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# "Potential Mobile Application and Integrated Device for Measuring Respiratory Function": A Systemic Review

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**KEYWORDS**

mobile application for respiratory function, respiratory disease, pulmonary rehabilitation, COPD, physical activity

**ABSTRACT:**

**Background**: Individuals with respiratory problems must participate in a rehabilitation program to enhance their quality of life and learn how to self-manage their illness at any age.

The addition of low to moderate-intensity daily physical activity increases fitness and respiratory muscle endurance.

Some specifications were found for a smartphone application allowing patients to receive automated feedback and remote help while exercising. Applications for mobile phones that track, help, and document fitness metrics have emerged as a practical and useful intervention.

**Method**: We looked through PubMed, Web of Science (SCI), Research Gate, Cochrane Library, and Google Scholar for pertinent papers released in the last 10 years, from 2012 to 2022.

Finally, this analysis included publications containing randomised controlled trials (RCTs).

**Result:** Very a small number of studies are available on the usage of mobile phone applications and innovative devices to access respiratory function.

## 1. Background

With the advancement of technology, the ease of access to healthcare facilities has been improved effectively. Several smartphone-based devices can be used to assess, record, interpret as well and modify the individual's rehabilitation program. [1,2]

For example, the QUT Inspire app for smartphones uses the microphone embedded in the device to identify inspiratory sounds when the device is held close to the lips (5 cm or less).[3,4]

Another wearable device using three surface electrodes, Zigbee, detects cardio-pulmonary parameters such as heart rate, R wave and inspiratory rate. [5]

Exhale Sense may identify forced exhalation attempts on smartphones using audio-time series data, differentiating between high-fidelity and low-fidelity efforts, and estimating lung obstruction, according to research.[6]

A different study has demonstrated that a person's vocal qualities are impacted by an obstruction in their respiratory airways. It was discovered that speech-based spirometry, or Speech Spiro, has the ability to monitor a person's condition using a smartphone by doing the lung function assessment without the need for a separate device.[7]

However, with the advancement in technology nowadays, management techniques are improvised. The major advantage of smartphone-based devices is their convenience. Also, these applications provide the patient ease of access to healthcare facilities as fast as possible. Moreover, mobile health applications are considered multifunctional media to review current health data,

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share information, and modify the intervention program accordingly.

## 2. Aim And Objectives

The present systematic review aims to come up with a refurbished evidence collection that includes the most published trials up to date for the use of innovative devices and mobile phone applications to access respiratory function. [1,2,3]

## 3. Methodology

sources of data and searches Using the databases from PubMed, Web of Science, the Cochrane Library, Research Gate, Science Direct, and Google Scholar, a language-neutral literature search was conducted to find possibly eligible studies published before 2012 to 2022 (the previous ten years). It searched through all of the abstracts, keywords, and titles using our search parameters.

In cases where there had been doubt, the whole papers were also examined. To find more relevant studies, the references of the collected papers and review articles were also manually examined. Inquiries for more details were even made to a few authors.

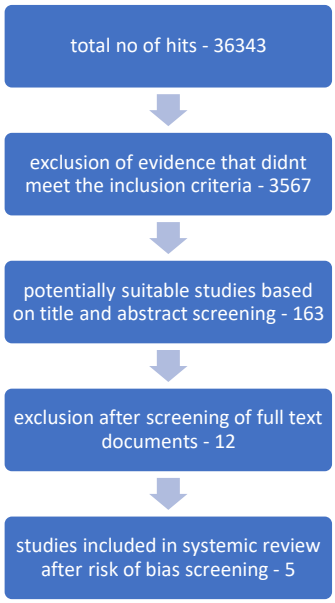


**Figure:** Flow chart for methodology

## 4. Criteria For Selection

| Inclusion Criteria | Exclusion Criteria |
|---|---|
| • Published by peer-reviewed journals Design RCT<br>• Articles from 2012 to 2022 | • Plagiarized or unethical studies<br>• Studies including conditions other than respiratory conditions |

*In a pulmonary rehabilitation setup, 25 cardiopulmonary patients completed 6-minute walk tests, according to the research. With customized software, they recorded phone motions while carrying smartphones in their pockets. Spirometry was used to measure the pulmonary function of each patient. After that, a universal model built on a support vector machine estimated the function category using data from patient demographics and signal processing properties.*

They demonstrated using 6MWT that patients' phones could be used to measure motion features and accurately compute physiological parameters for the health status of chronic respiratory disorders, such as oxygen saturation and gait speed. The computation of pulmonary function based on distinctive movements of health status is the scope of this investigation. Android phones have been used in this experiment. Three stages of the experiment—from technical assessment to passive monitoring—are planned to evaluate the use of cell phones to predict lung function.

According to research in additional sources, the latest mobile phones' e-MEMS microphones are capable of sensing human exhalation's direct airflow and recording it as an indicative signal. The volumetric flow rates of exhalation are required to compute the lung parameters FEV1 and FVC. However, the time and frequency responses of the audio signal can be extracted using arithmetic processing techniques, and subsequently, a model can be developed that relates characteristics of the recorded human exhalation by the mobile microphone and the actual flow rate.

A mobile device to record the airflow, a gadget to monitor the actual flow rate, and a source of airflow make up the setup. The Dyson AM06 fan serves as the airflow source. This fan, which is 30 cm large and has 10-speed settings, is bladeless and is believed to provide a speed-stable airflow. [8]

Fibre optic sensors are a particular type of sensor that was developed in 2007. Smart textiles that utilize fibre optic sensors have demonstrated positive results in the

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respiratory monitoring field. Particularly, by integrating the sensing elements into patches or clothing, fibre Bragg grating (FBG) sensors are utilized to track the respiration rate. [9]

For measuring physical activity, ***accelerometers*** that register movement using body-fixed motion sensors are the best option. Their application is predicated on established correlations between energy expenditure and accelerometer output for ergonomics and gait research. Most data are obtained from miniature accelerometers, which may be used to measure physical activities including riding, walking, jogging, and exercising. They can also be used to identify sedentary time and differentiate between various postures by sensing the acceleration of gravity. [10]

***SPIROSMART***, With SPIROSMART, a mobile application, a physician may precisely determine the amount of flow passing through the trachea and vocal tract based on resonances in the signal. This information is crucial for improving respiratory function.[11]

By blowing into a handheld device along with an Android smartphone's microphone, a person can get an initial assessment of how their lungs are functioning or monitor a lung disease. The Chulalongkorn University Faculty of Science and Faculty of Medicine developed "Lung Care," a mobile application to test the overall lung performance. People who smoke a lot, those who work in cement factories, and those who make chemicals can use this app anywhere, at any time.

## 5. Result

In this study out of 36343 articles, 5 articles were selected and their results showed

| **Author** | **Sample Size And Level Of Evidence** | **Outcome** | **Conclusion** |
|---|---|---|---|
| Eric C Larson et al. (2012) | 52 SUBJECTS, 1b | Lung function: FVC, FEV1, FEV1/FVC, PEFR | Spiro smart can be used to diagnose varying degrees of obstructive lung disease. |
| Lonneke boer et al. (2019) [12] | 43 SUBJECTS, 1b | 1. A computerized telephone questionnaire method to track weekly respiratory symptoms and treatment practices; exacerbation-free interval, measured in weeks without an exacerbation.<br>2. health state, usability, self-management practices, self-efficacy, and use of medical services. | COPD patients who prefer to use a digital tool rather than a paper action plan might realize that a mobile health tool is a useful and effective substitute. |
| Sigrid N W vorrink et al. (2016) [13] | 121 SUBJECTS, 1b | 1. The MF-SW small armband or SenseWear PRO were used to assess physical activity.<br>2. A modified six-minute walk test<br>3. Quality of life about health<br>4. Body Mass Index | Following a period of pulmonary rehabilitation, functional exercise capacity did not decrease, and the mHealth intervention did not increase or sustain physical activity in COPD patients. |
| Hee Kwon et al. (2018) [14] | 85 SUBJECTS, 1b | 1. forced expiratory volume in 1 second<br>2. Results of the COPD Assessment Test (CAT) | To improve patient health outcomes, a mobile rehabilitation application for COPD assessment and |

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| | | | |
|---|---|---|---|
| | | 3. 6MWT<br>4. Self-reported dyspnea evaluation | management can either replace or supplement conventional centre-based rehabilitation programs. |
| Haitham Saeed et al. (2020) [15] | 371 SUBJECTS, 1b | Lung function: FVC, FEV1, FEV1/FVC, PEFR | Compared to using traditional verbal counselling in the pressurized meter dose inhaler approach alone, using a training device with a smartphone mobile application produced significant gains in asthma control. |

## 6. Discussion

Research indicates that while smart mobile phone-based health applications for self-management may help patients with COPD avoid hospital visits and increase their ability to exercise, they may not decrease the average number of days spent in the hospital.

Patients with COPD found certain smartphone apps to be very simple to use and understand. As an intervention, it might be more practically possible to evaluate respiratory function.

According to several researchers, they are a straightforward, dependable, user-friendly, and affordable behaviour modification tool that has advantages over other smart electronic devices, including increased patient willingness to use and adherence to the interventions.

Smart application has higher accuracy, gives positive biofeedback, save data for future reference, and the patient can send data directly to the therapist or physician which can help them to reduce frequent laboratory visits and give an early alarming sign. From direct data, a physician or therapist can plan out their treatment sessions more efficiently.

## 7. Conclusion

The engineering work required to create wearable sensors and systems was prioritized during the first ten years of wearable technology research; more recently, studies have concentrated on the use of this technology to monitor health and wellness.

The past ten years have seen the development of enabling technologies, which place a strong emphasis on surveying research on the use of wearable sensors and systems in the context of real-world clinical applications, with a primary focus on rehabilitation.

As a result, a lot of effort has been put into integrating wearable technology with communication and data analysis tools to accomplish the objective of remotely monitoring people in their communities and at home. Additionally, researchers and doctors have included ambient sensors in remote monitoring systems when monitoring has been done at home. Additionally, we have seen an increase in interest in the newly recognized necessity of setting up telepresence in the house to carry out clinical interventions.

The pursuit of remote monitoring of elderly patients and patients receiving therapeutic procedures will soon require the development of business models that reimburse expenses and determine ways to compensate for the technology and its administration. To ensure that wearable sensors and systems remain up to the promise of enhancing the quality of care given to older adults and subjects affected by chronic conditions through remote monitoring of wellness and health in the home and community settings, we believe that resolving costs and reimbursement issues will be crucial.

The older age group population who generally suffer from respiratory diseases find these devices and applications very useful because it gives alarming sign before, during or after any minor changes in the respiratory mechanism.

## CONFLICT OF INTEREST

None

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