ORIGINAL ARTICLE

The Role of Artificial Intelligence in Diagnostic Radiology: A Survey at a Single Radiology Residency Training Program

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Purpose: Advances in artificial intelligence applied to diagnostic radiology are predicted to have a major impact on this medical subspecialty. With the goal of establishing a baseline upon which to build educational activities on this topic, a survey was conducted among trainees and attending radiologists at a single residency program.

Methods: An anonymous questionnaire was distributed. Comparisons of categorical data between groups (trainees and attending radiologists) were made using Pearson χ^2 analysis or an exact analysis when required. Comparisons were made using the Wilcoxon rank sum test when the data were not normally distributed. An α level of 0.05 was used.

Results: The overall response rate was 66% (69 of 104). Thirty-six percent of participants (n = 25) reported not having read a scientific medical article on the topic of artificial intelligence during the past 12 months. Twenty-nine percent of respondents (n = 12) reported using artificial intelligence tools during their daily work. Trainees were more likely to express doubts on whether they would have pursued diagnostic radiology as a career had they known of the potential impact artificial intelligence is predicted to have on the specialty ($P = .0254$) and were also more likely to plan to learn about the topic ($P = .0401$).

Conclusions: Radiologists lack exposure to current scientific medical articles on artificial intelligence. Trainees are concerned by the implications artificial intelligence may have on their jobs and desire to learn about the topic. There is a need to develop educational resources to help radiologists assume an active role in guiding and facilitating the development and implementation of artificial intelligence tools in diagnostic radiology.

Key Words: Artificial intelligence, diagnostic radiology, residency program, survey

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INTRODUCTION

Today, radiologists are overwhelmed not only by the vast amounts of imaging data they must review on a daily basis but also by the time it takes them to search and find contextual clinical information regarding the imaging studies they read. In the United States alone, it is estimated that because of the large number of multislice imaging examinations performed yearly, each of the approximately 32,000 practicing radiologists views an image every 3 seconds of every working day for the entire year [1].

Recent advances in the field of artificial intelligence (AI), including the development of high-performing artificial neural networks, robust machine learning (ML) algorithms, and powerful cloud-based computational capabilities, are being applied to the large amounts of machine-readable digital data generated by radiology imaging studies and by electronic medical records, with the goal of creating applications that, once clinically validated, are expected to change the way the specialty of diagnostic radiology (DR) is currently practiced [2-5].

Predictions on how disruptive the change these new technologies will produce and how soon it will take place range from radiologists' becoming obsolete in a relatively short period of time to a more gradual change, by the end of which radiologists are expected to assume a larger and more central role in health care [2,3].

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The ACR has taken notice, and the new Data Science Institute was formed in May 2017 with the goal to "work with government, industry, and others to guide and facilitate the appropriate development and implementation of AI tools to help radiologists improve medical imaging care" [6]. Recently, a call for action was issued at the 38th ACR Intersociety Summer Conference, at which the state of clinical data science was reviewed, and attendees speculated on how it will affect health care and radiology practice [3].

With the goal of establishing a baseline upon which to build educational activities on AI as it pertains to the field of DR, a survey was conducted among trainees and attending radiologists at a single DR residency training program to explore their general awareness and perceptions of this topic.

METHODS

An observational descriptive study was performed. No patient data were accessed, and no interaction with patients took place.

A web-based questionnaire on the topic of AI in DR was designed using Google Forms and distributed in an e-mail containing a nonserialized link to all residents, fellows, and attending radiologists at a large DR residency program. The initial e-mail was sent on July 26, 2017. This was followed by a reminder also sent via e-mail on August 11, 2017. Survey participation was closed on August 14, 2017.

No identifying information was requested. The anonymous survey contained a total of 13 questions, with sections revealed to survey takers on the basis of reported level of training. These included seven questions for all respondents, two questions for attending radiologists and fellows, and one question for residents. The questions were primarily multiple choice, with one Likert-type question. The survey was piloted with two individuals, one attending radiologist and one resident radiologist. There were subsequent edits for typographic and formatting improvements before distribution.

All results were automatically populated into a spreadsheet, which was exported as an Excel document (Microsoft, Redmond, Washington) for analysis.

For the purpose of this study, AI was referred to in its broader definition applied to DR tasks, such as quantification, segmentation, preliminary pattern recognition, and natural language processing.

At the time of the study, all fellowships at our residency program were accredited by the ACGME, with fellows acting solely as trainees and not as junior attending radiologists. For data analysis purposes, participants were categorized in two groups: trainees (residents and fellows) and attending radiologists.

STATISTICAL ANALYSIS

Frequencies and percentages were calculated for categorical data. For continuous data, means and standard deviations were calculated for normally distributed data, and medians and interquartile ranges (IQRs) were calculated for skewed data.

Comparisons of categorical data between groups were made using Pearson χ^2 analysis or an exact analysis when expected cell counts were less than five. Comparisons between groups were made using the Wilcoxon rank sum test when the data were not normally distributed. An α level of 0.05 was used to determine statistical significance. Analyses were performed using SAS version 9.3 (SAS Institute, Cary, North Carolina).

RESULTS

A total of 69 subjects participated in the survey, for an overall response rate of 66% (69 of 104).

The response rate for trainees was 63% (34 of 54), with fellows showing the lowest response rate (as depicted in Fig. 1).

Attending radiologists' response rate was 70% (35 of 50). They reported a median of 12 years in practice (IQR, 7-27 years). The most frequent subspecialty areas of practice to which they dedicate >50% of their daily work time were abdominal radiology and neuroradiology (as depicted in Fig. 2).

Overall, 25 participants (36%) reported not having read a scientific medical literature article on the topic of AI in radiology during the past 12 months, although fewer than 8% reported having read seven or more such

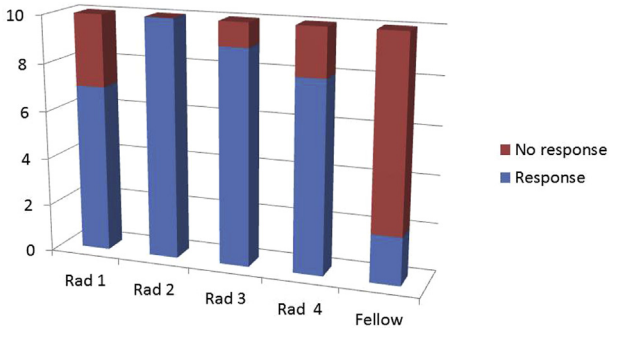

Fig 1. Distribution and response rate of trainees by year in training.