# Evaluation of new and conventional N95 fit testing protocols on equivalence and reproducibility

Submission date	<b>Recruitment status</b> Recruiting	Prospectively re	
27/05/2025		[] Protocol	
<b>Registration date</b> 28/05/2025	<b>Overall study status</b> Ongoing	Statistical analy	
		[] Results	
Last Edited 28/05/2025	<b>Condition category</b> Other	[] Individual partic	
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#### Plain English summary of protocol

Background and study aims

Global outbreaks of contagious respiratory illnesses have heightened awareness of occupational safety among healthcare workers (HCWs). An N95 filtering tight-fitting half-facepiece respirator (hereafter, N95 respirator) is a specialised mask designed to securely fit the face and efficiently filter airborne particles. For an ill-fitting respirator, the average infiltration of an ambient aerosol was determined to be 33%, vs only 4% for well-fitting respirators. Leakage (i.e., penetration) can occur when there is a gap between the respirator and the wearer's face. This gap (i.e., face-seal leakage) may enable the infiltration of airborne contaminants into the wearer' s respiratory area, compromising the effectiveness of protection. To ensure sustainable occupational safety, reputable authorities such as the National Institute for Occupational Safety and Health (NIOSH), the World Health Organization (WHO), the Center for Disease Control and Prevention (CDC), and the Hospital Authority in Hong Kong require HCWs to undergo N95 fit testing before using an N95 respirator, particularly if they are performing aerosol-generating procedures. N95 fit testing facilitates both the selection of a suitable respirator and the training of its user.

In 2019, OSHA introduced a shortened N95 fit testing protocol with four steps. This new protocol involves the performance of only four pre-determined exercises and has drastically decreased the time required for fit testing. Nevertheless, there has been a lack of empirical evidence to support this notion of equivalence. Additionally, no prior research has explored the stability (or reproducibility) of fit testing results, even in relation to the conventional protocol. Uncertainty regarding stability has led to uncertainty regarding the reproducibility of previous fit testing results for a given respirator. This study aims to investigate the equivalence (i.e., pass or fail) and evaluate the reproducibility of fit testing results, specifically the fit factor, of three different designed respirators among Chinese healthcare workers using the new and conventional protocols.

#### Who can participate?

Students pursuing healthcare disciplines or healthcare workers who are licensed staff members providing direct patient care, aged 18 years and above.

#### What does the study involve?

The data collection process will have four distinct phases: room and system preparation. registration, a training session, and a fit testing session. The participants' demographic information, including their sex, age, and body weight, along with the results of the user seal check and fit testing conducted using both the new and conventional protocols, will be documented in a data sheet. To regulate environmental variables that might impact the outcome of fit testing, all data will be collected in a designated air-conditioned room with an area of 10 m2. During registration, all participants will be obligated to provide signed consent and present themselves in a manner consistent with clinical duty. During the training session, a licensed nurse who has received specialised training will introduce a 30-minute training session covering the proper techniques for donning a standardised N95 respirator and conducting a user seal check. The session will include a video demonstration and opportunities for participants to practice the techniques. The trained nurses will evaluate the donning procedure and user seal check method of each participant through redemonstration before proceeding to the next session. In addition to the time spent on registration and the training session, which will vary among participants, an additional 60 minutes will be required to collect the remaining data. This process will include user seal check and fit testing of three types of N95 respirators according to the new and conventional protocols.

What are the possible benefits and risks of participating? Participants will be provided with an incentive of HK\$200 as time compensation upon completing six N95 fit tests (3 respirators x 2 protocols). There are no risks to participating in the study.

Where is the study from? School of Nursing, Tung Wah College, Hong Kong SAR, China

When is the study starting and how long is it expected to run for? November 2024 to November 2026

Who is funding the study? Health and Medical Research Fund (HMRF), Hong Kong SAR; ref: 24230052

Who is the main contact? Prof. Simon Ching LAM simonlam@twc.edu.hk; simlc@alumni.cuhk.net

## **Contact information**

**Type(s)** Public, Scientific, Principal Investigator

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### Additional identifiers

EudraCT/CTIS number Nil known

**IRAS number** 

**ClinicalTrials.gov number** Nil known

Secondary identifying numbers 24230052

# Study information

#### Scientific Title

Comparison of new and conventional N95 fit testing protocols for three respirators with different designs: Evaluation of equivalence and reproducibility

#### Study objectives

This study is a cross-sectional observational study to investigate the equivalence (i.e., pass or fail) and evaluate the reproducibility of fit testing results, specifically the fit factor, of three different designed respirators among Chinese healthcare workers using the new and conventional protocols.

The researchers hypothesise that there is no equivalence in the fit testing results between new and conventional fit testing protocols among Chinese healthcare workers donned with three different designed respirators. Besides, it is also hypothesised that the fit testing results of new and conventional fit testing protocols are not reproducible.

#### Ethics approval required

Ethics approval required

#### Ethics approval(s)

Approved 01/11/2024, Research Ethics Committee, Tung Wah College (31 Wylie Road, Homantin Kowloon, Hong Kong SAR, -, China; +852-3190-6678; ro@twc.edu.hk), ref: REC2024221

#### Study design

Multicenter cross-sectional observational study

**Primary study design** Observational

#### Secondary study design

Cross sectional study

**Study setting(s)** Training facility/simulation, University/medical school/dental school

**Study type(s)** Safety, Efficacy

**Participant information sheet** See study outputs table

#### Health condition(s) or problem(s) studied

Fit testing protocols for three respirators

#### Interventions

This proposed methodological study will have a cross-sectional observational design with repeated measures, according to the Guidelines for Reporting Reliability and Agreement Studies (GRRAS) (https://www.equator-network.org/)

The proposed cross-sectional observational study will evaluate the equivalence (also known as agreement) and reproducibility of the fit testing results of three different designed respirators tested among Chinese HCWs using the new and conventional fit testing protocols. A cross-sectional design is appropriate for testing the reliability of a protocol (including agreement and reproducibility) and is commonly used in instrument validation. Figure 1 in the appendix presents a flow diagram of the proposed study.

The fit testing device will be used in accordance with the manufacturer's instructions and the protocol established by OSHA. After following the manufacturer's instructions to don the respirator, the wearer will perform pre-defined exercises as instructed by the system. For the conventional eight-step protocol, OSHA 29CFR 1910.134, the participant will perform eight exercises: normal breathing, deep breathing, side-to-side head movement, up-and-down head movement, talking (a standard set of passages will be provided for reading aloud), grimacing, bending over, and normal breathing. The grimace is an intentional attempt to disrupt the face seal and observe the respirator's ability to subsequently reset itself. For the new four-step protocol, OSHA Fast-filtering Face, the participants will be required to perform only four exercises: side-to-side head movement, up-and-down head movement, talking, and bending over. Every exercise except the grimace task will be assigned a specific individual fit factor ranging from 0 to 200. Each fit factor (FF) will be determined as the ratio of the concentration of a challenge agent outside the respirator to the concentration of the same agent inside the respirator via leakage (Cout/Cin). The overall FF (range = 0–200) will be determined using a respective equation specified in the conventional and new protocol. An overall FF greater than 100 will indicate a 'pass', indicating that the tested respirator fits the wearer properly. The sequence in which each respirator and protocol is tested will be randomly assigned to the participants in a sealed envelope.

#### Intervention Type

Device

Pharmaceutical study type(s) Not Applicable **Phase** Not Applicable

**Drug/device/biological/vaccine name(s)** PortaCount respirator fit-tester system (model Pro+ 8048)

#### Primary outcome measure

Fit factor (range 0-200) and the pass rate of fit testing (pass or fail). A validated system will be used to measure these variables.

**Secondary outcome measures** There are no secondary outcome measures

Overall study start date 01/11/2024

**Completion date** 30/04/2026

### Eligibility

#### Key inclusion criteria

 Students pursuing healthcare disciplines or healthcare workers who are licensed staff members providing direct patient care.
Aged 18 years or above.

**Participant type(s)** Health professional, Learner/student, Other

**Age group** Adult

**Lower age limit** 18 Years

**Sex** Both

**Target number of participants** 102

#### Key exclusion criteria

 Healthcare workers with a documented medical history of chronic respiratory diseases or conditions such as asthma, congestive heart failure, or coronary heart disease.
Those who are currently pregnant.

#### Date of first enrolment

01/03/2025

Date of final enrolment 28/02/2026

### Locations

**Countries of recruitment** China

Hong Kong

**Study participating centre** Integrative Health Centre, Tung Wah College Room 1401, Mong Kok Campus Cheung Chin Lan Hong Building 98 Shantung Street Mong Kok, Kowloon Hong Kong SAR China

### Sponsor information

**Organisation** Tung Wah College

Sponsor details King's Park Campus, Ma Kam Chan Memorial Building 31 Wylie Road, Homantin Hong Kong SAR China -+852-3468-6829 nur@twc.edu.hk

**Sponsor type** University/education

Website http://www.twc.edu.hk/

ROR https://ror.org/04jfz0g97

# Funder(s)

Funder type Government

**Funder Name** Health and Medical Research Fund

**Alternative Name(s)** , HMRF

**Funding Body Type** Government organisation

**Funding Body Subtype** Trusts, charities, foundations (both public and private)

Location Hong Kong

# **Results and Publications**

#### Publication and dissemination plan

The research findings will be shared with the Infection Control Branch and Occupational Safety and Health of the Hospital Authority and the Centre for Health Protection of the Hong Kong SAR Government to inform them and provide a point of reference. The findings will also be shared through presentations at both local and international conferences and in reputable journals focused on infection control and occupational health.

#### Intention to publish date

31/10/2026

#### Individual participant data (IPD) sharing plan

The data set generated and analysed during the current study will be available upon request from Simon Ching Lam (simonlam@twc.edu.hk; simlc@alumni.cuhk.net)

IPD sharing plan summary

Available on request

#### Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Participant information sheet			28/05/2025	No	Yes