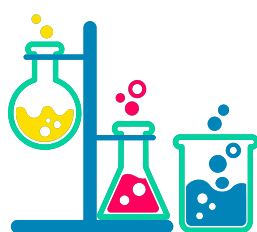


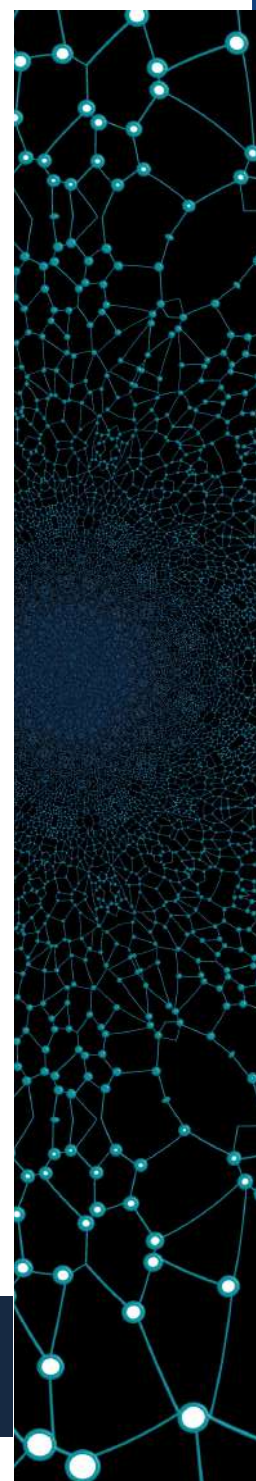
May 2021

Approach Paper

S&T Approach Addressing Resurgence of COVID-19(STAARC)



Technology Information, Forecasting & Assessment Council (TIFAC)



Brainstorming Meeting by TIFAC

Addressing COVID-19 Resurgence -S&T Perspective

May 10, 2021; Virtual Platform



Introduction & Welcome : 11.30 AM- 12.45 PM

Dr. V.K. Saraswat
Hon'ble Member, NITI Aayog
Chairman-TIFAC
Opening Remarks



Prof. Ashutosh Sharma
Secretary, DST
S&T Perspective



Dr. Vijay Chauthaiwale
Healthcare Consultant
Current Status & Need



.....
Clinical Health Perspective

Prof. Nandita Das
Professor - Pharmaceutical Sciences
College of Pharmacy & Health Sciences
Butler University, USA



Prof. Pradeep Srivastava
Executive Director, TIFAC
Welcome Address



Shri Pramod Kumar Pathak
Special Secretary, Ministry of AYUSH



Sessions & Speakers

**Pharma and Drugs- Availability
& Imports (12.45 PM - 1.15 PM)** 



Dr. P.B.N. Prasad
Joint Drugs Controller (India),
CDSO



Dr. Bakulesh Khamar
Executive Director- R & D
Cadila Pharma Ltd.

**Vaccines: Trials & Availability
(1.15 PM - 1.45 PM)** 



Dr. Suresh Jadhav
Executive Director,
Serum Institute of India, Pune



Dr. Siddharth Daga
CEO, M/s Vins Bioproducts Ltd.
Hyderabad

.....
**Medical Equipment & Infrastructure
(1.45 PM- 2.15 PM)** 



Shri Ravi Ramaswamy
Sr. Director, Healthcare Systems
Phillips Innovations



Shri Sunil Khurana
CEO, BPL Medical Technologies
Bengaluru

**Discussion & Road Ahead
(2.15 PM - 3.00 PM)** 

Dr. V.K. Saraswat, Chairman- TIFAC
Prof. Ashutosh Sharma, Secretary DST
Dr. Vijay Chauthaiwale, Healthcare Consultant
Dr. Raman Gangakhedkar, Former Head Scientist, ICMR
Dr. Jitendra Kumar, Nephrologist, Metro Hospital, Faridabad
Prof. Pradeep Srivastava, ED-TIFAC

Attendees link

<https://tifac.webex.com/tifac/onstage/g.php?MTID=e76e0b77dccaafde791158e0f50e076f0f>



APPROACH PAPER

**S &T Approach for Addressing
Resurgent COVID19(STAARC)**

**BASED ON
BRAINSTORMING WORKSHOP
(held on 10th May,2021)**

BACKGROUND

Technology Information, Forecasting and Assessment Council (TIFAC), is an autonomous body of Department of Science and Technology and works as National Technology Think Tank. TIFAC has been contributing to the nation preparing technology and policy advisory documents on contemporary issues and challenges.

The recent COVID-19 wave has hit the country hard in terms of number of infections and resultant deaths. Overwhelmed healthcare infrastructure is stretched to the point of coming apart. With fast mutating variants of the virus, constraints in vaccine supply vis-à-vis the requirement, increasing huge number of positive cases, with increased severity and health complications, increasing numbers of deaths gives a loud call for all round efforts to contain the losses.

In this scenario, the role and requirement of correct clinical approach, availability of medicines, vaccines, oxygen and requisite devices have assumed critical importance. A well-considered calibrated approach for addressing the COVID resurgence taking into view the opinions of doctors, industry and policy makers is of immediate necessity. Accordingly, TIFAC organized a brainstorming meeting on “**Addressing COVID Resurgence – S&T Perspective**” bringing doctors, industry, policymakers and other stakeholders on a virtual platform, was Chaired by Dr. V.K. Saraswat, Chairman TIFAC Governing Council and Member NITI Aayog. Prof. Ashutosh Sharma, Secretary DST and many associated eminent experts, vaccine manufacturers, clinicians, experts from US, and policy makers also participated.

The list of participants of the brainstorming meeting is at Annexure 1.

The deliberations and discussions were focused on the following topics:

1. Clinical Approach/Experiences

2. India’s Preparedness focusing on the following:

a. Drugs and Vaccines

- Production: Raw Material Requirements/ IP Issues/ Capacities/ Imports
- Local Availability & Distribution
- Vaccine Policy / IP: How quickly we can vaccinate our entire population, the vaccine production and distribution issues?
- Drugs and Vaccines on the Horizon to Augment the Supply : IP Issues
- Regulatory Compliances

b. Medical Equipment and associated Infrastructure

- Ensuring Adequate Availability of Oxygen
- New Technologies for Producing Oxygen: Oxygenators: Production Requirements/ Constituents Parts
- Need for Technology Sharing/Adoption/Acquisition

c. Skill & Manpower Capacity Development for COVID Management

d. Testing and Tracing

- Use of IT support for surveillance and coordination
- Quick testing machines (From Israel): Breath test

It is pertinent to mention here that last year, with the onset of COVID-19 pandemic and ensuing economic depression, TIFAC had brought out two policy papers - A White Paper for undertaking '*Focused specific S&T interventions for Make in India, post COVID 19*' and a comprehensive report for implementation, '*Action Agenda for an Aatma Nirbhar Bharat*' – ("AAAN") with sector specific action points. Both the reports were released by Hon'ble Minister for S&T Dr. Harsh Vardhan. The reports led to a number of follow up actions in various sectors.

CHAPTER 1: CLINICAL EXPERIENCES (INDIA & US)

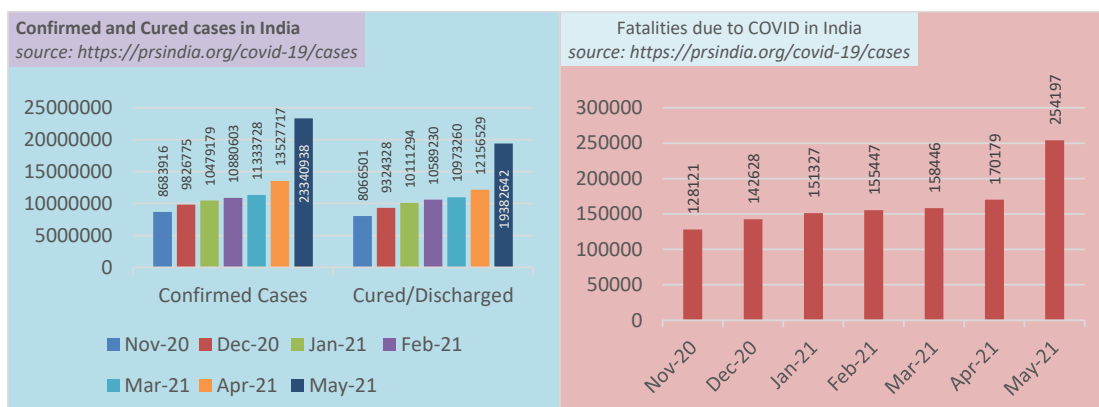
Current Indian Scenario

A combination of a large asymptomatic population and the presence of more infectious variants of the virus during the second wave, which is much steeper than the first wave that peaked in September 2020, continues to transmit the virus even to those who are staying indoors. For instance, the UK strain detected in a significant proportion during genome surveillance in Delhi and Punjab, has shown a 50% higher transmission, according to the US Centers for Disease Control and Prevention (CDC). The L452R mutation found in the variant B1.671, first detected in India, too has been associated with increased infection rate. Also, during this surge, there has been a long waiting period for testing. Until the results are available, many asymptomatic persons violate isolation guidelines and spread the infection.

Key statistics

Based on the data available on Government websites and open domain, a few key statistics are as given below:

a) COVID cases



Death Rate:1.07% Positivity Rate: 7.6% (MoHFW data accessed on 12th May 2021)

b) COVID Hospitals/Hospital Beds

Dedicated COVID Hospitals (DCH)	Dedicated COVID Health Centers (DCHC)	COVID Care Centers (CCC)	Railway coaches	DRDO facilities
2084	4043	12673	3816 coaches in 16 railway zones	1000 to 10,000 beds
Central-89 State-1995				
468974 beds	1383291 beds			

Source: SUPREME COURT DOCUMENT (Suo Motu Writ Petition (Civil) No.3 of 2021) released on May 2, 2021 regarding distribution of essential supplies and services during pandemic

c) Status of vaccination (As on 12th May,2021)

1st dose: 13,66,19,734 (10.2% of population 134 crores)

Both doses -fully vaccinated: 3,86,16,257 (2.8%)

d) Therapeutics

Commonly used drugs for treatment: azithromycin, doxycycline, paracetamol, *Remdesivir*, *Ivermectin*, *Steroids*, *Vitamin C*, *Vitamin D*, *Zn etc.*

e) Medical Devices

The critical situation calls for urgent augmentation of medical infrastructure in terms of number of hospital beds, availability of life support system such as oxygen concentrators, cylinders, ventilators etc along with trained medical and paramedical personnel for hospital/ICUs.

US Scenario

- a) Cumulative of 32.9 million cases till date.
- b) Cases in the last 7 days/100k people: **83**
- c) Daily cases change in the last 7 days : - **22%**
- d) Deaths % in the last 60 days: **1.4%**
- e) Current mobility change: **-22**

(Source: <https://rodillo.org> - accessed on 12.05.2021)

Therapeutics / Vaccination

- Therapy with anti SARS COV-2 monoclonal antibodies(EUA)
 - Bamlanivimab 700mg plus etesevimab 1400 mg;
 - Casarivimab 1200 mg plus imdevimab 1200 mg
- Recommended Critical care: Hemodynamics-use of buffered crystalloids to resuscitate from septic shock, CRRT (Continuous Renal Replacement Therapy) in case of acute kidney injury, Pharmacological interventions
- Not recommended in hospitalized patients (NIH/CDC)
 - Antithrombotic therapy (risk of cerebral hemorrhage)
 - COVID 19 convalescent plasma
 - HIV Protease inhibitors (Lopinavir/Ritonavir)
 - Sarilumab for Non-ventilated patients
 - Anti IL 6 monoclonal antibody siltuximab

US Govt Efforts: Free Vaccines / Large Scale vaccinations

Table 1: Top Vaccinating Countries

Sl.No		Total in million	Vaccinated %
	World	1,370,024,391	-
1	USA	267	41.5
2	India	179	11.17
3	U.K	54.8	41
4	Germany	36.9	22.2
5	Russia	19.8	6.7
6.	China	354	12.7

Source: www.bloomberg.com/vaccinetracker

CHAPTER – 2: INDIA’S PREPAREDNESS

1. PHARMA & DRUGS – AVAILABILITY and IMPORTS

In India, so far around 24 million people have been infected by COVID 19 virus. Out of that around 23.3 million have fully recovered. There have been around 0.254 million deaths so far.

Patients with SARS-CoV-2 infection can experience a range of clinical manifestations, from no symptoms to critical illness. In general, adults with symptomatic SARS-CoV-2 infection can be grouped into the following severity of illness categories with recommended drugs:

Mild illness: Individuals who have any of the various signs and symptoms of COVID-19, but who do not have shortness of breath, dyspnea, or abnormal chest imaging. These patients are generally treated with *Ivermectin, Hydroxychloroquine (HCQ), Budesonide and Paracetamol*.

Moderate illness: Individuals who show evidence of lower respiratory disease during clinical assessment or imaging and who have an oxygen saturation (SpO₂) ≥94% on room air at sea level. These patients are generally treated with *Methylprednisolone / Dexamethasone, Heparin, etc.*

Severe /Critical illness: Individuals who have SpO₂ <94% on room air or lung infiltrates >50%. These patients are generally treated with *Remdesivir, Tocilizumab, cortico-steroids etc.*

The most of APIs including paracetamol are currently imported. While there is not much of an issue regarding availability of other drugs, there is a severe shortage of Remdesivir and Tocilizumab.

As against estimated demand of about 14.4 million vials (100 mg) of Remdesivir, its total production in the country was 10.5 million (as on 4 May 2021). Similarly, the country was completely out of stock for Tocilizumab and is wholly dependent on imports from Switzerland-based pharmaceutical company Roche, marketed by Cipla in India. The Indian Government is in discussions with Roche for securing bulk supplies.

Key Recommendations

- a. **National stockpile be maintained for Remdesivir, Dexamethasone, Tocilizumab**
- b. Remdesivir production be escalated to more than 10 million Vials per month.
- c. There are about 6 manufacturers in India and Government may procure these drugs for stockpile. The manufacturing cost of Remdesivir is Rs 75.0 per vial of 100mg. Hence, the price be regulated accordingly.
- d. **Ramping up production and /or imports of Remdesivir & Tocilizumab**
- e. **Import availability of Tocilizumab and other similar Mab**, which are anti IL6, be maintained after discussing with Roche, invoking appropriate IP Laws like Section 47

or 100 of Patent Act to enhance production/import. The price be regulated henceforth (No Compulsory Licensing).

f. Import of Baricitinib as Mab from Eli Lilly

g. **Price Control /Regulation of Essential Drugs & Supply to be ensured**

h. Drugs like **Anti IL 2, Anti IgE, Mab(omalizumab)** for respiratory complications in pediatrics be procured from native manufacturers. Also, availability be ensured for antivirals like *ritonavir, fabipiravir*, etc.

i. Other requirements of *paracetamol, dexamethasone injections/tablets, Vitamin C, Injection D3, Zinc tablets*, price to be regulated and adequate supply be ensured.

j. Large scale availability be maintained for *AYUSH 64, Kaphasura Kudineer, Giloy tab, Ayush Qwath etc.*

k. Inventory be maintained for *Normal Saline, Blood test kits, Syringes, PPE Kits, Gloves, Masks, etc*

l. Emergency Use Approval for Newer Drugs-

- A new drug, *2-deoxy-D-glucose (2-DG)*, developed by DRDO in association with Dr Reddy's Laboratories Ltd has been approved for emergency use for the treatment of Covid-19 patients by the Drug Controller General of India (DCGI). Clinical trial results have shown faster recovery of hospitalized patients and reduces supplemental oxygen dependence.
- Similarly, the DCGI granted emergency use approval for pharma major Zydus Cadila's antiviral drug, *Pegylated Interferon alpha-2b, 'Virafin'*, to treat moderate COVID-19 disease in adults towards reducing external oxygen requirement.
- There are other drugs like *Equine Anti-Covid antibody* fragments, too on the horizon including the ones being developed by Vins Bioproducts Ltd. etc, which needs expedited trial and if effective, then emergency authorization needs to be accorded.
- Ambulances/ Oxygen supply, Oxygen concentrators, availability of Beds, ICUs, etc.

m. AYUSH Drugs

- Use of AYUSH recommended drugs for mild and moderate COVID 19 cases: *AYUSH 64, and Kaphasura Kudineer, AYUSH Kwath (Hot Decoction), Nasal Spray (Oil based)*. Both modern and traditional knowledge based therapies should be followed. The efficacy of these drugs has been proved through robust multi-centre clinical trials.
- Ayurvedic drugs to be made available in all medicine outlets PAN India to maximize benefit.

- AYUSH doctors can be engaged for COVID management and patient care under home monitoring
- Door to door distribution of essentials like Paracetamol / Nasal Spray/ AYUSH Kwath, etc. Use of IT Services for coordination and mapping of data (of Patients)/ Hospitals beds/Oxygen

2. VACCINES : TRIALS and AVAILABILITY

Equitable access to safe and effective vaccines is critical to ending the COVID-19 pandemic, so it is hugely encouraging to see so many vaccines proving and going into development. World over, more than 1.34 billion doses, across 175 countries have been administered. In nine countries, including *UK, USA, Israel, Canada, Chile, UAE, Bahrain, Chile, Seychelles, Maldives*, etc. more than 40 % of the population have been vaccinated. Approved vaccines across the globe include *Covaxin, Pfizer, Moderna, Astra Zeneca, Sinopharm, Sputnik, etc.*

Table 2: Approved vaccines and their status

Company	Technology	Phase	Status
Pfizer-BioNTech	<u>mRNA</u>	2,3	Approved in several countries. Emergency use in U.S., E.U., other countries.
Moderna	<u>mRNA</u>	3	Approved in Switzerland. Emergency use in U.S., E.U., other countries
Gamaleya	<u>mRNA</u>	3	Early use in Russia. Emergency use in other countries.
Oxford-AstraZeneca	<u>ChAdOx1</u>	2.3	Approved in Brazil. Stopped use in Denmark
CanSino	Ad5	3	Approved in China. Emergency use in other countries.
Johnson & Johnson	<u>Ad26</u>	3	Emergency use in U.S., E.U., other countries. Paused in some countries. Stopped use in Denmark.
Vector Institute	Protein	3	Early use in Russia. Approved in Turkmenistan.
Novavax	Protein	3	
Sinopharm	Inactivated	3	Approved in China, U.A.E., Bahrain. Emergency use in other countries.
Sinovac	Inactivated	3	Approved in China. Emergency use in other countries.
Sinopharm-Wuhan	Inactivated	3	Approved in China. Emergency use in other countries
Bharat Biotech	Inactivated	3	Emergency use in India, other countries.

Source: <https://www.nytimes.com/interactive/2020/science/coronavirus-vaccine-tracker.html>

In India, as against requirement of about 2000 million vaccine doses, a total of 179 million vaccine doses have been administered, since the vaccination campaign started on January 16, 2021. While it may look like a large number, it only translates to just 11.17% of the population covered with one dose and 2.9% fully vaccinated with two doses. With India recording over 0.3 million new cases every day, the call for vaccination has become louder.

Combined capacity of the two vaccine makers in India namely Bharat Biotech and Serum Institute of India (SII) is around 85 million doses/ month. At this rate, India would need more than two years to reach herd immunity. Therefore, the speed of vaccination has to pick up.

The GoI on 11th May 2021, has informed the Supreme Court that the vaccine production in India will be ramped up to more than 130 million/ month by the end of July, 2021.

According to reports, Serum Institute of India has a capacity to produce 70 million doses per month and to enhance this capacity to 100 million doses per month by the end of May 2021. Bharat Biotech has a much smaller manufacturing capacity of about 6-15 million doses per month. They will be also able to produce 30 million doses in May-2021 and further ramp up production to about 60 million doses per month by August 2021.

The current monthly production of both these vaccines together stands at about 70-85 million doses per month. Accounting for their export commitments (about 15 percent of total production), this means that supply of vaccines in India is currently about 60-70 million doses per month. Considering the doses already administered, we need a supply of about 170 million doses per month from May 2021 onwards to cover even 80 percent of the population by the end of this year. For universal coverage by year end we need about 220 million doses/month.

Further requirement will be met through a supply of about 650 million doses of Sputnik.

To augment the availability and supply of vaccines following key recommendations are made:

Key Recommendations

- Ramp up the production to the maximum extent possible of existing manufacturers and import more vaccines from global suppliers.
- To increase the availability of vaccines, the license to produce the vaccines may be granted to other companies using relevant patent clauses.. Production of COVAXIN is already being operationalized at the Haffkine Institute at Maharashtra.
- Enhanced Contract manufacturing of Vaccines at Bharat Immuno-biologicals Ltd (BIBCOL) and also Indian Immunologicals Ltd, Hyderabad may be initiated. The necessary regulatory compliances be ensured for the same.
- Upscaled production of Vaccines be initiated using novel Bioreactors for higher yield. (Regulatory compliances needed)
- Approval for other vaccines may be granted on fast track, as limited /nil duplication trials may be required for which trials have already been conducted in select foreign

countries. Though long-term safety data is not available, decisions are being taken on risk benefit evaluation.

- Use of Block Chain technology for systematic and transparent vaccine delivery to all Indians.
- Usage of vaccines from different global sources would require storage and transportation at varying cold temperatures. For ensuring this, the **existing cold chain system needs to be quickly augmented** with interconnections including flow of information across the network.
- **mRNA vaccines** need to be developed. These are based on an already established messenger RNA platform which would remain stable at 2-8 degree Celsius temperature. Gennova Biopharmaceuticals Ltd, Pune, will be the first company to develop mRNA vaccine indigenously.
- **Raw Materials Requirement for Vaccines:** Realigning the global supply chain for raw materials used in vaccine preparation is necessary till ramping up the domestic manufacturing capacity along with desired quality of raw material is ensured.
- **Imported vaccine technology** (Serum Institute India), would need to maintain a continuous enhanced inventory for imported quality raw materials (Quality by design) for enhanced production of vaccines (Suitable agreements be signed).
- Well planned administration of vaccination to prevent wastage
- Mobile vaccine administration system (vaccine Taxi) for avoiding overcrowding at vaccination centres

3. MEDICAL EQUIPMENT & INFRASTRUCTURE

Key Recommendations

- In-house production of oxygen be ensured in Hospitals with more than 100 beds
- Hospitals be sufficiently equipped with all requirements for all beds: vital data monitors/ metered syringes, Oxygen supply, BiPAP, Ventilators, nebulizers, catheters, etc.
- Indigenous development and production of Oxygen generators, Ventilators, X ray machines, diagnostic test kits, Oximeters, etc be taken on priority.
- Comprehensive Hospital preparedness checklist be prepared by Hospital administration (to include manpower details as well)
- Biohazard work management checklist at hospitals.
- All hospitals should have internal inventory for critical medicines
- Encourage telemedicine remote COVID testing, monitoring, etc.- Use of cloud
- Remote ICUs, Home ICUs using low cost equipment
- Reduce import dependency for different components of oxygen concentrator. Valves required for oxygen concentrators, Oxygen sensors and Oil free miniature compressors are not produced in India. To explore the option of preparing Li based silica zeolite which is not available in India for use in O₂ concentrator, which are currently imported.
- Indigenous manufacture of core components of medical equipment (for example ICs) to reduce external dependency.
- Creation of database to track Ventilators towards optimum utilization of them and

- distribution using digital technologies
- Use of digital technology for Surveillance
 - Hospital certifications with L2/ L3 facility be made on the basis of Manpower and infrastructure availability.

4. SKILL DEVELOPMENT

Key Recommendations

- Critical care medicine has a crucial role in public health emergencies. We need to certify and provide more standardized short-term trainings for healthcare personnel in various domains, such as emergency medicine, critical care, pulmonology, case management, infection control, safe testing and isolation protocols (A database be maintained of such healthcare personnel)
- Training for servicing and periodic maintenance of critical care equipment.
- Medical and Engineering institutions work closely for development of biomedical equipment.
- Forecasting of incidence of pandemic in future is important and need to evolve technology roadmap for critical care systems.

CHAPTER 3: RECOMMENDATIONS

Policy recommendations:

- i. Creation of a new National Biomedical Control authority , which may be responsible for the procurement and development of medical countermeasures, principally against bioterrorism, including chemical, biological, radiological and nuclear (CBRN) threats, as well as pandemic, COVID and emerging diseases. This may also regulate the national stock pile of select drugs for such exigencies.
- ii. Launching of National Pulse Survey on hospital experiences to capture the opinion of patients received from hospitals
- iii. Creation of Specific Relief Fund to support affected BPL citizens of India
- iv. Establishment of Integrated COVID 19 Command Center in each district of India which will be connected with State and Center (Hub and Spoke Model): for efficient Administration and Data management.
- v. Drug regulatory body, during pandemic should work as facilitating body
- vi. Supporting eligible Private Hospitals (based on National Pulse Survey result) with grant or loan to augment their infrastructure facility.

General recommendations:

- i. Indigenous Production of Active Pharmaceutical Ingredients (APIs) and Key Starting Materials (KSMs) for drugs.
- ii. Strengthen Genome Sequencing Research in the Country. More facilities for research should be created in every major city in India. The data should be open source and widely shared to design better prevention measures and treatment.
- iii. Expand the Institutional Expert Base and Manufacturing Facilities in the country to develop newer options for addressing treatment of COVID 19 virus through

- Biologicals e.g. *diagnostic kits, therapeutic monoclonal antibodies, blood products, etc.*
- iv. ABSL3 and BSL 3 facility be created urgently for enhancing approved clinical trials.
 - v. Explore usage of existing infrastructure for effective mass scale vaccination (auditorium, stadia, institute campuses etc).

CONCLUSION

India's second surge of COVID infections began around mid-March and increased rapidly, reaching a peak of more than 4 lakh recorded daily cases by 30 April 2021. It is worth taking care as the country has added 10 million cases in just over four months, after taking more than 10 months to reach its first 10 million. Only since this week, the infection rate has fallen below 4 lakhs daily and is hovering around 3.5 lakh cases. The active cases as on 13th May are more than 37 lakhs, compared to around 10 lakh cases during the peak of last wave (September – October 2020).

This evinces the extreme limits to which the Indian healthcare infrastructure has been stretched. Such situation needs urgent redressal. While Government and State agencies are putting their best, the efforts need specific directional thrust in identified domains.

TIFAC's document, STAARC, prepared in consultation with eminent clinicians, Scientists and Policy makers is an attempt to identify measures to control and arrest the pandemic proliferation with S&T perspective. The document addresses the pandemic from the perspectives of: Clinical overview, Pharma, drugs and vaccine, their efficacy and availability, along with that of Medical Equipment and infrastructure. The document also gives an insight into the requisite skill development and further, Policy recommendations which are required to augment the system towards preparedness for potential further waves, if any.

It is hoped that the document would be useful in formulating immediate action strategies to address the pandemic in the short term and also to augment the medical health system for any further pandemic.

Disclaimer

The information contained in this document is based on consultation with listed eminent panelists and various policy makers, and supplemented by team of TIFAC scientists. The opinion expressed in this publication are those of panelists and speakers. They do not purport to reflect the opinion or views of any Government agency or office. Some of the inputs and data are presented in the document are taken from available online resources. The information contained is intended for educational purpose and formulating strategies only. It should not be substituted for medical advice from a doctor or healthcare provider.

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- 1) <https://www.nationalheraldindia.com/india/india-stares-at-shortage-of-covid-19-drug-tocilizumab-as-importer-cipla-runs-out-of-stock>
- 2) <https://www.nytimes.com/interactive/2021/world/covid-vaccinations-tracker.html>
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- 4) <https://www.atlas-mag.net/en/article/covid-19-vaccine-ranking-of-countries-per-doses-administered>
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- 6) <https://prsindia.org/covid-19/cases>
- 7) <https://covid19.healthdata.org/india?view=cumulative-deaths&tab=trend>
- 8) <https://rodillo.org>
- 9) www.bloomberg.com/vaccinetracker
- 10) www.extranet.who.int

ANNEXURE -I

List of Panelists

1. **Dr V.K. Saraswat**, Hon'ble Member NITI Aayog & Chairman TIFAC
2. **Professor Ashutosh Sharma**, Secretary –DST
3. **Dr Vijay Chauthaiwale**, In-Charge, Foreign Affairs Dept. Healthcare-Biotech Consultant
4. **Professor Pradeep Srivastava**, Executive Director TIFAC
5. **Dr. Nandita Das**, Professor - Pharmaceutical Sciences, College of Pharmacy and Health Sciences, Butler University,
6. **Shri P K Pathak**, Special Secretary, Ministry of AYUSH
7. **Dr P B N Prasad**, Joint Drugs Controller (India), CDSCO
8. **Dr Bakulesh Khamar**, Executive Director- R & D, Cadila Pharma Ltd.
9. **Dr Suresh Jadhav**, Executive Director, Serum Institute of India, Pune
10. **Dr Siddharth Daga**, CEO, M/s Vins Bioproducts Ltd., Hyderabad
11. **Shri Ravi Ramaswamy**, Sr. Director, Healthcare Systems, Philips Innovations
12. **Shri Sunil Khurana**, CEO, BPL Medical Technologies Pvt.Ltd., Bengaluru
13. **Dr Raman Gangakhedkar**, Former Head Scientist-Epidemiology & Communicable Diseases- ICMR
14. **Dr. Jitendra Kumar**, Nephrologist, Metro Hospital, Faridabad
15. **Shri Sanjay Singh Scientist G, TIFAC**

Attendees

1. Dr. Aruna Tiwary	92. Dr Pradeep Singh
2. Shekharam Tammishetti	93. Dr Ramesh Shettar
3. Selvam Appar Nattar	94. Neeti Wilson
4. Jancy Ayyaswamy	95. Vandana Singh
5. Dr S K Chabak	96. Promodini
6. T Selvan	97. Ashvani Shukla
7. Prof Unnat Pandit	98. Niwesh Ojha
8. Ramakrishna Y B	99. Amit Kumar
9. Deepak Kumar	100. Razeena Shaik
10. Suja George	101. Anuradha Pughat
11. Dr. Pradeep Singh	102. Harish Bisht
12. Ms Gomati Padma S	103. Dr (Er) Manish Mudal
13. Navneet Kaushik	104. Amit Kulkarni
14. Rachna Bhatt	105. Suseela Mathew
15. Ketaki Bapat	106. Ajay Paul
16. Rahul Mohan	107. Tilak Joshi
17. Nalinaksh Vyas	108. Amrish Shah
18. Dr B K Sahu	109. Rajiv Kumar
19. Dr Neeraj Sharma	110. R Ahirwar
20. Deprosad Dauri	111. Dr Akhilesh Gupta
21. Dr. Arbind Mitra	112. Kutubuddin Molla

22. Mukesh Mathur	113. Prof S K Mishra
23. Punjab Singh	114. Tilak Joshi
24. DST Media Cell	115. P K
25. Bhasker Thallada	116. Paradigm Innomed
26. Jhansi Parimi	117. Anirudhha Sharma
27. Satish Vashist	118. Shishir Sinha
28. Sahebrao Muneshwar	119. Baisakhee Saha
29. Dr. Brajeshwar Chandelia	120. Chandrasekharam Malapaka
30. Dr Gautam Goswami	121. Ravindra Gavali
31. Dr Yashawant Dev Panwar	122. Mahak Garg
32. Pulak Ranjan Basak	123. Vikrant Rana
33. Nagesh DS	124. Sourabh Ghosh
34. Amit Rastogi	125. PBN Prasad
35. Dr T Chakradhar	126. Surra Ganauli
36. Charu Agarwal	127. R S Ahirwar
37. Dr Asokan Pappu	128. Kavita Tyagi
38. Nirmala Kaushik	129. JV Sharma
39. Praveen Gawali	130. Narendra Singh
40. Narendra Singh	131. Dr Amita Kumari
41. Avanish K Srivastava	132. Lipika Patnaik
42. Sunil Gairola	133. Indrani Ghosh
43. Kannan Srinivasan	134. Saguna Dewan
44. Rajesh Kumar	135. Bhanu Verma
45. Shishir Kumar Goel	136. Samir Kulkarni
46. Siddarth Daga	137. Dr. Dhanpat Ram Agarwal
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**A-Wing, Vishwakarma Bhavan
Shaheed Jeet Singh Marg
New Delhi - 110 016
www.tifac.org.in**