Chapter 5
Fairness and Ethics in Artificial Intelligence-Based Medical Imaging

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ABSTRACT

Artificial intelligence has a huge array of current and potential applications in healthcare and medicine. Ethical issues arising due to algorithmic biases are one of the greatest challenges faced in the generalizability of AI models today. The authors address safety and regulatory barriers that impede data sharing in medicine as well as potential changes to existing techniques and frameworks that might allow ethical data sharing for machine learning. With these developments in view, they also present different algorithmic models that are being used to develop machine learning-based medical systems that will potentially evolve to be free of the sample, annotator, and temporal bias. These AI-based medical imaging models will then be completely implemented in healthcare facilities and institutions all around the world, even in the remotest areas, making diagnosis and patient care both cheaper and freely accessible.

INTRODUCTION

The word "algorithm," derived from the name of Al-Khwārizmī (Persian: ىمزراوخ, c. 780–850) who was a Persian mathematician. It is a step process for solving various mathematical and logical problems. In machine learning, an algorithm is a set of instructions designed to perform a specific task which may be a simple process for example multiplying two numbers, or a complex operation like playing a compressed video file. Under computer, programming algorithms are often generated as functions. A good

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example of an algorithm is a recipe that indicates what is to be done, step by step. In particular, deep learning algorithms promise to transform the basis for decision-making and workflow, as these types of algorithms will "learn" to perform a task by example and interpret new data. Therefore, by incorporating AI in radiology workflows, it could be possible to help health delivery organizations achieve important organizational and clinical outcomes, such as helping to increase the effectiveness of clinical workflows using imaging, helping to minimize the likelihood of "negative" clinical effects associated with delays in reading, interpreting and reporting by radiologists or empowering care teams to easily view radiology work product, accelerate clinical decision making, and streamline workflows which in turn result in a better patient experience and consequences. The intelligent workflow and clinical assistant capabilities in the sense of the radiologist himself will enable radiologists to be more efficient by automating and prioritizing tasks and data feeds, more quantitative by providing applications and resources to extract and measure information semi-automatically or automatically, and more accurate by ensuring the correct information to support the diagnosis, as well as confirming the reproducibility of any quantification procedures.

Artificial intelligence (AI) is used in medical imaging including image processing and interpretation (Lakhani et al., 2018). AI term is used when a device imitates learning and problem-solving functions (Russell & Bohannon, 2015) and presently is one of the most likely fields of the health revolution. More specifically AI refers to a computer science field committed to the development of systems that perform tasks that frequently involve human intelligence for branching off into various techniques (Chartrand et al., 2017). Machine learning (ML) is a concept introduced in 1959 by Arthur Samuel to define a subfield of AI (Samuel, 1959) that includes all those methods that enable computers to learn from information without being directly programmed and has been extensively applied to medical imaging (Lee et al., 2017). Deep learning (DL) has emerged among the techniques that come under the ML canopy as one of the most promising fields.

Artificial Intelligence

Artificial intelligence (AI) is the simulation of human being's intelligence processes by machines, particularly computer systems. These methods include firstly, learning which is the acquisition of information and rules for using the data, secondly, argumentation which is using rules to reach relative or definite resolutions and lastly self-correction (Tripathi, 2021).

Artificial Intelligence, a term often used interchangeably with "machine learning" – has a huge array of current and potential applications in healthcare and medicine (Rigby, 2019). Machine learning can be defined as a family of statistical and mathematical modeling techniques that can 'learn' from data to perform a diagnosis or render a treatment decision and improve the prediction, without any explicit programming. "Learning" in machine learning is the reference of the desire to create a model that can learn like a human, through experience, and achieve an objective with little to no external (human) assistance (Tripathi, 2021). Machine learning is often anthropomorphized– however, the algorithms behind the scenes use mathematical formulations to represent models and strive to learn parameters in these formulations, by tracking them back from a dataset of observations.

All computer programs consist of three basic components: an input, a function, and an output. In traditional computer programming, the programmers generally tend to knows what the input and output look like and writes a function that processes input and produces an output. The programming and potential decisions are part of a manual effort to deliberately encode the steps or knowledge needed to