Metaverse Applications in Healthcare: SWOT Analysis

Nurgül ERDAL*, Ali ÖZBEK**, Barış GELAL***

Abstract

Aim: This study aims to introduce the use of virtual reality and augmented reality technologies in the health field and to reveal the strengths, weaknesses, opportunities and threats of Metaverse through SWOT analysis.

Method: A detailed literature review was conducted on the subject, Metaverse studies in healthcare were examined, and the strengths, weaknesses, opportunities, and threats of metaverse applications in healthcare were revealed through SWOT analysis.

Results: The strengths of Metaverse in health services include all people, not a specific group. It has an important place in the economy and will positively affect individual and social health. Diagnosis, treatment and control of patients will be easier, their recovery will be accelerated and hospital-acquired infections will be prevented. Its weaknesses are that it requires internet access. It is one of the biggest factors in the inadequacy of Research & Development studies. The low literacy rate of the society and the reluctance to use technological tools are important. As for the opportunities, investing in Metaverse technologies provides a competitive advantage. Health and medical education will become easier and the harm to the patient will be minimized. As for the risks, the innovation of Metaverse applications may lead to some ethical problems.

Conclusion: Digital universal health system integrated with healthcare reduces the high costs of therapeutic healthcare services, improves public health and increases quality of life.

Keywords: Healthcare, health management, artificial intelligence. SWOT, Metaverse.

Sağlık Hizmetlerinde Metaverse Uygulamaları: SWOT Analizi

Öz

Amaç: Bu çalışma, sanal gerçeklik ve artırılmış gerçeklik teknolojilerinin sağlık alanında kullanımını tanıtmak ve Metaverse'nin SWOT analizi ile güçlü, zayıf yönlerini, fırsatlarını ve tehditlerini ortaya koymaktır.

Yöntem: Konu ile ilgili ayrıntılı literatür taraması yapılmış, sağlık hizmetlerinde Metaverse çalışmaları incelenmiş ve SWOT analizi ile sağlık hizmetlerinde metaverse uygulamalarının güçlü ve zayıf yönleri, fırsat ve tehditleri ortaya çıkarılmıştır.

Bulgular: Metaverse'in sağlık hizmetlerinde güçlü yönleri, belirli bir grubu değil, tüm insanları kapsar. Ekonomide önemli bir yere sahiptir, bireysel ve toplumsal sağlığı olumlu yönde etkileyecektir. Hastaların teşhisi, tedavisi ve kontrolü daha kolay olacak, iyileşmeleri hızlanacak ve hastane kaynaklı enfeksiyonlar önlenecektir. Zayıf yönleri ise, internet erişimini gerekli kılmasıdır. Ar-ge çalışmalarındaki yetersizliğin en büyük etkenlerinden biridir. Toplumun düşük okuryazarlık oranı ve teknolojik araçları kullanma konusundaki isteksizlik önemlidir. Fırsatlar ise Metaverse teknolojilerine yatırım yapılması rekabet avantajı sağlar. Sağlık ve tıp eğitimi daha kolay hale gelecek ve hastaya verilen zarar en aza indirilecektir. Riskleri ise, Metaverse uygulamalarının yeniliği beraberinde bazı etik sorunlara yol açabilecektir.

Derleme Makale (Review Article)
Geliş / Received: 24.06.2024 & **Kabul / Accepted:** 24.02.2025
DOI: https://doi.org/10.38079/igusabder.1676432
* Asst. Prof., Istanbul Gelisim University, Faculty of Economics, Administrative and Social Sciences, Logistics Management, Istanbul, Türkiye. E-mail: nerdal@gelisim.edu.tr ORCID https://orcid.org/0000-0002-2961-3906
** Asst. Prof., Istanbul Gelisim University, Faculty of Economics, Administrative and Social Sciences, Department of Economics and Finance, Istanbul, Türkiye. E-mail: aozbek@gelişim.edu.tr ORCID https://orcid.org/0000-0001-9183-6513
*** Dr., Purchasing Director, Istanbul Gelisim University, Istanbul, Türkiye. E-mail: bgelal@gelisim.edu.tr ORCID https://orcid.org/0009-0002-5017-663X

Istanbul Gelisim University Journal of Health Sciences (IGUSABDER) is indexed by TUBITAK ULAKBIM TR Index.
Web site: https://dergipark.org.tr/en/pub/igusabder
Contact: igusabder@gelisim.edu.tr

Sonuç: Sağlık hizmetleriyle bütünleşmiş dijital evrensel sağlık sistemi, terapötik sağlık hizmetlerinin yüksek maliyetlerini azaltır, halk sağlığını iyileştirir ve yaşam kalitesini artırır.

Anahtar Sözcükler: Sağlık hizmetleri, sağlık yönetimi, yapay zekâ. SWOT, Metaverse.

Introduction

Nowadays, rapid changes and developments in technology and digitalization also affect the healthcare sector. Metaverse, which is among the popular topics of recent days, is developing in a way that will take the provision of health services beyond dreams. In health, Metaverse aims to provide digital health solutions using both AR and VR technologies. Thanks to groundbreaking artificial intelligence in the globalizing world, it is possible to diagnose diseases, perform medical scans, read records, develop drugs, perform robotic surgery, etc. applications have become possible and have been put into practice. Metaverse's developments in the field of healthcare will make positive contributions to both patients and healthcare professionals. Metaverse, a post-reality universe, merges physical reality and digital virtuality in a persistent and constantly multi-user environment. In other words, the Metaverse can be considered a parallel universe where all digital worlds are combined, and everything you can do on the internet is collected in a single space. Virtual environments are created in the Metaverse through the integration of virtual reality (VR) and augmented reality (AR) technologies. Thus, they engage in multisensory interactions with digital objects and people thanks to the Metaverse[1]. AR and VR technologies are widely used in the world and investments in these technologies are increasing rapidly. In addition, the use of technology increases success in education and enhances learning processes[2]. Thus, great advances will be made in human and animal health, improvements in health protection, treatment, and care processes will be made and daily activities will be easier.

Today, AR (Augmented Reality) and VR (Virtual Reality) technologies are used in almost all sectors. With Metaverse applications in health services, medicine and medical-related education and training, disease and drug research, patient care, rehabilitation services, patient examination, and hospital management are possible[3]. Businesses that follow these change and development processes quickly will be able to take their place in the market and gain a competitive advantage. Health businesses that fall behind technology are doomed to disappear[4].

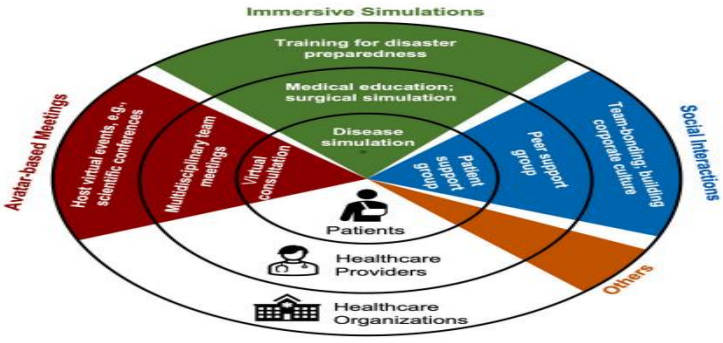
This study includes examining the applications of Metaverse, which is a product of technological developments in the world, in the field of health with Strength, Weakness, Opportunity, and Threat (SWOT) analysis. In the first part of the research, information about Metaverse is given. The emergence of Metaverse and where it is used are mentioned. In the second part, what are the Metaverse applications in health services are explained. In the third part, information about the purpose of the study, method and SWOT analysis is given. In this section, Metaverse applications in health services are evaluated as strengths, weaknesses, opportunities and threats. Discussion and suggestions are made in the conclusion section. Implementation in the Metaverse is necessary for the development of the global health ecosystem.

Istanbul Gelisim University Journal of Health Sciences (IGUSABDER) is indexed by TUBITAK ULAKBIM TR Index.
Web site: https://dergipark.org.tr/en/pub/igusabder
Contact: igusabder@gelisim.edu.tr

Metaverse in Health Ecosystems

The healthcare ecosystem consists of patients, physicians, various healthcare professionals, allied healthcare practitioners, government agencies, academic institutions, non-governmental organizations, and companies. The information flow from these actors combines to determine the target. The information collected here is combined[5]. The health ecosystem consists of three components. The first component is the patient, the second component is the healthcare professionals, and the third component is the institutions or organizations. With Metaverse, Avatar-based meetings, immersive simulations, social interactions and other applications can be taken to different dimensions and a healthcare ecosystem can be created. As seen in Figure 1, patients can participate in virtual consultations in the healthcare ecosystem with Avatar-based meetings. Online consultants are inferior in communication and interaction to Metaverse. VR and AR-based virtual diagnosis and treatment tools are becoming more tangible through avatars that reflect behavior [6].

Figure 1. The interoperable healthcare ecosystem in the metaverse [6].



It is the facilitation of human-computer MDT, which aims at consultation based on human-computer communication and interaction when applied to the Metaverse regarding the clinical management of a particular patient, involving groups of experts with various specialties. Here, comprehensive diagnosis and treatment plans that combine doctors' expertise, computerized data, and artificial intelligence-derived knowledge and guidance provide great benefit to the patient.

Metaverse Applications in Healthcare

Metaverse (virtual world) includes many technologies such as blockchain technology, cloud, and artificial intelligence. All virtual world applications realized with virtual and augmented reality and defined as extended reality are located in the Metaverse[7]. Table 1. Usage areas of Metaverse are seen) wledge and guidance provide great benefit to the patient. In the field of Metaverse Health, radiology, pain management, plastic surgery, healthy living, pychology, and health (medical) education are used[8,9].

Istanbul Gelisim University Journal of Health Sciences (IGUSABDER) is indexed by TUBITAK ULAKBIM TR Index.
Web site: https://dergipark.org.tr/en/pub/igusabder
Contact: igusabder@gelisim.edu.tr

Table 1. Key applications of metaverse in the healthcare industry [3]

The Healthcare Industry	Key Applications
Metaverse applications in radiology	X-ray and computed tomography, which have an important place in diagnosis and treatment, are necessary for planning the treatment of patients. In this process, Metaverse technology began to be used in the field of radiology. The use of Metaverse in the radiological segment is expected to contribute more to visual abilities. Radiologists will be able to see dynamic images in more detail thanks to the Metaverse. Disease, injury, fracture, mass, etc. Can be better diagnosed. Well-diagnosed images allow diseases to be treated more easily. In addition, medical images in 3D format can be evaluated by other healthcare professionals and collaboration will occur between different stakeholders[3].
Metaverse Applications in Pain Management	Metaverse Applications in Pain Management: In hospitalized patients, those with chronic pain, burns, etc. Metaverse applications can be used to relieve pain complaints and manage pain in patients with diabetes. Shortly, VR will be seen as the most promising and powerful noninvasive tool to treat and manage pain. With VR, pain can be mentally removed and it prevents it from sending signals to the brain[3]. This is a good example of drug-free pain relief techniques. VR Pain management procedures can help reduce fear and anxiety, especially among children and the elderly. In addition, side effects of medications are prevented[10] VR; In case of natural disasters, accidents, and infectious diseases, healthcare providers can provide pain management by creating an educational environment. Glasses, gloves, headphones, etc. can be worn on the body and work with VR technology infrastructure. Games that can be played with devices can also provide pain-reducing effects because they distract attention[11].
Metaverse Applications in Plastic Surgery	Beauty and aesthetic trends change every day. In the coming years, digital images, Metaverse clinics, virtual aesthetics, agelessness, and genderless face concepts will enter our lives. Instead of the uniform concept of 'ideal beauty', personally designed applications will come to the fore[12]. Everyone will focus on touches that will proudly reveal their uniqueness. As the world becomes more global, borders disappear; people are more embracing their ethnic roots and the characteristics that make them different. This brings with it a multinational understanding of aesthetics. This trend will continue further in the future[13].
Metaverse Apps for Fitness and Healthy Living	The world of good living, which is in the mind and center of the consumer, is preparing to offer new technologies that can better improve people's health. Many companies are launching new products that can improve people's health and lives. Additionally, “unprecedented new synergies” are beginning to emerge between the technology, wellness, and health industries to create the wellness Metaverse. Health sectors, including fitness, beauty, healthy eating, mental health, wellness tourism, wellness real estate, and spas, aim to impact people with new technologies and virtual worlds that provide a much more immersive experience and revolutionize the way health is delivered to global consumers. In terms of fitness and wellness, the Metaverse can be used to provide personalized and more effective workouts under the guidance of virtual trainers[14].
Metaverse in Surgical Applications	Nowadays, AR and VR technologies are used in various surgeries. Augmented reality combines information from multiple imaging sources, working more harmoniously with the surgical workflows of surgical personnel and the sterile field of the operating room[15]. Thanks to robotic surgery via Metaverse, direct surgical intervention will be possible in case of an emergency, regardless of location and time[16]. The removal of cancerous cells and tumor tissues or the most complex spinal system surgical interventions can be performed with robot

Istanbul Gelisim University Journal of Health Sciences (IGUSABDER) is indexed by TUBITAK ULAKBIM TR Index.
Web site: https://dergipark.org.tr/en/pub/igusabder
Contact: igusabder@gelisim.edu.tr

	support[17]. When surgeons use augmented reality glasses, they will be able to perform surgeries more accurately and easily at the right angle[18].
Metaverse Applications in Health Education	Literature shows that regardless of department, VR-assisted training is much more effective than traditional training. It minimizes the difficulty of application, especially in applied training, and can easily provide experiences that are difficult to experience. Students receiving health education receive practical internship training in hospitals. However, these trainings may also have incomplete aspects. Medical experiences gained through the computer-assisted, tactile feedback VR simulator training system through VR glasses can be more useful than traditional training. Students can create the medical events they want to experience in the Metaverse universe and gain experience with these medical events. Apart from this, the use of AR technologies in education is also very common. For example, the HoloAnatomy application, used by Microsoft and Cleveland Clinic to visualize the human body easily and effectively, offers an up-to-date perspective on the biology of the human organism. Thanks to this application, which will be a revolution in medical education, medical students will be able to work on a 3D human body hologram instead of 2D pictures. Another example in the field of health is VR-based pharmacy training. In this application produced thanks to VR glasses technology, you can receive training through simulation in a 3D pharmacy environment, pharmacy. They can gain experience in management and patient communication[15].
Metaverse Applications in Psychiatry	Metaverse Applications in Psychiatry: Metaverse can be especially beneficial in psychiatric therapies. Environments can be personalized according to patients. Similarly, VR is already used by psychologists and psychiatrists in avoidance therapy by creating safe environments in which patients can interact with situations that cause their anxiety, where every aspect of the interaction can be closely monitored and controlled[17]. It is valid for the treatment of "Social Phobia" in psychiatry. Virtual Reality Exposure Therapy is a psychotherapy method in which individuals are confronted with the stimuli they fear and worry about in three-dimensional virtual environments. Virtual reality exposure therapy is used to treat phobias, anxiety disorders, addictions, and post-traumatic stress disorder[15]

Table 1 shows the Basic Applications of Metaverse in the Health Sector. In the future, advances in information technology will add more applications to the health system.

Studies on Metaverse in The Field of Health

Metaverse has the power to impact digital twins, blockchain and digital hospitals. These three technologies can create new treatment methods, reduce treatment costs and significantly improve patient outcomes. Digital twins are digital copies of human physiology constructed digitally with data at both individual and societal levels. Since these are simulations, they can offer solutions without endangering individual and public health. Blockchain ensures that data is stored and transferred securely. Digital Hospitals' infrastructures extend beyond their physical infrastructure. Intelligent information systems, virtual reality (VR), augmented reality (AR), sensors, facility control systems and medical device control systems are present in a digital hospital. The technology team assists in the implementation and management of health services[15]. The number of studies conducted has increased with the spread of Metaverse applications in healthcare services.

Istanbul Gelisim University Journal of Health Sciences (IGUSABDER) is indexed by TUBITAK ULAKBIM TR Index.
Web site: https://dergipark.org.tr/en/pub/igusabder
Contact: igusabder@gelisim.edu.tr

Table 2. Studies on Metaverse in Healthcare[6,19-31].

Author	Year	Subject	Journal
Perez et.al[19].	2022	Establishing Standard Operating Procedures in a Precision Medicine Laboratory	Journal of Molecular Diagnostics
Saxena & Malviya[20].	2023	Printable Drug Delivery Systems	Current Pharmaceutical Design
Jung et.al[21].	2023	Metaverse for Service İndustries:	Computers in Human Behavior
Wider et.al[22].	2023	Metaverse Chronicles: A Bibliometric Analysis	International Journal of Human–Computer Interaction,
Moztarzadeh et al[23]	2023	Metaverse and Healthcare: Machine Learning	Bioengineering,
Gandi et al[24].	2023	What can the Metaverse do for Urology	Urologia Journal.
Randazzo et.al[25].	2023	Metaverse in the Field of Urology	World Journal of Urology
Nawaz et.al[26].	2023	Supporting Vaccine Confidence in Metadata	Digital Health
Li et.al[6].	2024	The Next Generation of Healthcare Ecosystem in the Metaverse	Biomedical Journal
Xiao et.al[27].	2024	Metaverse's relationship to ethical issues	Humanities & Social Sciences Communications
Skalidiset al[28].	2024	Metaverse-Based Cardiac Magnetic Resonance Imaging Simulation	Future Cardiology
Erginet e al[29]	2024	Nurses' Knowledge, Attitudes and Awareness about the Metaverse	BMC Nursing
Della Corte et.al[30].	2024	Pediatric Urology Metaverse Surgeries	Surgeries
Habbal et.al[31].	2024	Artificial Intelligence Trust, Risk and Security Management	Expert Systems with Applications

As seen in Table 2, a lot of research has been conducted on Metaverse applications in healthcare in recent years. The table above was created in line with the literature.

Material and Methods

Purpose of The Study

The health sector is among the most developing sectors. What distinguishes health services from other services is that they are different, important, and versatile. In healthcare delivery, with the advancement of technology, the structure of the service has changed and digital transformation has occurred. Institutions that could not keep up with this transformation had to withdraw from the fierce competition environment. This study evaluates the reflections of Metaverse, an indispensable element of the future, in the health sector, and reveals the strengths, weaknesses, opportunities, and threats of Metaverse.

Istanbul Gelisim University Journal of Health Sciences (IGUSABDER) is indexed by TUBITAK ULAKBIM TR Index.
Web site: https://dergipark.org.tr/en/pub/igusabder
Contact: igusabder@gelisim.edu.tr

Method of the Study

The study, was carried out by examining scientific studies in various databases and publications published on social media between 01.01.2025 and 01.03. 2025. A search was made with the keywords Metaverse, virtual universe, digital health, digital technology, virtual reality, and augmented reality, published in Google Academy, Web of Sciences, EBSCO, ULAKBİM, Science Direct, Scopus, and SOBIAD databases. Using the secondary data obtained from these studies, Metaverse SWOT in health was evaluated.

SWOT

One of the most important topics of strategic management is SWOT analysis. It is used to evaluate the internal and external environment of the business. It began to be widely used in business management, especially in the 1970s. SWOT analysis is also an important tool for strategic planning. It is also used as a planning tool[32-34]. SWOT word; it consists of the initial letters of four English words: advantages (strengths), disadvantages (Weaknesses), opportunities (Opportunities), and threats (threats)[34]. SWOT Analysis; it is accepted as an analysis method applied to identify the strengths or weaknesses of an institution, sector, investment, country, or region arising from the characteristics of the institution, sector, investment, country, or region, and to identify opportunities and threats arising from expected or unexpected future situations. Internal elements for the analysis to be successful: Strengths, weaknesses, and external elements; It is important to identify opportunities and threats well[35].

Figure 2. Research model

Figure 2 shows the SWOT analysis and research model of metaverse health applications. The research model was prepared in line with the literature.

Results

Metaverse's use in the health sector is shown in Table 3 by SWOT analysis.

Istanbul Gelisim University Journal of Health Sciences (IGUSABDER) is indexed by TUBITAK ULAKBIM TR Index.
Web site: https://dergipark.org.tr/en/pub/igusabder
Contact: igusabder@gelisim.edu.tr

Table 3. SWOT analysis of metaverse applications in healthcare

STRENGTHS OF METAVERSE HEALTH APPS	WEAKNESES OF METAVERSE HEALTH APPS
• Metaverse is a multi-user collaboration system that includes children, elderly, and disabled people, regardless of race, gender, religion, and age. Not a specific group, but anyone can be found in the virtual World[36]. • Entrepreneurship within the metaverse consists of social interaction through digital avatars[37]. Statistical reports show that businesses globally are investing billions of dollars in the metaverse[38]. •In the metaverse, users are less limited by time and space and can exist in multiple places through avatars. Since geographical borders will disappear, it will be possible to easily reach a doctor and get an examination from anywhere in the world. Additionally, thanks to the necessary equipment, surgical operations can be performed in health institutions in the region[39]. • With distance learning, many applications will be realized, health and medical education will be easier, applications will be made on model errors made in live animals will be reduced, and learners' skills such as self-directed learning and cooperative learning will increase[40]. • The health sector is a sector that requires teamwork. Meteverse Communication will accelerate interaction and teamwork processes and increase the quality of communication and interaction[41]. • XR technologies, including virtual, augmented, and mixed realities, increase the efficiency and quality of health education. Using these technologies allows medical professionals to practice in a safe space without fear of some type of loss or negative consequences and can provide highly interactive learning at a lower cost[42]. • Human cadavers and physical models can only represent a limited range of disease pathologies and are used in medical schools as a solution to issues such as inadequate measurement of the true range of individual variation. Thanks to this solution, multiple pathologies and subtle anatomical variations can be easily added to virtual cadaver representations with Metaverse technologies[43]. • By creating a dynamic real-time digital replica of the human body, new techniques, tools or therapies can be applied to the digital twin, minimizing risk to the patient[44]. • In clinical trials, principal investigators are not available at all times and in all settings to monitor the research or guide the team. Clinical research will be easier thanks to the metaverse[45]. • AR (augmented reality) and VR (virtual reality) technologies will facilitate hospital management[10]. • Meteverse enables real data analytics to benefit decision-making and policy-making. By opening existing digital health applications to the Metaverse universe, large data pools can be obtained and health needs can be determined more accurately and rationally[46]. • Integration of artificial intelligence technology into surgical operations may lead to disability or death It contributes to the	• Adequate internet access is required for the Metaverse. Poor internet access slows down or prevents meteverse apps from happening[50]. • Inadequacies in digital transformation in developing countries and insufficient accessibility to the public Insufficient R&D on the Metaverse[51]. • Health education students are not ready for digital transformation and there is no local infrastructure. • Low health literacy of the society[51]. • Cyber security breaches[51]. • Perception disorders between the virtual world and the real World[52]. • Metaverse may reduce privacy because it reveals people's behavior and threatens privacy and security[53]. • Too much use of digital media can lead to psychological disorders, mental disorders, and aggression [54].

Istanbul Gelisim University Journal of Health Sciences (IGUSABDER) is indexed by TUBITAK ULAKBIM TR Index.
Web site: https://dergipark.org.tr/en/pub/igusabder
Contact: igusabder@gelisim.edu.tr

prevention of human-related medical errors that may result in provides savings[47]. • One of the most important opportunities that Metaverse will offer to healthcare services is the ability to allow individuals to access healthcare services through the virtual universe, ensuring identity confidentiality. In this way, there will be no stigmatization since the identity of the patients is unknown[48]. • There are attempts to provide physical therapy services by developing interactive games that develop hand and wrist joints using game sensors that detect movement. It is expected that these initiatives will be furthered with the integration of gaming and healthcare as a field within the Metaverse[49].	
OPPORTUNITIES OF METAVERSE HEALTH APPS	**THREATS OF METAVERSE HEALTH APPS**
• Metaverse provides significant opportunities for the creation of new business areas[50]. • It provides significant opportunities for healthcare sector investors[51]. • It reduces health care and treatment costs[11]. • Metaverse will provide significant convenience in hospital and healthcare institution management, medical education, patient diagnosis, treatment, and follow-up[51]. • Metaverse evaluates alternative treatment methods, presents different scenarios, and helps find the most appropriate treatment[55]. • Metaverse's large data collection feature facilitates the creation of a global health organization. The increase in Metaverse applications in health leads to the advancement of technology and wearable technologies to come to the fore[23]. • The government may provide various incentives for investment in health technologies[56]. •It prevents hospital infections, reduces human errors, and reduces the workload of employees[57]. • Surgical robots will learn to perform surgery on humans and perform difficult procedures on sensitive areas, cancerous tumors, and complex spine surgeries. This will be possible much more easily with robotic support [13]. • Diseases that do not require physical control opportunity to see a doctor without going to a health institution. will be able to provide. This will provide time and cost advantages[58]. •Through Metaverse, healthcare professionals will be able to easily empathize with the elderly, and treat and rehabilitate them[57]. •Thanks to the Metaverse, infectious diseases can be prevented and treated without infecting others[58]. • Prevents violence against healthcare workers[58].	Since Metaverse is a new application, there are some ethical issues[51]. •There are inequalities in access to health services. While people with sufficient digital technology receive adequate service, those with inadequate access to digital technology cannot receive adequate service[51]. • Excessive use of Metaverse can create addiction, and people who use it excessively become distant from real life, and psychological and physiological disorders may occur [17]. • There may be stigma because people can easily access data[18].

In Table 3 we see the SWOT analysis of Metaverse applications in healthcare. The strengths of metaverse applications in the healthcare system should be increased, weaknesses should be strengthened, opportunities should be evaluated and threats should be prevented.

Istanbul Gelisim University Journal of Health Sciences (IGUSABDER) is indexed by TUBITAK ULAKBIM TR Index.
Web site: https://dergipark.org.tr/en/pub/igusabder
Contact: igusabder@gelisim.edu.tr

Discussion

A wide field of study has emerged with the use of the metaverse in various sectors. Studies on the Meteorverse in healthcare are increasing day by day and will continue to increase in the future. For example, Letafati and Otoum, (2023) investigated the privacy and security of e-health services in the metadata warehouse[59]. Li et al., (2024) examined the next generation healthcare ecosystem in the Metaverse[6]. Ahuja et al., (2023). Digital metaverse: Researched its applications in artificial intelligence, medical education and integrative healthcare[60]. Nguyen and Voznak, (2024). Conducted a bibliometric analysis of technology in digital health[61]. Sikandir et al., (2023) examined the interaction of metaverse, artificial intelligence and blockchain in healthcare[62]. Kulkarni et al., (2024) investigated the use of hybrid disease prediction, digital twin and metadata technologies[63]. Hulsen (2024) examined the applications of metadata in medicine and healthcare[64]. Thomason (2021) states that the Metaverse will offer significant opportunities and that healthcare professionals from all over the world will share their experiences in a virtual environment[46]. Johan, (2022) examined the effects of the Metaverse on the law and business world[65]. Jiang and Xu (2022) evaluated the education system with a SWOT analysis[66]. Akpınar (2023) examined gender investments in Metaverse, one of the digital games, with a SWOT analysis[67]. In addition, Filiz (2022)[51], Chengoden (2023)[68] and Adigüzel (2024)[69] examined metaverse applications in healthcare using SWOT analysis. As can be understood from here, Metaverse will make a difference in the provision of healthcare services and will make a positive contribution to the protection, maintenance and development of health. In addition, with its contributions to health education, it will ensure that students receive higher quality education, facilitate internship applications and prevent mistakes caused by inexperience.

Conclusion, Limitations and Recommendations

Metaverse combines digital and augmented reality technologies to create interactive virtual environments. The overall results of the research indicate that Metaverse will make significant positive contributions to the Turkish and global healthcare systems. Metaverse applications in the healthcare sector will significantly contribute to areas such as education and training, preventive healthcare services, diagnosis, treatment, patient experience, and management. The following conclusions were summarized when the research findings were evaluated using a SWOT analysis.

STRENGTHS

Revolution in education: With virtual reality (VR) and augmented reality (AR), medical students and other healthcare professionals can receive hands-on training through realistic simulations and practice without harming the patient.

Remote healthcare services: Patient-doctor conversations can be conducted through avatars via Metaverse, facilitating access, reducing costs and saving time.

Patient experience and comfort: Patients can access certain services without physically visiting the hospital. This prevents hospital-acquired infections.

Istanbul Gelisim University Journal of Health Sciences (IGUSABDER) is indexed by TUBITAK ULAKBIM TR Index.
Web site: https://dergipark.org.tr/en/pub/igusabder
Contact: igusabder@gelisim.edu.tr

Data collection and analysis: Patient data collected digitally is analyzed with artificial intelligence to provide better diagnosis and treatment. It also provides personalized treatment tailored to the patient.

WEAKNESSES

High cost: Significant capital is required to acquire the necessary technological infrastructure and devices.

Lack of technological knowledge: Healthcare professionals and patients struggle to use metaverse technologies.

Data security and privacy: Ensuring the security of patient information in virtual environments is more difficult and risky.

Lack of physical examinations: Some diseases may not be adequately examined in a virtual environment.

OPPORTUNITIES

Increased accessibility: Patients living in rural and remote areas will have easier access to healthcare services. Consulting with renowned doctors and obtaining information will become easier.

Global collaborations: Experts in different countries can connect simultaneously for multidisciplinary virtual consultations.

THREATS

Insufficient legal regulations: Legal regulations for healthcare applications in the metaverse environment have not yet been fully established.

Cyberattacks: Because health data carries high value, the risk of cyberattacks in the metaverse environment is high.

Addiction and isolation: Overreliance on digital media, especially in psychological treatments, can have negative effects.

Social acceptance: Using the metaverse can be challenging for elderly individuals or groups unfamiliar with technology.

As can be seen from this, metaverse applications offer numerous advantages for healthcare institutions, patients, and their families.

They can provide the following benefits to healthcare institutions and organizations

Increased Patient Satisfaction: Patient satisfaction increases with virtual consultations, short waiting times, and personalized services. Patient loyalty increases, increasing loyalty.

Strengthening Staff Training: Provides healthcare professionals with hands-on training opportunities using real-time scenarios, reducing error rates. Harm to patients and the institution due to inexperience is reduced.

Operational Efficiency: Patient volume can be better managed through virtual meetings, and resources can be planned more effectively.

Innovation and Brand Value: Institutions that adopt metaverse technologies early on stand out with their innovative image. They gain a competitive advantage and market leadership. Patient trust in the institution increases.

Research and Development: Thanks to virtual data analysis and patient monitoring, scientific research can be conducted more quickly and cost-effectively. Treatment, care, and drug development are facilitated.

This study only includes a SWOT analysis of Metaverse healthcare applications. It is anticipated that future researchers will find it beneficial to examine applications in other sectors. Healthcare institutions that adopt Metaverse applications early will have an advantage over others.

REFERENCES

1. Mystakidis S. Metaverse. *Encyclopedia*. 2022;2(1):486–497.
2. Cayır A. Hemşirelik eğitiminde yapay zekânın önemi ve yapay zekânın kullanım alanları. *Balkan Sağlık Bilimleri Dergisi*. 2025;3(3):187-192. doi: 10.61830/balkansbd.1620267.
3. Yılmaz F, Mete AH, Fidan Türkön B, İnce Ö. Sağlık hizmetlerinin geleceğinde metaverse ekosistemi ve teknolojileri: Uygulamalar, fırsatlar ve zorluklar. *Eurasian Journal of Health Technology Assessment*. 2022;6(1):1-22. doi: 10.52148/ehta.1082705.
4. Söyler S, Averbek GS. Sağlık teknolojileri ve metaverse: Potansiyel uygulama alanları ve mevcut engeller. *International Anatolia Academic Online Journal Health Sciences*. 2022;8(2):38-166.
5. Secundo G, Toma A, Schiuma G, et al. Knowledge transfer in open innovation: A classification framework for healthcare ecosystems. *Business Process Management Journal*. 2019;25(1):144-163.
6. Li Y, Gunasekeran DV, RaviChandran N, et al. The next generation of healthcare ecosystem in the Metaverse. *Biomedical Journal*. 2024;47(3):1-10. doi: 10.1016/j.bj.2023.100679
7. Doğanyiğit PB. Sağlık hizmetlerinde yenilik yaklaşımı. *Journal of Health and Management*. 2022;2(1):43-54.
8. Ağaoğlu FO, Ekinci LO, Tosun N. Metaverse ve sağlık hizmetleri üzerine bir değerlendirme. *Erzincan Binali Yıldırım Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*. 2022;4(1):95-102. doi: 10.46482/ebyuiibfdergi.1133902
9. Şimşir İ, Mete B. Sağlık hizmetlerinin geleceği: Dijital sağlık teknolojileri. *Journal of Innovative Healthcare Practices (JOINIHP)*. 2021;2(1):33-39.
10. Trost Z, France C, Anam M, et al. Virtual reality approaches to pain: Toward a state of the science. *Pain*. 2021;162(2):325-331. doi: 10.1097/j.pain.0000000000002060.

Istanbul Gelisim University Journal of Health Sciences (IGUSABDER) is indexed by TUBITAK ULAKBIM TR Index.
Web site: https://dergipark.org.tr/en/pub/igusabder
Contact: igusabder@gelisim.edu.tr

11. Duan H, Li J, Fan S, et al. Metaverse for social good: A university campus prototype. *In Proceedings of the 29th ACM International Conference on Multimedia*. 2021;153-161.

12. Ma M, Zheng H. *Virtual Reality And Serious Games In Healthcare*. Chapter, In Sheryl Brahnam, Lakhmi C.Jain (Eds.). doi: 10.1007/978-3-642-17824-5_

13. Elmer NA, Hassell N, Comer CD, et al. Plastic surgery in the metaverse. *Plast Surg (Oakv)*. 2024;32(2):355-356. doi: 10.1177/22925503221109714.

14. Bayer S. *Metaverse ve Sağlık Uygulamaları*. Editörler, Öz S, Akyıldız C, Yılmaz R, Metaverse; 2022.

15. Ergur A, Nuhoğlu Ş. Gamma knife, bir ışından fazlası: dolayımlanmış müdahalenin cerrahi alanı yeniden yapılandırıcı etkisi. *Sosyoloji Araştırmaları Dergisi*. 2021;24(2):199-226.

16. Demet EN. Endüstri 4.0'ın sağlıkta dönüşüm programı ve sağlık hizmeti sunumu üzerine etkisi. *Sosyal, Beşeri ve İdari Bilimler Alanında Gelişmeler*. 2024;299-313.

17. Wehde M. Healthcare 4.0. *IEEE Engineering Management Review*. 2019;47(3):24-28.

18. Tortorella GL, Saurin TA, Fogliatto FS, et al. Impacts of healthcare 4.0 digital technologies on the resilience of hospitals. *Technological Forecasting and Social Change*. 2021;166:120666. doi: 10.1016/j.techfore.2021.120666.

19. Perez N, Elemento O, Sboner A, Sigaras A. Building the healthcare metaverse: Leveraging mixed reality guides to augment standard operating procedures (sop) in a precision medicine laboratory, *In Journal of Molecular Diagnostics*. 2022;24(10):85-86.

20. Saxena A, Malviya R. 3D printable drug delivery systems: Next-generation healthcare technology and regulatory aspects, *Current Pharmaceutical Design*. 2023;29(35):2814-2826.

21. Jung T, Cho J, Han ID, et al. Metaverse for service industries: Future applications, opportunities, challenges and research directions. *Computers in Human Behavior*. 2023:108039. doi: 10.1016/j.chb.2023.108039.

22. Wider W, Jiang L, Lin J, et al. Metaverse chronicles: A bibliometric analysis of its evolving landscape. *International Journal of Human–Computer Interaction*. 2023;40(21):1-14.

23. Moztarzadeh O, Jamshidi M, Sargolzaei S, et al. Metaverse and healthcare: Machine learning-enabled digital twins of cancer. *Boengineering*. 2023;10(4):455.

24. Gandi C, Cosenza L, Campetella M, et al. What can the Metaverse do for urology? *Urologia Journal*. 2023;90(3):454-458. doi: 10.1177/03915603231175940.

25. Randazzo G, Reitano G, Carletti F, et al. Urology: A trip into Metaverse. *World J Urology*. 2023;41:2647–2657. doi: 10.1007/s00345-023-04560-3.

26. Nawaz FA, Mekki YM, Tharwani ZH, et al. Toward a meta-vaccine future: Promoting vaccine confidence in the Metaverse. *Digital Health*. 2023;9:20552076231171477.

27. Xiao Y, Ahmad SF, Irshad M, et al. Investigating the mediating role of ethical issues and healthcare between the metaverse and mental health in Pakistan,

Istanbul Gelisim University Journal of Health Sciences (IGUSABDER) is indexed by TUBITAK ULAKBIM TR Index.
Web site: https://dergipark.org.tr/en/pub/igusabder
Contact: igusabder@gelisim.edu.tr

China, and Saudi Arabia, *Humanit Soc Sci Commun*. 2024;1:441. doi: 10.1057/s41599-024-02643-z.

28. Skaldic I, Arangalag D, Kachrimanidis I, et al. Metaverse-based cardiac magnetic resonance imaging simulation application for overcoming claustrophobia: A preliminary feasibility trial. *Future Cardiology*. 2024;20(4):191–195.

29. Ergin E, Yalcinkaya T, Cınar Yücel S. Nurses' knowledge of, attitudes towards and awareness of the metaverse, and their future time perspectives: A cross-sectional study. *BMC Nurs*. 2024;23:414. doi: 10.1186/s12912-024-02048-y.

30. Della Corte M, Clemente E, Checcucci E, et al. Pediatric urology metaverse. *Surgeries*. 2023;4(3):325-334. doi: 10.3390/surgeries4030033.

31. Habbal A, Ali MK, Abuzaraida MA. Artificial ıntelligence trust, risk and security management (aı trism): Frameworks, applications, challenges and future research directions. *Expert Systems with Applications*. 2024;240:122442.

32. Devrim B. Strateji Formülasyonu: SWOT Analizi, Kurumsal Karne, Kalite Fonksiyon Yayılımı, Sun Tzu'nun İşletme Yönetimi Stratejilerinin Bütünleştirilmesi Üzerine Bir Çalışma. [yüksek lisans tezi]. Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü, İzmir, 2023.

33. Uçar D, Doğru Ö. Strategic planning of GIS projects and place of SWOT Analysis, TMMOB Chamber of Surveying and Cadastre Engineers. 10th Turkish Scientific and Technical Scientific Congress, 28 March - April 2005, Ankara.

34. Avcıkurt C, Köroğlu A, Doğdubay M. Alternatif turizmin planlanmasında swot analizinin uygulanması. *Türkiye'nin Alternatif Turizm Potansiyeli ve Güncel Sorunları Konferansı, 3-4 Mayıs 2003*, Çankırı.

35. Polat E, Özdemir SS, Özdemir M. Kırsal turizm potansiyelinin SWOT analizi ile değerlendirilmesi: Balıkesir örneği, *Coğrafyacılar Derneği Uluslararası Kongresi Bildiriler Kitabı,* 2014;4-6.

36. Lee LH, Braud T, Zhou P, at all. All one needs to know about metaverse: A complete survey on technological singularity. *Virtual Ecosystem, and Research Agenda*. 2021;14(8):1-66. doi: 10.48550/arXiv.2110.05352.

37. Insawan H, Alwahidin A, Kira H, Putri AI. Implementation of the eco-metaverse in Indonesia: Sharia economic perspective. Samarah*: Jurnal Hukum Keluarga dan Hukum Islam*. 2025;9(1):107-129. doi: 10.22373/sjhk.v9i1.26262.

38. Alomar JA, Alatawi FM. Evaluating the challenges of metaverse-enabled digital entrepreneurship: Evidence from Saudi Arabia as an emerging economy. *Journal of Entrepreneurship in Emerging Economies*. 2025. doi: 10.1108/JEEE-07-2024-0266.

39. Akour IA, Al-Maroof RS, Alfaisal R, Salloum SA. A conceptual framework for determining metaverse adoption in higher institutions of gulf area: An empirical study using hybridsem-ann approach, *Computers and Education: Artificial Intelligence*. 2022;3.

40. Díaz J, Saldaña C, Ávila C. Virtual world as a resource for hybrid education, *International Journal of Emerging Technologies in Learning* (iJET). 2022;15(15):94-109.

41. Davis A, Murphy JD, Owens D, Khazanchi D, Zigurs I. Avatars, people, and virtual worlds: Foundations for research in metaverses. *Journal of the Association for Information Systems*. 2009;10(2):90. doi: 10.17705/1jais.00183.
42. Logeswaran A, Munsch C, ChongYJ, Ralph N, McCrossnan J. The role of extended reality technology in healthcare education: Towards a learner-centered approach. *Future Healthcare Journal*. 2021;8(1):79-84. doi: 10.7861/fhj.2020-0112.
43. Sheikh AH, Barry DS, Gutierrez H, Cryan JF, O'Keeffe GW. Cadaveric anatomy in the future of medical education: What is the surgeon's view? *Anatomical Sciences Education*. 2016;9(2):203-208. doi: 10.1002/ase.1560.
44. Ahmed H, Devoto L. The potential of a digital twin in surgery. *Surgical Innovation*. 2021;28(4):509-510. doi: 10.1177/15533506209758.
45. Yang D, Zhou J, Song Y, at all. metaverse in medicine. *Clinical eHealth*. 2022;(5):39-43.
46. Thomason J. Met health will the metaverse change health care? *Journal of Metaverse*. 2021;1(1):13-16.
47. Yılmaz A, Ölçer İ. Yapay zekânın cerrahi uygulamalara entegrasyonu. *Beykent Üniversitesi Fen ve Mühendislik Bilimleri Dergisi*. 2021;13(2):21-27.
48. Çam O, Çuhadar D. Ruhsal hastalığa sahip bireylerde damgalama süreci ve içselleştirilmiş damgalama. *Psikiyatri Hemşireliği Dergisi*. 2011;2(3):136-140.
49. Arman N, Tarakci E, Tarakci D, Kasapcopur O. Effects of video games–based task-oriented activity training (Xbox 360 Kinect) on activity performance and participation in patients with juvenile idiopathic arthritis: A randomized clinical trial. *American Journal of Physical Medicine & Rehabilitation*. 2019;98(3):174-181.
50. Hardjanto RW. Digital economy and blockchain technology using the swot analysis model. *Int J Innov Sci Res Technol*. 2022;7(2):2456-2165.
51. Filiz M. Metaverse and a swot analysis of Turkish health system. *Turkish Research Journal of Academic Social Science*. 2022;5(1):61-68.
52. Holsapple C, Wu J. User acceptance of virtual worlds: The hedonic framework. *ACM SIGMIS Database*. 2007;38(2):86-89. doi: 10.1145/1314234.1314250.
53. Acquisti A, Taylor C, Wagman L. The economics of privacy. *Journal of Economic Literature*. 2016;54(2):442-492.
54. Jeong E, Kim D, Lee D. Game addiction from a psychosocial health perspective, Proceedings of the 17th International Conference on Electronic Commerce, ICEC'15. 2015; *Association for Computing Machinery*.
55. Rizk SH. Ethical and regulatory challenges of emerging health technologies in Applied Ethics in a Digital World, I.Vasiliu-Feltes and J. Thomason, Eds. *Hershey, PA: IGIGlobal*. 2021;84-100.
56. Kye B, Han N, Kim E, Park Y, Jo S. Educational applications of metaverse: Possibilities and limitations. *Journal of Educational Evaluation for Health Professions*, 2021;18(32).
57. Yıldırım TÖ. Metaverse ve sağlık hizmetleri. Editör; Kaya H, Şahin KE. *Sağlık & Bilim 2022:* Güncel Tıp-IV, Efe Yayınları.

Istanbul Gelisim University Journal of Health Sciences (IGUSABDER) is indexed by TUBITAK ULAKBIM TR Index.
Web site: https://dergipark.org.tr/en/pub/igusabder
Contact: igusabder@gelisim.edu.tr

58. Akalın B. *Sağlık Yöneticilerinde İletişim*. Sağlık profesyonellerinin iletişim becerileri. 2024.

59. Letafati M, Otoum S. On the privacy and security for e-health services in the metaverse: An overview. *Ad Hoc Networks*. 2023;150(2). doi:10.1016/j.adhoc.2023.103262.

60. Ahuja AS, Polascik BW, Doddapaneni D, Byrnes ES, Sridhar J. The digital metaverse: Applications in artificial intelligence, medical education, and integrative health. *Integrative Medicine Research*. 2023;12(1). doi: 10.1016/j.imr.2022.100917.

61. Nguyen HS, Voznak M. A bibliometric analysis of technology in digital health: Exploring health metaverse and visualizing emerging healthcare management trends. *IEEE Access*. 2024;12. doi: 10.1109/access.2024.3363165.

62. Sikandir A, Armand ATPT, Athar A, et al. Metaverse in healthcare integrated with explainable aı and blockchain: Enabling immersiveness, ensuring trust, and providing patient datasecurity. *Sensors*. 2023;23(565):1-17. doi: 10.3390/s23020565.

63. Kulkarni C, Quraishi A, Raparthi M, et al. Hybrid disease prediction approach leveraging digital twin and metaverse technologies for health consumer. *BMC Medical Informatics and Decision Making*. 2024;24(1):92. doi: 10.1186/s12911-024-02495-2.

64. Hulsen T. Applications of the metaverse in medicine and healthcare. *Advances in Laboratory Medicine/Avances en Medicina de Laboratorio*. 2024;5(2):159-165.

65. Johan S. Metaverse and its implication in law and business. *Jurnal Hukum Progresif*. 2022;10(2);153-166. doi: 10.14710/jhp.10.2.153-166.

66. Jiang C, Xu J. The application research of education metaverse under the framework of swot analysis. In International Conference on Metaverse. 2022;55-67. Cham, Springer Nature 2022, Switzerland.

67. Akpınar ME. A swot handbook of research on perspectives on society and technology addiction. *IGI Global*. 2023;318-327. doi: 10.4018/978-1-6684-8397-8.ch020.

68. Chengoden R, Victor N, Huynh-The T, at all. Metaverse for healthcare: A survey on potential applications, challenges and future directions. *IEEE Access*. 2023;11:12765-12795. doi: 10.1109/access.2023.3241628.

69. Adıgüzel DÜ. The metaverse within the swot framework in consumer experience and decision-making in the metaverse. *IGI Global*. 2024:248-251.