BEP PROPOSAL

Aerosol treatment efficiency and deposition

Team VERO

Aerosol treatment during the COVID-19 pandemic

It is considered a worldwide threat that the SARS-CoV-2 virus could be transmitted through aerosol. Therefore, it might be dangerous to use aerosol producing therapies e.g. nebulization treatments. During the COVID-19 pandemic the pressure on hospitals and pulmonologists increased and led to a decrease in health care quality. In many regions the use of aerosol generating procedures have either stopped or are only performed under strict conditions. One of the aerosol generating procedures is nebulization treatment. Nebulization treatment is harder to administer properly to children due to their tendency not to cooperate, therefore nebulization masks are used. These masks vent bio-aerosol and medical aerosol through ventilation holes into the environment. High concentrations of aerosols are generally present and are evidently inhaled by clinician and parents in that room. This is normally not considered a significant problem, as the dose of medication that is inhaled is considered low. However, the potential danger of COVID-19 being spread through aerosols demands optimization of the nebulization therapy, such that the treatment would become more efficient for the patient, and safer for patients, healthcare personnel and bystanders.

Project description

Aim

This research project focuses on investigating and improving the efficacy of aerosol treatment for several nebulizing systems. This is approached by comparing several commercially available nebulization masks and systems, and measuring the delivered aerosol in a model patient. Eventually, this results in a recommendation of the best performing systems to the problem-owner.

An experimental setup including a lung simulator has been created during the first months of the pandemic. It is located in Vertigo on TU/e campus, and available for this project. The setup uses an aerosol monitor that counts aerosol particles to analyze aerosol deposition and size distribution in the lungs.

Methods

- Improve or adjust an experiment proposal, delivered by Team VERO,
- create a procedure to make a base measurement for airborne particles,
- streamline the experimentation procedure to deliver results quickly,
- perform experiments using face models for 3 age categories in the lab,
- perform appropriate data analysis, e.g. create a time dependent histogram of airborne particles,
- use literature or simulations to convert this histogram to effective aerosol deposition in the lungs

The above project is suitable for BEP projects with an approximate workload of 140 hours (10ECTS) distributed over Q1&Q2, or condensed in either Q1 or Q2. It could be roughly divided into 2 weeks of literature research, 5 weeks of experimental work (approx. 15 hours a week), 2 weeks of report writing and 1 week to prepare a presentation, however this is for the student to decide and plan properly.

Alternatively, the project may be adjusted or extended to make it suitable as internship of final master project. Depending on the student's discipline/home department, potential extensions may

involve reproducing realistic breathing behaviour of patients of various ages, actual prototyping of new products, or performing measurements on actual persons in (semi)clinical settings.

Deliverable

- The methods are formulated in SOPs (Standard Operating Procedures), such that they can be repeated by others after the project ends.
- Introduction with background literature, methods, results, discussion and conclusions are delivered in a written report. In agreement with the departmental requirements, they may also be orally presented and defended.

Cooperation and guidance

The student will be part of Team VERO, an interdisciplinary team of students and alumni from the TU/e and other universities across the Netherlands. This team started a challenge provided by the problem-owner, Dr. Hettie Janssens paediatric pulmonologist at Erasmus MC/Sophia Children's Hospital, working on enhancing the quality of nebulization therapy.

In addition, it is the responsibility for the student to find a departmental supervisor, to ensure the disciplinary requirements are met. This supervisor will finally grade the student. It is advised to inform the departmental exam committee beforehand of the nature of the project.

Contact

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