

## What's the Problem?

The American Hospital Association estimates that the United States will experience a shortfall of approximately 800,000 ventilators in meeting the needs of critically ill patients from COVID-19. Even if curve flattening is effective, it is still likely that the United States alone will have a shortfall of hundreds of thousands of ventilators over the course of the pandemic.

## Approach:

Modern ventilators and Auto-PAP machines can provide a sufficient air supply, volume and pressure to support up to three patients in case of emergency shortage of dedicated ventilators. We believe that it may be possible to use a single ventilator to support up to three patients simultaneously without compromising their safety while providing adequate critical life support care.

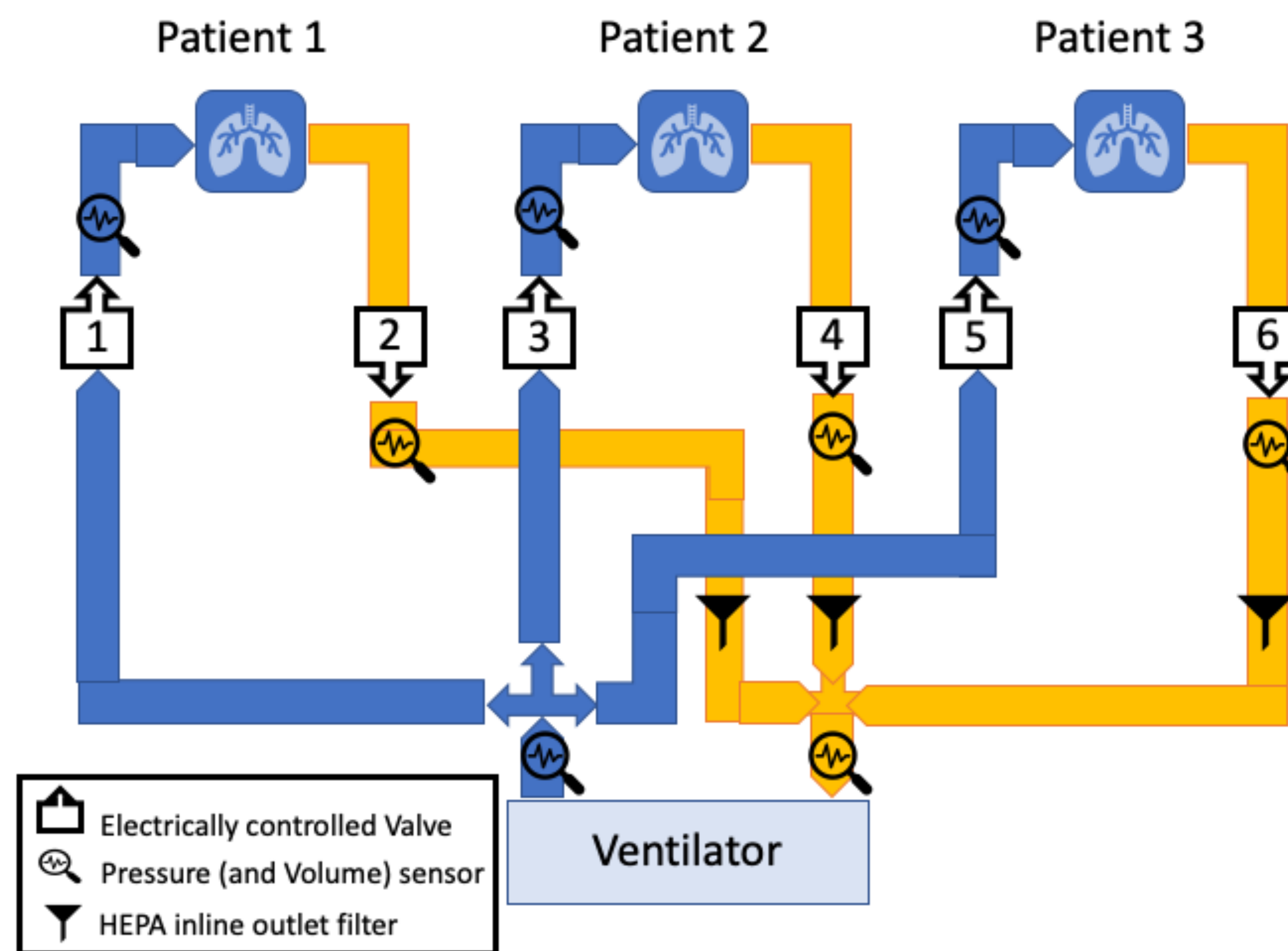
## Project Description:

We have designed and built a microprocessor-controlled valve manifold having a single air input supplied from a standard ventilator, three air outlets (one per patient), and a digital control panel for setting the pressure supplied to each patient as well as the desired respiration rate. The manifold features multiple pressure sensors for system monitoring. Each inspiration limb of the manifold will be fitted with a viral filter. Each expiration limb will have a passive HME in line with a viral filter to prevent patient cross-contamination and spread of virions.

Each patient will receive one epoch of inspiration pressure followed by expiration as set by the operator. The electronic system ensures that the respiratory cycles are repeated for each patient at a set respiratory rate. In a later version of the device, the pressure waveform may be variable and different for each patient. In operation, the device will display the real-time pressure and respiration rate for each outlet.

Because the device will merely multiplex an existing FDA-approved critical care ventilator now in use at Jefferson, it will not exceed the safety and therapy parameters set for the patients, merely delivering those parameters to three patients instead of one, thereby multiplying surge capacity.

How Might We: use a single ventilator to support up to three patients simultaneously without compromising any of them while delivering to each patient a different Inspiration/Expiration ratio if needed.



## System Design

The system is controlled by a single control unit combined with a touch screen display. The Control board manages six independently controlled solenoid pressure valves (2 for each individual patient limb). The system is synchronized to the main ventilator's positive pressure waveforms owing to its on-board pressure sensing capabilities. Settings can be changed using the built-in touch screen.

## Prototype Testing

The prototype system is currently undergoing functional and safety testing using a custom-made test rig built using three anesthesia circuits (to simulate patient lungs) and an AutoPAP device (to provide positive inlet pressure and drive the system).

