

Disparities in Regional Publication Trends on the Topic of Artificial Intelligence in Biomedical Science Over the Last Five Years: A Bibliometric Analysis

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Abstract. Bibliometric analysis is a scientific method that allows researchers to explore the current trend in a certain research area using citation information. This study aims to provide a meta-view of artificial intelligence studies focused on biomedicine in the last five years, which will provide an insight into current trends and future research directions. Besides the observation of increased publication rates in the area of AI in biomedicine, the results indicate a lower contribution from and a sparser network connectivity of countries with limited resources. Thus, working toward collaboration in terms of infrastructure and implementing alternative solutions such as FAIR (Findable, Accessible, Interoperable and Reproducible) and open access platforms could improve the collaborative nature of international health projects.

Keywords. Artificial Intelligence, Medicine, Biomedicine, Bibliometric Analysis

1. Introduction

Leveraging the vastly increasing volume of medical data being generated, the application of advanced Big Data analysis approaches such as Machine learning (ML) and Deep Learning (DL) are considered important milestones of the upcoming requirements in healthcare [1]. Several studies flagged the relevance of applying artificial intelligence (AI) in risk, treatment and event/outcome prediction [2]. The number of studies published in peer reviewed academic journals and suggesting customized models for predictions based on Big Data is steadily increasing. Synthesizing evidence in this area of research will provide a comprehensive input for upcoming clinical and methodological guideline development and an indication for potential research areas.

Bibliometric analysis is a scientific method that enables researchers to explore the current trend in a certain research area using citation information [3]. It mainly provides a bird's-eye view on the activities in the research domain, showing who is doing what, where, with whom and the intensity of cross-country, author and affiliation collaboration

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on that specific research area. This study aims to provide a meta-view of artificial intelligence studies focused on biomedicine in the last five years, which will provide an insight for further research and collaboration.

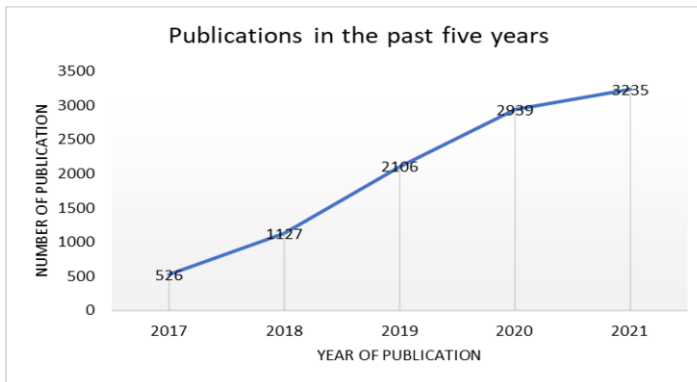
2. Methods

After keywords had been identified from previous literature (“Artificial intelligence” OR “Machine intelligence” OR “artificial neural network*” OR “Machine learning” OR “Deep learn*” OR “Natural language process*” OR “Robotic*” as a major intervention) [4], an iterative search was conducted on PubMed, which can be used as a bibliographic source for biomedical search containing more than 33million citations [5]. Medical subheadings, mixed keywords, truncated keywords and controlled vocabularies were used. The search was limited to human species, English language, studies with abstract and publications since 2017 (inclusion criteria). Using bibliometric analysis (bibliometrix package) [3], we then explored trend, growth rate and pattern of publications as well as collaboration networks.

3. Results

The search resulted in a total number of 24,979 studies. The first 10,000 best match studies were considered for further bibliometric analysis. The studies were identified using the PubMed built-in Best Match algorithm which analyzes each citation based on how many search terms are found and in which fields they are found [6].

Figure 1: Annual publication trend on the area of AI in Biomedical science 2017-2021



The result indicated that the majority of studies were journal articles (40.9% / 4,087). The annual percentage growth rate was 57.48% between 2017 and 2021. The highest increase in publication was observed between 2018 and 2020; it accounted for 77.45 % of the increase in scientific contributions in AI focusing on biomedicine in the last five years. The result includes a list of the top five relevant sources, corresponding author countries and affiliations (Table 1). The journal *Scientific Reports* was identified as the most relevant source for publications. The USA and the University of California were

also identified as the most productive country and the most relevant affiliation, respectively. Regarding collaboration, Germany was identified as the most collaborative country with 40.4% of publications, followed by the USA (29.6%).

Table 1: Top five sources, corresponding authors' countries and affiliations associated with scientific contributions focused on AI in biomedical science since 2017.

Top five sources	Top five corresponding authors' countries, SCP and MCP		Top five relevant affiliations
	Country (Number of publications)	SCP (%), MCP (%)	
Scientific reports (469)	USA (1765)	1243 (70.4%), 522 (29.6%)	University of California (1091)
Sensors (Basel Switzerland) (433)	China (1576)	1157 (73.4%), 419 (26.6%)	Stanford University (837)
Plos one (347)	Korea (512)	443 (86.5%), 69 (13.5%)	Harvard Medical school (676)
Annual international conference of the IEEE Engineering in medicine and biology society (306)	Germany (319)	190 (59.6%), 129 (40.4%)	SUN YAT-SEN University (396)
IEEE journal of biomedical and health informatics (197)	Japan (310)	272 (87.7%), 38 (12.3%)	Renim Hospital of Wuhan University (347)

SCP: Single country publication, MCP: Multiple country publication

Figure 2 shows each country's scientific contribution in the last five years. Considering the top contributor in each continent, USA (n=1,754), China (n=1,575), Germany (n=319), Australia (n=195), Brazil (n=69) and Egypt (n=23) are found to be the top contributors in their respective continent.

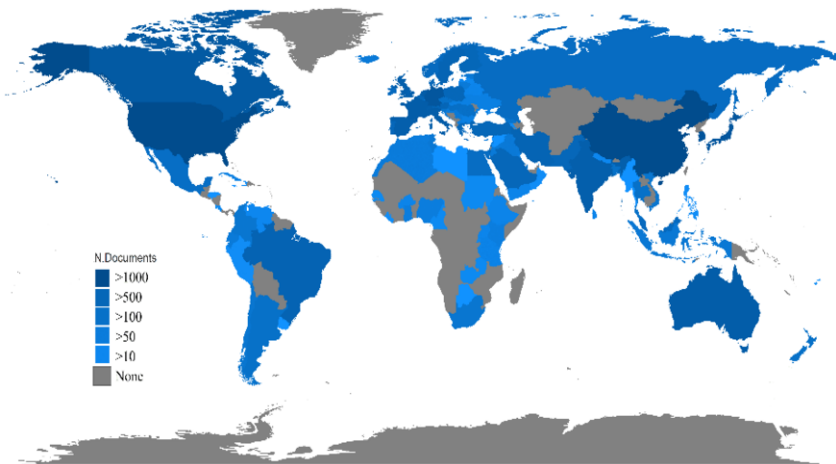


Figure 2: Country's scientific contribution

The country collaboration network depicted in Fig. 3 indicates a very intense and large number of collaborations among higher income countries but less intense networks between low and high-income countries. Moreover, a very low or no collaboration network is observed among low-income countries.

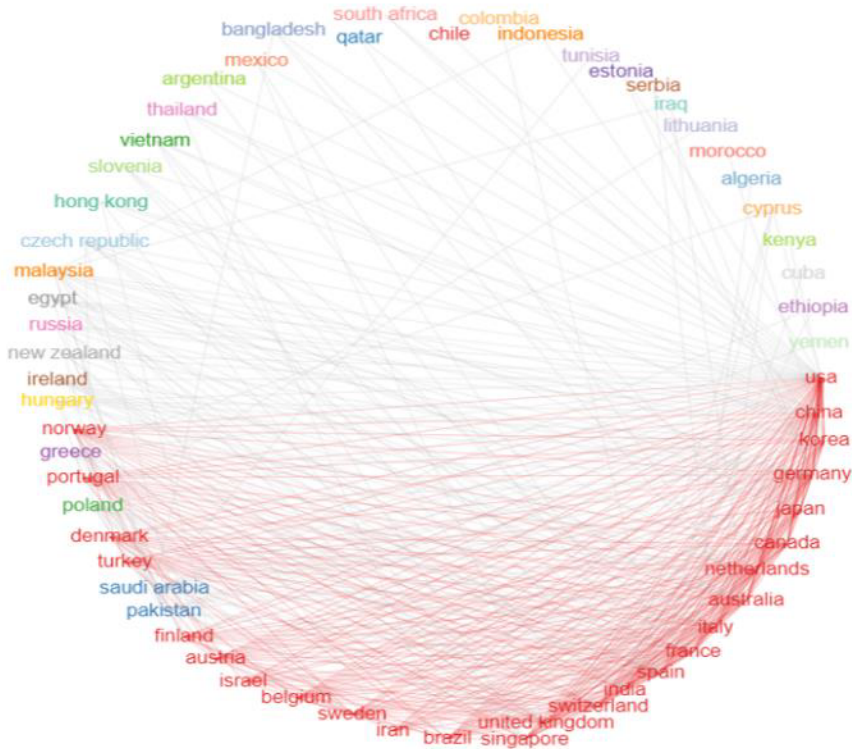


Figure 3: Country's collaboration network

4. Discussion

As a result of the ever-growing computing and storage capacity, the number of studies applying AI in biomedicine has drastically increased in the past decade [7]. More specifically, we noticed a significant increase in the number of publications in the past five years and especially after 2019. This could be due to the rush for digital solutions in early diagnosis, treatment and drug/vaccine development for the COVID-19 pandemics that we are still dealing with since 2019 [8, 9].

In terms of scientific contribution in the last five years, nearly half (44.8%) of the scientific contributions are from five countries only (USA, China, Korea, Germany and Japan), and the contribution from countries in Africa and central Asia is low in number and also with respect to collaboration networks. This could be due to the significant gap in national research and development infrastructure among the high- and low-income countries. AI-related research is dependent on data and computing power. Lack of infrastructural capacities for data, Internet, Hardware or Software in Central Asia and Africa could be one reason for non-uniform international collaborations [10]. This finding is also in line with another study by *Tran, B.X., et al, 2019* which indicated an intense collaboration among Europe [7].

To achieve the 2030 United Nations Sustainable Development Goals, specifically SDG-9 (Target 9.5) and SDG-17 (Target 17.6 and 17.9), improving North-South, South-

South and triangular regional and international cooperation on knowledge sharing, access to science, technology and innovation is important [11].

The current study comprises only published results in English language and this could result in publication bias since there are number of publications and grey literatures available in local databases in different languages across the world.

5. Conclusions

Besides the mounting indication of increased publication in the area of AI in biomedicine in the last five years, our results clearly show a lower contribution and networking activity from resource limited countries. Thus, further collaboration in terms of infrastructure development and implementation of solutions for data sharing and interoperability should be a mid-term goal in the field of AI. Here, FAIR concepts and open data platforms can help to improve the necessary networking capabilities and enable more intense collaborative data exchange.

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