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Penetration of AI in Global Health Care

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Artificial intelligence (AI) and related technologies are increasingly prevalent in business and society, and are beginning to be applied to healthcare. These technologies have the potential to transform many aspects of patient care, as well as administrative processes within provider, payer and pharmaceutical organizations.

There are already a number of research studies suggesting that AI can perform as well as or better than humans at key healthcare tasks, such as diagnosing disease. Today, algorithms are already outperforming radiologists at spotting malignant tumors, and guiding researchers in how to construct cohorts for costly clinical trials. However, for a variety of reasons, we believe that it will be many years before AI replaces humans for broad medical process domains.

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Types of AI relevance to healthcare

Artificial intelligence is not one technology, but rather a collection of them. Most of these technologies have immediate relevance to the healthcare field, but the specific processes and tasks they support vary widely. Some particular AI technologies of high importance to healthcare are defined and described below:

Machine learning – neural networks and deep learning

In healthcare, the most common application of traditional machine learning is precision medicine – predicting what treatment protocols are likely to succeed on a patient based on various patient attributes and the treatment context. The great majority of machine learning and precision medicine applications require a training dataset for which the outcome variable (eg onset of disease) this is called supervised learning.

A more complex form of machine learning is the *neural network* – a technology that has been available since the 1960s has been well established in healthcare research for several decades and has been used for categorization applications like determining whether a patient will acquire a particular disease. It views problems in terms of inputs, outputs and weights of variables or 'features' that associate inputs with outputs. It has been likened to the way that neurons process signals, but the analogy to the brain's function is relatively weak.

Natural language processing

Making sense of human language has been a goal of AI researchers since the 1950s. This field, NLP, includes applications such as speech recognition, text analysis, translation and other goals related to language. There are two basic approaches to it: statistical and semantic NLP. Statistical NLP is based on machine learning (deep learning neural networks in particular) and has contributed to a recent increase in accuracy of recognition. It requires a large 'corpus' or body of language from which to learn.

In healthcare, the dominant applications of NLP involve the creation, understanding and classification of clinical documentation and published research. NLP systems can analyze unstructured clinical notes on patients, prepare reports (eg on radiology examinations), transcribe patient interactions and conduct conversational AI.

Rule-based expert systems

Expert systems based on collections of 'if-then' rules were the dominant technology for AI in the 1980s and were widely used commercially in that and later periods. In healthcare, they were widely employed for 'clinical decision support' purposes over the last couple of decades and are still in wide use today. Many electronic health record (EHR) providers furnish a set of rules with their systems today.

Expert systems require human experts and knowledge engineers to construct a series of rules in a particular knowledge domain. They work well up to a point and are easy to understand. However, when the number of rules is large (usually over several thousand) and the rules begin to conflict with each other, they tend to break down. Moreover, if the knowledge domain changes, changing the rules can be difficult and time-consuming. They are slowly being replaced in healthcare by more approaches based on data and machine learning algorithms.

Robotic process automation

This technology performs structured digital tasks for administrative purposes, that is those involving information systems, as if they were a human user following a script or rules. Compared to other forms of AI they are inexpensive, easy to program and transparent in their actions. Robotic process automation (RPA) doesn't really involve robots – only computer programs on servers. It relies on a combination of workflow, business rules and 'presentation layer' integration with information systems to act like a semi-intelligent user of the systems. In healthcare, they are used for repetitive tasks like prior authorization, updating patient records or billing. When combined with other technologies like image recognition, they can be used to extract data from, for example, faxed images in order to input it into transactional systems.

We've described these technologies as individual ones, but increasingly they are being combined and integrated; robots are getting AI-based 'brains', image recognition is being integrated with RPA. Perhaps in the future these technologies will be so intermingled that composite solutions will be more likely or feasible.

Diagnosis and treatment applications

Diagnosis and treatment of disease has been a focus of AI since at least the 1970s, when MYCIN was developed at Stanford for diagnosing blood-borne bacterial infections. This and other early rule-based systems showed promise for accurately diagnosing and treating disease, but were not adopted for clinical practice. They were not substantially better than human diagnosticians, and they were poorly integrated with clinician workflows and medical record systems.

Implementation issues with AI bedevil many healthcare organizations. Although rule-based systems incorporated within EHR systems are widely used, including at the NHS, they lack the precision of more algorithmic systems based on machine learning. These rule-based clinical decision support systems are difficult to maintain as medical knowledge changes and are often not able to handle the explosion of data and knowledge based on genomic, proteomic, metabolic and other ‘omic-based’ approaches to care.

AI-based diagnosis and treatment recommendations are sometimes challenging to embed in clinical workflows and EHR systems. Such integration issues have probably been a greater barrier to broad implementation of AI than any inability to provide accurate and effective recommendations and many AI-based capabilities for diagnosis and treatment from tech firms are standalone in nature or address only a single aspect of care. Some EHR vendors have begun to embed limited AI functions (beyond rule-based clinical decision support) into their offerings, but these are in the early stages.

Patient engagement and adherence applications

Patient engagement and adherence has long been seen as the ‘last mile’ problem of healthcare – the final barrier between ineffective and good health outcomes. The more patients proactively participate in their own well-being and care, the better the outcomes – utilization, financial outcomes and member experience. These factors are increasingly being addressed by big data and AI.

Providers and hospitals often use their clinical expertise to develop a plan of care that they know will improve a chronic or acute patient's health. However, that often doesn't matter if the patient fails to make the behavioural adjustment necessary, eg losing weight, scheduling a follow-up visit, filling prescriptions or complying with a treatment plan. Noncompliance – when a patient does not follow a course of treatment or take the prescribed drugs as recommended – is a major problem.

In a survey of more than 300 clinical leaders and healthcare executives, more than 70% of the respondents reported having less than 50% of their patients highly engaged and 42% of respondents said less than 25% of their patients were highly engaged.

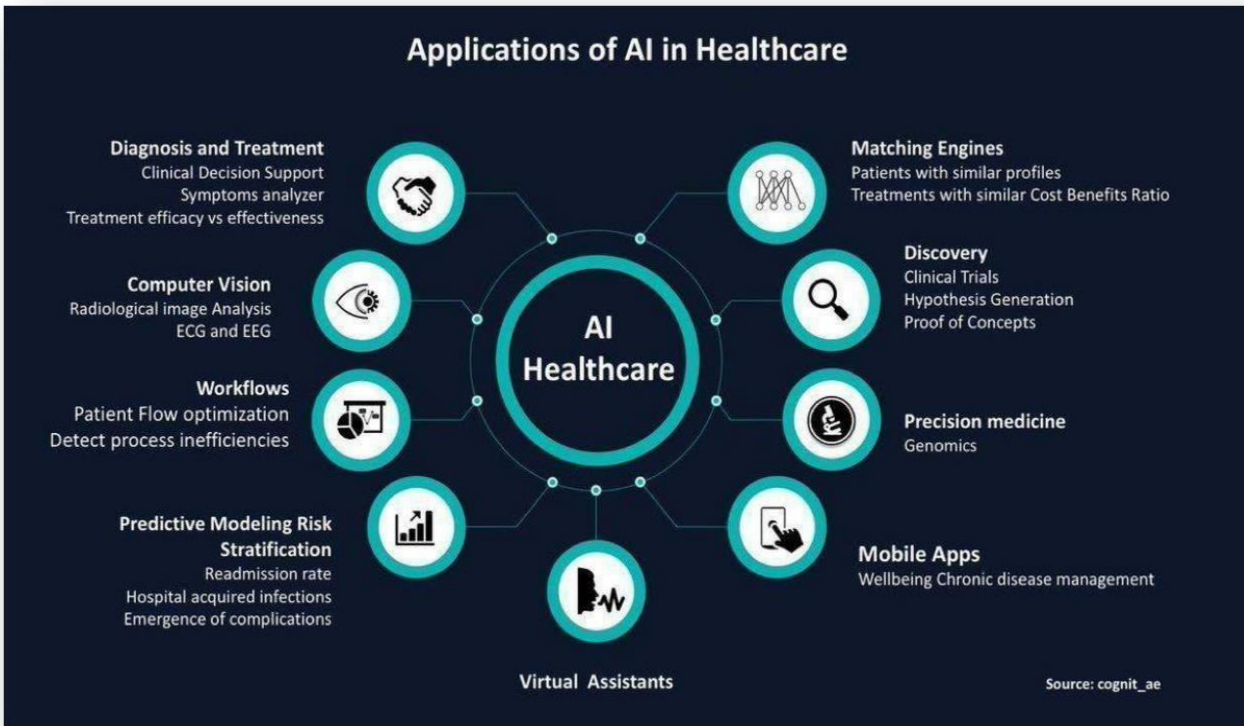
Another growing focus in healthcare is on effectively designing the 'choice architecture' to nudge patient behavior in a more anticipatory way based on real-world evidence. Through information provided by provider EHR systems, biosensors, watches, smartphones, conversational interfaces and other instrumentation, software can tailor recommendations by comparing patient data to other effective treatment pathways for similar cohorts. The recommendations can be provided to providers, patients, nurses, call-Centre agents or care delivery coordinators.

Challenges AI Facing in Global Health

The exact nature of challenges varies somewhat across groupings of AI use cases but the overall challenges are common to all (e.g. the type of data required for AI population health tools differs from those for patient-facing AI tools, but data availability and quality are challenges for both).

Administrative applications

There are also a great many administrative applications in healthcare. The use of AI is somewhat less potentially revolutionary in this domain as compared to patient care, but it can provide substantial efficiencies. These are needed in healthcare because, for example, the average US nurse spends 25% of work time on regulatory and administrative activities. The technology that is most likely to be relevant to this objective is RPA. It can be used for a variety of applications in healthcare, including claims processing, clinical documentation, revenue cycle management and medical records management.



The future of AI in healthcare

Bill Gates "*We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten*."

AI has an important role to play in the healthcare offerings of the future. In the form of machine learning, it is the primary capability behind the development of precision medicine, widely agreed to be a sorely needed advance in care. Although early efforts at providing diagnosis and treatment recommendations have proven challenging, we expect that AI will ultimately master that domain as well. Given the rapid advances in AI for imaging analysis, it seems likely that most radiology and pathology images will be examined at some point by a machine. Speech and text recognition are already employed for tasks like patient communication and capture of clinical notes, and their usage will increase.

Conclusion

With a plethora of issues to overcome, driven by well-documented factors like an aging population and growing rates of chronic disease, the need for new innovative solutions in healthcare is clear.

AI-powered solutions have made small steps towards addressing key issues, but still have yet to achieve a meaningful overall impact on the global healthcare industry, despite the substantial media attention surrounding it. If several key challenges can be addressed in the coming years, it could play a leading role in how healthcare systems of the future operate, augmenting clinical resources and ensuring optimal patient outcomes.