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How Artificial Intelligence for Healthcare Look Like in the Future?

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Abstract. Research on artificial intelligence (AI) for healthcare gained interest in recent years. However, the use of AI in daily clinical practice is still rare. We created and distributed an online survey among professionals working within the health informatics field to explore their views. The provided answers were classified into referring or not to: 1) Application areas; 2) Medical specialities; 3) Specific technologies; 4) Use cases; 5) Citizens involvement; and 6) Challenges. We received 42 valid responses. With regard to the sentiment of the answers, 71,4% were classified by the AFINN tool as being positive. In light of the open question, 76,2% of the respondents referred to possible applications areas. They think the most frequent uses will be for diagnostic, decision making and treatment. 54,8% of respondents referred to use cases, being personalized care and daily practice the most popular scenarios. 28,6% mentioned citizens' involvement, and 23,8% medical specialities in which AI might be used. There is a mostly positive attitude towards the application of AI in healthcare, in particular regarding its future use for realising routine tasks. From these results, we conclude that research should further focus on realising AI-based applications for relieving health professionals from repetitive tasks and optimize healthcare processes.

Keywords. Artificial Intelligence; Healthcare; Health; Participatory Health

1. Introduction

Artificial intelligence (AI) refers to computer systems imitating human intellectual processes, such as reasoning, discovering meaning, generalizing, predicting, or learning from past experiences [1]. Within healthcare, AI is starting to be applied to support clinical decision making [2], for diagnostic purposes [3], or for data analysis [4]. At the end of 2020, a simple PubMed query using the keyword ‘artificial intelligence’ retrieved more than 114.000 indexed papers. This search shows that the first paper on AI for health dates back to 1951[5]. Since then, the number of papers has grown year after year, and nearly 10% of all Pubmed indexed papers are from 2020. The interest of using AI in participatory health is also increasing [6]. Common applications include the secondary analysis of social media data[7]. Results of such analysis are among other things used for disease surveillance [8,9]. Other application areas include determining if online forums require assistance[10], identifying users who are likely to drop from forums [11], extracting terms to learn its vocabulary, highlighting contextual

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information [12], or paraphrasing medical terms [13]. Although all the attention, so far AI in healthcare is mainly prevalent in research labs, and not yet used in daily practice [14]. The objective of this paper is to explore views, perspectives and beliefs of professionals within the health informatics field regarding the future of AI.

2. Methods

We created an anonymous survey using Google Forms including the following question: "How do you think will be the future of artificial intelligence for healthcare? (e.g. To what extent will it be used, for which purposes, by whom?)". As demographic data, we asked for "Gender"; "Profession"; and "Background". The survey was distributed internationally via e-mail among professors, researchers, and students within the health informatics field, following a convenience sampling approach and using the business networks of the authors. The e-mail containing the link to the survey provided participants with information regarding the purpose of the study and anonymity. The online survey was available to be answered for 2 weeks, from November 23rd and until December 6th, 2020. We analyzed the free text responses regarding their sentiment (positive, neutral or negative) using AFINN sentiment analysis tool [15]. We classified the answers independently into referring or not to six main topics: 1) Application areas; 2) Medical specialities; 3) Specific technologies; 4) Use cases; 5) Citizens involvement; and 6) Challenges. We calculated the inter-rater agreement using Cohen kappa analysis. In case of discrepancies regarding categorization all identified topics. Data were analyzed using SPSS (version 25; IBM Corp).

3. Results

We received a total of 60 survey answers. After removing duplicates, and empty received questionnaires, a total of 42 answers were considered as valid. Among the 42 respondents, 22 identified themselves as male (52,4%) and 20 as female (47,6%). Respondents had a background in health sciences (15/42), computer science (15/42), social sciences (4/42), health and computer sciences (2/42), computer and social sciences (2/42), computer, health and social sciences (1/42) and other (3/42). Regarding profession, answers were given by researchers (12/42), professors (6/42), researcher and professor (13/42), student and researcher (1/42) and others (10/42). With regards to the sentiment of the answers, 30 of the responses were classified by AFINN tool as being positive (71,4%), 10 neutral (23,8%), and 2 negative (4,8%). Regarding the classification of the six main topics, the inter-rater agreement was moderate[16] for the topics "medical specialities" and "technologies" (Kappa= 0,442, and Kappa= 0,557 respectively); substantial [16] for the topics "challenges", "use case" and "application areas" (Kappa= 0,627, Kappa= 0,714 and Kappa= 0,738 respectively); and almost perfect agreement[16] for the "citizens involvement" topic (Kappa= 0,877). In light of the open question "How do you think will be the future of artificial intelligence for healthcare?", 76,2% of the respondents referred to application areas. The most common application areas were: diagnostic (mentioned by 47,6%), decision making (21,4%), and treatment (14,3%). A list of all reported application areas of is shown in Figure 1. Use cases were pointed out in 54,8% of responses, the most popular cases of use of

AI in the future being personalized care and the daily practice (cited 23,8% and 9,5% respectively). See Figure 1. Other issues mentioned in the answers were the citizens' involvement, which was named by 12 (28,6%); medical specialities were mentioned by 10 (23,8%); or specific technologies were referred in 8 responses (19,0%). Only 6 of the respondents (14,3%) alluded to the challenges of future AI for healthcare.

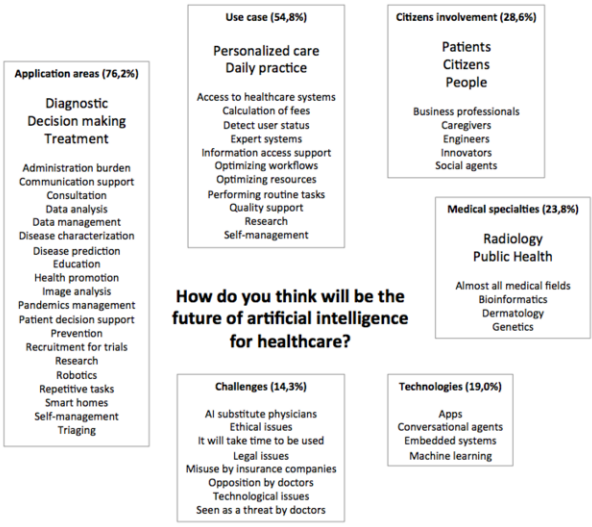

Figure 1. Issues raised by respondents within each of the six main topics.

4. Discussion and Conclusions

4.1. Uses of AI in the future

The most often mentioned medical speciality related to AI in future was radiology. This speciality is already highly digitized with image processing that can be processed by automated methods. It is expected that images will be examined at some point by a machine [14]. Many other medical specialities might benefit with the successful progress of AI in handling millions of images very rapidly [17], including public health. During the COVID-19 pandemic, research developed and tested a broad range of AI applications for monitoring, diagnosis, risk prediction and treatment [18]. Also public opinions on outbreak-related topics were analysed with AI [18-20]. These developments might have had an impact on the optimism regarding the future of AI for healthcare. Several answers claimed that AI will be used for realizing repetitive tasks. This is interesting, since this topic seems to be underrepresented in existing research. There are attempts where AI-based chatbots are used for collecting medical histories (e.g. Ana) [21], or the development of digital scribes to reduce clinical burden using speech recognition and natural language processing [22,23]. However, there are still some challenges [24]. It would be interesting to learn more about repetitive tasks that could be realized by AI. Many AI research seems to concentrate on analysing data [25] or on AI-empowered devices [26], but it seems that AI for performing repetitive tasks in healthcare has not yet been considered to a sufficient extent.

4.2. Positivity about the future of AI for healthcare

Although the future of AI for healthcare is uncertain, most of our survey´ respondents (seven out of ten) gave answers that were classified as having a positive sentiment. This positive sentiment could be interpreted as positive perceptions about the future of AI for healthcare, and perhaps even optimism about it. Only a few survey´ respondents referred to challenges of using AI for healthcare in the future. One of the mentioned issues was the concern that AI could substitute healthcare personnel in the future. Previous publications have reported experts´ concern about different healthcare professionals being replaced by AI, especially radiologists [17]. However, AI is likely to support clinicians with their routine tasks, improve their efficiency and allow them to spend more time with the patients[17]. Ethical, legal and technological issues were also mentioned as challenges, as well as the potential misuse by insurance companies. There are clearly more challenges than those, such as: the burden of missing training data, reproducibility of AI-decisions [27], privacy considerations [28], implementation challenges [29] or the possible overuse of healthcare due to overdiagnosis done by AI [30], etc.

4.3. Limitations of this study

Our survey was purely exploratory. The findings cannot be generalized to all professionals within the health informatics field. Future research could consider expanding the questionnaire and reaching out more professionals. Since the whole user statement was used as input for the sentiment analysis tool, it gives us only an overall sentiment and not an aspect-related sentiment.

4.4. Conclusions

There are visions for additional use cases of AI in healthcare that go beyond support in diagnosis or treatment and image analysis namely applications that support repetitive tasks. Research should start focusing also on such applications. AI applications relieving health professionals from their clinical documentation burden could address the fear that AI could replace physicians and could contribute to acceptance of AI in healthcare. In order to integrate AI into daily practice, efficiency and usefulness have to be studied and demonstrated.

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References

[1] Bali J, Garg R, Bali RT. Artificial intelligence (AI) in healthcare and biomedical research: Why a strong computational/AI bioethics framework is required? Indian J Ophthalmol. 2019;67(1):3-6.
[2] Magrabi F, Ammenwerth E, McNair JB, et al. Artificial Intelligence in Clinical Decision Support: Challenges for Evaluating AI and Practical Implications. Yearb Med Inform. 2019;28(1):128-34.
[3] Kulkarni S, Seneviratne N, Baig MS, et al. Artificial Intelligence in Medicine: Where Are We Now? Acad Radiol. 2020;27(1):62-70.

[4] Núñez Reiz A, Armengol de la Hoz MA, Sánchez García M. Big Data Analysis and Machine Learning in Intensive Care Units. Med Intensiva 2019;43(7):416-26.
[5] Fletcher KH. Matter with a mind; a neurological research robot. Research. 1951;4(7):305-7.
[6] Denecke K, Gabarron E, Grainger R, et al. Artificial Intelligence for Participatory Health: Applications, Impact, and Future Implications. Yearb Med Inform. 2019;28(1):165-73.
[7] Chee BW, Berlin R, Schatz B. Predicting adverse drug events from personal health messages. AMIA Annual Symposium proceedings AMIA Symposium. 2011;2011:217-26.
[8] Aiello AE, Renson A, Zivich PN. Social Media- and Internet-Based Disease Surveillance for Public Health. Annu Rev Public Health. 2020;41:101-18.
[9] Velasco E, Agheneza T, Denecke K, et al. Social media and internet-based data in global systems for public health surveillance: a systematic review. Milbank Q. 2014;92(1):7-33.
[10] Huh J, Yetisgen-Yildiz M, Pratt W. Text classification for assisting moderators in online health communities. J Biomed Inform. 2013;46(6):998-1005.
[11] Wang X, Zhao K, Street N. Analyzing and Predicting User Participations in Online Health Communities: A Social Support Perspective. J Medical Internet Res. 2017;19(4):e130.
[12] Eletriby MR, Tera LR, Ramesh J, et al. Investigating Named Entity Recognition of Contextual Information in Online Consumer Health Text. Eighth International Conference on Intelligent Computing and Information Systems (ICICIS) 2017.
[13] Grabar N, Hamon T. Automatic extraction of layman names for technical medical terms. IEEE International Conference on Healthcare Informatics 2014.
[14] Davenport T, Kalakota R. The potential for artificial intelligence in healthcare. Future Healthc J. 2019;6(2):94-8.
[15] Nielsen FA. A new ANEW: Evaluation of a word list for sentiment analysis in microblogs. Proceedings of the ESWC2011 Workshop on 'Making Sense of Microposts': Big things come in small packages. 2011:93-8. http://www2.imm.dtu.dk/pubdb/views/edoc_download.php/6006/pdf/imm6006.pdf
[16] Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics. 1977;33(1):159-74.
[17] Ahuja AS. The impact of artificial intelligence in medicine on the future role of the physician. PeerJ. 2019;7:e7702.
[18] Tayarani NM. Applications of Artificial Intelligence in Battling Against Covid-19: A Literature Review. Chaos Solitons Fractals. 2020:110338.
[19] Jelodar H, Wang Y, Orji R, et al. Deep Sentiment Classification and Topic Discovery on Novel Coronavirus or COVID-19 Online Discussions: NLP Using LSTM Recurrent Neural Network Approach. IEEE J Biomed Health Inform. 2020;24(10):2733-42.
[20] Islam A, Laato S, Talukder S, et al. Misinformation sharing and social media fatigue during COVID-19: An affordance and cognitive load perspective. Technol Forecast Soc Change. 2020;159:120201.
[21] Sesagiri Raamkumar A, Tan SG, Wee HL. Use of Health Belief Model-Based Deep Learning Classifiers for COVID-19 Social Media Content to Examine Public Perceptions of Physical Distancing: Model Development and Case Study. JMIR Public Health Surveill. 2020;6(3):e20493.
[22] Denecke K, May R, Pöpel A, et al. Can a Chatbot Increase the Motivation to Provide Personal Health Information? Stud Health Technol Inform. 2020;273:85-90.
[23] Bates DW, Landman AB. Use of Medical Scribes to Reduce Documentation Burden: Are They Where We Need to Go With Clinical Documentation? JAMA Intern Med. 2018;178(11):1472-3.
[24] Arndt BG, Beasley JW, Watkinson MD, et al. Tethered to the EHR: Primary Care Physician Workload Assessment Using EHR Event Log Data and Time-Motion Observations. Ann Fam Med. 2017;15(5):419-26.
[25] Quiroz JC, Laranjo L, Kocaballi AB, et al. Challenges of developing a digital scribe to reduce clinical documentation burden. NPJ Digit Med. 2019;2:114.
[26] Noorbakhsh-Sabet N, Zand R, Zhang Y, et al. Artificial Intelligence Transforms the Future of Health Care. Am J Med. 2019;132(7):795-801.
[27] Lin SY, Shanafelt TD, Asch SM. Reimagining Clinical Documentation With Artificial Intelligence. Mayo Clin Proc. 2018;93(5):563-5.
[28] Xu J, Yang P, Xue S, et al. Translating cancer genomics into precision medicine with artificial intelligence: applications, challenges and future perspectives. Hum Genet. 2019;138(2):109-24.
[29] Price WN, 2nd, Cohen IG. Privacy in the age of medical big data. Nat Med. 2019;25(1):37-43.
[30] Shaw J, Rudzicz F, Jamieson T, et al. Artificial Intelligence and the Implementation Challenge. J Med Internet Res. 2019 Jul 10;21(7):e13659 .
[31] Komorowski M, Celi LA. Will Artificial Intelligence Contribute to Overuse in Healthcare? Crit Care Med. 2017;45(5):912-3.