

7. COVID-19 outbreak: What Does It Take to Build a Ventilator

Prelims Syllabus: Science & Technology

Mains Syllabus: Science and Technology - Developments and their Applications and Effects in everyday life Achievements of Indians in Science & Technology; Indigenization of Technology and developing New Technology.

Why in News?

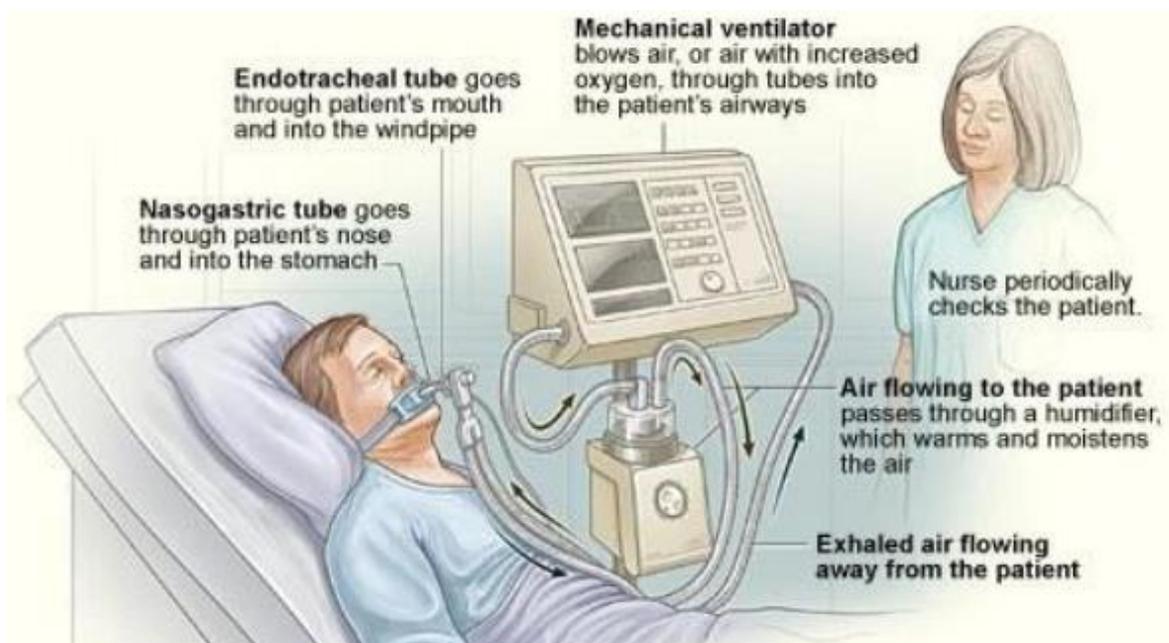
- As India faces the danger of community spread of the Novel Coronavirus and a spike in Hospital Admissions, the government is seeking to ramp up its capacity of ventilators.

Highlights:

- As a large number of ventilators may be required soon, the Railways-owned Integral Coach Factory (ICF) has made an attempt to reverse engineer the machines.
- Private sector carmakers with no experience in this line too, have also shown an interest to build the machines.

Ventilators:

- Ventilators (or respirators) are mechanical devices that help a patient breathe when they are unable to do so on their own.
- Hospitals have a supply system for gases like oxygen, which are used in ventilators.
- The ventilator takes the compressed gas (oxygen) and mixes it with other gases (because typically what we breathe is 21% oxygen from the atmosphere).



- It allows you to artificially push in a certain required amount of oxygen into the patient's lungs and allows them to deflate.

Importance of Ventilators in the Outbreak:

- The COVID-19 patient sometimes has interstitial pneumonia.
- In this disease, the virus causes inflammation in the air passages inside the lungs called bronchioles, causing inflammation in this area and in the alveoli (the tiny sacs that the air is delivered to).
- Any inflammation restricts air going inside the lungs. As the space for the exchange of air in the lungs decreases, the patient has to work harder to breathe, which may not be possible indefinitely.
- Role of ventilators: As patients can't breathe at rates of 40-45 (breaths) a minute and expect to sustain life, a ventilator allows one to rest the patient's lungs by giving them oxygen at higher rates.
- Ventilators allow the patient time to heal on their own by supporting a system that would have otherwise failed.

Does India have Enough Ventilators?

- As of now, India's state hospitals together have 14,220 ICU ventilators.
- Additionally, government (and some private) hospitals dedicated for the management of COVID-19 patients have about 6,000 ventilators.
- According to recent mathematical modelling by scientists of the Indian Council of Medical Research (ICMR), around half of those infected and in intensive care would require mechanical ventilation.
- Think tank Brookings India has estimated that India could, in the worst case, need between 1 lakh and 2.2 lakh ventilators by May 15.

How to Build a Ventilator?

- Different types of ventilators deliver air in different modes.
- To make a ventilator, one has to have core knowledge of the clinical aspects of the ventilator and the requirements of the doctors using them.
- These requirements have to then be converted into engineering components that can achieve the required outputs.
- Ventilators are a combination of technologies - not only software and electronics, but also pneumatics, as they Handle Gases.

- They are also required to adhere to safety standards, and include a mechanism to minimise the risk to the patient in the event the device malfunctions.

Classification of Ventilators:

- Based on the mechanism used to deliver the air (flow-delivery mechanism), there are **Three Major Classifications for Ventilators:**
 - 1. External compressed Air Driven Ventilators:** A pneumatic (operated by air or gas under pressure) external compressed air-driven ventilator in an ICU setting would be ideal for COVID-19 patients.
 - 2. Turbine Ventilators:** Turbine ventilators, although less effective, are the next best option - they have fewer components, and it would probably be easier to scale them up.
 - 3. Bellow-driven or piston ventilators.**
- A COVID-19 patient's lungs are relatively stiff and the air passages are swollen. Hence, low-flow gas will not help and one would need higher pressure and high flow.

Where the Problem Lies?

- Only 10% domestic manufacturing: According to industry sources, only about 10% of ventilators in use in India are manufactured in the country.
- The pandemic has affected global supply chains, even as demand has surged everywhere.
- With imports slowing, an increased burden now lies on Indian manufacturers, who have limited capacity to scale up production.
- Data from Indian manufacturers project their total monthly capacity to touch around 6,000 ventilators in a month from now.
- Question of raw material: At least 40% of a ventilator's physical components are imported from countries like the US, China, France, and Germany. These include several crucial components like sensors and displays.
- Failure of the government: In a usual situation, the government has an epidemic and disaster management cell, which is supposed to store ventilators in 'live' mode, running and monitored. Indian government has not done this.

Scaling up Domestic Manufacture of Ventilators:

- **Public sector:**
 - ✓ Bharat Electronics Ltd (BEL), a PSU under the Ministry of Defence, is in the process of manufacturing 30,000 ventilators.

- ✓ Health Ministry PSU HLL Lifecare Ltd has floated a tender for 20,000.
- ✓ ICF Chennai, maker of Train 18, is attempting to manufacture ventilators.
- **In the Private Sector:**
 - ✓ Mahindra & Mahindra to simplify the design of ventilators, and could start a collaboration with Tata, too. Simplifying the design would help overcome hurdles like sourcing imported components.
 - ✓ Maruti Suzuki India has announced an arrangement with Noida-based AgVa Healthcare to rapidly scale up production to 10,000 per month.

