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THE EFFECT OF THE METAVERSE ON THE HEALTH SECTOR

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ABSTRACT

Today, due to the metaverse gaining popularity and diversification of its use and purpose, in terms of states, institutions, individuals, etc., its usage potential is increasing. All kinds of innovations that can positively affect the health sector are important innovations that should not be ignored. Considering that the metaverse is an innovation and development that tends to be effective in many sectors, in order to benefit from the opportunities, it offers and can offer for the health sector, it is important to understand its potential impact, development, advantages and disadvantages. In this study, it is aimed to investigate the effect of the metaverse in the health sector in the light of studies in the international literature by researching the Web of Science, Scopus, Pubmed, Google Scholar indexes. As a result of the examination carried out for this purpose, it has been determined that the studies in the literature are mostly reviews, letters to the editor and similar studies, and there are few empirical and experimental studies yet. In addition, the metaverse of the studies in the literature is mental, psychological, cardiovascular, eye, tooth, mouth, etc. potential impact on health, medical therapy, rehabilitation, psychotherapy, telepresence, smart health, experience-based health, etc. It has been understood to have many potential effects, such as its potential effect on supporting health issues, its potential effect on disease prevention, its potential effect on providing outpatient care, its potential effect on effective collaboration and knowledge sharing, its potential for advanced visualization for medical databases, its potential effect on improving health education of physicians and patients. In addition studies in the literature shows that there are a lot of potential impacts of the metaverse on psychological, cardiovascular, eye, dental, oral health etc. as well as on medical therapy, rehabilitation, psychotherapy, telepresence, smart health, experience-based health and similar issues, and on prevention of diseases, and on providing outpatient treatment, and on effective collaboration and knowledge sharing, advanced visualization, and on medical databases, and on improving health education of physicians and patients.

Keywords: Metaverse, Health, 3D, Virtual World

1. INTRODUCTION

The technology sector, like most other sectors, includes constant changes and developments. From past to present, many technological innovations have been developed that can significantly affect people's lives. The metaverse contains many potentials that will become clearer over time and that can affect people's lives. With the technological developments obtained in recent years, the metaverse has become more applicable (Chakraborty, 2022).

The metaverse includes the real world depicted in the virtual world (Zhang et al., 2023, p. 299). The metaverse enables interaction in a realistic and separate world simulated outside the physical world, in the medium, by making use of "virtual and augmented reality" technologies through created "avatars" and "holograms" (Dwivedi et al., 2022, p. 2).

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Technologies that support the metaverse include AI, interactivity (e.g., virtual reality (VR), augmented reality technology (AR), extended reality (XR), mixed reality technology, blockchain, game (e.g., 3D modeling, real-time rendering), network (e.g., 5G, 6G, cloud computing) and internet of things (C. W. Lee, 2022, p. 2; Wei, 2022, pp. 330-331). Sectors such as education, marketing, health and tourism are among the sectors that fall under the influence of the metaverse (Akour et al., 2022, p. 12; Dwivedi et al., 2022, p. 2). Figure 1 shows current the metaverse adoption and future the metaverse investment distribution.

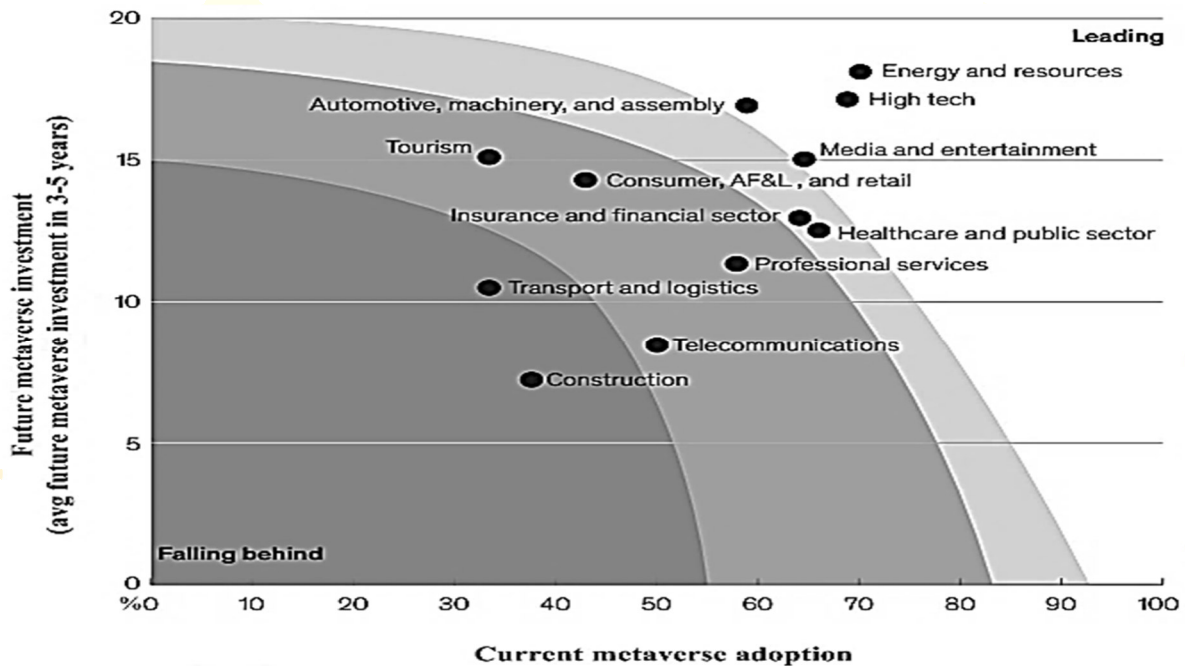


Figure 1. Current the metaverse adoption and future the metaverse investment distribution

Source: McKinsey and Company (2022, p. 21)

McKinsey and Company (2022) report is examined, it is understood that energy and resources, high tech, media and entertainment, insurance and financial sector, healthcare and public sector are among the sectors that started and adopted the metaverse initiatives and that have the potential to invest in the metaverse in the future. According to the Grand View Research (2022) market report, the global metaverse market size is estimated to be US\$38.85 billion in 2021. It is expected to expand at a compound annual growth rate (CAGR) of 39.4% from 2022 to 2030, and the metaverse's estimated revenue in 2030 is projected to reach 678.8 billion USD.

Metaverse, “was originally coined by science fiction author Neal Stephenson in his 1992 novel “Snow Crash”; in it, he describes the Metaverse as a virtual world composed of unique environments, each with a specific purpose: to entertain, socialize, educate, and more” (Pimentel et al., 2022, p. 2). Games and virtual environments such as “Fortnite”, “Second Life”, “VRChat” and “Roblox” are considered to be the predecessors of the meta-universe (Dwivedi et al., 2022, p. 2). The metaverse is a platform where a large number of users can come together in a digital virtual medium, and includes where different experiences can be obtained and simultaneous interactions can be realized. the network (Akour et al., 2022, p. 1). The metaverse includes four key technical features. These are (Madiaga et al., 2022, p. 2);

- **“Realism”:** Containing realism that can make people perceive themselves as exactly in that environment,

- **“Ubiquity”**: Being able to access virtual spaces through appropriate digital devices with a virtual identity,
- **“Interoperability”**: Enabling many different systems and platforms to interact and communicate with each other,
- **“Scalability”**: By utilizing the existing network architecture, it can provide a good user experience to users who have multiple access to metaverse environment.

The metaverse has the potential to significantly improve and redesign the experience between doctor and doctor, doctor and patient and others in health (Walcott, 2022). Understanding this potential for development and change is understood to be among issues of importance to academics, healthcare professionals, governments and others. Some studies in the literature have been carried out on the effect of the metaverse in various sectors such as advertising (Kim, 2021; Taylor, 2022) and education (Hwang & Chien, 2022; López-Belmonte et al., 2022). In this study, it is aimed to examine the effect of the metaverse in the health sector in the light of studies in the international literature.

2. THE EFFECT OF METAVERSE IN THE HEALTH SECTOR

The metaverse can provide interaction between patients and doctors in a virtual environment that carries reality, does not require the use of written text records, and ensures the follow-up of personal and clinical health data (Ahmadi Marzaleh et al., 2022). With “Meta-medicine”, everyone will be able to define a “digital identity” by utilizing the technology of digital twins. “Digital avatars” can be created according to the characteristics of patients' personal health information, reports and etc. Doctors and patients will be able to interact with these created avatars on this virtual platform without any restrictions (Sun et al., 2022, p. 54). Figure 2 shows the possible change of doctor-patient relationship with the metaverse.

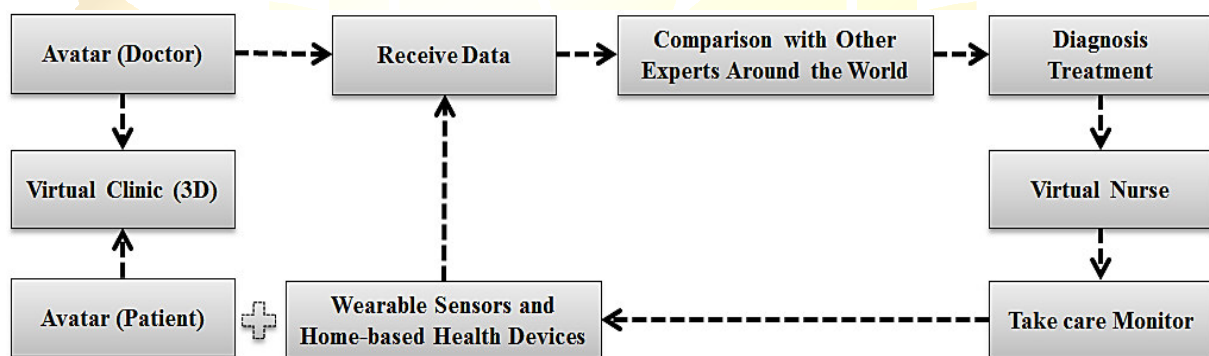


Figure 2. Possible change of doctor-patient relationship with the metaverse

Source: Petrigna and Musumeci (2022, p. 7)

Web of Science, Scopus, Pubmed and Google Scholar indexes were researched and the effect of the metaverse on the health sector was examined within the scope of studies in the international literature. In some studies in the literature, a general analysis has been made and it has been concluded that the metaverse has new opportunities and effects that are likely to provide for health services (Ahmadi Marzaleh et al., 2022; Bansal et al., 2022; Bhugaonkar et al., 2022; Curtis & Brolan, 2022; C. W. Lee, 2022; R.-A. Lee, 2022; Mejia & Rawat, 2022; Wang et al., 2022; Wiederhold & Riva, 2022).

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These possible opportunities and effects of the metaverse for health services include improving the quality of healthcare services, increasing patient satisfaction, preventing diseases, improving cost-effectiveness and accessibility, developing new educational tools and forms by using the metaverse infrastructure to improve medical education and communication skills of medical students and clinicians, obtaining outpatient treatment opportunities by using body sensor networks, providing realistic interaction between patients, doctors, objects, and reducing the need for physical documents and paper (Ahmadi Marzaleh et al., 2022; Bhugaonkar et al., 2022; Mejia & Rawat, 2022; Wang et al., 2022).

In some studies, examinations were made specifically for health areas. Among these studies are effects of the metaverse on mental health (Benrimoh et al., 2022; Cerasa et al., 2022; Huang et al., 2022; Ifdil et al., 2022; Situmorang, 2022a, 2022b; Usmani et al., 2022; Zhou et al., 2022), possible effects of the metaverse on cardiovascular health (Mesko, 2022; Skolidis et al., 2022), possible effects of the metaverse on eye health (Tan et al., 2022), possible effects of the metaverse on oral and dental health (Albujeeer & Khoshnevisan, 2022; Sailer, 2022).

The potential opportunities and effects of the metaverse for mental health include providing opportunities such as "avatar therapy", "virtual reality assisted therapy", "teletherapy" (Benrimoh et al., 2022), more effective prevention of Alzheimer's, cognitive decline (Zhou et al., 2022), more effective diagnosis and treatment etc. (Usmani et al., 2022). The potential opportunities of the metaverse for cardiovascular health include being able to explain the functioning of the cardiovascular system in three dimensions in education, conducting case discussions among doctors, bringing doctors and patients together with a digital avatar, and sharing digital medical data with the doctor more effectively etc. (Mesko, 2022). The potential opportunities that the metaverse may provide for eye health impacts include "the ability to create avatars for realistic consultations", "to provide personalized care", "to enable potential clinical applications in therapeutics, diagnostics and education" etc. (Tan et al., 2022). Among the possible opportunities and effects of the metaverse for oral and dental health are the ability to monitor oral health from home, the convenience of software to make appointments, and the pre-testing of treatment targets in the virtual world (Sailer, 2022).

In some studies, more specific investigations were made. Among the possible effects of the metaverse mentioned in these studies on the health sector are that with the transition from information-based communication to experience-based health communication, users will now be able to actively experience (Plechata et al., 2022) and interact with the consequences of their behavior, and that with "rapid tele-psychotherapy" for mental health services, with "rapid tele-psychotherapy" for mental health services, single session music therapy can be done (Situmorang, 2022a), with the use of schema therapy in the metaverse, which is used in the treatment of personality disorders, patients' schema modes can be reshaped, resulting in adaptive and more inclusive interaction with the real world (Yin et al., 2022), and users will be able to support effective collaboration and knowledge sharing in virtual teams (Yu et al., 2012), they will be able to develop telesurgery opportunities in health 5.0 (the metaverse supported) (Bhattacharya et al., 2022), they will be able to offer some opportunities such as "experience-based, effective education, interactive learning" for nursing (Damar & Turhan Damar, 2021), they will have some possibilities to provide 3D interaction for bioinformatics and work in various bioinformatics visualization scenarios (Taylor & Soneji, 2022), cognition experience can be increased and psychoemotional and social abilities can be developed with immersive social environments (Calabrò et al., 2022), and patient counseling can be improved (Anwer et al., 2022).

In some other studies, it has been concluded that the use of the metaverse in education may have effects (Huh, 2022; Hwang & Chien, 2022; Iwanaga et al., 2022; Kye et al., 2021; López-Belmonte et al., 2022; Park & Park, 2022). The potential opportunities that the metaverse may provide for education include opportunities for personalization in education, virtual interaction, instant translation of educational materials into different languages, providing students who do not have the opportunity to attend classes in a physical environment, the opportunity to attend classes in a virtual environment, providing education opportunities that cannot be experienced in a physical environment, etc. (Hwang & Chien, 2022; López-Belmonte et al., 2022).

In addition, some studies such as examining the development of the metaverse literature in the fields of medicine, nursing, public health, midwifery, and dentistry (Damar, 2022), and bibliometric examination of the research trends of emerging technologies in the health the metaverse are included in the literature (Chen & Zhang, 2022).

In some quantitative and experimental studies, which are found to be few in number for now, in the literature; Huang et al. (2022) found that metaverse-based virtual reality sports experiences had a significant positive effect on mental health in their study on Chinese athletes. In the research by Iwanaga et al. (2022) they conducted on 282 participants, consisting of anatomy educators, at the annual meeting of the American Association of Clinical Anatomists 2022, there were 64 people whose questionnaires were answered. Of these 64 people, only 43 were aware of the term metaverse. They concluded that only 6 of the 43 participants (9.4%) used the metaverse to teach anatomy. Shah, Hameed, et al. (2022), in their pilot study with 10 participants aged 64 to 82, concluded that the use of the metaverse-based games supports the participation of the elderly in physical exercise. Shah, Karlsen, et al. (2022) conducted a study with 14 other participants between the ages of 60 and 88, in the metaverse-based exercise game, the participants were divided into 2 individual and collaborative groups. They concluded that collaborating participants achieved higher intrinsic motivation than individual participants in terms of effort, pleasure, physical effort, and usefulness. In the study by Zhang et al. (2023), it has been understood that attribute-based encryption plays an important role in ensuring the security and efficient sharing of data in metaverse health services, with the simulated experiment they carried out.

3. CONCLUSION

In this study, the effect of the metaverse on the health sector was examined in the light of studies in the international literature by researching in Web of Science, Scopus, Pubmed and Google Scholar indexes. In the studies, the potential of the created metaverse virtual environments to support patient education and medical education, mental, psychological, etc. It is understood that it may have many potential effects such as the potential to support the solution of problems, medical therapy, rehabilitation, psychotherapy, the potential to provide telepresence, and the possibility of providing advanced visualization for medical databases (Mozumder et al., 2022, p. 260; Sun et al., 2022, p. 55). Thinking that some of them can integrate into the health sector with their full potential also makes us think that the metaverse has important opportunities for the health sector.

In the metaverse environments, differences are important on concerns about data security and privacy, high costs due to new technology and difficulties in convincing users to use these services, the possible need to provide technical support for the installation and use of the technology, disputes between healthcare providers in their willingness to acquire the metaverse technology, health care quality between countries with and without metaverse technology (Ahmadi Marzaleh et al., 2022; Grand View Research, 2022, p. 792; Mesko, 2022, p. 2649). Studies should be carried out on the aspects of the metaverse that are considered to be disadvantageous, and if solutions are provided, these disadvantages should be minimized in the future, and even an advantageous situation can be achieved. Regarding the mentioned cost problem, it can be predicted that a decrease in the prices of the metaverse equipment may be seen in favor of the segments (health education students, patients, etc.) who may have difficulty in purchasing this technology due to the increase in the production and supply of metaverse technology used in health. In addition, if the governments decide to use the metaverse extensively in the health sector, it is thought that the necessary technological infrastructure and support activities can be provided free of charge to the elderly and individuals with insufficient purchasing power, within the framework of the social state agreement for the cost problem. In the event that sensitive patient information is disclosed due to a security vulnerability, an irreparable loss of trust may occur for the metaverse in healthcare. For this reason, it is important to take the necessary precautions at the highest level and to protect the sensitive personal health information of the patients before there is a situation such as the disclosure of patient information regarding the cyber security risks that are stated as a disadvantage.

The experience offered by “Meta-medical” can be further enhanced with technologies such as “human sensors (ReSkin)”, “organ chips”, “organa-noids”, “holographic lenses (HoloLens 2)” (Sun et al., 2022, p. 56). With the continuation of technological developments, it can be understood that the potential of the metaverse to affect the health sector can be further increased in the future.

In the future, the effects of the metaverse, which is mentioned in this study in the light of the studies in the literature, on the health sector can be investigated empirically. Research can also be conducted on how to optimally benefit from the potential advantages of the metaverse in the health sector and how to minimize its disadvantages.

REFERENCES

Ahmadi Marzaleh, M., Peyravi, M., & Shaygani, F. (2022). A revolution in health: Opportunities and challenges of the Metaverse. *Excli j*, 21, 791-792. <https://doi.org/10.17179/excli2022-5017>

Akour, I. A., Al-Marroof, R. S., Alfaisal, R., & Salloum, S. A. (2022). A conceptual framework for determining metaverse adoption in higher institutions of gulf area: An empirical study using hybrid SEM-ANN approach. *Computers and Education: Artificial Intelligence*, 3, 100052. <https://doi.org/10.1016/j.caeai.2022.100052>

Albujee, A., & Khoshnevisan, M. (2022). Metaverse and oral health promotion. *British Dental Journal*, 232(9), 587-587. <https://doi.org/10.1038/s41415-022-4255-1>

Anwer, A., Jamil, Y., & Bilal, M. (2022). Provision of surgical pre-operative patient counseling services through the Metaverse technology. *Int J Surg*, 104, 106792. <https://doi.org/10.1016/j.ijsu.2022.106792>

Bansal, G., Rajgopal, K., Chamola, V., Xiong, Z., & Niyato, D. (2022). Healthcare in Metaverse: A Survey on Current Metaverse Applications in Healthcare. *IEEE Access*, 10, 119914-119946. <https://doi.org/10.1109/ACCESS.2022.3219845>

Benrimoh, D., Chheda, F. D., & Margolese, H. C. (2022). The Best Predictor of the Future-the Metaverse, Mental Health, and Lessons Learned From Current Technologies. *JMIR Ment Health*, 9(10), e40410. <https://doi.org/10.2196/40410>

Bhattacharya, P., Obaidat, M. S., Savaliya, D., Sanghavi, S., Tanwar, S., & Sadaun, B. (2022). Metaverse assisted Telesurgery in Healthcare 5.0: An interplay of Blockchain and Explainable AI. 2022 International Conference on Computer, Information and Telecommunication Systems (CITS), Piraeus, Greece, 13-15 July 2022. <https://doi.org/10.1109/CITS55221.2022.9832978>.

Bhugaonkar, K., Bhugaonkar, R., & Masne, N. (2022). The Trend of Metaverse and Augmented & Virtual Reality Extending to the Healthcare System. *Cureus Journal of Medical Science*, 14(9), 7. <https://doi.org/10.7759/cureus.29071>

Calabrò, R. S., Cerasa, A., Ciancarelli, I., Pignolo, L., Tonin, P., Iosa, M., & Morone, G. (2022). The Arrival of the Metaverse in Neurorehabilitation: Fact, Fake or Vision? *Biomedicines*, 10(10). <https://doi.org/10.3390/biomedicines10102602>

Cerasa, A., Gaggioli, A., Marino, F., Riva, G., & Pioggia, G. (2022). The promise of the metaverse in mental health: the new era of MEDverse. *Heliyon*, 8(11), e11762. <https://doi.org/10.1016/j.heliyon.2022.e11762>

Chakraborty, K. (2022). *The Metaverse: Possibilities and Perils*. Retrieved 09.12.2022 from <https://www.techopedia.com/the-metaverse-possibilities-and-perils/2/34689>

Chen, D., & Zhang, R. (2022). Exploring Research Trends of Emerging Technologies in Health Metaverse: A Bibliometric Analysis. *SSRN*. <https://doi.org/10.2139/ssrn.3998068>

Curtis, C., & Brolan, C. E. (2022). Health care in the metaverse. *Med J Aust*. <https://doi.org/10.5694/mja2.51793>

Damar, M. (2022). What the Literature on Medicine, Nursing, Public Health, Midwifery, and Dentistry Reveals: An Overview of the Rapidly Approaching Metaverse. *Journal of Metaverse*, 2(2), 62-70.

Damar, M., & Turhan Damar, H. (2021). Artırılmış Gerçeklik, Sanal Gerçeklik ve Metaverse: Hemşirelik Disiplini İçin Önemi ve Geleceği. In Y. Varışoğlu & P. I. Vural (Eds.), *Sağlık & Bilim: Hemşirelik-3*. İstanbul: Efe Akademi Yayınevi.

Dwivedi, Y. K., Hughes, L., Baabdullah, A. M., Ribeiro-Navarrete, S., Giannakis, M., Al-Debei, M. M., Dennehy, D., Metri, B., Buhalis, D., Cheung, C. M. K., Conboy, K., Doyle, R., Dubey, R., Dutot, V., Felix, R., Goyal, D. P., Gustafsson, A., Hinsch, C., Jebabli, I., . . . Wamba, S. F. (2022). Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *International Journal of Information Management*, 66, 102542. <https://doi.org/10.1016/j.ijinfomgt.2022.102542>

Grand View Research. (2022). *Metaverse Market Size, Share & Trends Analysis Report By Product, By Platform, By Technology (Blockchain, Virtual Reality (VR) & Augmented Reality (AR), Mixed Reality (MR)), By Offering, By Application, By End Use, By Region, And Segment Forecasts, 2022 - 2030*. Retrieved 03.12.2022 from <https://www.grandviewresearch.com/industry-analysis/metaverse-market-report>

Huang, Z. S., Choi, D. H., Lai, B. S., Lu, Z. C., & Tian, H. J. (2022). Metaverse-based virtual reality experience and endurance performance in sports economy: Mediating role of mental health and performance anxiety. *Frontiers in Public Health*, 10, 17, Article 991489. <https://doi.org/10.3389/fpubh.2022.991489>

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Huh, S. (2022). Application of computer-based testing in the Korean Medical Licensing Examination, the emergence of the metaverse in medical education, journal metrics and statistics, and appreciation to reviewers and volunteers. *J Educ Eval Health Prof*, 19, 2. <https://doi.org/10.3352/jeehp.2022.19.2>

Hwang, G.-J., & Chien, S.-Y. (2022). Definition, roles, and potential research issues of the metaverse in education: An artificial intelligence perspective. *Computers and Education: Artificial Intelligence*, 3, 100082. <https://doi.org/10.1016/j.caeai.2022.100082>

Ifdil, I., Situmorang, D. D. B., Firman, F., Zola, N., Rangka, I. B., & Fadli, R. P. (2022). Virtual reality in Metaverse for future mental health-helping profession: an alternative solution to the mental health challenges of the COVID-19 pandemic. *Journal of Public Health*. <https://doi.org/10.1093/pubmed/fdac049>

Iwanaga, J., Muo, E. C., Tabira, Y., Watanabe, K., Tubbs, S. J., D'Antoni, A. V., Rajaram-Gilkes, M., Loukas, M., Khalil, M. K., & Tubbs, R. S. (2022). Who really needs a Metaverse in anatomy education? A review with preliminary survey results. *Clinical Anatomy*, 1-6. <https://doi.org/10.1002/ca.23949>

Kim, J. (2021). Advertising in the Metaverse: Research Agenda. *Journal of Interactive Advertising*, 21(3), 141-144. <https://doi.org/10.1080/15252019.2021.2001273>

Kye, B., Han, N., Kim, E., Park, Y., & Jo, S. (2021). Educational applications of metaverse: possibilities and limitations. *J Educ Eval Health Prof*, 18, 32. <https://doi.org/10.3352/jeehp.2021.18.32>

Lee, C. W. (2022). Application of Metaverse Service to Healthcare Industry: A Strategic Perspective. *International Journal of Environmental Research and Public Health*, 19(20), 13038.

Lee, R.-A. (2022). Is It Possible to Apply the Metaverse to Health Care System? *The Ewha Medical Journal*, 45(1), 1-2. <https://doi.org/10.12771/emj.2022.45.1.1>

López-Belmonte, J., Pozo-Sánchez, S., Lampropoulos, G., & Moreno-Guerrero, A.-J. (2022). Design and validation of a questionnaire for the evaluation of educational experiences in the metaverse in Spanish students (METAEDU). *Heliyon*, 8(11), e11364. <https://doi.org/10.1016/j.heliyon.2022.e11364>

Madiega, T. A., Car, P., Niestadt, M., & Pol, L. V. d. (2022). Metaverse: Opportunities, risks and policy implications. *EPRS | European Parliamentary Research Service*, 1-12. [https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/733557/EPRS_BRI\(2022\)733557_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/733557/EPRS_BRI(2022)733557_EN.pdf)

McKinsey and Company. (2022). Value creation in the metaverse: The real business of the virtual world. *McKinsey & Company*. https://www.mckinsey.com/~media/mckinsey/business_functions/marketing_and_sales/our_insights/value_creation_in_the_metaverse/Value-creation-in-the-metaverse.pdf

Mejia, J. M. R., & Rawat, D. B. (2022). Recent Advances in a Medical Domain Metaverse: Status, Challenges, and Perspective. Thirteenth International Conference on Ubiquitous and Future Networks (ICUFN), Barcelona, Spain, 05-08 July 2022. <https://doi.org/10.1109/ICUFN55119.2022.9829645>

Mesko, B. (2022). The promise of the metaverse in cardiovascular health. *European Heart Journal*, 43(28), 2647-2649. <https://doi.org/10.1093/eurheartj/ehac231>

Mozumder, M. A. I., Sheeraz, M. M., Athar, A., Aich, S., & Kim, H. C. (2022). Overview: Technology Roadmap of the Future Trend of Metaverse based on IoT, Blockchain, AI Technique, and Medical Domain Metaverse Activity. 2022 24th International Conference on Advanced Communication Technology (ICACT), Pyeongchang, Korea (South), 13-16 February 2022. <https://doi.org/10.23919/ICACT53585.2022.9728808>

Park, C. S.-Y., & Park, N. J.-Y. (2022). Adapting to cutocracy: A survival strategy for prospective health professions educators in the era of the metaverse. *Journal of Professional Nursing*, 41, A1-A4. <https://doi.org/10.1016/j.profnurs.2022.06.004>

Petrigna, L., & Musumeci, G. (2022). The Metaverse: A New Challenge for the Healthcare System: A Scoping Review. *Journal of Functional Morphology and Kinesiology*, 7(3), 63. <https://www.mdpi.com/2411-5142/7/3/63>

Pimentel, D., Fauville, G., Frazier, K., McGivney, E., Rosas, S., & Woolsey, E. (2022). Learning in the Metaverse: A Guide for Practitioners. *Meridian Treehouse*, 1-21. <https://scholar.harvard.edu/files/mcgivney/files/introductionlearningmetaverse-april2022-meridiantreehouse.pdf>

Plechata, A., Makransky, G., & Böhm, R. (2022). Can extended reality in the metaverse revolutionise health communication? *npj Digital Medicine*, 5(1), 132. <https://doi.org/10.1038/s41746-022-00682-x>

Sailer, I. (2022). Are Big Data, Artificial Intelligence, Augmented Reality, Robotics, Teledentistry, and Metaverse Just Buzz Terms, or Do They Indicate a Paradigm Shift in Prosthodontics? [Editorial]. *International Journal of Prosthodontics*, 35(2), 137-138. <https://doi.org/10.11607/ijp.2022.2.e>

Shah, S. H. H., Hameed, I. A., Karlsen, A. S. T., & Solberg, M. (2022). Towards a Social VR-based Exergame for Elderly Users: An Exploratory Study of Acceptance, Experiences and Design Principles. In J. Y. C. Chen & G. Fragomeni (Eds.), *Virtual, Augmented and Mixed Reality: Design and Development* (pp. 495-504). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-05939-1_34

Shah, S. H. H., Karlsen, A. S. T., Solberg, M., & Hameed, I. A. (2022). A social VR-based collaborative exergame for rehabilitation: codesign, development and user study. *Virtual Reality*. <https://doi.org/10.1007/s10055-022-00721-8>

Situmorang, D. D. B. (2022a). "Rapid tele-psychotherapy" with single-session music therapy in the metaverse: An alternative solution for mental health services in the future. *Palliative and Supportive Care*, 1-2. <https://doi.org/10.1017/S1478951522001420>

Situmorang, D. D. B. (2022b). Will Metaverse become a more exciting place to listen to streaming music for mental health? *J Public Health (Oxf)*. <https://doi.org/10.1093/pubmed/fdac136>

Skalidis, I., Muller, O., & Fournier, S. (2022). The Metaverse in Cardiovascular Medicine: Applications, Challenges, and the Role of Non-Fungible Tokens. *Canadian Journal of Cardiology*, 38(9), 1467-1468. <https://doi.org/10.1016/j.cjca.2022.04.006>

Sun, M., Xie, L., Liu, Y., Li, K., Jiang, B., Lu, Y., Yang, Y., Yu, H., Song, Y., Bai, C., & Yang, D. (2022). The metaverse in current digital medicine. *Clinical eHealth*, 5, 52-57. <https://doi.org/10.1016/j.ceh.2022.07.002>

Tan, T. F., Li, Y., Lim, J. S., Gunasekaran, D. V., Teo, Z. L., Ng, W. Y., & Ting, D. S. W. (2022). Metaverse and Virtual Health Care in Ophthalmology: Opportunities and Challenges. *The Asia-Pacific Journal of Ophthalmology*, 11(3), 237-246. <https://doi.org/10.1097/APO.0000000000000537>

Taylor, C. R. (2022). Research on advertising in the metaverse: a call to action. *International Journal of Advertising*, 41(3), 383-384. <https://doi.org/10.1080/02650487.2022.2058786>

Taylor, S., & Soneji, S. (2022). Bioinformatics and the Metaverse: Are We Ready? *Front Bioinform*, 2, 863676. <https://doi.org/10.3389/fbinf.2022.863676>

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E-MAIL: editor@libertyacademicbooks.com

Usmani, S. S., Sharath, M., & Mehendale, M. (2022). Future of mental health in the metaverse. *General Psychiatry*, 35(4), e100825. <https://doi.org/10.1136/gpsych-2022-100825>
Walcott, D. (2022). *Can The Metaverse Drive The Metamorphosis Of Healthcare?* Retrieved 08.12.2022 from <https://www.forbes.com/sites/davidwalcott/2022/10/17/can-the-metaverse-drive-the-metamorphosis-of-healthcare/?sh=3a4d2472786c>

Wang, G., Badal, A., Jia, X., Maltz, J. S., Mueller, K., Myers, K. J., Niu, C., Vannier, M., Yan, P. K., Yu, Z., & Zeng, R. P. (2022). Development of metaverse for intelligent healthcare [Article]. *Nature Machine Intelligence*, 4(11), 922-929. <https://doi.org/10.1038/s42256-022-00549-6>

Wei, D. (2022). Gemiverse: The blockchain-based professional certification and tourism platform with its own ecosystem in the metaverse. *International Journal of Geoheritage and Parks*, 10(2), 322-336. <https://doi.org/10.1016/j.ijgeop.2022.05.004>

Wiederhold, B. K., & Riva, G. (2022). Metaverse Creates New Opportunities in Healthcare. *Annual Review of Cybertherapy and Telemedicine*, 20, 3-7.

Yin, B., Wang, Y. X., Fei, C. Y., & Jiang, K. (2022). Metaverse as a possible tool for reshaping schema modes in treating personality disorders. *Frontiers in Psychology*, 13, 8. <https://doi.org/10.3389/fpsyg.2022.1010971>

Yu, X., Owens, D., & Khazanchi, D. (2012). Building Socioemotional Environments in Metaverses for Virtual Teams in Healthcare: A Conceptual Exploration. In J. He, X. Liu, E. A. Krupinski, & G. Xu (Eds.), *Health Information Science* (pp. 4-12). Springer Berlin Heidelberg.

Zhang, T., Shen, J., Lai, C.-F., Ji, S., & Ren, Y. (2023). Multi-server assisted data sharing supporting secure deduplication for metaverse healthcare systems. *Future Generation Computer Systems*, 140, 299-310. <https://doi.org/10.1016/j.future.2022.10.031>

Zhou, H., Gao, J.-Y., & Chen, Y. (2022). The paradigm and future value of the metaverse for the intervention of cognitive decline. *Frontiers in Public Health*, 10, 1016680. <https://doi.org/10.3389/fpubh.2022.1016680>

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