



WWJMRD2022; 8(03):150-154

www.wwjmr.com

International Journal

Peer Reviewed Journal

Refereed Journal

Indexed Journal

Impact Factor SJIF 2017:

5.182 2018: 5.51, (ISI) 2020-

2021: 1.361

E-ISSN: 2454-6615

Hariom Dwivedi

Department of Physics,
Isabella Thoburn College,
Lucknow- (U.P.) India.

Analysis of controlling Covid-19 through Indian made drugs and supporting items

Hariom Dwivedi

Abstract

The COVID-19 pandemic firstly occurred in Dec 2019, caused by the novel coronavirus (SARS-CoV-2). Since then, it has affected millions of people worldwide, leading to an unprecedented global public health crisis. India, like many other countries, has been grappling with the pandemic since its outbreak in March 2020. However, the country has also made significant progress in controlling the spread of the virus, thanks to the use of several Indian-made drugs and supporting items. Technology played important role in managing infrastructure effectively and providing information timely to the persons in need. This paper analyses the effectiveness of these drugs and supporting items in controlling the COVID-19 pandemic in India.

Keywords: Covid-19, Technology, Indian Drugs, Vaccines, Devices, Supporting items, India.

1. Introduction

India, being the world's third-largest drug producer by volume and a manufacturer of 60 percent of vaccines globally, has played an active role in combating the COVID-19 pandemic both domestically and internationally. From the beginning of the pandemic and the resulting lockdown, Indian scientists and pharmaceutical companies worked tirelessly to address various challenges, such as coordinating with different ministries, departments and state governments to ensure the availability of essential drugs, including HCQ, Paracetamol, vaccines, insulin and cardiac drugs, and supporting items.

Despite facing initial challenges such as sub-optimal production, logistics, shortages and exports of pharmaceuticals and medical devices, lack of beds in hospitals, India worked round the clock to overcome these obstacles and provided aid to other nations as well. The whole world had to deal with a range of activities and multifaceted challenges that it had not faced before.

According to a report on the Indian pharmaceutical industry, the origin of Active Pharmaceutical Ingredients (APIs) plays a crucial role in the industry's strategic approach to addressing the COVID-19 pandemic. India is recognized as the primary global source of APIs for the production of generic drugs and contributes almost 20% of the generic APIs utilized in the United States.

The emergence of COVID-19 in China brought to the forefront the potential threat of supply chain disruption for crucial drugs in the Indian pharmaceutical industry, underscoring the urgency for India to achieve a significant level of self-sufficiency in drugs. To address this, a Technical Committee was constituted by the Department of Pharmaceuticals (DoP) with the Central Drugs Standard Control Organization (CDSCO) to make recommendations for the revival of new technologies for manufacturing APIs including its costing of the projects, backward integration and identification of strategic business models and the fermentation industry.

On the basis of the committee's recommendations, the Department prepared two schemes: the Production Linked Incentive (PLI) Scheme for promoting domestic manufacturing of critical Key Starting Materials (KSMs)/ Drug Intermediates (DIs) and Active Pharmaceutical Ingredients (APIs) by attracting investments in the sector to ensure their sustainable domestic supply and thereby reduce India's import dependence on other countries for critical

Correspondence:

Hariom Dwivedi

Department of Physics,
Isabella Thoburn College,
Lucknow- (U.P.) India.

KSMs/Drug Intermediates and APIs; and the Scheme for Promotion of Bulk Drug Parks, which provides grant-in-aid to three Bulk Drug Parks for the creation of Common Infrastructure Facilities (CIF) with a maximum limit of 70% of the project cost of CIF or Rs. One thousand crore per park, whichever is lower. Financial assistance for North Eastern States and Hilly States (Himachal Pradesh, Uttarakhand, Union Territory of Jammu & Kashmir and Union Territory of Ladakh) would be 90% of the project cost. The Scheme will last for a period of five years, from 2020-21 to 2024-25, and its total size is Rs. 3000 crore^[1]. India has succeeded in upholding some of the most impressive global statistics for the COVID-19 pandemic, including maintaining exceptionally low positivity and mortality rates alongside one of the highest recovery rates. This achievement has been attributed to the country's active engagement in the fight against the disease, as well as its significant endeavours towards the development and manufacturing of drugs for the treatment and prevention of COVID-19.

2. Methodology

This review paper deals with recent developments in the field of drugs and supporting items giving account of important technologies used in managing and controlling pandemic, by the literature review. During very short time, vaccines, discovered, are made available to all the peoples for which literature survey was done and data is presented through this paper.

3. Steps taken to fight against the Covid-19

Several Indian-made drugs and supporting items have been used in the management of COVID-19 in India, with varying degrees of success. Some of the drugs that have been found to be effective include Remdesivir, Favipiravir, Ivermectin and Tocilizumab. These drugs have been used for the treatment of COVID-19 patients and have been shown to reduce the severity of the disease and shorten the hospitalization period.

In addition to these drugs, several supporting items have also been used in the management of COVID-19 in India. These include personal protective equipment (PPE), oxygen concentrators, and ventilators. PPE, such as masks, gloves, and gowns, have been widely used to prevent the transmission of the virus. Oxygen concentrators and ventilators have been used to manage the respiratory complications of the disease, which is one of the leading causes of death in COVID-19 patients.

3.1 Remdesivir

Remdesivir is an antiviral medication that was initially developed for the treatment of Ebola virus disease. However, it has also shown effectiveness in treating COVID-19 patients, particularly those who are hospitalized and require oxygen therapy. Seven Indian companies - Mylan, Hetero, Jubilant Life Sciences, Cipla, Dr Reddy's, Zydus Cadila and Sun Pharma – produce Remdesivir injections under licensing agreement with Gilead Sciences. India is one of the major producers of Remdesivir and has exported close to 11 lakh injections of Remdesivir, an antiviral drug repurposed for Covid-19 treatment, in the last and first quarter of 2020 and 2021 to more than 100 countries. The clinical outcome of cure or improvement was recorded in 83.99% (improved- 56.33%; cured-

27.66%), death in 6.77% and no improvement was seen in 9.16% of the patients at the time of data collection^[2].

3.2 Favipiravir

Favipiravir is another antiviral drug that has shown promising results in the treatment of mild to moderate COVID-19 cases. It works by blocking the replication of the virus in the body and reducing the duration of illness.

3.3 Itolizumab

The Drugs Controller General of India has granted approval for emergency treatment of acute respiratory distress syndrome (ARDS) in COVID-19 patients using an anti-CD6 IgG1 monoclonal antibody produced by Biocon Biologics in Bengaluru, India^[3].

3.4 Covid-19 vaccines

India's endeavours to enhance digital literacy and connectivity have yielded fruitful outcomes during covid pandemic. The countries domestically produced digital platform, CoWIN, has revolutionized the way vaccine appointments are booked and vaccination certificates are generated in real-time. This innovative platform offers the convenience and safety for all residents of India to easily access and book vaccination appointments. Covaxin and Covishield are COVID-19 vaccines developed and manufactured in India to prevent COVID-19 infection.

3.4.1 Covaxin

It is an indigenous vaccine developed by Bharat Biotech in collaboration with the Indian Council of Medical Research (ICMR). Covaxin is an inactivated vaccine, which means it contains dead virus particles that cannot cause disease but can stimulate an immune response. Covaxin was granted emergency use authorization by the Indian government in January 2021. Covaxin is found effective against covid-19 as well as its variants^[4].

3.4.2 Covishield

It is the Indian version of the Oxford-AstraZeneca vaccine, which is produced locally by the Serum Institute of India (SII). Covishield is a viral vector vaccine that uses a weakened version of a common cold virus (adenovirus) to deliver a piece of the COVID-19 virus to stimulate an immune response. Covishield was granted emergency use authorization by the Indian government in January 2021.

On January 16, 2021, India initiated the world's most extensive vaccination campaign aimed at administering COVID-19 vaccines to approximately 300 million individuals within priority groups. The drive was primarily intended to safeguard higher-risk individuals, comprising 10 million health workers, 20 million frontline workers and around 270 million persons aged 50 years and above, or those with underlying health conditions that could exacerbate the severity of the disease.

To date, the nationwide vaccination campaign has administered a total of 219.71 crore doses of COVID-19 vaccines, which also includes the Covaxin vaccine. India has authorized the use of eight vaccines for emergency purposes, including Covishield, Covaxin, Sputnik V, ZyCoV-D, Moderna, Johnson and Johnson, Corbevax and Covovax^[5].

India, upholding the belief in 'Vasudhaiva Kutumbakam' has not only extended support to its own citizens by

offering free vaccine doses, but has also played a significant role in the global fight against COVID-19. India has provided vaccine doses to various countries and UN entities through a combination of grants, commercial export and contributions.

3.5 Hydroxychloroquine

Hydroxychloroquine is an antimalarial drug that has been repurposed for the treatment of COVID-19. India is one of the largest producers of hydroxychloroquine in the world. As part of the global efforts to combat the Covid-19 pandemic, the Indian government has authorized the distribution of the anti-malarial drug hydroxychloroquine to 55 countries through commercial sales or grants. For example, India shipped more than 50 million tablets of hydroxychloroquine to the United States^[6] itself and India also permitted the export of approximately, 31 million acetaminophen tablets and 5 million HCQ tablets along with 3510 kg of HCQ API to Canada by 6th April 2020^[7].

3.6 Paracetamol

Paracetamol, also known as acetaminophen, is a commonly available pain reliever and fever reducer medication that is widely used as an over-the-counter drug. India is one of the largest global manufacturers of paracetamol and during the pandemic, it exported this drug to many countries. In fact, India's export of the active pharmaceutical ingredient (API) for paracetamol, which is a commonly used pain reliever, totalled around 1,000 tonnes to Europe alone, helping to ease export controls on over-the-counter medicines used to cope with COVID-19 symptoms. By May 6, 2020, commercial exports of paracetamol had been dispatched to 87 countries around the world^[8].

3.7 Oxygen concentrators

COVID-19 is a respiratory illness that targets the lungs and can lead to critically low levels of oxygen. In such circumstances, a medical intervention called oxygen therapy is required to increase oxygen levels to a safe and acceptable range. Oxygen concentrators are medical devices that help patients with respiratory problems to breathe more easily by providing a concentrated supply of oxygen. India became a major manufacturer of oxygen concentrators during the pandemic to meet the growing demand for these devices.

3.8 Ventilators

Ventilators are crucial medical devices that provide mechanical support to the lungs and aid patients with severe respiratory problems to breathe. India recognized the increasing demand for ventilators during the pandemic and thus focused on ramping up their production. For instance, domestic manufacturers like Agva Healthcare in Noida developed suitable ventilators and received an order for 10,000 units. Furthermore, Bharat Electronics Limited received an order for 30,000 ventilators and is partnering with domestic manufacturers to meet the demand. Even Indian auto manufacturers came forward to assist in the production of ventilators. This concerted effort to scale up the production of ventilators exemplifies India's commitment to providing the necessary medical equipment during the pandemic.

3.9 Technical assistance

India provided technical assistance to other countries through various means, such as setting up COVID-19 help desks, providing teleconsultation and sharing guidelines and protocols. India's Ministry of External Affairs also organized virtual training programs for healthcare professionals in other countries.

3.10 Medical equipment

India not only exported essential medical equipment like oxygen concentrators and ventilators, but also provided assistance by supplying other crucial medical equipment such as PPE kits, diagnostic kits, and N95 masks to countries in need. The country's innovative start-ups from across the country developed and scaled up a range of low-cost technologies, which played a vital role in India becoming the world's second-largest Personal Protective Equipment (PPE) manufacturer during the COVID-19 pandemic. During the second wave of the pandemic in 2021, India provided medical aid to neighbouring countries like Nepal and Bangladesh, including oxygen concentrators and ventilators. India also exported 23 lakh PPE kits to five countries in July 2020^[9]. By December of the same year, India emerged as the world's second-largest manufacturer of PPE kits, with over 1,100 manufacturers producing 450,000 units daily^[10]. Nearly 30% of the total production was exported to countries around the world, further cementing India's role in the global fight against the pandemic.

During the lockdown, Mahindra Group quickly adapted and leveraged its supply chain to meet the urgent requirement of masks by manufacturing masks at their plant. This was a successful example of start-up-corporate collaboration, combining the innovation and agility of start-ups with the scaling up capabilities of corporations to cater to the needs of the time. Furthermore, from Bengaluru, India Printalytix Private Limited invented products such as contactless door openers, protective face shields, and intubation boxes for protection against infection.

NT-Mask, a transparent N95 mask with a special access point to help medical professionals collect oral swabs without infecting themselves was developed by Comofi Medtech. Not limiting to but, based in New Delhi a Nanoclean Global, developed the Nasomask, an N95/FFP2 grade face mask using nanofibers which has high breathability, and negligible breathing resistance and is highly efficient against contagious viruses^[11].

3.11 Humanitarian aid

In addition to sending medical teams to countries such as Maldives, Mauritius and Seychelles, India also provided humanitarian aid to countries such as Nepal and Bangladesh, which were affected by natural disasters during the pandemic. For example, India sent a relief package, including essential medicines and medical equipment to Nepal, which was hit by a second wave of COVID-19 and also facing the aftermath of a devastating earthquake.

3.12 Applications of Technology

Technology has played a crucial role in India's fight against the COVID-19 pandemic, enabling the country to respond more efficiently and effectively to the crisis. The use of remote communication and monitoring, contactless

delivery of goods and services, and the sharing of information and resources have all been made possible by technological advancements. For Examples –

Arogya Setu app, launched by the Indian Government in April 2020 as a contact tracing app to help citizens assess their risk of contracting COVID-19. The app uses GPS and Bluetooth to track the movement of users and notifies them if they have come into contact with an infected person. It also provides users with health-related information, self-assessment tools and a list of COVID-19 testing centres in their area. With millions of downloads, the app has played a significant role in India's efforts to control the spread of the virus.

During the pandemic, startups like Innefu and Qkopy leveraged their tech offerings to manage the crisis. They developed apps like Unmaze to help track quarantined individuals and GoK Direct-Kerala to share the latest health updates. The government authorities have also used several applications like Corona Watch, SMC-COVID Tracker, SAHYOG, and COVID19-Feedback to control the spread of the virus and map affected citizens. In addition, a whole new range of applications and portals like Search My Bed, COVID SoS, and SprinklR have focused on locating emergency medical supplies^[12].

To ensure accessibility of quality treatment for both COVID and non-COVID health issues, to far flung areas, use of telemedicine has been promoted in a big way. With telemedicine doctors were able to consult with patients remotely and provide medical advice without the need for physical contact. This helped reduce the risk of infection and ensured that patients received timely medical care. For example, 'eSanjeevani', a web-based comprehensive telemedicine solution is being utilized in 23 states to extend the reach of specialized healthcare services to masses in both rural areas and isolated communities. As of 29th December 2020, more than 11 lakh tele-consultations had been held on this digital platform.

In addition, the government and private companies in India offered mental health support to individuals who were quarantined or suffered from mental health issues due to prolonged periods of isolation at home. Such support was provided through online platforms, enabling individuals to access mental health professionals remotely and receive necessary counselling and therapy. This initiative helped address the psychological impact of the pandemic and provided much-needed support to people struggling with mental health issues during these challenging times. Overall, technology has enabled India to respond more effectively to the pandemic and will continue to play a critical role in the country's efforts to control the spread of the virus^[13].

3.13 Home remedies

The Ministry of AYUSH (Ayurveda, Yoga & Naturopathy, Unani, Siddha, and Homeopathy) advised individuals on healthcare measures and self-care guidelines to boost immunity and fight against COVID-19 with Ayurvedic procedures. These guidelines included drinking warm water throughout the day, practicing Yogasana, Pranayama and meditation for at least 30 minutes, consuming spices like Turmeric, Cumin, Coriander and Garlic, drinking herbal tea made from Basil, Cinnamon, Black pepper, Ginger, and Raisin once or twice a day, applying sesame or coconut oil in the nostrils every morning and evening, performing oil

pulling therapy, consuming chyawanprash and Golden Milk, and steam inhalation with fresh pudina, clove powder with honey to alleviate dry cough and sore throat.

In addition of that the Ministry of AYUSH also utilized Ayurvedic literature and scientific publications to make recommendations for preventive measures and immune-boosting techniques, with a particular emphasis on respiratory health. Various medicinal plants such as *Tinospora cordifolia*, *Andrographis paniculata*, *Cydonia oblonga*, *Zizyphus jujube* and *Cordia myxa* were studied for their immune-modulatory, anti-allergic, smooth muscle relaxant and anti-influenza properties and were recommended for COVID-19 treatment and immune system enhancement^[14].

3.14 Infrastructure

The laboratory network is continuously being strengthened. From a situation of a single laboratory equipped to undertake testing for COVID in January 2020, by the end of December, 2288 laboratories (as on 30th December 2020) are conducting COVID-19 Testing. Laboratories have been set up in challenging geographical locations such as Lakshadweep, Andaman & Nicobar Islands, Arunachal Pradesh, Sikkim, Nagaland, Ladakh as well as other states in North East India. The testing crossed 1.5 million tests a day, much higher than that stipulated by WHO which is 140 tests per million population per day^[15].

Overall, India's production of these items and drugs played a crucial role in the global fight against COVID-19 by ensuring the availability of essential medical supplies in many countries.

India's efforts to help other countries during the pandemic were diverse and extensive, ranging from providing essential medicines and vaccines to sharing technical expertise and providing humanitarian aid. These efforts helped India and other countries to combat the pandemic and were widely appreciated by the international community.

4. Future Scope

India has been actively fighting the COVID-19 pandemic since its outbreak in early 2020. The country has implemented various measures to control the spread of the virus, including lockdowns, mass testing, contact tracing, vaccination drives and awareness campaigns also. COVID Drugs Management Cell (CDMC) has been set up in the Department of Pharmaceuticals (DoP) to oversee the management of smooth supply of drugs used in COVID -19 management during the pandemic.

But as COVID-19 continues to evolve, new variants of the virus have emerged and have been detected in different parts of the world. These variants can potentially spread more rapidly, cause more severe disease and be resistant to existing treatments and vaccines.

The government and health authorities will also need to closely monitor the emergence of new variants and adjust their strategies accordingly. So, India has been monitoring the emergence of new variants and has been taking measures to control their spread. The Indian Council of Medical Research (ICMR) has been conducting genetic sequencing of samples collected from COVID-19 positive patients to identify new variants.

India will need to continue the fight with COVID-19 by further strengthening its healthcare infrastructure,

expanding its vaccination coverage, and promoting COVID-appropriate behaviour such as wearing masks, practicing social distancing and maintaining hand hygiene. India has a strong pharmaceutical industry, and the government is working with pharmaceutical companies to increase the production and supply of critical drugs, medical equipment and vaccines. The government has also established laboratories in remote and challenging regions of the country to enable quick detection and control of the spread of new variants.

Additionally, India can also collaborate with other countries and international organizations to share knowledge and resources to combat the pandemic on a global scale.

5. Conclusions

Indian-made drugs and supporting devices have played a significant role in controlling the COVID-19 pandemic in India. The drugs have been shown to be effective in reducing the severity of the disease and shortening the hospitalization period. The supporting items, such as PPE, oxygen concentrators, and ventilators have been essential in preventing the transmission of the virus and managing the respiratory complications of the disease.

The Indian COVID vaccine has played a crucial role in enabling the country to recover quickly and significantly reduce the number of COVID cases. However, more research is needed to determine the long-term effectiveness of these drugs and supporting items in controlling the COVID-19 pandemic.

Overall, the use of Indian-made drugs and supporting items has been a crucial factor in India's fight against the COVID-19 pandemic. These drugs and supporting items have helped to save thousands of lives and have been instrumental in reducing the burden on the healthcare system. Therefore, there is a need to continue to invest in the development and production of Indian-made drugs and supporting items to ensure that the country is better prepared to handle any future pandemics.

6. Acknowledgment

The author is thankful to college President Dr (Mrs) E. S. Charles and Principal Dr (Mrs) V. Prakash for encouragement and cooperation to do this work.

References

1. Annual report 2020-21. Department of Pharmaceuticals. <http://pharmaceuticals.gov.in>
2. Gupta, V., Hegde, R., Sawant, S. et al. Safety and clinical outcomes of Remdesivir in hospitalised COVID-19 patients: a retrospective analysis of active surveillance database. *BMC Infect Dis* 22, 1 (2022). <https://doi.org/10.1186/s12879-021-07004-8>.
3. <https://www.centerforbiosimilars.com/view/biocons-itolizumab-approved-in-india-for-covid19-inflammation>
4. Yadav P. D. et al, Inactivated COVID -19 vaccine BBV 152/COVAXIN effectively neutralizes recently emerged B.1.1.7 Variant of SARS-CoV-2. *Journal of Travel Medicine*, (2021), 1-3.
5. http://timesofindia.indiatimes.com/articleshow/88564472.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst
6. <https://health.economictimes.indiatimes.com/news/industry/india-exports-50-million-hydroxychloroquine-tablets-to-us-for-covid-19-fight-source/75490316>
7. <https://www.international.gc.ca/transparency-transparence/briefing-documents-information/parliamentary-committee-comite-parlementaire/2020-05-05-covi.aspx?lang=eng>
8. <https://www.reuters.com/article/us-health-coronavirus-india-paracetamol-idUSKBN22115P>
9. <https://www.deccanherald.com/national/india-exported-23-lakh-ppe-kits-to-5-countries-in-july-health-ministry-873251.html>
10. <https://www.hindustantimes.com/india-news/from-shortage-last-year-india-now-has-surplus-of-ppe-kits-n95-masks-101620620597446.html>
11. <https://dst.gov.in/technology-based-startups-played-crucial-role-converting-india-importer-second-largest-manufacturer>
12. Gangadharan S. How technology is helping India to fight covid-19. *FORTUNE India, Opinion* (2021). <https://www.fortuneindia.com/opinion/how-technology-is-helping-india-to-fight-covid-19/105560>
13. Ghosh, A., Nundy, S., Mallick T. K., How India is dealing with COVID-19 pandemic, *Sensors International*, 1, (2020) 100021, 1-8.
14. <https://www.mohfw.gov.in/pdf/ImmunityBoostingAYUSHAdvisory.pdf>
15. <https://pib.gov.in/PressReleasePage.aspx?PRID=1684546>