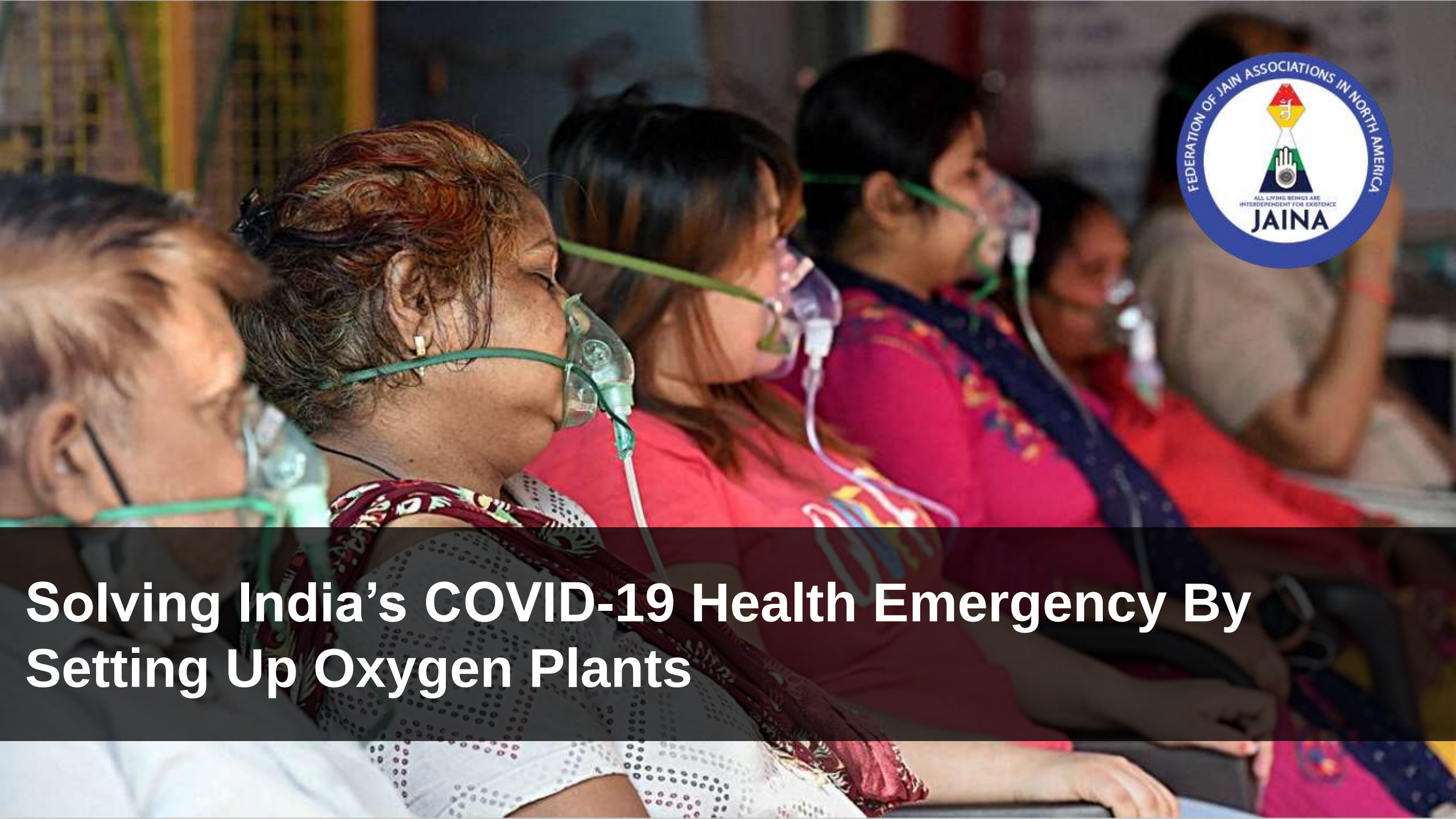

Solving India's COVID-19 Health Emergency By Setting Up Oxygen Plants

India’s Oxygen Crisis

Difference Sources of Medical Oxygen

Pressure Swing Adsorption (PSA)

Cylinders

- Very common
- Mobile but can be heavy
- Require high pressure compressor for filling
- Require supply chain

Manifold systems

- Cylinder based
- Require supply chain
- Require facility to have piping
- Relatively low maintenance
- Difficult to repair

Concentrators

- Mobile
- Do not require supply chain
- Require electricity
- Require maintenance

Oxygen plants

- Do not require supply chain
- Require electricity
- Require maintenance
- May need piping
- Capable of filling cylinders

Liquid oxygen

- Space requirements
- Requires facility to have piping
- Supply chain
- Suitable for larger facilities

Models to Estimate Oxygen Need

Essential Questions	Historical Oxygen Use	Facility-level estimation	Covid-19 health facilities estimation
Our Goal	To estimate the amount of oxygen an existing facility needs	To estimate the amount of oxygen a facility will need	To estimate the amount of oxygen a health facility or system needs
Our Data	Records of past oxygen use	1. Number of general beds 2. Number of critical care beds 3. Or specific facility infrastructure plans	1. Number of beds in each ward 2. Health facility bed occupancy rate 3. Hypoxemia rates by disease area or ward

Statistical Quantification as per Hosp. Size

Hosp Size in beds	Critical care beds	Total beds of Hosp	*Flow Rate(LPM*)/ Standard bed*	*Required LPM for standard beds*	*Flow rate(LPM) /Critical care bed*	Required LPM for critical care beds	**Total Required LPM (Standard & critical care bed)**
100	**8**	**108**	*0.75*	*75*	*10*	80	**155**
150	**12**	**162**	*0.75*	*113*	*10*	120	**233**
200	**16**	**216**	*0.75*	*150*	*10*	160	**310**
250	**20**	**270**	*0.75*	*188*	*10*	200	**388**
300	**24**	**324**	*0.75*	*225*	*10*	240	**465**

No of beds ĺ Flow rate(LPM) = Required Flow rate(LPM)
**LPM = Liter Per Minute*

Source: WHO formula

India’s Oxygen Crisis

Quick facts from the ground

Indian Government is controlling Industrial Oxygen at the federal level

Procurement efforts are being currently made from Steel & Petrochemical Plans: Reliance, Tata, Jindal etc.

India’s daily production capacity of **7127 MT per day**, 46% is industrial and **3842 MT is** used for medical consumption[1]

The medical consumption will increase to about 6,000 to 7,000 MT per day going forward with the current trajectory.[2]

Our Response From Southern California Through JAINA

Southern California is taking the lead under the guidance and 24/7 work of Dr. Nitin Shah in the last 2 weeks. Here are some of the updates we have on that front:

3000+

Oxygen concentrators have already reached India

- **80%** have a capacity of 6 or 7L/minute
- **10%** have a capacity of 10L/minute
- **10%** have a capacity of 5L/minute

Oxygen Plants in a Nutshell

	Step 1	Step 2	Step 3
With Liquefied O2	Liquefied oxygen is produced by industrial plants (usually given to govt. hospitals and controlled by govt.)	Liquefied oxygen is transferred and vaporized for further process	Oxygen gas is compressed in cylinders transferred to be used in hospitals at patient beds
With Atmospheric O2	Oxygen is concentrated from ambient air (21% Oxygen)	Oxygen is additionally compressed and distributed to hospital in cylinders	OR Oxygen is distributed to hospitals directly by installing pipes from the oxygen tank and pressure regulators

PSA Oxygen Plant

What is PSA?

PSA = Pressure Swing Adsorption, oxygen generator plant is a unit, designed to concentrate oxygen from ambient air at scale, with output capacity varying according to calculated oxygen demand, typically ranging from 2 Nm3 /hr to 200 Nm3 /hr.

Distribution from PSA plants to hospital can either be piped directly from the oxygen tank to hospital wards or further compressed to fill cylinders

PSA Oxygen Plant

Details about PSA Plant

- Produce medical oxygen 93%±3 from ambient air.
- Easy to install: Pre-assembled and skid-mounted, or containerised.
- 24/7 Oxygen production monitoring.
- Control panel / user interface, with numerical and graphical values.
- Life span of a minimum of 10 years.
- Alarm for low oxygen concentration.
- Alarm when automatic back-up engaged, as configured
- optional:
  - remote monitoring feature.
  - soft start or variable speed drive (VSD) compressor

Cost, Timeline, Benefits of Oxygen Plants

	Cost vs Capacity	Timeline	Long-term	Vendors
Liquefied O2 Plant 	**USD 165,000 to fill 1k bottles/day of 48L for 160-180 bedded hospital**	**7-10 days**	**Relies on nearby industrial plant for supply of liquefied oxygen.**	**INOX Air Products** and other vendors
Ambient Oxygen Plant 	**USD 80,000 for 250 bedded hospital at 100 cylinders/day**	**75 – 90 days. Negotiable**	**Self-sustaining once the plant is installed at or near a hospital(s)**	**Atmos Power and other vendors including in China**

Info About Atmos Power Pvt. Ltd.

**Other vendors are available in India and in China*

- ATMOS POWER have supplied and installed more than 300 projects globally.
- Atmos Plant Generate Oxygen as and when required – Plug – Switch on – Forget
- Lower Operation Cost – at facility
- Eliminate expense on purchase, receiving, monitoring hospital supply
- Monitor the Oxygen quality instantly
- Fully automated operation – Men less
- Easy to install and maintain- Skid mounted – pre-commissioned
- Purity of oxygen up to 93%
- No more explosion or fire hazard
- Generation cost Rs. 10 per Nm

Cost Benefit Analysis

Description	Oxygen From Cylinder	Oxygen From Generator
Basis of Calculation	8760 Hours/ Annum	8760 Hours/ Annum
Cost of Oxygen Cylinder	Rs. 1200 / - per cylinder	NIL
Handling Charges & Transportation	@ 10 %	
Power Consumption/hour	NIL	60 KWH
Power cost per KWH	NIL	Rs. 8/-
Cost of Oxygen per Nm3	**Rs. 216.9**	**Rs. 16.00**
Invstment	NIL	Rs. 4,800,000/-
Interest on capital Cost @ 18%	NIL	Rs. 864,000/-
Maintenance cost @ 3 %	NIL	Rs. 144,000/-
Final Cost of Oxygen per Nm3	**Rs. 216.9**	**Rs. 38.10**
Savings Per Annum if Hospital running 24 Hours per day	NIL	Rs. (Cost difference per Nm3 x 30 x 8760) = Rs.(178.8 x 30 x 8760) = **Rs. 46,988,640/-**
Pay back period		**12 – MONTHS approx.**

Market Availability and Pricing

- Negotiated Price based on installed capacity:
  For 250 bedded hospital average needs 100 cylinders per day. Therefore we need a plant with capacity of 30NM3. Price for such plant - 54 Lakhs + 12% GST

- Other Models Prices are as below :
  - 5Nm3/Hour equivalent to 17 Cylinders Per Day (upto 50 beds) @Rs. 18 Lakhs + GST
  - 10Nm3/Hour equivalent to 34 Cylinders Per Day (51-100 beds) @Rs. 29 Lakhs + GST
  - 20Nm3/Hour equivalent to 68 Cylinders Per Day (101-200 beds) @Rs. 39 Lakhs + GST
  - 30Nm3/Hour equivalent to 102 Cylinders Per Day (more than 200 beds) @Rs. 54 Lakhs + GST

- Above Price includes: Generators, Feed Air Compressor, Refrigerated Type Dryer, A Set off Filters, PSA Skid & 2m3 Storage Tank.

- Delivery Period: 75-90 Days currently
  Space Requirement. Room Length- 6.0 – 6.5 M, Width- 4.5 M, Room Height- 4.0 M

JAINA Oxygen Plan Initiative Stages

Info

1. Fill out the Google Form prepared by Jayana Shah to capture hospital and sponsor info.
2. Suggest a plant/vendor if any by hospital along with cost estimates (between INR 20 – 60 Lakhs

Approval

1. JAINA receives the application and approves it against set criteria (approval committee).
2. If there's no sponsorship – JAINA publicizes it via newsletters looking for sponsors.

Finance

1. JAINA receives 50% sponsorship (max $75k) for the proposed plant.
2. JAINA matches dollar-to-dollar from $27k to $70k (matched by $400k SMFT, $200k Jaswantbhai, $100k Maheshbhai) ***Money Transfer will be worked out preferably in 2 weeks.***

Video of Liquefied Oxygen Plant

Video of PSA Oxygen Plant

Create Demand

Please Note:

1. Total plants - where match is available - **are limited**.
2. Time is of essence. Summarizing the process:
   - ✓ *Filling out applications*
   - ✓ *Finding sponsors and financing by sponsors*
   - ✓ *Approval by JAINA for a particular hospital*
   - ✓ *Selecting vendor and advancing money by hospital to start manufacturing the oxygen plant.*
3. **Transferring money** from JAINA (finance committee) to hospital after app. paperwork

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