

# Device R&D and upgrading in the MedTech Lab

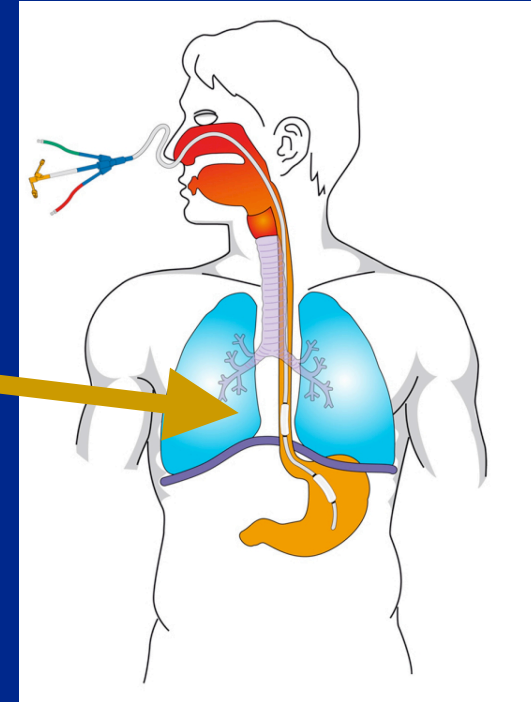
Pósfai Gergely - MedTech Innovation and Education Center



## Ventilation of ARDS patients

Standard procedure after intubation [1]

1. Oxygenation and Ventilation
  - 2. Esophageal pressure sensor emplacement**
  - 3. PEEP titration to transpulmonary pressure**
  4. Blood Gas Quality Control
  5. Conversion to APRV keeping Ventilation if  $P_{avg} \geq 20H_2Ocm$
  6. Prone ventilation
- I. Invasive procedure
- II. Could be automated



## Application of Digital Twin

Existing solution: PEEP-step method (PSM):  $Compliance = \Delta PEEP / \Delta EELV$  [2]

-> Positive End-Expiratory Pressure needs to be changed for the measurement: not optimal for continuous monitoring

Digital Twin:

Real time digital representation

Identify ventilation dynamics model, using only ventilator pneumotachograph

-> no need to change therapy

-> no need to use esophageal pressure sensor

Use cases: Prediction, Simulation, Control, Numeric analysis

## Mathematical Model

$$\frac{dV(t)}{dt} = Q(t)$$

$$Q(t) = \frac{P_{mou}(t) - P_{alv}(t)}{R}$$

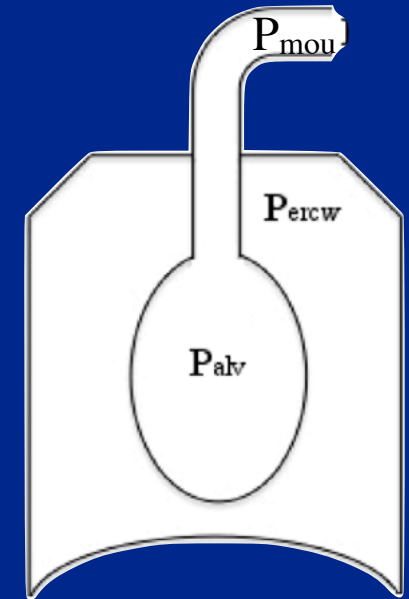
$$P_{alv}(t) = \frac{V(t)}{C} + P_{ercw}$$

$$P_{ercw} = -\frac{FRC}{C}$$

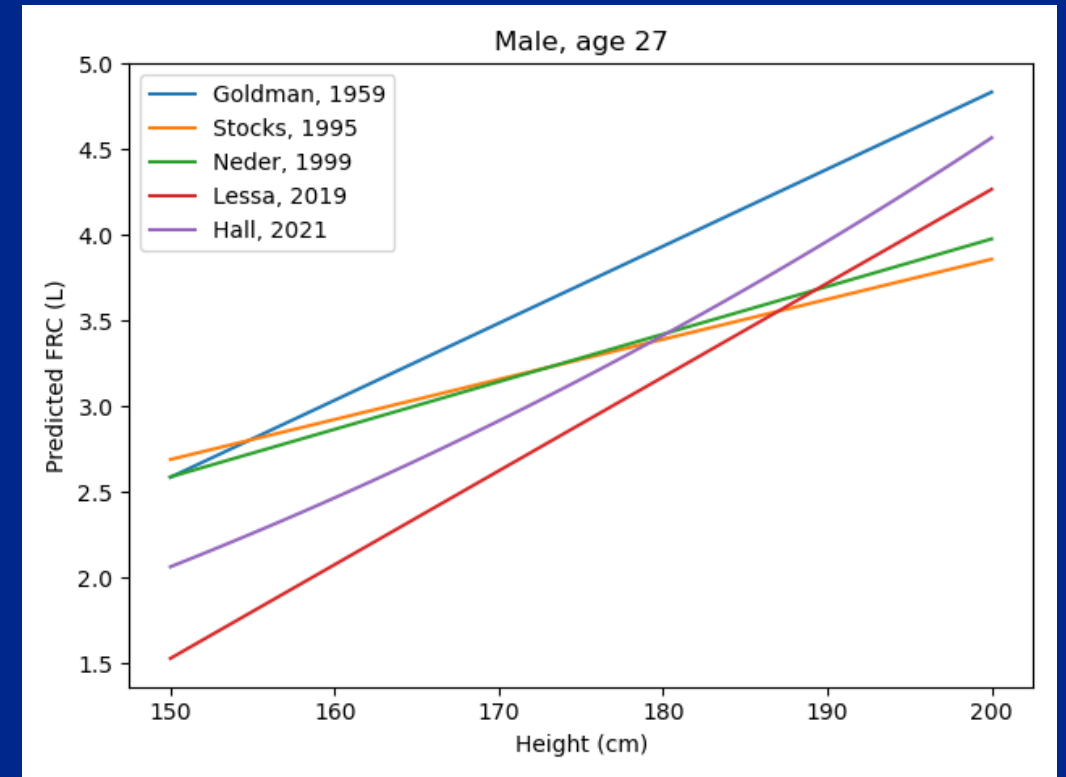
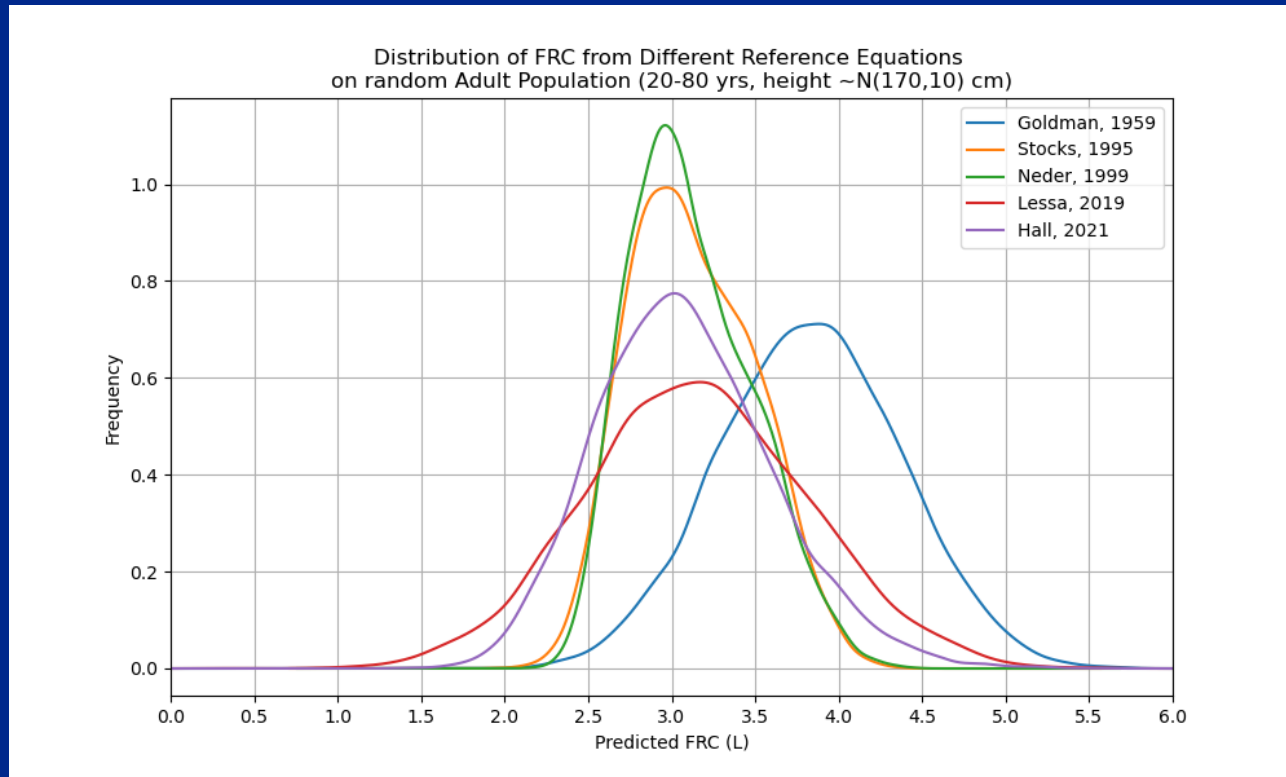
**R:** Airway resistance

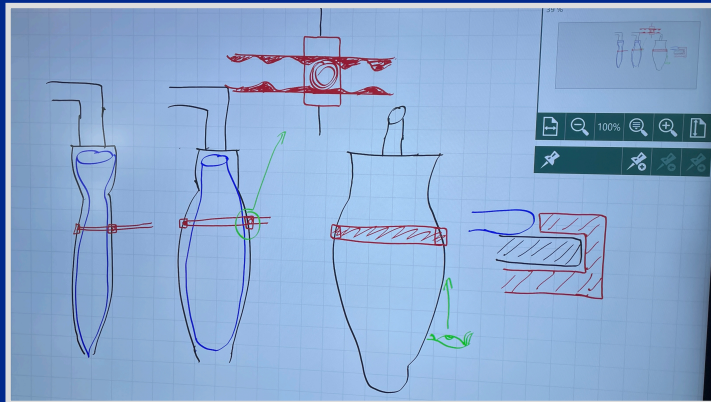
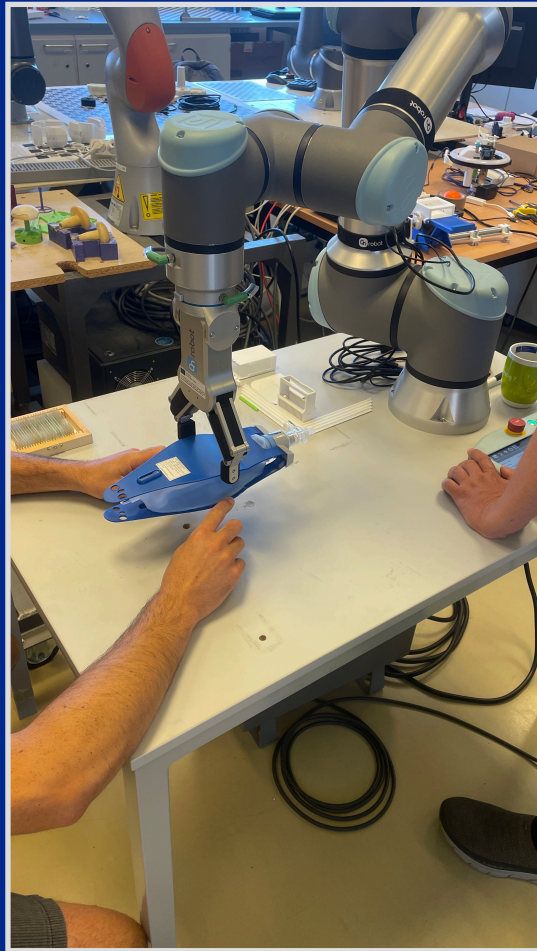
**C:** Lung compliance

FRC: Functional Residual Capacity

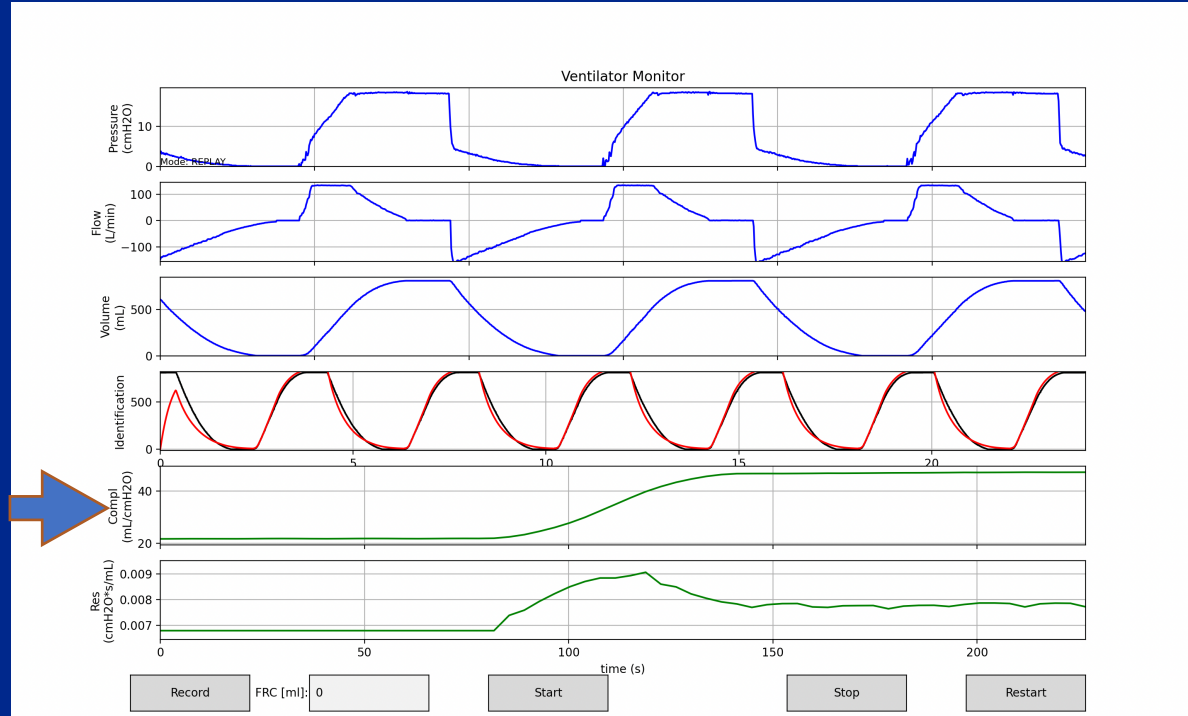


# Estimation of Functional Residual Capacity





# Proof of Concept Demonstration



Screenshot of the PoC desktop application

Times Higher Education Conference



MedTech Lab equipment

## Next step

1. Data collection with GOKVI
2. Validation of parameter estimation



Thank you for your attention!  
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