

## ORIGINAL ARTICLE

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## Bibliometric analysis of studies on the concept of ‘Telehealth’ with VOSviewer

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## Abstract

The research endeavours to map the studies conducted in the literature on the concept of telemedicine. Thus, the aim of the research is to make a systematic summary of the publications within the scope of Web of Science related to telehealth applications, which have become widespread in recent years due to the developments in technology, by using bibliometric analysis. The first work on telehealth was published in 1994 in the form of one article. Until 2010, the number of works published did not reach double digits, while the highest number of publications was 82 in 2022. The most academic studies have been produced in the fields of Health Sciences Services (92 publications), Medical Informatics (76 publications), and Engineering, Electrical-Electronics (72 publications). The highest number of publications in the field of telehealth are by Adrienne O'neil (6), Meikang Qiu (6) and Brian Oldenburg (5). The most cited authors were Amit Kumar Singh (283), Lindsey Anderson (264) and Rod S. Taylor (264). The most frequently used keywords in academic studies in the field of telehealth were telehealth (175 times), telemedicine (76 times) and COVID-19 (65 times). The number of publications produced on a country basis was as follows: USA (248), Australia (59), England (57) and India (57).

**Keywords:** Telehealth, bibliometrics, VOSviewer, analysis

## Introduction

Bibliometric analysis provides a concise classification of studies in any field. It offers access to detailed information about the studies conducted in the relevant field. It is argued that the first bibliometric study in the literature was conducted by Cole and Eales in 1917. Their study involved a statistical analysis of the comparative anatomy literature published between 1550 and 1860. As part of their research, a detailed study was carried out by analysing the distribution of literature by period, country and part of the animal kingdom [1]. On the other hand, bibliometric studies began with the use of the term 'statistical bibliography' by E. Wyndham Hulme in 1922 [2]. The term 'bibliometrics' was first used by Alan Pritchard in 1969. Pritchard defined bibliometrics as the application of mathematical and statistical methods to elucidate the processes of written communication and the nature and development of a discipline [1].

Bibliometric studies are designed to provide descriptive summary information about the researched topic. In these studies, there is

a lot of exploratory information available, in particular in which country and by whom the relevant studies were carried out, as well as citations. One of these studies is called 'bibliographic coupling' studies. Bibliographic coupling was used by Kessler to show the interrelationship between publications. It provides information about the strength of links between publications in the relevant literature [3]. Bibliometric analysis studies are a guide for researchers who will work in the relevant field. Researchers should summarise the studies conducted in their research fields before starting the study, as this will contribute to accessing the right resources in a short time and will increase the quality of the studies to be carried out.

## The Concept of ‘Telehealth’ in Literature

The concept of ‘telehealth’ or ‘eHealth’ (also called telemedicine) means the remote realisation of health services. The concept of telemedicine can be seen as a reflection of the technological changes that took place in the health sector at the beginning of the 20th century. Telemedicine, a term used synonymously with

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telehealth, is defined as the use of medical information transferred from one location to another via electronic communication to improve a patient's health [4]. It was used for the first time by Thomas Bird, an American scholar, in the 1970s. The origin of the concept dates back to the Dutch physiologist Willem Einthoven, who developed the first electrocardiograph in his laboratory in Leiden. Using a wire galvanometer and telephone cables, he recorded the electrical heart signals of patients in a hospital 1,000 km away. Einthoven is regarded as the first clinician-scientist to develop and systematically apply a technique very similar to telemedicine in the modern sense [5].

Telehealth covers a wide range of applications and specialisations and involves interactions between patients and providers via telephone, email, video chat or conferencing, the internet and remote devices. The main objective is to facilitate and improve health services. When equipped with smart phones, tablets, laptops and desktop computers, patients can easily use telehealth applications to connect with healthcare professionals who can potentially diagnose, monitor and treat a wide range of acute and chronic conditions. It is often used alongside traditional 'offline' (non-digital) approaches for the communication of information to patients and health care consumers [6-8].

In recent years, telehealth opportunities have been improved with wireless technology and mobile devices (mHealth) that offer greater access and use. mHealth's potential to serve underserved people with its potential for ubiquity and its scalable and reliable healthcare delivery platform facilitates access to healthcare services [9]. Telehealth, once restricted to rural or distant communities, is now increasingly being used to extend the geographical reach of health services and improve access to care. Factors such as convenience, efficiency, communication, privacy and comfort were found to be important criteria for patients to prefer the use of telehealth [6].

A survey of cancer patients found that the majority of patients felt more comfortable participating in both video and telephone telehealth visits, although they preferred the first visit to be face-to-face. Telehealth services were started to be provided in hospitals in the pre-pandemic period and were expanded and continued during the pandemic period with the COVID-19 virus [10]. The COVID-19 Pandemic period, which started in 2019, has accelerated the need for healthcare services to redesign the provision of healthcare services to patients. Telehealth technologies and principles have become essential for healthcare professionals to provide safe and effective care [11]. In this process, many healthcare institutions have resorted to Telehealth more frequently and tried to provide standard healthcare services [6].

In a study on voice therapy, it was found that there was no significant difference between telehealth applications and conventional health applications [12]. Another research, a study of nursing students' perceptions of telehealth applications, found that a large proportion of participants, 66%, would definitely

use a telehealth device in their future careers and 70% of them believed that telehealth should be included in the educational process. The research found that students adopted telehealth systems due to a) the efficient operation of the system, b) the convenience of telehealth, and c) the access to health services [13]. Health service students' evaluation creates an impression that telehealth applications will diversify and increase in the future.

Faster access, shorter visits, less travel and overall satisfaction with the response and treatment needed are the benefits of telehealth. Access to health services through telehealth facilitates early treatment of serious illnesses where there are possible delays. So much so that many patients in studies have indicated that if their current provider does not offer telehealth, they would switch to a provider that supports telehealth care [11].

Despite their advantages, telehealth applications and approaches have some flaws that prevent their clinical use. It is therefore imperative that all sectors work together to implement, operate and develop telehealth services to better meet the needs of patients. While governments need to address the legal aspects of telemedicine, hospitals and medical staff need to work in unison to maximise the clinical use of telemedicine [14]. When telehealth services are developed, various barriers may be encountered, such as confidentiality issues, licensing laws and electronic record access. Technology must comply with privacy laws at all points of service [11]. To these can be added various disadvantages, such as the lack of intimacy in telemedicine systems and the systemic failures that can occur in the technology [13].

The future of telehealth will benefit greatly from this technological innovation, especially in areas such as home telehealth and remote monitoring, eHealth and patient portal applications, personal health records, interactive internet technologies and robotics. While telehealth is not a panacea for all the challenges facing modern healthcare systems, it has significant and growing potential to revolutionise the way people receive medical care, while offering the opportunity to control costs, manage chronic diseases and prevent secondary complications. By demanding innovative solutions and raising its voice in support of the field, the telehealth community can lead the way towards greater attention to human factors in technology development, interoperable medical records, staff training and qualifications, standards and guidelines, and support for expanded medical practice [15].

As telehealth plays a greater role in global healthcare delivery, it will become increasingly important to develop a strong evidence base of successful, innovative telehealth solutions leading to scalable and sustainable telehealth programmes. The fact that the rate of increase in the number of health workers cannot catch up with the population growth will support the remote realisation of health services in the future. Health literacy, technology literacy and other types of literacy of patients, smart home, home integrated

with telehealth technologies, professional health personnel who are telehealth system practitioners, health system design, design of user-friendly technologies, integration of personal health records and telehealth devices and systems, through multi-model data platforms data analytics, factors such as the development of new telehealth technologies, multidisciplinary evaluation of the effectiveness of new telehealth services, financing of telehealth, privacy and security policies, and differences in intergovernmental and international telehealth policies have an important place in the future of telehealth applications [16,9].

As doctors care for patients from greater distances, the patient-doctor relationship is likely to evolve. Such remote care may create greater demand for the provision of personalised care, and may even require doctors to travel further to ensure that appropriate relationships are developed and maintained across distance and time [8].

The migration of care services from hospitals and clinics to homes and smartphones in the coming years could eventually reduce the demand for clinical space. This situation will be realised by adapting the changes occurring in other sectors affected by the Internet to the health sector. The nature of the patient visit will also change. This is because telehealth will not aim to replicate traditional office visits, but will instead seek to capitalise on their unique strengths to define new paradigms of care that improve health. For example, instead of periodic, highly structured in-clinic encounters, visits may be shorter and more frequent and may take place through multiple modes of communication with different providers [8].

Material and Methods

VOSviewer software was used in the analysis of the research data. In addition, the classification system in Web of Science was utilised. The research was conducted using secondary data, ethics committee permission was not required.

Aim of the Study

In the study, the concept of ‘telehealth’ was evaluated via bibliometric analysis. The aim of the study is to provide a comprehensive summary of the academic studies on ‘telehealth’ in Web of Science in the context of quantitative data and numerical measurement indicators and to visualise and analyse the relationships between each other.

Data and Analysis

With the VOSviewer Programme, summary about the studies conducted in the literature in the field of telehealth has been written for the convenience of researchers. The studies conducted in the field of telehealth can be listed chronologically and the relationships between publications can be identified. In addition, visualisation options such as mapping and multidimensional analysis can be considered as an important advantage for VOSviewer software.

Web of Science database was used in the research. Web of Science provides access to a comprehensive collection of data from different disciplines and has advanced search features for advanced data analysis. In addition, the fact that it covers qualified and reliable studies in terms of publication ethics and has various control mechanisms has been an important factor in the use of the Web of Science database.

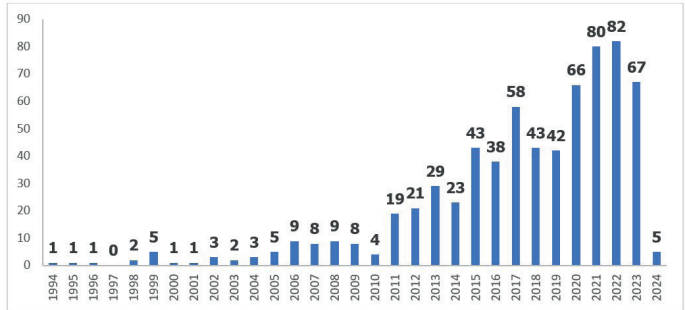
Results

On 26.02.2024, 679 works were found in the search made by selecting ‘all fields’ in Web of Science with the keyword ‘telehealth’.

Descriptive Information on Publications on Telehealth

In the field of telehealth, a significant majority of the publications in the Web of Science database, 59.35% (403 publications), are articles. 18.70% are proceedings papers (127 publications), 9.72% are review articles (66 publications), 9.28% are meeting abstracts (63 publications), 2.65% are editorial materials (18 publications), 0.15% are books (1 publication), and 0.15% (1 publication) are retracted publications.

As seen in Graph 1, it is understood that the first publication in the field of telehealth in Web Of Science was made in 1994 with the article titled ‘Global Access Tele-health and Education System’. Except 1997, it is seen that at least 1 publication was produced every year, while the most publications were made in 2022 with 82 publications. The reason for the low number of publications in 2024 is that the data of the research consists of publications until 26.02.2024.

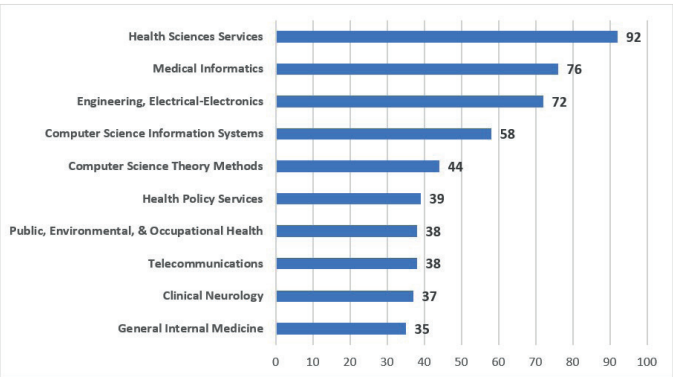


Graph 1. Distribution of publications in the field of telehealth by years

The majority of the works in the field of telehealth were published in English (669). Other languages of the publications are Spanish (4), Italian (2), Turkish (2), Chinese (1), German (1) and Korean (1). One of the Turkish publications was ‘Roles of nurses in tele-health services’ by Pazar et al. in 2015 and the other was ‘Facilitators and Barriers to Healthcare Professionals’ Adoption of Tele-Health Interventions’ by Karaca et al. in 2022 [17,18].

Studies in the field of telehealth have been carried out under many different disciplines. Information about the studies ranked in the top 10 in terms of quantity in Web of Science is given in Graph 2. As seen in the graph, the highest number of publications was

in Health Sciences Services, with 92 publications. The lowest number of publications in the top 10 was in the field of General Internal Medicine, with 35 publications.



Graph 2. Distribution of publications in the field of telehealth by fields of science

Co-authorship Analysis of Authors

In co-author analysis, it is aimed to identify the authors who are linked and collaborate with each other. The network map created in this context was based on at least 1 publication and 1 citation criterion. As can be seen in Figure 1, according to the analysis made among the names with the highest number of links between them, 30 names and a total of 188 links are combined in 4 separate clusters. The most cited authors (Amit Kumar Singh (283); Lindsey Anderson (264) and Rod S. Taylor (264)) are not the authors with most links. Adrienne O'neil (6 pieces) ranked first with a total of 50 link strengths, while Meikang Qiu (6 pieces) had 19 link strengths and Brian Oldenburg (5 pieces) had 45 link strengths. The other authors with link strength were Brian Oldenburg (45), Kristy Sanderson (41) and Bianca Chan (38).

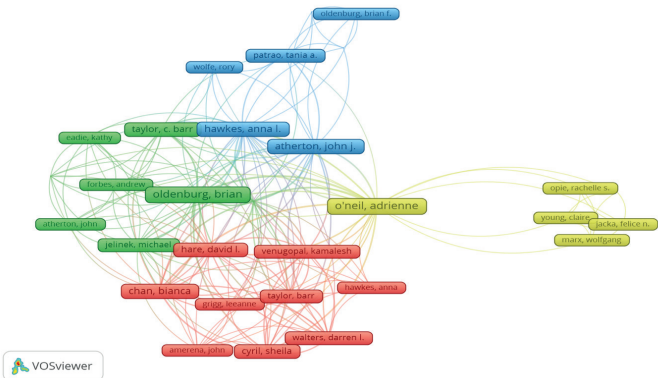


Figure 1. Co-author links indicating collaboration between authors

Citation Analysis of Authors

In bibliometric studies, the analysis of citations to authors' work is important for screening publications in the literature. In this context, based on at least 1 publication and at least 1 citation criterion, a network map for author citation analysis was drawn. In the studies on telehealth, 1005 links and 18 clusters with a total link strength of 1613 were identified. The most cited authors were Amit Kumar Singh with 283 citations; Lindsey Anderson

with 264 citations; Rod S. Taylor with 264 citations. In terms of total link strength, Adrienne O'neil (152), John J. Atherton (131) and Brian Oldenburg (103) are in the top 3 in representing the highest link strength.

If authors have more than one publication, the citations they receive may also vary. As seen in Figure 2, when the citation data was evaluated in terms of articles, the most cited article with 209 citations was 'Digital Technology, Tele-Medicine and Artificial Intelligence in Ophthalmology: A Global Perspective' published by Li et al. in 2021. The article titled 'A Comprehensive Survey of Wearable and Wireless ECG Monitoring Systems for Older Adults' published by Baig et al. in 2013 received 176 citations; and the article titled 'Psychological Interventions for Coronary Heart Disease' published by Richards et al. in 2017 received 164 citations.

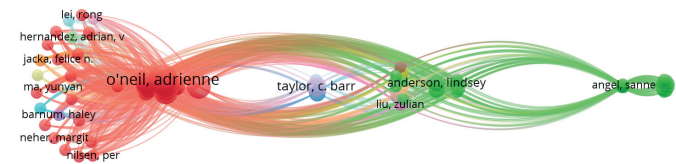


Figure 2. Authors' citation links

Analysis of Citations Across Countries

The research found that the majority of citations to studies in the field of telehealth were made in the USA (3529 citations). In the creation of the results visualised in Figure 3, analysis was made over 30 observation units within the scope of the criterion of at least 1 work and at least 1 citation. 12 clusters, 77 links and 147 total link strengths were identified. After the USA, the most cited countries were the England (1338 citations) and Australia (831 citations). In terms of total link strength, the USA (58 link strength), Australia (52 link strength) and Denmark (30 link strength) are in the top three places. In terms of the number of works, the order is as follows: USA (248 publications), Australia (59 publications), England (57 publications) and India (57 publications).

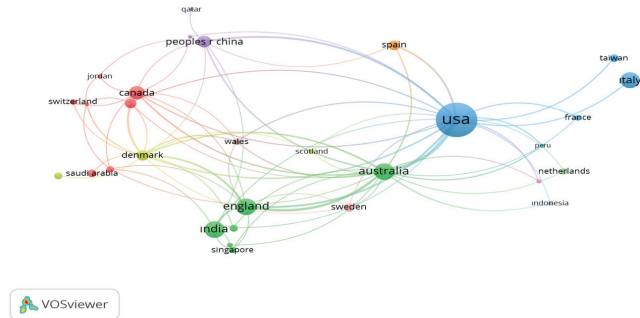


Figure 3. Citation links of countries

Analysis of Citations Across Organizations

The inter-institutional citation network map analyzed in Figure 4 within the framework of the criteria of publishing at least 1



## Discussion

In this research, studies in the field of 'telehealth' in Web of Science were analysed quantitatively. Telehealth means the remote fulfilment of health services. For many patients and healthcare professionals, face-to-face healthcare practices are considered essential. On the other hand, with the changes and developments in technology in recent years, some services in the field of health have started to be provided remotely.

As of 26.02.2024, there are 679 publications in the field of telehealth in Web of Science, where reliable publications that have passed through many stages are presented for researchers. While the first publication was produced as a single article in 1994, publications in this field have started to increase in recent years. The highest number of publications were published in 2022 and 2021. While there were publications on telehealth in many different fields, most publications were produced in the fields of Health Sciences Services (92), Medical Informatics (76) and Engineering, Electrical-Electronic (72).

In the field of telehealth, Adrienne O'Neil (6), Meikang Qiu (6), and Brian Oldenburg (5) generated the most works. The most cited authors Amit Kumar Singh (283); Lindsey Anderson (264) and Rod S. Taylor (264) are not the authors with most links. While O'Neil (6) ranked first with a total of 50 link strengths, the link strengths of the other authors who produced the most works were realised as low. When the publications are classified according to countries, the most cited country is the USA (3529). England (1338 citations) and Australia (831 citations) follow respectively. In terms of the number of publications, the ranking is as follows: USA (248 publications), Australia (59 publications), England (57 publications) and India (57 publications). When the institutional structures in which the publications were produced are evaluated, it is understood that the most publications were produced by the University of Melbourne (16 works). Monash University (12 works), University of Queensland (11 works) and Harvard Medical School (10 works) have also contributed to the field of telehealth. In publications on telehealth, the term 'telehealth' was the most used keyword with 175 repetitions. Other keywords frequently used in the studies were telemedicine (76 times) and COVID-19 (65 times).

The Web of Science classification of the sustainability of studies conducted in the field of telehealth shows that 498 of the publications are in the field of 'good health and well-being'. It can be said that the majority of publications in the current situation are in the form of health practices that improve the well-being of individuals in society. This situation can be seen as an important guide for researchers working in the field of telehealth. In addition to studies on improving well-being, publications were produced in the areas of 'Gender equality' and 'Sustainable cities and communities' with 16 publications, 'Quality of education' with 13 publications and 'Industrial innovation and infrastructure' with 12 publications.

A comprehensive evaluation of studies in the literature using

the term telehealth shows that the majority of publications have been carried out in recent years. Changes in technology have been particularly effective in the emergence of this situation. Especially the restrictions on face-to-face communication in social life during the COVID-19 pandemic period, which began in 2019, have accelerated the applicability of 'remote' services, preferred in many other sectors, to the health sector. This situation is expected to continue to increase in the coming years.

## Conclusion

One of the basic principles in the field of health is patient satisfaction. The main purpose of the relationship between health professionals (e.g., doctors and nurses) and patients is to cure disease. Some health services performed remotely with technological developments provide many advantages, especially accessibility for patients. This situation becomes even more important for patients with physical disabilities such as travelling etc. Moreover, in the coming years when telehealth applications are expected to increase, it is necessary to train and develop healthcare personnel on telehealth literacy together with legal regulations protecting patient privacy. Furthermore, it is imperative to enhance the technological habits of patients and their families in relation to the various health services that are now offered via mobile applications.

Telehealth application, which is one of the methods currently used to treat the disease, can be given a different mission. Considering the intensity of hospital services around the world, tele-health applications are becoming even more important, especially for the 'pre-patient processes'. The workload of healthcare personnel can be reduced by working on disease preventive roles with the tele-health method. This will improve the quality of healthcare services.

### Conflict of Interests

*The authors declare that there is no conflict of interest in the study.*

### Financial Disclosure

*The authors declare that they have received no financial support for the study.*

### Ethical Approval

*This research does not require Ethics Committee approval.*

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