

# Digital Innovations in Pneumonia Care: A Mini Review

Snehasish Tripathy<sup>1</sup>, Sapna Negi<sup>2</sup>, Ankita Mathur<sup>3</sup>, Vini Mehta<sup>4\*</sup>

<sup>1,2,3,4</sup>Dr. D. Y. Patil Dental College and Hospital, Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune, India

DOI: 10.55489/njcm.150420243745

## ABSTRACT

**Introduction:** Pneumonia is a severe respiratory disease threatening public health and requires timely and accurate diagnosis and early intervention for effective treatment. The emergence of telemedicine during COVID-19 has offered new solutions to solve health problem. This review examines recent studies focusing on effectiveness of telemedicine intervention in pneumonia care.

**Methods:** We systematically searched five databases to retrieve original research that addressed telemedicine's use in pneumonia diagnosis, treatment, monitoring, or patient assistance. Two independent reviewers performed screening to confirm alignment with inclusion criteria. The findings were synthesised narratively.

**Results:** A total of five studies were included in the review. The interventions across studies were telephonic follow-ups, Smartphone-based algorithm for diagnosing pneumonia, telemedicine set-up at patients' homes and Interactive videoconferencing. The findings suggest that telephone consultation is effective for patients with low-risk respiratory infections and may be more effective in early diagnosis of pneumonia patients.

**Conclusion:** The planning for work in telemedicine, whether in regulations or private practice, is necessary to ensure the quality, safety, and consistency of telemedicine practices. The use and availability of telemedicine services, especially in rural areas and on mobile phones, must be expanded to reduce problems in the region.

**Keywords:** Pneumonia; telemedicine; telehealth; digital innovations; mini review

## ARTICLE INFO

**Financial Support:** None declared

**Conflict of Interest:** None declared

**Received:** 21-01-2024, **Accepted:** 04-03-2024, **Published:** 01-04-2024

**\*Correspondence:** Dr. Vini Mehta (Email: vini.mehta@statsense.in)

**How to cite this article:** Tripathy S, Negi S, Mathur A, Mehta V. Digital Innovations in Pneumonia Care: A Mini Review. Natl J Community Med 2024;15(4):327-331. DOI: 10.55489/njcm.150420243745

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www.njcmindia.com | pISSN09763325 | eISSN22296816 | Published by Medsci Publications

## INTRODUCTION

Pneumonia is a severe respiratory disease threatening public health and requires timely and accurate diagnosis and early intervention for effective treatment.<sup>1</sup> The World Health Organization (WHO) reported that there were 7,40,180 cases of pneumonia in 2019, accounting for 14% of all deaths among children under five years of age globally.<sup>2</sup> Pneumonia is characterised by inflammation of the air sacs in the lungs and is caused by bacteria, viruses, or parasites.<sup>1</sup> It causes symptoms such as cough, chest pain, fever, and difficulty breathing, and if left untreated, it often leads to severe complications and death.<sup>3</sup> In addition, this infectious disease's outcomes become worse in Covid-19 disease.<sup>4</sup> This highlights the importance of more robust healthcare services to reduce the spread of disease while providing the care they need. The World Health Organization warns of the global impact of pneumonia and the need for a better way to deal with the problem.<sup>5</sup>

In the face of these challenges, the emergence of telemedicine is a sign of hope, offering new solutions to solve health problems. Telemedicine has become a cornerstone of the fight against COVID-19, providing remote counselling, patient care, and psychological support to those affected by the disease.<sup>6</sup> Telemedicine is an integrated healthcare system that uses communication and technology to provide healthcare services remotely. The system helps increase the doctor's consultation time and enables the patient to be evaluated effectively by monitoring his disease without commuting to health facility and losing productivity hours.<sup>7,8</sup> In the case of pneumonia, pharmacies are being studied to conduct research and provide remote care and professional advice, especially in rural areas where medical device use is restricted.<sup>9,10</sup> This review examines recent studies focusing on phone monitoring, mobile phone use, home networking, and telephone conversation. Collectively, these studies demonstrate the effectiveness of telemedicine in diagnosing, monitoring, and treating lung disease and provide insight into its potential to transform lung disease.

## METHODOLOGY

We did a systematic literature search for publications about telemedicine interventions for remote management of pneumonia patients to explore telehealth's contribution to pneumonia care thoroughly. We searched five databases (PubMed, Embase, Scopus, IEEE and Google Scholar), restricting our search to papers published in English. From 1970 until September 20th, 2023, the search used the phrases (Telemedicine OR Telehealth OR E-Health) AND (Pneumonia OR Pneumonitis OR Pneumonitides OR Pneumonias). Articles were chosen based on relevance and included original research that addressed telemedicine's use in pneumonia diagnosis, treatment,

monitoring, or patient assistance. Duplicate papers were eliminated, and two independent reviewers checked titles, abstracts, and full texts to confirm alignment with inclusion criteria. The findings synthesised from selected papers provide a detailed overview of the present landscape of telemedicine in pneumonia care.

## RESULTS & DISCUSSION

A total of five studies were included in the review, the details of which are presented in Table 1. The results from these studies are presented under the following two themes.

### Telephonic Follow-ups for Early Detection

Diez et al.<sup>11</sup> conducted a prospective cohort study in Spain explored telephonic follow-ups for patients with SARS-CoV-2. The study conducted during the first wave of COVID-19 showed that cell phones in medical facilities were less effective at diagnosing pneumonia in SARS-CoV-2 patients. Remote care excludes patients without severe symptoms, focuses on those requiring hospitalisation, and has hygiene products available. Moreover, the tracking system supports the annual evaluation of patients in the hospital and helps improve their treatment.

This study highlights the importance of telemedicine, specifically telemedicine, in managing public health problems such as COVID-19. Additionally, the study shows that continued efforts are needed to create effective partnerships and ensure a comprehensive relationship to improve the quality and use of cleaning services. It is essential to evaluate the effectiveness and safety of self-care and telemedicine. There is a need for continued research and development in telemedicine technology to meet the medical needs of patients and doctors.

The article by Porter et al., 2021<sup>12</sup> discusses developing and testing a smartphone-based algorithm to diagnose community-acquired pneumonia (CAP) without needing clinical or radiological referral. CAP is a respiratory disease that can be difficult to diagnose accurately, especially during telemedicine sessions when a specific diagnosis cannot be made. This study developed a system that identifies cough sounds and symptoms to enable rapid and accurate diagnosis of CAP. The algorithm was developed and tested in a large hospital in Western Australia. The per cent agreement with the diagnosis (PPA) was 86.2%, and the per cent negative agreement (NPA) was 86.5%. Its accuracy is based on age groups and CAP severity, making it a reliable tool for diagnosing CAP in many clinical settings. The algorithm can detect CAP without physical or electronic testing, making it useful for mobile services to solve problems caused by the COVID-19 pandemic and quickly switch to digital regulation. Early diagnosis and treatment results may lead to earlier treatment of CAP, reduced complications, and better use of antibiotics.

**Table 1: Summary of the studies included in the review**

Author and Year of Publication	Country	Study Design	Technology Used	Major Finding
Diez et al. 2021 <sup>11</sup>	Spain	Prospective cohort study	Telephonic follow-ups.	The 14-day follow-up was completed in 430 patients (99%), with 1798 calls performed. Telephone follow-up by a primary healthcare center was effective to detect SARS-CoV-2 pneumonias and to monitor related complications.
Porter et al. 2021 <sup>12</sup>	Australia	Prospective cohort study	Smartphone-based Algorithm for diagnosing CAP.	The smartphone-based algorithm had high percentage agreement with the clinical diagnosis of CAP in the total cohort.
Eron et al. 2004 <sup>13</sup>	USA	Case-control study	Telemedicine set-up at patients' homes.	Patients treated with telemedicine have satisfactory clinical outcomes, and their recovery appears to be more rapid than comparable hospitalized patients. Telemedicine in the home results in considerable savings by averting or shortening hospital stays.
Assimacopoulos et. al. 2008 <sup>18</sup>	USA	Retrospective, comparative review of medical records	Interactive video-conferencing	Patients treated via telehealth had fewer days on antibiotics and fewer days hospitalized than patients treated via in-person intervention.
Accorsi et. al. 2022 <sup>19</sup>	Brazil	Randomized, unicentric study	Brief telemedicine	Diagnostic telemedicine consultation of low-risk patients with acute respiratory symptoms is not inferior to face-to-face evaluation at emergency department. Telemedicine is to be reinforced in the health care system as a strategy for the initial assessment of acute patients

Community-acquired pneumonia (CAP)

### Telemedicine and Telehealth Consultations

The research article by Eron et al.<sup>13</sup> evaluated the use of telemedicine at home in the treatment of patients with serious diseases such as community-acquired pneumonia (CAP), skin and soft tissue infections (SSTI), urinary tract infections (UTI), and bacterial endocarditis. (BE). The study aims to increase the efficiency of hospital beds by providing treatment to patients who need it in their environment, thus avoiding hospitalisation. Patients were selected based on specific criteria, including appropriate home environment, caregiver support, and willingness to self-administer antibiotics. Telemedicine systems transmit video, audio and high-quality data from the patient's home to a central location, allowing doctors to monitor the patient's condition. The study identified three stages of patient recovery: initial stabilisation, improvement, and final stabilisation. Since appropriate antibiotic treatment can resolve many infections over time, patients can be discharged early, even with a fever. Telemedicine systems monitor patients, allowing doctors to assess their health status and take appropriate measures. On-call patients receive the same treatment as hospitalised patients but return to their daily routine more quickly.<sup>14</sup> Telemedicine systems are very efficient and can save hospitals much time.

However, the research revealed many problems,

such as economic problems, agreement between the patient and the doctor, lack of insurance reimbursements and legal problems. Similar barriers are reiterated by previous researches too towards implementation of telemedicine.<sup>15-17</sup> Despite promising results, patient length of stay demonstrates the need to realise the vision for greater acceptance of telemedicine. In addition, the clinical challenges related to telemedicine products were identified, comparing the current situation with the first days of parenteral antibiotic therapy (OPAT), which has become a standard of care with good results.

Pilot trials have demonstrated home telemedicine's effectiveness and benefits in treating infectious diseases. Although the study had some limitations, including a small sample size and lack of randomisation, it provided significant insight into the use of telemedicine in the management of outpatient procedures. The authors emphasise the need for more extensive studies on various needs to validate the findings and promote telemedicine at home as a standard of care. Assimacopoulos et al.<sup>18</sup> retrospectively analysed 107 medical records to evaluate the effectiveness of medical technology in managing infectious diseases in patients with influenza and pneumonia. Assimacopoulos et al.<sup>18</sup> compared patients treated by specialist physicians in private hospitals with those treated by telemedicine in significant cities' hospitals. They found that patients who

received telemedicine used fewer antibiotics and had shorter hospital stays compared to in-person interventions. Survival rates were similar between groups, but patients required transfer to the intensive care unit. The study concluded that IDS treatment is only effective when administered in person. At the same time, communication technology treats infectious diseases promptly and effectively, especially in rural areas.

This study was conducted by Accorsi et al.<sup>19</sup> conducted a comparative trial comparing ubiquitous face-to-face telemedicine evaluation of patients with respiratory tract infection (RTI) during the COVID-19 pandemic. The trial was conducted between September and November 2020 and included 98 low-risk patients evaluated in the emergency department (ED) with symptoms of acute IRI. Patients were assigned to face-to-face evaluation (TM-ED group) or face-to-face evaluation (ED group), followed by a brief interview.

The primary purpose is to compare the accuracy of telephone interviews with face-to-face assessments. One study found that on-site evaluation of low-risk patients with respiratory symptoms was faster than on-site evaluation in the emergency department. Telephone interviews were rapid (5 minutes and 30 seconds on average), and patients received appropriate treatment based on drug testing.<sup>19</sup> There were no significant differences between the telemedicine and control groups in final diagnoses, orders, ED visit times, or prescriptions.

Overall, the study found that telephone consultation is effective for patients with low-risk respiratory infections and may be more effective in early diagnosis of pneumonia patients, especially compared to face-to-face emergency telephone screening during COVID-19 disease. It is essential and effective to reduce ED infections and the impact of the infection.

## CONCLUSION

A comprehensive review of these studies was conducted to identify changes in telemedicine in lung care. Telemedicine offers a complete solution, from early detection and accurate diagnosis to effective treatment and reduction of hospital stays. However, issues such as cost, availability and comparative effectiveness remain. Future research should address these issues by increasing equity in global healthcare. As technology advances, telemedicine is expected to revolutionise lung care, ultimately improving patient outcomes and shaping the future of healthcare.

## RECOMMENDATIONS

The planning for work in telemedicine, whether in regulations or private practice, is necessary to en-

sure the quality, safety, and consistency of telemedicine practices. The use and availability of telemedicine services, especially in rural areas and on mobile phones, must be expanded to reduce problems in the region. There should be expanding international collaboration and conducting long-term studies to evaluate the impact of telemedicine.

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