Research Article

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Role of biostatistics and biometrics based artificial intelligence in human medicare system in 2050

Abstract

Artificial Intelligence (AI) seems to be the third biggest scientific discovery after fire and electricity that have and will change the life of human on this earth. Various applications of AI are based on simple mathematical, biometrical and statistical applications using computer and machine learning (ML). Strong networking is the key of the success of the AI based technology. The world is progressing very fast and it is expected that in 2050, AI based diagnosis and the tele-surgery will play an important role in human health. AI based human medicare system may change the human life and prolong the life expectancy to close to 120years for which the human genome is made for.

Keywords: artificial intelligence, machine learning, medicare system, mathematics, statistics, biometrics

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Abbreviations: AI, artificial intelligence; ML, machine learning; FDA, food and drug administration; CKRT, continuous kidney replacement therapy; IBD, inflammatory bowel disease

Introduction

The drive to incorporate machine learning (ML), a subfield of artificial intelligence (AI), into the medical sciences has grown since the dawn of the twenty-first century. One of the fundamental goals of humans is to regulate these changes for human welfare. This is especially true in the fields of medicine and pharmaceuticals, which are continually undergoing vast changes. These fields concentrate on the development and discovery of medical diagnosis, surgery and treatment with biomolecules/chemicals and their various combinations including their uses to alleviate both physical and mental suffering. Our lives are being significantly changed with practical applications of artificial intelligence (AI), and it is important to comprehend this progress and its successes in order to forecast future developmental plans. This is also true for oncology and allied sectors, where AI is currently creating new, significant prospects for bettering the treatment of cancer patients.[1] With this viewpoint, the present paper will emphasize on various opportunities and challenges in human medicare system in 2050. A regulatory framework that protects the quality of finished products through testing of raw materials, in-process materials, end-product characteristics, batch-based operations, and fixed process conditions has been in place for many decades that now controls the manufacturing of pharmaceutical products.[2]

But there has long been a connection between artificial intelligence and medicine. The foundations of AI can be seen in Isaac Asimov's science fiction works from the 1940s and Alan Turing's groundbreaking work on computing devices during World War-II.[3] The concept of utilizing mathematics, statistics and biometrics-based computers to simulate intelligent behavior and critical thinking was initially thought up by Alan Turing,[3] while John McCarthy was the first to use the term "artificial intelligence" in 1956 to describe the engineering and science of creating intelligent machines.[4,5] In the 1970s, health science research became the driving force for AI innovation with the development of various "expert systems" to aid with scientific and clinical decision-making. Medical schools in the United States were fast to collaborate with pioneers in this emerging field.[6] These AI-based "expert systems" were hampered by rigid, rule-based structures, which prevented them from being generalizable, preventing widespread acceptance and causing a split between the areas of AI and medicine until the turn of the century when various applications of AI were projected for the human welfare.[7–10]

The term "Medical Technology and Biomedical Engineering" is frequently used to refer to a variety of instruments that can help medical practitioners diagnose patients earlier, prevent problems, optimize therapy and/or offer less intrusive options, and shortens hospital stays for patients and society as a whole.[11] Prior to the advent of smart phones, wearable's, sensors, and communication systems, medical technologies were primarily known as traditional medical devices (such as prosthetics, stents, and implants). However, with the ability to contain artificial intelligence (AI) powered tools (such as applications) in very small sizes, these devices have revolutionized medicine.[12] A typical definition of artificial intelligence (AI) is a branch of computer science that has many applications in fields with vast amounts of data but little theory and has revolutionized medical technology.[11–13]

One of the most important areas of mathematical application has evolved into the new "Physics" of mathematics in the current modern technology era: biology.[2] The cornerstones of biotechnology-based industries are recombinant DNA technology and genetic engineering that also need the knowledge of mathematics, statistics and biometrics. In genetic engineering, a number of structural predictions call for a fundamental understanding of mathematics. Mathematical skills are required even in the commercial manufacturing of very valuable biomolecules, biomass production and fermentor design.[7,11] Structural and developmental biology, modelling, population genetics, ecology, epidemiology, molecular biology, medication design, bioinformatics, as well as routine calculations in scientific research and bio-reagent formulations, all require a working knowledge of mathematics and statistics.[12] Even though a biologist does not necessarily need to have a strong background in mathematics, the simple additions, subtractions, multiplications, and divisions, statistical tools, micro level units, and a few equations are crucial components of the biological research and biotechnology-based industries.[13] The use of mathematics will be of utmost relevance in the future as scientific knowledge of biological signals, biological chips, biological memory cards, cells, digital storage of data in biomolecules like DNA. In summary, it can be deduced logically that, just as physics served as the 19th century equivalent of a battleground where mathematics and reality clashed, biology will serve as the biggest intellectual challenge of this century and mathematics will play a significant role in their practical applications for human welfare.[8,15] The two most lucrative technologies in the world are going to be the artificial intelligence and biological cells in next thirty years.[8,16] The use of biological cell-based systems, such as nutritional therapy (functional foods including probiotics), will replace chemotherapy. Biotechnology based cell biomass production will help to increase food quality and quantity both.[15,17] The future of environmental purification will be built on microbial cells, bioenergy and bio-electricity, where mathematics will be crucial.[18] The development of new ideas or interpretations in general chemical and mechanical engineering has been driven by the drug and biopharmaceutical sectors, which have been a restricted source of imaginative and original technologies or machinery (Figure 1) showing the strategies to design mathematical models. Mechanical innovation is urgently needed in the pharmaceutical sector to facilitate the production of drugs for human use. Due to the current limits on technological resources, it has been difficult to develop and manufacture complex processes pharmaceuticals that are safe for people on a commercial scale, and to incorporate them into common therapeutic use.[2,14] The “one size fits all” philosophy underlies current prescription practices; nonetheless, some crucial areas of medicine need for unique approaches, necessitating new pharmaceutical development procedures.[3,4,13] New and innovative pharmaceutical goods and procedures, based on new analytic instruments and precise portions, are now possible to facilitate the advancements in genetics and diagnostics based on biosensors (Figure 2). It will revolutionize the medical diagnostic system as the biological cells are being exploited for their sensory properties. The effectiveness of this sector would increase with the development of customized drugs, treatment using gene transplantation (CRISPR-Cas-9 technology), tissue engineering for culture of organs that are adapted to the biology of the patient.[14] The challenges of personalized medication cannot be resolved at the existing level of medical plan advancement and assembly and the practical applications of AI based models will solve this issue in next 10-15 years. The pharmaceutical sector needs novel manufacturing arrangements that enable the adaptive assembling of specialized equipment and technologies.[3] The general public has embraced intelligent medical technologies (*i.e.*, AI-powered ones) in part because they enable the 4P model of medicine (Predictive, Preventive, Personalized, and Participatory),[15] which increase patient’s autonomy. For instance, smartphones are increasingly being used to fill out and distribute electronic personal health records,[16] monitor vital functions with biosensors, and help patients to achieve optimal therapeutic outcomes.[17] The emergence of augmented medicine, or the application of modern medical technology to enhance various facets of clinical practice, is made possible by the development of intelligent medical technologies.[18] The Food and Drug Administration (FDA) has approved several AI-based algorithms in the last ten years; as a result, they could be used.[19,20] In addition to AI-based technology, augmented medicine is made possible by a number of additional digital tools,[21] including surgical navigation systems for computer-assisted surgery[22] and vitality-reality continuum tools for pain management and psychiatric problems.[11,19]

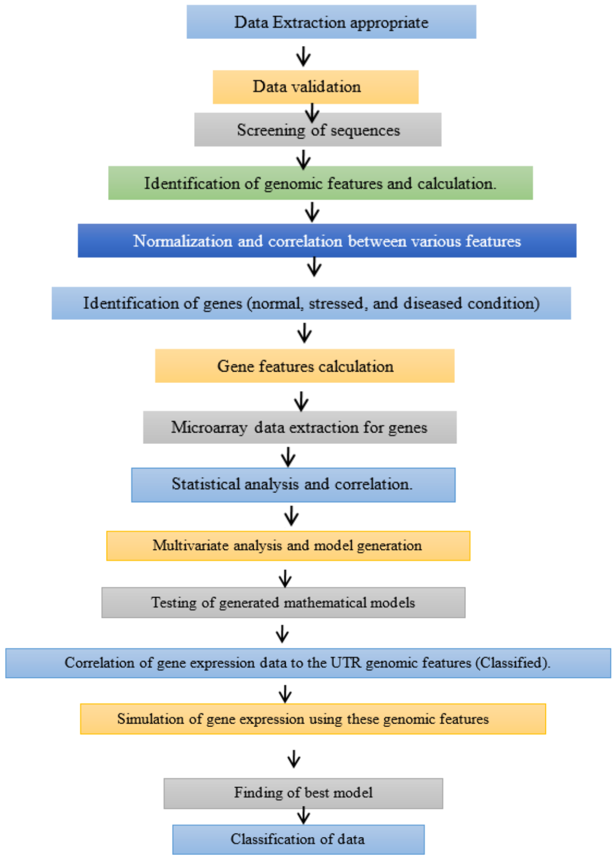

Figure 1 Various strategies to design and develop mathematical models.

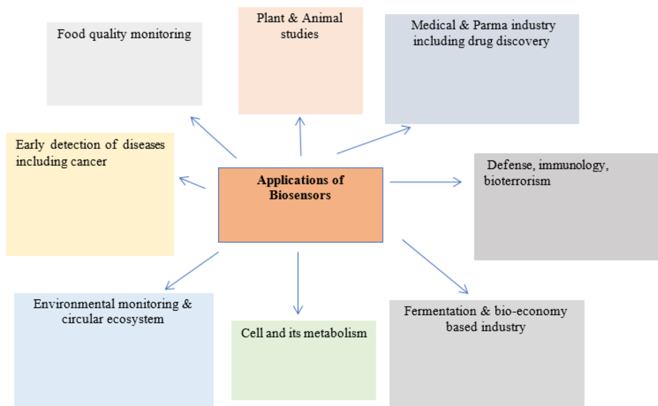

Figure 2 Few important applications of biosensors in various fields.

Artificial intelligence (AI) is being used more frequently, which will probably alter how clinical evaluations and trainings are conducted[14] Figure 3 shows the various possible applications of artificial intelligence (AI) in the medical field. To ensure that the potential of AI to dramatically improve medical care is realized, doctors can

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engage in the development of this technology for application in the medical and pharmaceutical industries.[23] There are now four main methods that AI is applied in the pharmaceutical sector. The first is in determining the extent of the illness and forecasting, even before the treatment is started, if it will be effective for a certain patient. Second, it is employed to avoid or resolve issues that may arise during therapy. As an aid during patient treatment procedures or operations is its third primary purpose.[3,14] It is also used to develop or extrapolate new uses for instruments or drugs to increase safety and efficacy, as well as to understand the rationale behind the use of specific instruments or chemicals during therapy.[20,23]

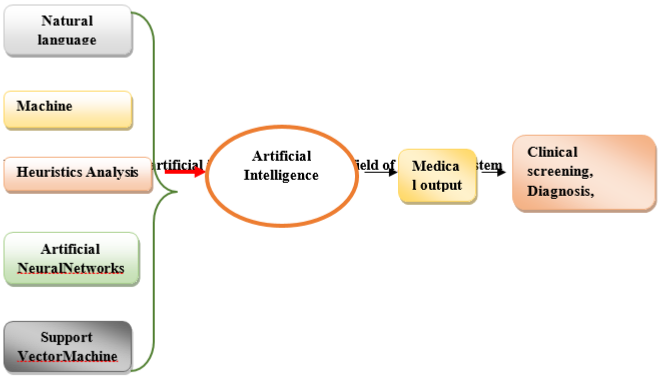

Figure 3 Artificial Intelligence in the medical field.

Despite the fact that the field of augmented medicine appears to be successful with patients, it can run into some opposition from medical professionals, especially doctors.[24] Four generally discussed arguments need to be given to explain this phenomenon. Secondly, a clear absence of fundamental and ongoing education in this field contributes to people's lack of understanding of the possibilities of digital medicine.[11,25] Second, the early digitization of healthcare processes, which was very different from the promise of augmented medicine, was accompanied by a sharp increase in the administrative burden, which was primarily associated with electronic health records and is now recognized as one of the primary causes of physician burnout.[26] Third, despite the prevalent and present view in the literature that AI will eventually complement physician intelligence,[27] there is growing concern about the possibility of AI replacing doctors.[28] Fourth, the physician utilizing AI is vulnerable to potential legal repercussions because there is currently no global legal framework defining the idea of liability in the case of adoption or rejection of algorithm recommendations.[14,29] Several private medical schools are educating their future medical leaders to the challenge of augmented medicine by both integrating digital health literacy[30] and use into an enhanced curriculum or by linking the medical curriculum with the engineering curriculum.[31,32] Various steps of Artificial Intelligence in the medical field are summarized in Figure 3.

This paper aims to summarize recent developments in AI in medicine, provide the main use-cases where AI-powered medical technologies can already be used in clinical practice, and perspectives on the difficulties and dangers that healthcare providers and institutions face when implementing augmented medicine, both in clinical practice and in the training of future medical leaders.

Applications of artificial intelligence in human medicare system

Gastroenterology

Gastroenterology is a field that benefits from a variety of uses of AI in clinical settings. Convolution neural networks and other deep learning models were used by gastroenterologists to analyze pictures from endoscopy[14,34] and ultrasound[33] and find aberrant structures like colonic polyps.[34] In addition to diagnosing esophageal squamous cell carcinoma,[35] metastasis in colorectal cancer,[36] gastro esophageal reflux disease[37] and atrophic gastritis,[38] artificial neural networks have also been used to forecast outcomes in gastrointestinal bleeding, esophageal cancer survival[39] and inflammatory bowel disease.[40,41] The use of biosensors will enhance the early and accurate diagnosis. The data collected may be statistically analyzed to formulate better treatment strategies. Laser driven technology coupled with mathematical modeling will become the ideal diagnostic system in next 10 years. To maximize intestine microbial colonization and subsequent therapeutic advantages, oral distribution of precision probiotics should be a planned approach. Excipients can exert considerable impacts on probiotic proliferation. This work is one of the first in the field of pharmaceutical sciences to employ active machine learning to the investigation of the microbiome. Working with tiny datasets, active machine learning is the best method for utilising the advantages of artificial intelligence.

Pulmonary medicine

It has been suggested that the interpretation of lung function tests is a promising area for the creation of AI applications in pulmonary medicine. In the instance of analyzing the results of pulmonary function tests, a recent study showed how AI-based software offers more accurate interpretation and acts as a decision support tool.[32,42] The study was subject to a number of criticisms, one of which was how the study's pulmonologists' rate of accurate diagnosis was significantly lower than the national norm.[43,44] The recent Covid-19 pandemic has invited the attention of the world medical microbiologists towards the throat and lungs infections. Newly emerging strains of infectious microbes will be identified using AI based diagnostic tools to better fight with the future pandemics. The recent strains of Influenza A, B, C and D types with various subtypes are now been identified using AI and ML. ML and AI have been having a substantial impact on the identification and categorization of interstitial lung illnesses, and they have the potential to transform many aspects of respiratory care, notably in the field of medical imaging. The mathematical models have been developed to predict the future epidemics and to plan better strategies to fight the pathogens. It is predicted that the next pandemic after Covid-19, will include lung based respiratory ailments and then AI will play a significant role in mass diagnosis and prescription. For drug designing, the use of AI based tools including bioinformatics will change the medical system by 2050 and microbial based drugs including probiotics and functional foods will become common strategy to manage the diseases for human welfare.

Nephrology

Clinical nephrology has used artificial intelligence in a number of settings.[44] Examples include predicting the progression of IgA nephropathy and determining risk for glomerular filtration rate reduction in patients with polycystic kidney disease.[45] A recent analysis, however, shows how the sample size required for inference currently limits research.[46] In recent years, the kidney associated diseases have become common mainly because of the unplanned strategies to fight microbial infections in developing countries. AI based technology will facilitate the identification of antibiotic resistant microbes and the planning of better treatment strategies. AI/ML-based solutions could make it easier for smart choices to be made, improving continuous kidney replacement therapy (CKRT) goal-oriented deliverables, resource allocation, and patient-relevant outcomes. The systematic and dynamic risk classification, sub-phenotyping, quality assurance, as well as improved decision-making for the beginning of CKRT, dose

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modifications, and anticoagulation control are examples of potential applications of AI/ML in CKRT.

Inflammatory bowel disease

Inflammatory bowel disease (IBD) endoscopic assessment can be subjective, and differences in disease severity assessment might result in different therapeutic approaches and patient outcomes.[47] With some success, artificial intelligence (AI) methods have been created to standardize endoscopic assessment in IBD.[48] A system that successfully distinguished between normal mucosa (Mayo 0) and a "mucosal healing state" (Mayo 0 to 1) is one example. Remission (Mayo 0 or 1) and moderate or severe disease (Mayo 2 or 3) could be distinguished by another comparable approach. These models were created using conventional WL endoscopy. AI may one day be able to completely replace pathologic inspection of biopsy specimens.[49] A system created for use with endo-cytoscopy was able to instantly assess both the endoscopic and histologic severity of IBD.[47,49] The application of AI for IBD is probably also going to spread to clinical trials and endoscopic reading centres.[49,50] Gut microbiome is responsible for 70% of the immunity and the recent advancement in non-invasive diagnosis will become a common technology in next decade.[56,58] The research at Shobhit Institute of Engineering & Technology (SIET), Meerut have shown that the gut microbiome can fight with majority of stomach infections including depression. The populations of happy bacteria (*Bifidobacterium* sp.) are enhanced by incorporating high fibre based vegetable in diet.[62,63] The recent studies have revealed that the type of food determine the quality of gut microbiome that gives the signals to brain which control all body functions.[59-63] On perusal of vedic literature, it is clear that the type of food determine the mood of the human and modern scientific research have proved that mood of human is controlled by food through gut microbiome.

Cardiology

One of the first uses of AI in medicine was the early diagnosis of atrial fibrillation. In 2014, the FDA approved AliveCor's mobile application Kardia, enabling smartphone-based ECG monitoring and atrial fibrillation detection.[50] In mobile patients, remote ECG monitoring with Kardia is more likely to detect atrial fibrillation than usual care, according to the current REHEARSE-AF research.[51] Also, Apple received FDA certification for the Apple Watch 4, which enables simple ECG acquisition and atrial fibrillation diagnosis and facilitates sharing with the practitioner of your choice through a smartphone. There have been a number of criticisms of wearable and portable ECG technologies addressed,[52] highlighting their drawbacks such as the false positive rate caused by movement artefacts and difficulties in implementing wearable technology in elderly patients who are more likely to experience atrial fibrillation.[50,52] AI has been utilized to predict the risk of cardiovascular illness, such as acute coronary syndrome[53] and heart failure[54] better than conventional scales, when applied to electronic patient information. However, more recent thorough reviews[55] have noted how the sample size employed in a study report might affect the outcomes. The diagnosis and control of various cardiac ailments is still under the purview of AI based technology and in coming years, 3-d printing and the culture of organs using AI and ML will entirely change the medical health system in next 3 decades.

Endocrinology

Patients with diabetes can examine interstitial glucose readings in real-time using continuous glucose monitoring, which also offers data on the direction and rate of change of blood glucose levels.[56] For its smartphone-compatible Guardian glucose monitoring system, Medtronic gained FDA certification.[57] For their Sugar.IQ solution, the business teamed up with Watson (AI created by IBM) in 2018 to help their customers better prevent hypoglycemia episodes based on repeated assessment. Continuous blood glucose monitoring can help patients improve their blood glucose control and lessen the stigma associated with hypoglycemic episodes, but a study on patients' experiences with the technology found that while participants expressed confidence in the notifications, they also admitted to feeling personally inadequate to control their blood glucose levels.[14,35,57] The entire endocrinological diagnosis is based on biosensor based technology.

Will AI replace doctors in the medical field?

Doctors won't likely be replaced by AI, as has lately been suggested in the literature,[29, 30] because smart medical technologies already exist to assist clinicians in better patient management. Nonetheless, as recent studies have shown[1, 10] comparisons between artificial intelligence solutions and doctors regularly take place, as if the two counterparts, were in competition. Figure 4 show the *In-silico* Analysis of Bioinformatics Future research should compare doctors who use artificial intelligence apps versus doctors who don't, and should include translational clinical trials in those comparisons. Only then will artificial intelligence be acknowledged as a medical supplement. Although a significant overhaul of medical education is required to give future leaders the skills to do so, healthcare professionals are currently in a unique position to welcome the digital transformation and be the key drivers of change. This is the most interesting question which is being asked by public from the heath care professional that "Will AI replace Doctors in medicare system?" The answer is simple, yes to some extent but the doctors will not and can't be entirely replaced.

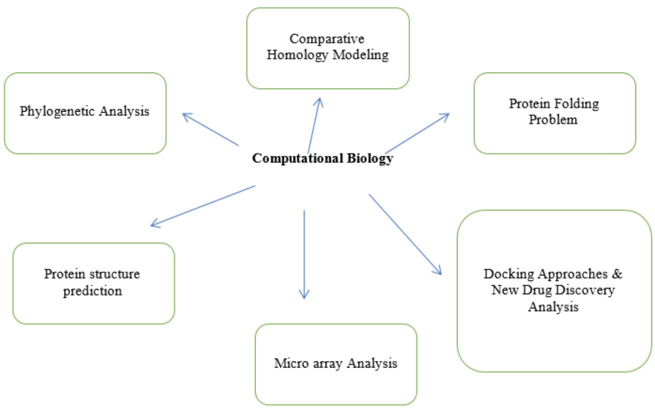

Figure 4 *In silico* Analysis of bioinformatics.

Conclusion

A promising area of research and development is the application of artificial intelligence in clinical practice, which is developing quickly alongside other cutting-edge disciplines like precision medicine, genomics, and tele-consultation. Drug research is anticipated to undergo a revolution as a result of integrating AI and machine learning, but there are still a number of obstacles to overcome, such as the need to clean up unstructured and diverse datasets and occasional computing equipment incompetence. The pharmaceutical sector will enter a new era once these obstacles are removed, allowing machine learning and AI to be more widely used and enhanced. Health policies should now be concentrated on addressing the ethical and financial challenges related with this pillar of the evolution of medicine, while scientific research should continue to be rigorous and transparent in creating new solutions to better modern healthcare.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

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