A NEW AGE IN HEALTH: METAVERSE

SAĞLIKTA YENİ BİR ÇAĞ: METAVERSE

Burhanettin UYSAL [1] Tarık SEMIZ [2]

[1]Bilecik Şeyh Edebali University, Department of Healthcare Management, Bilecik, Turkey
[2]Bilecik Şeyh Edebali University, Department of Management Information Systems, Bilecik, Turkey

ABSTRACT

With the ever-growing technology, people's needs and expectations in both the real and virtual worlds are changing rapidly over time. Metaverse, which has recently entered our lives, is predicted to be a central concept in the health sector, as it is in many other sectors. Many tools, such as virtual reality, artificial intelligence, and digital applications, are already being used in the health sector. By ensuring synchronization with Metaverse in the coming years, it will be possible to create an adaptable platform in all health services using this framework. The aim of this study is to share information in the form of a compilation about the benefits of Metaverse applications in the field of health by referring to Metaverse' conceptual information.

Keywords: Health, Metaverse, Telemedicine, Virtual Reality

ÖZET

Gelişen teknoloji ile birlikte hem gerçek hem de sanal alemde insanların ihtiyaçları ve beklentileri zaman içerisinde çok hızlı değişmektedir. Son dönemde hayatımıza giren Metaverse, pek çok sektörde olduğu gibi sağlık sektöründe de ön plana çıkan bir kavram olacağı öngörülmektedir. Nitekim sanal gerçeklik, yapay zekâ, dijital uygulamalar gibi birçok araç, sağlık sektöründe zaten halihazırda kullanılmaktadır. Bu çerçevede Metaverse ile senkronizasyonun sağlanarak tüm sağlık hizmetlerinde adapte edilebilir bir plaftformun oluşturulması gelecek yıllar içerisinde mümkün olabilecektir. Bu çalışmada Metaverse üzerine kavramsal bilgilere değinilerek sağlık alanında Metaverse uygulamalarının sektöre sağlayacağı avantajlar hakkında derleme türünde bilgiler paylaşılması amaçlanmıştır.

Anahtar Kelimeler: Sağlık, Metaverse, Teletıp, Sanal Gerçeklik

INTRODUCTION

The COVID-19 Pandemic has caused radical changes in people's lives, revealing many changes and innovations, particularly in health services, which are an essential pillar of the service sector. This has aided in the replacement of healthcare as one of the service sectors most impacted by the COVID-19 Pandemic. To minimize this impact, the delivery of some services via digital platforms has made and continues to make a difference in ensuring health efficiency and effectiveness. Digital applications, which play critical roles in difficult times, have demonstrated that some services can be performed entirely in the virtual world during the pandemic. For a time, education services were entirely provided by distance education and are still partially provided by distance education (Leenes, 2007; Camargo et al., 2020; Dhawan, 2020; Schneider and Council, 2021; Hyun-Jae, 2021).

One of the fundamental concepts that has emerged as a result of the COVID-19 Pandemic is digital health. Digital health must be integrated into health priorities and benefit people in ways that are ethical, safe, dependable, equitable, transparent, accessible, scalable, reproducible, interoperable, privacy, secure, and long-term (WHO, 2021). When viewed within the framework of this concept, the effect of digitalization in the health sector is also in question. Semiz (2021) defines digital health as "the use of health information technologies in the diagnosis and treatment processes of patients, in the training of health workers and improving public health, and in monitoring the health status and risk formations of healthy individuals." Digital health is transforming areas like direct care and is becoming a critical enabler of change in the pharmaceutical and biotechnology industries. We live in a digital age, and the COVID-19 Pandemic is hastening healthcare innovation and revealing new business models and opportunities. They are critical innovations for Blockchain and Fungible Tokens (NFTs), which allow people to exchange value on a decentralized network, in addition to telehealth, data sharing, and remote monitoring. Futurists and technologists are also investigating the Metaverse's role in various industries (Thomason, 2021).

Despite the fact that digitalization has had a significant impact on people's lives, it has also had a significant impact on the health sector (Uysal and Ulusinan, 2020). Mobile applications, particularly those used during the COVID-19 Pandemic, played an important role in maintaining public order in the social isolation of individuals. For example, the Ministry of Health's "Hayat Eve Sığar" (HES) application has played a critical role in the fight against the Pandemic (HES, 2022). As demonstrated by this exemplary application, digitalization brings important conveniences into people's lives. People's expectations are shaped and diversified as the digital environment evolves. However, it is clear that we are moving toward a world in which digital change evolves, expands, and is used more effectively.

Keeping up with the technological world is an essential issue for humanity and its future. In particular, the contribution of technologies used in the field of health has a significant share in improving people's health status and bringing them to a better point. Both the training of human resources and the ability of patients to adapt to the growing human resource are required. It is predicted that this adaptation can be achieved with Metaverse. In this study, Metaverse, a new concept, will be methodologically examined through these issues, and the innovations in the health field will be evaluated.

1. METAVERSE CONCEPT

The post-reality universe, the Metaverse, is a combination of physical reality and digital virtuality in a persistent and persistent multi-user environment. Virtual environments are based on integrating virtual reality (VR) and augmented reality (AR) technologies, enabling multi-sensory interactions with digital objects and people (Mystakidis 2022).

The term "metaverse," which has been around for about 30 years, is derived from the words "meta" (meaning "beyond") and "verse," which are derived from the root of the universe (Duan et al., 2021). The Metaverse, which was created as a simulation of the natural world, covers all aspects of humans and society and provides a suitable working platform for researchers in all fields, from health to sports, education to art (Narin, 2021).

1.1. Emergence and Development of Metaverse Concept

The virtual world, which is a concept that needs to be explained before talking about the concept of the Metaverse, contains many concepts, and the emergence of these concepts is described by Dionisio et al. (2013) in five stages. The first phase was handled in the productions of fantastic realities (the movie

"Lord of the Rings" written by Tolkien and the game "Dungeons & Dragons") in the late 1970s. About ten years after the first phase, the second phase was introduced in 1984 by William Gibson's 'Neuromancer,' and 'Habitat' emerged for the Commodore 64 in 1986 and the Fujitsu platform in 1989. The third phase was three-dimensional graphics, open-ended socialization, integrated audio, etc., in the mid-1990s. It is the time of progress. The third phase is the period when Snow Crash is introduced, as mentioned in the paragraph below. The fourth phase occurred in the decade after the millennium. Released in 2009, the production of "Avatar Reality's Blue Mars" is a production in which graphical reality is transferred to the virtual world. In this framework, in this period, Blue Mars marked the expansion of the virtual commercial world such as 'Second Life.' The fifth phase, which started and continues in 2007, is a period that coincides with the introduction of Blue Mars and Second Life and has made decentralized open-source contributions to the development of three-dimensional virtual worlds (Dionisio et al., 2013). It can be said that since 2007, three-dimensional productions in the virtual world (especially the film industry) have entered our lives. Three-dimensional productions are offered as an option in movie screenings in the cinema industry.

The term "Metaverse" first appeared in science-fiction novelist Neal Stephenson's 1992 novel "Snow Crash" to describe the virtual world in which the hero, Hiro Protagonist, socializes, shops, and defeats real-world enemies via his avatar (Lee et al., 2021; Lee, 2021; Narin, 2021; Duan et al., 2021). The recently popular metaverse opens up new possibilities and opportunities for game-based learning while also increasing the interaction of game-based platforms. Aside from the game, the Metaverse environment can be changed and designed according to the people's wishes and desires. As previously stated, people in the real world adopt characters that will represent them permanently in the virtual environment with their avatars, just as they do in the real world. Although some real-world behaviors (such as passing through a wall) are desirable in the Metaverse, they may not be possible. Some arrangements, such as teleporting, flying, and so on, may be exceptional (Getchell et al., 2010).

With the rapidly developing digital economy, the development of the Metaverse is gaining widespread attention (Kim, 2021). Mark Zuckerberg announced that the company's name would be changed to Meta in 2021, indicating that Facebook is more than just a social media platform and that they have the vision to create the next stage in the evolution of the internet (Dijitalage, 2022). Following Mark Zuckerberg's statement, the concept of the Metaverse has become much more important for social networks and has captured the attention of many industries. Some platforms in the Metaverse world have begun to sell virtual lands. A few of these platforms are below (Metaverse properties, 2022; Superworldapp, 2022; Ovr, 2022; Axieinfinity, 2022):

- Decentraland
- The Sandbox
- Somnium
- Cryptovoxels
- Upland
- Superworld
- OVER
- Axie Infinity

With the acceleration of virtual land sales in the metaverse world, some cryptocurrencies such as SLP, HIGH, ALICE, GHST, DAR, MANA, SAND, AXS, TVK, ILV, and PYR have emerged and become well-known in these sales (Binance, 2022). Based on this information, it is believed that businesses that produce and sell any goods or services will want to establish themselves in the Metaverse world.

For the Metaverse, which is the center of attention in the virtual world, many studies have been carried out in many countries and continue to be done. One of them is the outcome of Metaverse-related search traffic. According to these findings, while the term Metaverse refers to metaverse games around the world, the search for this concept in South Korea is primarily focused on metaverse stocks and virtual currency (Lee, 2021). The metaverse, which affects many industries, plays an important role, particularly in the provision of educational services. Throughout human history, educational services have been provided, first in the form of the invention of letters, then in the form of group education, and finally in the form of online courses. It is predicted that it will be a critical education model in the form of a new super-learning model that will allow the development and acquisition of personal talent by

entering a completely different dimension with technologies such as artificial intelligence, virtual reality, and Metaverse, which are a revolutionary model for humans (Hyun-Jae, 2021).

Figure 1. Featured Use Cases for Metaverse (Citivelocity, 2022)

As illustrated in Figure 1, Metaverse has already begun to be active in a variety of areas, including concerts, shows, digital entertainment events, virtual advertising, e-commerce, virtual cities, and public services, as well as intelligent production, recruitment and education, and health. Because health services are also considered a public good, it is clear that it has found a home in the Metaverse to provide a unified service to society. This situation suggests that some virtual health platforms, which will be used more widely in the Metaverse as health services become more digitalized, may emerge.

According to the findings of this study, the Metaverse concept has emerged as the most popular in recent times. It is a critical tool for businesses in Metaverse for cost reduction. Building on land in the concrete world, establishing a facility, administrative expenses, labor expenses, machinery equipment expenses, and general production expenses are all necessary expenses. General administrative costs are minimal. Capable of performing the role. The cost of land in the concrete world is well known to be much higher than the cost of land in the Metaverse.

With the power of developing technology, the metaverse, which is the product of the idea of creating a virtual and twin world, has become a phenomenon in every field today. The Metaverse provides an environment that extends from experiences that individuals are unable to have due to time and place constraints to absolute reality in a variety of sector (Kalkan, 2021).

2. METAVERSE IN HEALTH

The structure of cyber-physical systems, which appear as the main component in the development of Industry 4.0 and contribute to production processes, bridges the natural and virtual worlds (Kamer and Sancar, 2022). In the Metaverse, some applications are discussed in terms of health. Exercise, for example, will contribute to the development and improvement of an individual's overall health status (Kalkan, 2021). Metaverse in Health encourages additional innovation and the development of advanced clinical decision support. As more advanced AI methodologies become available, Meta-Learning will be critical to the success of a Health Metaverse. Physicians can communicate with the following people in Health Metaverse: They can remotely control patients via Health Metaverse and transform patient-health data into a digital virtual environment. Over time, they can explain the patient's condition and treatment to the patient or patient relatives. Converting biological signals from medical devices into digital form enables physicians to care for patients in intensive care. It enables nurses to monitor the patient's body in real time while interacting with family and friends to overcome the limitations of physical activity. Physicians can consult with other physicians about their patients' diagnoses in a virtual environment (Chen and Zhang, 2022).

As previously stated, many areas are entering the Metaverse era. While the COVID-19 Pandemic is still ongoing, there has been a rapid transition to the Metaverse world that dates back 30 years. Indeed, according to the World Economic Forum (2016), the introduction of digital services will be one of the most critical factors in transforming healthcare over the next decade. As the Metaverse evolves, technologies such as Artificial Intelligence, Virtual Reality, Augmented Reality, Internet of Medical Devices, Web 3.0, intelligent cloud systems, and so on will have a high potential for health services.

Some services (particularly imaging and laboratory services) in the health sector can be made ready for use by health service stakeholders in a virtual environment with digital technological opportunities. Furthermore, the use of virtual realities within the framework of digital possibilities in the Metaverse world is likely to make the work of healthcare professionals producing services easier.

When the literature on the Metaverse in health services is examined, it is discovered that there are more studies in areas such as computer science, engineering, education, and psychology; however, new studies on Health and many other fields have been conducted (Damar, 2021).

2.1. Uses of Metaverse in Health Care

The following are some of the applications of Metaverse in healthcare (News Medical Life Sciences, 2022).

2.1.1. In Medical Education

Current medical education has shifted away from memorizing facts and toward learning how to use facts to develop an appropriate management strategy when confronted with a specific patient. This training consists of problem-solving skills, communication skills, and VR-based learning (News Medical Life Sciences, 2022). Because medical education is a costly field, it is anticipated that the use of virtual reality in the educational process will significantly contribute to cost reduction and education efficiency. At the same time, this situation may reduce the rate of erroneous medical malpractice among newly graduated physicians who have begun working life.

Facebook, a platform that works with training hospitals and provides services in delivering virtual reality-based medical education tools to users, offers significant support to preventive health services by establishing a team (Thomason, 2021).

Figure 2. Virtual Reality in Health Education (Trade Med, 2022)

2.1.2. In Medical Services

Physicians are recognized as a competent professional group in medical services, which are an important part of the health-care production process. The more practice-oriented medical education there is, the more efficient physicians will be in providing medical services. Medical students are educated using virtual reality facilities, and the use of virtual reality facilities in the healthcare service production process is seen as one of the factors that can improve service quality and patient satisfaction. Many positive effects can be seen, such as shorter patient wait times, optimal and rational patient examination time, and shorter interventional procedures.

Figure 3. Representation of a Virtual Reality Doctor's Consultation (Mesko, 2022)

2.1.3. In the Diagnosis and Treatment of Diseases

Basic medical sciences, internal medical sciences, and surgical medical sciences all work together to diagnose and treat diseases. In this regard, imaging and medical laboratory services play a critical role in disease diagnosis. For imaging service provision, software systems are used for transferring and storing images taken from magnetic resonance (MR) or tomography devices installed in hospitals in two-dimensional and three-dimensional formats. DICOM (Digital Imaging and Communications in Medicine) software is a medical imaging and communication software system (EKAP, 2022). DICOM, which includes a variety of numerical variables in technical terms, can circulate patient data over virtual networks; it serves as an important intermediary, particularly for physicians who request a consultation for their patients (Yorulmaz and Demirhan, 2022).

2.1.4. Pain Management

Virtual reality has also been found to be beneficial in pain relief and rehabilitation studies of patients with severe pain, such as those recovering from skin grafting, cleaning burn wounds on a daily basis, or making daily injections more bearable (News Medical Life Sciences, 2022). It has been discovered that the virtual reality application, which assists burn patients by providing a non-pharmacological method, reduces the painful treatment time, hospitalization time, and wound healing time. It plays an important role in reducing pain and anxiety in patients (Kaya and Karaman Özlü, 2022).

2.1.5. Physical therapy and rehabilitation

There are numerous studies in the literature on virtual reality in the field of physical therapy, and it is expected that these studies will significantly support Metaverse studies. Aran et al. (2014) are one of them. Işık et al. (2021) created a game-based virtual reality application by detecting patients' movements during the rehabilitation process and immediately beginning the early diagnosis and rehabilitation process for patients with hemiplegia, i.e., partial paralysis, without affecting other body functions. It was expected to make a significant contribution to the recovery of hemiplegia patients. Metin Ökmen et al. (2013) discovered that virtual reality therapy is a beneficial treatment method used in cerebral palsy rehabilitation and improves mental adjustment in another study.

2.1.6. Addiction

Medical VR can also aid in the recovery from substance addiction by employing gradual exposure techniques and coaching on how to respond to addictive urges. The use of the patient's environment in the simulated situation can assist him in practicing resisting common triggers before being exposed to the real thing (News Medical Life Sciences, 2022). On the other hand, there are concrete disadvantages to conducting the treatment process in an environment where people who abuse substances live. Optimal and efficient treatment management can be achieved by ensuring that addicted individuals fully participate in the treatment process of these negatives.

2.1.7. Health Education

Virtual reality can help patients understand their medical condition by providing a clear and detailed reconstruction of the organs and tissues of interest. This improves the patient's understanding of treatment principles and increases his or her satisfaction with the medical intervention (News Medical Life Sciences, 2022). Based on the evolution of education processes (as a new education model), it is estimated that providing health education with Metaverse, which can be a super education model, will be possible within the next few years. It will be more effective than ZOOM, a popular application, particularly in the COVID-19 Pandemic (Hyun-Jae, 2021).

Figure 4. Healthcare in Metaverse at Seoul National University Bunag Hospital (Soo-Youn, 2022)

Universities like Seoul National University Bunag Hospital (SNUBH) can already train medical personnel in intelligent operations. The Asian Cardiovascular Society and Thoracic Surgery (ASCVTS) used the metaverse platform to train more than 200 people in lung cancer surgery in 2021 (Citivelocity, 2022).

There are approaches that using Metaverse, oral health education can be given to the society on behalf of the public benefit by institutions serving in both the public and private sectors (Albujeer and Khoshnevisan, 2022).

Metaverse is thought to be capable of actively participating in the analysis of information asymmetry, which is one of the features of health services, in order to increase patients' knowledge level. It is predicted that in the future, patients will be able to realize their health-related problems, which they usually query from some search platforms via Metaverse.

2.1.8. Fitness

Virtual reality has been used in a plethora of fitness applications to increase physical activity on a daily basis by making it more enjoyable. Physical exercise is either gamified, with goals and rewards, and feedback on movements, or it is made more enjoyable by immersing the user in a beautiful setting (News Medical Life Sciences, 2022). Individuals can create healthy living conditions and be more motivated in various environments with their opportunities in this situation.

2.1.9. Marketing

Marketing in healthcare is an important aspect of modern medicine. Virtual reality enables physicians to share their knowledge with patients and communicate their experiences nonverbally to physicians, resulting in powerful and effective communication as well as increased awareness of the illness and potential interventions.

Individuals in the COVID-19 pandemic process have begun to exhibit different behavioral models in response to new living conditions. This is thought to improve individuals' adaptation to technological innovations in a new era where time to go out is limited and time spent without physical activity increases.

According to Vintage Market Research's most recent analysis of the Global Augmented and Virtual Reality in Healthcare Market, increased consumer awareness drives market growth. The total Global Augmented and Virtual Reality in Healthcare Market is expected to reach $18.7 billion by 2028, up from $1.5 billion in 2021, owing primarily to the increasing penetration of connected devices in the healthcare industry (Vantage Market Research, 2022). According to these figures, the metaverse market

in Health is expected to have a large network within the framework of medical technological developments in Health.

2.1.10. Digital Patient

The traditional definition of the patient has shifted as a result of digitalization. Furthermore, it has been dealt with under three headings. The first is the digital patient, followed by the virtual patient, and finally by the actual patient. A digital patient is defined as the digitization of patient data (such as clinical information, imaging information, and transcripts) and its storage and archival in the patient's digital records. A virtual patient's mental rehabilitation planning can be aided by digital treatment planning and screen simulation (computer-aided design). If the patient is real, treatment procedures can be aided by computer-aided (CAM) devices that use 3D printing technology (Vandenberghe, 2018).

Digital Patient   Virtual Patient   Real Patient
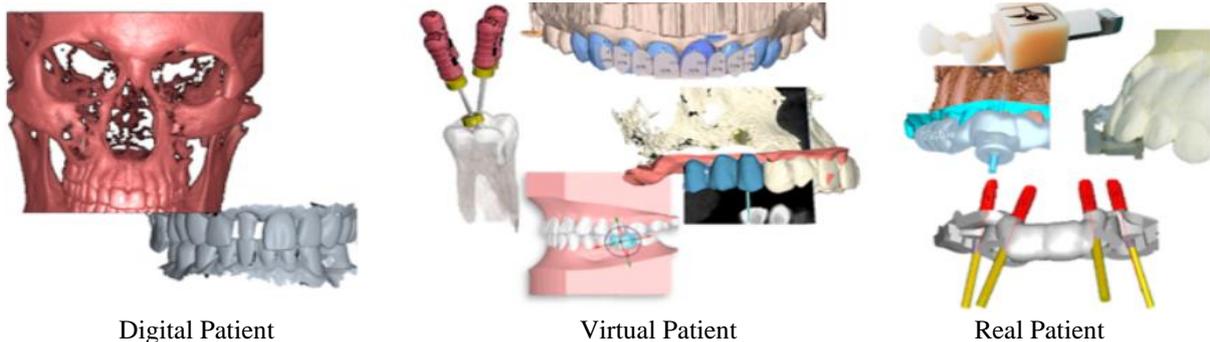
Figure 5. Example of Digital Treatment Workflow in the Dental Field (Vandenberghe, 2018).

CONCLUSION

Today, the Metaverse concept, this study, which reveals that there are and will be various revolutionary developments in Health, aims to draw the attention of those involved in the health sector. The concept of the Metaverse is thought to be included in many fields of activity in the health sector; various studies on this subject are ongoing, and it will establish an integrated relationship with many other fields.

Despite these advancements, metaverse applications in the field of health are still in the early stages of development. VR and Metaverse will most likely be used more and more in the field of health in the future. On the other hand, the number of large-scale studies demonstrating the benefits of the Metaverse remains low. Furthermore, it is believed that in the early stages of using Metaverse in the health field, learning may be insufficient and potentially dangerous to the patient.

In light of recent developments in the virtual world, and as previously stated, the Metaverse in health will play an important role in the diagnosis and diagnosis parts of the health service production process, resulting in a radical shift. Studies on the early Metaverse appear to be more focused on games and entertainment. Metaverse, which healthcare providers use, is expected to make it a new center of attraction for online users (Chen and Zhang, 2022).

On the one hand, the Metaverse concept becomes essential for the delivery of health services; on the other hand, it is likely to reveal some developments in terms of payment instruments for health insurance organizations. As it is known, there are many alternative cryptocurrencies used for Metaverse. In the second part, some of these cryptocurrencies are mentioned. However, it should be ensured that health insurance organizations accept the crypto money they will use as a means of payment in this regard. They should be allowed to legally present this situation to their customers, namely their patients.

On the one hand, while the Metaverse concept in Health has numerous benefits, the concepts of privacy in the virtual world make the Metaverse concept in Health more meaningful and vital. Legal arrangements should be made as soon as possible in this regard. Furthermore, one of the most critical issues for Metaverse's future is ensuring global security of virtual platforms and protection against cyber-attacks. As a result, it is anticipated that the Metaverse concept will play an important role in the field of health, and that advancements in the literature may provide various opportunities to the health sector and its environment. It is recommended in this area that both health care providers and healthcare recipients contribute to more detailed scientific research on the Metaverse, both qualitatively and quantitatively.

In the past, if someone said, "One day, algorithms, machine learning systems, and robots will be the greatest helpers to practitioners," We would not have believed it; we might not have understood it. With the use of Metaverse in medicine, examinations can be done remotely online; in cases and diseases that do not require physical control, physicians will be able to meet with physicians without having to go to the hospital, and they will be able to perform various surgeries regardless of location, time, or physical ability, without the need for physicians and patients to travel between countries.

Although Metaverse is regarded as a good platform for healthcare services, future studies should look into its potential drawbacks.

Conflict of Interest
The authors report no actual or potential conflicts of interest.

Author Contributions
All authors contributed equally.

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