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REVIEW ARTICLE

Mushrooms, Lichens and Allopathic Medicine: Principles and Performs

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Abstract

Recent medical achievements entered the new healthcare era, accompanying significant advances in the treatment and care of patients. The most groundbreaking achievements among these new tools are artificial intelligence, personalized medicine, and telemedicine-all with a great impact on modern healthcare development. Mushrooms and lichens were described as folk or ancient medicine. Mushrooms and lichens play an important role as a source of many natural classes with varying biological potentials including antiviral, antifungal, analgesic, antipyretic, antioxidant, anticancer effects and others. Telemedicine, an innovation that has really revolutionized and increased the access of medical services, allows continuous monitoring of patients and remote consultations. This has been proved to reduce travel-related barriers and improve accessibility in areas less privileged or more distant and remote. It provides immediate medical assistance and in relation to this, especially in respect of the COVID-19 pandemic, emphasized the telemedicine aspect improving care delivery even during routine and emergency settings. Using vast amounts of medical data, AI and machine learning have completely flipped diagnosis and treatment planning. Advances in genetics and biotechnology have made it possible for a new way of tailoring medicine to a patient's unique genetic profile, a method that is often called personalized medicine. Overall, all these developments enrich the healthcare landscape, bring it alive, and make it really critical to the patient. It addresses topics such as health inequalities, improves the precision of treatment, and holds some promise toward more critical changes in general health outcomes. Eventually, a combination of telemedicine, artificial intelligence and personalization of medicine redraws the line of health care and makes it more accurate and accessible and individualized. These advances promise more effective and efficient health care by setting new benchmarks for patient care and medical practice.

Introduction

The last few years have witnessed unseconded breakthroughs in medicine, changing the healthcare landscape entirely. Success rates of treatments, outcomes for patients, and diagnostic precision have dramatically soared due to advancement. Critical examples within these domains involve artificial intelligence, personalized medicine, and telemedicine, each of which has a different role in enhancing patient care and delivery of healthcare.

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Fungi in general (Especially mushrooms) and lichens are extremely diverse in terms of morphology, ecology, metabolism, and phylogeny. Lichens and mushrooms are a generous source of novel compounds that can be investigated for their potential biological activities [1]. More than, 100 medicinal activities like antitumor, immunomodulation, antioxidant, radical scavenging, cardioprotective and antiviral actions are assumed to be produced by the various varieties of medicinal mushrooms (Like *Agaricus blazei, Ganoderma lucidum, Cordyceps militaris, Cordyceps sinensis* and others) [2,3] and lichens (Like *Usnea, Letharia, Xanthoparmelia, Ramalina, Lobaria, Peltigera, Cladonia, Cladina, Umbilicaria, Pseudevernia, Cetraria*, were commonly used in Europe and Asian countries included, *Parmotrema, Hypotrachyna, Thamnolia,* and *Lethariella*) [4].

Although involved since centuries in traditional folk medicine, lichens have attracted extra attention of scientists owing to the emergence of new diseases, which has required screening for novel compounds capable of curing or supporting currently used compounds [4]. The polysaccharides, present in mushrooms like β-glucans, micronutrients, and antioxidants like glycoproteins, triterpenoids, flavonoids, and ergosterols can help establish natural resistance against infections and toxins. The terpenes, polyketides, and tannins, present in lichens like *Candelariella vitellina, Lepraria incana* and *Dirinaria applanata* can help establish natural resistance against many infectious diseases [5].

The human evaluation dose studies had been also performed and the toxicity dose was evaluated from the literature for number of mushrooms. Most medicinal mushrooms and lichens were found to be safe but some with mild side effects [6]. In complement to the vital nutritional significance of medicinal mushrooms and lichens, numerous species have been identified as sources of bioactive chemicals. Moreover, there are unanswered queries regarding its safety, efficacy, critical issues that affect the future mushroom medicine and lichen development, that could expose its usage in the twenty-first century [7,8].

Telemedicine is among the pioneering inventions which enhance the effectiveness and accessibility of medical services. Telemedicine permits patients to begin communication with doctors for consultation and follow up from remote settings, which is useful in most rural and neglected regions. In this approach, it reduces the congestion in traditional health facilities while promoting emergency medication [9]. The COVID-19 pandemic underlined the essence of telemedicine with decreased exposure risks for continuity of care. There is, of course, more adoption of telemedicine; it has now become an integral part of modern healthcare and allows for accessible and adaptable care solutions. AI and machine learning are changing many aspects in medicine with advanced analytics and predictive models. Another area where AI systems have amazed people is in anomaly and disease identification, especially with those designed specifically to read medical images [10]. Machine learning techniques also improve diagnostic processes by identifying patterns and trends in vast data sets, hence the diagnosis of diseases becomes more accurate and timely [11]. Integrating AI in healthcare allows personalized treatment planning, acceleration of clinical workflows, improved patient management, and increase on the level of accuracy of diagnosis. Personalized medicine is a paradigm shift toward personalized care due to unique genetic profiles. Personalized medicine, spurred by genetics, has biotechnology that offers more targeted therapies with reduced side effects as compared to traditional approaches [12]. The doctors can tailor-make therapeutic treatments based on genetic analysis so that the medical treatment shall focus on particular variations of the gene when dealing with specific diseases. This approach does not only increase the success rate of the treatment but also inspires the development of precautionary measures to minimize hereditary risk factors [13]. Both relate to pressing issues in healthcare. The approach of personalized medicine allows for individualized and specific treatment options, and the latest advancements in artificial intelligence and machine learning enhance diagnostic as well as therapeutic accuracy, while telemedicine provides better access and continuity of care. Each of these new developments is modifying the practice of medicine and changes the focus for patient care itself. With this, incorporating these technologies into the routine medical practice unravels a more dynamic and patient-centered healthcare system. The potential of these technologies continues to evolve the health industry into a better-working machinery for health delivery and enhanced patient care as they continue to develop and study.

Telemedicine

This telemedicine technology, which transformed the practice of providing health care through

telecommunications technology, has been one of the main aspects of current healthcare systems. Through this innovation, it is worth noting that there has been a marked improvement in easy access to healthcare among patients, particularly those at distant and resource-deficit locations. Telemedicine overcomes geographical boundaries often hindering timely medical treatment through its provision of virtual consultation. Patients do not have to visit physical medical facilities in a real-life scenario just to undergo evaluation, diagnosis, and follow-up treatments. This thereby saves them time and money in traveling and relevant inconveniences [9]. Advances in digital communication technology, such as secure messaging, video conferencing applications and remote monitoring devices, have further ensured that the gain of telemedicine continues to expand. The technologies enable instant communication between the patient and the healthcare provider, ensuring thus that the patient is well communicated to and engaged effectively. For example, video consultations enable a person to be visually assessed and educated on treatment, which is vital in the treatment and diagnosis of various diseases [14]. Secure messaging ensures the confidentiality of private patient information while also abiding by the privacy laws, such as Health Insurance Portability and Accountability Act (HIPAA) in the US. One of the most notable effects that telemedicine has in relation to the current COVID-19 pandemic is that it has shown the world how resourceful people can be during times of desperation. Given these demands of closures and social distancing measures imposed by the pandemic, there has been an incredibly increased use of telemedicine to continue providing care while reducing the danger of the transmission of the virus [14]. In this regard, telemedicine was welcomed as evidenced by the fact that it was indeed practical, efficient, and even capable of revolutionizing routine medical care delivery. Since then, telemedicine has since become a common practice in many healthcare systems as they have come to understand its utility in addressing non-emergency medical needs and maintaining continuity of patient care [9]. Remote monitoring technologies and wearable technology/mhealth apps may be applied to track health parameters in real time, such as blood pressure, blood glucose, level of physical activity, etc. Telemedicine has a great importance in managing and follow up chronic diseases. This data, according to Krupinski and Weinstein [9], can then be transmitted to healthcare providers for further assessments and treatments that eventually increase the benefits of chronic disease outcomes and timely interventions when needed. Telemedicine also makes it easier to obtain second opinions and consultations by specialists, which would greatly benefit patients who require highly specialized care unavailable in their areas. Telemedicine offers the numerous benefits that make its implementation appealing, yet on the other side, there are disadvantages to be taken into consideration: there are issues of data security, different access to technology, as well as legal barriers that can impact equitability and effectiveness of telemedicine services. This would require bridging the digital divide and assistance for patients without available equipment, or a reliable internet connection, for example. There would also be a need for strong cybersecurity defenses against attacks and illegal access to patient data. In a nutshell, telemedicine represents a gigantic leap in the history of health care; it is convenient, readily available, and an effective substitute to conventional face-to-face healthcare. Its continuous advance and integration into the health care systems are meant to improve the patient outcomes; reduce disparities in access to health care and improve the delivery of care. Personalized Medicine The shift towards personalized medicine is a revolutionary approach in healthcare that entails tailoring the care with regard to each individual's uniqueness. The method zeroes in on recent discoveries in data analytics, biotechnology, and genomics to provide better and more customized care. The consideration of how a patient's genetic makeup, lifestyle, and environment may affect their healthcare allows for personalized medicine to tailor medical care, enhance treatment outcomes, and lower the risk of side effects.

At the core of personalized medicine lies the use of genetic information to guide the choice of treatments

With the latest technological advancement in the genomic sequencing of next-generation sequencing, deep analysis of a patient's genetic code is now possible. Such detailed information about a patient's genetic code, including identification of some genetic variants associated with the disease, helps in the development of targeted drugs, fully customized by each patient's particular genetic profile [12]. For example, in oncology, targeted anticancer drugs have been developed that target the mutations that cause growth of the tumors due to individualized medicine, which also offers better treatment options than traditional chemotherapies. In addition,

biotechnology has played a key role in the development of individualized medicine. Advances in technology, for example the CRISPR-Cas9 gene editing system allows to precisely modify the genetic sequences, which may thus eradicate inherited diseases, enabling therapies to be personalized. Beyond this, biotechnology has allowed the developments to produce refined diagnostic instruments and biomarkers that help patients seek an early diagnosis and monitoring for disease providing care that is tailored to the individual. Data analytics and machine learning provide for the integration and interpretation of large data sets from genetics, Electronic Health Records (EHRs), and patient-reported outcomes, while also being essential for personalized medicine. Using these technologies, more individualized treatment plans may be developed through searching for patterns and connections [11]. The predictive models, for example, can predict a person's genetic and lifestyle-related risk for various diseases in order for early detection and therapies depending on the individual's risk profile. Personalized medicine, aside from merely treating patients, has many benefits. The strategy identifies which patient subgroups are likely to benefit from new medicines, thereby enhancing drug development efficiency through timely completion of clinical trials while making the process cheaper overall. Personalized medicine encourages the development of preventive measures tailored to an individual's genetic makeup and environmental risks. Such measures have the potential to radically reduce disease prevalence and consequently advance public health outcomes. Despite the promise it holds, personalized treatment has several disadvantages. To ensure that the benefits of personalized medicine are better diffused, various concerns such as data privacy, the high cost of genomic testing, and unequal access to cutting-edge technologies should be better addressed [12]. Developing the science of personalized medicine and surmounting these obstacles will call for developed ethical frameworks and regulatory standards. In sum, the approach of personalized medicine would revolutionize healthcare by providing individualized therapy according to a patient's unique personal and genetic data. As such, this method will improve the accuracy and effectiveness of medical treatments so that, in the long run, it would attain a more personalized, economical, and egalitarian healthcare system. Genomics is the study of genomes, or the entire set of DNA of an organism, including all of its genes. This rapidly developing discipline has affected agriculture, medicine, and even evolutionary biology to change our understanding of genetics. Fundamentally, it seeks to understand the composition, function and evolution of genomes to understand the genetic bases of both health and disease.

The application of genomics has dramatically changed with NGS technologies

Whole genomes can now be sequenced quickly and affordably by applying NGS, providing levels of precise understanding of genetic variants never seen before [15]. This technology allows researchers to identify several genetic variations associated with a multitude of diseases, including different cancers, heart conditions, and various rare forms of inherited diseases. For example, the identification of particular mutations within genes such as BRCA1 and BRCA2 has led to advanced understanding and treatment strategies for inherited cancers of the breast and ovaries [16]. Yet another essential component of the discipline is functional genomics, which concerns an understanding of the relation between genes and their functions. This involves research on cellular pathway relationships, protein functions, and gene expression patterns. Upon exploring how differently the same gene is expressed in different settings, more information about disease mechanisms, potential therapeutic targets, and generally relevant issues in the diagnosis of diseases are gathered [17]. For example, through functional genomics, people may be able to understand the molecular basis of complex diseases such as diabetes and Alzheimer's disease. Comparative genomics compares the genomes of different animals for determining conserved genetic elements or components and understanding evolutionary relationships. This technique has actually helped scientists gain insights on how differences in genetics contribute to diversity on Earth by shedding light upon the genetic basis of speciation and adaptation [18]. For example, comparative genomics has been used to trace the evolutionary history of disparate species and find genes associated with unique features of humans. Genomics can be integrated with bioinformatics and data analysis only when it's used to manage a huge amount of data that's generated through genetic research. For the analysis of genomic data as well as the detection of genetic variations and prediction of their likely effects on health, sophisticated computational techniques and algorithms are used [19]. In turn, they allow scientists and physicians to synthesize complex genetic data applicable to

disease prevention, drug development, and tailored therapy. Genomics has a tremendous promise to transform the world but is fraught with challenges like disparities in access to genetic technology, data privacy concerns, and uniform interpretation of data. Such problems need to be addressed to allow equitable access to genetic resources and technologies so that advancements in genomics benefit everybody in its entirety, according to Hudson K, et al. [20]. In a nutshell, the research on genomics is quite important and has significantly increased our knowledge of genetic material and its implications in health as well as disease. Continued developments in biology and medicine can be integrated with the help of functional and comparative methodologies to guarantee more individualized and efficient healthcare. Biotechnology The multidisciplinary field of biotechnology involves the use of biological systems, organisms, or their derivatives to develop or produce technologies and products for various applications. It addresses problems of agriculture, industry, medicine, and environmental management by fusing ideas from biology, chemistry, and engineering. Genetic engineering has led to rapid growth in the area as a result of increases in synthetic biology and bioinformatics.

Genetic engineering is one of the most revolutionary applications in the field of biotechnology

It involves the alteration of an organism's genetic makeup for the purpose of producing specific end-products or acquiring desirable traits. With genetic improvement, this technology has actually enabled the production of improved organisms, such as crops developed with better resistance to pests and diseases or plants having higher nutritional value [21]. Hormones, vaccines and therapeutic proteins in medicine are examples of what genetic engineering has been able to achieve in producing the aforementioned items through recombinant DNA technology. As an example, genetically modified bacteria are used to make insulin that is prescribed for diabetic patients [22]. Another significant development in biotechnology is synthetic biology. It is a multidisciplinary science that uses the basic principles of engineering and biology to design and construct new biological components, devices, and systems. The development of organisms with unique functionalities that do not occur in naturally occurring organisms could potentially be a great resource for the solution of complex problems concerning sustainability while relating to the environment and health, as done through the efficient execution of synthetic biology. For example, designing biological strategies with the help of synthetic biology principles is aimed towards the degradation of environmental pollutants by microbes or the generation of biofuels through renewable resources [23]. An important area of the application of biotechnology is biopharmaceuticals, which the field is related to the production of drugs produced from living organisms. Many diseases have been treated based on the production of these biopharmaceuticals as genetic therapies and the other type being monoclonal antibodies. These monoclonal antibodies that are produced by hybridomas are applied in targeted treatments for certain types of cancers and chronic diseases [24]. Muscular dystrophy and cystic fibrosis are the most commonly known genetic conditions that hold promise for gene treatment, which is a kind of treatment that alters a patient's DNA to either prevent or treat a disease [25]. Bioinformatics is quite important in biotechnology as it offers tools and techniques for handling biological data. Bioinformatics and biotechnology converge to efficiently analyze large data sets of proteomics, metabolomics, and genomics research. This convergence can lead to a better understanding of mechanisms of various diseases and identification of new therapeutic targets in a completely personalized way, with medical interventions tailored according to the genetic profiles of the patients themselves [26]. The second common function of bioinformatics is through improving research and development since it supports designing experiments and interpreting complicated biological data. There are several advantages of biotechnology; however, it has several disadvantages in terms of ethical, environmental, and legal issues. The issues that are put up for debate and research include the safety concerns associated with GMOs, the unforeseen effects in synthetic biology, and the strengthening of a comprehensive regimen of regulatory protections [27]. In conclusion, scientists, policymakers, and the public at large need to address these concerns to ensure the ethical development and usage of biotechnological discoveries. In a nutshell, this is a science that is rapidly changing as a result of improvements in synthetic biology and genetic engineering, besides biopharmaceuticals. Its applications still spark innovative ideas and offer solutions to some of the world's most pressing issues. Healthcare Technology All instruments, devices, and frameworks that are directed toward the optimization

of patients' outcomes, simplification of healthcare procedures, and better implementation of medical treatments are broadly referred to as healthcare technology. Improvements in the delivery of medical services have led to complete overhauling by integrating modern technologies into health systems, which in turn has resulted in increased improvements in patient care treatment, treatment efficacy, and diagnostic accuracy. One of the most revolutionary advancements in healthcare technology is electronic health records, abbreviated to EHR.

An EHR is a computer-based system that offers easy storage, retrieval, and sharing of patient information, thus eliminating much of the paper-based medical record

The transition to electronic medical records has improved patient safety through fewer errors due to manual record-keeping, easy access and accuracy, and coordination amongst care providers. Telemedicine is the other health technology critically advanced in healthcare. Telemedicine is that health technology which allows doctors to reach and treat patients at remote distances using various forms of communication such as video conferencing, remote monitoring equipment among others. As postulated by Krupinski and Weinstein [9], this health technology has shown very excellent utility in terms of increased specialized consultations for patients irrespective of distance and or socio-economic background and even monitoring patients with chronic conditions. The COVID-19 pandemic has further accelerated the adoption of telemedicine, which has proven that it can also conserve continuity of care while the danger from transferring the virus is reduced [14]. Advances in medical imaging technologies and tools like Positron Emission Tomography (PET), Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) offer complex information about the human body. These imaging modalities are highly useful in the diagnosis, treatment planning, and track condition diagnosis as they allow for a non-invasive inspection of interior structures. For example, the development in the technology of MRI has improved the resolution of images related to musculoskeletal and neurological condition diagnosis [28]. Popularity in wearable health devices has increased because, with these gadgets on their bodies, patients and healthcare professionals can access real-time data on health parameters, for example, heart rate, blood glucose levels, and physical activity. These are examples of devices that would continue monitoring physiological data, hence allowing for proactive management of health and early detection of potential problems. These devices allow for individualized health management using actionable insights derived from personal health data. Today, healthcare technology has been shifting towards more instances of machine learning and artificial intelligence. The AI algorithms are used in the predictions of outcomes for patients, assessment of medical data, and increase the accuracy of diagnosis. For example, AI-based technologies can easily translate medical images, enable disease discovery at earlier stages, and provide suggestions for individualized therapy based on very high levels of data [10]. Machine learning models in predictive analytics enhance strategies of patient care and decisioning clinically. Healthcare technology lags on questions of data security and interoperability, whereas the digital divide is still a problem and not completely addressed by recent advances. While fully realizing healthcare technology, key issues that need to be addressed include the securing of information of patients, integration of various technological systems, and elimination of inequality in the distribution of access to technology [11]. Conclusion In a nutshell, a collection of various developments that have transformed the medical technology practice, improved patient outcomes, and increased the efficiency of service delivery are termed health technology. Continuing advancement and integration of these technologies will likely lead to further advancement of the field and open up new avenues for enhancing health care and its management. Health Disparities Health disparities are disparities in health outcomes and access to health care systematically linked to social, economic, and environmental disadvantages. Differences often appear in relation to socioeconomic position, region, race, ethnicity, and other social determinants of health. This is by addressing health disparities so as to promote health equity and generally improve public health.

Socio-economic status is also an important contributing factor to health disparities

Health outcomes can be worse for those people who have lower incomes and educational levels because of their limited access to safe housing, healthy food, and quality health care. Research has shown that those regions characterized by the higher proportions of chronic diseases such as diabetes and cardiovascular conditions have been associated with low educational level and poverty-related socio-economic factors [29]. Further, populations dwelling

in the impoverished environments will find it challenging to access prompt medical and preventive care, thus compounding health inequalities. A further contributor to health inequalities has been the racial and ethnic disparities. Extensive studies have proven that racial and ethnic minorities tend to have poorer health compared to whites. African Americans and Hispanics, for instance, suffer from greater proportions of obesity, hypertension, and a diversity of cancer-related disorders and experience difficulty accessing quality care [30]. Some of the factors that cause such inequalities include racial discrimination in systems, linguistic and cultural barriers, as well as health insurance coverage differences. The health outcomes are largely affected by the geographical component. For example, the rural and under-served metropolitan regions lack access to specialized care, preventive services, and a health facility. In these places, inadequacies also encompass how locals reach the health care providers, fewer resources are available, and there is a lack of medical experts [31]. Poorer overall health outcomes, higher rates of chronic diseases, and delays in receiving treatment are a few consequences of inadequate access to care. Another significant determinant for health disparities is health literacy. These patients might lack the ability to understand medical information, grasp the health care system, and make their own decisions about the treatment they need. Such inadequacies might mean failure for the patients to adhere to treatment programs, utilize preventive services, or interact in a maximally effective way with health care providers, making the outcomes less than optimal [32]. Health inequities can be reduced by interventions and education to increase health literacy. Regarding clinical service, there is a need for multimodal approaches such as community initiatives, policy interventions, and attempts to access health care that are increasing the disparities in health. Other tactics that are being applied to reduce gaps and improve health equity include the introduction of culturally competent treatment practices, increases in funding for community health centers, and expanding health insurance coverage [33]. Finally, long-term gains in health equity will also depend on public health programs that address the socioeconomic determinants of health, for example, improving access to economic, housing, and educational opportunities.

Conclusion

Health disparities are a complex and multifaceted issue that are also a reflection of broader social injustices. Knowing the causes of these differences and implementing specific plans to address them will move us closer to health equity and more improved health results in all groups. Conclusion: The outstanding changes in healthcare, brought about by advances in medical science, have, in fact been behind the improvements made in the diagnosis, treatment, and outcomes in patients. Mushrooms and lichens, which are existing everywhere and have prestigious contributions in traditional folk medicine all over the world, is currently of great interest. Moreover, a remarkable list of applications are based on mushrooms and lichens. Screening for novel compounds are extremely important nowadays due to the emergence of new fatal diseases especially cancers, infections caused by drug-resistant microbes, or the currently spreading Corona virus disease caused by COVID-19 virus. Mushrooms and Lichens are generous source of novel compounds that can be investigated for their potential biological activities. Innovations like electronic health records and telemedicine have promoted more access and efficiency in the healthcare system. Other innovations, for instance, include genetics, personalized medicine, and biotechnology, which enable the delivery of more accurate and individualized health care. Despite this, however, there are other issues to be solved, including equitable access to the new technologies and moral dilemmas. Considering everything, the further development and unification of these innovations has huge potential to make healthcare delivery more effective and of quality so as to achieve better health outcomes globally.

References

1. Elkhateeb WA, Elnahas MO, Daba GM. Lichentherapy: Highlights on the pharmaceutical potentials of lichens. J Microbiol Biotechnol. 2021;6(2):1-10. doi: 10.23880/oajmb-16000190.

2. Elkhateeb WA, Daba GM, Thomas PW, Wen TC. Medicinal mushrooms as a new source of natural therapeutic bioactive compounds. Egyptian Pharmaceutical Journal. 2019;18(2):88-101. doi: 10.4103/epj.epj_17_19.

3. Elkhateeb WA, Daba GM. Cordyceps more than edible mushroom—a rich source of diverse bioactive metabolites with huge medicinal benefits. Journal of Biomedical Research and Environmental Sciences. 2022;3(5):566-574. doi: 10.37871/jbres1481.

4. Elkhateeb WA, Daba GM. Lichens– masters of extraordinary symbiosis with potent pharmaceuticals. Egyptian Pharmaceutical Journal. 2020;19(3):197-201. doi: 10.4103/epj.epj_11_20.

5. Elkhateeb WA, Daba GM. Occurrence of terpenes, polyketides and tannins in some Japanese lichens and green mosses. Egyptian Pharmaceutical Journal. 2020;19(3):216-223. doi: 10.4103/epj.epj_17_20.

6. Elkhateeb W, Thomas P, Elnahas M, Daba G. Hypogeous and epigeous mushrooms in human health. In Advances in Macrofungi. 1st ed. CRC Press; 2021. p.7-19.

7. Elkhateeb WA, El-Ghwas, DE, & Daba GM. Mushrooms and lichens the factory of important secondary metabolites. Journal of Biomedical Research and Environmental Sciences. 2023;4(6):1072-1082. doi: 10.37871/jbres1770.

8. Elkhateeb W, Galappaththi MC, El-Ghwas DE, Daba G. The anti-diabetic potential of mushrooms: A review. Current Trends in Biotechnology and Pharmacy. 2023;17(4):1415-1424. doi: 10.5530/ctbp.2023.4.77.

9. Krupinski EA, Weinstein RS. Telemedicine and telehealth: The current state of the art. Journal of Telemedicine and Telecare. 2018;24(7):490-496.

10. Esteva A, Kuprel B, Novoa RA, Ko J, Swetter SM, Blau HM, Thrun S. Dermatologist-level classification of skin cancer with deep neural networks. Nature. 2017 Feb 2;542(7639):115-118. doi: 10.1038/nature21056. Epub 2017 Jan 25. Erratum in: Nature. 2017 Jun 28;546(7660):686. doi: 10.1038/nature22985. PMID: 28117445; PMCID: PMC8382232.

11. Topol EJ. High-performance medicine: the convergence of human and artificial intelligence. Nat Med. 2019 Jan;25(1):44-56. doi: 10.1038/s41591-018-0300-7. Epub 2019 Jan 7. PMID: 30617339.

12. Collins FS, Varmus H. A new initiative on precision medicine. N Engl J Med. 2015 Feb 26;372(9):793-5. doi: 10.1056/NEJMp1500523. Epub 2015 Jan 30. PMID: 25635347; PMCID: PMC5101938.

13. Doudna JA, Charpentier E. The new frontier of genome engineering with CRISPR-Cas9. Science. 2014;346(6213). doi: 10.1126/science.1258096.

14. Smith AC, Thomas E, Snoswell CL, Haydon H, Mehrotra A, Clemensen J, Caffery LJ. Telehealth for global emergencies: Implications for coronavirus disease 2019 (COVID-19). J Telemed Telecare. 2020 Jun;26(5):309-313. doi: 10.1177/1357633X20916567. Epub 2020 Mar 20. PMID: 32196391; PMCID: PMC7140977.

15. Mardis ER. Next-generation DNA sequencing methods. Annu Rev Genomics Hum Genet. 2008;9:387-402. doi: 10.1146/annurev.genom.9.081307.164359. PMID: 18576944.

16. Easton DF, Pharoah PD, Antoniou AC. Gene-panel testing for personalized treatment of hereditary breast cancer. New England Journal of Medicine. 2015;372(23):2220-2227. doi: 10.1056/NEJMsr1501341.

17. Flint J, Mackay TF. Genetic architecture of quantitative traits in mice, flies, and humans. Genome Res. 2009 May;19(5):723-33. doi: 10.1101/gr.086660.108. PMID: 19411597; PMCID: PMC3647534.

18. Gibson G, Muse SV. A primer of genome science. 3rd ed. Sinauer Associates; 2009.

19. Cordero F, Kholodov M, Fridman A. Bioinformatics and computational genomics: Current applications and future directions. Genomics. 2014;104(6):417-424.

20. Hudson K, Holohan MK, Collins FS. Genomics and the American public: A review of the literature. Journal of Health Communication. 2016;21(9):985-995.

21. James C. Global status of commercialized biotech/GM Crops. 2014.

22. Baeshen NA, Baeshen MN, Sheikh AA. Cell factories for insulin production: Recent advances and future perspectives. Applied Microbiology and Biotechnology. 2014;98(11);4699-4713.

23. Packer MS, Antoniewicz MR. Synthetic biology: New engineering rules for designing and building biological systems. Nature Reviews Molecular Cell Biology. 2015;16(5):289-304.

24. Kohler G, Milstein C. Continuous cultures of fused cells secreting antibody of predefined specificity. Nature. 1975:256(5517);495-497. doi: 10.1038/256495a0.

25. Mingozzi F, High KA. Therapeutic in vivo gene transfer for genetic disease using AAV: progress and challenges. Nat Rev Genet. 2011 May;12(5):341-55. doi: 10.1038/nrg2988. Erratum in: Nat Rev Genet. 2011 Jul;12(7):515. PMID: 21499295.

26. Hood L, Eberwine J, Khosla C. The new era of systems biology. Nature Reviews Molecular Cell Biology. 2012;13(2):135-137.

27. Nuffield Council on Bioethics. Emerging biotechnologies: Technology, choice and the public good. Nuffield Council on Bioethics. 2012.

28. Reeder SB, Arai AE. MR imaging techniques in clinical practice. Radiology. 2016;279(1):20-29.

29. Williams DR, Jackson PB. Social sources of racial disparities in health. Health Aff (Millwood). 2005 Mar-Apr;24(2):325-34. doi: 10.1377/hlthaff.24.2.325. PMID: 15757915.

30. Williams DR, Mohammed SA. Discrimination and racial disparities in health: evidence and needed research. J Behav Med. 2009 Feb;32(1):20-47. doi: 10.1007/s10865-008-9185-0. Epub 2008 Nov 22. PMID: 19030981; PMCID: PMC2821669.

31. Miller, C.L., Nies, M.A., & Phelan, M.R. (2016). Rural health disparities: Context, concepts, and strategies. Journal of Rural Health, 32(2), 252-261.

32. Baker DW, Parker RM, Williams MV, Clark WS. Health literacy and the risk of hospital admission. J Gen Intern Med. 1998 Dec;13(12):791-8. doi: 10.1046/j.1525-1497.1998.00242.x. PMID: 9844076; PMCID: PMC1497036.

33. Institute of Medicine (US) Committee on Understanding and Eliminating Racial and Ethnic Disparities in Health Care. Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care. Smedley BD, Stith AY, Nelson AR, editors. Washington (DC): National Academies Press (US); 2003. PMID: 25032386.