

# Learning cardiac ultrasound: a study comparing extended reality–based training with standard teaching for medical students

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<b>Registration date</b> 08/01/2026	<b>Overall study status</b> Completed	<input type="checkbox"/> Statistical analysis plan <input type="checkbox"/> Results
<b>Last Edited</b> 08/01/2026	<b>Condition category</b> Circulatory System	<input type="checkbox"/> Individual participant data <input checked="" type="checkbox"/> Record updated in last year

## Plain English summary of protocol

### Background and study aims

Point-of-care ultrasound (POCUS) is increasingly used, but learning basic cardiac image acquisition and probe orientation is challenging for beginners. Extended reality (XR) can support training by showing a 3D heart model and providing real-time feedback on probe position and the intended view. This study compares XR-supported training using the “Augmedicine: Ultrasound” application with standard instructor-led training, to evaluate whether XR training leads to similar competence in basic cardiac ultrasound measurements.

### Who can participate?

Medical students during their internal medicine clerkship at Leiden University Medical Center (LUMC) with little to no prior ultrasound experience. Students are not eligible if they previously participated in an XR ultrasound study or completed substantial extracurricular anatomy training (e.g., dissection courses outside the regular curriculum).

### What does the study involve?

Participants complete brief baseline assessments (questionnaire, mental rotation test, and a short anatomy knowledge test). All participants receive the same introductory cardiac ultrasound teaching and supervised practice. They are then randomly allocated to either (1) a fixed period of independent practice with the XR application or (2) a fixed period of one-to-one supervised practice on a volunteer. Afterwards, all participants complete a practical ultrasound test on a volunteer, including two measurements. The examiner is blinded to the training group. XR participants also complete a short questionnaire about any XR-related discomfort.

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

Participants may benefit from additional cardiac POCUS practice. The main burden is extra time during a clerkship day. Risks are minimal; XR use may cause temporary symptoms such as dizziness, headache, nausea, or eye strain. Participants can stop at any time.

### Where is the study run from?

Leiden University Medical Center (LUMC) (Netherlands)

When is the study starting and how long is it expected to run for?  
March 2024 to May 2024

Who is funding the study?  
Investigator initiated and funded

Who is the main contact?  
Tessa Mulder, t.a.mulder@lumc.nl

## Contact information

### Type(s)

Public, Scientific, Principal investigator

### Contact name

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## Additional identifiers

### Clinical Trials Information System (CTIS)

Nil known

### Integrated Research Application System (IRAS)

Nil known

### Protocol serial number

Nil known

## Study information

### Scientific Title

Augmedicine: Ultrasound. Training in Ultrasound Using XR – a randomized controlled trial

### Study objectives

The aim of this study is to assess if training using the XR application is non-inferior compared to standard training to learn POCUS.

### Ethics approval required

Ethics approval required

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

approved 22/02/2024, Educational Research Review Board of the LUMC (Hippocratespad 21, Leiden, 2333 ZD, Netherlands; +31 (0)71 526 91 11; p.g.m.de\_jong@lumc.nl), ref: OEC/ERRB /20240213/1

### **Study design**

Single-centre assessor-blinded parallel-group non-inferiority randomized controlled trial

### **Primary study design**

Interventional

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

Efficacy

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

Training effectivity of XR application in medical students

### **Interventions**

Novice medical students during their internal medicine clerkship were allocated 1:1 by block randomization (block size 2) to XR-integrated POCUS training (intervention) or standard instructor-guided POCUS training (control), with outcomes assessed immediately after training.

### **Intervention Type**

Behavioural

### **Primary outcome(s)**

1. E-point septal separation (EPSS) measured in millimetres using M-mode echocardiography during a parasternal long-axis view, assessed during a practical ultrasound test immediately after training and compared to expert reference measurements.
2. Tricuspid annular plane systolic excursion (TAPSE) measured in millimetres using M-mode echocardiography during an apical four-chamber view, assessed during the same practical ultrasound test immediately after training and compared to expert reference measurements.

### **Key secondary outcome(s)**

1. Time to complete the ultrasound test, measured in seconds using a stopwatch during the practical test immediately after training.
2. Image quality, assessed by two blinded experts using a validated point-of-care echocardiography image scoring form, based on images obtained during the practical test immediately after training.
3. XR-related discomfort (cybersickness symptoms), assessed using a short self-report questionnaire completed immediately after XR training (XR group only).

### **Completion date**

28/05/2024

## **Eligibility**

### **Key inclusion criteria**

Medical students without previous ultrasound experience

**Participant type(s)**

Learner/student

**Healthy volunteers allowed**

No

**Age group**

Mixed

**Lower age limit**

18 years

**Upper age limit**

100 years

**Sex**

All

**Total final enrolment**

56

**Key exclusion criteria**

1. Prior participation in a study with an XR ultrasound application
2. Participated in extracurricular activities related to anatomical education, such as dissection courses

**Date of first enrolment**

20/03/2024

**Date of final enrolment**

28/05/2024

**Locations**

**Countries of recruitment**

Netherlands

**Study participating centre**

**Leiden University Medical Centre**

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**Sponsor information**

**Organisation**

Leiden University Medical Center

**ROR**

<https://ror.org/05xvt9f17>

**Funder(s)****Funder type**

Not defined

**Funder Name**

Investigator initiated and funded

**Results and Publications****Individual participant data (IPD) sharing plan**

Individual participant data (IPD) will be available upon reasonable request from the corresponding author Tessa Mulder (t.a.mulder@lumc.nl)

**IPD sharing plan summary**

Available on request