Public and research interest in telemedicine from 2017 to 2022: Infodemiology study of Google Trends data and bibliometric analysis of scientific literature

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Abstract

Background: Telemedicine offers a multitude of potential advantages, such as enhanced healthcare accessibility, cost reduction, and improved patient outcomes. The significance of telemedicine has been underscored by the COVID-19 pandemic, as it plays a crucial role in maintaining uninterrupted care while minimizing the risk of viral exposure. However, the adoption and implementation of telemedicine have been relatively sluggish in certain areas. Assessing the level of interest in telemedicine can provide valuable insights into areas that require enhancement.

Objective: To provide a comprehensive analysis of the level of public and research interest in telemedicine from 2017 to 2022, also considering any potential impact of the COVID-19 pandemic.

Methods: Google Trends data were used to assess public interest in telemedicine, its geographic distribution, and trends through a joinpoint regression. Bibliographic data from Scopus were used to map publications on telemedicine in terms of scientific production, most relevant countries and keywords, collaboration and co-occurrence networks.

Results: Chile, Australia, Canada, and the USA had the greatest public interest in telemedicine. In these countries, moderate to strong correlations were evident between Google Trends and COVID-19 data (i.e., new cases and deaths, and hospitalized patients). Public interest rapidly increased from January to April 2020, with a monthly percentage change of 95.7%. After that, it decreased until August 2020 and then stabilized.
Bibliometric analysis also revealed a significant increase in the number of publications, especially from 2020 onwards. Most publications came from a single country, while 1 in 5 featured international collaborations. As the most productive country, the USA led a cluster that included Canada and Australia as well. European, Asian, and Latin American countries made up the remaining three clusters. In an analysis of the most common keywords, the following were of particular interest: the application of eHealth, mHealth, or digital health to noncommunicable diseases; telemedicine and telehealth were instead used in relation to COVID-19.

Conclusions: Our analysis of search and bibliographic data over time and across regions helps us understand the level of interest in this topic, identify areas for further research and awareness-raising efforts, and inform policy decisions regarding telemedicine adoption and implementation.

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Abstract

Background: Telemedicine offers a multitude of potential advantages, such as enhanced healthcare accessibility, cost reduction, and improved patient outcomes. The significance of telemedicine has been underscored by the COVID-19 pandemic, as it plays a crucial role in maintaining uninterrupted care while minimizing the risk of viral exposure. However, the adoption and implementation of telemedicine have been relatively sluggish in certain areas. Assessing the level of interest in telemedicine can provide valuable insights into areas that require enhancement.
Objective: To provide a comprehensive analysis of the level of public and research interest in telemedicine from 2017 to 2022, also considering any potential impact of the COVID-19 pandemic.
Methods: Google Trends data were retrieved using the search topics “telemedicine” or “e-health” to assess public interest, its geographic distribution, and trends through a joinpoint regression analysis. Bibliographic data from Scopus were utilized to chart publications referencing the terms 'telemedicine' or 'eHealth' (in the title, abstract, and keywords) in terms of scientific production, key countries, prominent keywords, as well as collaboration and co-occurrence networks.
Results: Worldwide, telemedicine generated higher mean public interest (Relative Search Volume, RSV = 26.3%) compared to eHealth (RSV = 17.6%). Interest in telemedicine remained stable until January 2020, experienced a sudden surge (Monthly Percent Change, MPC = 95.7%) peaking in April 2020, followed by a decline (MPC = -22.7%) until August 2020, and then returned to stability. A similar trend was noted in the public interest regarding eHealth. Chile, Australia, Canada, and the USA had the greatest public interest in telemedicine. In these countries, moderate to strong correlations were evident between Google Trends and COVID-19 data (i.e., new cases and deaths, and hospitalized patients).
Examining 19,539 original medical articles in the Scopus database unveiled a substantial rise in telemedicine-related publications, showing a total increase of 201.5% from 2017 to 2022 and an average annual growth rate of 24.7%. The most significant surge occurred between 2019 and 2020. Notably, the majority of publications originated from a single country, with 20.8% involving international co-authorships. As the most productive country, the USA led a cluster that included Canada and Australia as well. European, Asian, and Latin American countries made up the remaining three clusters. The co-occurrence network categorized prevalent keywords into two clusters: the first cluster primarily focused on applying eHealth, mHealth, or digital health to non-communicable/chronic diseases; the second cluster was centered around the application of telemedicine and telehealth within the context of the COVID-19 pandemic.
Conclusions: Our analysis of search and bibliographic data over time and across regions allows us to gauge the interest in this topic, offer evidence regarding potential applications, and pinpoint areas for additional research and awareness-raising initiatives.
Keywords: Telemedicine; eHealth; Digital Medicine; COVID-19; Google Trends; Bibliometric.

Introduction

The concept of telemedicine – defined as the use of technology to provide healthcare services remotely – has been around since the early 20th century, but it has gained significant attention globally only in recent years [1]. The development of technology such as video conferencing, remote monitoring devices, and mobile health apps has made it possible to deliver healthcare services remotely, paving the way for the widespread adoption of telemedicine [2-4]. It is worth noting that the term telemedicine also covers health data analysis and application of big data and Artificial Intelligence methods for epidemiological research and diagnosis support [3, 5-7].

The use of technology allows patients to access care from anywhere, at any time, and reduces the need for in-person visits, which can be particularly beneficial for individuals with mobility issues, those living in rural or remote areas, and individuals with chronic diseases [8, 9]. The potential benefits of telemedicine are numerous, including increased access to healthcare services, reduced healthcare costs, and improved patient outcomes [8-11]. Telemedicine can also help to address workforce shortages in healthcare, particularly in rural and remote areas, by enabling healthcare providers to deliver care to patients in those regions without the need for travel [10, 12].

The COVID-19 pandemic has underscored the significance of telemedicine in maintaining uninterrupted healthcare delivery while mitigating the risk of virus transmission [13-18]. As an illustration, in light of the imperative to reduce COVID-19 exposure among patients and healthcare providers, many elective surgical procedures were rescheduled, prompting surgeons to adopt telemedicine as an alternative for preoperative, follow-up, and urgent surgical care consultations [15, 19]. The pandemic has therefore forced healthcare providers to adapt quickly to the new reality of delivering care remotely, leading to a significant increase in the adoption and use of telemedicine globally [3, 20]. As demand grew exponentially during the pandemic period, even the telehealth market is expected to grow to US$ 218.5 billion by 2025 [3]. Nevertheless, even after the COVID-19 pandemic recedes, it is highly improbable that this mode of healthcare delivery will be disregarded.

Despite the potential benefits of telemedicine, its adoption and implementation have been slow in some regions. Barriers to adoption include regulatory challenges, technological limitations, and resistance from healthcare providers and patients. People living in poorer regions, women, the elderly, and those living in rural or remote areas are far less likely to be online than those in wealthier regions [1, 11]. Of those connected, nearly 90 percent use mobile devices to access the internet, which might not be appropriate for delivering digital health services [3]. A digital divide also exists in terms of digital literacy or low skills, which is a concern for the poorest, elderly, and others with limited access to technology [3]. For these reasons, understanding the level of interest in telemedicine among the public and research community can help identify areas for improvement. Google Trends is a valuable tool for investigating the level of interest of the general public in a specific topic. As such, it has been utilized in previous research to analyze the public's interest in various health and healthcare-related subjects [21-32]. The same applies for a topic such telemedicine, for which there is little evidence. From a research standpoint, we have recently observed a significant increase in the number of publications related to telemedicine, indicating a growing interest in this field among researchers. An interest that needs to be mapped in terms of scientists and groups of researchers, countries that are contributing most to the research, and areas of applications.

Overall, this study aims to provide a comprehensive analysis of the level of public and research interest in telemedicine, also considering any potential impact of the COVID-19 pandemic. We therefore limit our analysis to the period between 2017 and 2022, a period of six years preceding and following the pandemic. We use two different approaches to analyze the level of interest in telemedicine. The first approach is an analysis of Google Trends data, which allow us to analyze the level of interest in telemedicine among the general public. The second approach is a bibliometric data analysis, which involves examining publications related to telemedicine over the past six years. Our analysis of search and bibliographic data over time and across regions helps us understand the level of interest in this topic, identify areas for further research and awareness-raising efforts, and inform policy decisions regarding telemedicine adoption and implementation.

Methods

Data collection

Google Trends data

Google Trends provides open access to time-series data related to Google searches for specific terms and topics [33]. According to the framework proposed by Mavragani and Ochoa [34], we retrieved Google Trends data separately by using the search topics “telemedicine” or “e-health”, encompassing all search categories. We queried Google Trends on 9th March 2023 and Google Trends data were obtained at the global level, as well as by country, for the period between 1st January 2017 to 31st December 2022. It is worth mentioning that search topics are a group of terms that share the same concept across languages, covering an array of variations, typos, and related searches [34, 35]. This precludes the need of entering a set of individual keywords, while maintaining the consistency of search queries across all regions and timeframes [34, 35]. Furthermore, employing specific search topics without any search category restrictions proves beneficial for capturing the general interest of diverse populations [34, 35]. We also obtained data for the “top related topics” that are most frequently searched with the topics under investigation (i.e., telemedicine” or “e-health”).

In general, Google Trends data are provided as a normalized measure (i.e., Relative Search Volume, RSV), obtained by dividing the search volume for a given term or topic by the total number of searches. This normalization process resulted in a percentage scale, with 100% corresponding to the peak in search volume in any given time frame and location. The value 0% does not necessarily indicate no searches, but rather a very low search volume for a given term or topic [34].

Bibliometric data

Before describing the collection of bibliometric data, it is necessary to distinguish bibliometric analysis from reviews and systematic reviews of scientific literature. The first primarily uses a mechanistic method to track the global research trends in a certain field based on the outputs of scientific literature databases. Reviews and systematic reviews are instead characterized by methodical and replicable methodologies to find, select, and synthesize all available evidence on a particular topic or clinical question.

In our study, we searched the Scopus database for all articles mentioning the terms "telemedicine" or "eHealth" in the title, abstract, and keywords. We have chosen Scopus because it is recognized as the largest scientific literature database of peer-reviewed articles covering a wide range of subjects [36]. The literature search was conducted on 9th March 2023 and was limited to original articles published in English and in the subject area of medicine from 2017 to 2022. The query string used for the search was: TITLE-ABS-KEY (“telemedicine” OR “eHealth”) AND PUBYEAR > 2016 AND PUBYEAR < 2023 AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SUBJAREA , "MEDI")). The Scopus search result was exported in the format of a CSV file with all data elements, including information on citation, bibliography, abstract and keywords.

Data analysis

Google Trends data analysis

We first conducted a univariate analysis and compared the public interest in the topics telemedicine and eHealth at the global level. Next, a joinpoint regression analysis was carried out to identify possible time points at which public interest trend changed. This analysis was conducted on log-transformed RSV, with 5000 permutations and assuming uncorrelated errors. The grid search method was chosen to determine where to locate joinpoint/s on the timescale [37]. Results were reported as the Monthly Percent Change (MPC), calculated as the average percentage change per month between different joinpoints. Joinpoint regression analysis was performed using the Joinpoint Regression Program (version 4.3.1.0; Statistical Research and Applications Branch, National Cancer Institute, Bethesda, MD, USA) provided by the Surveillance, Epidemiology, and End Results Program (National Cancer Institute) on the website http://surveillance.cancer.gov/joinpoint. We next mapped the public interest in telemedicine and eHealth by country, selecting the top five countries with the greatest interest. In these countries, Google Trends data were correlated with the number of new confirmed COVID-19 cases, deaths, hospitalizations, and intensive care unit (ICU) patients per million residents. These data were obtained from the Our World in Data website [38]. Results were reported as the Spearman's rank correlation coefficient (ρ). All statistical analyses were two-tailed and performed with a significance level of 0.05.

Descriptive analysis of bibliometric data

Descriptive analysis of bibliometric data was performed using Bibliometrix, an open-source R-tool for automating the stages of data-analysis and data-visualization [39]. After loading and converting bibliometric data in R, the main descriptive results were summarized as of number of documents, authors, sources, keywords, timespan, and average number of citations. Accordingly, tables and visualizations were obtained for the annual scientific production, top manuscripts per number of citations, most productive authors, most productive countries, total citations per country, most relevant journals, and most relevant keywords.

Network analysis of bibliometric data

Next, the VOSviewer software v.1.6.16 (Centre for Science and Technology Studies, Leiden University) was used to construct networks projecting authors' and countries' collaborations, as well as trending research topics through the analysis of keywords. This mapping method is generally used to estimate the association strength between different bibliometric items (i.e., the nodes of the network), which may for example be publications, authors, or keywords [40]. The relation between two items is represented by a link (i.e., the edges of the network), which may be a bibliographic coupling link between publications, a co-authorship link between authors, or a co-occurrence link between keywords. Each link has a strength, indicated by a positive number with higher values associated with stronger links [40]. The association strength may for example be indicated as the number of cited references two publications have in common for the bibliographic coupling link; as the number of publications two authors have co-authored for the co-authorship links; or as the number of publications in which two keywords occur together for the co-occurrence link [40]. Accordingly, each item receives different attributes, such as the weight and score attributes. Weight is a non-negative numerical attribute indicating the importance of the item in the network. From a graphical perspective, items with higher weights are shown more prominently than those with lower weights [40]. Score attributes instead indicate additional numerical properties of the item, which can be only visualized in the overlay visualization of a map. There are also two standard weight attributes that can be used with descriptive purposes and computed for each item or for the entire network: the Links attribute and the Total link strength attribute [40]. By creating the network map, items can be

grouped into clusters, which correspond to linked items, labelled with colors and numbers.
We first performed network analyses of co-authorship at the author and country level, using the fractional method to reduce the influence of documents with many authors. With this approach, the strength of a co-authorship between two authors is determined considering the number of documents co-authored normalized for the total number of authors of each co-authored document. At the author level, we included authors who have published at least 20 articles on the topic, with no restrictions on the number of citations. At the country level, we included the first 50 countries with the greatest number of articles, with no restrictions on the number of citations. To identify research areas of greatest interest and their connections, we also applied a co-occurrence analysis of author keywords occurring more than 50 times.

Results

Public interest over time

Globally, the mean public interest in telemedicine and eHealth – expressed as RSV – was 26.3% (Standard Deviation, SD = 18.1%) and 17.6% (SD = 8.8%), respectively. The greater interest in telemedicine rather than in eHealth is evident from Figure 1, which shows RSVs from January 2017 to December 2022. According to the above figure, public interest in both topics was stable before the COVID-19 pandemic and then increased rapidly for telemedicine and more gradually for eHealth. Based on the joinpoint regression analysis (Figure S1), public interest in telemedicine was stable until January 2020 (MPC = 0.36%), which corresponded to the first joinpoint (37th month of the time-series; 95%CI = 36 - 38). Then, public interest suddenly increased (MPC = 95.7%) to the highest peak reached in April 2020, which was the second joinpoint detected in the 40th month of the time-series (95%CI = 39 - 41). From that point on, public interest decreased (MPC = -22.7%) until August 2020 (i.e., the third joinpoint on the 44th month; 95%CI = 42 - 48) and then returned to being stable (MPC = -0.14%). Similarly, public interest in eHealth was stable until January 2020 (MPC = 0.34%), which again was the first joinpoint of the time-series (37th month; 95%CI = 32 - 43). From that point on, public interest gradually increased (MPC = 5.5%) to the highest peak reached in January 2022, which corresponded the second joinpoint detected in the 61st month of the time-series (95%CI = 46 - 63). Then, public interest rapidly decreased (MPC = -20.1%) until May 2022 (i.e., the third joinpoint on the 65th month; 95%CI = 58 - 67) and then returned to being almost stable (MPC = 1.8%).

Geographic distribution of public interest and correlations with COVID-19 data

The map in Figure 2 shows the geographic distribution of public interest in telemedicine from 2017 to 2022. The top five countries were: Chile, Australia, Canada, the USA, and Puerto Rico (Figure S2). Public interest in eHealth was less widespread (Figure S3), therefore we have not considered this topic for further analyses. For those countries included in the top-five, we evaluated correlations between the RSV for telemedicine and COVID-19 data per million residents. Public interest in Chile was strongly correlated with the number of new cases ($\rho = 0.718$; $P < .001$), and weakly with the number of new deaths ($\rho = 0.321$; $P = .006$). In Australia, public interest moderately correlated with the number of new cases ($\rho = 0.537$; $P < .001$), new deaths ($\rho = 0.505$; $P < .001$), hospitalized ($\rho = 0.559$; $P < .001$) and ICU patients ($\rho = 0.483$; $P < .001$). Public interest in Canada was weakly correlated with the number of new cases ($\rho = 0.265$; $P = .001$) and deaths ($\rho = 0.333$; $P < .001$). In the USA, public interest weakly correlated with the number of new deaths ($\rho = 0.295$; $P < .001$). No correlations were evident for the public interest in Puerto Rico.

Common topics related to telemedicine

Despite the considerable impact of the pandemic on the public interest in telemedicine, there were few COVID-19-related topics among those that were commonly searched with telemedicine (Figure S4). In particular, Google users interested in telemedicine mainly searched for general topics including health, physician, healthcare, medicine, and therapy. Moreover, there were some common topics related to specific telemedicine providers (e.g., Telehealth Ontario, Medicare, Santa Catarina, Cigna, CVS Pharmacy, etc.).

Description of bibliometric data

We identified 19,539 original medical articles published in English and indexed in the Scopus database from 2017 to 2022. These articles were published by 2,824 different sources (e.g., journals, books, etc.), with a document average age of 2.8 years. Notably, the first two sources (Journal of Medical Internet Research and Telemedicine and E-Health) published a number of articles that was nearly 40% of the sum of the first ten sources (Table S1). The overall average number of citations per document was 11.2, while the average number of citations per document and per year was 2.6. The top ten articles per citations are reported in Table S2: their total citations ranged from 506 to 999, while their total citations per year ranged from 121 to 221. A total of 553,913 references were found in the bibliometric analysis of all the articles. The top ten cited references are reported in Table S3, with total citations ranging from 70 to 161.

Research interest over time

Our analysis of the bibliometric data also revealed a significant increase in the number of publications related to telemedicine over the past six years (Figure 3a). The number of publications per year increased from 1,615 in 2017 to 4,870 in 2022, showing an overall increase of 201.5% and an annual average growth rate of 24.7%. The greatest increase has been reported between 2019 and 2020, with an annual growth rate of 89.0%. Regarding citations, the average total citations per year decreased from 2017 to 2022 (Figure 3b), probably as a consequence of different document ages. By contrast, the average article citations per year was stable from 2017 to 2019, followed by a peak in 2020, and then decreased until 2022 (Figure 3c).

Most productive authors and co-authorship network

Among the included articles, there were 93,394 authors appearing for 136,956 times overall. In particular, there were 690 single-authored documents wrote by 642 independent authors. Accordingly, the number of documents per author was 0.2, while the number of co-authors per document was 7.0. Table S4 shows the list of the ten most productive authors in terms of total and fractionalized articles. Their contribution to the field ranged from 48 to 80 articles (7.2 to 10.0 fractionalized articles). According to Figure 4, 71 of the authors who published at least 20 documents (n = 80) were well connected. There were 488 links between these authors – which were grouped into seven clusters – with a total link strength of 988.

Most contributing countries and international collaboration network

The majority of publications came from a single country, while 20.8% featured international co-authorships. Figure 5 shows the top ten corresponding author's countries per documents, also considering differences between single-country and multiple-country publications. One thing to note was that the USA alone published almost the same number of articles as the other nine (6,610 vs. 6,653), representing 33.8% of all articles analyzed. Countries with the highest proportion of multiple-country publications were Germany (31.5%), the United Kingdom (27.9%), and the Netherlands (26.8%); those with the lowest proportion were the USA (11.4%), India (20.3%), and Italy (22.5%). Similar results were evident in terms of citations, with average citations per document

ranging from 8.9 for Spain to 15.2 for India (Table S5).
The co-authorship network based on the top fifty most contributing countries is illustrated in Figure 6. Overall, there were 1,051 links with a total link strength of 14,751. Accordingly, countries were divided into four clusters: cluster 1 consisted exclusively of European countries (n= 21) with the United Kingdom, Germany, and Italy being the most interconnected; cluster 2 consisted of Asian countries (n= 18) led by India and China; cluster 3 consisted of 6 countries, with the USA, Canada, and Australia being the most interconnected; cluster 4 consisted of 5 countries of Latin America (i.e., Brazil, Argentina, Chile, Colombia, and Mexico).

Most relevant keywords and co-occurrence network

Overall, 22,798 author's keywords were found among the included studies. Based on the analysis of the most common keywords, COVID-19-related terms appear in the top ten (Table S6). In particular, this ranking put "COVID-19" and "pandemic" respectively in 2nd and 8th place. In addition to common terms related to telemedicine (e.g., telehealth, eHealth, mHealth, etc.), the analysis also revealed mental health as an area of relevant interest.
The co-occurrence network based on the top fifty most common keywords is illustrated in Figure 7. Overall, there were 1,030 links with a total link strength of 21,275. Accordingly, keywords were divided into two clusters: cluster 1 seemed mostly related to the application of eHealth, mHealth, or digital health to non-communicable/chronic diseases (e.g., diabetes, hypertension, depression, anxiety, etc.); cluster 2 was instead related to the application of telemedicine and telehealth in the context of the COVID-19 pandemic.

Discussion

Principal Results and Comparison with Prior Work

Our research highlights the increasing interest in telemedicine among the general public and researchers, particularly in response to the COVID-19 pandemic. Even prior to the outbreak, telemedicine had already demonstrated significant potential across various healthcare sectors. It offered a practical solution for delivering remote consultations, conducting preoperative evaluations, and facilitating postoperative follow-ups, particularly for patients residing in remote or underserved areas [9, 19]. Although telemedicine comes with numerous advantages, it also presents certain drawbacks. For example, it may prove unsuitable for emergency situations requiring immediate hands-on medical attention, necessitating traditional, in-person emergency care [41]. Additionally, specific diagnostic procedures, like imaging or laboratory tests, may demand specialized equipment unavailable in a patient's home, potentially impacting diagnostic accuracy [42]. Furthermore, not all individuals have access to the requisite technology for telemedicine consultations, such as a reliable internet connection, a suitable device, or the technical skills for virtual appointments [43]. This discrepancy in access can result in healthcare disparities. Lastly, telemedicine involves transmitting sensitive health information over digital networks, posing challenges in ensuring the privacy and security of patient data and carrying a risk of data breaches or unauthorized access [43].
Despite these advantages and disadvantages , the pandemic served as a catalyst for the widespread adoption and acceptance of telemedicine [14, 15, 18]. Notably, telemedicine has garnered increased attention, especially in the aftermath of the COVID-19 pandemic, where its significance became evident due to the implementation of social distancing measures. However, limited studies have explored the population-level interest in telemedicine, as measured by tools such as Google Trends. Some of these studies are summarized in Table S7 [44-51]. To the best of our knowledge, our study provides the most recent and comprehensive analysis in this field, shedding light on the level of interest among both the general public and researchers. An example of the use of infodemiological methods to explore global interest in telemedicine during the COVID-19 pandemic can be seen in the study conducted by Leochico and colleagues in 2020 [51]. Their study revealed a significant surge in

online searches for telemedicine and related terms after the outbreak of the pandemic [51]. Extending the analysis period until the end of 2022, our study showed that while the level of public interest in telemedicine experienced a significant increase from January to April 2020, it later declined until August 2020 and eventually stabilized. Nevertheless, public interest has remained slightly higher compared to the pre-pandemic period. This finding is consistent with the results of a Google Trends analysis conducted by Wong and colleagues on the 50 countries most affected by the COVID-19 pandemic until July 2020 [47]. According to our findings, Chile, Australia, Canada, and the USA demonstrated the highest levels of public interest in telemedicine. In these countries, we observed moderate to strong correlations between Google Trends and COVID-19 data, including new cases and deaths, as well as hospitalizations. This finding is consistent with the results reported by Arshad Ali and colleagues, who found a significant global correlation between the increase in COVID-19 cases and deaths and the interest in telemedicine [45].

With regard to research interest, there are examples of bibliometric analyses that existed even before the COVID-19 pandemic. For instance, Armfield and colleagues analyzed nearly 18,000 publication records, published between 2009 and 2013, to investigate the themes in telemedicine and telehealth literature [52]. They found that the majority of studies focused on the clinical effectiveness of telemedicine. Other research questions include the adoption and implementation of telemedicine and e-health technologies in healthcare systems [52]. Edirippulige and colleagues conducted a bibliometric analysis of telemedicine-related literature published until 2018 in highly ranked clinical journals and revealed that the acceptance of telemedicine research by these journals indicated a maturing of the telemedicine field [53]. However, the pandemic has led to a surge of research interest in telemedicine and related fields. Our bibliometric analysis, in fact, revealed a considerable increase in the number of publications, particularly from 2020 onwards. Most of these publications came from a single country, with only one in five featuring international collaborations. Despite the importance of fostering collaborations among various stakeholders, including academics, health administrators, practitioners, policymakers, and communities, which involve reciprocal knowledge translation, such partnerships are often lacking [54]. The USA led the way as the most productive country, with Canada and Australia following in a cluster. Meanwhile, European, Asian, and Latin American countries comprised the other three clusters. Previous studies already demonstrated the predominant role of the USA, with Lan et al. providing a general overview [55], and Kumar et al. analyzing the trends in orthopedics and trauma-related telemedicine during the COVID-19 pandemic [56]. Another aspect of our analysis focused on whether the different terms, such as telemedicine, telehealth, eHealth, mHealth, etc., can be used interchangeably or if each of them refers to a specific area of research. Fatehi and Wootton conducted a bibliometric analysis in 2012 to examine the trends in the use of terms such as telemedicine, telehealth, and eHealth. They discovered that these terms were frequently used interchangeably, with a growing prevalence of the term eHealth in more recent years. On the contrary, our analysis revealed a specific focus on the use of eHealth, mHealth, or digital health for non-communicable and chronic diseases, while telemedicine and telehealth were predominantly used in the context of COVID-19. The analysis by Lan and colleagues, limited to the application of telemedicine to COVID-19, showed similar results [55]. In particular, telemedicine was mainly used to provide mental health services, healthcare services delivery, and to control cross-infection. In contrast, the term "mobile apps" was closely associated with chronic illness entities such as diabetes, heart failure, and asthma, as well as health service entities such as patient education and self-care [55].

Limitations

While Google Trends provides a valuable tool for analyzing public interest, there are several limitations to this approach. Firstly, Google Trends only provides information on internet searches and does not account for offline discussions, media coverage, or other forms of engagement with the topic. This means that our results may not be representative of the entire population or capture the full extent of public interest. Secondly, the data provided by Google Trends is aggregated and anonymous, making it difficult to determine the specific demographics, motivations, or intentions behind the searches. This can limit the ability to draw meaningful conclusions or make accurate predictions about public behavior or attitudes towards telemedicine. Thirdly, Google Trends data may be subject to various biases, such as the effect of media coverage or search engine optimization strategies. Additionally, the results may be influenced by factors such as seasonality, news events, or changes in search algorithms, making it challenging to compare trends over time or across different regions. Some of these limitations also apply to bibliometric analysis. Firstly, bibliometric data may not reflect the complete picture of research interest as not all research is published and indexed in databases. Some research may be unpublished or published in non-indexed sources. Secondly, bibliometric analysis may not capture changes in research interest in real-time. It can take some time for research to be published, indexed, and reflected in bibliometric data, meaning that the data may not reflect the most current state of research interest. Thirdly, bibliometric analysis may not capture the full range of research interest as it is limited to the keywords used in publications. For instance, to offer a more comprehensive overview, one might consider examining interest in other trending subjects, like generative artificial intelligence and large language models. Lastly, bibliometric analysis does not provide insights into the reasons behind the trends observed. It is limited to providing quantitative data on the number and frequency of publications and citations, and cannot provide qualitative insights into the motivations or drivers behind the research interest. For all these reasons, while the analysis of Google Trends and bibliometric data can provide a useful starting point for understanding public and research interest in telemedicine, it is essential to supplement this analysis with other sources of data and to interpret the results with caution.

Conclusions

Our study offers a comprehensive picture of the evolving landscape of telemedicine and its growing importance in healthcare delivery. By analyzing search and bibliographic data across regions and over time, our study provides valuable insights into the level of interest in telemedicine. This information serves to pinpoint potential application fields, identify gaps in current research, and emphasize areas that warrant additional attention and efforts in raising awareness.

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AM, MB, and AA conceived and designed the study. AM and MB contributed to data collection. AM and MB contributed to the data analysis; AM, MB, GB, and AA contributed to the interpretation of results; AM, MB, GB, and AA contributed to writing the paper.

Data Availability

The data sets analyzed during this study are available from the corresponding author on reasonable request.

Conflicts of Interest

None declared.

Abbreviations

ICU: intensive care unit
MPC: monthly percent change
RSV: relative search volume
SD: standard deviation

Multimedia Appendix 1

Supplementary Materials.

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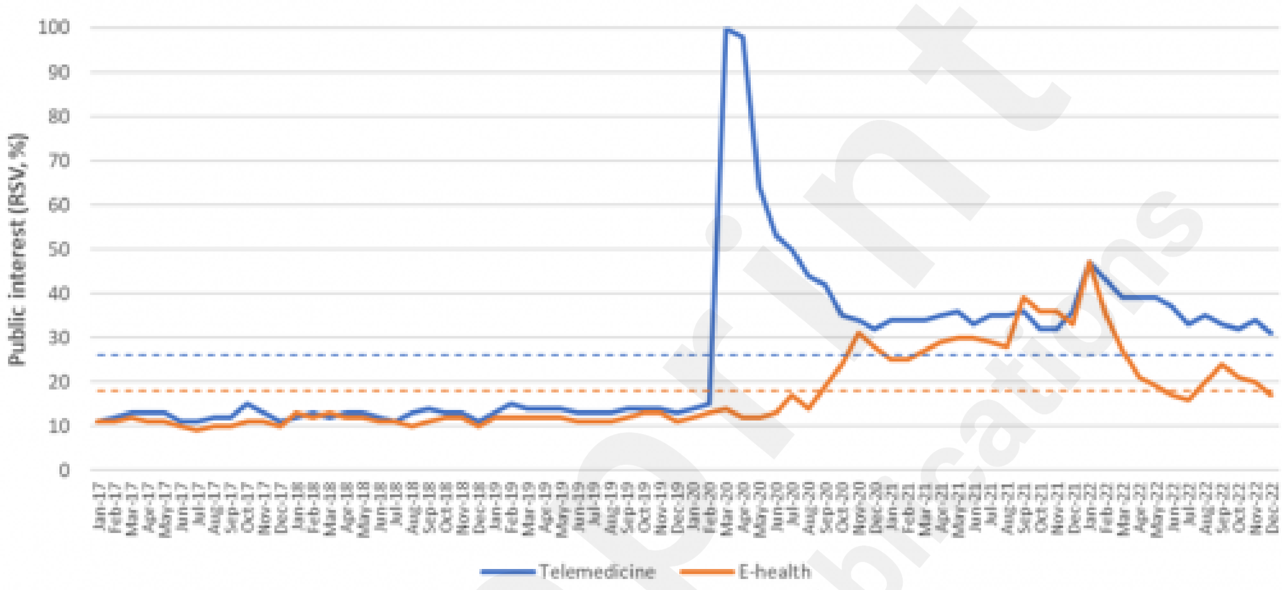
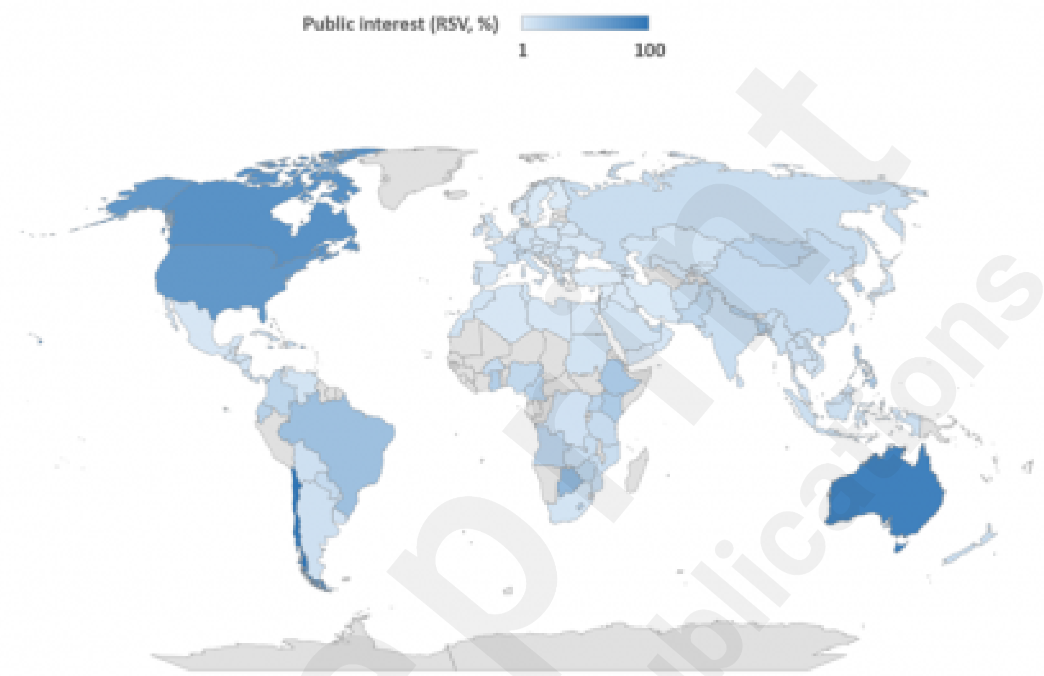
Supplementary Files

Figures

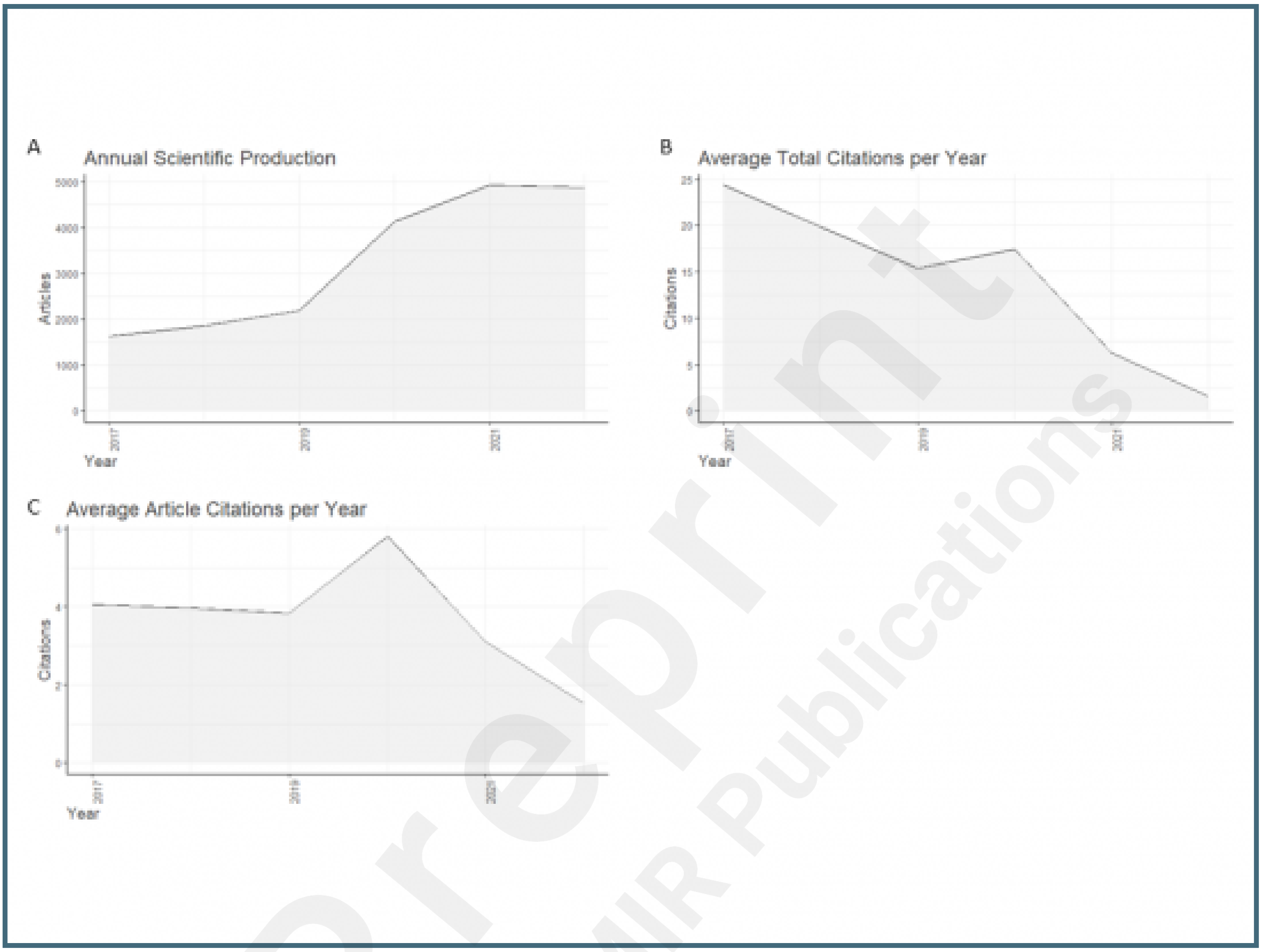
Public interest in telemedicine and e-health from January 2017 to December 2020, assessed through the Google Trends analysis. This graph shows the relative search volumes (RSVs) for the topics of telemedicine (blue line) and e-health (orange line) over time. Dotted lines represent the average values.



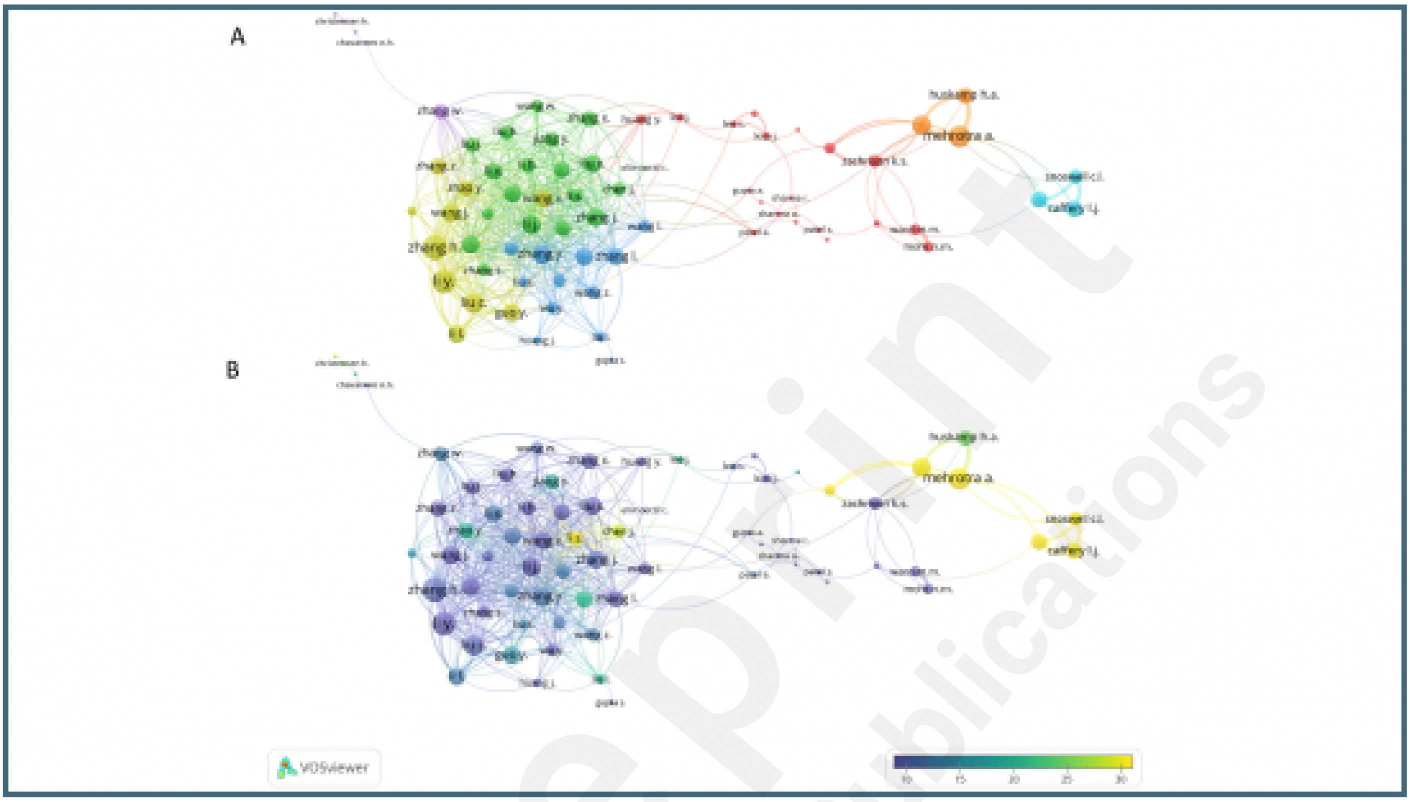
Geographic distribution of the public interest in telemedicine from January 2017 to December 2022, assessed through the Google Trends analysis. This choropleth map illustrates the relative search volumes (RSVs) for the topic of telemedicine at the country level.



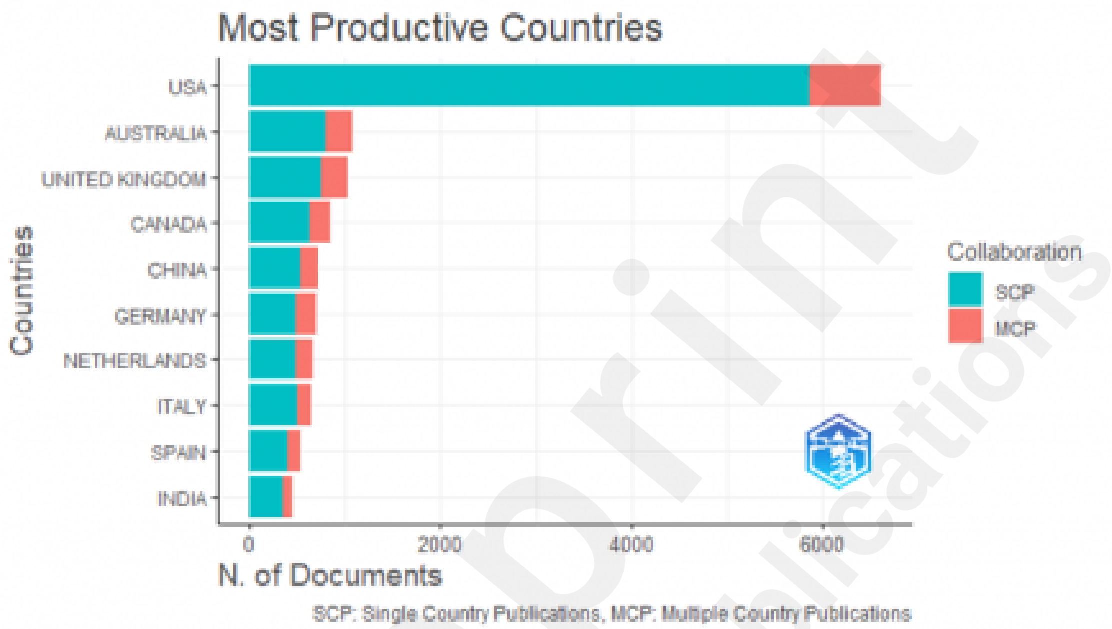
Research interest in telemedicine from 2017 to 2022, assessed through the analysis of bibliometric data. (A) Number of publications included in the bibliometric analysis from 2017 to 2022; (B) Average total citations per year from 2017 to 2022; (C) Average article citations per year from 2017 to 2022.



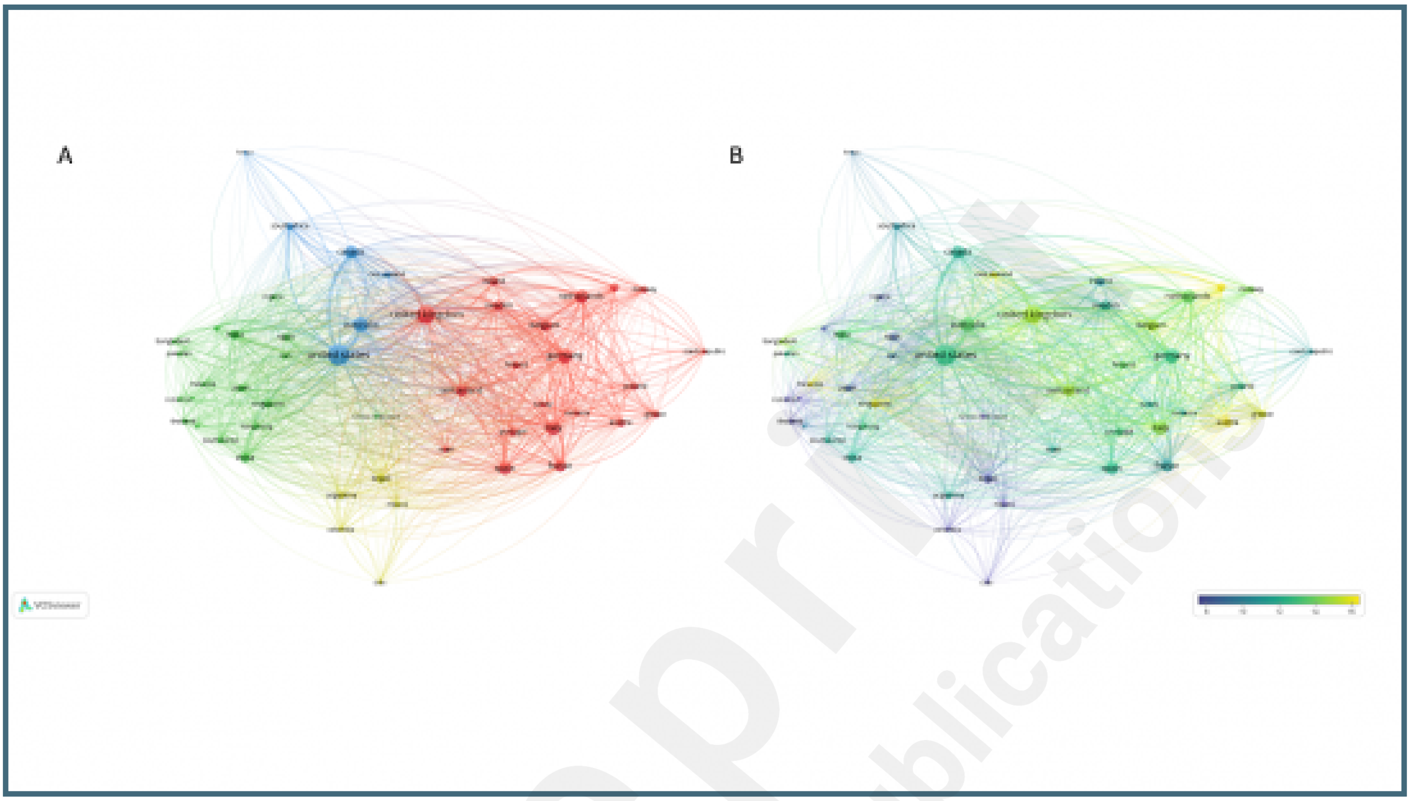
Co-authorship network of the most productive authors. The graphs show co-authorships between 71 authors with at least 20 publications on telemedicine, weighted by number of links. (A) Network visualization representing 7 clusters of collaborations; (B) Overlay visualization weighted by the number of links and scored by the average number of citations. The figures are prepared using VOSviewer.



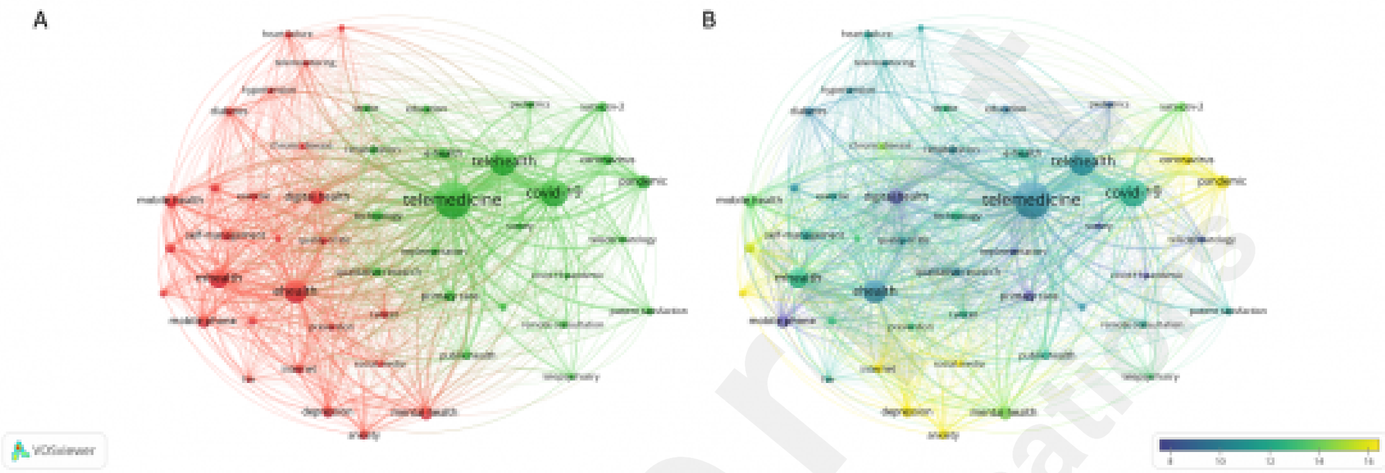
Top ten corresponding author’s countries per documents. The bar graph shows the number of single country and multiple country publications (SCP and MCP) from 2017 to 2022.



Collaboration network of the most contributing countries. The graphs show collaborations between the top fifty most contributing countries, weighted by number of documents. (A) Network visualization representing 4 clusters of countries; (B) Overlay visualization weighted by the number of links and scored by the average number of citations. The figures are prepared using VOSviewer.



Co-occurrence network of the most common keywords. The graphs show the co-occurrence of the top fifty most common keywords, weighted by number of links. (A) Network visualization representing 2 clusters of common keywords; (B) Overlay visualization weighted by the number of links and scored by the average number of citations. The figures are prepared using VOSviewer.



Multimedia Appendixes

Supplementary Materials.
URL: http://asset.jmir.pub/assets/d0d86b3ee5d4aa699cc3f043b9fda136.docx