WHAT MAKES VENTILATORS HARD TO ENGINEER

Ventilators are the last line of defense against coronavirus. They deliver concentrated oxygen to patients with fluid in their lungs and remove toxic carbon dioxide. Many hackers and industrial giants, such as Dyson, Ford, GE, and Tesla, are engineering simplified systems to fight Covid-19. **Here are the key challenges they face:**

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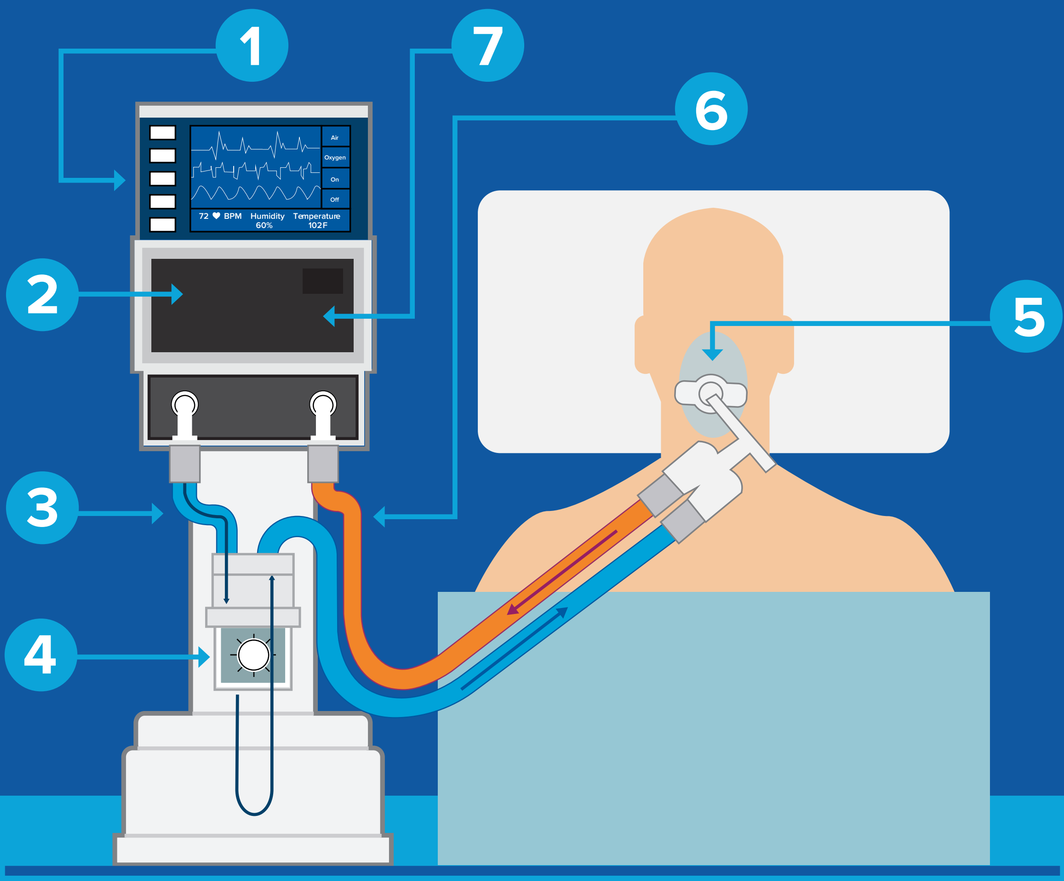

1 EASE OF USE

Controls should be intuitive because patients need constant readjustment. Components must detach for manual disinfection.

2 MECHANICAL

Ventilators must run 24/7 without failure and have battery backup. They must support a range of pressures to assist those who breathe independently and those who cannot.

3 OXYGEN

Air is 21 percent oxygen. Ventilators should supply 30-100 percent oxygen with sensors to ensure accurate doses. With such high oxygen levels, any leaks could lead to fire.

4 HUMIDIFIER

Ventilators must heat and humidify air because their tubes bypass the sinuses, which ordinarily do this.

5 MASKS

Patients receive oxygen from a tube in their nose or mouth or from a non-invasive mask. All need a tight seal to prevent leakage and failure.

6 RETURN

Ventilators remove carbon dioxide when patients exhale and filter air to prevent the virus particles from escaping. They must also manage secretions without clogging.

7 CONTROL

The control system must sense flow, pressure, and air composition to monitor and automatically adjust patient ventilation. It must also alert medical staff if a patient rolls over and pinches or detaches a tube.

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