COVID-19 Pandemic: A Review

"To succeed our war against COVID-19, we should, kill the virus before it kills us".

- **R. Rajasekharan Nair & Vinod R. Alappad**

1.0 INTRODUCTION

Ever since the *World Health Organisation (WHO)* has declared the Corona Virus Disease as Pandemic, the entire world is passing through a grave situation. The War against corona virus i.e. COVID-19 is on throughout the world. The situation in some countries are very severe and already affected the socio-economic fabric of the country itself. As on today, the 26th April, 2020, COVID-19 has spread to more than 29 lakh persons and out of which more than 2 lakhs died.

The first three cases of COVID-19 were reported in India from the three districts of *Kerala* viz. *Thrissur* on 30th January, 2020; *Alappuzha* on 2nd February, 2020 and *Kasaragod* on 3rd February, 2020. All three COVID-19 patients are medical students who had returned from *Wuhan, China*, where the COVID-19 originated. All of them were admitted in respective district hospitals of *Kerala* for treatment and all of them have been fully recovered and discharged. For about a month, there was no reporting of COVID-19 cases in India. However, from 1st week of March, 2020, onwards, there were a number of COVID-19 cases reported from various parts of India and all of them had travelled from other countries. Incidentally, by 26th April, 2020, the confirmed COVID-19 cases in *India* rose to 27,886 and out of which about 880 died.

As the COVID-19 was spreading, some of the States in India, notably *Kerala* had taken a number of measures to contain the spread of virus. In order to contain the COVID-19, on 22nd March 2020, India observed a 14-hour voluntary public curfew (Janata Curfew) at the instance of the Prime Minister *Narendra Modi.* The government followed it up with lockdowns in 75 districts, where COVID-19 cases had occurred. Further, on 24th March, 2020, the Prime Minister announced a Nationwide Lockdown for 21 days. On 14th April, 2020, the Prime Minister had extended the ongoing Nationwide Lockdown till 3rd May, 2020. Thus, the war against COVID-19 will be continuing for another 19 days.

This article deals with the existing scenario of COVID-19 Pandemic and the control measures adopted or to be adopted by *India* to contain its spread. It may be noted here that, the data used in this article are compiled from various sources, such as *Indian Council for Medical Research (ICMR), Ministry of Health & Family Welfare (MoHFW), World Health Organization (WHO); worldOmeter, covid19india.org;* etc. The compiled data is only up to   26th April, 2020. It may be mentioned here that the data released by *MoHFW* and the State Governments always differ. The data used in this article is compiled from the sources of the State Governments, and therefore the data quoted is more than the data released by *MoHFW*. As the data is being updated constantly, the data quoted in this article may vary, by the time this article is published.   Though, the economic aspects of this pandemic are also very much important, these aspects are not dealt in this feature, which we will be dealing in a separate article.
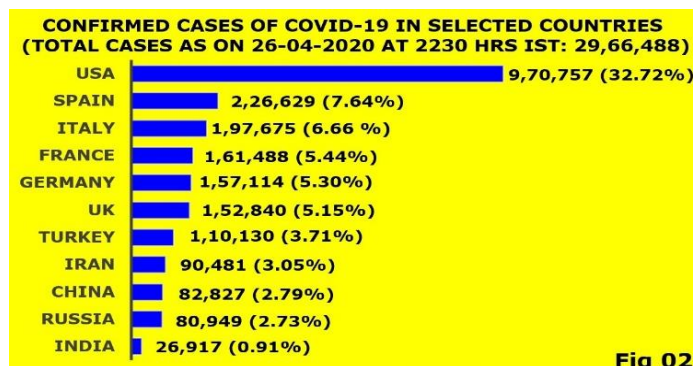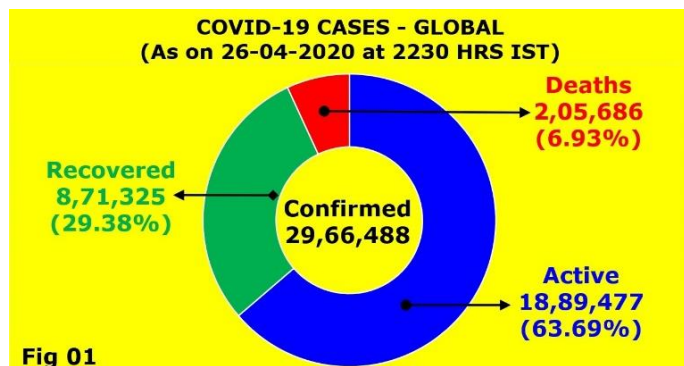
2.0 HISTORY OF PANDEMICS

Throughout history, there have been a number of pandemic diseases such as **Smallpox, The Plague, Spanish Flu, HIV/AIDS**, and so on. The **Table 01** shows a selected list of epidemics and pandemics from AD 165 to present. It may be seen from the Table, that Smallpox, is the highest killer amongst the pandemics, which killed about 500 Million people.

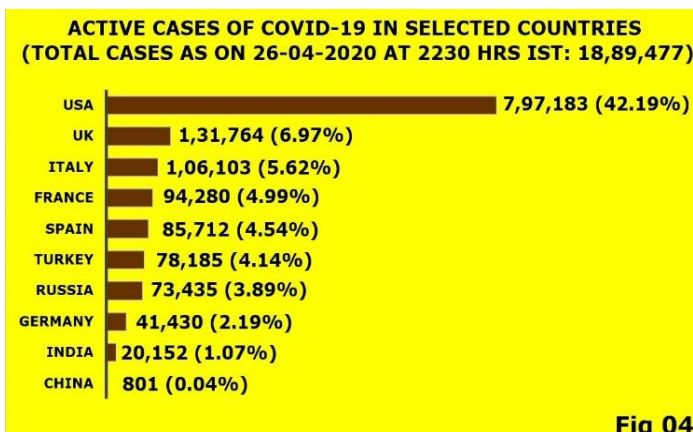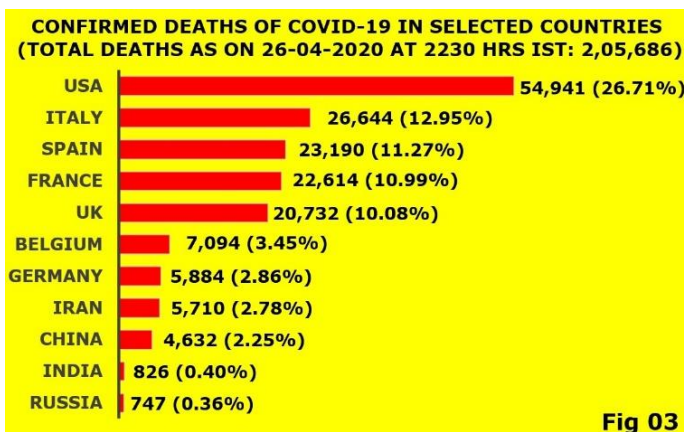|	Sr. No.	YEAR	DISEASE	DEATHS	LOCATION
AD 165 – 737	1	165 – 180	Antonine Plague	50 Lacs	Roman Empire
	2	256 – 266	Plague of Cyprian	10 Lacs	Europe
	3	541 – 542	Plague of Justinian	500 Lacs	Middle East to Western Europe
	4	735 – 737	Japan Smallpox	20 Lacs	Japan
AD 1331 - 1890	5	1331 – 1353	Black Death	2000 Lacs	Europe, Asia and North Africa
	6	1520	Smallpox Epidemic	80 Lacs	Mexico
	7	1545 – 1548	Cocoliztli Epidemic	150 Lacs	Mexico and Central America
	8	1576 – 1580	Cocoliztli epidemic	25 Lacs	Mexico
	9	1846 – 1860	Cholera	10 Lacs	India
	10	1855 – 1860	Bubonic plague	150 Lacs	China, India, USA, Australia
	11	1889 – 1890	Influenza (Russian Flu)	10 Lacs	Russia
AD 1915 - PRESENT	12	1915 – 1926	Encephalitis lethargica	15 Lacs	Worldwide
	13	1918 – 1920	Spanish Flu	1000 Lacs	Worldwide
	14	1957 – 1958	Asian Flu	20 Lacs	Worldwide
	15	1877 – 1977	Smallpox	5000 Lacs	Worldwide
	16	1960 – Present	HIV / AIDS	320 Lacs	Worldwide
	17	1968 – 1969	Hong Kong Flu	10 Lacs	Worldwide
	18	2009 – 2019	Swine Flu (H1N1)	5 Lacs	Worldwide
	19	2013 – 2016	Ebola	11000	West Africa
	20	2019 – Present	COVID - 19	2,05,686	Worldwide

Table 01: SELECTED LIST OF EPIDEMICS AND PANDEMICS

As on 26th April, 2020 at 2230 hrs. IST
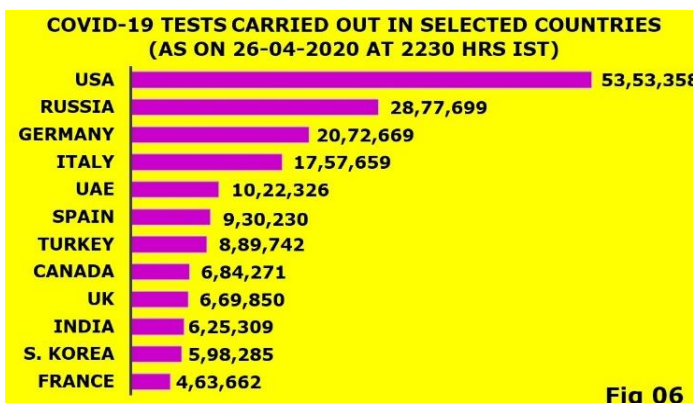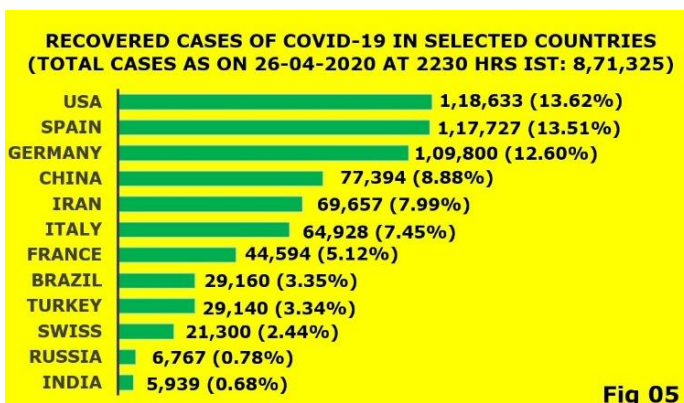
3.0 GLOBAL SCENARIO

The Global Scenario of COVID-19, are presented here through various charts and graphs *(See Fig 1 to 6)*. As on 26th April, 2020, at 2230 hrs. IST, there were 29,66,488 Confirmed Cases of Coronavirus in the globe and out of which 205686 persons Died. On this date there were 18,89,477 Active cases in the hospitals. As on this date 8,71,325 persons got Recovered, out of the total confirmed cases *(See Fig 01)*. Amongst the countries, *USA* topped the list of countries with 9,70,757 confirmed Coronavirus cases, which is 32.72% of the total confirmed cases reported in the world *(See Fig 02)*. It may be noted from the figure, that 5 *European* countries viz. *Spain*, *Italy*, *France*, *Germany* and *UK* have Coronavirus cases ranging from 1.5 Lakhs to 2.3 Lakhs, which **together** shared 30.20% of Coronavirus cases reported in the world. Incidentally, all the above countries are partially or fully locked down to contain the spread of virus.

COVID-19 CASES - GLOBAL
(As on 26-04-2020 at 2230 HRS IST)

Deaths 2,05,686 (6.93%)
Recovered 8,71,325 (29.38%)
Confirmed 29,66,488
Active 18,89,477 (63.69%)

Fig 01

CONFIRMED CASES OF COVID-19 IN SELECTED COUNTRIES
(TOTAL CASES AS ON 26-04-2020 AT 2230 HRS IST: 29,66,488)

USA	9,70,757 (32.72%)
SPAIN	2,26,629 (7.64%)
ITALY	1,97,675 (6.66 %)
FRANCE	1,61,488 (5.44%)
GERMANY	1,57,114 (5.30%)
UK	1,52,840 (5.15%)
TURKEY	1,10,130 (3.71%)
IRAN	90,481 (3.05%)
CHINA	82,827 (2.79%)
RUSSIA	80,949 (2.73%)
INDIA	26,917 (0.91%)

Fig 02

The *USA* also accounts for the highest number of Coronavirus deaths (54,941) in the world, which is 26.71% of the total Coronavirus deaths reported in the world *(See Fig 03)*. Though Coronavirus has originated from *China*, the death toll figure released by the Chinese Government still stands at 4,632. As far as the active cases are concerned, *USA* has 7,97,183 cases, which is 42.19% of the total Active Coronavirus cases in the world *(See Fig 04)*.
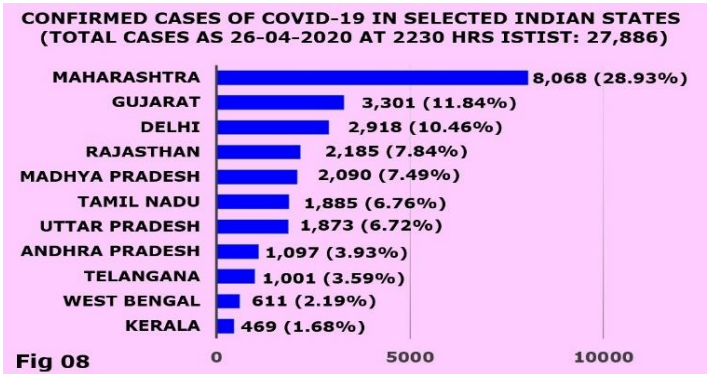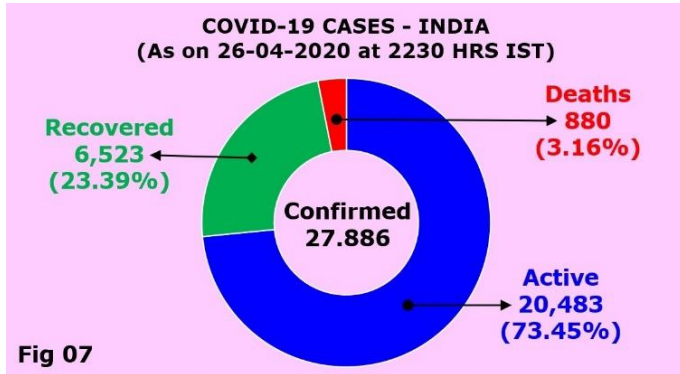
CONFIRMED DEATHS OF COVID-19 IN SELECTED COUNTRIES
(TOTAL DEATHS AS ON 26-04-2020 AT 2230 HRS IST: 2,05,686)

USA	54,941 (26.71%)
ITALY	26,644 (12.95%)
SPAIN	23,190 (11.27%)
FRANCE	22,614 (10.99%)
UK	20,732 (10.08%)
BELGIUM	7,094 (3.45%)
GERMANY	5,884 (2.86%)
IRAN	5,710 (2.78%)
CHINA	4,632 (2.25%)
INDIA	826 (0.40%)
RUSSIA	747 (0.36%)

Fig 03

ACTIVE CASES OF COVID-19 IN SELECTED COUNTRIES
(TOTAL CASES AS ON 26-04-2020 AT 2230 HRS IST: 18,89,477)

USA	7,97,183 (42.19%)
UK	1,31,764 (6.97%)
ITALY	1,06,103 (5.62%)
FRANCE	94,280 (4.99%)
SPAIN	85,712 (4.54%)
TURKEY	78,185 (4.14%)
RUSSIA	73,435 (3.89%)
GERMANY	41,430 (2.19%)
INDIA	20,152 (1.07%)
CHINA	801 (0.04%)

Fig 04

As far as the recovered persons are concerned, amongst the leading nations, *USA* takes the lead with 1,18,633 recovered persons *(See Fig 05)*. With regard to testing of Coronavirus cases, the *USA* leads with 53,53,358 tests *(See Fig 06)*. Though, *Russia* had tested the second highest number of Coronavirus samples in the world i.e. 28,77,699, the confirmed cases has not drastically reduced, which stood at 80,949 cases.
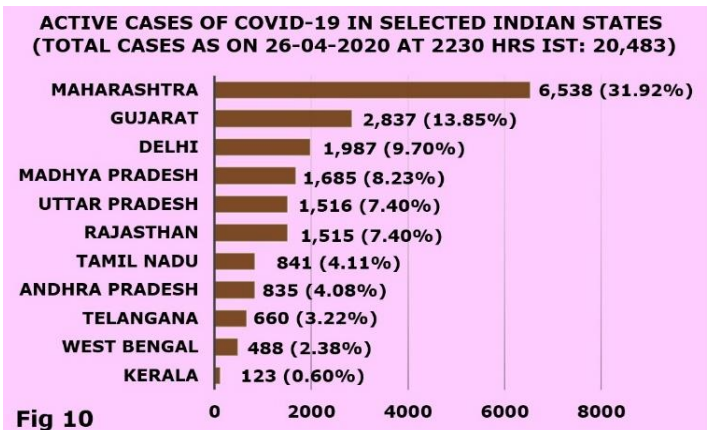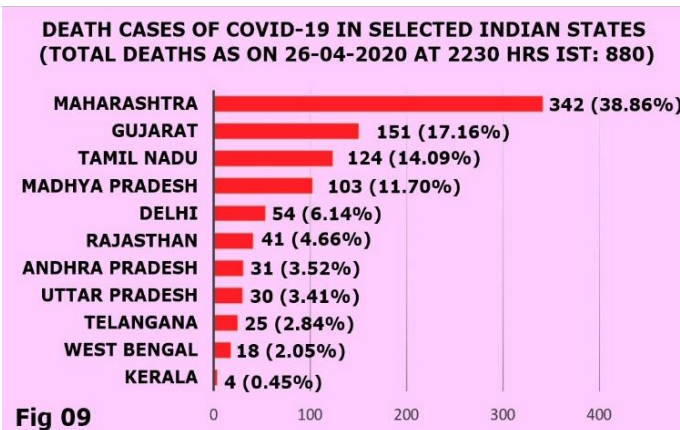
RECOVERED CASES OF COVID-19 IN SELECTED COUNTRIES
(TOTAL CASES AS ON 26-04-2020 AT 2230 HRS IST: 8,71,325)

USA	1,18,633 (13.62%)
SPAIN	1,17,727 (13.51%)
GERMANY	1,09,800 (12.60%)
CHINA	77,394 (8.88%)
IRAN	69,657 (7.99%)
ITALY	64,928 (7.45%)
FRANCE	44,594 (5.12%)
BRAZIL	29,160 (3.35%)
TURKEY	29,140 (3.34%)
SWISS	21,300 (2.44%)
RUSSIA	6,767 (0.78%)
INDIA	5,939 (0.68%)

Fig 05

COVID-19 TESTS CARRIED OUT IN SELECTED COUNTRIES
(AS ON 26-04-2020 AT 2230 HRS IST)

USA	53,53,358
RUSSIA	28,77,699
GERMANY	20,72,669
ITALY	17,57,659
UAE	10,22,326
SPAIN	9,30,230
TURKEY	8,89,742
CANADA	6,84,271
UK	6,69,850
INDIA	6,25,309
S. KOREA	5,98,285
FRANCE	4,63,662

Fig 06

4.0 INDIAN SCENARIO

The Indian Scenario of Coronavirus are presented through various charts and graphs *(See Fig 7 to 13)*. As on 26th April, 2020, at 2230 hrs. IST, in *India*, 27,886 persons got infected with COVID-19, out of which 880 persons died. On this date, 6,523 persons have been recovered and 20,483 persons are still under treatment for Coronavirus *(See Fig 07)*. Amongst 36 States and Union Territories, the *Maharashtra* is on the top of the list with 8,068 confirmed cases of COVID-19, which is 28.93% of the total confirmed Coronavirus cases reported in the country *(See Fig 08)*. Incidentally, *Mumbai* city alone have contributed 5,407 out of the 8,068 confirmed cases reported in *Maharashtra*. Seven States viz. *Gujarat*, *Delhi*, *Rajasthan*, *Madhya Pradesh*, *Tamil Nadu*, *Uttar Pradesh* and *Andhra Pradesh* have higher incidence of Coronavirus cases, which together shared 58.63% of the Coronavirus cases reported in the country. The rest of the States and Union Territories shared only 12.44% of the cases reported in the country. Though the *Kerala* had reported the first case of COVID-19, about 85 days ago, it has contributed only 1.68% (469 cases) of the total cases reported in *India*, which is commendable.
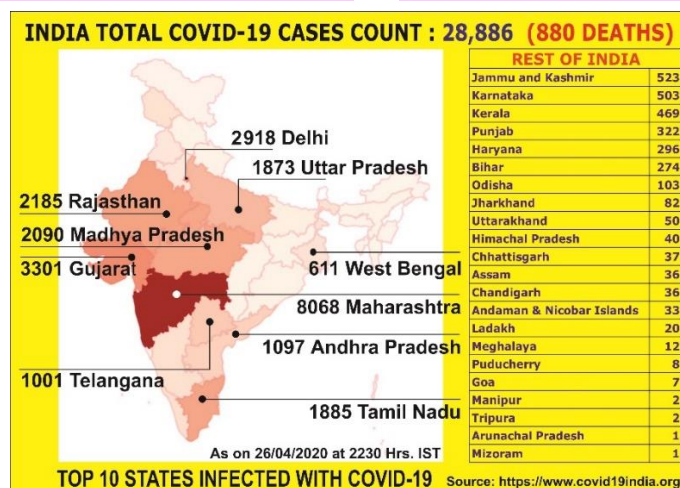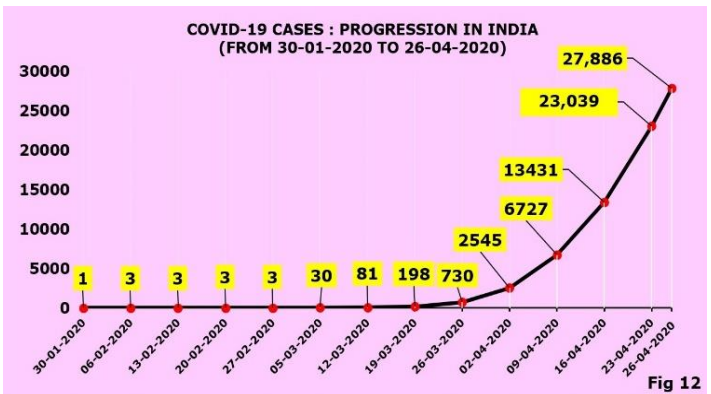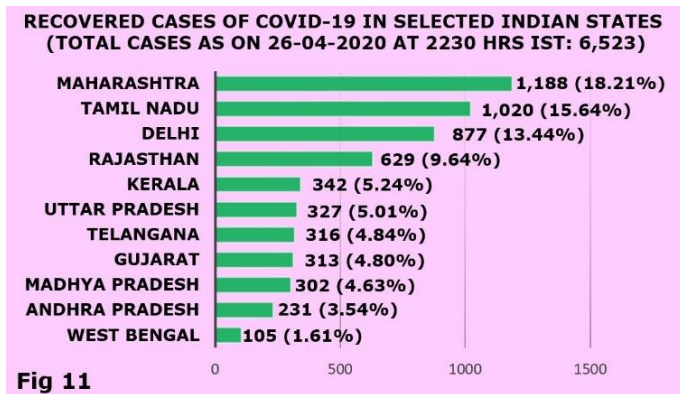
COVID-19 CASES - INDIA
(As on 26-04-2020 at 2230 HRS IST)

Recovered
6,523
(23.39%)

Deaths
880
(3.16%)

Confirmed
27.886

Active
20,483
(73.45%)

Fig 07

CONFIRMED CASES OF COVID-19 IN SELECTED INDIAN STATES
(TOTAL CASES AS 26-04-2020 AT 2230 HRS ISTIST: 27,886)

State	Cases
MAHARASHTRA	8,068 (28.93%)
GUJARAT	3,301 (11.84%)
DELHI	2,918 (10.46%)
RAJASTHAN	2,185 (7.84%)
MADHYA PRADESH	2,090 (7.49%)
TAMIL NADU	1,885 (6.76%)
UTTAR PRADESH	1,873 (6.72%)
ANDHRA PRADESH	1,097 (3.93%)
TELANGANA	1,001 (3.59%)
WEST BENGAL	611 (2.19%)
KERALA	469 (1.68%)

Fig 08

Maharashtra also accounts for the highest number of Coronavirus deaths (342) in the country, which is 38.86% of the total Coronavirus deaths reported in the country *(See Fig 09).* As on 26th April, 2020, there were 20,483 persons admitted in various hospitals in India for Coronavirus treatment *(See Fig 10).*

DEATH CASES OF COVID-19 IN SELECTED INDIAN STATES
(TOTAL DEATHS AS ON 26-04-2020 AT 2230 HRS IST: 880)

State	Deaths
MAHARASHTRA	342 (38.86%)
GUJARAT	151 (17.16%)
TAMIL NADU	124 (14.09%)
MADHYA PRADESH	103 (11.70%)
DELHI	54 (6.14%)
RAJASTHAN	41 (4.66%)
ANDHRA PRADESH	31 (3.52%)
UTTAR PRADESH	30 (3.41%)
TELANGANA	25 (2.84%)
WEST BENGAL	18 (2.05%)
KERALA	4 (0.45%)

Fig 09

ACTIVE CASES OF COVID-19 IN SELECTED INDIAN STATES
(TOTAL CASES AS ON 26-04-2020 AT 2230 HRS IST: 20,483)

| State	Cases
MAHARASHTRA	6,538 (31.92%)
GUJARAT	2,837 (13.85%)
DELHI	1,987 (9.70%)
MADHYA PRADESH	1,685 (8.23%)
UTTAR PRADESH	1,516 (7.40%)
RAJASTHAN	1,515 (7.40%)
TAMIL NADU	841 (4.11%)
ANDHRA PRADESH	835 (4.08%)
TELANGANA	660 (3.22%)
WEST BENGAL	488 (2.38%)
KERALA	123 (0.60%)

Fig 10

The number of persons recovered from Coronavirus cases are shown in *Fig 11*. Incidentally, it may be added here that the *Alappuzha Medical College Hospital*, *Kerala*, has the distinction of curing the first Coronavirus patient in the country. The progression of the Coronavirus cases in India from 30th January, 2020 to 26th April, 2020 is shown in *Fig 12.* It may be seen that, between the 26th March, 2020 and the 26th April, 2020, there has been a steep rise in the Coronavirus cases in the country. Incidentally, this steep rise had happened during the periods of National Lockdowns. Had the lockdown not been implemented, the figures would have gone up much higher, probably in lakhs. The top 10 States infected with Coronavirus as on 26th April, 2020 is also shown in *Fig 13.*

RECOVERED CASES OF COVID-19 IN SELECTED INDIAN STATES
(TOTAL CASES AS ON 26-04-2020 AT 2230 HRS IST: 6,523)

State	Cases
MAHARASHTRA	1,188 (18.21%)
TAMIL NADU	1,020 (15.64%)
DELHI	877 (13.44%)
RAJASTHAN	629 (9.64%)
KERALA	342 (5.24%)
UTTAR PRADESH	327 (5.01%)
TELANGANA	316 (4.84%)
GUJARAT	313 (4.80%)
MADHYA PRADESH	302 (4.63%)
ANDHRA PRADESH	231 (3.54%)
WEST BENGAL	105 (1.61%)

Fig 11

COVID-19 CASES : PROGRESSION IN INDIA
(FROM 30-01-2020 TO 26-04-2020)

27,886
23,039
13431
6727
2545
1 3 3 3 3 30 81 198 730

30-01-2020, 06-02-2020, 13-02-2020, 20-02-2020, 27-02-2020, 05-03-2020, 12-03-2020, 19-03-2020, 26-03-2020, 02-04-2020, 09-04-2020, 16-04-2020, 23-04-2020, 26-04-2020

Fig 12

INDIA TOTAL COVID-19 CASES COUNT : 28,886 (880 DEATHS)

2918 Delhi
1873 Uttar Pradesh
2185 Rajasthan
2090 Madhya Pradesh
3301 Gujarat
611 West Bengal
8068 Maharashtra
1097 Andhra Pradesh
1001 Telangana
1885 Tamil Nadu

As on 26/04/2020 at 2230 Hrs. IST
TOP 10 STATES INFECTED WITH COVID-19 Source: https://www.covid19india.org/

REST OF INDIA

State	Cases
Jammu and Kashmir	523
Karnataka	503
Kerala	469
Punjab	322
Haryana	296
Bihar	274
Odisha	103
Jharkhand	82
Uttarakhand	50
Himachal Pradesh	40
Chhattisgarh	37
Assam	36
Chandigarh	36
Andaman & Nicobar Islands	33
Ladakh	20
Meghalaya	12
Puducherry	8
Goa	7
Manipur	2
Tripura	2
Arunachal Pradesh	1
Mizoram	1

Fig 13

5.0 ABOUT THE VIRUS

The coronavirus pandemic is an ongoing pandemic caused by SARS-CoV-2 (Severe Acute Respirator Syndrome Corona Virus 2). The outbreak was first identified in *Wuhan*, *Hubei, China*, in December 2019, and was recognized as a pandemic by the *World Health Organization (WHO)* on 11th March, 2020.

The throat swabs from the woman, among the three students studying medicine in *Wuhan*, *China*, was taken for testing at the *National Institute of Virology*, *Kerala Unit, Alappuzha*, when they returned to India on the last week of January, 2020. The tested samples were diagnosed with COVID-19. The gene sequencing of the samples was done at the *National Institute of Virology (NIV) in Pune* and found that the virus was a 99.98 % match with the virus of *Wuhan*. The microscopic images of SARS-CoV-2, taken on 30th January, 2020, is given in *Fig 14*. The images have been captured using the transmission electron microscope imaging, which was published in the *Indian Journal of Medical Research*.
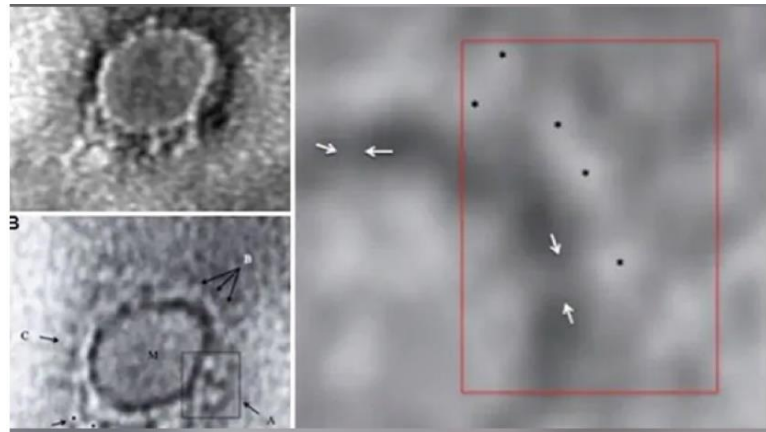
Fig 14: Microscopic view of the SARS-CoV-2 detected from 1st COVID-19 case reported in India.

SARS-CoV-2 is causing a Global Pandemic. While it belongs to Coronavirus family – variants of which cause the common cold – scientists and health care workers are trying to fathom the nature of the virus, its behaviour and patterns, and gain familiarity with the pathogen, hoping that it will give them a better handle on this pandemic.

Coronavirus, which primarily affects the upper respiratory tract in people, are transmitted through respiratory droplets. The simple act of being close to persons who sneeze or cough, even speak loudly (if they are carrying the infection) and the involuntary act of touching surfaces where the virus has been deposited can infect someone. The period that the virus remains on the surface and remains capable of spreading infection, can be considered the period for which the virus is viable.

6.0 SYMPTOMS OF COVID-19

Some of the symptoms associated with COVID-19 are listed in *Table 02*. It may be noted here that all the symptoms listed in the table may not be present in every case. However, common symptoms include fever, cough, and shortness of breath. Complications may include pneumonia and acute respiratory distress syndrome. It may be added here that according to the research carried out by eminent scientists like *Claire Hopkins*, *Shannon Palus* and *Gareth Iacobucci*, that loss of smell (Anosmia) were reported in 15% to 30% patients with no other symptoms and these patients could be asymptomatic carriers of COVID-19. While the loss of sense of smell is often hard to detect, this may be an early indicator in many COVID-19 patients

Table 02: SYMPTOMS ASSOCIATED WITH COVID-19			
Symptoms	**%**	**Symptoms**	**%**
FEVER	87.90 %	HEADACHE	13.60 %
DRY COUGH	67.70 %	CHILLS	11.40 %
FATIGUE	38.10 %	NAUSEA OR VOMITTING	5.00 %
SPUTUM PRODUCTION	33.40 %	NASAL CONGESTION	4.80 %
ANOSMIA (Loss of Smell)	15 – 30 %	DIARRHOEA	3.7 – 31 %
SHORTNESS OF BREATH	18.60 %	HAEMOPTYSIS	0.90 %
MUSCLE OR JOINT PAIN	14.80 %	CONJUCTIVAL CONGESTION	0.80 %
SORE THROAT	13.90 %		

who are infected. If such patients are isolated at an early stage, the spread of the infection from asymptomatic patients could be reduced.

7.0 TRANSMISSION OF VIRUS

The *World Health Organization (WHO)* and *Centers for Disease Control and Prevention (CDC)* state that it is primarily spread during close contact and by respiratory droplets produced when people cough or sneeze; with close contact being within 1 to 2 meters (3 to 6 feet). A study in *Singapore* found that an uncovered coughing can lead to droplets traveling up to 4.5 metres (15 feet).

Respiratory droplets may also be produced during breathing out, including when talking, though the virus is not generally airborne. Exceptions to this is during certain operations such as intubation and cardiopulmonary resuscitation (CPR). It may also spread when one touches a contaminated surface and then touches their eyes, nose, or mouth.

The virus is most contagious when people are symptomatic; while spread may be possible before symptoms appear. However, this risk is very low. The *European Centre for Disease Prevention and Control (ECDC)* states that while it is not entirely clear how easily the disease spreads, one person generally infects two to three others.

The *Centers for Disease Control and Prevention (CDC), Atlanta,* has said that the current evidence suggests that the SARS-CoV-2 may remain viable for hours to days on surfaces made from a variety of surfaces.

The studies conducted by the *National Institute of Health, Centers for Disease Control and Prevention, University of California, and Princeton University* found that SAR-CoV-2 was detectable in Aerosols for up to 3 hours, up to 4 hours on Copper, up to 24 hours on Cardboard and the longest up to 72 hours on Plastic and Stainless Steel. This however varies, based on the humidity and temperature.

One study found that small droplets with coronavirus, generated by laboratory equipment, could stay airborne for three hours.

According to the *World Economic Forum* and *Reuters*, the Coronavirus spreads much faster than other viruses such as MERS and SARS. According to this report, MERS virus took 903 days to infect first 1000 people, whereas, SARS took 130 days and Coronavirus took only 48 days to infect first 1000 people.

7.1 Basic Reproduction Ratio

An infected person can transmit the virus directly to many uninfected persons. The Basic Reproduction Ratio, (R_0), which is pronounced as R-naught. If the R-naught is more, the disease caused by the virus is more contagious and the faster it will spread in the community.

R-naught can be viewed as the product of three numbers, viz. (1) the number of days an infected person remains ineffective i.e. can infect others, (2) the number of susceptible persons available to infect and (3) the chance that a susceptible person gets infected.

For SARS-CoV-2, R-naught has been estimated between 2 and 3. According to *Dr. Partha P. Majumder*, emeritus professor at the *Indian Statistical Institute*, *Kolkata*, if the R-naught is 2 and the infection period is 10 days, in 10 days this one infected person will infect 2046 persons.

The easiest way to keep R-naught low is keep ourselves distanced from every other person. However, many apparently normal persons may actually be infected without showing symptoms of infection. Therefore, just as R-naught influences the spread of COVID-19, our behaviour also influences the spread of COVID-19.

8.0 TESTING OF VIRUS
There are several ways to test for the new strain of coronavirus such as molecular tests, serological tests, imaging tests, antigen test.

8.1 Molecular tests
Molecular tests look for signs of an active infection. They usually involve taking a sample from the back of the throat with a cotton swab.

8.1.1 PCR Test
After taking the sample, the doctor then sends off the sample for testing. The sample will undergo a Polymerase Chain Reaction (PCR) test. This type of test detects signs of the virus's genetic material. A PCR test can confirm a diagnosis of COVID-19, if it identifies two specific SARS-CoV-2 genes. If it identifies only one of these genes, it will produce an inconclusive result. Molecular tests can only help diagnose current cases of COVID-19. They cannot tell whether someone has had the infection and since recovered.

As of 23rd March, 2020, *ICMR* has recommended two RT-PCR (reverse transcription polymerase chain reaction) test kits for use in labs after evaluation of several others.

According to *Dr. Edward Wright*, Senior Lecturer in Microbiology, at *University of Sussex*, the majority of the current COVID-19 tests are carried out by using PCR. "They detect the genetic information of the virus, the RNA. That's only possible if the virus is there and someone is actively infected."

PCR tests are used to directly detect the presence of an antigen, rather than the presence of the body's immune response, or antibodies. By detecting viral RNA, which will be present in the body before antibodies form or symptoms of the disease are present, the tests can tell whether or not someone has the virus very early on.

"PCR gives us a good indication of who is infected. They can be isolated and get in contact with people they've been in touch with so they can be quarantined too, just in case. That's the true advantage of the current major diagnostic tests, you can break that transmission chain and get a clearer picture of what's happening," says *Wright*.

By scaling PCR testing to screen, vast swathes of nasopharyngeal swab samples from within a population, public health officials can get a clearer picture of the spread of a disease like Covid-19 within a population.

The *WHO* has published several RNA testings' protocols for SARS-CoV-2, with the first issued on 17th January, 2020. Testing uses real-time Reverse Transcription Polymerase Chain Reaction (rRT-PCR). The test can be done on respiratory or blood samples. Results are generally available within a few hours to days.

An article entitled "How do you test for coronavirus? – all you want to know about testing kits, process, results" by *Angana Chakrabarti* and *Sandhya Ramesh*, appeared on 24th March, 2020 in *"The Print"* gives a good account of the methods and processes of testing. According to the authors, the article, was prepared in consultation with an *ICMR* official and *Guruprasad Medigeshi*, a professor with the *Translational Health Science and Technology Institute*, *Faridabad, Haryana*.

8.1.2 NAT Test
NAT tests are currently the most reliable COVID 19 tests for diagnosing infections with the new coronavirus SARS-CoV-2. NAT stands for Nucleic Acid Amplification Technique. This includes the PCR method, developed by a working group at the *Charité* in *Berlin*, which can be used to directly detect the SARS-CoV-2 virus in infected persons on the basis of a throat swab.

An *Australian* bio tech company provides real time Coronavirus testing to rural and remote communities. The *Australian* biotech has helped develop a mobile COVID-19 testing system that delivers highly accurate results within an hour, potentially slowing the spread of the virus.

The Mic (pronounced Mick) instrument from *Bio Molecular Systems* is portable, meaning it can take patient samples and analyse them on the spot. That makes it ideal for use in remote or vulnerable communities, third-world countries, cruise ships and even mine sites. The Mic is a portable Nucleic Acid Testing (NAT) system, which uses quantitative real-time Polymerase Chain Reaction (qPCR). Known as "molecular photocopying".

Unlike traditional instruments, the Mic can process samples at the source rather than having them be sent to a large central diagnostic laboratory or hospital for analysis, a process which can take several days to produce results. The Mic analyses samples on-site and the COVID-19 tests can process almost 50 samples in 90 minutes. More than 200 Mic machines are already being used worldwide for COVID-19 testing.

8.2 Serological test
The Serological test is also known as 'Rapid Antibody Test (RAT)'. These tests detect antibodies that the body produces to fight the virus.

A rapid antibody test shows if a person once infected by the coronavirus has developed immunity to it. The human body develops two kinds of antibodies — Immunoglobulin M (IgM) and Immunoglobulin G (IgG). These antibodies remain in the body from between a month to a year, or even longer in some cases. The IgM antibody arrives within five to seven days of acquiring the infection, whereas IgG arrives later, when the person has recovered. When a person is IgG-positive, it means that the person has been exposed to the infection and their body has developed the immune response.

A serological test usually requires a blood sample. Serological tests are particularly useful for detecting cases of infection with mild or no symptoms.

There is a misconception that the rapid tests are used for diagnosing COVID-19 cases. In this context the *Indian Council of Medical Research (ICMR)* has clarified that the rapid testing kit is not for diagnosis but for surveillance, especially in hotspots.

Dr. Raman R Gangakhedkar, Head of *Epidemiology and Communicable Diseases* at *ICMR*, said that India has on 16th April, 2020 received 5 lakh rapid test kits for COVID-19 from *China*. According to him, "these have a sensitivity of over 80% and are serology kits which is not to be used for early diagnosis but for surveillance purpose, especially in hotspots". However, as the quality of the kit was not up to the mark, the ICMR has advised all the State Governments to stop the rapid tests using these kits until further orders.

The majority of the tests for COVID-19 can be divided into polymerise chain reaction (PCR) or serologic tests. Both of these tests use different kinds of samples to search for different hallmarks of the SARS-CoV-2 virus – and neither of them are exactly perfect.

8.3 Imaging Test

Characteristic imaging features on radiographs and computed tomography (CT) of symptomatic patients include asymmetric peripheral ground glass opacities and absent pleural effusions. The *Italian Radiological Society* is compiling an international online database of imaging findings for confirmed cases. Due to overlap with other infections such as adenovirus, imaging without confirmation by PCR is of limited specificity in identifying COVID-19.

However, a large study in *China* compared chest CT results to PCR and demonstrated that though imaging is less specific for the infection, it is faster and more sensitive, suggesting its consideration as a screening tool in epidemic areas. Artificial intelligence-based convolutional neural networks have been developed to detect imaging features of the virus with both Radiographs and CT.

8.4 Antigen Test

All states should be encouraged to initiate seroprevalence study of COVID-19 to understand the community spread of the disease and also to formulate appropriate state health system polices. Currently testing of COVID-19 is confined to viral and antibody tests. Attempts are being made by institutions such as the *Sree Chitra Tirunal Institute for Medical Sciences & Technology*, *Trivandrum*, to develop an antigen test for COVID-19.

Incidentally, as on 22nd April, 2020, India has 176, Operational Government Laboratories (initiated independent testing) and 3 collection sites for testing COVID-19 under *ICMR*. In addition, 87 Private Laboratories approved by *ICMR* are also available for testing COVID-19.

9.0 THE DEVELOPMENT OF VACCINE

As of today, there is no COVID-19 vaccine, though many organizations are working to develop one.

With the genetic information of the Novel Corona Virus (SARS-CoV-2) available online, governments across the globe, top private players, academics and no-for-profit organisations are working at a breakneck pace to find a COVID-19 vaccine. According to the *WHO*, two vaccines are currently being tested on humans.

One vaccine, a non-replicating viral vector vaccine, is jointly developed by *CanSino Biologics Inc*. and *Beijing Institute of Biotechnology*. A non-replicating viral vector vaccine can be developed either using a virus that is killed or a part of the virus. Since it is not a complete virus, it cannot replicate inside the host; but the antigens trigger our immune system to produce antibodies, which help to fight the disease in case we contact it in the future.

The other vaccine is jointly developed by US-based biotech firm *Moderna* and the *National Institute of Allergy and Infectious Diseases (NIAID)*. This vaccine is based on RNA platform. In RNA vaccine, messenger RNA, acts as an intermediary between the genetic information in DNA and the amino acid sequence of proteins, which gives cells command to make proteins that fight the viruses.

The COVID-19 vaccine R & D landscape includes 115 vaccine candidates of which 78 are confirmed as active and 37 are unconfirmed. Along with the 2 vaccines mentioned by the *WHO*, the list includes one vaccine developed by *Inovio Pharmaceuticals* and 2 from *Shenzhen Genoimmune Medical Institute*.

The *WHO* draft adds that 60 candidates' vaccines are in pre-clinical trials. The list contains DNA plasmid developed by *Gujarat* based *Zydus Cadila* and live attenuated virus vaccine developed by the *Serum Institute of India*.

The DNA vaccines are comparatively easy to make, transport, store and are cheaper.

10.0 DRUG FOR COVID-19

There is no medicine for COVID-19 so far. However, some countries use *Hydroxychloroquine* – a drug used for the treatment of Malaria – for treatment of COVID-19.

It may be added here that, the Hydroxychloroquine is found to be effective against coronavirus in laboratory studies and in-vivo studies. Its use in prophylaxis is derived from available evidence of benefit as treatment and supported by pre-clinical data. The use of Hydroxychloroquine as a prophylactic agent against SARS-CoV-2 infection is based on these considerations, as well as risk benefit consideration, under exceptional circumstances that call for protection of high-risk individuals.

The *National Task Force* for COVID-19 recommends the use of Hydroxychloroquine for prophylaxis of SARS-CoV-2 infection for selected individuals such as: (i) Asymptomatic healthcare workers involved in the care of suspected or confirmed cases of COVID-19. The dosage is 400 mg twice a day on Day 1, followed by 400 mg once weekly for next 7 weeks; to be taken with meals. and (ii) Asymptomatic household contacts of laboratory confirmed cases. The dosage is 400 mg twice a day on Day 1, followed by 400 mg once weekly for next 3 weeks; to be taken with meals.

The drug is not recommended for prophylaxis in children under 15 years of age. It is also contraindicated in persons with known case of retinopathy, known hypersensitivity to Hydroxychloroquine, 4-aminoquinoline compounds. It may be reminded here that the drug has to be given only on the prescription of a registered medical practitioner.

According to *Dr. D. Balasubramanian*, Director of Research, *L V Prasad Eye Institute Hyderabad*, while the possibility of a preventive vaccine for large scale use in India is at least a year away, we need to turn to molecules and drug based approaches, in which India has great internal expertise a team of excellent organic and biological scientists.

The *Council of Scientific and Industrial Research (CSIR)* has already roped in Organic Chemists and Bioinformatics experts who can predict the 3D structure of proteins, so as to look for potential areas on their surface to which molecules can fit (Lock & Key approach). With such team efforts *India* can come out with *"Made in India"* drug molecules to overcome this killing virus.

11.0 PREVENTIVE MEASURES

Strategies for preventing transmission of the disease include maintaining overall good personal hygiene, washing hands, avoiding touching the eyes, nose, or mouth with unwashed hands, and coughing or sneezing into a tissue and putting the tissue directly into a waste container. Those who may already have the infection have been advised to wear a surgical mask in public. Physical distancing measures are also recommended to prevent transmission.

Many governments have restricted or advised against all non-essential travel to and from countries and areas affected by the outbreak. However, the virus has reached the stage of community spread in large parts of the world. This means that the virus is spreading within communities, and some community members don't know where or how they were infected.

Health care providers taking care of someone who may be infected are recommended to use standard precautions, contact precautions, and eye protection.

Contact tracing is an important method for health authorities to determine the source of an infection and to prevent further transmission.

11.1 Hand washing

Hand washing is recommended to prevent the spread of the disease. The *CDC* recommends that people wash hands often with soap and water for at least 20 seconds, especially after going to the toilet or when hands are visibly dirty; before eating; and after blowing one's nose, coughing, or sneezing.

The *CDC* further recommended using an alcohol-based hand sanitizer with at least 60% alcohol by volume when soap and water are not readily available. The *WHO* advises people to avoid touching the eyes, nose, or mouth with unwashed hands.

11.2 Respiratory hygiene

Health organizations recommended that people cover their mouth and nose with a bent elbow or a tissue when coughing or sneezing, and disposing of any tissue immediately. Surgical masks are recommended for those who may be infected, as wearing a mask can limit the volume and travel distance of expiratory droplets dispersed when talking, sneezing, and coughing. The *WHO* has issued instructions on when and how to use masks. According to *Dr. Stephen Griffin*, a virologist at the *University of Leeds*, "Wearing a mask can reduce the propensity for people to touch their faces, which is a major source of infection without proper hand hygiene."

Masks have also been recommended for use by those taking care of someone who may have the disease. The *WHO* has recommended the wearing of masks by healthy people only if they are at high risk, such as those who are caring for a person with COVID-19, although they also acknowledge that wearing masks may help people avoid touching their face.

India insists for wearing a mask by health workers and those persons who are required to attend public places for procuring essential items from essential stores, hospitals, etc.

11.3 Social distancing

Social distancing (also known as physical distancing) includes infection control actions intended to slow the spread of disease by minimizing close contact between individuals. Methods include quarantines; travel restrictions; and the closing of schools, workplaces, stadiums, cinema theatres, or shopping centres.

Individuals may apply social distancing methods by staying at home, limiting travel, avoiding crowded areas, using no-contact greetings, and physically distancing themselves from others. Many governments are now mandating or recommending social distancing in regions affected by the outbreak. The maximum gathering size recommended by government bodies and health organizations was swiftly reduced from 250 people (if there was no known COVID-19 spread in a region) to 50 people, and later to 10 people. On 22th March 2020, *Germany* banned public gatherings of more than two people. *India* too banned public gatherings limiting to 5 persons. For effective social distancing, the *Government of India*, has banned all social gatherings such as worships in temples, churches, mosques; cinema halls; cultural events; festivals; etc.

Older adults and those with underlying medical conditions such as diabetes, heart disease, respiratory disease, hypertension, and compromised immune systems face increased risk of serious illness and complications and have been advised by the CDC to stay home as much as possible in areas of community outbreak. In this context *ICMR* has issued an advisory.

It may be noted here that, in late March 2020, the *WHO* and other health bodies began to replace the use of the term "social distancing" with "physical distancing", to clarify that the aim is to reduce physical contact while maintaining social connections, either virtually or at a distance. The use of the term "social distancing" had led to implications that people should engage in complete social isolation, rather than encouraging them to stay in contact with others through alternative means.

11.4 Self-isolation

Self-isolation at home has been recommended for those diagnosed with COVID-19 and those who suspect they have been infected. Health agencies have issued detailed instructions for proper self-isolation.

Many governments have mandated or recommended self-quarantine for entire populations living in affected areas. The strongest self-quarantine instructions have been issued to those in high risk groups. Those who may have been exposed to someone with COVID-19 and those who have recently travelled to a country or region with widespread transmission have been advised to self-quarantine for 14 days from the time of last possible exposure.

However, some governments have advised 28 days of self-quarantine for those who had visited or travelled to a country or regions with wide spread transmission (high risk areas).

11.5 Disinfection Gateway

The Scientists, *Jithin Krishan* and *Subash V.V.* at the *Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST),* Trivandrum, an autonomous institute under the *Department of Science and Technology (DST)* of the central government have come up with a 'Disinfectant Gateway' – a portable system that generates hydrogen-peroxide mist and UV-based decontamination facility to fight the Covid-19 pandemic. *Professor Ashutosh Sharma*, the DST secretary said the disinfectant gateway is an electronically controlled system.

According to *SCTIMST*, the hydrogen-peroxide fumes will decontaminate the body, hands, and clothes of a person, whereas, the UV system will decontaminate the chamber attached to it. The electronically controlled system will have sensors that will detect the entry of a person in a room and generate hydrogen-peroxide mist for fumigation. The person will be required to walk through the chamber attached to its end. When the person exits, the system will shut off the hydrogen peroxide fumigation system and will turn on the UV lamp inside the chamber to decontaminate it. The UV light will get switched off automatically after a prescribed time. The chamber will then get ready for the next person. The whole process takes just 40 seconds for disinfecting one person. The system has see-through glass panels on sidewalls for monitoring and is fitted with lights for illumination during use *(See Fig 15)*. "The design and Know-how have been transferred to *HMT Machine Tools*, *Ernakulam, Kerala*" for mass production. According to *Professor Sharma*, the use of hydrogen-peroxide spray and ultraviolet light in appropriate doses are two robust weapons to fight Covid-19 pandemic.

It may be reminded here that various countries including *India*, follow the disinfection guidelines given by the *World Health Organisation* and the *Centers for Disease Control and Prevention* in *America*. They do not recommend Sodium Hypochlorite or Hydrogen Peroxide for fumigation, which will work only on surfaces, but not on the human body, and can also harm people.

The technology can be proved crucial in the times of the pandemic spread. *Professor Sharma*, said that the disinfection of people, garments, surfaces and used disposable protective gears is vital to break the chain of transmission of viral infection from one person to another.

Fig 15: Disinfection Gateway developed by the scientists of SCTIMST.

11.6 Facemask Disposal Bin

The *SCTIMST* has also developed a UV-based facemask disposal bin that can be useful in fight against Covid-19. It can be used by health workers in hospitals and in public places, where decontamination of used facemasks, overhead covers and face shields are required to break the infection chain. Face masks are a must-have item due to the current Covid-19 outbreak, but the used masks are hazardous waste and can spread infection further, if not disposed of properly. The waste collectors are at risk of being exposed to Covid-19, while performing their duties. Instead of just throwing used face masks into the waste bin, disinfecting the used mask is a must. The design and know-how of the new dustbin have been transferred to *HMT Machine Tools*.

11.7 Personal Protective Equipment

An important way to protect oneself against the invasion by the COVID-19 is to wear protective equipment, in particular a N95 mask *(See Fig 16)*. According to well-known infection expert *Dr. Jacob John* of *CMC Vellore*, it is vital that we mask over selves, as the virus is also air-borne. It was observed that after the government clarifications and advice on this matter, more and more people are seen to mask themselves. *DRDO* have come up with a special kind of tape in order to make patient protection gowns for clinicians, nurses and paramedics. The *Fig 17* shows a group of Doctors gathered in *Ahmedabad*, wearing protective gear to take swabs from the residents to test for coronavirus, on 8th April, 2020.

Fig 16: N95 Mask used by the Healthcare workers.

Fig 17: A group of Doctors gathered in Ahmedabad, wearing protective gear to take swabs for COVID-19 testing.

11.8 PPE Kiosk

The *Defence Research Development Organisation (DRDO)* of the *Government of India*, has developed a COVid SAmple Collection Kiosk (COVSACK) to enable health care workers to collect samples for testing from persons suspected to have been infected, without coming into direct contact with them *(See Fig 18)*. COVSACK does away with the need for health workers to wear Personal Protective Equipment (PPE) while collecting oral samples of people coming in for COVID-19 testing.

The Kiosk is designed for automatic disinfection, once again eliminating the need for human personnel from coming in contact with a possibly contaminated environment. Sprayers with disinfectant solution, water and UV lights are used to sanitise the booth. A person who arrives for testing enters the kiosk from where their oral swabs are collected by healthcare workers outside the chamber. A screen protects the healthcare worker from droplets that might be emitted by the breath, cough or sneeze of a potential carrier of the contagion.

The auto-disinfection sprayers mounted in the kiosk spray 1% sodium hypochlorite solution for a period of 1 minute to sanitise the walls, gloves and insides of the chamber, after the person being tested exits. The automated system then flushes the cabin with water from the inbuilt sprayers after which it disperses UV light to complete the disinfection process. After this, the next person is allowed in for sample collection.

Television channels are also doing a very useful service by inviting experts and asking them to offer valuable advice to people who have specific questions and doubts about protection in specific individual instances.

Fig 18: A COVid SAmple Collection Kiosk (COVSACK) developed by DRDO.

Another exiting advance towards protection and prevention of spread of coronavirus has been the large-scale production of incubators, ventilators and devices to monitor the individuals who have been in such quarantine centres. *Mahindra* has successfully made ventilators in large scale at affordable prices, and

In addition to what the central and state governments and notable private hospitals such as *Apollo, Medanta* have setup isolation and quarantine centres. Several private agencies such as *Infosys Foundation, Skoda*, *Mercedes Benz*, *Mahindra*, etc. have also helped to setup such centres in various parts of the country.

12.0 LOCKDOWN

Lockdown is one of the measures adopted by any government to contain the transmission chain of a pandemic. According to the *WHO* Director General, *Dr. Tedros Adhanom Ghebreyesus*, "Shutting down population movement is buying time and reducing the pressure on health systems. But on their own, these measures will not extinguish the epidemic. The point of these actions is to enable the more precious and targeted measures that are needed to stop transmission and save lives". Among other measures, every country should take, the production, capacity and availability of testing has to be ramped up, and a system to find, every suspected case at community level has to be implemented.

India had imposed a 21-Day National Lockdown on 25th March, 2020, much earlier than many countries, including *China*, which failed to contain the initial spread of the virus. During the lockdown, *India* had adopted the containment measures of screening, testing, isolating and contacts tracing. The March 25th Lockdown was expired on 14th April, which was extended up to 3rd May, 2020.

Epidemiologists say that the measures implemented by *China* during the lockdown did work. But *China's* mammoth response had gone one glaring flaw: it started too late. This delayed the measures to contain it. According to one expert, if *China* could have implemented the measure 3 weeks earlier, from the beginning of January, would have cut the number of infections to 5% of the total.

Many experts are of the opinion that the COVID-19 effectively hides and quickly doubles. By testing only suspected cases, we might miss many of those who are asymptomatic during screening. The best strategy is to test among the severely affected respiratory infections admitted in the hospitals and the OPDs of these areas. It is sad that many states have not even begun testing such cases. Therefore, strong national and local surveillance preview is needed.

12.1 Contact Tracing

Contact tracing, quarantining, and testing of contacts of people who participated in the religious congregation like *Nizamuddin Markaz* are definitely most necessary.

According to the health ministry, around 30% of the total confirmed cases of COVID-19 in India are linked to the Tablighi Jamaat event held in mid-March at Nizamuddin Markaz in *New Delhi*. It was reported on 18th April, 2020, that out of the total 14,378 confirmed cases of COVID, 4,291 or 29.8% were linked to the Nizamuddin Markaz religious congregation. *Mr. Lav Agarwal*, the Joint Secretary, Health Ministry, said that these cases are spread across 23 states and Union Territories, which include most of the high burden states, he added that 80% of cases in *Tamil Nadu*, 63% cases in *Delhi*, 79% cases in *Telangana*, 59% cases in *Uttar Pradesh* and 61% cases in *Andhra Pradesh* are related to the event *(See Fig 19)*.

Fig 19: Markaz Link. Courtesy – The Times of India Newspaper.

Incidentally, according to *Punya Salila Srivastava*, Joint Secretary of the *Union Home Ministry*, that "the Ministry has identified 9000 *Tablighi Jamat* workers and their contacts, and placed them in quarantine". She added that, out of these 9000 people, 1306 are foreigners and the rest are *Indians*. The home ministry also said that, over 40,000 people, which includes members of the congregation and their contacts, were quarantined.

12.2 COVID-19 Hotspots

On 16th April, 2020, the *Government of India* has declared 170 districts in *India* as Hot Spots for COVID-19 *(See Fig 20)*. In the figure, the hot spots are marked in red. The 170 hot spots are further divided into two categories, viz. 123 districts that have seen large outbreaks and 47 hot spot districts with 'clusters.'

According to *Dr. Harsh Vardhan*, Union Health Minister, "Through a graded, pre-emptive and pro-active approach, the Central Government is taking several steps along with States / Union Territories, for prevention, containment and management of COVID-19." He further said that "The situation is improving in *India*, as Hotspot districts are moving towards becoming non-hotspot districts."

Wherever hotspots are present, the stricter enforcement of lockdown is needed. There should be enforcement of active surveillance in these areas for any flu like illness, and people should be encouraging to self-report.

According to *Dr. Soumya Swaminathan*, Ex Director General of the *Indian Council of Medical Research* and Chief Scientist at the *World Health Organisation*, that the fight against COVID-19 is likely to be long term, and lockdowns alone cannot be effective unless combined with other health measures. She says that the *WHO* had laid out quite clearly that physical distancing, of which one extreme form is a lockdown, does help in bringing down the transmission of the virus in the population. Health care workers need to wear masks and proper personal protective equipment as they are the ones that are likely to see a lot of patients. It may be reminded here that though you don't show any symptoms you still have the infection; you can be spreading the virus.

Mr. Lav Agrawal, Joint Secretary of *Ministry of Health and Family Welfare* said on 11th April, 2020, that "had a lockdown not been imposed, the country would have reached about 8.2 lakh COVID-19 cases by 15th April". However, *ICMR* – the technical arm of the Ministry, that is overseeing testing and epidemiology in India – was not involved in preparing this estimate.

Fig 20: COVID-19 hotspots declared by the Government of India. Courtesy – The Hindustan Times.

A study in February, which was published on 23rd March, 2020, remains the only actual modelling study involving *ICMR* epidemiologists and international experts in the field. That study did not estimate numbers but – based on the state of affairs in February – recommended that India should have focused on finding transmission in the community and quarantining instead of 'border control' because of the large uncertainty in detecting asymptomatic travellers harbouring the infection and becoming spreaders.
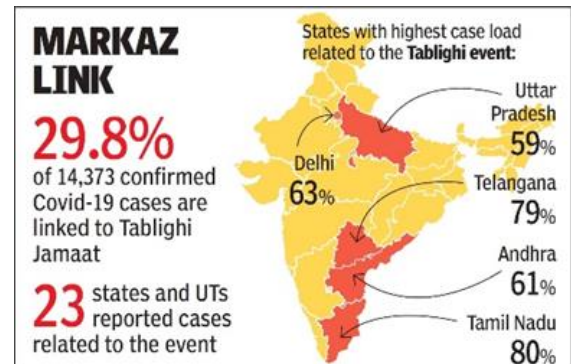
Another *ICMR* study published during the 2nd week of April, 2020, found that 40% of those with severe respiratory illnesses sampled and detected with COVID-19 could not have their contact history established. The *ICMR*, said 1,71,718 samples were tested, including 16,564 in 24 hours from 10th to 11th April, 2020.

12.2 Guidelines for Lockdowns

First Lockdown

Selected guidelines issued by the Government of India for the 1st Lockdown (25th March to 14th April, 2020) are listed below:

- The lockdown restricts people from stepping out of their homes.
- All transport services – road, air and rail were suspended with exceptions for transportation of essential goods, fire, police and emergency services.
- Educational institutions, industrial establishments and hospitality services were also suspended.
- Services such as food shops, banks and ATMs, petrol pumps, other essentials and their manufacturing are exempted.
- The Home Ministry said that anyone who fails to follow the restrictions can face up to a year in jail.

The Central and State Governments adopted lot of measures for implementing the lockdown conditions, which include restrictions for travel, assembly of more than 5 persons, etc. The government has also initiated the free supply of essential commodities through Public Distribution System and maintaining community kitchen for feeding the migrant labours.

By and large everyone in the country followed / observed the norms of the lockdown. However, there were few violations in few spots in the country which are reflected in *Fig 21*. Over all, the 1st Lockdown was successful, even though the COVID-19 cases were on the rise at many States. The rise in the COVID-19 cases prompted the government to go for the lockdown extension for another 19 days.

Fig 21: Violation of Lockdown norms – About 2000 Migrant Labourers at Bandra Railway Station demanding train services for returning to their native places.
Courtesy – Mid-day Newspaper

Second Lockdown

Selected guidelines issued by the *Government of India* for the Lockdown Extension (15th March to 3rd May, 2020) are listed below:

- Inter-state, inter-district movement of people, metro, bus services continue to be prohibited till 3rd May, 2020.
- Educational institutions, coaching centres, domestic, international air travel, train services to remain suspended till 3rd May, 2020.
- Cinema halls, malls, shopping complexes, gymnasiums, sports complexes, swimming pools, bars to remain closed till 3rd May, 2020.
- All social, political, sports, religious functions, religious places, places of worship shall be closed for public till 3rd May, 2020.

According to the new guidelines, the following services will be fully-functional after 26th April, 2020:

- Agriculture and Horticulture related activities, procurement of agriculture products, 'mandis', MGNREGA related work.
- Shops of farm machinery, its spare parts, supply chain, repairs, 'Custom Hiring Centres' related to machinery.
- All Medical facilities that include Aayush, health infrastructure related works, Manufacturing units of pharmaceuticals, medical devices, construction of medical infrastructure.
- Financial sector including bank branches and ATMs.
- Industries related to the production of essential goods.
- Movement of cargos and essential items across the country.

13.0 CONCLUSION

The COVID-19 is spreading very fast and many countries are yet to flatten the curve. Though, *India's* share is only about 0.91% of the total COVID-19 cases in the Globe, the impact of this pandemic in *India* is severe and long term. In *India*, the Central Government along with State Governments had taken a series of measures to contain the spread of COVID-19. *India* had adopted lockdown measures as back as 25th March, 2020, which is now extended up to 3rd May, 2020. The first phase of the lockdown had yielded with some success. However, the COVID-19 cases are on the rise. It means, the measures adopted by *India* are not adequate to contain the spread of virus.

The lockdown not only buys time but also decreases the overall burden and delays the outbreaks in most places. Stronger containment measures done together with these mitigation methods done will ensure flattening the epidemic.

Mitigation measures or lockdown alone are not enough. The containment strategies include identifying all cases which are positive and identifying their contacts too. Once identified, cases will have to be isolated, and contacts will have to be placed under quarantine

Mitigation is precursory measure and if containment is also not done, it is not going to help. Both need to go hand-in-hand. Contact tracing of all those people who might have got the infection is highly needed. Only then will India succeed the current strategies to combat Coronavirus.

Aggressive testing alone without mitigation does not help in breaking the chain of transmission. Without mitigation, the spread of the infection from one person to another will happen at a faster rate.

The lockdown is an opportunity for us to rapidly scale up the capacity to have enough sources to manage, isolate and provide intensive care for those who needed it. But measures going hand-in-hand could have a reasonable effect on the flattening the epidemic curve.

With its high population, testing everybody in India is out of question. Therefore, we need to follow mitigation measures. We need to manage every case of fever, cough and respiratory ailments as COVID-19 unless otherwise proved.

Stringent measures are to be resorted along with the implementation of a well-planned economic package, so that the collapsed economy can be revived. The economic package should have a meaningful thought with a view to boost the production and employment in all sectors.

Let us continue our war against COVID-19. To succeed our fight, we should, **KILL THE COVID-19 BEFORE IT KILLS US.**

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