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Artificial Intelligence In Radiology Practice: The "Augmented Radiologist"

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Abstract:
Artificial intelligence (AI), which can "see" more than human radiologists in areas like tumor size, shape, morphology, texture, and kinetics, is highly anticipated in the medical field, especially in radiology. This will allow for better care through earlier detection or more accurate reports. AI is also capable of managing sizable data sets in high-dimensional environments. But it's important to remember that AI is only as good as the training data it has access to, which should ideally be enough to cover every variation. However, content knowledge and the capacity for near-optimal solution finding are the primary characteristics of human intelligence. Reviewing the complexity of radiology workplaces today and outlining their benefits and drawbacks is the aim of this paper. We also provide an overview of the various AI types and features that have been utilized thus far. We also discuss how AI and human intelligence differ in their ability to solve problems. We introduce "explainable AI," a new kind of AI that should allow for a balance or collaboration between AI and human intelligence, bringing both domains into compliance with legal requirements. We suggest developing an artificial intelligence (AI) assistant to assist (pediatric) radiologists, freeing up their brains for general tasks.

Keywords: Artificial intelligence, Radiology practice.

Introduction:

A crucial component of medical diagnostics is imaging. Although advanced technology is used to acquire images, the "human radiologist" is still responsible for interpreting them. People need nearly three decades of education in addition to continuing medical education (CME) to complete this difficult task. Perception and diagnostic errors persist in spite of all these efforts. New modalities and steadily rising temporal, geometric, and radiometric resolution are two benefits of maturing imaging technology, which raises the number of images per case. For instance, a trauma patient's CT scan may include up to 1,000 pictures. Furthermore, the interfaces of various imaging modalities are non- standardized and vary (Ravesloot, 2017).

Radiologists manage multiple interfaces and information technology (IT) systems in a workspace that resembles a cockpit with streaming data. All systems have limitations and preconceived notions about how they should be used, which hinders radiologists' ability to freely use their intellectual property when creating reports, even with their clear benefits. Artificial intelligence (AI) has the potential to impact nearly every aspect of medicine and enhance patient outcomes in numerous ways. It is anticipated that radiologists' reports will improve and become more accurate. Because AI will handle everything, some researchers have even declared radiologists to be extinct. examined the employment opportunities for radiologists in relation to AI use (Nguyen, 2019).

Thus, the aim of this paper is to outline the current environment of radiologists, including IT support, its intrinsic flaws, and the challenges of current AI applications. Furthermore, we outline a novel strategy known as "explainable AI" and explain how AI can support pediatric radiologists.

Artificial intelligence:

Alan Turing first proposed the concept of artificial intelligence (AI) in 1950 when he posed the question, "Can computers reason as well as humans?" Although this served as the foundation for numerous definitions, "AI represents the ability of a digital computer or computer- controlled robot to perform tasks commonly associated with intelligent beings" from a computer science standpoint. To complete those tasks, computers must use patterns and policies to inform their decisions and conclusions. The techniques employed are known as machine learning algorithms or machine learning methods (Neri, 2019).
Computer algorithms are used in machine learning to automatically get better with practice. Data analysis, model and model optimization (machine learning algorithms or methods are typically referred to as the model), and goal function or cost function (a term used for a function measuring the model's performance on a given task) are the three basic characteristics that all algorithms share (Choy, 2018).

Medical applications of artificial intelligence:

Radiomics is a technique that can assist with diagnosis by extracting a lot of features from images. In order to help with diagnosis, prognosis prediction, and therapy management for a variety of conditions, the general idea is to extract multiple image features, such as the size and shapes of various regions, descriptors of the image intensity histograms, different texture extractions or irregularities, etc. Software for computer- aided diagnosis is built on these characteristics. CAD software's primary goal is to boost productivity and decrease human labor. According to how features are extracted, CAD, as illustrated can be classified into two categories: deep learning AI CAD, where valuable features are proposed and learned by machine learning, and conventional CAD, where features are proposed by humans (Miyagawa, 2020).

Challenges and shortcomings of applied artificial intelligence in medicine:

AI is undergoing a massive renaissance due to the success of machine learning, especially deep learning. Successful radiology examples have been mentioned, but there are also new challenges. A significant issue with traceability and, consequently, explainability arises when AI systems are viewed as "black boxes." For radiologists, this means having the technical capabilities to be able to trace, comprehend, and interpret how AI produced results on demand. In order to make such "black box" approaches understandable to humans, a growing community is working in the field known as explainable AI (Longjiang, 2019).

How can radiology benefit from artificial intelligence?: There are numerous opportunities to integrate AI into radiology's everyday workflow. Re-engineering the human–computer interface is one example of a general application. Keyboards and mice have been the primary tools for decades. The only devices that allow for more intuitive finge use are smartphones, tablets, and certain laptop touchscreens. Using spoken instructions or gestures to communicate with IT systems is an additional strategy. By hovering notes over the relevant HIS sections, AI should alert users while operating in the background. The foundation for medical staff acceptance will be a complete HIS integration; they cannot choose to spend their time maintaining multiple IT systems.

Recommendations:

- AI could choose the most appropriate conference partner by examining the available personal profiles, and it should be simple to share with colleagues for a second opinion.

- Key images, videos, animations, and simulations should be able to be stored in the report, which can also be voice- or gesture-driven and copy information from other sources. Once more, information would be presented in an intuitive manner with hovering notes, and all of these tasks would operate in real time and in the background.

- Less description but more accurate results, such as quantitative data or proper scoring of even rare diseases, could have an impact on radiology reports. Combining human traits like creativity, problem-solving skills, content knowledge, and an exceptional, exemplary memory with AI- supported information management would enable this accomplishment.

- When taken as a whole, these AI applications can be thought of as radiologists' constant personal AI assistant.

- But in order to use AI effectively, a massive cross-domain collective effort is required, which includes: (a) increasing awareness; (b) ensuring that AI is ethical, social, and legal; and (c) education at all levels of curricula, from students to residents to continuing education. Redesigning the human-computer interface and developing methods for generating ground truth in large datasets are essential for engineers.

Conclusion:

In conclusion, A crucial component of medical diagnostics is imaging. People need to study for nearly thirty years and continue their medical education in order to complete this difficult task. Perception and diagnostic errors persist in spite of all these efforts. New modalities and steadily rising temporal, geometric, and radiometric resolution are two benefits of maturing imaging technology, which raises the number of images per case.

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