REVIEW

Radiology and artificial intelligence (AI): the ethical issues

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Abstract: The use of artificial intelligence (AI) algorithms in medicine has exploded over the past ten years especially in radiology. This revolution necessarily impacts previous usages and the relationship between patients and physicians. Many ethical aspects have to be considered. This paper aims to review those fundamental questions.

Keywords: radiology; ethical issues; AI in medicine

1. Introduction

Ethics is often brought to bear in situations of uncertainty, crisis, and information overload. The current period has all of these elements, and radiology in particular offers a wealth of ethical aspects to consider. The use of artificial intelligence (AI) algorithms in medicine has exploded over the past ten years – in radiology, especially (1). This blossoming has radiologists questioning its implications for patients, society, and the future of their profession. Several publications have already underlined the specific impact of IA on regulation issues in radiology, but also on responsibilities and commitments whether concerning data relevance and quality, patient information and equity (2). These issues further raise many ethical questions, which we need to set out clearly before we can address them.

2. Ethical questions

1. What is the real advantage of using AI in medical diagnosis? Are algorithms designed and tailored to match a medical need, whether on individual or on a populational basis? Should algorithms only be used to screen out normal radiological examinations? How much extra time does using AI software typically take?
2. What level of validation does an AI algorithm require, and what "gold standard" is used? What are the validation conditions, both in real life and in silico? Have the data used for the algorithm design been integrated following all accepted regulations regarding data collection principles, and do these data match the expected quality required to design an appropriate algorithm? How can software development be supported over time (re-validation? other?). Is this different – and if so, how – than for other types of software updates and maintenance?
3. How can radiologists identify potential bias? This includes statistical bias (usually from training data) and cognitive biases (framing, confirmation, complacency, etc.). The issue of bias is often linked to the idea of neutrality. What does expecting an algorithm to be neutral mean? Is any part of the process (from deciding to acquire medical images to choosing acquisition type/parameters to making a final decision) truly neutral? What does being faithful to reality mean when several steps in the process involve coding and computation?
4. How should the "human guarantee" principle be applied? Does it require knowing how the algorithm works? Does a human need to control its use, i.e., ensure that the question is relevant, requiring human validation each time it is used? How should radiologists be involved in the design of AI methods, and to what extent should they understand those methods? And upstream of the design process, what is required

of those who decide that an AI algorithm should be developed? Of those who actually design and develop the algorithm? And has the role of the algorithm in the medical management path been anticipated?

5. Explainable artificial intelligence (XAI) is a current research trend that is advancing in several directions. While symbolic artificial intelligence is often said to be naturally explainable, there continue to be questions about the complexity and intelligibility of its explanations. When it comes to machine learning methods – neural networks with millions of parameters, in particular – the explainability issue becomes even more complex.
   What is it we want to explain? Is it the training data (and their potential bias)? The method itself and its invisible reasoning process? The result? The sources of potential errors? Good practices for utilizing the method? Its generalization capabilities? Which of these is most important and relevant to radiologists?
   Another question is this: what is the aim of explanation? It might be to justify, to control, to improve, or to discover. What are the challenges and impact of explanation (in terms of ethics, responsibility and law, confidence and adoption, economics, etc)?
   When should we ask for an explanation? As cognitive science has shown, explanation is needed when we are surprised, when there is dissonance with the usual schemas. For whom is the explanation intended? It will probably be different for the radiologist than for the patient or for other medical specialists (3).
   In what form should the explanation be given? Visual? Linguistic (if which case, in what language)? Other? According to T. Miller (4), explanations should be contrastive (why a particular decision was made rather than another), selected (from among possibly numerous explanations), causal (rather than statistics- or probability-based), social (with conversation and interaction), and contextual. How do these requirements translate to the specific case of radiology?
   Can we expect (or demand) that explanations compensate for potential biases, whether statistical or cognitive? Will explanations help in addressing ethical questions?
6. Can radiologists correctly understand the representativeness of the database used to train the algorithm? This question is linked to the first question regarding XAI.
7. Can people resist the temptation to get as much information as possible without knowing the final destination? For example, the increased use of whole-body imaging, which yields copious amounts of information, will likely lead to more frequent discovery of "incidentalomas" (5). What is the ultimate purpose of a diagnostic exam?
8. Who will make the final "human decision" regarding the diagnosis, and who will take or share responsibility for it? If there is disagreement between human and machine, which will be believed or trusted? Will the radiologist's clinical intuition still count in the face of statistical data? The unexpected – so common in medicine – often involves contextual knowledge about the patient. It does not, however, readily lend itself to modeling, and the radiologist's experience is often needed to deal with it. How will that experience be preserved if generations of radiologists are trained using AI data alone?
9. How will the radiology profession change? Should radiologists be given more time for explanations to patients? Will there be a new communications position to serve as an interface between the engineer or computer/data scientist, the patient, and the radiologist? Upon what will the legitimacy of that person's actions (confirming a diagnosis, communicating with the patient, proposing a treatment plan) be based?
10. How can training for health professionals be designed to raise their awareness of their ethical responsibilities in applying and using AI-augmented medical imaging? In a cost control context, how can the replacement of human beings with machines – which can result in suboptimal medical care – be regulated?
11. How do these new possibilities affect how we think about environmental responsibility in radiology?

3. Conclusion

Though the use of artificial intelligence in radiology is certain to shift the added value of radiologists, we still need to evaluate the "promises" regarding the advantages of AI carefully in terms of individual and societal benefit/risk.

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