

Artificial Intelligence in Medicine & Healthcare

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Research one (Basic)



Abstract

Artificial Intelligence-powered medical technologies are rapidly evolving into applicable solutions for clinical practice. Deep learning algorithms can deal with increasing amounts of data provided by wearables, smartphones, and other mobile monitoring sensors in different areas of medicine. Currently, only very specific settings in clinical practice benefit from the application of artificial intelligence, such as the detection of atrial fibrillation, epilepsy seizures, and hypoglycemia, or the diagnosis of disease based on histopathological examination or medical imaging.



Abstract

The implementation of augmented medicine is long-awaited by patients because it allows for a greater autonomy and a more personalized treatment, however, it is met with resistance from physicians which were not prepared for such an evolution of clinical practice. This phenomenon also creates the need to validate these modern tools with traditional clinical trials, debate the educational upgrade of the medical curriculum considering digital medicine as well as ethical consideration of the ongoing connected monitoring. The aim of this paper is to discuss recent scientific literature and provide a perspective on the benefits, future opportunities and risks of established artificial intelligence applications in clinical practice on physicians, healthcare institutions, medical education, and bioethics.



Current Applications of Artificial Intelligence in Medicine

• Atrial Fibrillation (happens when abnormal electrical impulses suddenly start firing in the atria)

The early detection of atrial fibrillation was one of the first application of AI in medicine.

AliveCor received FDA (The Food and Drug Administration) approval in 2014 for their mobile application Kardia allowing for a smartphone-based ECG (Electrocardiogram is a simple test that can be used to check your heart's rhythm and electrical activity) monitoring and detection of atrial fibrillation.

The recent REHEARSE-AF (Asymptomatic atrial fibrillation (AF) is increasingly common in the aging population and implicated in many ischemic strokes) study showed that remote ECG monitoring with Kardia in ambulatory patients is more likely to identify atrial fibrillation than routine care.

Atrial Fibrillation

Apple also obtained FDA approval for their Apple Watch 4 that allows for easy acquirement of ECG and detection of atrial fibrillation that can be shared with the practitioner of choice through a smartphone. Several critiques of wearable and portable ECG technologies have been addressed, highlighting limitations to their use, such as the false positive rate originated from movement artifacts, and barriers in the adoption of wearable technology in the elderly patients that are more likely to suffer from atrial fibrillation.

Gait, Posture, and Tremor Assessment

Wearable sensors have proven useful to quantitatively assess gait, posture, and tremor in patients with multiple sclerosis, Parkinson disease, Parkinsonism, and Huntington disease.

Medical Imaging and Validation of AI-Based Technologies

A long-awaited meta-analysis compared performances of deep learning software and radiologists in the field of imaging-based diagnosis: although deep learning seems to be as efficient as radiologist for diagnosis, the authors pointed that 99% of studies were found not to have a reliable design; furthermore, only one thousandth of the papers that were reviewed validated their results by having algorithms diagnose medical imaging coming from other source populations. These findings support the need of an extensive validation of Al-based technologies through rigorous clinical trials.

Cardiovascular Risk

Applied to electronic patient records, AI has been used to predict the risk of cardiovascular disease, for instance acute coronary syndrome and heart failure better than traditional scales. Recent comprehensive reviews have however reported how results can vary depending on the sample size used in research report.

Challenges and Future Directions of Artificial Intelligence in Medicine

Validation of AI-Based Technologies

One of the core challenges of the application of AI in medicine in the next years will be the clinical validation of the core concepts and tools recently developed. Although many studies have already introduced the utility of AI with clear opportunities based on promising results, several well recognized and frequently reported limitations of AI studies are likely to complicate such validation. We will hereby address three of such limitations, as well as provide possible ways to overcome them.

First, the majority of studies comparing efficiency of AI vs. clinicians are found to have unreliable design and known to lack primary replication, i.e., the validation of the algorithms developed in samples coming from other sources than the one used to train algorithms.



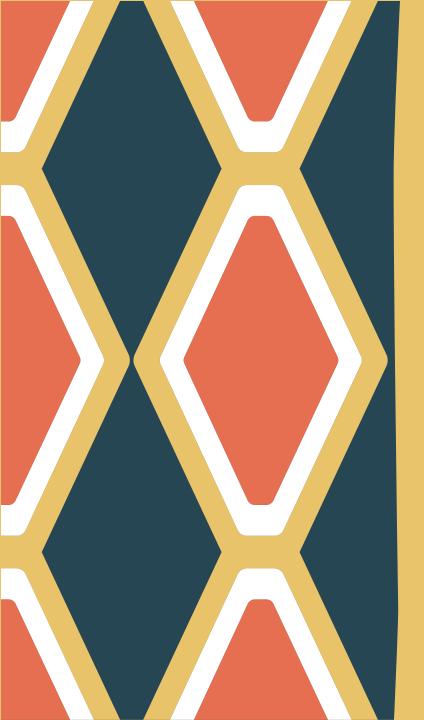
Validation of Al-Based Technologies

This difficulty could be overcome in the open science era as open data and open methods are bound to receive more and more attention as best practices in research. However, transitioning to open science could prove difficult for medical Al companies that develop software as a core business.

Second, studies reporting AI application in clinical practice are known to be limited because of retrospective designs and sample sizes; such designs potentially include selection and spectrum bias, i.e., models are developed to optimally fit a given data set (this phenomenon is also known as overfitting), but do not replicate the same results in other datasets.







Validation of AI-Based Technologies

Continuous reevaluation and calibration after the adoption of algorithms that are suspected of overfitting should be necessary to adapt software to the fluctuation of patient demographics. Furthermore, there is a growing consensus as of the need of development of algorithms designed to fit larger communities while taking into account subgroups.

Third, only few studies are known to compare AI and clinicians based on same data sets; even in that scenario, critiques have been made pointing at lower diagnostic accuracy rate than expected in specialty doctors. Opposing AI and clinicians is, although well represented in the scientific literature, probably not the best way to tackle the issue of performance in medical expertise: several studies are now approaching the interaction between clinicians and algorithms as the combination of human and artificial intelligence outperforms either alone.

Will Doctors Be Replaced by Artificial Intelligence?

As recently discussed in the literature doctors will most likely not be replaced by artificial intelligence: smart medical technologies exist as such as support to the physician in order to improve patient management. As recent studies have indicated, however, comparisons frequently occur between artificial intelligence solutions and physicians, as if the two counterparts were in competition. Future studies should focus on the comparison between physicians using artificial intelligence solutions with physicians without the aid of such applications and extend those comparisons to translational clinical trials; only then will artificial intelligence be accepted as complementary to physicians. Healthcare professionals stand nowadays in a privileged position, to be able to welcome the digital evolution and be the main drivers of change, although a major revision of medical education is needed to provide future leaders with the competences to do so.



The implementation of artificial intelligence in clinical practice is a promising area of development, that rapidly evolves together with the other modern fields of precision medicine, genomics and teleconsultation. While scientific progress should remain rigorous and transparent in developing new solutions to improve modern healthcare, health policies should now be focused on tackling the ethical and financial issues associated with this cornerstone of the evolution of medicine.

Questions & Answers

Thanks for your attention

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Resources

List the resources I used for my research:

- Future Healthcare Journal
- The words of DR. Meghdari
- Some online articles