Artificial Intelligence in Medicine: An Endeavor to the Future

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ABSTRACT In this special issue of *Israel Medical Association Journal* (*IMAJ*) we expose readers to the topic of artificial intelligence (AI) in medicine. AI has become a powerful tool, which enables healthcare professionals to personalize treatment based on many factors, including genetic analyses of tumors, and to consider other co-morbidities affecting a specific patient. AI gives physicians the ability to analyze huge amounts of data and to combine data from different sources. AI can be implemented make a diagnosis based on computed tomography (CT) scans and magnetic resonance imaging (MRI) scans using deep machine learning and data that are stored in the memory of mega computers. AI assists in tailoring more precise surgery to train surgeons before surgery and to support surgeons during procedures. This advancement may benefit surgical procedures by making them more accurate and faster; thus, patients face fewer complications, lower rates of infection, and more operation theater time. In this issue, we include three original studies that describe the use of AI in clinical medicine and academia and eight review articles that discuss applications of AI in different specialties in medicine. One of the review articles addresses ethical issues and concerns that are raised due to the more advanced use of AI in medicine.

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Exponential discoveries in medical sciences are rapidly progressing, with huge amounts of data from different fields in science. It is impossible to combine and access this vast knowledge without using advanced artificial intelligence (AI) technologies.

AI in medicine is a powerful tool that enables physicians, together with scientists, to tailor personalized treatment based on many factors, including, for example genetic analyses of tumors, and to consider other co-morbidities of a specific patient.

AI enables researchers to analyze huge amounts of data within seconds, to combine data from different sources, and to use the data in a timely manner to tailor a specific treatment for an individual patient.

Sophisticated imaging technologies may support diagnoses based on computed tomography (CT) or magnetic resonance imaging (MRI) scans, using deep machine learning and data that are stored in the memory of mega computers. Advanced AI techniques may help with diagnoses based on images alone, without human involvement, with the advantage that these diagnoses can be conducted 24/7 without the machine ever tiring, as humans do.

However, we must develop AI technologies that can oversee the protocols used, to ensure that no mistakes or misinterpretation occur.

There are also ethical issues concerning AI. Who will be responsible for the surgery? Who will oversee the process of data mining and using data wisely and without machine-based mistakes?

We know that AI is used to diagnose tumors by interpreting CT images based on millions of similar images, which may lead to a much better accuracy and appropriate diagnosis and treatment.

In this issue of *IMAJ*, we collected original and review articles that communicate the cutting-edge knowledge of AI in medicine.

Loebl, Wertheim, and Perl [1] described their experience in establishing an AI center at a tertiary medical center, the added value of using AI in medicine, and the need to build an AI center at the medical center to enable physicians and scientists to focus on AI, to exchange ideas and experience with engineers and colleagues, and to promote and adopt projects of advanced technologies based on AI in different departments at the medical center. Building a center of AI at the hospital encouraged physicians to promote innovative and imaginary projects.

The physicians could implement their innovative ideas quickly and promote medical care using AI.

Tessler et al. [2] conducted a meta-analysis of 27 studies that explored the use of natural language processing (NLP) to develop language models like ChatGPT in medicine. ChatGPT can be a useful tool to gather research ideas and to perform clinical analyses. However, this tool has limitations, such as inaccurate data analysis, and ethical issues. There is no doubt that this AI system needs to be improved before it can be implemented for clinical purposes. The authors concluded that ChatGPT can be a useful tool to support big data mining but cannot be considered as the sole tool to make clinical decisions.

Ozeri and colleagues [3] described their experience using ChatGPT for academic purposes as well as answering academic questions in medicine and to discovering interesting outcomes. They found that using ChatGPT in Hebrew was not accurate and could not correctly answer the questions on the board exams for internal medicine. ChatGPT has been examined in the American boards, and it was found to answer correctly. Thus, a language gap was found, which poses limitations of AI in the academic milieu.

Dvir and Shoenfeld [4] published an editorial summarizing the advantages of AI in different fields in medicine, including ophthalmology, cardiology, imaging, and genetics. They also addressed ethical concerns, mainly due to a machine handling health data autonomously and treating patients without a human touch.

One of the medical fields that is already using AI is ophthalmology. Gal-Or and co-authors [5] described how AI is used to achieve a more accurate diagnosis, to analyze results, and to predict outcomes of specific treatments. AI techniques based on deep machine learning support diagnosing vision-threatening diseases like diabetic retinopathy, glaucoma, age-related macular degeneration, and retinopathy of prematurity. AI is used for screening the severity of diabetic retinopathy with the same level of accuracy as experts in the specific field. Glaucoma, if not discovered in time, can cause irreversible damage to vision. Studies have shown that AI techniques can identify early visual field damage. Timely diagnosis and intervention can prevent irreversible damage.

Shair and Soudry [6] described AI in retinal medicine. Computer vision improved the segmentation of visual information. With rapid analysis, big data can help to identify patterns typical of different stages in retinal disease and enable timely intervention that may prevent catastrophic damage and blindness. AI technologies may support classification, predict outcomes, and prioritize patients based on urgency of surgical interventions.

Perl and co-authors [7] reviewed the role of AI in cardiology, focusing on the role of AI in disease detection and prediction, in improving precision medicine in interventional cardiovascular procedures, in improving patient wellbeing, and in reducing hospitalizations.

The AI revolution has come to electrocardiogram interpretation and diagnosis of acute coronary heart disease by assessing the potential need for emergency intervention and predicting the development of atrial fibrillation. AI has improved accurate assessment of coronary artery lesions, one of the major issues in invasive cardiology. AI also contributes to CT assessment of coronary artery disease, including plaque composition and prediction of plaque rupture, and in MRI of the myocardium [7].

Nathan and colleagues [8] described how AI can support management of chronic diseases like heart failure, diabetes mellites, and chronic lung disease. AI can help in assessing risk so that resources can be more efficiently and effectively allocated to patients, thereby minimizing unexpected visits to the emergency department due to the progression of chronic heart failure. Interventions could begin earlier to prevent deterioration and to reduce emergency situations, hospitalizations, and the burden on healthcare systems.

Tsiogkas and colleagues [9] explained how AI can improve management of patients presenting with autoimmune diseases like psoriasis. AI enables physicians to predict responses to treatment by analyzing data of cells characteristics measured by flow cytometry and tailoring a specific therapy for a specific patient so that treatment will be more effective and safer [9].

Sorin and Klang [10] described an interesting phenomenon (the emergence phenomenon) that was discovered only after using AI for NLP. Emergence means unpredictable discoveries that are found through using simpler components. The combination of different research fields may create an unexpected new discovery. For example, by using NLP to analyze huge amounts of medical records, researchers may discover unexpected outcomes, like the ability to predict a future heart attack by measuring bilirubin levels. Even though such data are not mechanistically understood and have not been investigated in the laboratory, such an interaction could be interesting and may suggest new frontiers in medical research. We must consider the ethical issues of AI because

unpredictable results may be unethical, and it would be difficult to regulate and control such findings; therefore, every emergent phenomenon should be created under regulations and limitations, including ethical limitations. These unexpected results could be harmful to patients and should be regulated and supervised by physicians who are experts in the field.

Wimpfheimer and Kimmel [11] illuminated AI in medical imaging. AI algorithms help to interpret chest X-rays and CT scans. Even though in the beginning there were mistakes, in recent years the AI algorithms have improved, and the interpretations are more accurate. Another advantage is the ability of AI algorithms to prioritize patients who had previously undergone a CT scan image according to the image interpretation.

Ben Shetrit, Daghash, and Sperling [12] raised some concerns about AI use in medical issues like end-of-life concerns. They discussed the legal, ethical, cultural, and religious perspectives as well as the ability to overcome obstacles.

CONCLUSIONS

AI in medicine is a powerful tool that may be used as a platform to upgrade accuracy in diagnosis and to tailor personal medical care. It may support research and novel findings to enable more efficient medical care, improve care in medical organizations, support clinicians, and facilitate more accurate diagnoses in a timely fashion.

There are ethical and legal concerns involved in non-human machine-decision processes, and we need to create regulatory procedures and safety systems that will oversee the whole process of AI-decision protocols in medicine and medical science.

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Capsule

How to promote thymus regeneration

The thymus undergoes transient but reversible involution in response to stress stimuli, but the molecular mechanisms mediating thymic regeneration after involution are not well defined. **Nevo** et al. performed single-cell RNA sequencing on the thymic non-T cell compartment after dexamethasone-induced acute thymic involution in mice. This treatment promoted a type 2 immune response driven by thymic-resident innate lymphoid cells type-2 (ILC2s), which were activated in response to tissue damage by cytokines produced by thymic tuft cells and fibroblasts. ILC2s were required for tissue regeneration by producing effector molecules that promoted medullary thymic epithelial cell differentiation. Together, these findings identify a thymic tuft cell–fibroblast–ILC2 axis required for thymic regeneration after acute thymic involution.

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