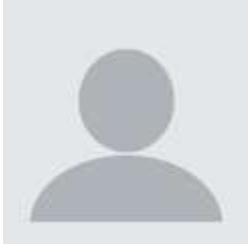
[1] T. C. Wu and C. T. Ho, A scoping review of metaverse in emergency medicine. Australasian emergency care. 2022.

[2] B. Uysal and T. Semiz, 'A New Age in Health: Metaverse', Gevher Nesibe Journal IESDR, vol. 7, pp. 93-102. doi.org/10.46648/gnj.424

[3] Priyansha Singh. Pharma Companies In The Metaverse: It Is Now Possible. URL Ehttps://www.oodlestechnologies.com/blogs/pharma-companies-in-the-metaverse:-itisnowpossible/#:~:text=The%20metaverse%20has%20the%20potential,more%20hyper%2Drealistic%2C%20personalized%2C

How to Cite: Athmaja Shetty, Gururaj S Kulkarni, Rakesh Babu SN, Padma M Paarakh. (2023). A review on: metaverse in health care and pharma. Journal of Community Pharmacy Practice (JCPP), 3(1), 1-11. https://doi.org/10.55529/jcpp.31.1.11

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