

# Can a nebulized medication reduce death rates in adults with severe lung failure on ventilators?

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<b>Registration date</b> 21/03/2025	<b>Overall study status</b> Ongoing	<input type="checkbox"/> Statistical analysis plan <input type="checkbox"/> Results
<b>Last Edited</b> 23/04/2025	<b>Condition category</b> Respiratory	<input type="checkbox"/> Individual participant data <input checked="" type="checkbox"/> Record updated in last year

## Plain English summary of protocol

### Background and study aims

Acute respiratory distress syndrome (ARDS) is a common and serious condition in intensive care units. It affects the lungs, making it difficult for patients to breathe normally, so they need mechanical ventilation to help them breathe. ARDS can be caused by various factors like infections, trauma, or smoke inhalation, and it has a high mortality rate because there is no single cause or definitive treatment. The main issue in ARDS is lung inflammation, and many anti-inflammatory medications have been tried. This study aims to see if nebulized furosemide, a drug usually used to increase urine production, can reduce death rates in ARDS patients on ventilators.

### Who can participate?

Adults aged 18 years or older who have been on mechanical ventilation in the ICU for 7 days or less and are diagnosed with ARDS according to internationally accepted criteria can participate.

### What does the study involve?

Participants will receive nebulized furosemide four times a day for up to 28 days. The study will monitor their health and progress during this period.

### What are the possible benefits and risks of participating?

Possible benefits include reduced mortality, shorter duration on mechanical ventilation, and shorter ICU and hospital stays. While furosemide is generally safe, potential risks include allergic reactions, changes in blood element concentrations (especially potassium), increased urine output, and altered kidney functions.

### Where is the study run from?

King Saud Medical City (Saudi Arabia)

### When is the study starting and how long is it expected to run for?

The study will start recruiting patients on April 1, 2025, and is expected to complete by June 30, 2026.

Who is funding the study?  
Investigator initiated and funded

Who is the main contact?  
Dr Waleed Aletreby, waleedaletreby@gmail.com)

## Contact information

### Type(s)

Public, Scientific, Principal Investigator

### Contact name

Dr Waleed Aletreby

### ORCID ID

<http://orcid.org/0000-0001-8387-1829>

### Contact details

Riyadh Al Badiaa Ibraheem Bin Eidan Street  
Riyadh  
Saudi Arabia  
11373  
+966 543531552  
wthashim@ksmc.med.sa

## Additional identifiers

### EudraCT/CTIS number

Nil known

### IRAS number

### ClinicalTrials.gov number

Nil known

### Secondary identifying numbers

researchregistry #10765

## Study information

### Scientific Title

Effect of Nebulized Furosemide on Mortality of Adult Mechanically Ventilated ARDS Patients.  
Protocol of a Randomized Clinical Trial (ENHALE Trial)

### Acronym

ENHALE

### Study objectives

Nebulized furosemide may be able to reduce 28 day ICU mortality of adult mechanically ventilated ARDS patients

### **Ethics approval required**

Ethics approval required

### **Ethics approval(s)**

Approved 29/08/2024, King Saud Medical City Institutional Review Board (Turki Bin Abdullah Street - Al Shemaisi, Riyadh, 12746, Saudi Arabia; +966118371777; irb@ksmc.med.sa), ref: H1RI-19-Aug24-01

### **Study design**

Single center double blind placebo controlled parallel arm superiority randomized clinical trial

### **Primary study design**

Interventional

### **Secondary study design**

Randomised parallel trial

### **Study setting(s)**

Hospital

### **Study type(s)**

Treatment

### **Participant information sheet**

No participant information sheet available

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

Treatment of mechanically ventilated adults with Acute Respiratory Distress Syndrome (ARDS)

### **Interventions**

The intervention will be Nebulized Furosemide, in a dose of 40 mg furosemide in four ml of 0.9% saline, administered every six hours via the ventilator circuit over 30 minutes. The nebulization circuit used in our ICU is Aerogen ®. The intervention continues till extubation, death, or completion of 28 days

The control group receives placebo. They will receive the same regimen, but 0.9% Saline

### **Enrollment, randomization, and allocation concealment**

Dedicated study team will round the ICU twice a day (8 AM and 8 PM) to identify patients who could be eligible for enrollment, once an eligible patient who fulfills inclusion criteria and has no exclusion criteria is identified, the patient or legal guardian will be approached for consenting in participation. Only after obtaining an informed consent, randomization will be obtained via phone call to an independent statistician who will provide a study code, without breaking the allocation concealment.

The independent statistician will prepare randomization sequences using variable size blocks (4, 6, 8) stratified by ARDS severity (Mild – Moderate – Severe), with unique study codes. Only the study code will be disclosed to the study team

## Blinding

Furosemide and saline are identical in appearance, color, and solution characteristics. The investigational product will be prepared by an independent study pharmacist, put in identical vials, labelled only with study code and patient identifiers (name and MRN), and delivered to the clinical area. The independent study pharmacist will not have any contact with the clinical team, and will not participate in the clinical care, or any other study role.

## Intervention Type

Drug

## Pharmaceutical study type(s)

Dose response

## Phase

Phase II

## Drug/device/biological/vaccine name(s)

Furosemide

## Primary outcome measure

28 day mortality measured using hospital records

## Secondary outcome measures

1. All-cause hospital mortality is measured using hospital records at discharge
2. ICU length of stay (LOS) is measured using ICU records at discharge
3. Hospital length of stay (LOS) is measured using hospital records at discharge
4. Difference of P/F ratio is measured using arterial blood gas analysis at day one and day seven (not calculated for patients who are censored before seven days)
5. Ventilator-free days (VFD) is measured using ventilator records at 28 days
6. Successful extubation rate is measured using patient records at extubation
7. Hypersensitivity reactions of any magnitude are measured using patient reports and clinical assessments at any time during the study
8. Abnormal lab investigations, specifically electrolytes and renal function tests, are measured using blood tests at baseline and at regular intervals during the study
9. Volume of urine output is measured using urine output records at baseline and at regular intervals during the study

## Overall study start date

12/01/2024

## Completion date

30/06/2026

# Eligibility

## Key inclusion criteria

1. Adults ( $\geq 18$  years).
2. ICU admission.
3. Mechanical ventilation for  $< 7$  days.
4. ARDS diagnosed within 24 hours per Berlin Definition, which includes:

- 4.1. Chest x-ray showing bilateral opacities, not fully explained by effusions, lobar/lung collapse, or nodules.
- 4.2. Respiratory failure not fully explained by cardiac failure or fluid overload, and exclusion of hydrostatic edema (by echocardiography).
- 4.3. Oxygenation and ventilator settings matching one of the three categories of ARDS: Mild:  $200 \text{ mm Hg} < \text{PaO}_2/\text{FIO}_2 \leq 300 \text{ mm Hg}$  with PEEP or CPAP  $\geq 5 \text{ cm H}_2\text{O}$ . Moderate:  $100 \text{ mm Hg} < \text{PaO}_2/\text{FIO}_2 \leq 200 \text{ mm Hg}$  with PEEP  $\geq 5 \text{ cm H}_2\text{O}$ . Severe:  $\text{PaO}_2/\text{FIO}_2 \leq 100 \text{ mm Hg}$  with PEEP  $\geq 5 \text{ cm H}_2\text{O}$ .

**Participant type(s)**

Patient

**Age group**

Adult

**Lower age limit**

18 Years

**Sex**

Both

**Target number of participants**

784

**Key exclusion criteria**

1. Pregnant or lactating ladies.
2. Patients who are not expected to survive more than 48 hours, according to the treating team.
3. Mechanical ventilation is expected to continue for less than 48 hours (due to rapid recovery) according to the treating team.
4. Advanced directive of Do Not Resuscitate (DNR).
5. Refusal to participate in the trial by the patient, or official surrogate.
6. Known allergy to furosemide.
7. Previous enrollment in the trial (a patient can only be enrolled once).

**Date of first enrolment**

01/04/2025

**Date of final enrolment**

30/06/2026

**Locations****Countries of recruitment**

Saudi Arabia

**Study participating centre**

King Saud Medical City

Turki Bin Abdullah Street - Al Shemaisi

Riyadh

Saudi Arabia  
12746

## Sponsor information

### Organisation

King Saud Medical City

### Sponsor details

Turki Bin Abdullah Street - Al Shemaisi  
Riyadh  
Saudi Arabia  
12746  
+966118371777  
irb@ksmc.med.sa

### Sponsor type

Hospital/treatment centre

### Website

[http://www.ksmc.med.sa/user\\_en/login\\_ar/index](http://www.ksmc.med.sa/user_en/login_ar/index)

### ROR

<https://ror.org/03aj9rj02>

## Funder(s)

### Funder type

Other

### Funder Name

Investigator initiated and funded

## Results and Publications

### Publication and dissemination plan

Once the study is completed, and a manuscript has been drafted and approved by all authors, we plan to publish the study in a peer reviewed journal.

### Intention to publish date

01/01/2027

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

The dataset generated during and/or analysed during the current study will be stored in a publicly available repository. We plan to store data in: <https://www.kaggle.com/>

**IPD sharing plan summary**

Stored in publicly available repository

**Study outputs**

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
<a href="#">Protocol file</a>			21/03/2025	No	No
<a href="#">Protocol article</a>		22/03/2025	23/04/2025	Yes	No