

# Bibliometric Analysis of Artificial Intelligence and Machine Learning Applications in Healthcare

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**Abstract:** This study aims to examine the applications of artificial intelligence (AI) and machine learning (ML) in the healthcare field using bibliometric methods. The main objective of the study is to provide a comprehensive overview of scientific publications based on the keywords “artificial intelligence,” “AI,” “yapay zekâ,” “A.I.,” “machine learning,” “ML,” and “makine öğrenimi.” Bibliometric analysis is a powerful tool for identifying research trends, collaboration networks, and emerging topics by leveraging large data sets. The analysis identified 5,200 studies published between 2020 and 2026. Journal articles published in scientific journals constitute a significant portion of these publications, while research reports and conference abstracts also account for a notable share. The findings were visualized using figures, tables, and maps created with VOSviewer software. The results obtained reveal that AI and ML research in healthcare services is predominantly concentrated in the fields of computer science and medical informatics, while engineering disciplines and basic sciences also make significant contributions to the process. In this context, it has been revealed that the research area examined has gained considerable momentum in recent years. The study provides a comprehensive framework regarding the development trajectory of AI and ML research in healthcare, a multidisciplinary field.

**Keywords:** Artificial Intelligence, Machine Learning, Healthcare, Bibliometric Analysis

## 1. Introduction

### 1.1 Artificial Intelligence

Artificial intelligence (AI) is a technology capable of imitating human intelligence and enabling the creation of a form of intelligence other than that of humans themselves. The concept, which first emerged with the advent of computers, dates back to the 1950s. Since then, many different definitions have been proposed. According to some researchers, AI provides convenience, speed, time, and cost savings, while others argue that it may lead to job losses and alienation from human values. Various definitions have been presented in the literature depending on different perspectives.

According to Atalay and Çelik (2017), “expert systems, genetic algorithms, fuzzy logic, artificial neural networks, and machine learning techniques are generally referred to as artificial intelligence technologies.” Ulaşan (2023) defines AI as technologies that can understand, observe, reason, predict, interact, learn, self-develop, operate, and find solutions to complex problems. Dönerçark and Tecim (2020) also note that brief definitions such as “the execution of intelligent behaviors by machines or software” are available.

AI, with the innovations it introduces, is described as an “interdisciplinary research field offering new opportunities for individuals and institutions” (Çeber, 2022, p. 30). As a discipline within computer science, it can also be expressed as environments that imitate the human thinking process. From past to present, with the advancement of technology, the use of artificial intelligence has increased significantly. Innovations in machine learning algorithms have improved the speed and computational efficiency of AI systems. In AI applications, the processing, classification, and storage of information collected from digital sources such as images, sensors, and videos have become increasingly prominent. Innovations offering cost-effective solutions in the field of robotics have also contributed to the development of this area (Efe & Özdemir, 2021).

## 1.2 Machine Learning

For this reason, many machine learning methods have been developed and continue to evolve. Some of these include the k-nearest neighbors algorithm, decision trees, naïve Bayes classifier, logistic regression analysis, k-means algorithm, support vector machines, and *artificial neural networks*. Some of these approaches are capable of making predictions and forecasts, while others can perform clustering or classification (Atalay & Çevik, 2017).

According to Kaba & Kalkan (2022), “machine learning techniques are currently used in many areas and are defined as systems that allow us to classify large datasets and extract useful information through predictive analyses.” In recent years, many researchers and experts have applied machine learning algorithms in disease diagnosis (Başer et al., 2021). Today, researchers and institutions focus on improving healthcare services, addressing deficiencies, and enhancing efficiency through the use of machine learning algorithms. Machine learning has become a highly demanded and effective method for improving healthcare quality, preventing disease spread, enabling early diagnosis, minimizing hospital operational costs, supporting government health policies, and increasing the efficiency of health services (Polatlı & Karadayı, 2022).

In healthcare applications, machine learning -recognized as a subfield of artificial intelligence is particularly preferred for disease diagnosis, and this trend continues to grow (Şahin et al., 2023). Kaya (2019) emphasize that deep learning, a subfield of machine learning, is used in developing healthcare applications. The algorithms used in machine learning techniques for disease prediction may vary depending on the source of the problem and the volume of data. Researchers and professionals in the healthcare sector choose algorithms tailored to their specific needs (Veranyurt et al., 2020).

## 1.3 The Use of Artificial Intelligence and Machine Learning in Healthcare Services

The use of artificial intelligence applications in healthcare first began in the 1970s. Today, although its use is not yet widespread, factors such as the increase in the number of patients caused by poor and outdated environmental conditions and the necessity of using the existing workforce more efficiently have made the use of AI in healthcare inevitable (Çetin, 2023). According to Çelik and Tüfekçi (2024), AI and machine learning are transformative approaches in the field of health informatics and have the power to reshape decision-making processes in the delivery of healthcare services. In recent years, the use of machine learning technologies in medical and public health research has gained increasing importance (Arisoy et al., 2023).

According to Emre et al. (2021), “machine learning methods provide highly accurate and effective support in processes such as disease diagnosis, prognosis, predicting the course of a disease, or determining and monitoring the response to treatment.” Artificial intelligence applications, on the other hand, are effectively and efficiently used in healthcare services, particularly in early disease diagnosis, radiology, pathology, and imaging fields. In imaging techniques such as tomography, magnetic resonance imaging (MRI), and X-rays, AI algorithms can identify abnormalities while minimizing human error, thereby facilitating accurate diagnosis (Wang et al., 2021; Chen et al.2022, as cited in Çetin, 2023).

From the end-user perspective, applications such as “NeyimVar” guide patients to preliminary diagnoses and relevant clinics based on their symptoms. Users receive recommendations according to the urgency of their symptoms, and in potentially serious cases, they are directed to emergency services which is especially critical for conditions such as heart attacks. According to Ekrem and Daşikan (2021), “AI technology, frequently used in the field of women’s health and the perinatal period, has been successfully applied in pregnancy disease screening and management, remote pregnancy monitoring, pregnancy pharmacology, fetal development, electronic monitoring, genetic screening, and the postpartum period, yielding positive results.”

Advancements in AI and machine learning applications, along with their positive impacts on the healthcare sector, have also led to their adoption in the field of dentistry (Özkesici & Yılmaz, 2021). AI and machine learning applications can analyze patients’ personal medical data to create personalized

treatment plans. For diseases such as cancer or those that present cancer-like symptoms these systems examine patients' genetic and health data to develop personalized treatment methods (Asiri & Altuwalah, 2022).

Furthermore, the use of these technologies in the development and design of new drugs has gained increasing importance. By analyzing molecular structures and drug interactions, they can predict possible effects and provide insights into potential new drugs (Zhavoronkov, 2020). Both AI and machine learning systems enhance efficiency, reduce costs, and improve patient satisfaction by optimizing hospital operations, processes, and resource management.

Spyropoulos (2000) found that these systems accelerate processes such as appointment scheduling and patient tracking, significantly improving the efficiency of planning, implementation, and control activities. The ability of these systems to analyze large patient datasets using precise methods helps prepare public health systems for potential epidemic situations (Jiang et al., 2017; Panch et al., 2018).

According to Saygın and Baykara (2021), "advancements in artificial intelligence, machine learning, and related supporting technologies have achieved great success in disease diagnosis within the medical field." The increasing use of AI- and ML-based healthcare applications and services has led to critical advancements in treatment, diagnosis, and patient monitoring processes in both administrative and practical healthcare institutions (Nehir & Özcengiz, 2021).

Today, especially in developed and developing countries, fuzzy logic, natural language processing, speech recognition, pattern recognition, artificial neural networks, machine learning, genetic algorithms, and predominantly artificial intelligence systems are among the preferred technologies in healthcare applications, and their usage rate continues to increase (Vatansever et al., 2021). Research results indicate that AI- and ML-supported products used in treatment have significantly improved patient experiences (Nemli, 2024).

## 2. Method

This study aims to analyze scientific publications related to the applications of Artificial Intelligence (AI) and Machine Learning (ML) technologies in the healthcare sector using the bibliometric analysis method. "In today's world, where scientific knowledge and access to it are constantly increasing, bibliometric analysis one of the tools used to reach accurate information and to analyze studies conducted in any field provides convenience for researchers" (Keçeli & Erciyas, 2022).

This section of the study covers the process of obtaining, organizing, and analyzing relevant data in line with the main objective of the research. "Bibliometric analysis, which has become one of the fundamental research methods in recent years, is increasingly used across nearly all disciplines to reveal distinctive characteristics or to provide in-depth insight into journals, authors, and publications" (Kalyoncu, 2021). To ensure scientific reliability, the Web of Science (WoS) database was used for the bibliometric analyses applied in this research.

In this study, the methodological approach proposed by Guo et al. (2019) in their research titled *Artificial Intelligence in Health Care: Bibliometric Analysis* was adopted, focusing on the period between 2020 and 2026. In this way, rather than examining an extensive historical timeframe, the study aims to concentrate on current trends in the use of AI and ML in healthcare after 2020, thereby establishing a narrower but more reliable dataset. The aforementioned study analyzed works published up to 2019, while the present research was designed to examine the developmental dynamics of artificial intelligence and machine learning in healthcare beginning in 2020.

## 3. Findings

The data were obtained from the Web of Science Core Collection database on September 25, 2025. During the search process, the Science Citation Index Expanded (SCI-EXPANDED) and the Social Sciences Citation Index (SSCI) were selected. The search was conducted in the Topic (TS) field, which includes the title, abstract, author keywords, and Keywords Plus, using the following query:

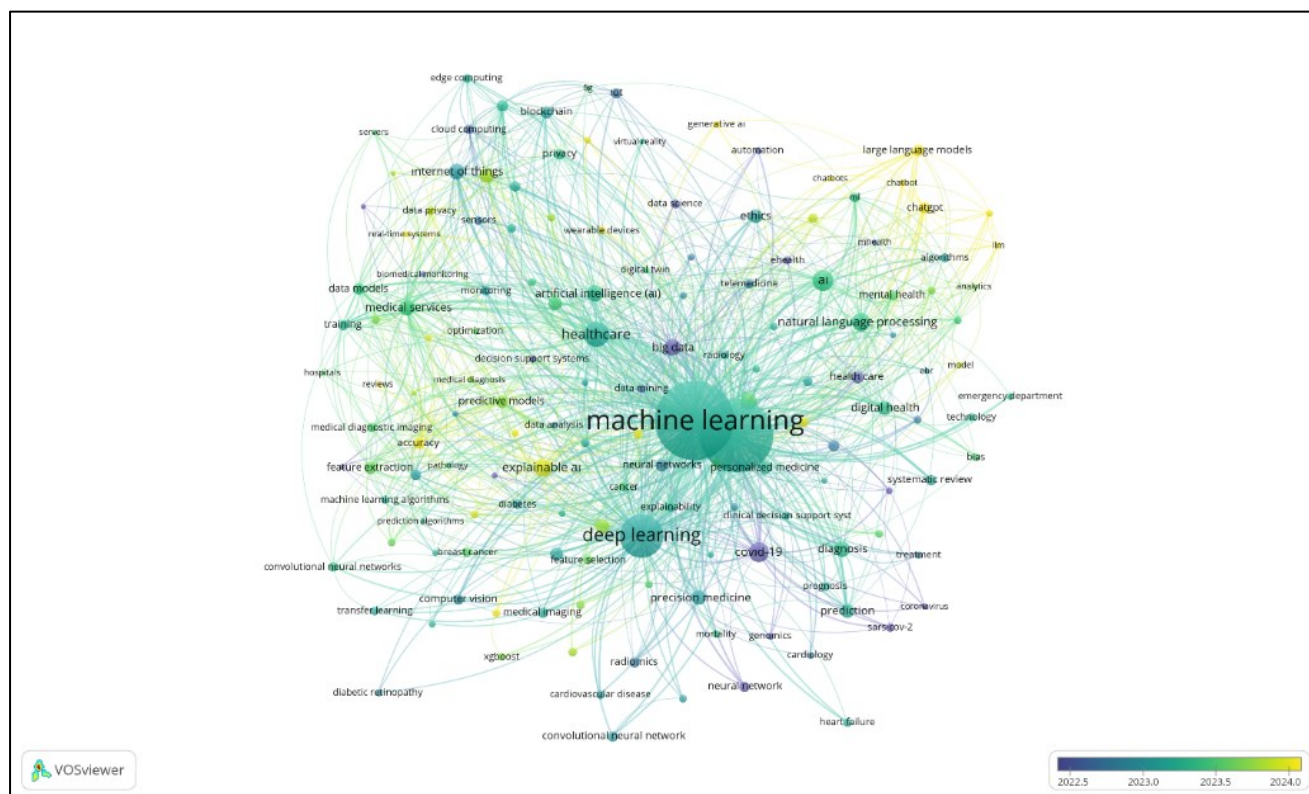
TS = (“artificial intelligence” OR “AI” OR “yapay zekâ” OR “A.I.”) AND (“machine learning” OR “ML” OR “makine öğrenme”) AND (“healthcare” OR “health care” OR “sağlık”).

The search was limited to publications from 2020 to 2026. A document type filter was applied to include articles, review papers, early access papers, and proceedings papers.

During the data cleaning stage, records obtained from the Web of Science Core Collection for the years 2020–2026 were filtered by document type. Specifically, only articles (4,634), review papers (2,311), early access publications (205), and conference papers (896) were included. Publications that were retracted (34), book chapters (60), letters (2), editorial materials (201), meeting abstracts (12), data papers (8), news items (4), and corrections (4) a total of 42 records were excluded due to irrelevance or limited contribution to the bibliometric analysis.

After keyword standardization and the removal of duplicate records, the final dataset consisted of 5,207 publications.

As a result of this strategy, a total of 5,207 records were obtained. The collected data were analyzed using bibliometric analysis techniques. The VOSviewer software was selected for its functional advantages and user-friendly interface, and maps were generated using VOSviewer version 1.6.20. Analyses conducted included keyword co-occurrence, average publication year layer, country co-authorship network, and author co-authorship network. A minimum occurrence threshold was applied during the analyses.

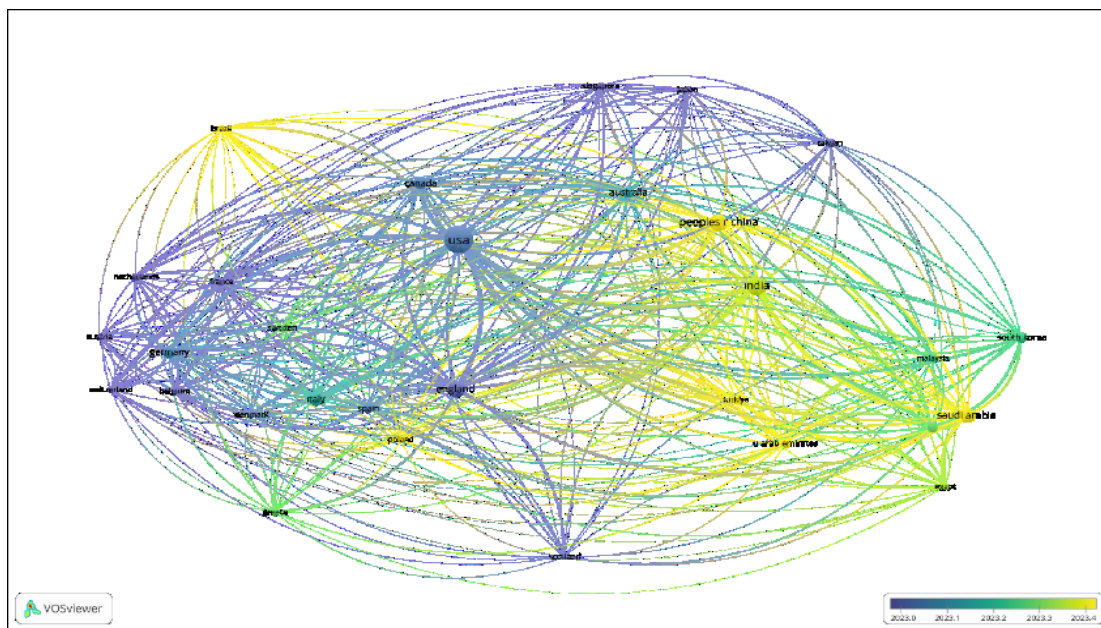


**Figure 1.** Keyword Co-Occurrence Map

In the keyword co-occurrence map (Figure 1), research on artificial intelligence and healthcare is systematically grouped into four distinct thematic clusters. At the central nodes of the network, “machine learning” and “deep learning” are positioned, indicating the methodological centrality of these topics and representing the fundamental algorithmic building blocks of research in the field.

The sections highlighted in the yellow cluster focus on studies related to algorithmic foundations and personalized treatment applications, directly connecting to individualized medicine approaches in the literature. The blue cluster covers medical devices, cloud computing, and data privacy, reflecting current research trends concerning technological infrastructure and data management. The green cluster





**Figure 3.** Country Co-Authorship Network Map

The map of the inter-country collaboration network (Figure 3) illustrates international collaboration relationships in the field of artificial intelligence in healthcare. This map helps to understand the size and significance of the United States (US) collaboration network and its importance for global knowledge transfer. Traditional collaboration relationships are indicated by dark purple/blue lines between the US, Canada, and Western European countries (e.g., the United Kingdom), reflecting a long and stable history of cooperation among these nations.

Meanwhile, the yellow and light green areas on the right and lower sides of the map indicate that countries such as Saudi Arabia, Malaysia, and Egypt have actively joined international collaboration networks in recent years and have become emerging collaboration hubs. This demonstrates that, in addition to the traditional Western-centered collaboration structures, new emerging actors are being integrated into research networks, resulting in a dynamic and globalized collaboration structure in this field.



**Figure 4.** Author Co-Authorship Analysis

The author co-authorship analysis (Figure 4) focuses on examining the collaboration structures of the most productive researchers in the field. The analysis reveals that the co-author networks exhibit unexpectedly small-scale and isolated structures. Among the six authors who exceed the minimum publication threshold, only uom.a.g. and ozsahin, alper have established effective co-authorship relationships, which are indicated by yellow lines.

The other four authors are positioned as isolated nodes in the network and do not have any strong connections. This finding suggests that high productivity in this field is sustained not through a large, interconnected research community, but rather through influential individual researchers and small regional collaboration groups. Furthermore, the yellow connection between these two authors highlights that this collaborative relationship currently represents a prominent and developing central node in the network.

#### 4. Discussion and Conclusion

In this study, bibliometric methods were used to analyze the application of artificial intelligence (AI) and machine learning (ML) in the healthcare sector, examining research trends, leading authors, countries, institutions, and thematic areas in the field. According to data from the Web of Science Core Collection comprising 5,200 publications, the number of publications between 2020 and 2024 showed a steady and sharp increase, rising from approximately 350 publications in 2020 to around 1,250 in 2024. This growth indicates that the field is rapidly expanding, attracting increasing academic interest, and generating a high research output. In 2025, 1,235 publications were recorded. The relative stabilization of these numbers compared to the previous year suggests that while the growth rate is approaching saturation, the field continues to remain vibrant. Overall, these findings support the notion that the research domain gained substantial momentum in the first half of the 2020s and has entered a stage of maturation.

Previous bibliometric analyses by Guo and colleagues, covering the period 1995–2019, indicated a significant increase in AI publications in healthcare, particularly between 2014 and 2019. Machine learning, artificial neural networks, and deep learning approaches were highlighted, with chronic diseases such as cancer being central research topics. In the present study, filtered data for the period 2020–2026 showed an annual publication increase from approximately 350 to 1,200 publications. The rapid growth reported by Guo et al. continued in the early 2020s but displayed a plateau in the 2024–2025 period, confirming that the field's evolution follows the expected trajectory of rapid growth followed by maturation.

In conclusion, research on artificial intelligence and machine learning in healthcare is expected to continue increasing rapidly, both in academic domains and practical applications, further contributing to the development and implementation of advanced healthcare technologies.

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#### Author Contributions

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