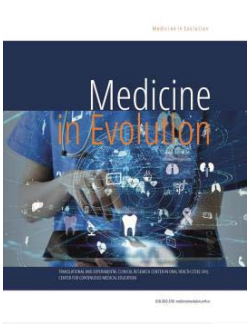
A bibliometric analysis of digitalization challenges in healthcare systems of the European Union



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Abstract

This study aims to analyze the challenges in health systems at the level of the European Union in terms of digitization, with the help of bibliometric analysis. The proposed empirical analysis aims to select the most relevant scientific articles from the Web of Science Core Collection, a highly trusted scientific literature database, due to its comprehensive coverage of high-impact journals across the world, including open access journals, conference proceedings and books. Bibliometric analysis is a methodical approach to quantifying the state of knowledge in the field of digitization of health systems in the EU, involving several steps, each designed to provide insights into publication patterns, citation patterns and the overall landscape of academic research. Two concepts were considered, respectively "e-health" and"digital," following that the type of articles included was only"Article", and as the last condition for the search was the analysis period that was between the years 2010-2022. The visual results of the investigation undertaken indicate a significant increase in interest in the topic investigated in our study, observable not only among the member countries of the European Union, but also internationally. This trend reflects the relevance and novelty of the topic in the global scientific community.

Keywords: digitalization, bibliometric analysis, EU, e-health

INTRODUCTION

Digitalization aims to facilitate the work of both patients and healthcare professionals by providing high-quality services, prompt and accurate responses, and safety. Living in a period of continuous development, certain challenges may arise regarding implementation and the quality of services offered because despite all the available technology, we are only at the beginning, and continuous testing is being done to improve the current healthcare system. On the other hand, other challenges regarding the digitalization of healthcare systems can be the percentage of expenditure allocated to healthcare systems, with all countries allocating a different percentage for this purpose, thus creating a discrepancy among the countries of the European Union [1].

Data confidentiality and security are also obstacles because the information within the healthcare system contains sensitive data and must be protected so that unauthorized individuals cannot access it or misuse it. Given that digitalization is continuously evolving, and cyber security risks are increasing, trust in a digitized system is becoming more difficult to accept [2].

Another challenge regarding the digitalization of healthcare systems in the EU relates to its adoption and acceptance by both medical professionals and patients. Digitalization changes the way a doctor would collaborate with a patient, which must be done with adequate training and the benefits of such a doctor-patient relationship must be highlighted.

Aim and objectives

This study aims to identify the challenges in healthcare systems in the EU, and this was made possible with the help of methodology, hierarchical clustering of EU member states, using a bibliometric analysis. The proposed empirical analysis aims to select the most relevant scientific articles from the Web of Science Core Collection, a highly trusted scientific literature database, due to its comprehensive coverage of high-impact journals across the world, including open access journals, conference proceedings and books.

Since e-health consists of vast and complex literature, as well as the need for citizens to benefit from quality and efficient health services, prioritizing patient protection, we have decided to investigate the state of knowledge in the field, followed by conducting a comprehensive analysis.

MATERIAL AND METHODS

Since e-health consists of vast and complex literature, as well as the need for citizens to benefit from quality and efficient health services, prioritizing patient protection, it was decided to investigate the state of knowledge in the field. Facilitated by VOSviewer software, all articles produced in this research domain were organized, revealing the most used keywords, the most important authors, as well as the collaborations between certain countries.

In the Web of Science database, the following two concepts were used:”e-health” and”digital,” with the type of articles included being only”Article,” and the last condition for the search was the analysis period, which was between 2010-2022, the first year from which articles published on this topic began to appear being 2010. Web of Science found 296 results, which were then downloaded into a.txt file that was input into the VOSviewer software for analysis.

RESULTS

(1) The analysis of "key words"

Through the analysis of keywords, we can observe the trend of the most frequently used words in this theme. Essentially, we report on the fact that these words appear most often in the analyzed articles. The main purpose is to observe the most common words used in the field of e-health by authors addressing this subject. In our initial search, we used terms such as "e-health" and "digital," and the network facilitated by VOSviewer shows other important words in this field that appear predominantly in the analyzed articles: "telemedicine" (with 77 occurrences), "technology" (with 75 occurrences), "care" (with 52 occurrences), and "internet" (with 36 occurrences) (Fig.1).

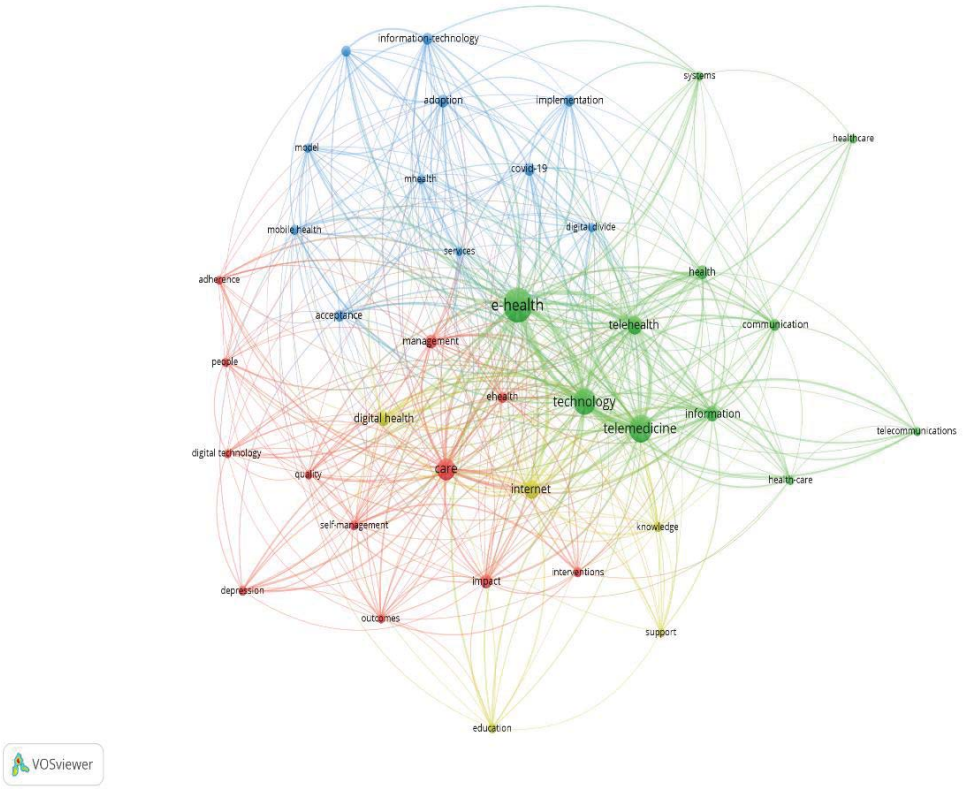

Figure 1. The Key Word Network.
Source: Processed by the author using VOSviewer

Figure No. 1 provides an overview of the most important keywords and the connections between them: the larger the size of the nodes and the words, the higher the frequency of occurrence of these keywords in the analyzed articles. On the other hand, a greater distance between nodes signifies a weaker connection between them. Thicker lines represent more frequent coincidences. A group of keywords or a series of related words is represented by the same colour. Figure No. 1 presents the most frequent keywords used in the field of e-health (applying a threshold of 9 coincidences). The largest group is the green one, which includes words such as "e-health", which is also one of the keywords chosen by me, as well as associated words like "technology", "telemedicine", and "information". The second group is the red one, where the most frequent words are "care", "management", "impact", and "inventions". The third group is yellow, containing predominant words such as "internet", "education", and "digital health". The last group, the blue one, includes terms

like “implementation”, “covid-19”, and “acceptance”. The complete groups are detailed and can be viewed in Table No. 1.

Table 1. Groups of the keywords

Number of words	Group 1 (Green)	Group 2 (Red)	Group 3 (Yellow)	Group 4 (Blue)
1	(communication)	(adherence)	(digital health)	(acceptance)
2	(e-health)	(care)	(education)	(adoption)
3	(health)	(depression)	(internet)	(covid-19)
4	(health-care)	(digital technology)	(knowledge)	(digital divide)
5	(healthcare)	(ehealth)	(support)	(implementation)
6	(information)	(impact)		(information-technology)
7	(systems)	(interventions)		(mhealth)
8	(technology)	(management)		(mobile health)
9	(telecommunications)	(outcomes)		(model)
10	(telehealth)	(people)		(services)
11	(telemedicine)	(quality)		(user acceptance)
12		(self-management)		

The bibliometric analysis reveals that “e-health”, the most frequently used keyword it is associated with information and technology. The green group focuses on health information and new medical technologies. The second group pertains to patient issues and the technology's impact on them. The yellow group emphasizes knowledge and education's role in e-health implementation. Lastly, the blue group addresses e-health adoption and implementation, showing widespread acceptance of such systems.

(2) Analysis of “scientific co-authorship” regarding the number of documents and citations of authors.

In this section, the analysis focuses on the research area of the main authors' network. This initial citation network focused on the two selected analysis concepts, namely “e-health” and”digital,” with authors included being those who have published at least two articles indexed in Web of Science and have at least twenty-four citations. Figure 2 highlights this network of authors, grouped into 9 clusters. According to VOSviewer, the most cited authors are: with 2 documents, we have Ebert David D. (137 citations) belonging to group 5 (Purple) and Mcalearney, Ann S. (114 citations) belonging to group 9 (Pink), with the remaining authors also having 2 documents but fewer than 100 citations. Details regarding the number of documents and citations are included in Table 2.

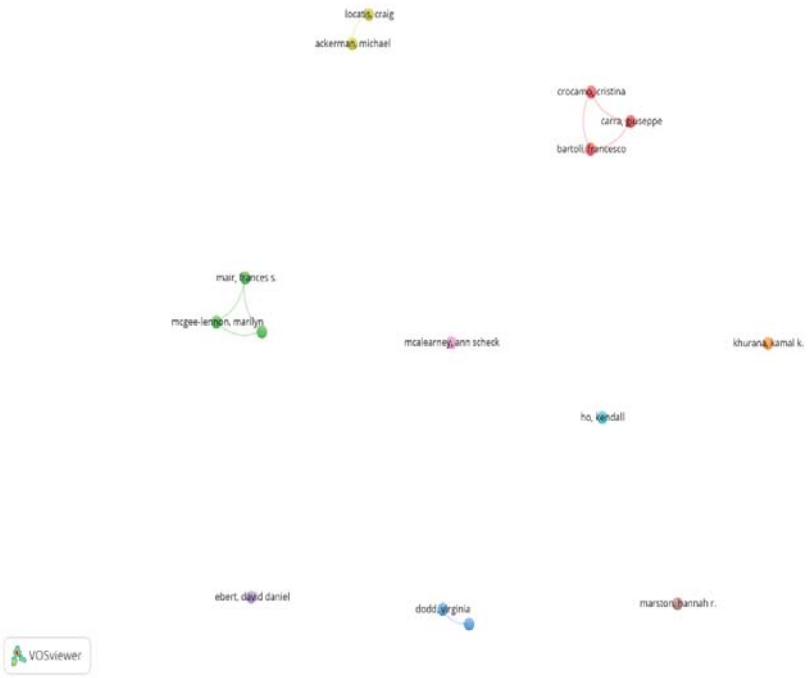

Figure 2. Co-authorship network based on the number of publications per author.
Source: Processed using VOSviewer

Table 2. Groups of publications and citations per author

Group	Authors	Documents	Link Strength
Group 1 (Red)	bartoli, francesco, carra, giuseppe, crocamo, cristina	2\29 2\29 2\29	4 4 4
Group 2 (Green)	mair, frances s. wyke, sally mcgee-lennon, marilyn	2\56 2\56 2\56	4 4 4
Group 3 (Blue)	dodd, virginia hall, amanda k.	2\84 2\84	2 2
Group 4 (Yellow)	ackerman, michael locatis, craig	2\24 2\24	2 2
Group 5 (Purple)	ebert, david daniel	2\137	0
Group 6 (Cyan)	ho, kendall	2\27	0
Group 7 (Orange)	khurana, kamal k.	2\29	0
Group 8 (Brown)	marston, hannah r.	2\52	0
Group 9 (Pink)	mcalearney, ann scheck	2\114	0

Group 5, the purple one, contains the author with the highest number of citations, specifically 137. This makes this group the main one due to its high citation count. The next impactful group in terms of citation count is group 9, the pink one, with 114 citations. Following that is group 3, the blue one, consisting of 2 authors who didn't reach the threshold of over 100 citations, each having only 84 citations. The subsequent groups obtained below the threshold of 56 citations, with the minimum being in group 4, the yellow one, which has only 24 citations.

(3) Analysis of "scientific co-authorship" in terms of the number of documents and citations reported by country.

The final segment of the study focuses on analyzing scientific co-authorship based on the countries contributing articles. Using the dataset of 296 articles, were identified countries with at least 7 publications in VOSviewer. The resulting map reveals collaboration links between authors from various countries, highlighting communication and influence (Table 3). In Figure 3, four color-coded groups are depicted, with red representing the most influential countries in e-health, including England, India, Norway, China, the United Arab Emirates, and the United States. Thicker connections, such as between England and the USA, signify closer ties. The presence of non-European countries underscores international interest in the thesis topic.

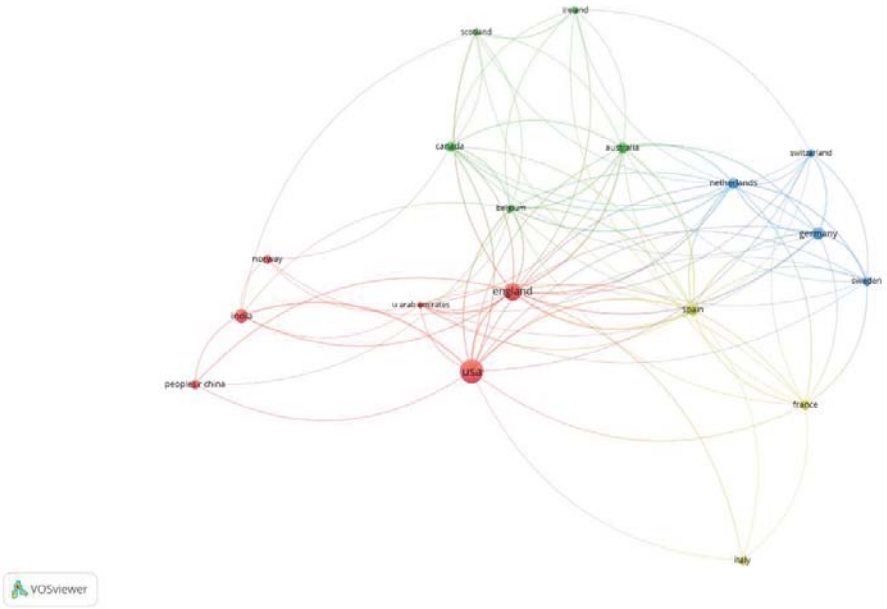

Figure 3. Scientific Co-authorship Network based on Countries of Publication.
Source: Processed by author using VOSviewer

Table 3. Groups of countries of publication and number of documents

Group	Countries	Documents	Link Strength
Group 1 (Red)	England	42/953	60
	USA	78/1372	41
	India	26/236	15
	Norway	11/147	4
	Peoples r China	13/81	8
	United Arab Emirates	7/6	17
Group 2 (Green)	Australia	17/246	29
	Belgium	7/132	29
	Canada	16/301	20
	Ireland	7/82	10
	Scotland	7/131	12
Group 3 (Blue)	Germany	21/491	30
	Netherlands	17/369	37
	Sweden	11/157	20
	Switzerland	9/205	15

Group 4 (Yellow)	France	13/193	20
	Italy	11/106	5
	Spain	17/387	42

DISCUSSIONS

The role of e-health is to provide patients with added safety and confidence in the quality of their treatment. However, its impact varies between developed and developing countries. Experts suggest that for implementation in developing countries, cultural and educational factors are crucial, followed by economic resources and long-term policies [3].

E-health implementation has led to a wealth of health information today. Technologies like online social networks, personalized health education, mobile health devices, and telemedicine aim to improve access to health information and enhance healthcare quality while reducing errors and promoting healthier lifestyles [4].

The European Commission supports e-health implementation, seeing it as crucial for healthcare system reforms to ensure sustainability and universal access to healthcare. Despite increasing adoption, challenges remain, including slow implementation of electronic health records (EHR) and electronic prescribing systems, along with financial, legal, social, and ethical barriers [5].

In Italy, e-health is recognized in national legislation, but regional efforts have led to uneven development in service quality. Nevertheless, the Italian Council supports healthcare digitalization, aiming to enhance health protection through solutions like electronic medical records, telemedicine, and electronic prescriptions, widely used among citizens [6].

CONCLUSIONS

The bibliometric analysis aimed to obtain the most important keywords, scientific collaborations among authors, and countries with the greatest influence on health and digitalization articles. Moreover, scientific co-authorship showed countries with the most publications on our topic, namely the USA, UK, India, and Germany, with only one of them being a current EU member.

In conclusion, when it comes to digitalizing healthcare systems in the European Union, there are both positive aspects and significant challenges. The use of digital technology in healthcare can bring numerous benefits, facilitating access to medical services, promoting health care, and prevention, and improving diagnosis and treatment. However, challenges include disparities between developed and developing countries and ensuring data security and patient confidentiality. Overcoming these challenges requires a collaborative approach among EU member states, exchanging best practices, and experiences, along with appropriate policies and regulations to protect data and ensure patient privacy. Ultimately, digitalization offers opportunities for substantial improvements in healthcare quality and access, contributing to the well-being of European citizens.

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