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A study to develop a computer model for measuring how a drug is distributed in the lungs

Submission date
24/08/2026

Recruitment status
No longer recruiting

Registration date
27/08/2026

Overall study status
Completed

Last Edited
27/08/2026

Condition category
Respiratory

[ ] Prospectively registered
[ ] Protocol
[ ] Statistical analysis plan
[ ] Results
[ ] Individual participant data
[X] Record updated in last year

Plain English summary of protocol

Background and study aims
The purpose of this study is to generate lung deposition data from various populations i.e., healthy volunteers, patients with asthma and patients with chronic obstructive pulmonary disease (COPD) to support the building of a computer model/simulation which can be used to assess the effectiveness of different inhaler technologies used in the treatment of various lung conditions such as asthma and COPD. The overall intention of the study is to generate this data such that this computer model may be used in future to allow developers of new inhaler technologies to be able to predict how effective their technology will be in delivering the study drug to the desired areas in the lungs without the need to conduct extensive clinical trials. This has numerous advantages, in particular the ability to use historical imaging data rather than having to expose research participants, and the ability to test multiple different variations of the inhaler technology and drug delivery method with relatively little additional financial burden.

Who can participate?
The study will consist of 15 participants: 5 healthy volunteers, 5 patients with asthma and 5 patients with COPD. Participants will be male or female aged 21 years and over.

What does the study involve?
The study will consist of a screening visit (in Belgium), a CT scanning imaging visit (in Belgium), three gamma scintigraphy imaging periods (of about 4 days duration combined from Day -1 to Day 3 at Simbec-Orion) and a follow up telephone call 7 days following the last visit. With respect to the conduct of the study, the screening procedures (including CT scanning visit), and follow up telephone call will be conducted by Medimprove BV, based in Belgium with all participants to be screened and recruited in Belgium and the three gamma scintigraphy imaging periods will be conducted at the Simbec-Orion Clinical Pharmacology Unit in the UK.
Each participant will be required to complete three gamma scintigraphy imaging periods which will involve the administration of three different commercially available inhalers. All of the products will be administered via a pressurised metered dose inhaler (pMDI). Across the three periods, each participant will receive:
1. Two actuations of Atrovent® (containing 20 microgram [µg] ipratropium bromide [monohydrate] per dose)
2. Two actuations of Flixotide® (containing 250 µg fluticasone propionate per dose)

3. Two actuations of Bevespi® (containing glycopyrrolate 7.2 µg and formoterol fumarate dihydrate 5 µg per dose)
In order to generate the data required for this study, a technique called gamma scintigraphy imaging will be used. Gamma scintigraphy is a technique which uses a special camera to detect and measure a radiolabelled tracer inside the body. In this case, the three study products will contain a small amount of radioactivity that will allow the drug to be visible in the lungs when the camera is scanning the body. There is a 24-hour interval between each gamma scintigraphy imaging session (these are carried out on three consecutive days).

What are the possible benefits and risks of participating?
Taking part in this study is not expected to provide participants with any direct medical benefit. Possible risks included the following:
The participant's blood pressure and pulse were measured using an inflatable cuff which will be placed on the arm. They may have experienced mild discomfort in the arm whilst the cuff is inflated.
Small sticky pads were placed on the participants' upper bodies before the ECG and an ECG machine measured the electrical activity of the participant's heart. Before the pads were applied, the skin was cleaned. Trained staff may have needed to shave/clip small patches of the participant's hair in these areas. Like Elastoplast® these sticky pads were uncomfortable to remove.
Performing the lung function and breathing tests may cause some coughing, shortness of breath and lightheadedness.
As part of the lung function testing, participants will be required to undergo a lung diffusion test which will measure how well the lungs allow oxygen and carbon dioxide to pass in and out of the blood. For this test, participants may be required to sit in a small chamber known as a body box. This is a small, confined space (roughly the same size as a standard toilet cubicle) and therefore, participants may feel claustrophobic during the conduct of this test. The test may take up to 20-30 minutes to complete and therefore, participants should make the study doctor aware at any time if they start to feel claustrophobic and the test may be stopped.
Participants will have four different types of procedures which will involve exposure to ionising radiation as follows. Participants will have CT scans of the chest on one occasion (requiring three individual sets of scans). These procedures use ionising radiation to form images of the body and provide the study doctor with other clinical information. Additional radiation exposures will be extra to those that participants would have if they did not take part in the study. Ionising radiation can cause cancer many years or even decades after exposure. Given the participants current clinical condition, the likelihood of this happening is extremely low.
The total radiation dose for these scanning procedures is approximately 4.1 millisieverts (mSv), which is a measure of radiation dose. By way of comparison: an X-ray of the spine is 0.38 mSv, a chest X-ray is 0.014 mSv and a transatlantic flight is equivalent to 0.08 mSv. The average annual exposure to ionising radiation from all sources (natural and artificial) in Belgium is 4.5 mSv (https://fanc.fgov.be/nl/informatiedossiers/watradioactiviteit-ioniserende-straling/gemiddelde-blootstelling). The radiation exposure from the CT scan in this study is therefore equivalent to approximately 12 months' worth of background radiation for residents of Belgium. By way of comparison: the average annual dose of ionising radiation in the United Kingdom, from all sources (natural and artificial radiation), is 2.7 mSv (rising to 7.4 mSv for residents of Cornwall).
During this examination, participants will also be exposed to a small amount of radioactivity during the imaging procedure using Krypton-81m gas ventilation, the cobalt-57 transmission scan and the three imaging procedures using inhaled products. During these procedures, participants will be exposed to ionising radiation. The maximum total effective radiation dose participants will receive from all sources during the gamma scintigraphy examination (excluding the CT scans described above) is approximately 0.47 millisieverts (mSv) (where mSv is a measure of the radioactive dose).

By way of comparison, an X-ray of the spine has a radiation dose of 0.38 mSv, a chest X-ray 0.014 mSv and a transatlantic flight 0.08 mSv. As described above, the average annual dose of ionising radiation in Belgium is 4.5 mSv. The radiation exposure from the imaging procedures in this examination is therefore equivalent to 1.25 months of background radiation. By way of comparison, an X-ray of the spine is equivalent to approximately 1 month of background radiation. The dose of radiation participants will receive during this examination is very low. Participation in this study will result in a total radiation exposure of 4.57 mSv. Ionising radiation may cause cancer many years or decades after the exposure. In patients with asthma, COPD or as a healthy volunteer, the chance of this happening to participants is extremely small. We are all at risk of developing cancer during our lifetime. 50% of the population is likely to develop one of the many forms of cancer at some stage during our lifetime. Studies which have investigated this risk estimate that a radiation dose of 1 mSv is equivalent to an additional fatal cancer risk of 1: 20,000. Taking part in this study will increase the chances of this happening from 50% to 50.02% (based upon a combined radiation exposure of 4.57 mSv from the CT scans, Krypton-81m gas ventilation imaging procedure, Cobalt-57 transmission scan and three gamma scintigraphy imaging procedures).
Therefore, the exposure in this study has been assessed and it is considered that the increased risk of participants developing cancer as a result of this exposure is minimal as the exposure is overall equivalent to the annual radiation exposure for individuals living in Belgium.
The treatment might harm the unborn child; therefore, volunteers who are pregnant, breastfeeding or who intend to become pregnant until completion of the post-study follow up telephone call are not eligible to take part. For male participants and female participants (of childbearing potential), they must agree to use a highly effective form of contraception (in addition to a male condom) or an effective form of contraception from one month prior to the screening visit until completion of the post-study follow up telephone call. In addition, for female participants (of childbearing potential) a negative pregnancy result was required prior the start of the study.
Throughout the study the health of the participants will be regularly monitored and appropriate treatment for any medical condition was provided if required. All doctors employed by Simbec-Orion are trained and certified in Advanced Life Support Procedures in order to deal with a medical emergency. Nurses and other clinical staff are also trained in emergency procedures. Simbec-Orion also has an agreement with Prince Charles Hospital for referral of participants if required following a medical emergency.

Where is the study run from?
With respect to the conduct of the study, the screening procedures (including CT scanning visit), and follow-up telephone call will be conducted by Medimprove BV, based in Belgium, with all participants to be screened and recruited in Belgium, and the three gamma scintigraphy imaging periods will be conducted at the Simbec-Orion Clinical Pharmacology Unit in the UK.

When is the study starting and how long is it expected to run for?
August 2026 to September 2026

Who is funding the study?
Fluidda (Belgium)

Who is the main contact?
Hosein Sadafi, hosein.sadafi@fluidda.com

Contact information

Type(s)
Public, Scientific

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Additional identifiers

Integrated Research Application System (IRAS)
359142

Study information

Scientific Title
A prospective study to support validation of computational fluid dynamics based lung deposition models with nuclear medicine imaging methods

Acronym
FLU2025-DMF-CFD-v1

Study objectives
The primary objective of this study is:
1. To establish a reference in-vivo dataset of regional deposition of inhaled products for use in validation of in-silico lung deposition models, based on the characteristics of healthy volunteers, and volunteers with asthma or COPD.

Ethics approval required
Ethics approval required

Ethics approval(s)
1. Approved 16/07/2025, Wales Research Ethics Committee 2 (Health and Care Research Wales Floor 4, Crown Building Cathays Park, Cardiff, CF10 3NQ, United Kingdom; N/A; Wales. REC2@wales.nhs.uk), ref: 25/WA/0193

2. Approved 18/05/2026, EC University Hospital Antwerp (EC University Hospital Antwerp Drie Eikenstraat 655 2650 Edegem (Belgium), Antwerp, 2650, Belgium; +32 3 821 38 97; Ethisch. Comite@uza.be), ref: EC UZA Reference: 7818

Primary study design
Interventional

Allocation
Non-randomized controlled trial

Masking
Open (masking not used)

Control
Active

Assignment
Crossover

Purpose
Treatment

Study type(s)

Health condition(s) or problem(s) studied
Chronic obstructive pulmonary disease (COPD), asthma

Interventions
The purpose of this study is to generate lung deposition data from various populations i.e., healthy volunteers, patients with asthma and patients with chronic obstructive pulmonary disease (COPD) to support the building of a computer model/simulation which can be used to assess the effectiveness of different inhaler technologies used in the treatment of various lung conditions such as asthma and COPD.

The overall intention of the study is to generate this data such that this computer model may be used in future to allow developers of new inhaler technologies to be able to predict how effective their technology will be in delivering the study drug to the desired areas in the lungs without the need to conduct extensive clinical trials. This has numerous advantages, in particular the ability to use historical imaging data rather than having to expose research participants, and the ability to test multiple different variations of the inhaler technology and drug delivery method with relatively little additional financial burden.

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The study will consist of a screening visit, a CT scanning imaging visit, 3 gamma scintigraphy imaging periods (of approximately 4 days duration combined – Day -1 to Day 3) and a follow up telephone call 7 days following the last visit.

Intervention Type
Drug

Phase
Phase I

Drug/device/biological/vaccine name(s)
Ipratropium bromide (monohydrate), fluticasone propionate, glycopyrrolate, formoterol fumarate dihydrate

Primary outcome(s)
1. The fraction of the dose of radiolabeled OIDP deposited in the lungs and in the oropharyngeal and stomach regions (expressed as % emitted dose) measured using gamma scintigraphy imaging at Day 1, Day 2 and Day 3 immediately post-product administration

2. The fraction of the dose of radiolabeled OIDP deposited on the actuator (expressed as % ex-valve dose) and exhalation filter (expressed as % emitted dose). measured using gamma scintigraphy imaging at Day 1, Day 2 and Day 3 immediately post-product administration

3. The regional airway deposition ratios i.e. outer to inner (O/I) regions of the radiolabeled OIDP in the lungs. For each administration the emitted dose is defined as the sum of corrected activities detected in the lungs and oropharynx (including mouth washings and stomach deposition) and on the exhalation filter, measured using gamma scintigraphy imaging at Day 1, Day 2 and Day 3 immediately post-product administration

Key secondary outcome(s)

Completion date
25/09/2026

Eligibility

Key inclusion criteria
A patient will be eligible for inclusion in this study only if all of the general criteria and the criteria specified per cohort apply as listed below.

General:
1. All volunteers must be at least 21 years old and be competent to understand and give written informed consent
2. If female, meets all of the following requirements:
2.1. Is not currently pregnant or breastfeeding;
2.2. Has a negative urine pregnancy test; and
2.3. Meets either of the following criteria:
2.3.1. Is of non-childbearing potential, defined as:
2.3.1.1. >1 year post-menopausal;
2.3.1.2. Surgically sterile (tubal ligation, oophorectomy, or hysterectomy); or
2.3.1.3. Diagnosed as infertile and not undergoing treatment to reverse infertility.
2.3.2. Is of childbearing potential and:
2.3.2.1. Has a negative urine pregnancy test at the screening visit; and
2.3.2.2. Is willing to commit to using a consistent and acceptable method of birth control, as defined below, for the duration of the study, or exclusively has same-sex partners:
2.3.2.2.1. Systemic contraception used for >1 month prior to screening, including birth control pills, transdermal patch (EVRA® or equivalent), vaginal ring (NUVARING® or equivalent), levonorgestrel implant (NORPLANT® or equivalent), or injectable progesterone (DEPO-PROVERA® or equivalent);
2.3.2.2.2. Double barrier methods (condoms, cervical cap, diaphragm, and vaginal contraceptive film with spermicide);
2.3.2.2.3. Intrauterine device (IUD) with a low failure rate <1% per year; or
2.3.2.2.4. Monogamous with a vasectomized male partner or exclusively has same-sex partners.
3. Body weight ≤120 kg and BMI within the range 18–30 kg/m2 (inclusive)
4. All volunteers must be able to follow instructions to adequately perform specific breathing maneuvers during the imaging procedure and pulmonary function tests
5. Subject must be able to understand and complete the protocol requirements, instructions, and protocol-stated restrictions
6. Ability to perform acceptable and repeatable spirometry according to the American Thoracic Society (ATS)/European Respiratory Society (ERS) 2005 criteria and/or protocol-defined criteria
7. Subject must be satisfying the investigator regarding fitness to participate in the study
8. Available to complete the study

Cohort A: Healthy volunteers
1. Healthy as determined by a responsible and experienced physician, based on a medical evaluation including medical history and physical examination. A subject with a clinical abnormality or parameters outside the reference range for the population being studied may be included if the Investigator agrees that the finding is unlikely to introduce additional risk factors and will not interfere with the study procedures.
2. Forced Expiratory Volume in one second (FEV1) and Forced Vital Capacity (FVC) >80 % predicted
3. Non-smokers and not vaping (never smoked or not smoking at least 12 months prior to

screening with <1 pack year history)
4. No significant history of medicinal or recreational use of inhaled cannabis (smoking or vaping) within the 12-month period prior to screening

Cohort B: COPD
1. Documented diagnosis of COPD according to the Global initiative for chronic Obstructive Lung Disease (GOLD) criteria with a post-bronchodilator Tiffeneau index (FEV1/FVC) of <0.7 and an FEV1 ≥30-65 % predicted.
2. Current smoker or ex-smoker with a minimum 10 pack-years of historical use.
3. Clinically stable at the time of screening, that is, patients are on a stable treatment regimen for 4 weeks prior to screening.

Cohort C: Asthma
1. Documented diagnosis of moderate-to-severe asthma in accordance with the GINA guidelines (2023 GINA Report, Global Strategy for Asthma Management and Prevention)
2. Historical documented reversibility of ≥12% or >0.20 L reversibility of FEV1 in daily variability or within 30 minutes following 400 mcg of salbutamol inhalation (pMDI)
3. Clinically stable at the time of screening, that is, patients are on a stable treatment regimen for four weeks prior to screening
4. Historical pre-bronchodilator forced expiratory volume in one second (FEV1) of ≥45% and ≤85%
5. Non-smokers and not vaping (never smoked or cessation of smoking at least 12 months prior to screening with <1 pack year history)
6. No significant history of medicinal or recreational use of inhaled cannabis (smoking or vaping) within the 12-month period prior to screening

Healthy volunteers allowed
Yes

Age group
Mixed

Lower age limit
21 Years

Upper age limit
75 Years

Sex
All

Total final enrolment
0

Key exclusion criteria
A patient will not be eligible for inclusion in this study if any of the general criteria or the criteria specified per cohort apply.

General:
1. As a result of the medical interview, physical examination or screening investigations, the physician responsible considers the volunteer unfit for the study

2. Volunteer experienced health issues due to travelling in the past 12 months
3. Any contraindications to use the selected OIDP or radio compound
4. Any radiological investigations with significant radiation burden within the 12-month period prior to screening and planned radiological investigations 12-month period post screening. A significant radiation burden is defined as ICRP category IIb or above: no more than 10 mSv in addition to natural background radiation, in the previous year including the dose from this study for volunteers under 50 years of age. For volunteers ≥50 years, the acceptable dose may be increased by a factor 5-10 mSv (10).
5. Volunteer is pregnant or lactating or plans to become pregnant
6. Volunteer has a history of alcohol or drug abuse within 2 years prior to screening
7. Unwillingness or inability to follow any of the procedures outlined in the protocol

Cohort A: Healthy volunteers
1. History of a chronic respiratory disorder
2. History of acute respiratory disease within 4 weeks prior to inclusion
3. History of breathing problems such as a history of asthma, unless the asthma was in childhood and has now completely resolved, no longer requiring maintenance or intermittent therapy
4. Other significant medical disorders that may affect the respiratory system or that causes significant disability

Cohort B: COPD
1. Presence of a known pre-existing, clinically important lung condition other than COPD. This includes but is not limited to current infection, pronounced bronchiectasis, pulmonary fibrosis, bronchopulmonary aspergillosis, interstitial lung abnormalities, or a history of lung cancer
2. History of lung volume reduction intervention
3. One or more exacerbation, defined as a sustained and acute deterioration of subject's symptoms and signs (dyspnoea, cough and/or sputum production/purulence) requiring treatment with systemic (oral/IV/IM) corticosteroids and/or antibiotics, or requiring hospitalization, within 4 weeks prior to screening, or between screening and study visit

Cohort C: Asthma
1. Presence of a known pre-existing, clinically important lung condition other than asthma. This includes but is not limited to current infection, pronounced bronchiectasis, pulmonary fibrosis, bronchopulmonary aspergillosis, interstitial lung abnormalities, or a history of lung cancer
2. One or more exacerbation, defined as a deterioration of asthma signs and symptoms resulting in emergency treatment, hospitalization due to asthma, or treatment with systemic steroids within 4 weeks prior to screening or between screening and study visit

Date of first enrolment
30/06/2026

Date of final enrolment
14/09/2026

Locations

Countries of recruitment
United Kingdom

Wales

Belgium

Study participating centre
Simbec Research Limited
Simbec-Orion Clinical Pharmacology
Merthyr Tydfil Industrial Park
Cardiff Road
Merthyr Tydfil
Wales
CF48 4DR

Study participating centre
Medimprove BV
Groeningenlei 132c
Kontich
Belgium
2550

Study participating centre
Medimprove BV
Antwerpsestraat 50
Mortsel
Belgium
2640

Sponsor information

Organisation
Fluidda (Belgium)

ROR
https://ror.org/03wj3v998

Funder(s)

Funder type

Funder Name

Results and Publications

Individual participant data (IPD) sharing plan

IPD sharing plan summary
Not expected to be made available