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Telemedicine in lung cancer during COVID-19 outbreak: A scoping review

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Abstract:

The coronavirus disease 2019 (COVID-19) pandemic has negatively affected the medical services, particularly cancer diagnosis and treatment, for vulnerable cancer patients. Although lung cancer has a high mortality rate, monitoring and following up of these patients can help to improve disease management during the pandemic. Telemedicine has proven to be an effective method of providing health care to these patients. As a result, the purpose of this study was to identify telemedicine applications in the management of lung cancer patients during the COVID-19 pandemic. In this scoping review, studies published in online scientific databases such as Web of Science, Scopus, and PubMed between January 1, 2020 and September 1, 2021 were systematically searched and screened. The studies were chosen using predetermined inclusion and exclusion criteria. The bibliometric information and technological aspects of included studies were collected using a data extraction form and the data was analyzed using the content analysis approach. A total of 68 articles were found, from which four articles were finally selected based on specific inclusion/exclusion criteria. Real-time consultation was one of the most common applications of telemedicine to deliver health-care services to cancer patients. Health-care providers used applications such as Zoom, Facetime, WeChat, and e-mail, as well as devices including PCs, phones, and smartphones to provide real-time consultation to patients via videoconferencing, phone calls, and messaging, as well as store and forward consultation via e-mail. Telemedicine in the COVID-19 pandemic provides health-care services to lung cancer patients at their homes by enabling physicians and patients to communicate in real time. Several telemedicine services are still unavailable for patients with lung cancer. As a result, health experts, politicians, and entrepreneurs must pay special attention to this issue.

Keywords:

COVID-19, lung cancer, telemedicine, tele-oncology

Introduction

Cancer is a major economic and public health concern, and its prevalence is anticipated to rise.^[1] One of the most concerning health issues for cancer patients is their quality of life. Telemedicine, as a technology-based solution, offers various medical services to patients that have a substantial influence on lowering costs and improving quality care.^[2] In the coronavirus disease 2019 (COVID-19) pandemic, there is a tremendous need for telemedicine for cancer patients, particularly lung cancer patients.

Physicians are having difficulty managing the treatment of cancer patients who have been infected with the COVID-19 virus. This pandemic has had a severe effect on the health-care system, particularly on cancer detection and treatment.^[3] On the other hand, due to frequent contact with the health-care system, immunocompromised state from cancer or its treatments, supportive drugs such as steroids and, most significantly, advanced age and comorbidities, cancer patients are extremely vulnerable to Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections.^[4] In 2020, the American Cancer Society Cancer Action Network (ACS CAN) conducted a survey of over 1200 cancer patients and survivors

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during the period of COVID-19. The coronavirus, according to the survey, caused care complications and financial difficulties, and one out of every four people reported receiving delayed care or treatment. Fifty percent of these delays were due to delayed face-to-face appointments with health-care providers (HCPs), 20% were due to imaging services delays, 20% were due to delays in support services, such as physiotherapy or mental health care, and 8% were due to surgery delays.^[5]

Several cancer patients died after being infected with SARS-CoV-2 virus. As the severity of the viral disease has progressed, symptomatic management for cancer patients infected with this virus has become increasingly complicated.^[3] Managing cancer patients during an epidemic is, therefore, extremely difficult and complicated for a variety of reasons. The vulnerability of cancer patients as a result of the immunocompromised condition caused by cancer and/or its treatment (e.g., surgery and chemotherapy) has resulted in the severity of COVID-19 disease.^[6] Several studies in this regard have found the risk of death to be associated with the type of cancer or the stage of cancer at the time of diagnosis.^[7] When compared to other cancers, patients with lung cancer have regularly been shown to have a higher chance of death. This could be attributed to a combination of pathophysiological factors such as preexisting pulmonary impairment induced by smoking history and increased specific constraints on respiratory health-care services caused by the pandemic.^[6]

In lung cancer, as COVID-19 infection is more common in adult men (aged over 60) with non-small cell lung cancer (NSCLC),^[8] they are at a higher risk of severe disease and/or mortality.^[9] Referral to health-care facilities where he or she may be exposed to COVID-19 is another risk factor for these patients. On the other hand, using anti-inflammatory medications, such as steroids, for COVID-19 treatment leads to cancer progression and additional complications.^[6] Notably, patients with lung cancer are more likely to experience COVID-19 complications than patients with other types of cancer, which may be related to the type of tissue that they primarily affect in parallel.^[6] Postponement or cancellation of cancer therapy sessions is one of the most serious concerns for these patients during the pandemic. Furthermore, because these people's respiratory systems are involved, their vulnerability is considerable, and as a result, their hospitalization time or probability of death is higher.^[10]

Since the COVID-19 outbreak, the number of suspected cancer cases in emergency care has reduced,^[11] leading to increased mortality. During this time, the number of newly diagnosed lung cancer patients has also fallen considerably.^[12,13] Therefore, the pandemic COVID-19 is

a huge and ongoing concern in all parts of lung cancer patients' care system, from screening and symptom recognition to therapy and palliative care.^[14] For example, a study conducted in Spain found that during the COVID-19 outbreak, the identification of new cases of NSCLC lung cancer with severe symptoms decreased by 38%; however, the decline in the Small cell lung cancer (SCLC) type, which has milder symptoms, can be more drastic.^[15] To address these issues, the health-care system should adopt new methods of communicating with and monitoring cancer patients.

Cancer patients should be managed as much as possible at home during COVID-19 pandemic. This includes using telemedicine and phone calls to replace risky visits, as well as replacing intravenous drugs with oral medications whenever possible. IT-based alternatives have the potential to eliminate a large number of unnecessary face-to-face interactions.^[16] During the pandemic, telemedicine is the most commonly used method of providing health services in remote and rural locations.^[17]

Telemedicine provides patients with health-care services such as diagnosis, consultation, and treatment^[18] and employs information and communication technologies (ICT) to exchange any information, including text, images, audio, or video between the health-care professionals and patients.^[19] Because of the high vulnerability of patients with lung cancer in the incidence of COVID-19, as well as the need to avoid their infection while delivering the necessary care services, using telemedicine capabilities is a viable alternative.^[20] Telemedicine offers a wide range of remote services, including counseling (through video, audio, or text), medical treatments, and palliative interventions, all of which can be delivered both synchronously and asynchronously.^[21]

Because of the importance of tele-oncology applications for patients with lung cancer, and also, to the best of the authors' knowledge, no study has reviewed the results and effects of these applications in the COVID-19 pandemic to date, the goal of this study was to identify telemedicine applications in the care of patients with lung cancer during the COVID-19 outbreak. By identifying these applications and their effects during this time, we can help HCPs and system developers in making appropriate decisions for the proper use of this technology in similar situations and crises.

Materials and Methods

This is a scoping review study which was conducted in 2021 based on scoping review and systematic review guidelines.^[22,23] Scoping reviews have three main parts

including Population, Context, and Concept (PCC).^[24] Therefore, the present study was formulated based on the scoping review parts.

Search strategy and data sources

Systematically searched scientific databases included PubMed, Scopus, and ISI Web of Sciences for articles published in the last 2 years by using a combination of related keywords shown in Table 1.

Inclusion and exclusion criteria

The study included original articles which have full text in English language. The articles should be about using telemedicine for providing health-care services to lung cancer patients during COVID-19 outbreak. Other types of articles, such as all types of review articles, short communications, letters, commentaries, and case reports, were excluded from the study. Articles that were not about using telemedicine to provide health-care services to lung cancer patients during COVID-19, such as those about other types of cancers (except lung cancer) or other types of health information technologies (except any type of telemedicine), as well as articles that were not published during the COVID-19 period were excluded. Articles in languages other than English were not considered.

Data extraction

Data was extracted independently by two authors, and incidents of inconsistency were forwarded to a third author. A data extraction form was used to extract data. Article title, publication year, country, purpose of the studies, kind of cancer, type of telemedicine, telemedicine modality, technical aspects of system, and interaction types were all included in the form.

Data analysis

The content analyses approach was used to analyze the data, and the results were reported in accordance with the study objectives.

Table 1: Search strategy

Time limitation	Up to September 1, 2021
#1	"telemedicine" OR "tele-medicine" OR "Mobile Health" OR "telehealth" OR "tele-health" OR "mhealth" OR "ehealth" OR "m-health" OR "telemonitor*" OR "telecommunication" OR "telemanagement" OR "telecare" OR "telepathology" OR "telerehabilitation" OR "telescreening" OR "telediagnos*" OR "teletreatment"
#2	"Lung Neoplasm*" OR "Pulmonary Neoplasm*" OR "Lung Cancer*" OR "Pulmonary Cancer*" OR "Cancer of the Lung" OR "Cancer of Lung" OR "Lung Carcinoma*" OR "Pulmonary Carcinoma*" OR "Lung tumor*" OR "Pulmonary tumor*"
#3	"COVID-19" OR "SARS-COV-2" OR "corona virus" OR "COVID"
Search strategy	#1 AND #2 AND #3

Results

After searching scientific databases, a total of 68 articles were found and saved in EndNote, a citation management software. Initially, 27 duplicate articles were removed and the remaining 41 were carried on to the next step, where the title and abstract were reviewed based on inclusion and exclusion criteria. At this point, the editorial or review articles were removed from the study and the titles and abstracts of the remaining articles were reviewed, with 16 articles being selected for the following step. In the last step, the full text of these articles was read and five articles were selected based on the inclusion and exclusion criteria. The article selection process is depicted in Figure 1.

As shown in Table 2, the real-time telemedicine modality was more used to provide health care. The most important application of telemedicine was consultation. Also, other features of the selected studies are presented in this table.

Figure 2 depicts in four layers the technological aspects of telemedicine systems presented in the studies. To deliver services to cancer patients, HCPs in the first layer use applications such as Zoom, Facetime, WeChat, Microsoft Teams, WeTransfer, and e-mail, as well as devices such as PCs, phones, and smartphones (in the second layer). In the next layers, HCPs provide real-time (synchronous) consultation to recipients of health care (patients and caregivers) via videoconferencing, phone calls, and messaging, as well as store and forward (asynchronous) consultation via e-mail.

Discussion

The SARS-CoV-2 outbreak has had a substantial impact on lung cancer patients and has made lung cancer treatment more difficult. Lung cancer patients are more likely to be infected and have a greater morbidity and mortality rate than the general population.^[29] Over the last 2 years, treating and monitoring lung cancer patients properly and safely during the epidemic has become a constant problem. The major recurrent challenge for lung cancer specialists is deciding whether to offer, modify, postpone, or even cancel therapies for this specific patient population.^[30] In the selected studies, Cloud SYSUCC app introduced in the study of Chen *et al.*^[25] had two interfaces: one for medical professionals (therapeutic interface) and the other one for patients (patient interface). Doctors can use the app to prescribe drugs in the therapeutic interface and they utilize the app to look at the patient's medical history, interact with them, and order examinations. In another study,^[26] yoga therapy is delivered as a supportive care to patient-family caregiver dyads using videoconferencing technology by certified

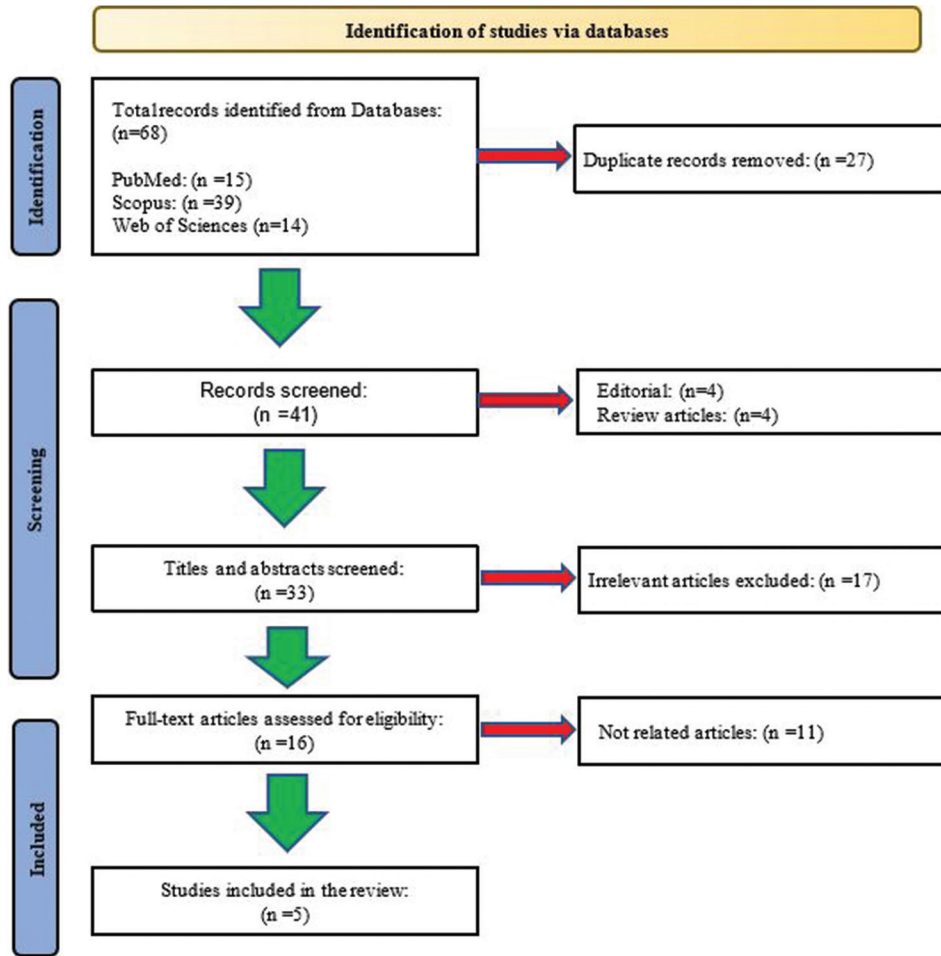


Figure 1: Article selection process

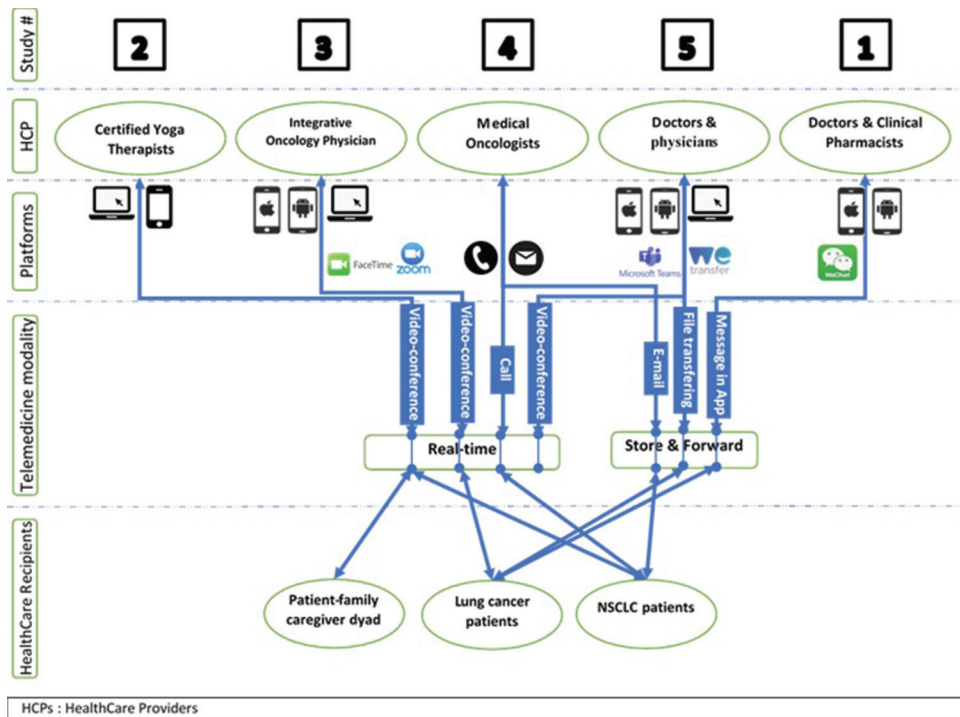


Figure 2: Technological aspects of telemedicine used in the included studies

Table 2: The features of selected studies

Study #	Authors	Country	Aim of study	Kind of cancer	Type of telemedicine	Telemedicine modality	Technical aspects	Interaction types
1	Chen <i>et al.</i> ^[25]	China	Investigate the features, acceptance, and initial impact of the cloud SYSUCC application during COVID-19 outbreaks for remote drug consultation, drug distribution services, and home delivery	Several types of cancers, including lung cancer	Real-time remote oncology pharmacy Medication consultation Drug dispensation Home delivery service Mobile based	Store and forward	A private cloud connects the public cloud-based hospital information system using a web services Internet tool Hospital-based mobile app called Cloud SYSUCC that enables remote medication consultation between doctors and patients, based on Android and iOS mobile operating systems Prescriptions are verified by an automated drug rationality review system integrated into the cloud-based hospital information system	Patient–medical staff (treating doctors and clinical pharmacists)
2	Snyder <i>et al.</i> ^[26]	USA	To perform yoga activities, a comparison of face-to-face and videoconferencing was made during the outbreak	Several types of cancers, including thoracic cancer (NSCLC-stage III)	Videoconferencing delivery of yoga interventions Mobile based	Real time	Identify the modality (FaceTime or Zoom) via laptop computer or phone	Patient–family caregiver dyads–certified yoga therapists
3	Narayanan <i>et al.</i> ^[27]	USA	Investigate and compare integrative oncology consultations performed via videoconferencing in 2020 to face-to-face consultations performed in 2019	Several types of cancers, including lung cancer	Integrative oncology consultations (videoconferencing)	Real time	Using Zoom as the communication platform All appointments were scheduled and accessed through the EPIC electronic health record	Patient–integrative oncology physicians
4	Marinis <i>et al.</i> ^[28]	Italy	Screening for lung cancer patients using e-mail and telephone triage as a preventive measure to identify patients with suspected COVID-19 symptoms	NSCLC	Social media Telemedicine and telephone triage for screening patients Telematic consultation by phone or e-mail	Real time/ store and forward	Replacement of follow-up visits with e-mail or phone call and telematic evaluation of CT scan imaging in the absence of urgent medical needs	Patient–medical oncologists
5	Pardolesi <i>et al.</i> ^[20]	Italy	Management of patients with lung diseases – report the initial experience of the SmartDoc Project, a telemedicine program during the COVID-19 pandemic in Italy	Lung cancer	Videoconsultation: -New visits -Second opinions -30-day postsurgery controls -Long-term follow-up	Real time/ store and forward	-The workstation included a Surface Pro laptop and a dedicated Microsoft Teams account to perform video meetings -Patients could upload and send images and clinical files for practitioner evaluation via a dedicated WeTransfer link - Clinical documents were sent via traditional mail service	Patient–physician

COVID-19=coronavirus disease 2019, CT=computed tomography, NSCLC=non-small cell lung cancer

yoga therapists. Yoga therapy is one of the ways of self-care followed by these people. Narayanan *et al.* used a videoconferencing system to interact with oncology specialists who practice integrative medicine with cancer patients. Integrative oncology consultations covered topics such as healthy lifestyles, nonpharmacological therapy, and answering questions about integrative modalities.^[27] In the study of Marinis *et al.*,^[28] oncologists used e-mail and phone triage to take preventative and containment measures for NSCLC patients at risk of infection by COVID-19. Oncologists should assess tumor histology, disease state, clinical conditions, and disease load, as well as expected benefit, toxicity, and response to planned or ongoing treatment. Pardolesi *et al.*^[20] presented the results of using a telemedicine program called SmartDoc Project in an Italian cancer center during the beginning of the COVID-19 pandemic. Physicians in this program used the Microsoft Teams platform to conduct online video consultations with patients. Also, patients could upload and send images and clinical files for practitioner evaluation via a dedicated WeTransfer link. According to their study, teleconsultation is an effective method that can be used in place of face-to-face consultations.

Lung cancer is the main cause of death in both sexes, according to the World Health Organization (WHO) estimations for 2019, with males having the highest prevalence of lung cancer in China. Lung cancer incidence and mortality rates are three to four times higher in transitioned countries than in transitional ones.^[31] Pang *et al.*^[32] demonstrated in a review study that the USA and China are paying attention to the use of telemedicine for lung cancer patients. Our findings, in line with these studies, reveal that three transitioned countries (the USA, China, and Italy) are devoting special attention to the use of telemedicine in cancer diagnosis and therapy during the COVID-19 outbreak, owing to their health-care policies or infrastructure.

Three studies^[25-27] are concerned with telemedicine systems that have been utilized to address a wide variety of cancers, not just lung cancer. One of the cancers addressed in these articles is lung cancer. Interactions between various parties of the health-care system are developed in order to deliver medical services to lung cancer patients. Patients and patient-family caregiver dyads were on one side of the interaction, while medical staff (treating doctors and clinical pharmacists,^[25] certified yoga therapists,^[26] integrative oncology physician,^[27] and medical oncologists^[28]) were on the other side.

Telemedicine makes use of a variety of technologies, such as cloud, mobile, communication, and Internet of Things (IoT).^[33] In included studies, telemedicine systems have used these technologies to deliver real-time

counseling. Physicians were able to provide medication consultation to patients, thanks to messaging in mobile and cloud-based app.^[25] The app connected the private cloud-based hospital information system to the public cloud-based hospital information system via a web services Internet tool. Prescriptions are verified using an automated drug rationale review system integrated into the cloud-based hospital information system.^[25] Patient-family caregiver dyads and certified yoga therapists used FaceTime or Zoom as videoconferencing platforms via laptop and phone in order to undertake yoga activities.^[26] Oncology Physicians employed Zoom as a communication platform for videoconferencing technology-integrated oncology consultations. The EPIC electronic health record was used to schedule and access all appointments.^[27] Medical oncologists employed social media and telematic consultations via phone or e-mail to screen their patients. They replaced face-to-face follow-up visits with e-mail or phone calls, as well as telematic evaluation of computed tomography (CT) scan imaging.^[28] As a result, the usage of new technologies such as mobile and cloud can aid in the patient-physician communications.

Limitations

This review has a number of limitations. Due to the exclusion of non-English language publications, some related studies may have been ignored. The quality assessment of the included articles was not performed in the current study for the following two reasons: a) unlike systematic reviews, quality assessment of the included articles is optional in scoping reviews and b) “we did not want to overlook any attempts in the field.

Conclusion

The current study was conducted due to the vulnerability of lung cancer patients during the COVID-19 pandemic, and also, due to the lack of a thorough study that analyzes existing telemedicine systems in terms of technology and feature aspects. The priority of telemedicine is to provide health-care services to patients at their homes as well as to enable communication between the physician and the patient in order to provide real-time counseling. The advent of technologies such as cloud and mobile has resulted in the deployment of real-time communication applications. The findings of this study revealed that telemedicine in COVID-19 for lung cancer patients is still relatively unexplored, and that few studies have been conducted in this area. During the COVID-19 pandemic, there are still numerous services available for patients with lung cancer, for whom the system has not been designed and implemented. Unfortunately, one important sort of interaction, physician-physician interaction, was not observed in the included studies, despite the fact that this type of interaction is essential and commonly used

by physicians to provide expert consultation for a specific patient. As a result, health researchers, policymakers, and developers should pay close attention to this issue.

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Conflicts of interest

There are no conflicts of interest.

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