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How does the radiology community discuss the benefits and limitations of artificial intelligence for their work? A systematic discourse analysis

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ABSTRACT

Purpose: We aimed to systematically analyse how the radiology community discusses the concept of artificial intelligence (AI), perceives its benefits, and reflects on its limitations.
Methods: We conducted a qualitative, systematic discourse analysis on 200 social-media posts collected over a period of five months (April–August 2020).
Results: The discourse on AI is active, albeit often referring to AI as an umbrella term and lacking precision on the context (e.g. research, clinical) and the temporal focus (e.g. current AI, future AI). The discourse is also somewhat split between optimism and pessimism. The latter considers a wider range of social, ethical and legal factors than the former, which tends to focus on concrete technologies and their functionalities.
Conclusions: Further precision in the discourse could lead to more constructive conversations around AI. The split between optimism and pessimism calls for a constant exchange and synthesis between the two perspectives. Practical conversations (e.g. business models) remain rare, but may be crucial for an effective implementation of AI in clinical practice.

1. Introduction

With the advent of new machine-learning technologies, radiology is claimed to be fundamentally transformed by artificial intelligence (AI). Today, we see more than 100 commercial companies offering over 300 AI applications in diagnostic radiology [1] and more than 8000 accumulated publications on AI in radiology worldwide [2].

Along with these developments, radiologists are increasingly active in discussing how AI can impact their work [3]. This discourse becomes a powerful driver for shaping how the community understands AI technology, participates in its development, and decides on how best to implement AI at work [4]. The discourse has power because it not only reflects how radiologists understand AI, but also *constructs* how they further make sense of AI [5]. The role of discourse is particularly crucial in the early phase of exploring and experimenting with a novel technology [6,7].

Hence, it is crucial to scrutinise the discourse around AI and examine how the community perceives the technology's benefits as well as the limitations and challenges of working with AI [8]. An accurate picture of what topics are discussed and how (deeply) they are discussed can help radiologists realise what areas they are overlooking and how to further enrich the discourse. Metaphorically, we need to continuously look into a mirror reflecting how we discuss AI to further inform the way we participate in the development, validation, implementation, and use of

Abbreviations: ACR, American College of Rheumatology; AI, artificial intelligence; COVID-19, Coronavirus disease 2019; ESR, European Society of Radiology; EuSoMII, European Society of Medical Imaging Informatics; ML, machine learning; DL, deep learning.

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AI. This mirror needs to be based on a scientific and rigorous analysis of the discourse; known as discourse analysis [7]. In this paper, we systematically analyse the discourse around AI on social media, which is an increasingly active medium of discussion for healthcare professionals [4].

Firstly, we scrutinise how the community discusses the concept of AI in order to understand what radiologists mean when they talk about AI and whether they refer to AI as a general concept or specific technological objects or features. This inquiry is important to examine whether the community recognises the difference between technologies that are often conflated under the term AI (e.g. rule-based systems vs. deep-learning algorithms).

Secondly, we analyse whether radiologists refer to the current state of AI and its applications or the future possibilities of AI and potential ways of applying AI to work. This is relevant since the AI field and its applications are rapidly changing and because future expectations of AI can influence how resources are mobilised around AI and how the technology gets further shaped in the present [9].

Thirdly, we examine how radiologists perceive the (potential) benefits of AI for work, which benefits are more prevalent in the discourse and which are marginally discussed, potentially deserving more attention. This question helps us understand what AI functionalities radiologists consider important and what expectations they have regarding this technology. In particular, regarding clinical functionalities of AI, we examine to what extent radiologists consider AI as a technology which potentially replaces radiologists and/or an instrument that radiologists use to augment their capability [10].

Finally, we explore how the community critically reflects on the limitations of the technology and the barriers to bringing AI to radiology work. This is to understand the challenges that need to be tackled to successfully bring AI to radiology work as well as to avoid hyped expectations from AI.

In the following section, we describe how we conducted our systematic discourse analysis of the radiology online discourse. Then, we report our findings and discuss their implications for enriching the AI discourse.

2. Methods

A discourse is a collection of texts [11] situated in larger social, political, and historical contexts [12]. Following a systematic discourse analysis process [13], we analysed both what is said and how it is said. To capture a wide variety of voices, we selected three different online platforms where the radiology community is active: 1) AuntMinnie[1], 2) LinkedIn, and 3) Twitter.[2]

2.1. Data collection

To immerse ourselves in the discourse, we first performed netnography [14] for one month by reading online posts by radiologists who actively produced discourse on AI. We took fieldnotes and screenshots to record our observations (approximately eight hours a week). We started following key actors who either 1) were radiologists or their posts were endorsed by radiologists or 3) had a profile indicating a link to radiology and AI, and 3) posted regularly about AI in radiology. A leading expert on the topic reviewed the list of key actors and helped us expand it. Then, we followed the selected key actors for approximately eight hours a week for five months (April-August 2020) on the three platforms to collect posts. Posts were included when they 1) concerned AI, ML, or DL in relation to radiology, 2) were written or endorsed by a key actor, and 3) were published in 2020. For each post, we archived the content and meta-data (e.g. publishing date, author type, post URL) in a separate database. We also collected external references in posts (e.g. media articles) when it helped us interpret the post.

2.2. Data analysis

We analysed the data in three steps. Firstly, we developed a codebook based on the questions that we derived from our research question (see Appendix 1). Secondly, we divided the posts between the first and the second authors who coded data independently, following the interpretive thematic analysis principles [15]. To ensure consistency in data interpretation and coding, the two observers continuously communicated and resolved uncertainties throughout the coding process. At the end, we ran an inter-observer reliability test on a subset (20 %) of our data.[3] We deliberately allowed multiple coding for most posts instead of force-fitting them into a single code to preserve the complexity of the discourse: i.e. a post could be discussing five different benefits of AI. Thirdly, we used each dimension of the codebook to examine how each topic is discussed and what patterns can be identified. We then examined the conceptual and empirical relations between dimensions (Fig. 1).

3. Results

The analysed posts cover a wide range of topics from 1) various AI technologies and functionalities, 2) scientific practices along the AI development pipeline, 3) factors impacting AI (e.g. financial restrictions, legal regulations), to 4) the community, patients, and policy makers' perception of AI (Fig. 2).

3.1. What are radiologists referring to when they discuss AI?

When radiologists talk about “AI”, they refer to multiple objects (see Fig. 3). Nearly half of the posts discuss AI broadly as an umbrella concept, without specifying the technology or model behind it. These posts talk about AI as a general technological domain or field. In other posts, radiologists discuss AI to refer to various technological objects, ranging from ‘data and databases used for algorithm development’, ‘models and algorithms in concept or development phase’, to ‘certified and commercialised applications and software solutions’.

3.2. When are radiologists referring to when they discuss AI?

When talking about AI, radiologists sometimes refer to the current state of AI technology and existing instances. More often, however, radiologists refer to the technology and use cases that are forthcoming without indicating clearly when they may happen (see Fig. 4). Posts that are grounded in the present discuss specific and tangible examples of AI models and applications. Conversely, when not grounded in the present, post tend to discuss AI as an umbrella term, make normative claims on what AI objects should look like (e.g. AI development should entail intended end-users), or discuss what AI could look like hypothetically in the future.

3.3. What are the perceived benefits of AI in the discourse?

Fig. 5 provides an overview of the (potential) benefits of AI discussed in the community (see Table 1 for detailed examples). The perceived benefits of AI usually pertain to ‘clinical support’, ‘efficiency gains’,

[1] AuntMinnie is the biggest online professional community for radiologists and medical imaging specialists that features the latest news and information about medical imaging.

[2] Following [4], we chose these platforms to cover the voices of radiologists from different geographical regions. (Roughly speaking, LinkedIn to cover EU-based, Twitter and AuntMinnie to cover US-based radiologists.)

[3] The inter-observer reliability was 0.73 which is considered sufficient for an inductive coding approach [16].

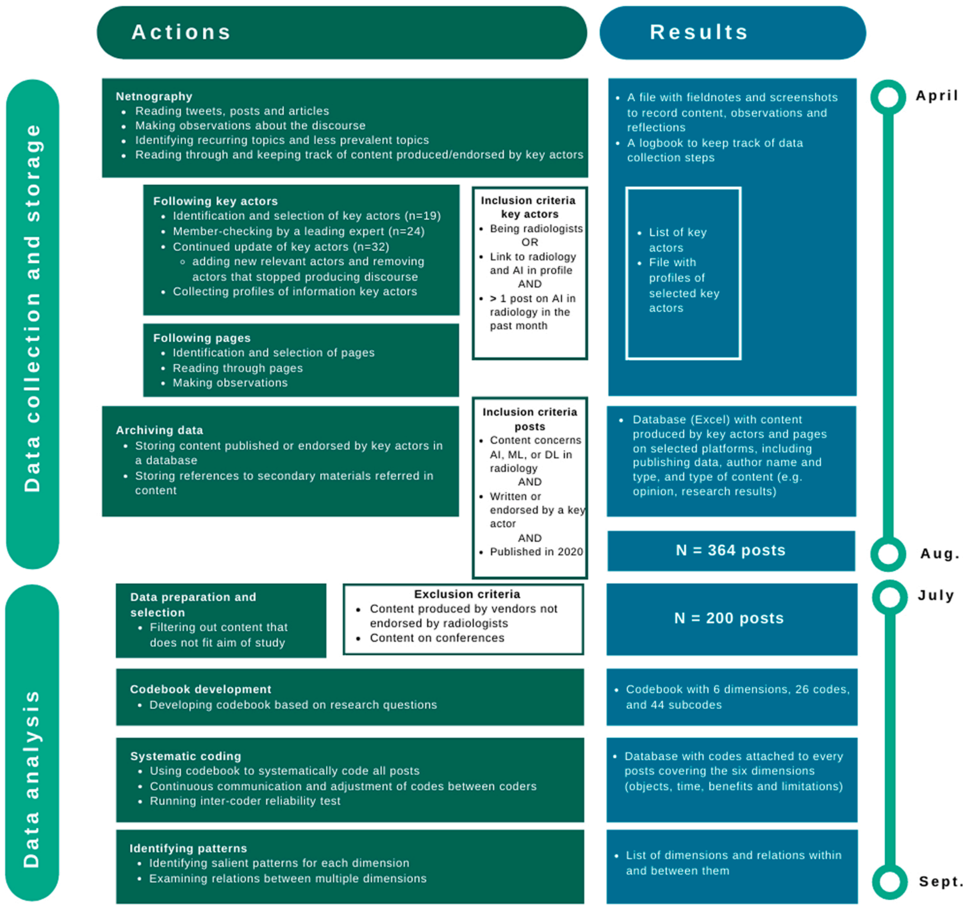

Fig. 1. Overview of methods.

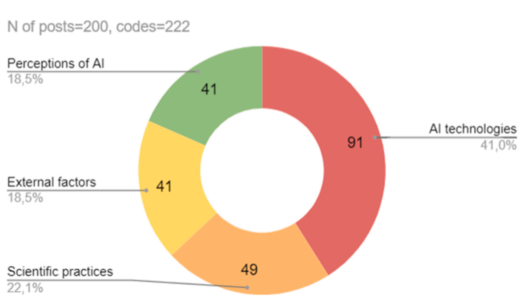

Fig. 2. Major topics in the discourse.

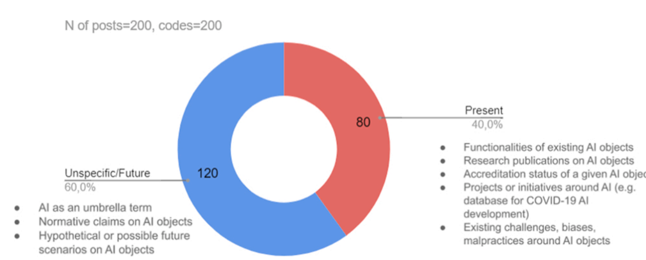

Fig. 4. Temporal focus of AI objects.

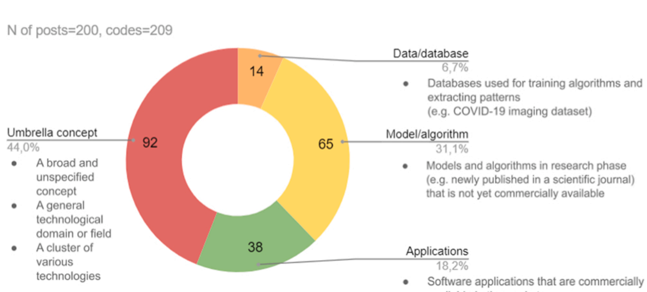

Fig. 3. Specificity of AI objects.

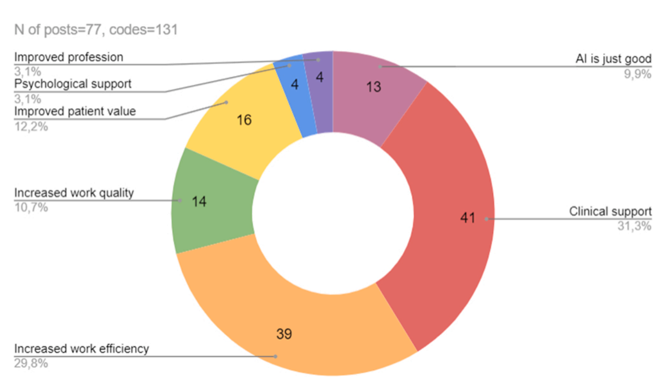

Fig. 5. Perceived benefits of AI in radiology.

Table 1
Perceived benefits of AI in radiology.

Benefits of AI	Empirical Examples
Clinical support	• Detecting abnormalities on images • Segmenting anatomical structures or abnormalities • Classifying imaging findings (e.g. types of shoulder implants) • Triaging patient cases, enabling risk stratification • Quantifying various imaging findings • Predicting care outcomes (e.g. if a coma patient will regain consciousness) • Helping radiologists in decision-making (e.g. to select the right response strategy based on AI-predicted outcomes)
Increased work efficiency	• Saving radiologists' time by accelerating tasks (e.g. with faster patient assessments, by flagging abnormalities for review) • Enhancing the productivity of the department (e.g. by increasing throughput, by prioritizing patient cases) • Enabling a more efficient use of images (e.g. by increasing image resolution, by enabling MRI-to-CT translation) • Improving cost-effectiveness by using the time of radiologists to work on more complex, special, intelligent tasks • Automating certain radiological tasks (e.g. automatic classification)
Improved patient value	• Advancing patient care and care outcomes (e.g. by personalized care) • Enhancing patient experience and comfort (e.g. by shortening acquisition time) • Improving patient trust or (perceived) safety (e.g. by reducing radiation dose)
Increased work quality	• Improving accuracy of work (e.g. by reducing errors) • Increasing the consistency between radiologists (e.g. decreasing observer dependency) • Enhancing the capabilities of radiologists to see subtle or novel patterns in images
Psychological support	• Reducing the cognitive burden of radiologists (e.g. reducing the information overload by highlighting regions of interest) • Enhancing radiologists' assurance/confidence in their decisions (e.g. by providing a second pair of eyes)
Improved profession	• Emancipating radiologists from tedious work by delegating the routine tasks to AI (radiology becomes a more attractive profession) • Enabling precision education (e.g. through personalized case selection) • Reducing stress and burnout through reducing the workload
AI is just good (no further elaboration)	• AI is a technology with a lot of potentials • AI can change the profession for the better • AI is the inevitable future of the profession

'improved patient value', and 'improved work quality'. Clinical support concerns AI's ability to detect and identify abnormalities on scans, automatically measure and quantify features on scans, and predict care outcomes. Clinical functionalities of AI are often discussed in concrete clinical contexts (e.g. pulmonary embolism) with respect to specific AI objects such as an existing product in the market.

Regarding efficiency gains, radiologists suggest that AI can expedite radiological tasks, increase throughput, and improve image quality assessment and reconstruction. Increased efficiency is often discussed in concrete clinical contexts. Additionally, radiologists often stress the benefits of AI for patients. This includes advanced patient health outcomes, improved patient comfort and safety. Interestingly, a small portion of posts advocate AI technology without further explanations, as if it is a known fact that AI will bring benefits to radiology.

When discussing how AI can assist in performing clinical tasks[4] (e.g. measuring tumors), half the time AI is considered as an autonomous tool which performs tasks on its own, hence potentially rendering radiologists to be unnecessary. These posts predominantly refer to research outputs showing that AI algorithms in research settings perform on the level of expert radiologists (e.g. "[AI algorithm] can segment the right & left ventricles with accuracy similar to that of expert readers"). Contrarily, about one third of posts discuss AI explicitly as an instrument for radiologists by using phrases such as "help", "enable", "assist", "support" or "could be used to." Here, radiologists perform the tasks and AI is there only to assist them. These posts often relate to (upcoming) AI applications in the market: e.g. "[AI product] gives radiologists support to identify high-risk cases."

3.4. What are the limitations of AI in the discourse?

Fig. 6 provides an overview of the limitations of AI discussed by the radiology community (see Table 2 for detailed examples). The most frequent concern pertains to the hype around AI. Many radiologists are

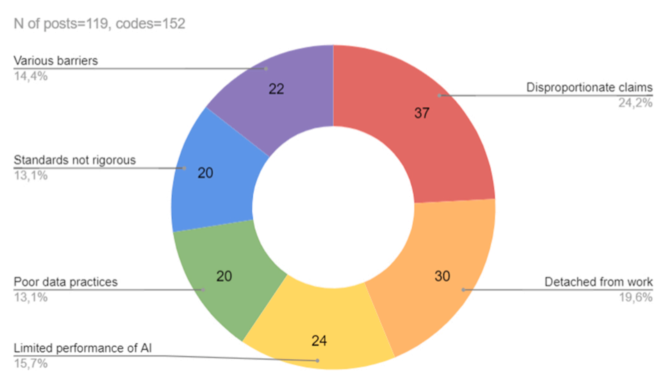

Fig. 6. Perceived limitations and criticisms of AI in radiology.

critical of the argument that radiologists will be obsolete soon because of AI. Although these radiologists often stress the benefits of AI themselves, they point out the naivety and lack of evidence for such bold claims and raise concerns about the detrimental impacts of such claims for the profession (e.g. spreading fear among junior radiologists). Furthermore, the community criticises expectations of AI that are disproportionate to its actual capabilities. For example, radiologists feared that grand claims about the role of AI in tackling COVID-19 would fuel the AI hype again. Other criticisms stress that AI is yet to fulfil its promises and that the field of radiology is not ready for AI yet.

Another common concern is that AI development is detached from radiology work and thus is based on an incomplete understanding of what radiologists do. This includes concerns that vendors often fail to involve radiologists in the development process, which negatively influences the user-friendliness and clinical utility of AI applications. According to these posts, detachment from work often results in AI applications that solve problems with a minor impact and fail to address actual clinical needs in radiology practice.

The remaining posts point to AI's limited performance, poor practices around data in AI development, and the lack of scientific evidence on AI. Radiologists raise concerns about AI algorithms generating false positives or false negatives and failing to generalise beyond research settings or across institutions. These limitations justify the community's

[4] We exclusively focus on clinical functionalities because this is the area where the performance levels of radiologists and AI algorithms are compared and competed against (see e.g. [17]), feeding into discussions around replacement vs. augmentation.

Table 2
Perceived limitations and criticisms of AI in radiology.

Limitations and Criticisms	Empirical Examples
Disproportionate claims (hype) around AI	• Criticizing claims that AI will replace radiologists • Pointing out overblown arguments around the capabilities of AI (e.g. AI is not capable of diagnosing solo) • Stressing the delayed delivery of AI promises (e.g. after many years, we still do not see AI implemented in clinical practice) • Emphasizing that radiology is not ready for AI (e.g. limited training, lack of infrastructure)
AI development detached from radiology work	• Not involving radiologists in the development process • Having a poor product-market fit and lacking clear benefits for clinical practice (e.g. being driven by the "race to innovate" with limited attention to real clinical problems, being overly "narrow") • Lacking compatibility with existing systems (e.g. workflow integration, interoperability)
Limited performance of AI	• Poor accuracy level of AI (e.g. too many false positives or false negatives) • Performance failure when deployed in real-life settings (vs. research settings) • Inherent instability of the AI technology (e.g. lack of generalizability, being sensitive to: perturbations, modality and acquisition protocol, scanning technologies, and case compositions)
Poor data standards/practices	• Using unsuitable data (quality) (e.g. using data from lung cancer patients to quickly develop COVID-19 algorithms, using data with gender and racial biases and resulting in a biased algorithm) • Lacking large enough data (quantity) with enough variation for training and validating AI algorithms • Poor data protection and data processing practices (e.g. not anonymizing data properly)
Lack of rigorous and scientific evidence	• Limited evidence regarding the real-life clinical utility of AI applications • Limited evidence regarding the safety of using AI in clinical practice
Various barriers in the environment	• Patients show perception barriers (e.g. lack of trust, accountability issues, reluctant to accept AI) • Radiologists consider explainability and interpretability essential to use AI in clinical practice • Rigid legal regulations around data privacy/ownership slow down AI development • Financial bottlenecks (e.g. lack of viable financing models or reimbursement schemes) • Healthcare systems are difficult to penetrate (e.g. due to heavy bureaucracy, complex systems)

argument against deploying AI autonomously. Additionally, many radiologists highlight diverse barriers to a successful AI implementation including legal regulations, financial restrictions, perception barriers such as lack of trust from both patients and radiologists.

When radiologists talk about the limitations of AI, they discuss not only the technology, but also the broader range of development practices, regulations, and cultural and economic factors. Contrarily, when examining the benefits, the focus is narrower on clinical tasks and the technology itself.

Looking across the discourse, we find that when radiologists discuss the benefits of AI, they tend to (62 %) talk about specific objects that exist in the present. Contrarily, when talking about limitations, radiologists often (55 %) refer to AI in a general and abstract sense, beyond the current technologies and applications.

4. Discussion

We analysed the radiology community's online discourse on AI regarding 1) the AI objects, 2) the temporal focus, 3) benefits and 4) limitations of AI. Firstly, our systematic analysis shows that radiologists actively discuss AI; yet in a way that lacks specificity. Radiologists often refer to AI as an unspecified technological trend or field. Other times, they refer to various technological objects such as algorithms in the research phase or commercialised applications, which are sometimes existing instances and other times future possibilities. From this, we argue that there is room for precision in the discourse regarding the AI object, the intended context (e.g. research or clinical practice) and the temporal focus (e.g. current AI or future AI). By specifying the object and context of discussion, the community could have more constructive conversations around AI.

Secondly, we find that the discourse is quite heterogeneous and dispersed regarding both the perceived benefits and limitations of AI, showing consensus on neither. The unconsolidated state of the discourse partly reflects the rapidly developing nature of AI technology. It also reveals that the community is yet to grasp AI technology and define its position within radiology. Meanwhile, we emphasise that the multiplicity of views suggests that there is still an opportunity for a wide range of radiologists to participate in the collective process of defining effective ways to develop and implement AI in radiology work.

Thirdly, the discourse is somewhat divided into optimism, which stresses the (potential) benefits of AI and pessimism, which highlights the limitations of AI and the challenges around implementing AI at work. Our data shows that optimistic and pessimistic posts often refer to different AI objects and focus on different aspects, with the latter considering a broader range of social, ethical and legal factors than the former, which tends to focus on concrete technologies and their functionalities. While it is good that opinions are not skewed to one side, this divide can hinder mutually beneficial conversations. For the community to generate practical ways to develop and implement AI, it is crucial that a constant exchange and synthesis between the two perspectives takes place.

Fourthly, regarding areas that warrant more attention, we see that practical discussions remain scarce regarding how AI projects can be financed and how viable reimbursement schemes and business cases for AI applications can be defined. Without practical translations, the active discourse around potential benefits of AI risks remaining theoretical. The community needs to discuss these practical matters in order to take a step closer to an effective AI implementation in clinical practice. Next to that, when advocating the benefits of AI, the community predominantly refers to research outputs where the performance of AI algorithms is assessed in controlled settings. There is a need for 'real-world' evidence regarding the benefits of AI in clinical practice that are lived and experienced by radiologists.

4.1. Limitations and future research

Our study was limited to the Anglo-Saxon part of the discourse. Although North America and Europe have a dominant position in the field of AI, countries in other regions have become increasingly significant contributors as well (e.g. China, India, and South Korea) [2]. To be more representative, future research should investigate discourses from different regions and languages.

We focused on the general patterns of the discourse across three different platforms. Future research can investigate differences in the discourse between platforms and geographical regions.[5] Moreover, we have not differentiated between types of actors. Future studies could, for example, expand the scope and compare the contributions of different actors: radiologists with different sub-specialisations, radiographers, AI

[5] Previous studies such as [5] have identified correlation between different social media platforms and different geographical regions.

vendors, researchers and radiological societies (e.g. ESR, EuSoMII, ACR) to the discourse on AI in radiology. Additionally, future research could compare the discourse of the radiology community with communities facing similar discussions related to AI, such as oncology, nuclear medicine, pathology, and ophthalmology.

Lastly, it did not become clear from our analysis if the discourse produced by the radiology community has reached the wider public. Given that policy makers continue to argue that AI is going to replace radiologists,[6] we argue, in line with Gupta et al. [18], that the radiology community should engage more actively with the broader public discourse around AI. Future research could investigate the extent to which the radiology discourse indeed informs opinions about artificial intelligence beyond their own community.

5. Conclusions

Using a qualitative, systematic analysis of the discourse, we scrutinise the radiology community's discourse on AI [7]. Discourse has the potential to shape the way radiologists perceive and participate in the development and implementation of AI [5,19]. Therefore, it is crucial for the community to constantly reflect on what is being discussed how, as well as how rich, accurate, and constructive the discourse is. We provide an in-depth overview of the current discourse on AI in the radiology community and suggest ways to further enrich the discourse to collectively define effective ways to develop and implement AI in radiology work.

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Ethical Approval and consent to participate

Institutional Review Board approval was not required because it is based on reviewing the information publicly available on the Internet.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Authors' contributions

BK, IK, MR have equally contributed in data collection, data interpretation and analysis, and writing of the findings. MH and ER have contributed by providing substantial revision ideas to the draft. All authors read and approved the final manuscript.

CRediT authorship contribution statement

Bomi Kim: Conceptualization, Methodology, Formal analysis, Data curation, Writing - original draft, Writing - review & editing, Project administration. **Isabel Koopmanschap:** Conceptualization, Methodology, Formal analysis, Data curation, Writing - original draft, Writing - review & editing, Project administration. **Mohammad H. Rezazade Mehrizi:** Conceptualization, Methodology, Writing - original draft, Supervision. **Marleen Huysman:** Writing - original draft, Supervision. **Erik Ranschaert:** Writing - original draft, Supervision.

Declaration of Competing Interest

The authors report no declarations of interest.

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Appendix A. Supplementary data

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References

[1] M.H. Rezazade Mehrizi, P. van Ooijen, M. Homan, Applications of artificial intelligence (AI) in diagnostic radiology: a technography study, Eur. Radiol. (2020), https://doi.org/10.1007/s00330-020-07230-9.
[2] E. West, S. Mutasa, Z. Zhu, R. Ha, Global trend in artificial intelligence–based publications in radiology from 2000 to 2018, Am. J. Roentgenol. 213 (2019) 1204–1206, https://doi.org/10.2214/AJR.19.21346.
[3] M. Huisman, E. Ranschaert, W. Parker, et al., An International Survey on AI in Radiology in 1,041 Radiologists and Radiology Residents Part 2: Expectations, Hurdles to Implementation and Education, 2021.
[4] E.R. Ranschaert, P.M.A. Van Ooijen, G.B. McGinty, P.M. Parizel, Radiologists' usage of social media: results of the RANSOM survey, J. Digit. Imaging 29 (2016) 443–449, https://doi.org/10.1007/s10278-016-9865-1.
[5] J. Potter, M. Wetherell, Discourse and Social Psychology: Beyond Attitudes and Behaviour, 1987.
[6] P.M. Leonardi, S.R. Barley, What's under construction here? Social action, materiality, and power in constructivist studies of technology and organizing, Acad. Manag. Ann. 4 (2010) 1–51.
[7] M. Stevens, R. Wehrens, A. de Bont, Conceptualizations of Big Data and their epistemological claims in healthcare: a discourse analysis, Big Data Soc. 5 (2018), https://doi.org/10.1177/2053951718816727, 2053951718816727.
[8] C.N. Driver, B.S. Bowles, B.J. Bartholmai, A.J. Greenberg-Worisek, Artificial intelligence in radiology: a call for thoughtful application, Clin. Transl. Sci. 13 (2020) 216–218, https://doi.org/10.1111/cts.12704.
[9] M. Borup, N. Brown, K. Konrad, H. Van Lente, The sociology of expectations in science and technology, Technol. Anal. Strateg. Manag. 18 (2006) 285–298, https://doi.org/10.1080/09537320600777002.
[10] S. Raisch, S. Krakowski, Artificial intelligence and management: the automation-augmentation paradox, AMRO (2020), https://doi.org/10.5465/2018.0072.
[11] I. Parker, Discourse Dynamics: Critical Analysis for Social and Individual Psychology, Taylor & Frances/Routledge, Florence, KY, US, 1992.
[12] J. Cheek, At the margins? Discourse analysis and qualitative research, Qual. Health Res. 14 (2004) 1140–1150, https://doi.org/10.1177/1049732304266820.
[13] T.A. van Dijk, Editorial: analysing discourse analysis, Discourse Soc. 8 (1997) 5–6, https://doi.org/10.1177/0957926597008001001.
[14] R.V. Kozinets, Netnography, in: G. Ritzer (Ed.), The Blackwell Encyclopedia of Sociology, John Wiley & Sons, Ltd, Oxford, UK, 2007, pp. 1–2.
[15] R.E. Boyatzis, Transforming Qualitative Information: Thematic Analysis and Code Development, 1998.
[16] M. Allen, The SAGE Encyclopedia of Communication Research Methods, SAGE Publications, 2017.
[17] P. Rajpurkar, J. Irvin, K. Zhu, et al., CheXNet: Radiologist-Level Pneumonia Detection on Chest X-Rays with Deep Learning, arXiv [cs.CV], 2017.
[18] S. Gupta, T.M. Kattapuram, T.Y. Patel, Social media's role in the perception of radiologists and artificial intelligence, Clin. Imaging 68 (2020) 158–160, https://doi.org/10.1016/j.clinimag.2020.06.003.
[19] B.K. Sovacool, D.J. Hess, Ordering theories: typologies and conceptual frameworks for sociotechnical change, Soc. Stud. Sci. 47 (2017) 703–750, https://doi.org/10.1177/0306312717709363.

[6] See e.g. the recent speech by the Dutch Minister of Finances, Wopke Hoekstra, arguing that AI is going to replace the old-fashioned profession of radiologists.