GENERATIVE ARTIFICIAL INTELLIGENCE IN HEALTH PROFESSIONS: A BIBLIOMETRIC DESCRIPTIVE ANALYSIS

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Abstract

Introduction and Objectives: Generative artificial intelligence (AI) refers to a type of AI that has the ability to create text, images and other media using models. These models learn patterns and structures, from training data in order to generate outputs. Generative AI finds applications in fields such as business, education, and healthcare. Some examples of AI systems include ChatGPT developed by OpenAI, Bard by Google and Claude from Anthropic. In the healthcare sector, generative AI has applications from gathering information during interactions between healthcare professionals and patients for creating clinical records to enhancing diagnostic accuracy and clinical efficiency to support continuity of care. Over the last year, there has been growth in the use of generative AI in healthcare with potential impacts on education and research as well. However, due to the amount of literature in this field comprehending its scientific structure and development presents challenges. To overcome this impact, visualization techniques based on data can prove helpful, for understanding the specific domains.

Material and Methods: This is a bibliometric, descriptive, and retrospective study. The author identified publications from the PubMed database from November 2022 till November 2023 related to the use of Generative Artificial Intelligence in Health Professions, using this search string (("chatbot"[All Fields] OR "GPT"[All Fields] OR "ChatGPT"[All Fields] OR "Bard"[All Fields] OR "Bing"[All Fields]) AND ("Artificial Intelligence"[MeSH Terms] OR "Large Language Models"[All Fields] OR "LLM"[All Fields]) AND ("Health Personnel"[MeSH Terms] OR "Health Occupations"[MeSH Terms])) AND (2022/11/30:2023/11/30[pdat]). From the titles and abstracts of these publications, was selected the main terms related to the field, extracted by VOSviewer software, to create a visualization of the most important trends referred to in the literature.

Results: The researchers identified a total of 248 relevant references, including clinical trials and randomized controlled trials, as well as meta-analyses and systematic reviews. Upon examining the co-occurrence of MeSH terms and authors' terms associated with Generative AI and healthcare professionals, we found that the most common association of terms was related to the medical profession across various medical specialities. This was followed by terms related to allied health professions. Another relevant observation was the dominance of ChatGPT from OpenAI in comparison to other chatbots trained on different Large Language Models.

Conclusions: Overall, as shown by published research, the interest in Generative AI has grown exponentially, influencing all aspects related to the use of this approach in the practice, education, and research of healthcare professions. The use of generative AI has the potential to enhance the knowledge, clinical skills, and decision-making abilities of healthcare professionals, and ultimately lead to better patient outcomes. However, it is important to ensure that these technologies are designed and implemented in an ethical and responsible manner, with appropriate consideration given to issues such as bias, privacy, and transparency.

Keywords: Generative Artificial Intelligence, Health Professions, Bibliometric.

1 INTRODUCTION

Artificial intelligence (AI), a subdivision of computer science, is dedicated to the development of machines and software capable of executing tasks that generally necessitate human intelligence, about learning, problem-solving, decision-making, and comprehension of language. This field involves various technologies such as machine learning, deep learning, natural language processing, and computer vision and Generative AI [1].

Generative artificial intelligence (AI) refers to a type of AI that has the ability to create text, images and other media using models. These models learn patterns and structures, from training data in order to generate outputs. Generative AI finds applications in fields such as business, education, and healthcare. Some examples of AI systems include ChatGPT developed by OpenAI, Bard by Google and Claude

from Anthropic. In the healthcare sector, generative AI has applications from gathering information during interactions between healthcare professionals and patients for creating clinical records to enhancing diagnostic accuracy and clinical efficiency to support continuity of care. Over the last year, there has been growth in the use of generative AI in healthcare with potential impacts on education and research as well.

In the field of educating healthcare professionals, Generative AI stands as a transformative force, introducing novel tools and methods for teaching and training [2]. AI's potential applications in healthcare education encompass:

- Customized Learning: AI facilitates individualized learning experiences by offering recommendations tailored to each student's unique learning needs, preferences, and progress. Adaptive learning platforms powered by AI can adjust the learning pace and complexity, providing specific feedback to improve student performance [3].
- Virtual Simulation: Leveraging AI, virtual simulation tools can create lifelike scenarios enabling healthcare professionals to hone their clinical skills and decision-making in a safe, controlled setting [4]. This is particularly beneficial for high-risk procedures or scenarios difficult to replicate in the real world.
- Intelligent Tutoring: AI-driven tutoring systems offer immediate feedback and guidance, helping students pinpoint and address their learning gaps with appropriate resources [5].
- Automated Grading: AI algorithms can autonomously grade assessments and give feedback, saving educators time and allowing for more frequent, timely evaluations [6].
- Data Analytics: AI's ability to analyse student data helps instructors identify learning patterns and trends, enabling them to adjust their teaching strategies to better meet student needs [7].

Incorporating Generative AI in healthcare education can not only enhance the learning experience but also improve clinical skills and decision-making, ultimately leading to improved patient outcomes. However, it's vital to design and implement these technologies ethically and responsibly, considering issues like bias, privacy, and transparency [8].

AI's role in health professions education is increasingly influential, impacting research as well. However, due to the amount of literature in this field comprehending its scientific structure and development presents challenges. To overcome this impact, visualization techniques based on data can prove helpful, for understanding the specific domains. Utilizing bibliometric data visualization techniques can provide clearer insights into these scientific domains.

Bibliometrics, an academic field, scrutinizes research literature patterns and trends using statistical and mathematical methods to evaluate the impact of research papers and scholarly works. These studies often measure research productivity and influence in specific fields or institutions, influencing decisions on funding, hiring, and promotions [9]. Bibliometric studies employ various metrics, including:

- Citation Count: Measures how often a paper is cited by others.
- Impact Factor: Reflects the average citation count of papers in a particular journal.
- H-index: Assesses an author's productivity and impact based on their published papers and the citations these receive.
- Co-citation Analysis: Investigates patterns of papers cited together to identify key research areas and trends.

These studies are instrumental in identifying influential research, pinpointing gaps in literature, and evaluating the impact of research funding. However, it is important to recognize that bibliometrics is only one aspect of research evaluation and should be used alongside other methods [10].

2 METHODOLOGY

This is a bibliometric, descriptive, and retrospective study. The author identified publications from the PubMed database from November 2022 till November 2023 related to the use of Generative Artificial Intelligence in Health Professions, using this search string ((("chatbot"[All Fields] OR "GPT"[All Fields] OR "ChatGPT"[All Fields] OR "Bard"[All Fields] OR "Bing"[All Fields]) AND ("Artificial Intelligence"[MeSH Terms] OR "Large Language Models"[All Fields] OR "LLM"[All Fields]) AND ("Health Personnel"[MeSH Terms] OR "Health Occupations"[MeSH Terms])) AND (2022/11/30:2023/11/30[pdat]).

From the titles and abstracts of these publications, was selected the main terms related to the field, extracted by VOSviewer software, to create a visualization of the most important trends referred to in the literature.

3 RESULTS

The researchers identified a total of 248 relevant references, including clinical trials and randomized controlled trials, as well as meta-analyses and systematic reviews.

We can observe in the bibliometric visualization created by VOSviewer software (Fig.1), the central node, represented by the term "artificial intelligence" suggests its relevance and centrality in the literature examined. The size of this node indicates a high frequency of occurrence, positioning AI as a foundational element around which other research topics converge. Adjacent to the central AI node are clusters of related terms, each distinguished by a unique colour.

These clusters signify thematic groupings within the broader field of AI research. One cluster includes terms like "natural language processing," "deep learning" and "language models". The proximity and dense interlinking of these terms highlight a significant research focus on the development and application of AI in understanding and generating human language.

Another significant cluster encompasses "GPT-4" ,"large language models", "chatbot " and "chatbots". The strength of the connections between these terms, as indicated by the thickness of the lines, points to a substantial and concentrated area of research interest in conversational AI systems and advanced language model development.

The visualization provides insights into the co-occurrence of terms within the literature, where the frequency of term pairings is visually encoded through the thickness of the lines connecting the nodes. Thicker lines suggest a stronger association or co-occurrence in the literature, reflecting the intensity of research dialogue between the connected concepts.

In summary, this bibliometric network visualization sums up the collaborative and often interdisciplinary nature of AI research. It reveals the dominant themes and their interrelations within the field, offering a macroscopic view of the scientific discourse shaping the current and future directions of AI research in healthcare context.

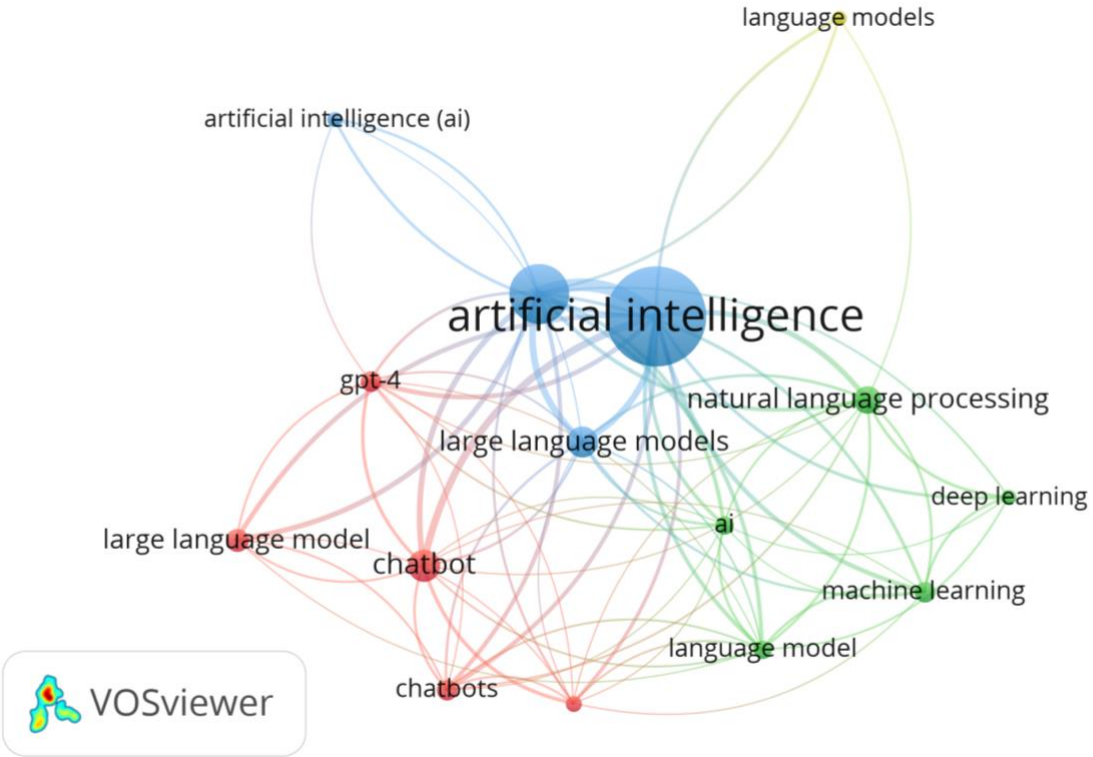

Figure 1. Co-occurrence of the terms associated with AI (VOSviewer)

Upon examining the co-occurrence of Mesh terms associated with Generative AI and healthcare professionals and fields (Fig.2), we can see that the term "artificial intelligence," centrally positioned and considerable node size within the network underscores the term's frequent occurrence and role in medical research.

Linkages between the nodes, manifesting as lines of varying thickness, denote the co-occurrence of terms within the medical literature. Thicker connections portray a more robust association between AI and the connected medical fields, indicating a heightened focus of academic discussion and research.

In the proximity of main term, a range of nodes exemplifies diverse medical disciplines, each distinguished by its size and colour, which report the term's prevalence and thematic correlations. A significant cluster, rendered in blue, features terms such as "radiology" and "medicine". The strong ties between these nodes and AI may reflect the increasing application of AI technologies in diagnostic processes and overall medical practice, signifying the technological transformation within these areas.

Adjacent clusters further illustrate AI's reach into various branches of medicine. Red-tinted nodes encompass disciplines like "physicians" and "dentistry" indicating a research trajectory into AI's practical implementations in clinical and dental settings. The green hues trace a connection through "gynaecology" "internal medicine" and "cardiology" revealing a widespread engagement with AI applications across these specialties. Meanwhile, the yellow-toned cluster, comprising "surgeons" "orthopaedics" and "anaesthesiology" likely denotes the exploration of AI in surgical planning, patient monitoring, and procedural efficiency.

In essence, the visualization captures the impact of AI throughout the medical sciences. It highlights the capacity of AI to push advancements across a range of medical practices.

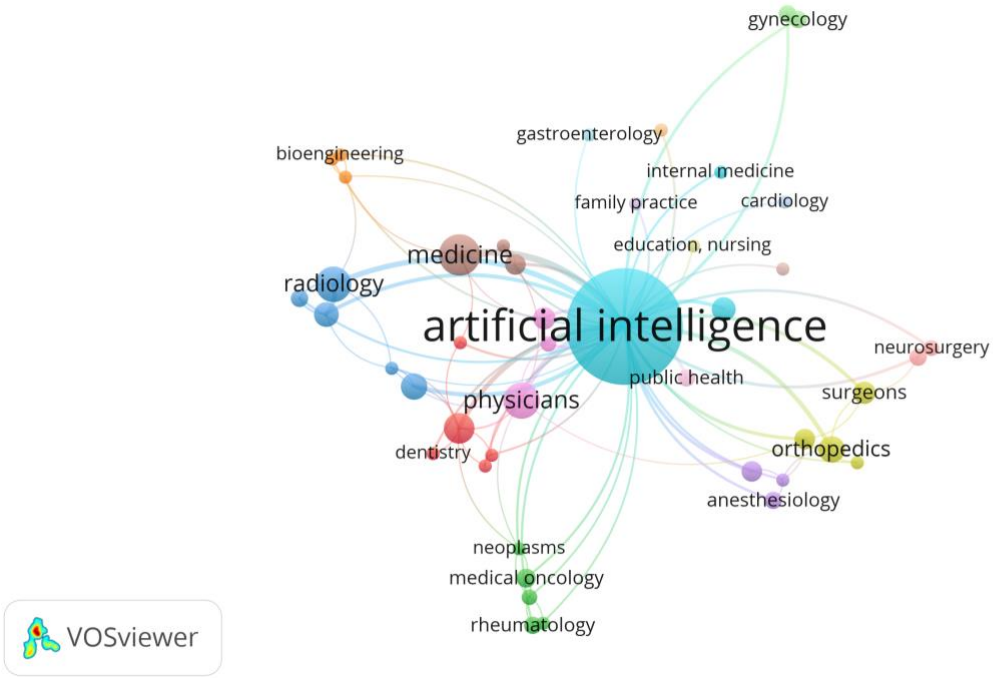

Figure 2. Co-occurrence of the terms associated with Generative AI and health professions (VOSviewer)

In the context of applications of Generative AI in healthcare, it is evident by bibliometric visualization presented in the Figure 3, that besides the central node, "artificial intelligence", we see significant terms like "medical education", "chatbot", "telemedicine" and "digital health" closely linked to AI. These links suggest that AI is not an isolated research topic but is integrated with these domains, indicating a trend towards the incorporation of AI in medical and health education, patient interaction through chatbots, and remote healthcare services.

The presence of terms such as "gpt-4", an advanced language model, highlights the exploration of cutting-innovative AI technologies in the medical field. The co-occurrence of "gpt-4" with "medical writing" and "curriculum" may suggest an emerging trend of using AI for educational content creation and curriculum development in medical training and education.

In bibliometric terms, the thickness of the lines, or edges, between the nodes indicates the strength of the co-occurrence, which in this case underscores the robust connections between AI and various aspects of digital health and education. The color-coded clusters may represent distinct, yet interconnected, thematic areas, with each colour group indicating a different focus area within the broader topic.

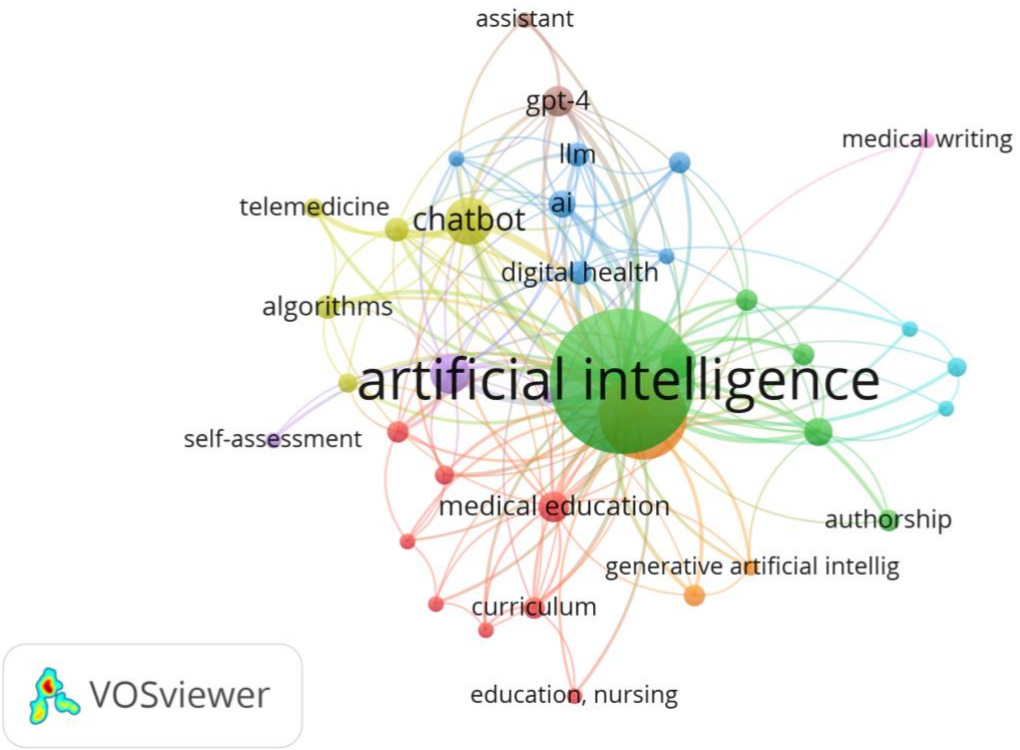

Figure 3. Co-occurrence of the terms associated with the types of generative AI usage in healthcare (VOSviewer)

4 CONCLUSIONS

In conclusion, the findings from the bibliometric analysis, it is evident that the domain of generative artificial intelligence (AI), particularly in the context of healthcare, is characterized by diverse and substantial research. The analysis of 248 relevant references, including clinical trials, randomized controlled trials, meta-analyses, and systematic reviews, has revealed several key insights.

The bibliometric visualization demonstrates the central role of "artificial intelligence" in the current literature, suggesting its foundational importance in the field. Terms like "natural language processing", "deep learning" and "language models" signifying a strong research emphasis on AI's capabilities in language understanding and generation, and the presence of terms such as "GPT-4", "large language models" and "chatbots" reflect growing interest in conversational AI systems and advanced language model development.

Further examination of the co-occurrence of Mesh terms, demonstrates the prevalence and its thematic relationships with different medical disciplines. Notably, AI's integration into fields such as radiology, medicine, dentistry, gynaecology, internal medicine, cardiology, surgery, orthopaedics, and anaesthesiology. These connections indicate AI's growing influence in diagnostic processes, medical practice, and surgical planning.

Additionally, the application of Generative AI in healthcare is further highlighted by terms like "medical education", "chatbot", "telemedicine" and "digital health" which are closely linked to. The presence of "GPT-4" alongside terms like "medical writing" and "curriculum" suggests an emerging trend in utilizing AI for educational content creation and curriculum development in medical training.

This bibliometric analysis demonstrates the robust connections between AI and various aspects of digital health and education, indicating that AI is increasingly integrated with these domains.

In summary, recent research points to a growing interest in the application of Generative AI across various aspects of healthcare, including practice, education, and research. The implementation of such

technologies holds promise for enhancing the knowledge and clinical skills of healthcare professionals. However, it is imperative to consider ethical aspects such as bias, privacy, and transparency in the development and implementation of these AI technologies. This will ensure that their integration into healthcare is both effective and responsible, ultimately benefiting patient outcomes.

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