

Development of a low cost vibrating vest for use as an airway clearance device in children with bronchiectasis

Introduction

Bronchiectasis refers to an irreversible air way dilation that involves the lung either in a focal or a diffuse manner. It serves as the final result of multiple modes of pulmonary insults ranging from genetic disorders, infections to autoimmune disorders and as such has a significant global prevalence of 680 per 100000 population (1). This condition places a significant economic burden on the society due to increase in all cause physician visits and management (2). Literature on the prevalence of this condition in India is scarce prompting the setting up of a registry with multiple locations to delineate the clinical characteristics and outcomes of our population (3). Treatment of bronchiectasis involves a multipronged approach including 1) antibiotic therapy, 2) anti-inflammatory medications, 3) immune modulation, 4) air way clearance techniques (ACTs), and 5) nutritional interventions. Airway clearance techniques are a mainstay of therapy for conditions that are associated with an increase in airway secretions and consists of various methods that help in the mucociliary clearance and gas exchange (4). Some of the methods used include 1) postural drainage, 2) chest percussion, 3) positive expiratory pressure (PEP) devices 4) high frequency chest wall oscillation (HFCWO) and 5) general exercise and physical activity (5).

Children with bronchiectasis present unique challenges because of their smaller airway calibre and predisposition to develop frequent respiratory infections. Untreated, there is risk of falling lung function over the years and with prompt treatment there is an opportunity to fully reverse the bronchiectasis unlike in the adults, especially when they are mild (6)

HFCWO is a personalised, easy to use mechanical method of airway clearance that utilises a series of air inflation and deflation in quick succession capable of generating an oscillating impulse which helps to loosen the airway secretions and promotes drainage. It is proven to be non-inferior to other methods (7). It has been advocated due to its convenience and effectiveness and might be of value especially in children who have difficulty in cooperating with respiratory therapists for airway clearance. However, due to its high-cost majority of the people who need it rarely get access to the same. This study aims to make a simple low cost vibratory vest which can help in achieving good airway clearance and prevent lung function decline.

Objective

Primary objective- To build a working, affordable and easy to use model of a vibratory vest for airway clearance in children with bronchiectasis.

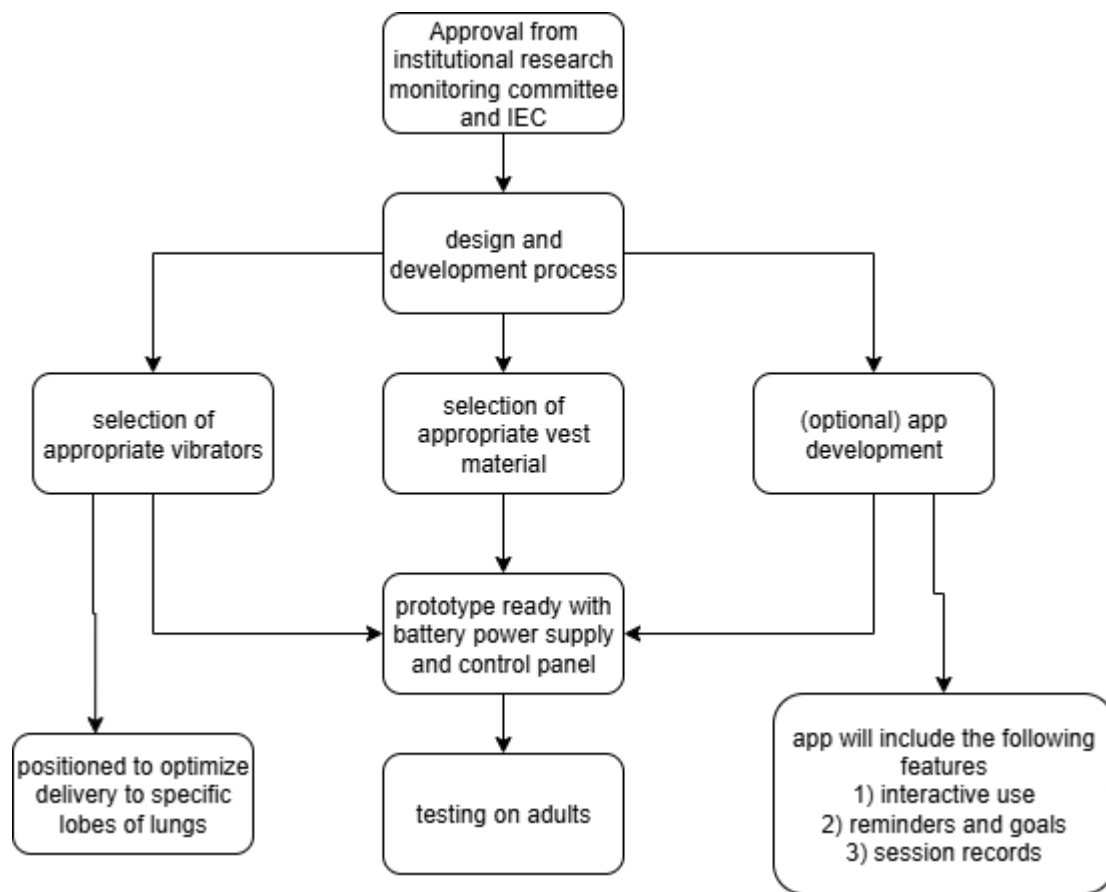
Methodology

After approval from institute research monitoring committee and Institute ethics committee, vests of different sizes (infant, toddler, pre-schooler, primary school years, middle school years, high school years and higher secondary years) will be stitched as a double layered front open jackets with adjustable Velcro tapes to help in approximation to the chest wall. The material will be chosen in such a way to be hypo-allergenic, durable, breathable and washable. Pockets will be made between the two layers to house a direct current vibratory motor with its wiring. The pockets will be designed in such a way that it houses individual motors one each anteriorly for each of the lung lobes with additional posterior motors for upper and lower lobes. The power supply will be provided by a battery source with a panel system for operating the motors either individually or in unison. If possible a mobile app will be created

for interactive use of the vest device which can offer unique user experiences, set reminders and goals for each session as well as to keep a record of the number of airway clearance sessions performed by the individual.

The safety of this device will be tested on healthy adult volunteers for variable time periods. The effectiveness of this device will be tested by using the same on willing adult volunteers with bronchiectasis once it is made sure that there are no safety concerns. After successful tests on adults, we will extend the testing to adolescents and then on to children of younger age groups. If they are found to be successful, patent will be applied for the device.

Schematic line diagram depicting the project idea



Expected Ethical Issues

As there will be intervention in the form of using a device especially on children who constitute a vulnerable age group, the risk involved is more than minimal risk. However due precautions will be followed by having safety check at multiple levels before being used in children.

Implications

A successful working model of the vest will enable children with bronchiectasis or any condition where there is a tendency for retained respiratory secretions to have an exacerbation free healthy lung life and ultimately lead a qualitatively better life.

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