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RESEARCH ARTICLE

THE ECONOMIC IMPACT OF COVID-19 RELATED LUNG COMPLICATIONS ON THE INDIAN HEALTHCARE SYSTEM

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Abstract

COVID-19 has been spreading across the world, causing a major global crisis. Each successive wave of the pandemic is more dangerous than the previous one. The virus is constantly mutating. The Alpha, Beta, Gamma and Delta variants have been flagged as variants of concern. The Delta variant is especially prominent in India which has higher transmissibility. Several drugs and medicines need to be administered to severely ill patients. Adding to the problem, there have been several instances of black-marketing of drugs such as Remdesivir as they are in short supply but in huge demand. Furthermore, India is even facing an oxygen crisis where there is also a supply-demand mismatch. Many have died due to shortages of oxygen. This virus has had a massive impact on the Indian healthcare system. It may be counterintuitive but despite the huge rise in COVID-19 patients, hospitals, like nearly all other sectors, have faced big economic problems due to this virus. This virus has caused major humanitarian and economic problems. The only solutions the world has include hand-washing, wearing masks, social distancing, and vaccinations. People need to be prudent and follow these measures to reduce the impact of this pandemic and return to normalcy as fast as possible.

Introduction:-

COVID-19 or SARS-CoV-2 has been spreading across the world. The pandemic is a major global health crisis. India particularly has been impacted severely by the same. There are 523257 active cases and there have been 399459 deaths (10:00 AM 1 July 2021). The country saw a major spike in both cases and fatalities in the second wave of the pandemic which has proven to be much worse than the first.

One major reason for this was a particular mutation: B.1.617.2 or the Delta variant. It was declared by the World Health Organization (WHO) as a Variant of Interest on 4th April, 2021 and as a Variant of Concern on 11th May, 2021. There are three other variants of concern apart from the delta variant: B.1.1.7 or the Alpha variant, first detected in the United Kingdom; B.1.351 or the Beta variant, first detected in South Africa; and P.1 or the Gamma variant, first detected in Brazil.

These, as the name suggests, are causes for concern. Some of the changes include increased transmissibility, change in clinical disease presentation, and decrease in the effectiveness of public health and social measures or available

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diagnostics, vaccines, therapeutics. According to health experts, the transmissibility of the Delta variant is quite high.

Unfortunately, many who contract the virus aren't vaccinated. Thus, several lung complications arise in severe cases of COVID-19. This includes Pneumonia and Acute Respiratory Distress Syndrome (ARDS). In Pneumonia, the air sacs or alveoli of the lungs get filled with neutrophils and opsonins. ARDS usually sets in after Pneumonia. The blood vessels of the lungs leak into the alveoli. The disease can enter the bloodstream and move to other organs which can lead to organ failure. Even survivors may have lasting scarring.

In such lung complications, oxygen can be required. In a less severe scenario, the patient can inhale oxygen while in more severe scenarios, a ventilator may be needed. There has been a massive surge in oxygen demand since the onset of the second wave in India. Oxygen supplied to hospitals hit a peak of 8.944 MT on May 9. The oxygen usage has been dipping since then. There are several difficulties that the healthcare system faces in ensuring the timely provision of oxygen to patients. Many hospitals don't have the skilled personnel required to operate ventilators. Also, the transportation of oxygen is often a logistical challenge. Many parts of India are quite far from oxygen plants. Furthermore, many such plants only deliver in a 50-kilometre radius. Ones who deliver beyond that often charge extra. Also, oxygen needs to be handled very carefully; it is a combustible gas that can lead to fires in case of negligence.

India faced a major oxygen crisis and is still looking for ways to tackle the shortage. Before this, about 85% of oxygen use in India was for commercial purposes and 15% was for medical use. To address the problem, a blanket ban on oxygen supply to industries was issued on April 22 and supply resumed only on June 1. Many private sector companies such as (but not limited to) Reliance and Tata Group started contributing towards producing medical oxygen using their industrial equipment and machinery.

Many pressure swing absorption (PSA) plants were set up for oxygen production to cope with the surge in demand. Due to various reasons, PSA plants were chosen over their cryogenic counterparts. They are relatively much cheaper to build and the maximum area required is 7ft/9ft/7ft. As they use adsorption technology to obtain oxygen-rich air, they produce a comparatively low purity of oxygen.However, in the current predicament,they were necessary. 201.58 crore was deployed to build 162 plants. As of 18th April, 33 were built.

In addition to an oxygen supply, many drugs and medicines also need to be provided in severe cases. The efficacy of many such drugs has been debated. There has been significant research on this topic and there are mixed conclusions. However, the scenario is becoming clearer with time. Recently, the government removed Ivermectin, Azithromycin, Doxycycline, Zinc, Favipiravir and plasma therapy from the approved list of drugs.

Remdesivir has been used frequently in serious cases as the government has approved it for restricted emergency use. This drug is a bit expensive and there is significant demand for it. Hence, prices were slashed at the government's request, and Remdesivir API and formulation was placed under an export ban by DGFT on 11th April.Due to the drug's enormous demand, there have been multiple cases of illegal sale at a price several times higher than its MRP. The black market for this drug is a grave problem and measures have to be taken to prevent this.

In cases where the patient is critically ill, steroids such as Dexamethasone are provided to them. Dexamethasone is a life-saving drug that has saved many patients on ventilators. Fortunately, even its price is not that high. Even the monoclonal antibody cocktail developed by Regeneron and Roche has shown positive results.

However, these drugs would not completely solve the problem.There is broad consensus that vaccination is one of the only long-term solutions to COVID-19. There is sufficient scientific data to prove the efficacy of such vaccines. Currently, only around 3.5% of India's population is vaccinated. The country needs to ensure a faster vaccine rollout to minimise the health and economic impact.

The Delta Variant

Different variants of COVID-19 are caused by mutations or alterations in the genetic material of the virus. SARS-COV-2 is made of about 30,000 base pairs of amino acids and changes in even a single pair can cause a mutation.

This particular variant has multiple mutations in its spike protein. (The spike protein of a coronavirus is a glycoprotein protruding from its envelope that facilitates its entry into a host cell.)

The most important mutations are L452R, P681R, D614G, and T478K. According to Public Health England (PHE), the P681R mutation has been associated with chemical processes that may increase transmissibility. PHE states that there are analyses from England and Scotland supporting a reduction in vaccine effectiveness for Delta when compared to Alpha. A paper in the Lancet stated that adults fully vaccinated with the Pfizer-BioNTech vaccine are likely to have five times lower levels of neutralising antibodies against the Delta variant when compared to other variants.

Adding to the problem, the high transmissibility of this virus is causing it to spread to various countries. According to data from WHO, this variant has spread to more than 80 countries. It even replaced the Alpha strain as the dominant strain in the United Kingdom. On 19th June, CDC director Rochelle Walensky stated that she anticipates it could become the dominant strain in the United States as well.

Furthermore, there has been another mutation in this strain to form the Delta Plus or AY.1 variant. It has acquired the K417N mutation. This has major ramifications. It has been found to resist the monoclonal antibody treatment which was being used as a treatment for the virus. However, as of now, there is limited data on the virus and the WHO has only categorised it as a Variant of Interest and not a Variant of Concern.

Pulmonary Complications

In certain cases, a person who has contracted COVID-19 develops Pneumonia. The patient's air sacs or alveoli present in the lungs get filled with fluid consisting of neutrophils and opsonins. Also, white blood cells produce toxic chemicals like hypochlorite to kill the bacteria. (Bleach is also a hypochlorite; hence, it was the subject of many rumours suggesting that it could kill the virus. Multiple health agencies have debunked this myth to prevent consumption of this chemical which could cause serious bodily harm.)

Sometimes, severely ill Pneumonia patients also suffer from acute respiratory distress syndrome (ARDS). This is a life-threatening disease that allows fluid to leak into the lungs. Blood vessels of the lungs may leak into the alveoli and patients may face grave breathing difficulties. It causes many fatalities and even the survivors often suffer from lasting scarring.

If the disease progresses further, Sepsis may occur. In such cases, the infection enters the bloodstream and starts affecting other organs which leads to organ failure. This disease can affect any organ in the human body and it starts causing tissue damage wherever it occurs. Patients have suffered heart failures and serious kidney damage due to this.

When such pulmonary diseases set in, major problems occur. Patients need external support for respiration and breathing mechanisms as their natural respiratory system is unable to function optimally. In these circumstances, ventilators or oxygen masks may be needed. Due to the rapid spread of the virus throughout the country, there has been a massive surge in demand for such devices and the oxygen needed to run them. This led to a nationwide oxygen crisis. In addition to medical oxygen, several drugs are given to patients suffering from such complications. There has been a similar surge in demand for drugs which has led to a new problem: a black market where these drugs are sold illegally at inflated prices.

Drugs

Multiple drugs are given to patients in severe cases of COVID-19. There was no definite cure for the virus and initially, there was a lot of uncertainty. Various drugs were approved for usage. However, as time progressed and our knowledge of the virus improved, the efficacy of various drugs became much clearer. As research continued, it became easier to decide which drugs to administer in which cases. Still, changes to these lists are being made constantly. Recently the government prevented the usage of various drugs like Ivermectin, Azithromycin, Doxycycline, Zinc, Favipiravir, and plasma therapy. Remdesivir is a drug that has always been deemed to be more effective. There is controversy regarding this matter but in many situations, this drug is administered in emergencies. There is a very high demand for this and hence, illegal activities such as hoarding and black-marketing take place. Steroids such as dexamethasone have also proven to be effective in very severe cases. In fact, dexamethasone has been labelled as life-saving by many as it has significantly reduced deaths. The monoclonal antibody cocktail, which

is a combination of Casirivimab and Imdevimab has also shown promising results. According to the Economic Times, some doctors even refer to it as the 'first Covid treatment'.

Despite multiple drugs being available, they are in short supply. Hence, as mentioned earlier, there is a presence of a black market for drugs, especially Remdesivir. Although it has not been conclusively proved that Remdesivir helps in recovery, there is empirical evidence that it may be effective in certain cases. Many are desperate in India's adverse COVID-19 situation; thus, patients often resort to buying from illegal markets due to shortages. Currently, all legal Remdesivir in the country has a price between □ 899 and □ 3,490 depending on the pharmaceutical company you are purchasing from. However, there have been instances where the drug is even sold at □ 30,000 which is around ten times the MRP of the most expensive vial. Even these exorbitant prices may not be enough as they may be others who are willing to pay even more.

Oxygen Crisis

As mentioned earlier, in many of the COVID-related lung complications, the patient's respiratory system ceases to function normally. Thus, they need additional oxygen support in the form of oxygen masks or in very severe cases, even ventilators. This oxygen is usually supplied through positive pressure ventilation wherein the air in the oxygen cylinder is at a higher pressure than that of the lungs. In milder cases, this is done in a non-invasive manner with the patient simply putting on an oxygen mask. In severe circumstances, a ventilator needs to be used which practically takes over the entire breathing process by inserting a tube into the patient's trachea. Ventilators are often used only as last resort. It requires the patient to be heavily sedated and frequent ventilation can even lead to lung damage. However, in extreme situations, a ventilator can be the difference between life and death. As current models are large and bulky, expensive, and require extensive training to operate, many hospitals only have a few of them and some of them don't have any at all.

A major problem in the oxygen supply chain is transportation. Most manufacturers don't deliver outside a 50 km radius and those who do charge extra. This leaves large areas which aren't in the proximity of any oxygen manufacturers and thus, vulnerable to oxygen shortages. Moreover, there was a significant surge in demand for oxygen cylinders and not enough supply. Typically, around 85% of oxygen produced in India is used by industries whereas only 15% is sent to hospitals. However, given these extraordinary circumstances, certain alterations had to be made. On April 22, the central government issued a blanket ban on oxygen supply to all industries by invoking the Disaster Management Act. Supply was resumed only on June 1.

To address the shortage, lots of oxygen plants were set up. Mostly pressure swing absorption plants were set up instead of cryogenic oxygen plants. Although they provide a lower purity of oxygen, they were used in the crisis as they were inexpensive and easy to set up. Also, they didn't take up much space, the maximum space needed is 7'/9'/7'. Such plants use adsorption technology to obtain oxygen-rich air.

The government had commissioned the construction of 162 plants using □ 201.58 crores; as of 18th April, 33 had been built. On April 28, it was announced that the government would procure 1 lakh oxygen concentrators and 500 more PSA plants using the Prime Minister's Citizen Assistance and Relief in Emergency Situations (PM-CARES) fund. Even the private sector stepped in for assistance. Many companies started repurposing industrial oxygen or began producing oxygen. There are many such examples: Reliance supplied 700 tonnes of oxygen a day to Covid-hit states and ramped up medical grade oxygen production capacity to 1000 MT per day; Tata group and Linde India secured 24 cryogenic oxygen containers for medical use.

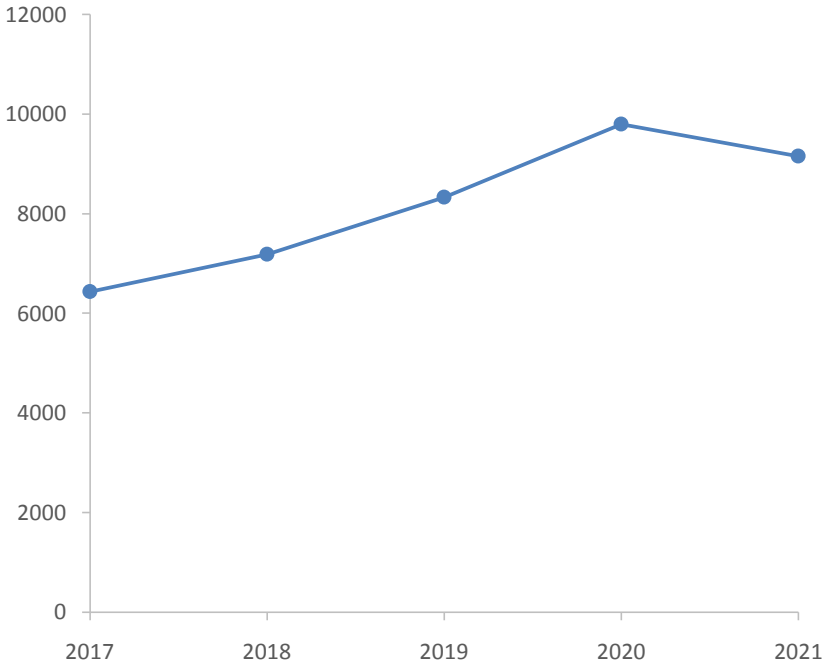
Economic Impact

It should come as no surprise that businesses were adversely impacted by COVID-19. There were so many lockdowns and restrictions that prevented them from carrying out their tasks effectively. Many would have expected, however, that hospitals would have done well. The lungcomplications caused by COVID-19 led to the hospitalisation of many patients. Obviously, this was horrifying; however, speaking strictly from an economic perspective, this would suggest a large increase in hospitals' customer base.

The logic used is pretty simple: patients provide more revenue, so more patients mean more revenue. However, this is deeply flawed. This hypothesis makes many false assumptions and doesn't include important factors. COVID-19 actually had a negative economic impact on hospitals.

Below is data (taken from BSE) from Apollo Hospitals, the biggest hospital and medical services company in the country by market capitalisation (around □ 53,000 Cr as of 1st July).

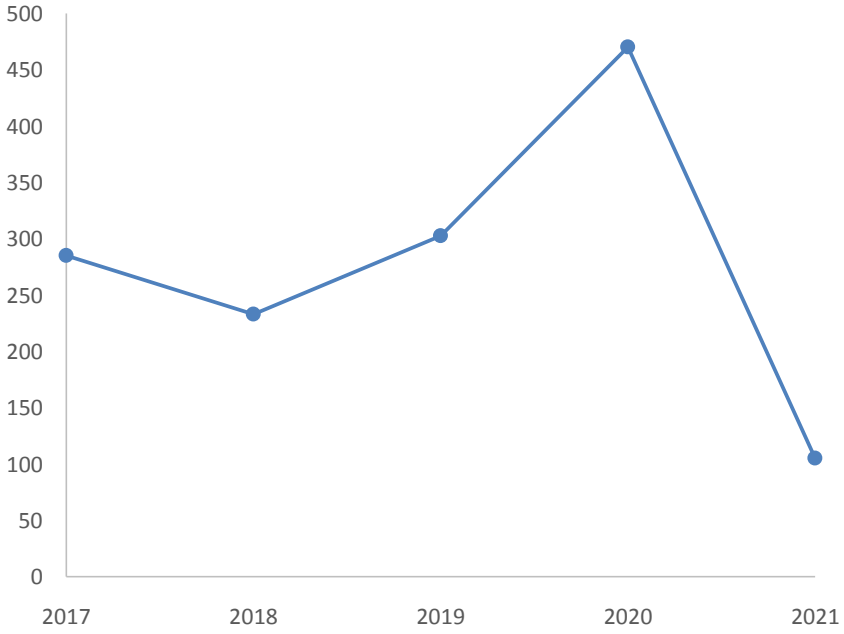
Apollo Hospitals Revenue (FY17-21)



Year	Revenue (in Cr.)
2017	6441.77
2018	7183.01
2019	8336.66
2020	9794.43
2021	9153.04

Figure 1:-

Apollo Hospitals Profit (FY17-21)



Year	Net Profit (in Cr.)
2017	285.15
2018	233.2
2019	302.76
2020	470.25
2021	105.15

Figure 2:-

As we can see from the above data, revenue as well as profit fell in FY 2021. Profit, in fact, saw a much steeper fall probably due to several additional and extraordinary costs that hospitals might have had to incur due to the COVID-19 pandemic.

To ensure that hospitals are ready for an increase in COVID-19 patients, they had to increase the number of negative pressure rooms, recruit a backup workforce, give overtime to employees, and acquired personal protection equipment (PPE).

There was a big impact on both the in-patient division (IPD) and out-patient division (OPD) of hospitals. (Outpatients are people with health problems that do not require a bed and don't need to be admitted for overnight care. Inpatients are people who have to live in the hospital during the course of their treatment.) The OPD was impacted as the general public did not want to go to hospitals unless it was an emergency and absolutely necessary. The IPD was impacted by the government notification to postpone all non-essential and elective surgeries. Even medical tourism in India took a massive hit due to the restrictions on international travel due to COVID-19.

There is actually a close adherence between India's quarterly GDP growth trend and Apollo Hospitals' quarterly profit trend. This shows that hospitals weren't outliers and they too, like many other businesses, suffered during the COVID-19 pandemic.

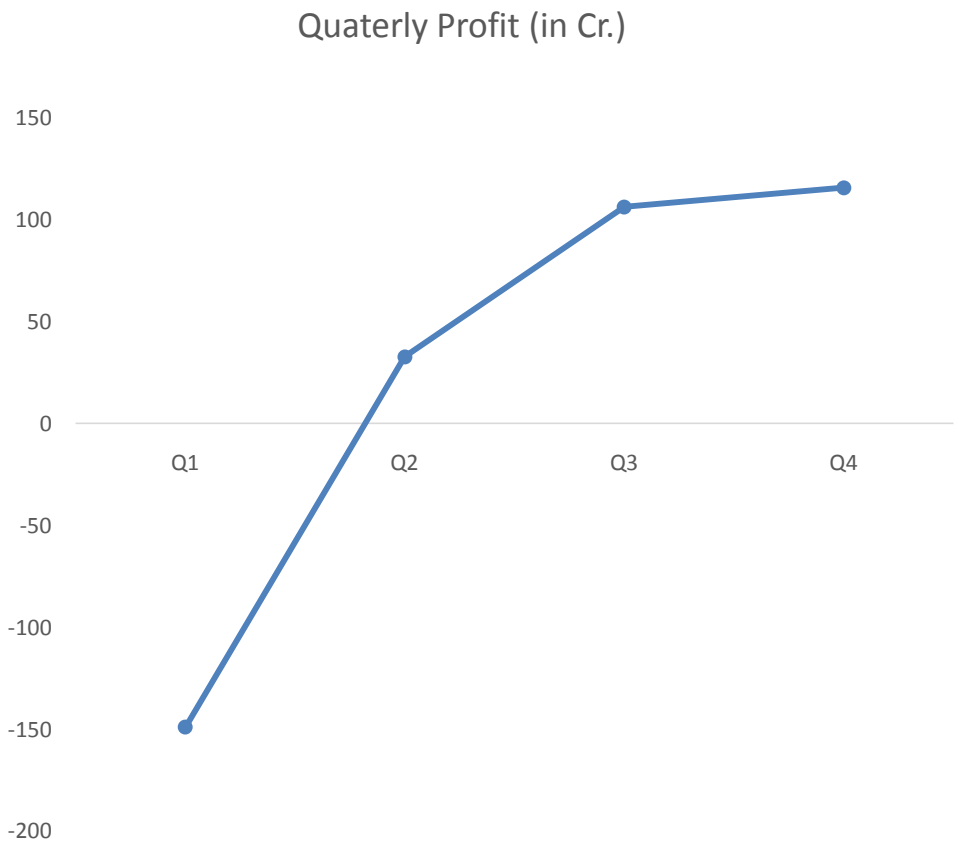


Figure 3:-

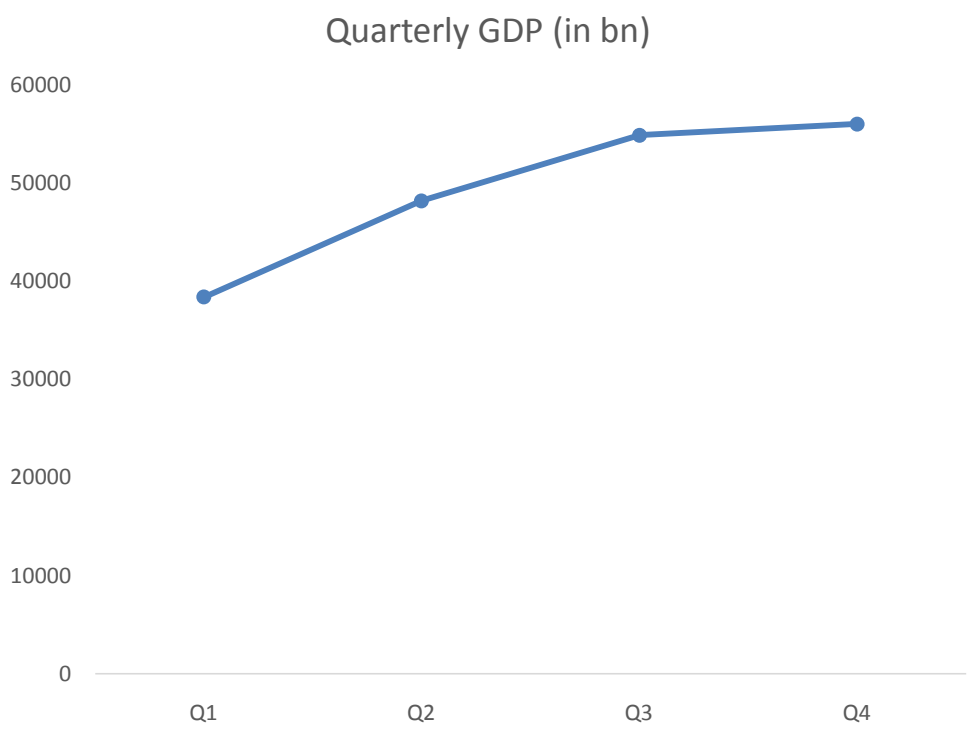


Figure 4:-

Quarter	Net Profit (in Cr.)	Quarter	GDP (in bn)
Q1	(149.11)	Q1	38,376
Q2	32.52	Q2	48,188
Q3	106.22	Q3	54,879
Q4	115.52	Q4	56,012

Furthermore, even before COVID-19, several problems were plaguing our healthcare system. India ranked 145th out of 195 on the Healthcare Access and Quality Index according to a report published by the Lancet. India's availability of beds ranges from 0.2 to 4.5 beds per 1000 people, with an overall average of 0.5 per 1000. Approximately, there are only 70,000 ICU beds and 40,000 ventilators in the country. These severe problems were only highlighted by the pandemic.

Conclusion:-

The COVID situation in India is dire, to say the least. The exponentially rising cases coupled with the healthcare system shortages has been a massive humanitarian and economic crisis. Wave after wave, this virus takes lives and ravages the economy. The second wave is in progress and, according to experts, even a third one is expected in due course of time. There is no silver bullet to tackle this virus. After all the research done on the virus, the most effective methods of preventing outbreaks are still wearing masks, social distancing, sanitizing hands, and taking vaccines. Furthermore, blackmarketing and hoarding of drugs need to be prevented by increasing vigilance and spreading awareness about this issue. As for the oxygen crisis, it is something that the government and industry need to tackle together to ensure an efficient and well-coordinated response. These measures need to be taken to minimise the effect of this deadly virus. The country's citizens have been suffering for a long time now and they deserve a return to normalcy.

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