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Role of Artificial Intelligence in Workforce Performance Monitoring of Hospitals Using KPIs: Bibliometric Study.

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A B S T R A C T :

Objectives: Healthcare and hospitals like other industries, have undergone rapid improvements with the advent of artificial intelligence and its integration in performance monitoring. To find out the global scientific publications productivity, country-wise distribution of scientific production and institutions producing publications in AI in workforce performance monitoring using Key Performance Indicators (KPI).

Methodology: We collected data from the Web Of Science database developed by Clarivate analysis in November 2024 using the keywords of Work performance monitoring and hospitals or healthcare and Artificial Intelligence or AI and Key performance indicators or KPI.

Study selection: Data was selected from the Web of Science database based on keywords, Reviewed articles, English language, and healthcare sciences and services categories from 2015 to 2024.

Data Extraction: We identified 258 articles based on keywords and objectives, and the dataset was exported as the Bibtex file.

Results and Implications: There has been an increase in annual scientific publication productivity due to a rise in global interest and development of AI technologies. Also, results reveal that developed countries occupy the highest rank compared to developing countries, and the same trend is followed in leading institutions, which are again dominated by North American and European institutions.

Conclusions: AI plays a vital role in enhancing hospital workforce performance monitoring, with KPIs as a crucial tool for improving operational efficiency. The research need was to understand the domain knowledge and promote advancements.

Keywords: Work performance monitoring, hospitals, Artificial Intelligence, Key Performance Indicators, workforce productivity.

Introduction

Healthcare and hospitals, like other industries, have undergone rapid improvements with the advent of artificial intelligence and machine learning. The large amount of data generated in a hospital and healthcare industry holds great potential to bring improvements across domains, particularly in performance monitoring, a critical indicator of workforce performance in healthcare.

Key Performance Indicators (KPIs) is a quantifiable metric for performance monitoring are designed to identify the goals and objectives of an organization, mainly focused on measuring current performance. This allows the hospital to improve for more significant growth in the future and base decisions on information. In this sense, KPIs work as performance-based decision-making tools for hospital administrators[1].

Artificial Intelligence (AI) is the ability of machines or software to perform tasks that typically require human intelligence—such as learning, decision-making, problem-solving, and understanding language. In hospitals AI has become an area of widespread interest. It promises to enhance and improve how hospital services are provided[2]. Hospitals serve various services, from Diagnostics to curative and administrative, in a complex environment, prompting a need for workforce Performance monitoring in every hospital department to ensure resource management and quality healthcare services delivery[3].

To obtain necessary information, healthcare providers use methods or dashboards that contain data management tools that collect data from various information systems available in the organization and present that data in the comprise, comprehensive and meaningful manner in the form of key performance indicators; these methods allows managers to identify the problems, analyze the root cause and to do performance Evaluation of every department[4].

Domain analysis of the field is possible through mapping development. It studies the structure of the specified field by substantiating publication productivity, citation analysis, analyzing trends, and measuring impact[5]. The constant growth of new studies and the spread of research across multiple

disciplines have made it increasingly challenging work to stay informed in the field. Keeping up-to-date requires filtering through vast amounts of information, identifying reliable and well-authenticated sources, and discerning high-quality content. This challenge is further amplified by advancements, which demand continual learning and careful evaluation of sources to ensure relevance and accuracy[6].

Bibliometric analysis offers a holistic view of a field by identifying key trends, influential authors, and significant publications. It helps understand the growth, scope, and impact of research within a discipline, enabling researchers to track the evolution of topics, uncover collaboration networks, and assess the influence of various studies. This approach not only aids in gaining a broad overview but also supports informed decision-making for future research directions[6].

Review of Literature

Fadl Ba-Alwi, (2024)[1], conducted a systematic review and meta-analysis to assess the effectiveness of various Key Performance Indicators (KPIs) for evaluating healthcare performance in hospital systems. The study aimed to identify common Critical Success Factors (CSFs) in healthcare quality, focusing specifically on KPIs for Health Facility Management (FM). Their analysis highlighted vital indicators such as patient satisfaction, cash flow, infection rate, length of stay, average waiting time, incidents and errors, and bed occupancy rate. The study concluded that these KPIs are foundational for assessing hospital performance and developing future KPIs tailored to healthcare environments, including settings like Yemen, with the potential for enhancing healthcare quality and operational efficiency.

Mowafa Househ, (2021)[2], reviewed the application of big data analytics, business intelligence, and AI to address challenges in healthcare and propose evidence-based solutions for strategic and operational efficiency. The study aimed to identify and categorize the benefits of health analytics. Keywords included "health analytics," "healthcare big data," and "business intelligence." Reviewing sixty studies from databases such as Medline and Cinahl, the study outlined three frameworks for categorizing health analytics benefits by healthcare dimensions, aspects, and levels while categorizing challenges into human, technological, and organizational areas.

Garima Gujral, (2022)[5], conducted a domain analysis of health informatics literature to examine global publication productivity, analyze the growth of health informatics literature, and map publication distribution by country. The study also identified leading universities, institutes, funding bodies, core journals, popular topics, and emerging research trends. Employing scientometric methods and knowledge visualization, the study successfully highlighted global trends, performed thematic analysis, identified knowledge gaps, and projected future developments from 2009 to 2021, offering comprehensive insights for researchers and healthcare professionals.

Jacqueline DeMellow, (2018)[7], conducted a comprehensive study on technology-enabled performance monitoring within intensive care units, focusing on implementing evidence-based bundles to improve care quality and patient outcomes. The study's primary aim was to assess how effectively technology-enabled performance monitoring and feedback mechanisms contributed to enhancing care quality. An integrative literature review was conducted to achieve this, utilizing scientific databases such as PubMed, Embase, Scopus, CINAHL, and Ovid Medline. The review encompassed nine studies, which showed improvements in patient outcomes ranging from 3% to 60% after implementing technology-enabled performance monitoring and feedback.

While studies exist on health informatics, health analytics, and performance monitoring individually, there is a research gap of targeted scientometric analysis that combines AI, workforce performance monitoring, and KPI-based evaluation, especially in terms of global productivity, country-wise contributions, and institutional outputs.

Objectives

- To find out the global scientific publication productivity in Artificial Intelligence in workforce Performance monitoring using KPI.
- To study the country-wise distribution of scientific publications in Artificial Intelligence in workforce Performance monitoring using KPI**.**
- To study the universities producing scientific publications in Artificial Intelligence in workforce performance monitoring using KPI.

Research Methodology

1.1. Data Source

Data was collected from the Web of Science bibliographic database developed by Clarivate analysis. It provides access to multiple subscription-based databases. Comprehensive data is provided across various academic disciplines. The database covers full-text articles, editorials, reviews, abstracts, and periodical titles. The depth of records ranges from indexing citations, authors, titles, subject keywords, abstracts, publication year, affiliations, DOI, document type, journal, and language. Data was extracted from core collections of the Web of Science bibliographical database on 4th November 2024.

Keywords used to extract data: Workforce Performance monitoring and hospitals or healthcare and Artificial intelligence or AI and Key performance indicators or KPI.

1.2. Sample of the study

The sample for this study consists of the target audience and relevant datasets gathered from the Web of Science database using a search query focused on the workforce performance monitoring field. Initially, the keyword search yielded 12,381 documents. Filters were applied to align with the study objectives. Limiting the results to scholarly literature from 2015 to 2024 reduced the count to 12,135. After selecting peer-reviewed articles, the results were further narrowed to 2,474. Applying an English-language filter brought the total down to 2,462. Finally, restricting the category to healthcare sciences and services reduced the sample to 258 documents. Thus, the study's sample comprises 258 scholarly works on workforce performance monitoring indexed in the Web of Science database.

1.3. Period and coverage of the study.

The period taken into consideration for the study was from 2015 to 2024. A decade-old data was considered to study the productivity of scholarly publications. The coverage of the study across 58 countries was explored. The publication trends across the USA, UK, Canada, Germany, Australia, China, Netherlands, Brazil, Sweden, Spain, Scotland, Italy, Austria, South Korea, Taiwan, Finland, France, and Norway. Belgium, Denmark, Switzerland, Norway, Belgium, Denmark, Ireland, Greece, and Japan were studied.

1.4. Data Collection

Data was collected from the core Web of Science database, based on keywords, Reviewed articles, English language, and healthcare sciences and services categories from 2015 to 2024. A total of 258 scholarly records were extracted during the study period.

1.5. Data Extraction

Data were extracted from the core collection of the Web of Science (WoS) bibliographical database. WoS has been composed of highly cited literature, especially in science and technology. Web of Science gives a variety of filters and advanced searching mechanisms ranging from keywords, open access sources, author and country-wise search, and organized enhanced features.

Table 1: Methods for data extraction

Sr. no.	Steps for data extraction	Description of methodologies for data extraction
1.	Keyword based search.	Selected keywords i.e. “workforce performance monitoring” and “Hospital” or “Healthcare” and “Artificial Intelligence” or “AI” and “Key Performance Indicators” were used to run the search query.
2.	Customization based on Objectives.	The filters applied (Reviewed articles, English language, Healthcare sciences and services) were based on objectives. The timeframe for the period of study was selected and customized data for the period of data were retrieved.
3.	Export data as per desired file formats.	The data set were exported as Bibtex file.

1.6. Data Analysis

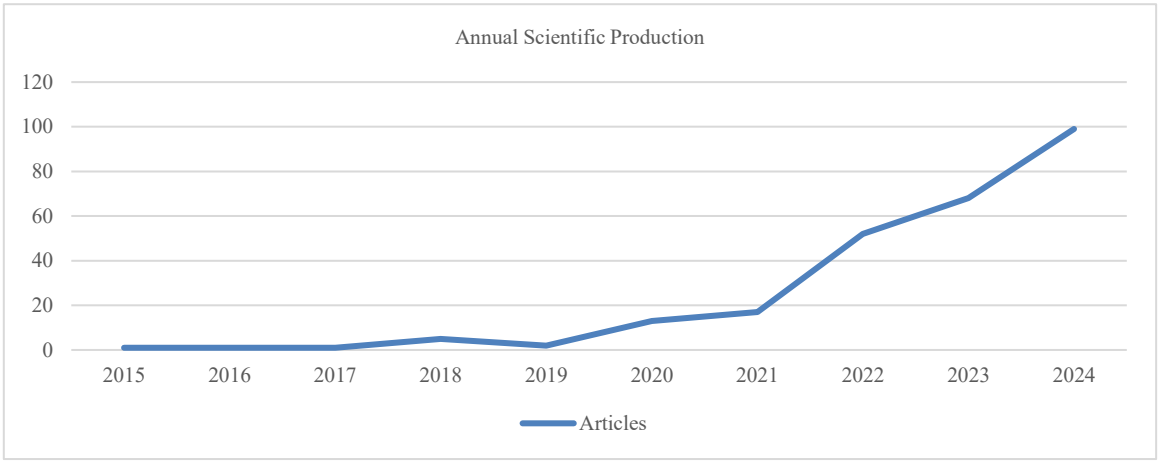
The data analysis was carried out using R 4.4.1 and R studio software to derive the most productive countries, institutions, and publications, creating a literature production graph and calculating basic statistics, bibliometric maps, and knowledge maps.

Scope and limitation of the study.

Quantitative methods allow for a broad study that involves large data sets and diverse subjects. It enhances the generalizations of the results. Greater accuracy in terms of results can be achieved. Summaries of data that support inferences and findings can be provided. There is less chance for personal bias and computational techniques to be applied. The Web of Science Bibliographical database has only been used, which may lead to contextual details needing to be included. The period taken for the study is only limited from 2015-2024, limiting the scope of and vastness of literature available in the field of workforce performance monitoring.

Results

1.7. Scientific Publication Productivity and Year Wise Growth in the Field of Artificial Intelligence in Workforce performance Monitoring.



Line Graph 1: Annual scientific publication productivity.

The line graph 1 shows an exponential increase in publications related to artificial intelligence (AI) in workforce performance monitoring in recent years from 2015 to 2017; overall publications were just 0.6% of the total, showing minimal growth during this time and in 2018 and 2019, making a slight growth during this period, with 1.5% of publication in 2018 and 0.7 % in 2019. A more notable increase was between 2020 and 2021, with an increase of 5% in 2020 and 6.5 in 2021. This period starts the mark of exponential growth, driven by the worldwide adoption of AI-based technology and its growing application in workforce performance monitoring. Starting in 2022, publication reached 20% in 2022, 26.3% in 2023, and 38% in 2024. This growth reflects the rising global interest and development of AI technologies, which has been important in advancing the field of workforce performance overall; while the years 2015 to 2017 saw limited growth, the period from 2020 to 2025 experienced an exponential rise in scholarly publication, attributed to accelerating pace of technological progress and the increasing recognition of AIs transformative role in workforce management[5].

1.8. Country-wise division of scientific production concerning authors in Artificial Intelligence in workforce performance monitoring domain from 2015 to 2024.

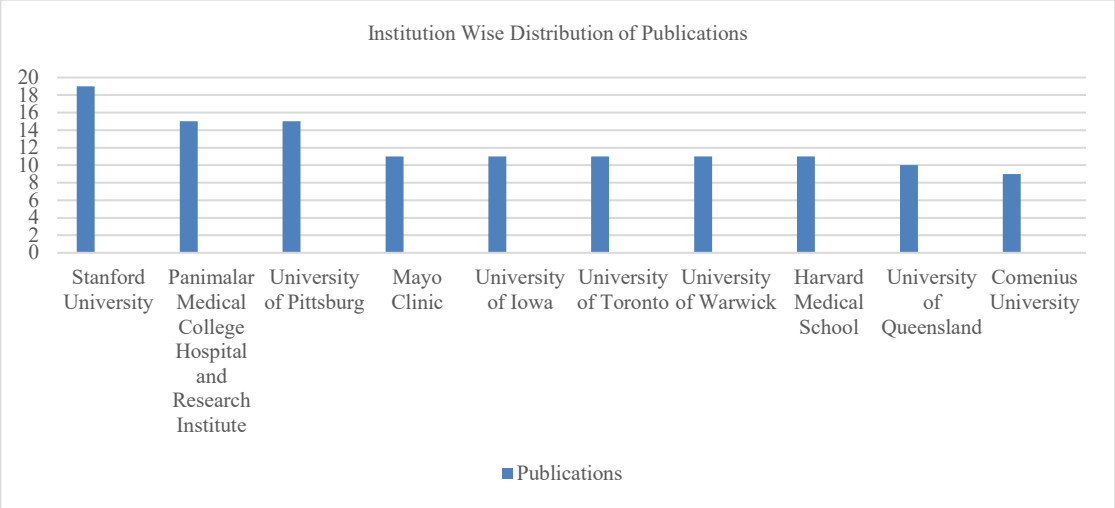
A country-wise division of scientific productivity was carried out, and the leading countries are shown below, along with the frequency and percentage of publications concerning authors and the rank at which the countries lie are enlisted in the table below:

Table 2: Country-wise distribution of scientific production concerning the author.

Country	Frequency
USA	329
Italy	140
UK	128
China	115
Australia	85
India	63
Germany	55
Canada	51
Spain	49
Saudi Arabia	47

Table 2 reveals the top ten most productive countries producing research output, along with the ranking of each country. The United States of America ranks first with 329 (21.9%) frequency of publications from 2015 to 2024. Italy lies second with 140 (9.33%) frequency of publications. The United Kingdom lies in third place with 128 (8.53%) frequency of productions. The United States occupies the first rank, starkly different from other countries. The findings reveal that developed countries occupy the highest ranks compared to developing countries.

1.9. Institution-Wise Distribution of Publication in the Field of Artificial Intelligence in Workforce Performance Monitoring.



Bar Graph 1: Institution-wise distribution of publications.

The bar graph 1 reflects the top 10 most productive institutions in the field of Artificial Intelligence in Workforce performance monitoring. Stanford University ranks first with 19 (1.28%) scientific publications, followed by Panimalar Medical College Hospital and the University of Pittsburgh with 15 (1.01%) scientific publications each. The Mayo Clinic, the University of Iowa, the University of Toronto, the University of Warwick, and Harvard Medical School are in third rank and have 11 (0.74%) scientific publications each. The findings reveal that universities and academic institutions in the North American and European Continents dominate the top positions. Moreover, one of the second most productive institutions is in Asia. Country-wise publications also showed the highest number of publications Produced in the United States of America. The most productive academic institutions are also in the US.

DISCUSSION

The line graph 1 shows a sharp rise in publications on AI in workforce performance monitoring over the past few years. From 2015 to 2017, research was minimal, with only 0.6% of total publications, reflecting the early stage of AI development. However, between 2018 and 2019, there was a small increase, indicating growing interest in AI's potential. The real surge began in 2020 and 2021, with publications jumping to 5% and 6.5%, driven by technological advancements and the increased adoption of AI during the COVID-19 pandemic. By 2022, the growth became exponential, reaching 20% and continuing to rise sharply in 2023 and 2024. This reflects both the rapid development of AI technologies and their expanding role in workforce management, as organizations increasingly rely on AI to improve productivity and performance monitoring[5].

As shown in table 2 a wide range of factors are responsible for developed countries occupying the leading ranks, comprising well-defined clinical guidelines, formal terminologies, information communication systems, and more robust research and development frameworks. In order to increase the global outreach of this field, re-thinking Artificial intelligence in workforce Performance monitoring has to span policy, research, and practice. The learning process at the policy level needs to be drafted[5]. Artificial intelligence in workforce performance monitoring systems is surrounded by concerns about global inequality, ethical and social implications, and brain drain[8].

The bar graph 1 displayed in the results shows the top 10 most productive institutions concerning the authors in the field of AI in workforce monitoring, with Stanford University having 1.28% of publications. Followed by Panimalar University and the University of Pittsburgh, each having 1.01% of publications. The observed finding may be due to a strong research framework showing clear dominance of North American and European institutions; the presence of the Panimalar University of India is observable, highlighting the emergence of Asian institutions in AI-related research. This emergence may be attributed to an increased focus on AI-related publications productivity and increased investment in the field of study[5].

CONCLUSION

AI plays a vital role in enhancing hospital workforce performance monitoring, with KPIs acting as critical tool for assessing and improving operational efficiency. The study shows the dominance of developed countries and top academic institutions in driving research within this field, drawing attention for a globally inclusive approach for AI development in healthcare. Addressing concerns such as ethical and social which is essential for bridging gaps between developed and developing nations which will promote equitable advancements in AI workforce monitoring, thereby improving healthcare outcomes on a global scale.

IMPLICATIONS

This study implications are multiple, the bibliometric analysis adds to existing data shows the role of Artificial Intelligence and Key Performance Indicators based workforce monitoring has evolved over the years. It highlights areas of future research, reveals trends and impact of AI on the workforce. The study can help policy makers to divert investments in AI.

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