



The COVID-19 repercussion on Google Trend data analyses

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Background: In response to the coronavirus disease 2019 (COVID-19) pandemic, the use of Telemedicine has skyrocketed. This study aimed to assess the relationship between the changes in Google relative search volume (RSV) of telehealth and COVID-19 worldwide and in different Italian regions over 18 months during the pandemic.

Methods: Data about the Google searches Telemedicine and COVID-19 were analysed (01/12/2019–31/08/2021). The number of Google searches was measured in RSV (range, 0–100).

Results: Mean worldwide RSV was 52.2 ± 17.6 for the Telemedicine and 57.7 ± 19.5 for COVID-19; mean Italian RSV was 17.5 ± 21.6 for the Telemedicine and 42.0 ± 20.0 for COVID-19. The maximum interest for Telemedicine was observed on 16/02/2020, while the maximum interest for COVID-19 was registered on 25/10/2020. The RSV curve of COVID-19 presented two nadirs during the summer periods. On the other hand, the RSV curve of Telemedicine presented a single peak in May 2020. After the peak, interest in Telemedicine continued declining (mean RSV = 18).

Conclusions: COVID-19 has expanded the use of all telemedicine modalities. Future research is required to improve the understanding of user needs and the effects of Telemedicine on providers at various levels of experience to guide efforts to encourage telemedicine adoption and usage after the COVID-19 pandemic.

Keywords: Telemedicine; coronavirus disease 2019 (COVID-19); lung cancer; SARS-CoV2; Google Trends

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Introduction

Coronavirus disease 2019 (COVID-19) was reported for the first time in December 2019 in Wuhan (Hubei, China). During the pandemics, in several medical centres, in-person outpatient medical visits were cancelled or postponed (1). Telemedicine and virtual care were previously offered to maintain a healthcare continuum for patients if needed (2).

Due to COVID-19, the prevalence of Telemedicine and virtual care has risen. Telemedicine and virtual care were integrated into healthcare systems to optimise healthcare delivery efficiency. By limiting in-person visits and direct interaction between physicians and patients, virtual care solutions helped reduce viral transmission and safeguard medical practitioners from infection (3). Technological

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advancements and cost reductions in telemedicine solutions, together with the widespread use of high-speed Internet and smartphones, enable the use of this framework and the rapid deployment of video teleconsultations from a patient's home. However, most nations lack a legislative framework for authorizing, integrating, and reimbursing Telemedicine in all patient care settings, particularly in emergency and outbreak scenarios. While these solutions may be beneficial in terms of assisting and relieving strain on health care systems during an epidemic, they are still mostly unintegrated with national health care systems. They do not share data with public health authorities for epidemiological surveillance. Italy, which has the second-highest COVID-19 load globally, does not integrate Telemedicine in the basic levels of treatment provided to all residents through the National Health Service. Despite the intense strain on health services during the early period of the pandemic, health officials made no public recommendations on Telemedicine (4).

Google Trends is an example of a Big Data surveillance tool used to analyse and understand temporal and geographic patterns in internet search terms using the Google search engine. Analysing relative search volume (RSV) with Google Trends reveals the extent to which the public is interested in a specific subject. Since these searches are timestamped, their timing can be linked to a specific public event or verified disease transmission and used to forecast disease spread associated with these events (5).

This study aimed to report the relationship between the changes in RSV of telehealth and COVID-19 worldwide and the different Italian regions over 18 months of the pandemic.

Methods

Google Trends enables users to extract current and archived data for any selected terms searched via Google from 2004 to the present day, geolocated and analysed across many areas and periods. As a result, Google Trends "+" function can include synonyms or related terms for a search query. This generates a list of keywords encompassing all reasonable search requests for a particular health issue, allowing a thorough study. Appropriate keyword selection is critical for achieving reliable results when evaluating Google search queries.

Google Trends output is given as RSV, the search volume associated with the number of times a keyword has been searched on Google. It displays the search volume for the

specified terms concerning all other searches made during the same period and region.

It is scored from 0 to 100, with 100 representing the maximum number of search requests for the given duration and geographic location and 0 representing a minimal number of search requests.

The period from 01/12/2019 to 31/08/2021 was analysed. The keywords searched in Google Trends were: "COVID-19", "telehealth", "telemedicine", "eHealth", and "mHealth", which were combined. These terms were chosen because they are frequently and interchangeably used by the public when looking for information on the availability of telehealth services in their area. The search data were extracted from the Google Trends website. The site's RSV database was used to create a global picture of public interest in Telemedicine during pandemics (6). Economic data for countries that issued COVID-19 management guidelines were collected from the Organization for Economic Cooperation and Development (OECD) health statistics database. OECD included the percentage of gross domestic product allocated to health expenditure and the absolute amount of health expenditure (per capita). For each country, the collected data referred to the year of the publication of the guidelines (7). Costs were converted from US \$ to € as per the conversion rate on 18 October 2021.

Statistical analysis

The RSV statistics were plotted against the COVID-19. The data were analysed graphically using the Shapiro-Wilk test. Due to the data being proven to be atypically distributed, the link between the RSV, the number of COVID-19 cases and Telemedicine, globally and in each selected country and region, was analysed using Spearman's rank-order correlation test. Statistical significance was defined as a two-sided P value of 0.05.

Results

Mean global RSV was 52.2 ± 17.6 for the topic "telemedicine", 57.7 ± 9.5 for "COVID-19"; mean national RSV was 17.5 ± 21.6 for the topic "telemedicine", 42.0 ± 20.0 for "COVID-19". The maximum interest in Telemedicine in the world (RSV =100) was reached on 10/05/2020, whereas COVID-19 searches reached a peak (RSV =100) on 22/03/2020. The maximum interest (RSV =100) for Telemedicine in Italy was observed on 16/02/2020, whereas

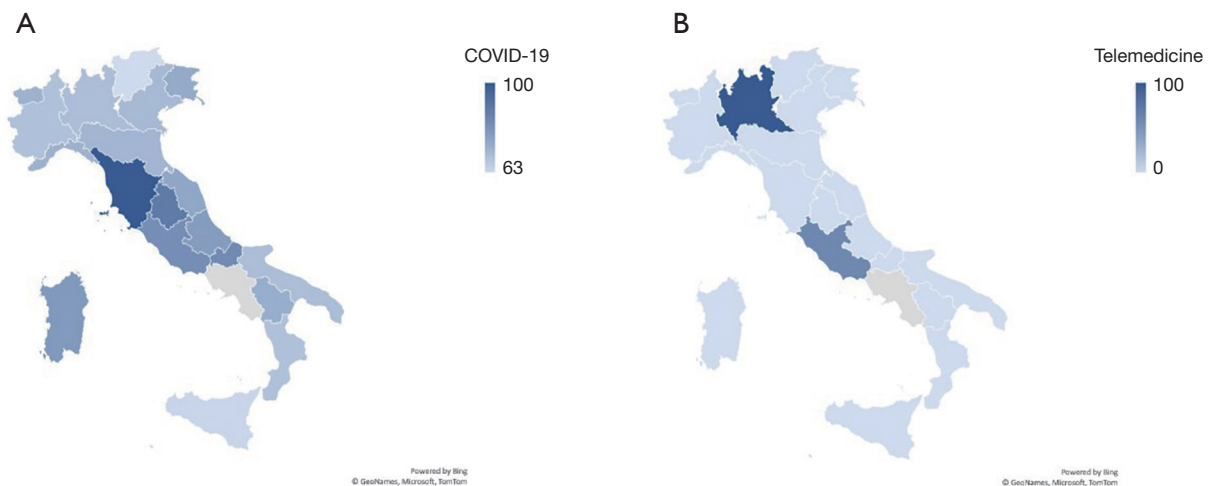


Figure 1 Comparison of relative internet search volumes for the terms COVID-19 (A) and telemedicine (B) in Italy. COVID-19, coronavirus disease 2019.

the maximum interest for COVID-19 (RSV =100) was on 25/10/2020. The global RSV curve for “COVID-19” increased at the highest rate and reached the most significant interest in March 2020, at the beginning of the pandemics in the Western countries, and presented two nadirs during the summer periods. On the other hand, the RSV curve for “telemedicine” presented a single peak in May 2020. After the peak, the interest in the Telemedicine topic continued declining (mean RSV =18).

The data curve for Italy presents the maximum interest for COVID-19 in the fall of 2020, between October and December, and a second lower peak in March 2021 with the lowest point in Summer 2020, while “telemedicine” reached its peak at the beginning of the pandemic in March 2020 and then declined for the rest of the analysed period.

“Telemedicine” was searched for in Latin America more than in the rest of the world, particularly in Brazil and Chile. RSV was 30 for both “COVID-19” and “telemedicine” in Brazil, while it was 37 for “COVID-19” and 100 for “telemedicine” in Chile (*Figure 1*). In Italy, “telemedicine” was far more frequently searched in Lombardy and Lazio (RSV values: 100 and 59 respectively), while “COVID-19” was searched more in Tuscany (RSV value: 100) (*Figure 2*). However, the interest in the two topics presents a homogeneous distribution in the territory.

In contrast, world data show similar interest in the Western countries, with peaks in Europe (Italy, France, and the United Kingdom) and Oceania (Australia and New Zealand). The country showing the highest interest in the

world was Canada. The OECD data concerning health care costs are: 3,279 EUR/capita for Italy, 4,522 EUR/capita for the United Kingdom, 4,528 EUR/capita for France, 4,223 EUR/capita for Australia, 3,615 EUR/capita for New Zealand, 1,915 EUR/capita for Chile; no data were available for Brazil. The percentage of health care costs with regards to Gross Domestic Product (GDP) according to the OECD DATA is 9.4% for Australia, 9.3% for Chile, 11.1% for France, 9.7% for Italy, 9.06% for New Zealand, 12.75% for the United Kingdom; no data were available for Brazil.

Further analysis of GDP shows that Countries with the highest rate of “COVID-19” and “telemedicine” search on Google Trend belong to countries located in the 65th positions in the world ranking, over 226 reported countries. In the analysis, there is a lack of data from countries where the Internet service is hard to access or controlled by local authorities, particularly the Middle East, Central Asian countries, and most of Africa.

Discussion

Close monitoring and continuous refinement of enhanced communication tactics are required to give actionable information for self-protection to the general community and vulnerable populations most at risk, including detecting symptoms. The use of internet data in health care research commonly referred to as infodemiology is an exciting new topic that can enhance and extend existing data sources and foundations. Globally and in many countries examined in

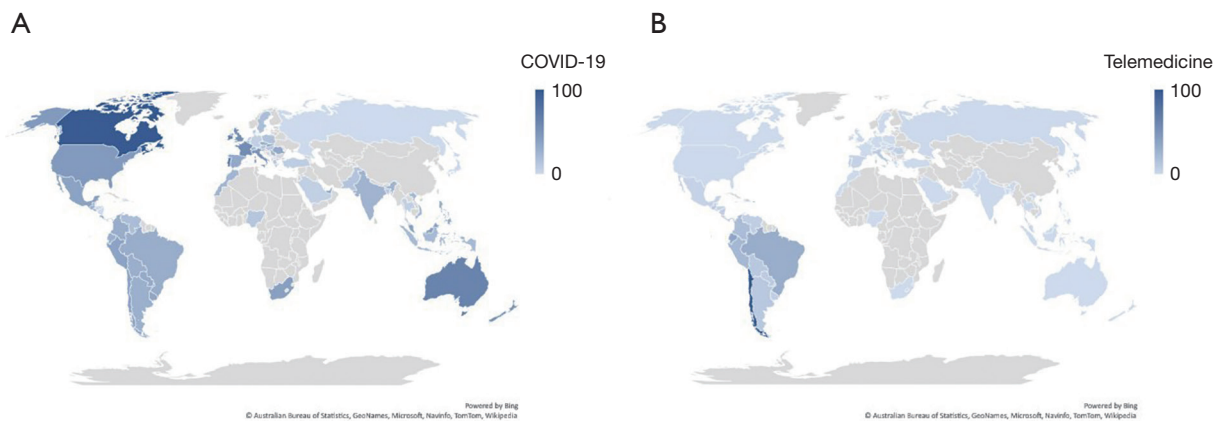


Figure 2 Worldwide comparison of relative internet search volumes for the terms COVID-19 (A) and telemedicine (B) in Italy. COVID-19, coronavirus disease 2019.

this study, awareness of COVID-19 grew days to weeks before the outbreak's peak. This supports our conclusion that the RSV is an effective instrument for monitoring infectious disease epidemics, both locally and globally. The Internet is the most widely used platform for search engines and social media, which provide real-time data and information on outbreaks.

Additionally, infodemiology and Google Trends construct awareness profiles and serve as a suitable substitute for more traditional data collection methods such as surveys. A Google Trends search demonstrates the value of precision in establishing search queries for the term "pneumonia". Pneumonia is related to COVID-19; however, it does not express COVID-19 specifically. Thus, while the query "pneumonia" may be beneficial for analysing curious symptoms, it does not describe COVID-19 outbreaks (8).

The COVID-19 pandemic has had a profound impact on worldwide healthcare provision. The necessity for digital technologies such as Telemedicine to be implemented has never been more critical. Telemedicine is likely to be a highly beneficial, if not indispensable, technique for combating this pandemic due to the variety of uses and benefits. However, obtaining these benefits needs extensive organization to ensure their deployment is successful. Latin American hospital infrastructures are not as robust and homogeneous as North Americans and European ones at all levels. Hospitals in low- and middle-income nations remain concentrated in large cities. Few have the necessary level of experience, technology, and money, an element that might prevent the deployment of Telemedicine, particularly in rural areas. Telemedicine and virtual platforms can

respond to large-scale outbreaks and emergencies in highly unpredictable environments. Physicians, therefore, may employ Telemedicine to give necessary medical treatment to patients during and after a pandemic. However, many hospitals and clinics in several countries lacked the resources needed to manage the boom in Telemedicine and virtual patient care. Thus, considering many outpatients in need of medical care during this pandemic, adopting Telemedicine could be a viable strategy (3).

The switch to Telemedicine happened in reaction to the COVID-19 pandemic's rapid spatial-temporal spread. It has been impulsive and dramatic, with little opportunity for thoughtful planning or preparation. This atypical case may have involved omissions and commissions. To date, prohibitive restrictions governing reimbursement, interstate licensing (although not all states adhere to these requirements), patient location, confidentiality, and technology setups have had to be waived to facilitate the expansion of Telemedicine (6).

Google Trends has the potential to be a cost-effective, easy-to-use tool for analysing large-scale population search data to gain relevant insights about population behaviour and its relationship to health and health care. However, to be used reliably as a research instrument, it should become more transparent, increasing the trustworthiness of the generated results and their general relevance to health care research. Additionally, researchers must clearly express their reasons and document their experiments to ensure reproducible findings. The lessons learned from this review also apply to other technologies that are not fundamentally built for research but may arise in an era of Big Data to

ensure that they are handled responsibly by the scientific community (9).

Numerous ethical and legal issues about patient confidentiality and privacy have been expressed frequently on Telemedicine. These concerns are primarily motivated by security concerns regarding the repository of electronic medical records—which are more technological than ethical—and are frequently attributed to the absence of regulation governing Telemedicine. Confidentiality and privacy protection are critical concerns in any area in the information age, and a particular definition of sensitive health-related data is barely meaningful. However, patients, and particularly the chronic ones, are typically far less concerned about privacy than healthy citizens, believing that the benefits of speedy communication with specialists outweigh the risks. Privacy issues have been extended to telemedicine consultations, arguing that personal information may be overheard by relatives or friends present during chats. However, a warning or reassurance to the patient/caregiver at the start of the conversation should suffice to address these concerns (10). Data is a deidentified aggregation of searches conducted by prospective and previous patients, providers, and third parties (11).

A multifaceted strategy can be utilised to overcome challenges to telemedicine service deployment. Significant measures include establishing a skilled staff or competence in using eHealth technologies and appropriate governance and finance. The establishment and oversight of a standardised, legal, and technological infrastructure and a comprehensive action plan and goal are critical components of a national e-Health strategy. Growth in the population's online interest in telehealth is not indicative of the number of persons seeking teleconsultation. As a result, a nationwide health survey should be done to ascertain how people are aware of and predictors of teleconsultation. This may include clinician and patient comments following an e-Health appointment. There should be no uncertainty surrounding the offering and consumption of telehealth services. It is necessary to build a systematic strategy for telehealth via e-learning. This may include simple access to instructions that provide multilingual knowledge assistance to health care professionals and citizens via electronic media campaigns. In a pandemic, frequent usage of electronic health records can increase the tracking, usability, and precision of the regional coverage monitoring network.

Additionally, cost-effective e-Health solutions should be prioritised. Mobile communications technology can be

provided at a lower cost than giving in-person help. With the advent of mobile phones, patient monitoring devices, personal digital assistants, and wireless devices for medical and public health practice, the notion of telehealth has been transformed into mobile health (affectionately referred to as m-Health). It can be utilised to improve healthcare services in locations with a tenuous infrastructure capable of supporting cyberspace or other technology. In conclusion, governments should ensure that the lessons and benefits of telemedicine implementation are widely disseminated, develop a well-governed e-Health policy, and establish sponsored e-Health programs to promote the spread and prosperity of Telemedicine during challenging times as the COVID-19 pandemic (4).

Similarly, Telemedicine has the most significant impact and perform well; it must be integrated into health systems. To do this, adjustments in regulations and policies must be made to include this new service offering model, allowing insurers to authorize it. The COVID-19 pandemic will become a watershed moment in telemedicine history. Health systems now have a once-in-a-generation opportunity to learn from their current circumstances and use those lessons in the future. To enable low and middle-income nations to make widespread use of this instrument, additional information about the costs and resources required to assure its implementation is required (12).

This study contains several strengths and weaknesses that should be recognised. We conducted the study during the first wave of the pandemic (and subsequent national lockdown) in Spring and the second wave (and subsequent national lockdown). An unprecedented increase in the number of infections and deaths occurred. Nonetheless, a flaw that should be addressed is that the Google Trend tool is not typical of all Internet searches since it differs by country and is most favoured through numerous research engines (13).

Conclusions

Our analysis discovered a considerable increase in global interest in telehealth during the current epidemic using Google Trends. Observing the global interest in Telemedicine during outbreaks can assist us in developing more effective healthcare policies and initiatives. Prior assessments, however, have revealed a dearth of suitable infrastructure and surveillance of available telemedicine networks. Digitization of health services may also be a unique area of growth in the post-COVID-19 era.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://jmai.amegroups.com/article/view/10.21037/jmai-22-2/coif>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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