# The role of telehealth during COVID-19 outbreak: A systematic review based on current evidence

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# Abstract

**Purpose:** The outbreak of coronavirus disease-19 (COVID-19) is a public health emergency of international concern. Telehealth is an effective option to fight the outbreak of COVID-19. The aim of this systematic review was to identify the role of telehealth services in preventing, diagnosing, treating, and controlling diseases during COVID-19 outbreak.

**Methods:** This systematic review was conducted through searching five databases including PubMed, Scopus, Embase, Web of Science, and Science Direct. Inclusion criteria included studies clearly defining any use of telehealth services in all aspects of health care during COVID-19 outbreak, published from December 31, 2019, written in English language and published in peer reviewed journals. Two reviewers independently assessed search results, extracted data, and assessed the quality of the included studies. Quality assessment was based on the Critical Appraisal Skills Program (CASP) checklist. Narrative synthesis was undertaken to summarize and report the findings.

**Results:** Eight studies met the inclusion out of the 142 search results. Currently, healthcare providers and patients who are self-isolating, telehealth is certainly appropriate in minimizing the risk of COVID-19 transmission. This solution has the potential to prevent any sort of direct physical contact, provide continuous care to the community, and finally reduce morbidity and mortality in COVID-19 outbreak.

**Conclusions**: The use of telehealth improves the provision of health services. Therefore, telehealth should be an important tool in caring services while keeping patients and health providers safe during COVID-19 outbreak.


# Introduction

Coronaviruses, a genus of the coronaviridae family, may cause illness in animals or humans (1, 2). In humans, several coronaviruses are known to cause respiratory infections ranging from the common cold to more severe diseases. The most recently discovered coronavirus causes coronavirus disease-19 (COVID-19) (1). The disease originated in Wuhan, China and has kept spreading widely to other countries (3). Early symptoms of COVID-19 include fever, dry cough, breathing difficulty, and tiredness (4, 5). Older people and those with underlying medical problems such as hypertension, heart problems, and diabetes are more prone to develop the disease in its most severe form (1). This global event has been announced a pandemic by the World Health Organization (WHO) (6). A major factor in slowing down the transmission of the virus is the "social gap" or social distancing that is made possible by the reduction of person-to-person contact (7, 8).

To reduce transmission, travel restrictions have been established and enforced around the world, and most cities have been quarantined (9). However, people who are not infected with the COVID-19, especially those who are at greater risk of developing the disease (e.g. Elderly people and those with underlying diseases), should receive daily care without the risk of exposure to other patients in the hospital (7). Moreover, under strict infection control, unnecessary personnel such as clinical psychiatrists

strongly refuse to enter ward of COVID-19 patients (10, 11). Natural disasters and epidemics pose many challenges in providing health care (12). As a result, unique and innovative solutions are needed to address both the critical needs of patients with COVID-19 and other people who need medical care. In this respect, technological advances provide new options (13). Although the ultimate solution for COVID-19 will be multifaceted, it is one of the effective ways to use existing technologies to facilitate optimal service delivery while minimizing the risk of direct person-to-person exposure (7, 14). The use of telemedicine at the time of epidemic conditions (COVID-19 outbreak) has the potential to improve epidemiological research, disease control and clinical case management (7, 14, 15).

The use of telehealth technology is a 21st century approach that is both patient-centered and protects patients, physicians, as well as others (16, 17). Telehealth is the delivery of health care services by health care professionals, where distance is a critical factor, through using information and communication technologies (ICT) for the exchange of valid information (18). Telehealth services are delivered using real-time or store-and-forward techniques (19). With the rapid evolution and downsizing of portable electronics, most families have at least one digital device, such as smartphones (20) and webcams, that provide patient and provider communication (21). Video conferencing and similar television systems are also used to provide health care programs for people who are hospitalized or in quarantine to reduce the risk of exposure to others and employees (7). Physicians who are in quarantine can employ these services to take care of their patients remotely (8, 22). In addition, covering multiple sites with a tele-physician can address some of the challenges of the workforce (8, 23).

There are several benefits in using telehealth, especially in non-emergency / routine care and in cases where services do not require direct patient-provider interaction, such as providing psychological services (24). Remote care reduces the use of resources in health centers, improves access to care, while minimizing the risk of direct transmission of the infectious agent from person to person (25). In addition to being useful in keeping people safe, including the general public, patients and health workers, another important advantage is providing access to care givers widely. (12). Therefore, this technology is an attractive, effective and affordable option (14, 26, 27). Patients are eager to use telehealth, but barriers still exist (28, 29). The barriers of implementing these programs also largely depend on payments, accreditation, and insurance (8). Furthermore, some physicians are concerned about technical and clinical quality, privacy, safety, and accountability (23, 30).

Telehealth can become a basic need for the general population, health care providers, and patients with COVID-19, especially when people are in quarantine, enabling patients in real time through contact with health care provider for advice on their health problems. Thus, the aim of this review was to identify and systematically review the role of telehealth services in preventing, diagnosing, treating, and controlling diseases during COVID-19 outbreak.

# Methods

### Study design

This systematic review was conducted based on the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. A systematic review method was selected to allow a robust and reproducible approach to structure a critical synthesis of the existing and current evidence. Considering the urgency of the matter and limited available evidence on the topic, we did not register the systematic review protocol.

### Search strategy and data sources

Five online databases, included PubMed, Scopus, Embase, Web of Science and Science Direct, were searched to identify relevant and published studies. The search was conducted on Titles and Abstracts. A preliminary search in March 26, 2020 identified a range of available evidence on the role of telehealth services during 2019 novel coronavirus (COVID-19) outbreak. A subsequent search was conducted on April 3, 2020 to update the results. The combination of keywords and Medical Subject Headings (MeSH) were used: COVID19, COVID-19, Coronavirus, Novel coronavirus, 2019-nCoV, Wuhan coronavirus, SARS-CoV-2, SARS2, Tele*, Telemedicine, Tele-medicine, Telehealth, Tele-health, Telecare, Mobile Health, mHealth, Electronic health, and ehealth. The Boolean operators (AND, OR and NOT) were used to combine terms. A librarian was consulted during this phase to ensure that the search strategy was satisfactory. The search in each database was adapted accordingly. For example, the search strategy in the PubMed database was executed as follows:

(COVID-19[title/abstract] OR COVID19[title/abstract] OR Coronavirus[title/abstract] OR Novel coronavirus[title/abstract] OR 2019-nCoV[title/abstract] OR Wuhan coronavirus[title/abstract] OR SARS-CoV-2[title/abstract] OR SARS2[title/abstract]) AND (Telemedicine[title/abstract] OR Tele-medicine[title/abstract] OR Telehealth[title/abstract] OR Tele-health[title/abstract] OR Telecare[title/abstract] OR Mobile health[title/abstract] OR mHealth[title/abstract] OR Electronic health[title/abstract] OR eHealth[title/abstract]).

Manual search in web-based resources was performed on Google, Google Scholar, journals which published key articles and through searching specific website (WHO, https://www.who.int, Centers for Disease Control and Prevention, https://www.cdc.gov, National Institute for Health and Clinical Excellence, https://www.nice.org.uk, National Health Commission of the People's Republic of China http://www.nhc.gov and National Administration of Traditional Chinese Medicine http://www.satcm.gov.cn). In addition, we reviewed the references of the selected articles in order to identify additional studies or reports not retrieved by the preliminary searches (reference by reference).

### Eligibility criteria

All studies with primary sources of evidence reporting the role of telehealth services in COVID-19 were included in our analyses. In fact, studies were included if they clearly defined function type of telehealth in diagnosis, management, prevention and treatment of COVID-19, published from December 31, 2019 to April 3, 2020 , were written in English language and published in peer reviewed journals. The reason for choosing December 31 was due to the fact that this date coincides with the emergence of COVID-19 in

Wuhan, Hubei Province, China. Actually, all studies illustrating any sorts of using telehealth tools in all aspects of health care (primary, secondary or tertiary level health care) to provide clinical services, diagnosis of clinical education, assessment of symptoms, triage of patients, consultation services, and training or supervision of clinicians were included. Studies about other technologies (e.g. Internet of Medical Things or IoMT), duplicate publications, review articles, opinion articles, and letters not presenting original data were excluded, as well as studies reporting incomplete information.

### Study selection and data extraction

Two authors (A.H. and E.M.) who performed the literature search also independently followed the application of the inclusion and exclusion criteria and screened the studies based on the titles and abstracts. After initial screening, full-text of studies were obtained and examined to ensure eligibility for the development of the data extraction form.

Data were extracted for all papers which met the eligibility and inclusion criteria for the review. The following data were extracted and analyzed: first author, date of publication, country, design of study, type of used telehealth, key outputs of studies and effects of telehealth.

### Quality assessment

To assess the quality of the included studies, the Critical Appraisal Skills Program (CASP) checklists were adopted. The CASP tools were developed to teach people how to critically appraise different types of evidence (31). For scoring the quality of the included studies, they were divided into three categories of poor, medium, and good quality.

### Evidence synthesis

For expressing and synthesizing the results of the included studies, narrative synthesis of overall evidence was undertaken by comparing and contrasting the data. Three stages of the narrative synthesis included the development of a preliminary synthesis, exploration of the relationships within and between studies and the determination of the robustness of the synthesis (32). Data of the included studies was qualitatively described and presented. The authors met frequently to discuss and reach consensus on the findings.

## Results

### Search results

The details on the literature search and screening processes are shown in Figure 1. Following the removal of duplicate search records and screening titles and abstracts, we evaluated 46 relevant studies in full text. From the remaining studies, 39 articles did not meet our inclusion criteria. Finally, one study was added after reference screening and eight full studies included for evidence synthesis.

## Characteristics of the included studies

Some general characteristics of the included studies are displayed in Table 1. The included studies published in different journals between February 17, 2020 and Apr 9, 2020 were mostly carried out in the USA. Eight studies were conducted in six countries: USA (n=5), China (n=2), UK (n=2), Canada (n=2), Iran (n=1) and Italy (n=1). Five studies were cross-sectional in design, two were case studies and one was case-control. In the included studies, most of telehealth and social media channels were used during COVID-19 pandemic such as live video conferencing, telephone, and email.

Table 1: Summary characteristic of included studies in systematic review.

| Author/ Date | Country | Design of study | Type of telehealth | Key outputs | Effects |
|---|---|---|---|---|---|
| Davarpanah et al./ 17/02/2020 (33) | Iran | Case study | Social media platform including messaging software, WhatsApp, and email | • Faster rate in teleradiology services delivery<br>• Assembled an opinion teleradiology group<br>• Create volunteer network coordinator (humanitarian)<br>• Triage of COVID-19 infection using radiology experts from centers from around the world | • Eliminated the need to send patients to overpopulated hospitals<br>• Provided near real-time consultation from experts located around the country and the world<br>• Addressed the local need<br>• Could solve the shortage of on-site thoracic radiologists<br>• Provided consultation in regions with limited access to thoracic radiology expertise<br>• Established consensus among radiologists through discussions in the online group |
| Zhai et al./ 23/02/2020 (34) | China, UK | Case study | Live video conferencing and mobile | • Providing clinicians and patients with immediate diagnosis and consultations regarding COVID-19<br>• Wireless remote monitoring of patients<br>• Remote multiple disciplinary care<br>• Education and training of patients<br>• Performing the collects, transforms, and evaluation of patients health data | • Led to capture, store and process patient medical records<br>• Achieved real-time data exchange<br>• Accessed prevention and treatment guidelines, and guidance on drug use and management of coronavirus patients<br>• Prevented direct physical contact<br>• Reduced the risk of exposure to respiratory secretions<br>• Prevented the potential transmission of infection to physicians and nurses<br>• Helped the specialist treatment team to provide primary care guidance on coronavirus for all physicians and nurses |

| Author/ Date | Country | Design of study | Type of telehealth | Key outputs | Effects |
|---|---|---|---|---|---|
| Reeves et al./ 24/03/2020 (35) | USA | Cross-sectional | Phone calls and electronic health record (EHR) | • Triage of patient with phone calls<br>• Screening or treating a patient in an ambulatory care setting<br>• Screening or treating a patient in an urgent care setting<br>• Offering decision support for those in need of testing<br>• Repurposing and utilizing EHR optimization team to train end users' video visit workflow<br>• Telemedicine–video visits for outpatient clinic encounters | • Managing patients' concerns<br>• Tracking of COVID-related infection in EHR embedded database<br>• Tracking of persons under investigation (PUI) in EHR embedded database<br>• Reports regarding prior PUI, existing and pending tests, training completion and screening/documentation compliance<br>• Updated travel and symptom screening, testing criteria, and clear guidance on best setting and location of patient care<br>• Clinical decision support on testing criteria, recommended additional work-up, admission criteria/protocol, and discharge information<br>• Standard documentation of any screening of patient visitors for symptoms of infection<br>• Template excuse letter for providers to recommend working from home |

| Author/ Date | Country | Design of study | Type of telehealth | Key outputs | Effects |
|---|---|---|---|---|---|
| Nicol et al./ 24/03/2020 (36) | USA, Canada | Cross-sectional | Social media or other digital platforms including telephone, email and videoconferencing | • Facilitating electronic informed consent, digital assessment tools and virtual study visits<br>• E-consent, remote assessment, and telephone or videoconference visits<br>• Provide e-consultation or advice to health providers | • Helped in implementing social distancing<br>• Could be implemented far from high-risk areas such as hospital grounds<br>• Reduced the use of public transportation<br>• Provided all of the components of human research protection<br>• Reduced viral transmission risk from in-person contacts<br>• Prevented morbidity in these at-risk individuals during the COVID-19 pandemic<br>• Communicated accurate and clear information, at a time when older adults and their family are bombarded with contradictory and confusing messages |
| Simcock et al./ 24/03/2020 (37) | UK, USA, Italy | Cross-sectional | Telephone, video, and laptops | • Telephone follow up in multiple cancer settings (endometrial, prostate, lung, and colorectal cancer)<br>• Use in remote monitoring<br>• Provide video consultations | • Minimized the risk of COVID-19 transmission during radiotherapy treatment<br>• Reduced infection risk and the risks of workforce depletion<br>• Facilitated access to hospital data or to treatment planning systems |

| Author/ Date | Country | Design of study | Type of telehealth | Key outputs | Effects |
|---|---|---|---|---|---|
| Greenhawt/ 26/03/2020 (38) | USA, Canada | Cross-sectional | Telephone, electronic medical record, patient portal messaging, digital photography, video using a HIPAA compliant platform, website | • Delivering allergy services<br>• Phone triage as available options in allergic rhinitis<br>• Provide telehealth visits<br>• Follow-up visits, via phone triage or telehealth in patients with urticaria, angioedema, and atopic dermatitis<br>• Service adjustment for food allergy, Eosinophilic Esophagitis (EoE), drug allergy, and anaphylaxis<br>• Service adjustment for allergic skin disorders and<br>• Service adjustment for immunodeficiency<br>• Immunotherapy appointments or schedules<br>• Served as a portal for sharing timely information to large numbers of patients | • Limited the exposure of providers to potentially infected patients<br>• Provided access to rapid evaluation for potential COVID-19 infection<br>• Reduced exposure of patients<br>• Preserved social distancing<br>• Could meet healthcare needs<br>• Helped visualize any rash<br>• Reduced the need for face-to-face visits<br>• Virtual care options to ensure continuity of care<br>• Was Effective for managing patients with chronic conditions<br>• Provided an opportunity to introduce telehealth in to an allergy practice<br>• Reduced burden on practice resources |

| Author/ Date | Country | Design of study | Type of telehealth | Key outputs | Effects |
|---|---|---|---|---|---|
| Cohen et al./ 07/04/2020 (39) | USA | Cross-sectional | Applications including Apple FaceTime, Facebook Messenger video chat, Skype, and Mobile health technology | • To develop staffing plans<br>• Using to conducted billing of patients<br>• To appropriately-performed telehealth visits<br>• Use in psychological treatments<br>• contact with family, friends and colleagues<br>• In-person evaluation, telemedicine evaluation if high-risk for infection (patient or location-specific) | • Minimized "unnecessary" exposure of hospital staff to patients, and to themselves<br>• Led to early treatment associated with better outcomes |
| Zhou et al./ 09/04/2020 (40) | China | Case-control | combined mode of MOOC micro-video | • The live broadcast of the training video<br>• Can be watched repeatedly videos<br>• Was applied to the communication ability training of new nurses | • Satisfaction was higher<br>• Understanding was easy<br>• The teachers' evaluation and harvest were higher<br>• Obtained the real clinical experience<br>• Helped to alleviate the lack of clinical nursing teaching resources |

## Quality assessment

Our review included eight studies that were assessed using the CASP tools. The qualities of the assessed studies were generally high. Six (75%) studies enjoyed good quality, and two (25%) had medium quality. No studies were excluded on the basis of the level of evidence or quality assessment.

## Telehealth services during the COVID-19 outbreak

We identified eight studies that reported data on telehealth regarding the status of patients infected with COVID-19. Telehealth has the ability to unite several medical organizations and situations into one virtual network, led by the central clinic. This network can include different physical locations: central and remote clinics, state and private clinics, rehab centers and prevention centers, physicians’ private offices

and all registered patients within their locations. By using virtual care for much regular, necessary medical care, and deferring elective procedures or annual checkups, we can free up medical staff and equipment needed for those who become seriously ill from COVID-19. Additionally, by not congregating in small spaces like waiting rooms, we thwart the ability of the virus to hop from one person to another. Keeping people apart is called “social distancing”. Keeping healthcare providers apart from patients and other providers is “medical distancing”. Telehealth is one strategy to help us accomplish this.

Telehealth can mobilize all aspects of healthcare potentials to reduce transmission of disease, ensure safety of online health services, direct people to the right level of care, protect patients, clinicians, and the community from exposure to infection, and finally decrease the burden on the healthcare system. Some of the telehealth usage cases for patients were control and triage during the spread of COVID-19, self and distance monitoring, treatment, patients after discharge (follow-ups) and implementation of online health services. These methods have the potential to reduce morbidity and mortality. For health workers, clinicians with mild symptoms can still work remotely with patients, facilitate rapid access to medical decision making, seek second opinion for severe cases, exchange cross-border experiences, and offer teleradiology and online trainings for health workers. To provide continued access to essential health services, telehealth should be a key weapon in the fight against the COVID-19 pandemic.

# Discussion

The aim of this systematic review was to identify the role of telehealth services in preventing, diagnosing, treating, and controlling diseases during COVID-19 outbreak. We described the benefits and implications of several telehealth tools with the aim of improving the management of COVID-19 infection. Nowadays, for the general population, there is no vaccine to prevent COVID-19, and the best preventive strategy is to avoid being exposed to the coronavirus (41). A series of measures have been suggested for infection preventive and control (IPC) that may reduce the risk of exposure including the use of face masks, covering coughs and sneezes with tissues, regular hand washing with soap or disinfection with hand sanitizers containing at least 60% alcohol, avoidance of contact with infected people and maintaining an appropriate distance as much as possible, and refraining from touching eyes, nose, and mouth with unwashed hands (42).

Meanwhile, healthcare providers can communicate with patients by telehealth and other remote means for triaging, assessing and caring for all patients to reduce the number of those who seek face-to-face care (43). Telehealth uses live video conferencing, or even a simple mobile call, to allow medical staff to ask specific questions and gather information, supply consultation and triage of patient, or if a person can continue to self-monitor symptoms at home while recovering. It can also be used for regular check-ins such as blood pressure, oxygen level and respiratory rate, as needed (34).

During the COVID-19 outbreak in China, online mental health surveys with communication programs, such as WeChat, Weibo, and TikTok have enabled mental health professionals and health authorities to provide online mental health services during the COVID-19 outbreak (44). In order to ensure the

ongoing provision of mental health services and reduce the risk of cross-infections, Chinese government launched a remote consultation network where telephone or internet consultations can be carried out in a safe setting (45). The National Health Commission of China have published several online guideline documents and free electronic books on COVID-19 with the aim of helping the development of Chinese public emergency interventions, improving the quality and effectiveness of emergency interventions (10). In addition, telehealth can provide mental health services in the context of patient isolation through reducing the mental health burden from COVID-19 and share information about symptoms of burnout, depression, and anxiety (14).

Greenhawt et al. suggested that telehealth has several advantages in delivering allergy and immunology services such as limiting exposure of healthcare to potentially infected patients and providing access to the rapid evaluation for COVID-19 infection (38). Apart from the commonly used methods in diagnosing OVID-19, one study in Iran identified a novel screening and triage strategy during deadly COVID-19 pandemic. In response to the shortage of on-site thoracic radiologists, Iranian Society of Radiology (ISR) delivered teleradiology services and provided teleconsultation for triage of COVID-19 infection through a social media massager (33). In addition to taking actions to protect the health and safety of patients, staff should also take mobile health technology to develop staffing plans and conduct billing for healthcare services (39).

Our results demonstrate that to manageCOVID-19, there are many easy-to- set-up potentials in video consulting. Live video conferencing can lead to the avoidance of direct physical contact, thereby diminishing the hazard of exposure to respiratory secretions, preventing the potential transmission of infection to physicians and other health staffs (34). Also, for patients seeking consultation on covid-19, video could be useful for people with heightened anxiety and instead of in-person visits in cases of chronic disease reviews, some medication checks, and triage when telephone is insufficient (23). In order to halt the spread of the COVID-19 outbreak, telephone and video consultations follow-up is possible in multiple cancer settings including endometrial, prostate, lung, and colorectal (37).

Based on the study conducted in the USA, phone calls and electronic health records (EHR) can facilitates screening or treating a patient in an ambulatory and urgent care setting without the need for in-person visits and improve decision making process among healthcare team (35). Overall, the impact of telehealth tools during the COVID-19 pandemic in preventing morbidity and avoiding the public from high-risk areas such as hospital premises was significant. Also, the elderly can access health services by using electronic devices (36). These days, the major barrier for the large-scale use of telehealth to deal with COVID-19 infection including appropriate adaptation of local systems with changes is concerned with payment and coordination of services (8). We hope that through further training of health providers and patients on how to make the most of telehealth tools, revisiting traditional definitions of clinical practice and using closed online platforms, we can make substantial progress in preventing and controlling COVID-19.

## Future research

The biggest challenge for future research in the use of telehealth is probably defining the obstacles and facilitators in health providers and patients. Future research is suggested to specify the effects of telehealth solutions in the efficiency indicators and hospital performance. Also, further global research is warranted to determine how to set up telehealth in primary care. Researchers can also examine the effectiveness of using telehealth approaches in different health areas, especially in the field of home nursing the elderly who are high-risk people in the community. It is also highly recommended to use this technology in the field of psychiatry as it does not require in-person visits. Other future research can tap into evaluating the satisfaction of patients and providers with telehealth services.

### Limitations

Our systematic review holds three limitations. Firstly, it is possible that some relevant studies were not taken into account because they have been published in languages other than English (e.g. Chinese). Secondly, we did not have access to some other databases such as CINAHL and PsycINFO. Thirdly, there could be some other studies on this theme in the literature that skipped our attention and analyses though we did our best to adopt a comprehensive search strategy and cover a broad range of evidence across the world.

## Conclusion

This study provides a comprehensive systematic review solely exploring the potentials of telehealth during the COVID-19 pandemic. In response to WHO's call for studies on the COVID-19 infection and presentation of the most recent evidence published in this early period of the outbreak for health care providers, this study was conducted to identify the role of telehealth during COVID-19 outbreak. As the COVID-19 epidemic scales exponentially across the worlds, calls for expended use of telehealth, innovative solutions and optimization of life-saving critical care hospital beds clearly highlight unmet needs in the world healthcare system. Telehealth has the potential to address many of the key challenges in providing health services during the outbreak of COVID-19. Telehealth can help us avoid direct physical contact and minimize the risk of COVID transmission and finally provide continuous care to the community. Based on the findings of this review study, clinicians and patients are strongly recommended to apply telehealth as an appropriate option to prevent and contain COVID-19 infection.

## Abbreviations

COVID-19: Corona Virus Disease 2019, CASP: Critical Appraisal Skills Program, WHO: World Health Organization, MeSH: Medical Subject Headings, IoMT: Internet of Medical Things, IPC: Infection Preventive and Control, HER: Electronic Health Record, PUI: Persons Under Investigation.

## Declarations

### Ethics approval and consent to participate

Not applicable.

### Consent for publication

Not applicable.

### Availability of data and materials

Datasets are available through the corresponding author upon request.

### Declaration of interests

None.

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### Authors' contribution

AH and EM developed the design and were involved in the study selection, data extraction, quality assessment, evidence synthesis and crafted the first draft of the manuscript. Both authors read and approved the final draft of the manuscript.

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# Figures

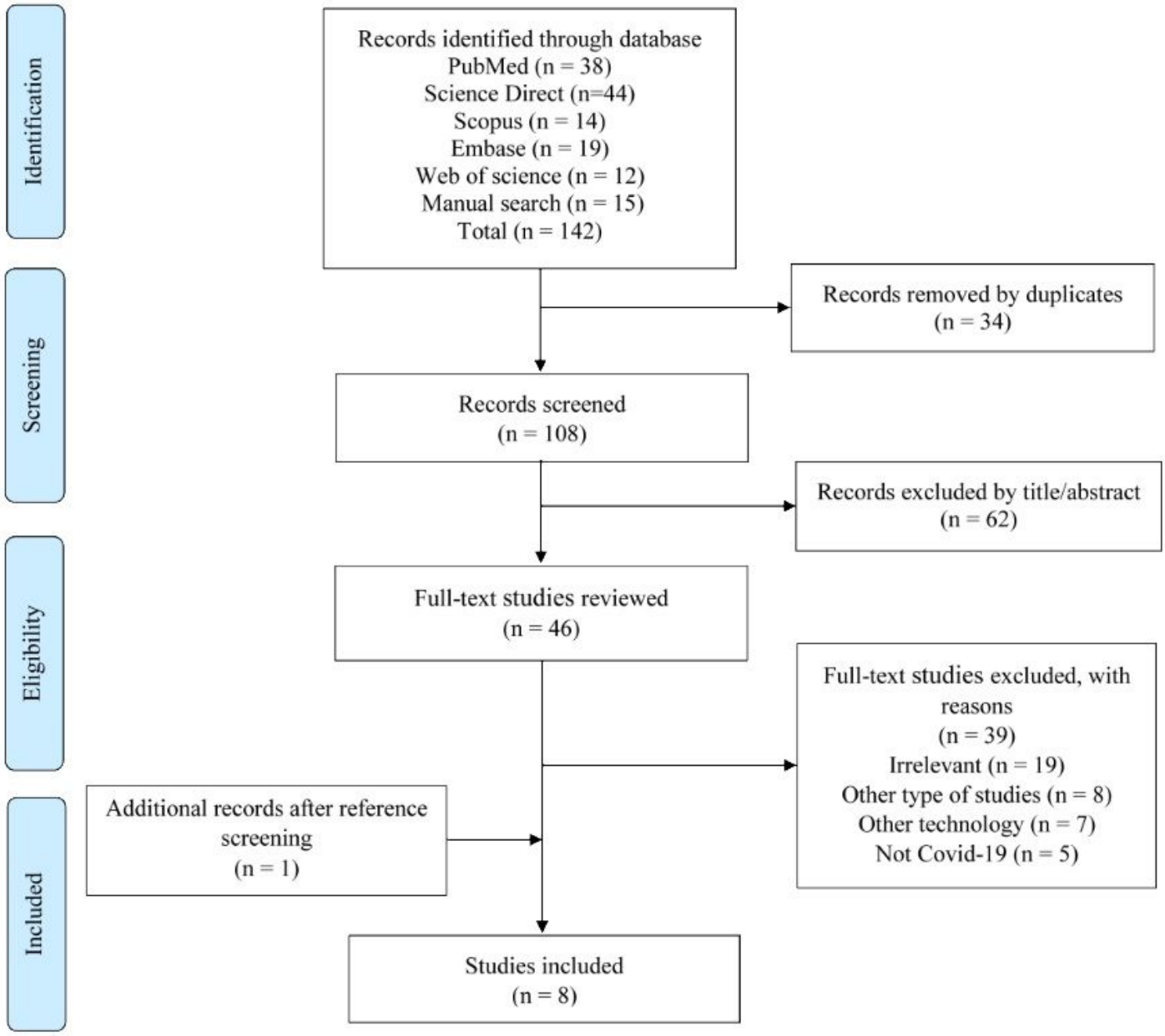


**Figure 1**

PRISMA flow diagram illustrating study selection.