

## Artificial Intelligence in Radiology

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### ABSTRACT

Artificial intelligence is invading the medical practice and radiology field in particular. Many medical professionals concerned about replacing humans with robots to conduct medical examinations, diagnoses, and treatments. The aim of this paper is to explain-in details-the benefits and risks of artificial intelligence on radiology field and whether or not medical professionals' jobs will be in risk.

**Key words:** Artificial Intelligence; Robot; Machine Learning; Deep Learning; Radiology

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### EDITORIAL

Since an IBM's Deep Blue computer won the famous chess game against the top-rated human chess player Garry Kasparov in 1996<sup>[1]</sup>, the term artificial intelligence (AI) became more popular term. John McCarthy is an American computer scientist who was the first person to described AI in 1956<sup>[2]</sup>. According to Merriam Webster dictionary, AI is a machine that capable of imitating human behavioral intelligence<sup>[3]</sup>. In simple words, it can be described as machines that were made for collecting information, reaching definite or semi-definite conclusions, and self-checking for mistakes. There are two methods of AI learning; first method is machine learning (ML) which depend on algorithms that identify shapes, histograms, and textures then by exposing a machine to a data to learn and practice analyzing pixels to identify the data based on what the machine already know. Second method is deep learning (DL) which uses convolutional neural networks which analyzes the data first to find any specific pattern. Next step, it will select the most accurate patterns among all other patterns. After that, it will classify those patterns into normal or pathologic. Those pattern which are recognized by DL can't be recognized by human Radiologists<sup>[4]</sup>. Many think that DL has more potentials more than ML, but eventually both methods work on the same goal which is to develop AI. From automation of robotic process to running a real robot to do a specific task all are considered AI. There are two types of AI system; the AI system that is able to perform a single task or the AI system that is able to perform multiple tasks<sup>[5]</sup>.

The uses of AI are to find solutions for complex issues when human can't solve them, double checking to make sure of conducting any task with a high accuracy level, or using AI for a second opinion. The benefits of using AI is to do tasks in a short time, at any time, with large quantities, with a high accuracy rate, and for a less cost (which human can't compete with). In radiology, AI can be used to evaluate all patients automatically, suggest differential diagnoses, collect patients' history, read all the previous radiology scans for patients like a background check to help in understanding the current case in hand, and interpret current radiology scans to give an initial

diagnosis for all cases.

Learning process required from ML to improve AI to learn more and more to become better than any experienced Radiologist. In the future, AI will be trained to become able to solve any complex case. The robotic Radiologists will be able to work all the time without any need for a break! The human Radiologists job will be in risk and maybe replaced, but humans need their human Radiologists to be there to avoid any machinery error or simply patients can't trust machines on their lives. Furthermore, reports that made by robotic Radiologists will be as good as human Radiologists with training and more developed algorithms will be able of; delivering the news (good or bad), or describing the findings from a human perspective, and sending emotional messages in the radiology report similar to a real Radiologist (congratulation, sympathy, support, etc.)!

Comparing AI to humans, AI do not take a break, do not have a fatigue or stress or heavy workload, and do not required a salary, but only required a maintenance and check up to make sure the system is working without errors which AI can do the check in an automatic fashion or by humans.

According to Tractica estimation, the market for AI software will reach \$109.6 billions by 2025<sup>[6]</sup>. There are more than 40 corporation in the United States specialized in AI for radiology departments and the FDA approved some of their inventions<sup>[6]</sup>. Some of AI inventions for radiology that are available today in the market can do many things like: detecting hemorrhage, subtlePET which make PET scan faster 4 times (approved by FDA in 2018), detecting coronary artery diseases technology without a contrast media, detecting TB, detecting cardiomegaly, detecting fibrosis, detecting fractures, detecting pneumonia, etc. In the next ten years, all the imaging studies will be reviewed by a robotic Radiologist before have been presented to a real Radiologist. In addition, AI will easily find the urgent medical imaging cases to presented them faster to human Radiologists which will make a positive impact on healthcare by identifying which case is urgent.

Actually AI can solve many problems. For example, it can solve the large salaries issue for Radiologists, where they take as an average salary a \$419,000 annually in the United States<sup>[7]</sup>. As well, AI can solve the Radiologists shortage issue in different countries or rural areas. According to the Minister of Health in the UAE in 2018, the detection system for TB in all the public hospital in the UAE which cost around \$50,000 US only for the entire country which is not expensive<sup>[8]</sup>. The number of cases that Radiologists have to see every day can make a huge stress and workload on the doctor which will lead to a wrong diagnosis or inability to take all the cases which will cause delaying and the patient's (on-waiting) condition maybe worsen. In many countries, AI used to find tuberculosis (TB) patients which requires only two seconds by AI, while with a human Radiologist will take up to 6 minutes<sup>[8]</sup>.

There are many disadvantages or weaknesses of AI in radiology. One of the AI's weakness is with artifacts detection which is not good compare to a real Radiologist. As well, AI in radiology today is a narrow task-specific AI system which is able to do only one task per a specific time and there is no a such technology that exists now that can identify and detect all different types of pathology in medical imaging studies<sup>[5]</sup>. Engineers who are developing AI, don't understand that there is a huge gray area in radiology and medicine in general. No one can guarantee that a certain change is pathological or normal change (aging, artifact, anatomical variation, etc.) which makes a huge obstacle in developing algorithms which only understand the binary language where there is two options either 0 or 1 only. Many patterns which were recognized by DL are not reliable

because it's more superficial and it can be tricked easily by artifacts, but there are other claims stating that those patterns are real, accurate, and human can't understand those patterns<sup>[3]</sup>. Another issue is, when scientists train AI in a specific database, the AI system will be able to detect only the diseases that has been trained to recognize and detect only inside the database that has been trained on. When AI applied on another database with a slight difference in the look of those patterns, the AI system failed immediately. This point is seen in China, where the most advances in AI is happening in China more than the United States because of the data privacy measures in the United States compare to the open databases (no privacy) in China which allowed more ML and DL to learn more and more from all the open databases that contain medical imaging studies<sup>[9]</sup>. Not to mention what patients would feel when they know that a computer will make the diagnosis for them instead of a real Radiologist! But, why the fear? On airplanes, autopilots control 90% of the flying time and they are granted a global confidence by federal regulators all over the world, otherwise flights will not be using any autopilot.

Is AI systems will replace Radiologists? Maybe the Radiologist with small experience will be replaced. Some speculations claim that by 2022 Radiologist replacement will be seen and by 2030 the experienced Radiologists will be able only to evaluate the complex cases and AI's reports<sup>[10]</sup>. According to Bluemke there are two type of Radiologist; the one who will use AI on a daily bases to verify their results and the one who will be replaced for refusing to use AI<sup>[10]</sup>. Where other experts like Geoffrey Hinton called to stop training Radiologist immediately in 2016! Because they will be replaced within 5 years by DL<sup>[11]</sup>. In regard to interventional Radiologists, AI is not a threat so far for Angiographers and Interventionists. Radiographers can be replaced by AI easily, where corporate already invented new methods of patient positioning, slice selecting and scan manipulating automatically. The issue is patients want to work with humans not machines, so Radiographer will have a better chance to keep their jobs compare to Radiologists. CT scanners now minimized Radiographers' role where the machine select most of the settings automatically without the need for any help from the Radiographer in charge. Generally, not only radiology field will be affected by AI, but neurology, cardiology, surgery, and many other specialties will be affected as well.

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