

Summer Training Report

By

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“It is easy to acknowledge, but almost impossible to realize for long, that we are mirrors whose brightness, if we are bright, is wholly derived from the sun that shines upon us.”

-C. S. Lewis

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ABBREVIATIONS/ACRONYMS:

ADB: “Asian Development Bank.”

AIIMS: “All India Institute of Medical Sciences.”

COVID-19: “Corona Virus Disease 2019.”

CSIR-IMTECH: “Council of Scientific & Industrial Research-Institute of Microbial Technology.”

DALY: “Disability-Adjusted Life Years.”

DAY-NULM: “Deendayal Antyodaya Yojana-National Urban Livelihoods Mission.”

DCH: “Category 1 Dedicated COVID Hospital”.

DCHC: “Category 2 Dedicated COVID Health Center.”

DCCC: “Category 3 Dedicated COVID Care Center.”

DGCA/MoCA: “Director General of Civil Aviation/ Ministry of Civil Aviation.”

DOTS: “Directly Observed Therapy Short Course.”

DoNER: “Development of North East Region.”

DRDO: “Defense Research and Development Organization.”

EDRM: “Emergency and Disaster Risk Management Framework.”

EPI: “Expanded Program for Immunization.”

EPFO: “Employee’s Provident Fund Organization.”

ESIC: “Employee’s State Insurance Corporation.”

GAVI: “Global Alliance for Vaccines and Immunizations.”

GDP: “Gross Domestic Product.”

GMC: “Government Medical College.”

GoI: “Government of India.”

HiB: “Human influenza Type B.”

ICMR-NICED: “Indian Council of Medical Research-National Institute of Cholera and Enteric Diseases.”

ICU: “Intensive Care Unit.”

IDSP: “Integrated Disease Surveillance Program.”

IGGMC: “Indira Gandhi Government Medical College.”

IHR: “International Health Regulations.”

IPC: “Infection, Prevention, and Control.”

IRCTC: “Indian Railway Catering and Tourism Corporation.”

ITBP: “Indo-Tibetan Border Police.”

IT/GST: “Income Tax/Goods and Service Tax.”

KIPMR: “King Institute of Preventive Medicine and Research.”

KGMU: “King George Medical University.”

LPG: “Liquified Petroleum Gas”

MDR-TB: “Multi-Drug Resistant Tuberculosis.”

MERS: “Middle East Respiratory Syndrome.”

MGNREGA: “Mahatma Gandhi National Rural Employment Guarantee Act.”

MHRD: “Ministry of Human Resource Development.”

MoFHW: “Ministry of Health, Family, and Welfare.”

N95: “Not resistant to oil-95%”

NCC: “National Cadet Corps.”

NCD: “Non-Communicable Diseases.”

NCDC: “National Center for Disease Control.”

NCR: “National Capital Region.”

NHPC: “National Hydro-Power Corporation.”

NTD: “Neglected Tropical Diseases.”

NTFP: “Non-Timber Forest Product.”

NTPC: “National Thermal Power Corporation.”

PF/EPF: “Provident Fund/ Employee Provident Fund.”

PM-CARES: “Prime Minister’s Citizen Assistance and Relief in Emergency Situations.”

PM-KISAN: “Pradhan Mantri Kisan Samman Nidhi Yojana.”

PMUY: “Pradhan Mantri Ujjwala Yojana.”

PPE: “Personal Protective Equipment.”

PPP: “Public-Private Partnership.”

PSU: “Public Sector Unit.”

RNA: “Ribo-Nucleic Acid.”

RPF: “Railway Police Force.”

SARS: “Severe Acute Respiratory Syndrome.”

SARS-Cov-2: “Severe Acute Respiratory Syndrome-Coronavirus-2.”

SMS Hospital: “Sawai Man Singh Hospital.”

TRIFED: “Tribal Cooperative Marketing Development Federation of India.”

UT: “Union Territory.”

WHO/WCO: “World Health Organization/ WHO Country Office.”

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Summer Training Report

Part-1 (Secondary Research Report)

COVID-19 and India: An Epidemiological Context

INTRODUCTION:

“COVID-19” or “Novel Coronavirus Disease 2019 (nCov-19)” or the “Severe Acute Respiratory Syndrome-Coronavirus-2 (SARS-Cov-2)” as it has been named, is the new pandemic that has threatened the global community on Social, Economic and Political fronts in the past few months.

The disease, COVID-19, originated from the Wuhan district of The Republic of China. In early December 2019, local hospitals in Wuhan district of the Hubei province, saw cases presenting with pneumonia of unknown origin. Many of these cases were frequent visitors of the Huanan wholesale seafood market. On the 31st of December, WHO’s Epidemic Intelligence system, noted evidence about a “*local cluster of pneumonia cases of unknown etiology*” in Wuhan, China. On 7th January 2020, the virus was affirmed to be a coronavirus with >70% similarity with the SARS-Cov (2012). Samples taken from the seafood market confirmed that the virus originated from there ^[1]. On January 11, China reported its first death due to Novel COVID-19.

WHO declared Covid-19 as a “*Public Health Emergency of International Concerns*” on January 30, 2020. On February 11, 2020, WHO officially designated the disease caused by the ‘SARS-Cov-2’ as “COVID-19” ^[2]. It was later declared as a Global Pandemic on March 12, 2020. On May 24, 2020, since the appearance of its first case in India, COVID-19 has claimed 4024 nationwide deaths and 343,364 deaths worldwide. There are 5,3360,841 active cases of Covid-19 globally of which 138,536 cases are from India ^[3].

First described by “**Tyrell and Bynoe (1966)**” Coronaviruses are enveloped positive, single stranded large RNA viruses. The spherical virions, morphologically, consist of a core shell and crown shaped surface projections, hence termed coronaviruses (*corona is the Latin term for crown*) ^[4].

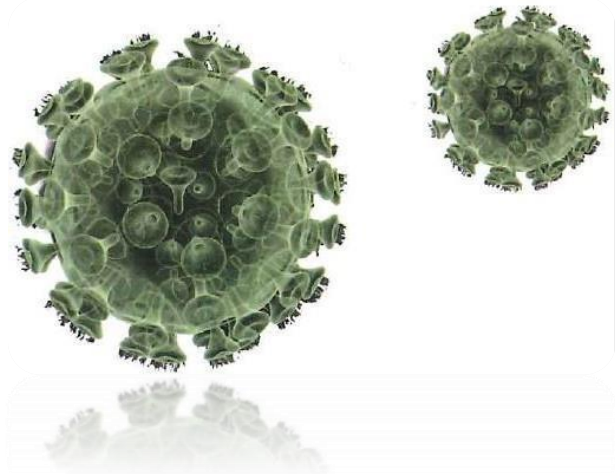


Fig. 1. An illustration of SARS-Cov-2 virus. Source: www.mofhw.gov.in;

Novel coronavirus is a beta-coronavirus (zoonotic origin; primarily bats), that causes acute respiratory infections in animals and humans, ranging from common cold to severe cases like MERS and SARS.

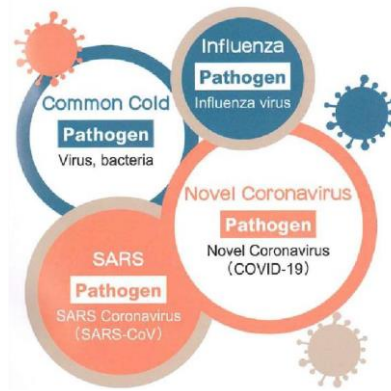


Fig. 2. Novel coronavirus and other similar pathogens. Source: www.mofhw.gov.in

COVID-19 is the most recent pandemic associated with the beta-coronaviridae family. The earlier reports of patients infected with COVID 19 were associated with the direct exposure to the local seafood market in Wuhan, China. It is therefore presumed that the disease exposure occurred mainly via animal to human transmission. As the incidence of COVID-19 increased and spread to other countries, it was presumed that human-to-human transmission was prevailing factor for further disease progression ^[5]. According to WHO, a person can contact the disease through droplet (*sneezing or coughing*) or fomite infection, or by coming in direct contact with the infected person ^[6]. The incubation period of COVID-19 ranges from 1 to 14 days, with an average of 5-6 days. Elderly, and people with co-morbidities (*hypertension, heart and lung problems, diabetes, and cancer*) are more susceptible to COVID-19 and are at greater risk of developing serious illnesses. However, the risk of getting infected with COVID-19 is equal for all age groups. Fever, dry-cough, and muscle pain are the most common symptoms of the disease. Other less common symptoms include nasal congestion, headache, sore throat, conjunctivitis, diarrhea, rashes, and loss of taste or smell.

The course of COVID-19 pandemic in India began on 30th January, when a female student who had returned from Wuhan, China was found positive for SARS-Cov-2 ^[7]. According to Ministry of Health and Family Welfare, India has seen a total of 1,38,536 cases, 57,694 recoveries (including 1 migration) and 4,024 deaths in the country, on May 24, 2020. ^[8]. The infection rate of COVID-19 in India is reported to be 1.27 on May 16, 2020, significantly lower than in the worst affected countries ^[9]. The recovery rate is estimated to be 41.5% whereas fatality or death rate is 2.9% of total cases ^[10]. Even before the first case appeared in India, several measures were adopted by the Indian Govt. This included preventive measures such as thermal screening of passengers arriving from China and other infected countries ^[11] and travel restrictions, setting up of quarantine and treatment facilities across the country ^[12], Issuing advisory to adopt preventive measures and practice social distancing ^[13], and imposing complete nationwide lockdown on March 23, 2020 ^[14]. National Institute of Virology

was designated the nodal center for testing. It was the first center to become available for COVID-19 confirmatory tests. National and state health authorities had been reviewing the public health preparedness strategies including infection control and prevention, risk management, health system strengthening and surveillance protocols. A Strategic Health Operations center (SHOC) was set up by The National Centre for Disease Control (NCDC) for operations management and a helpline (+91- 11-23978046) opened for public awareness and queries ^[15].

We are now seeing Nations and their states struggling at various stages of COVID-19 outbreaks. The nations which have been able to reduce disease transmission and bring the outbreak under control by successful implementation of prevention and risk management strategies have fared better than those where casualties have been high. Covid-19. Although SARS-Cov-2 belongs to the same coronavirus family as SARS and MERS causing pathogens, its course had been far more dynamic and diverse. Therefore, it becomes necessary to study the epidemiological characteristics of the SARS-Cov-2 pandemic Furthermore, the strategies which have been effective in delimiting disease transmission and outbreak control should also be evaluated and compared with those that have failed to provide desired outcomes.

RESEARCH QUESTION:

1. What are the epidemiological characteristics of COVID-19 outbreak in India?
2. What are the Indian government's mobilization and response approach strategies for management of COVID-19 outbreak?

OBJECTIVES:

1. To study the epidemiological characteristics of Covid-19 in India from 30th January to 23rd May 2020 and perform a situational analysis.
2. To enumerate Indian government's mobilization and response approach strategies on ***"WHO Health Emergency and Disaster Risk Management Framework"*** parameters up to May 23, 2020.

METHODOLOGY:

Descriptive secondary research:

1. To illustrate the epidemiological features and perform a detailed situational analysis through a review of databases available on government official sites, relevant articles, and publications.
2. Taking for the Indian government's mobilization and response approach strategies by a review of e-newspapers and the official online press releases of GOI.

Initial search was carried out on, Pubmed and Google Scholar, screening for comprehensive materials on the current status of COVID-19. The keywords included were *"emerging coronavirus"*, *"2019-nCov"*, *"SARS-Cov-2"*, *"COVID-19"*, *"India"*, *"epidemiology"*, *"WHO"* and *"global pandemic"*. Official WHO's website (www.who.org) acted as the primary source of information for this study. Databases from Ministry of Family Health and Welfare (www.mofhw.com), John Hopkins Coronavirus Resource Center (www.coronavirus.jhu.edu), Corona Tracker (www.coronatracker.com) and Kaggle (www.kaggle.com) were evaluated for daily updates on the pandemic and secondary data sources. Furthermore, several e-newspapers were also taken into considerations. PIB's (Press Information Bureau) official website (www.pib.gov.in), was the major source of updates on measures taken by the Indian government.

RESULTS AND DISCUSSIONS:

OBJECTIVE 1: To study the epidemiological characteristics of Covid-19 in India from 30th January to 23rd May 2020 and perform a situational analysis.

A. EPIDEMIC CURVE: A COMPARISON BETWEEN INDIA AND CHINA:

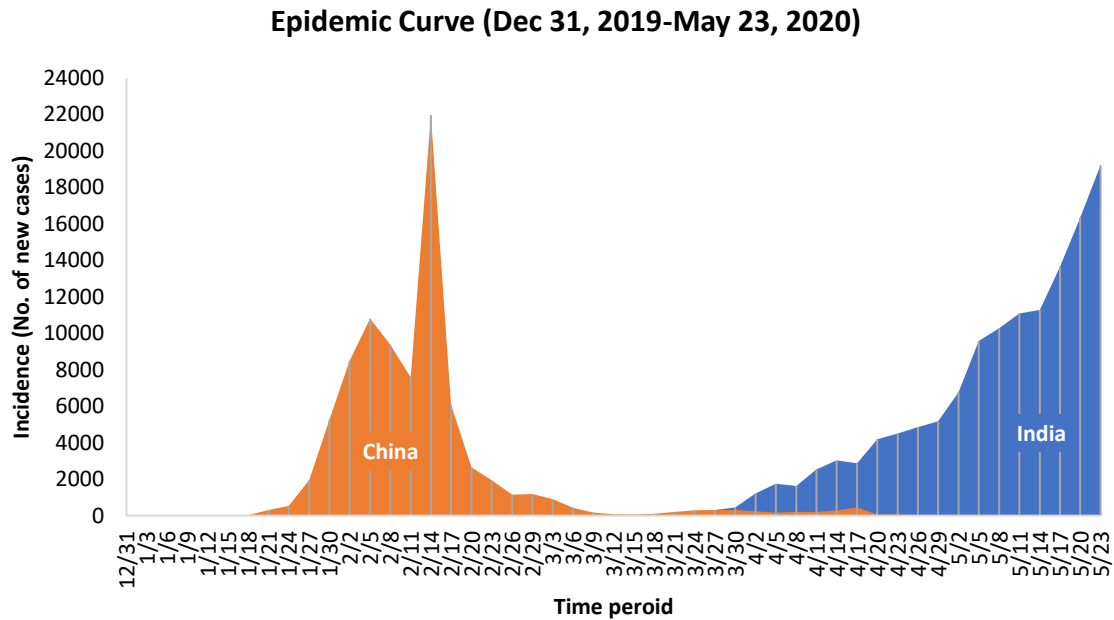


Fig. 3: Epidemic Curve- Comparison between India and China

Fig 3. represents the epidemic curve of COVID-19 outbreak in India and China. The epidemic course of China is illustrated since COVID-19 originated from Wuhan, China and thus provides a good measure for comparison. This is typical example of intermittent propagated epidemic and it confirms the already established fact that COVID-19 can be transmitted through humans. However, there is significant difference between the pattern of epidemic between the two countries. Firstly, the curve in China is already towards its decline except for a few cases that emerge probably due to secondary infections. Secondly, even though it has a larger population, the course of the epidemic in China is of shorter duration if the outliers are excluded. The epidemic curve shows two major peaks, where incidence have been highest and then it gradually declined. In India, the outbreak shows an altogether different course. There have been multiple peaks, each one higher than the previous one and the overall incidence seems to be increasing. This signifies that the outbreak is in the progression phase

and has not reached the point after which the incidence begins to decline. Therefore, a further rise in number of cases can be expected. It also signifies the effectiveness of preventive measures taken by both the countries. At a glance, it seems that China has been more successful in its response approach and strategic implementation than India has been.

B. EPIDEMIOLOGICAL CHARACTERISTICS OF COVID-19 IN INDIA:

I. STATEWISE DISTRIBUTION OF CASES:

Table 1. shows the state wise tally of COVID-19 cases in India. The table shows the data as of May 23, 2020 and include total number of confirmed, deceased, and recovered cases up to the specified time.

STATES	TOTAL CONFIRMED CASES	TOTAL RECOVERED CASES	TOTAL DECEASED CASES
ANDAMAN & NICOBAR	33	33	0
ANDHRA PRADESH	2714	1779	56
ARUNACHAL PRADESH	1	1	0
ASSAM	347	57	3
BIHAR	2394	653	11
CHANDIGARH	225	179	3
CHATTISHGARH	214	64	0
DADRA & NAGAR HAVELI	2	1	0
DAMAN & DIU	0	0	0
DELHI	12910	6267	231
GOA	55	16	0
GUJARAT	13669	6169	829
HARYANA	1131	749	16

HIMACHAL PRADESH	185	58	4
JAMMU & KASHMIR	1569	774	21
JHARKHAND	350	141	3
KARNATAKA	1959	608	42
KERALA	795	515	5
LADAKH	49	48	0
LAKHSHADWEEP	0	0	0
MADHYA PRADESH	6371	3267	282
MAHARASHTRA	47190	13404	1576
MANIPUR	27	2	0
MEGHALAYA	14	12	1
MIZORAM	1	1	0
NAGALAND	0	0	0
ORISSA	1269	497	7
PONDICHERRY	26	10	0
PUNJAB	2045	1870	38
RAJASTHAN	6738	3772	160
SIKKIM	1	0	0
TAMILNADU	15512	7491	104
TELANGANA	1813	1068	47
TRIPURA	190	152	0
UTTAR PRADESH	6017	3406	155
UTTARAKHAND	244	55	1
WEST BENGAL	3459	1281	269

In the above table, the ten states which have highest number of confirmed, deceased, and recovered cases are highlighted. Maharashtra has highest number of confirmed (47,190), deceased (1,576), and recovered (13,404) cases while the state with lowest numbers are Daman-Diu, Lakshadweep, and Nagaland with 0 cases. Fig. 4, 5, 6 gives the geographical representation of the state wise confirmed, recovered, and deceased cases.

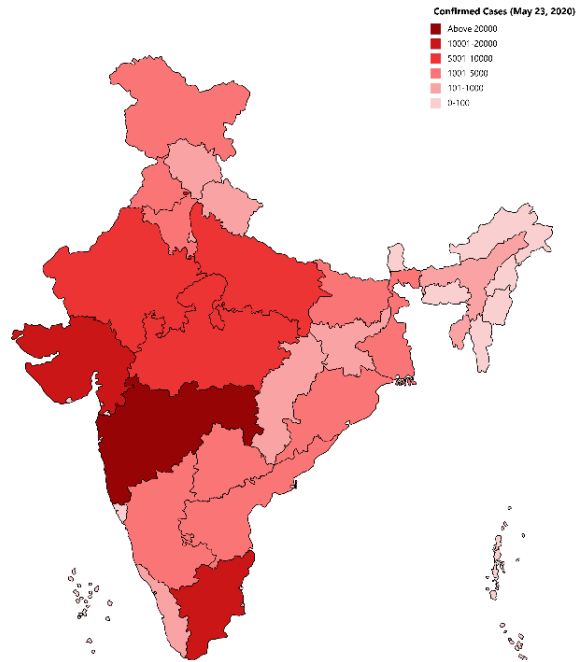


Fig. 4: State-wise distribution of Confirmed cases as of May 23, 2020.

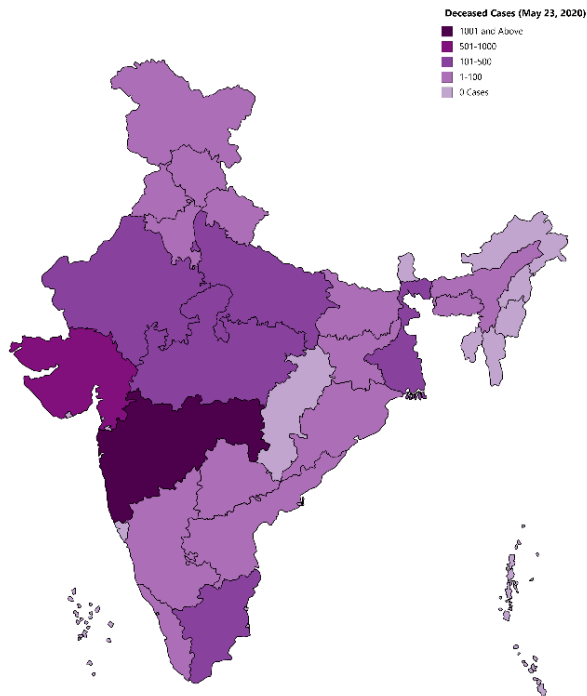


Fig. 5: State-wise distribution of Deceased cases as of May 23, 2020.

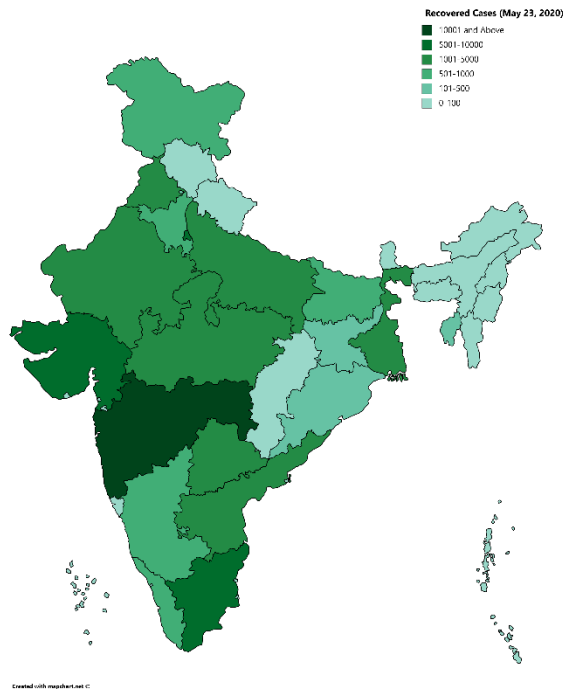


Fig 6: State-wise distribution of Recovered cases as of May 23, 2020.

II. GENDER DISTRIBUTION:

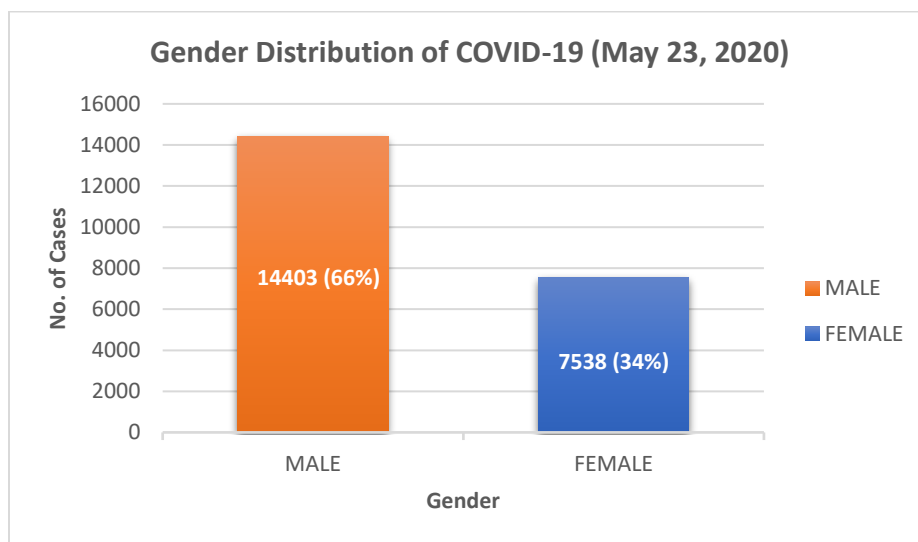


Fig. 7: Gender distribution of COVID-19 cases (May 23, 2020)

Fig. 7 shows the gender distribution pattern of COVID-19 cases in India. Of 21,941 cases, for which the data was available, 14,403 (66%) cases were male whereas 7,538 (34%) cases were female. According to this data, the risk of getting infected with COVID-19 is higher in

men as compared to women. However, this pattern may change as the outbreak progresses and more data is available.

III. AGE-WISE DISTRIBUTION:

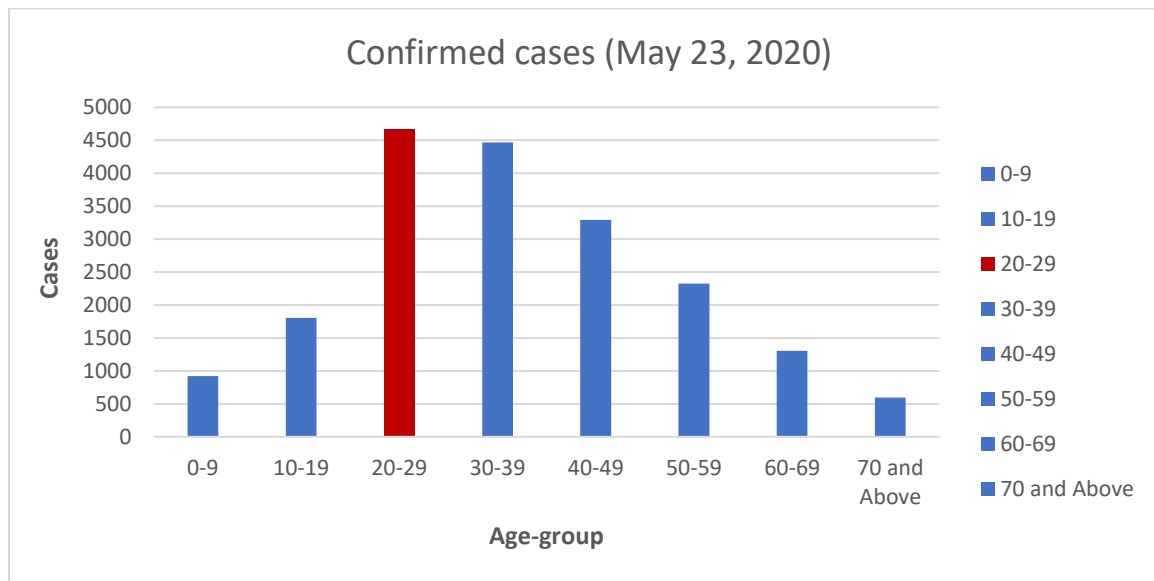


Fig. 8: Confirmed cases by age group (May 23, 2020).

Fig. 9: Deceased cases by age group (May 23, 2020).

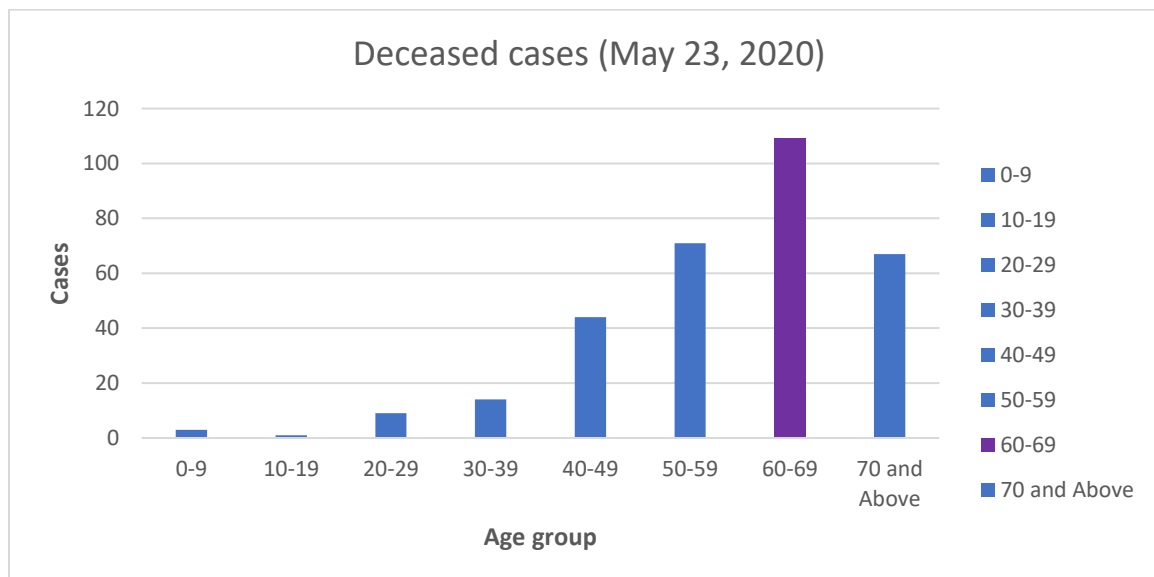


Fig. 8 shows the age-wise distribution of COVID-19 cases in 19,386 hospitalized cases. The age-group of 20-29 years is at the most risk of getting infected with 'SARS-Cov-2' followed by 30-39 years. Older people in India are at lesser risk of getting infected. Even though older people pose lesser risk of getting infected, the mortality is observed highest in age group 60-69 years followed by 50-59 and 70 above age groups (Fig. 9). This pattern was seen in 318 patients, in which 109 cases belonged to 60-69 years, and 71 and 67, to 50-59 and 70 above age groups, respectively.

IV. STATE EPIDEMIOLOGY:

1. Cases confirmed per million:

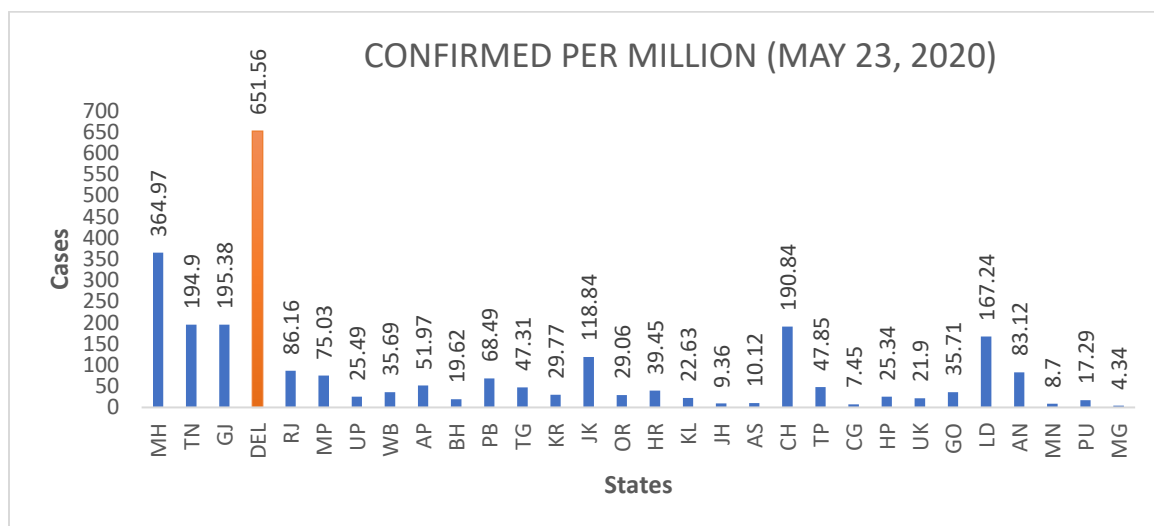


Fig. 10: Confirmed/Million (May 23, 2020). "MH=Maharashtra, TN=Tamil Nadu, GJ=Gujarat, DEL=Delhi, RJ=Rajasthan, MP=Madhya Pradesh, UP=Uttar Pradesh, WB=West Bengal, AP=Andhra Pradesh, BH=Bihar, PB=Punjab, TG=Telangana, KR=Karnataka, JK=Jammu Kashmir, OR=Odisha, HR=Haryana, KL=Kerala, JH=Jharkhand, AS=Assam, CH=Chandigarh, TP=Tripura, CG=Chhattisgarh, HP=Himachal Pradesh, UK=Uttarakhand, GO=Goa, LD=Lakshadweep, AN=Andaman-Nicobar, MN=Manipur, PU=Pondicherry, MG=Meghalaya."

Fig. 10 illustrates that Delhi has highest rate of 'Confirmed per million' cases with 651.56 to 1,000,000. This means that out of 1 million people in Delhi around 651-652 people are infected with COVID-19. The state with lowest score is Meghalaya, where out of 1 million people about 4-5 people are infected.

2. Percentage of Active cases:

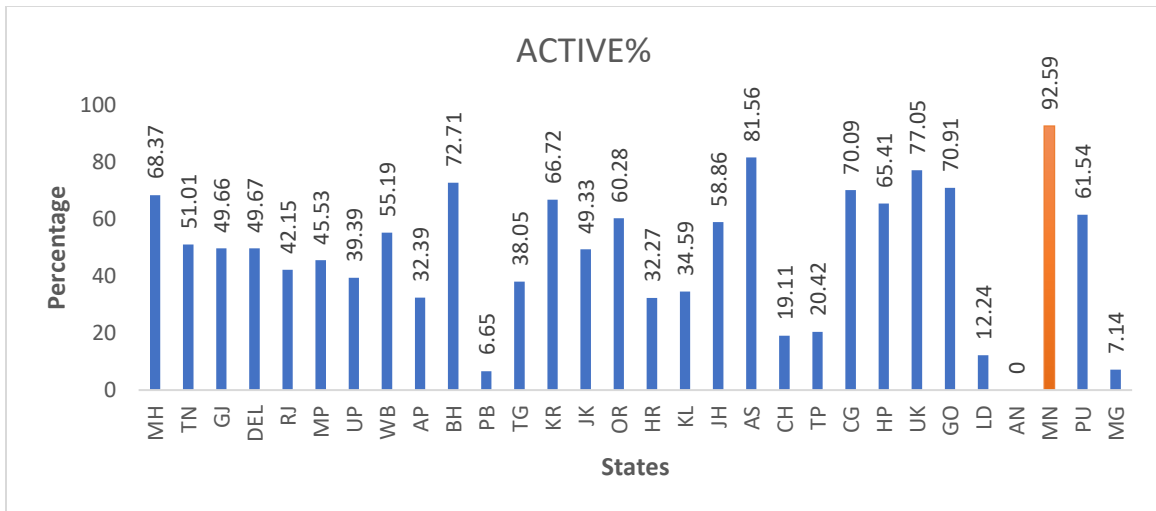


Fig. 11: Percentage of Active cases among total confirmed cases (May 23, 2020). "MH=Maharashtra, TN=Tamil Nadu, GJ=Gujarat, DEL=Delhi, RJ=Rajasthan, MP=Madhya Pradesh, UP=Uttar Pradesh, WB=West Bengal, AP=Andhra Pradesh, BH=Bihar, PB=Punjab, TG=Telangana, KR=Karnataka, JK=Jammu Kashmir, OR=Odisha, HR=Haryana, KL=Kerala, JH=Jharkhand, AS=Assam, CH=Chandigarh, TP=Tripura, CG=Chhattisgarh, HP=Himachal Pradesh, UK=Uttarakhand, GO=Goa, LD=Lakshadweep, AN=Andaman-Nicobar, MN=Manipur, PU=Pondicherry, MG=Meghalaya."

According to Fig. 11, Manipur has highest percentage of active cases in India. This signifies that out of total confirmed cases Manipur has highest number of cases that are active until May 23, 2020. Andaman-Nicobar Islands have the lowest percentage of active cases at 0.

3. Recovery Rate per 100 Population:

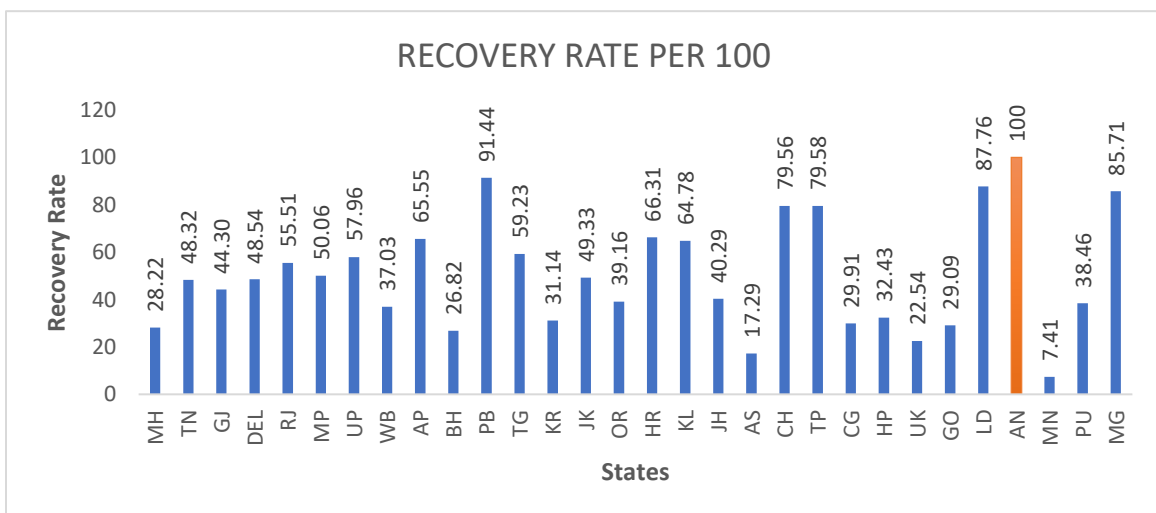


Fig. 12: Recovery rate/100 confirmed cases (May 23, 2020). "MH=Maharashtra, TN=Tamil Nadu, GJ=Gujarat, DEL=Delhi, RJ=Rajasthan, MP=Madhya Pradesh, UP=Uttar Pradesh, WB=West Bengal, AP=Andhra Pradesh, BH=Bihar, PB=Punjab, TG=Telangana, KR=Karnataka, JK=Jammu Kashmir, OR=Odisha, HR=Haryana, KL=Kerala, JH=Jharkhand, AS=Assam, CH=Chandigarh, TP=Tripura, CG=Chhattisgarh, HP=Himachal Pradesh, UK=Uttarakhand, GO=Goa, LD=Lakshadweep, AN=Andaman-Nicobar, MN=Manipur, PU=Pondicherry, MG=Meghalaya."

Andaman-Nicobar Islands have highest recovery rate at 100 [Fig. 12]. This implies that all the confirmed cases for COVID-19 have been recovered as of May 23, 2020. This is followed by Punjab where the recovery rate is 91.44. This means that out of 100 people infected, about 91 people have recovered from the infection. The state with lowest recovery rate is Manipur with recovery rate of 7.41.

4. Mortality Rate per 100 Population:

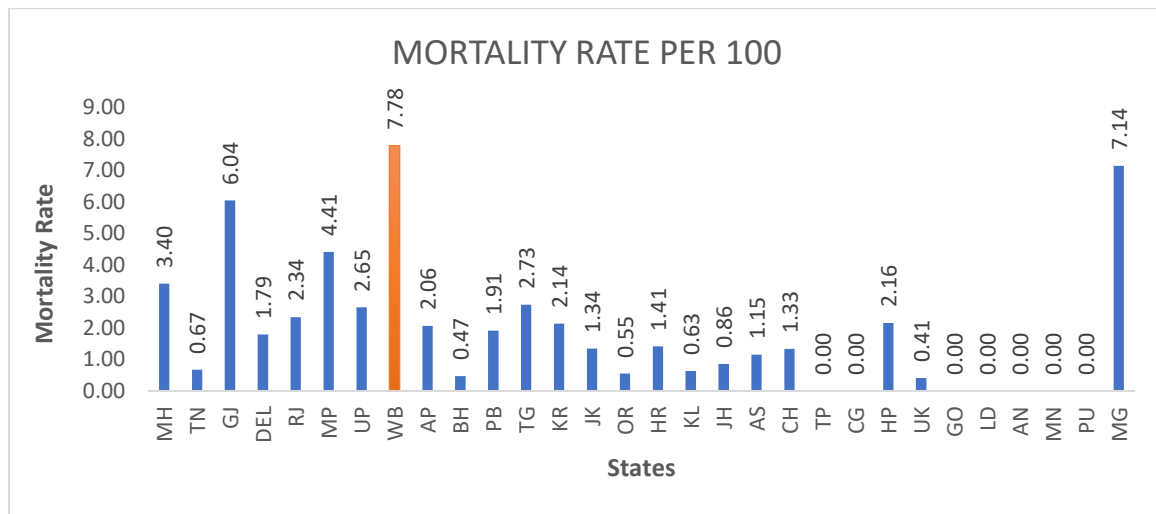


Fig. 13: Mortality Rate/100 confirmed cases (May 23, 2020). "MH=Maharashtra, TN=Tamil Nadu, GJ=Gujarat, DEL=Delhi, RJ=Rajasthan, MP=Madhya Pradesh, UP=Uttar Pradesh, WB=West Bengal, AP=Andhra Pradesh, BH=Bihar, PB=Punjab, TG=Telangana, KR=Karnataka, JK=Jammu Kashmir, OR=Odisha, HR=Haryana, KL=Kerala, JH=Jharkhand, AS=Assam, CH=Chandigarh, TP=Tripura, CG=Chhattisgarh, HP=Himachal Pradesh, UK=Uttarakhand, GO=Goa, LD=Lakshadweep, AN=Andaman-Nicobar, MN=Manipur, PU=Pondicherry, MG=Meghalaya."

Fig. 13 shows that West Bengal has highest mortality rate at 7.78, which means that out of 100 infected people 8 people died/are at risk due to COVID-19. This is followed by Meghalaya where the mortality rate is 7.14. The states with lowest mortality rate are Andaman-Nicobar, Manipur, Puducherry, Ladakh, Chandigarh, Tripura, and Goa, with 0 deaths.

5. Average Growth Rate per 100:

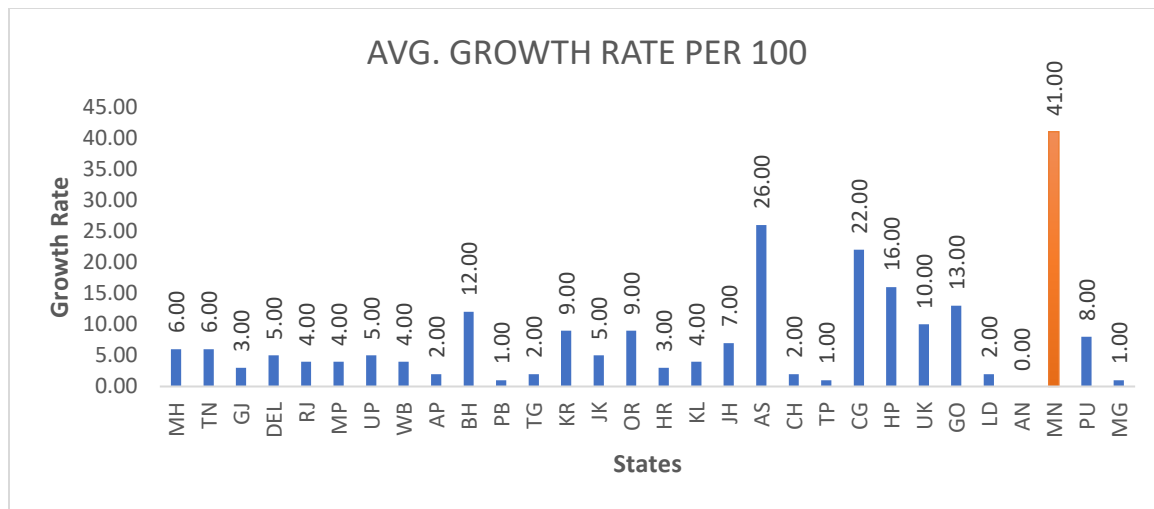


Fig. 14: Average Growth Rate over past 7 days (May 23, 2020). "MH=Maharashtra, TN=Tamil Nadu, GJ=Gujarat, DEL=Delhi, RJ=Rajasthan, MP=Madhya Pradesh, UP=Uttar Pradesh, WB=West Bengal, AP=Andhra Pradesh, BH=Bihar, PB=Punjab, TG=Telangana, KR=Karnataka, JK=Jammu Kashmir, OR=Odisha, HR=Haryana, KL=Kerala, JH=Jharkhand, AS=Assam, CH=Chandigarh, TP=Tripura, CG=Chhattisgarh, HP=Himachal Pradesh, UK=Uttarakhand, GO=Goa, LD=Lakshadweep, AN=Andaman-Nicobar, MN=Manipur, PU=Pondicherry, MG=Meghalaya."

The average growth rate is calculated by taking an average of confirmed cases for last seven days up to May 23, 2020. Manipur showed the highest growth rate at 41 [Fig. 14]. This implies that in the next seven days, 41 out of 100 people are at risk of getting infected with 'SARS-Cov-2' in Manipur. The state with lowest growth rate was Andaman-Nicobar Islands where out of 100 people 0 people possess the risk of getting infected.

V. TRENDS:

a. Confirmed Cases:

Fig. 15 illustrates the state wise trend of confirmed cases in ten states with highest confirmed cases up to May 23, 2020. This graph shows a more linear growth in Maharashtra and Tamil Nadu than the rest of states. Also, the slope curves upward in 1st week of May, and a more rapid growth is observed for all states. In 2nd week of May, Bihar, which was earlier unaffected by the pandemic, shows the presence of COVID-19 infected cases.

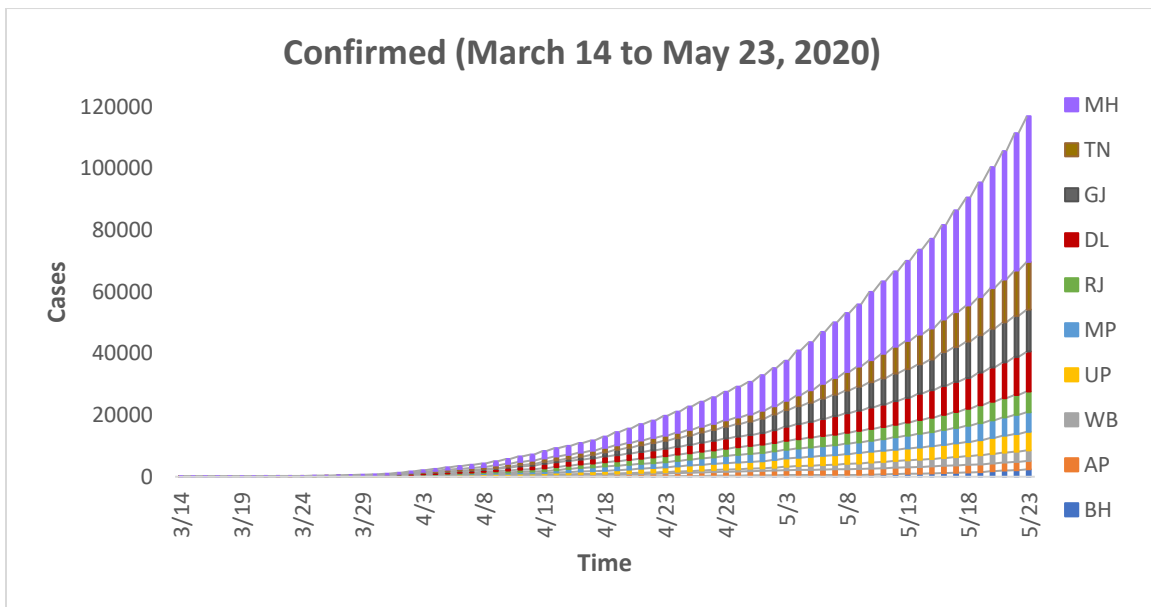


Fig 15: Top ten State's trends for number of Confirmed cases (March 14-May 23,2020). "MH=Maharashtra, TN=Tamil Nadu, GJ=Gujarat, DL=Delhi, RJ=Rajasthan, MP=Madhya Pradesh, UP=Uttar Pradesh, WB=West Bengal, AP=Andhra Pradesh, BH=Bihar."

b. Recovered Cases:

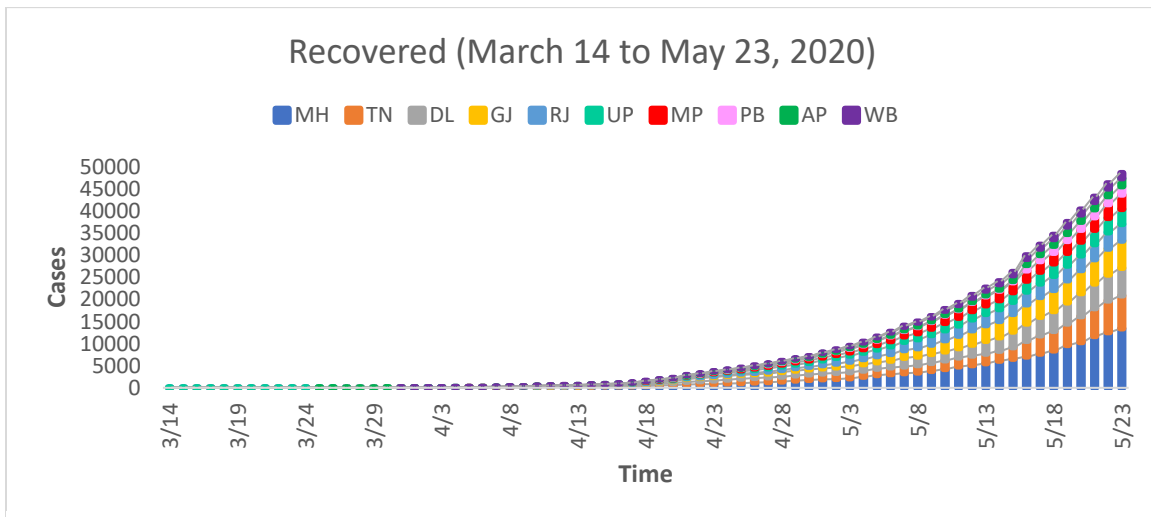


Fig 16: Top ten State's trends for number of Recovered cases (March 14-May 23,2020). "MH=Maharashtra, TN=Tamil Nadu, GJ=Gujarat, DL=Delhi, RJ=Rajasthan, MP=Madhya Pradesh, UP=Uttar Pradesh, WB=West Bengal, AP=Andhra Pradesh, PB=Punjab."

This graph shows the trend for ten states with highest recovered cases. There is an overall upward slope of the graph which signifies that recovery from COVID-19 has been increasing particularly after 2nd week of May. In the above graph, even though Maharashtra shows more

recovered cases than the other states, Tamil Nadu demonstrates better recovery trend. Punjab also shows a high COVID-19 recovery trend after Mid-May.

c. Deceased Cases:

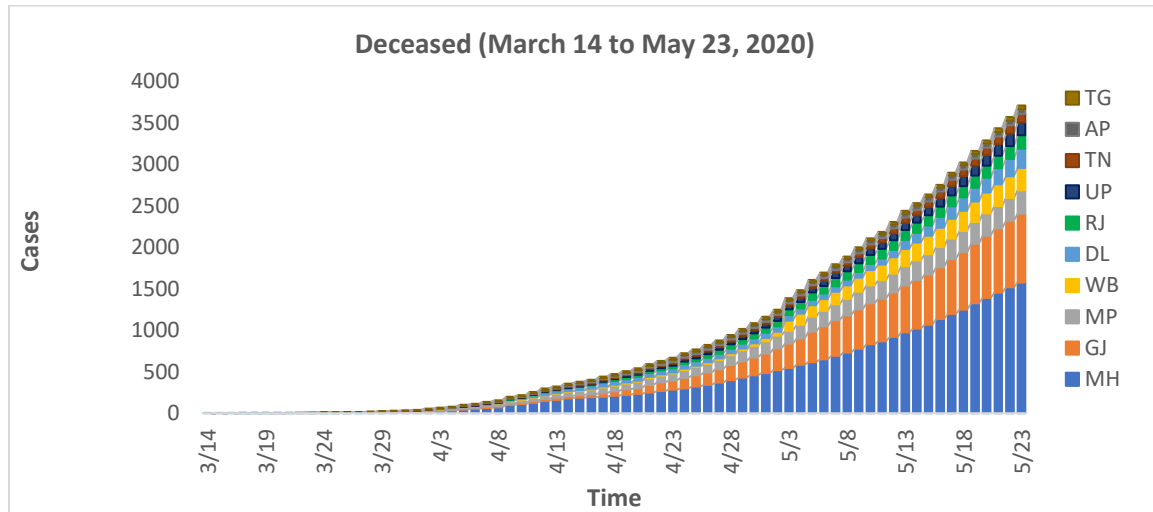


Fig 17: Top ten State's trends for number of Deceased cases (March 14-May 23,2020). "MH=Maharashtra, TN=Tamil Nadu, GJ=Gujarat, DL=Delhi, RJ=Rajasthan, MP=Madhya Pradesh, UP=Uttar Pradesh, WB=West Bengal, AP=Andhra Pradesh, TG=Telangana."

According to Fig. 17, the slope becomes more steeper as it curves upwards, which signifies the sudden increase in the number of deceased cases altogether. The highest increase is seen in Gujarat, MP and West Bengal around 1st week of May, although Maharashtra has highest number of deceased cases as of 23rd May, 2020.

C. INDIA'S GLOBAL SITUATION:

Fig 18 (a, b, c) illustrates the current global position of India in terms of confirmed, recovered, and deceased COVID-19 cases as of May 23, 2020.

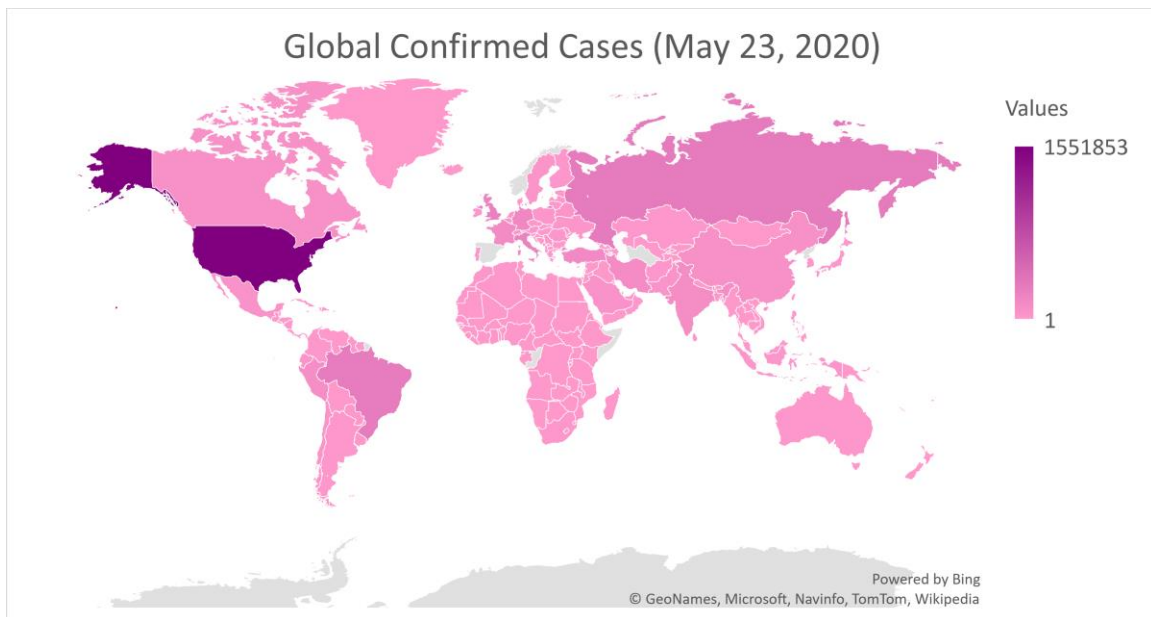
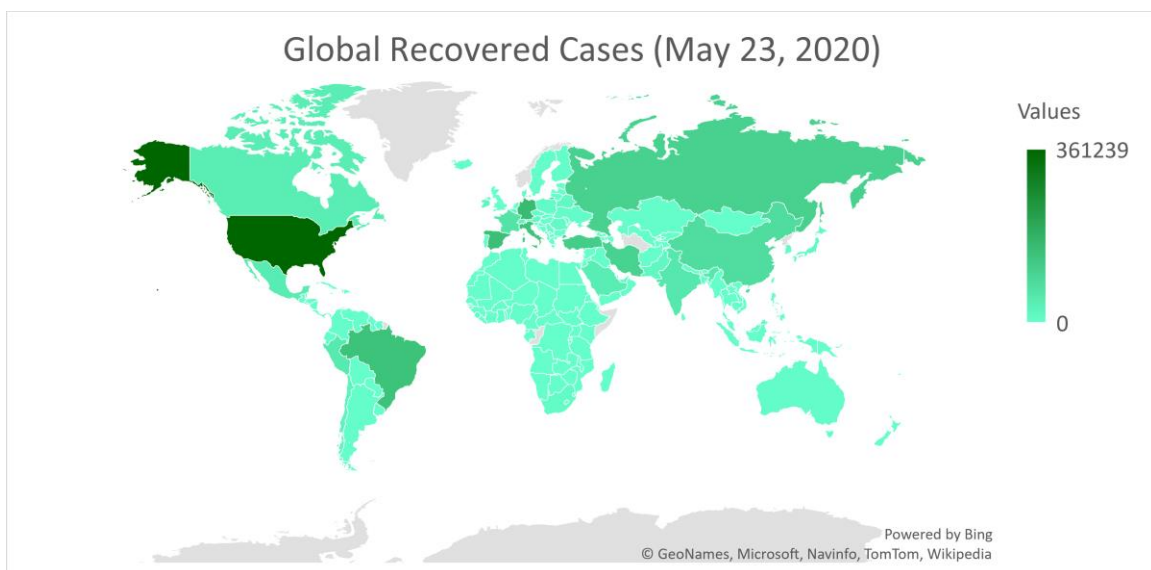


Fig. 18.a: Global distribution of number of Confirmed cases (May 23, 2020).

Fig. 18.b: Global distribution of number of Recovered cases (May 23, 2020).



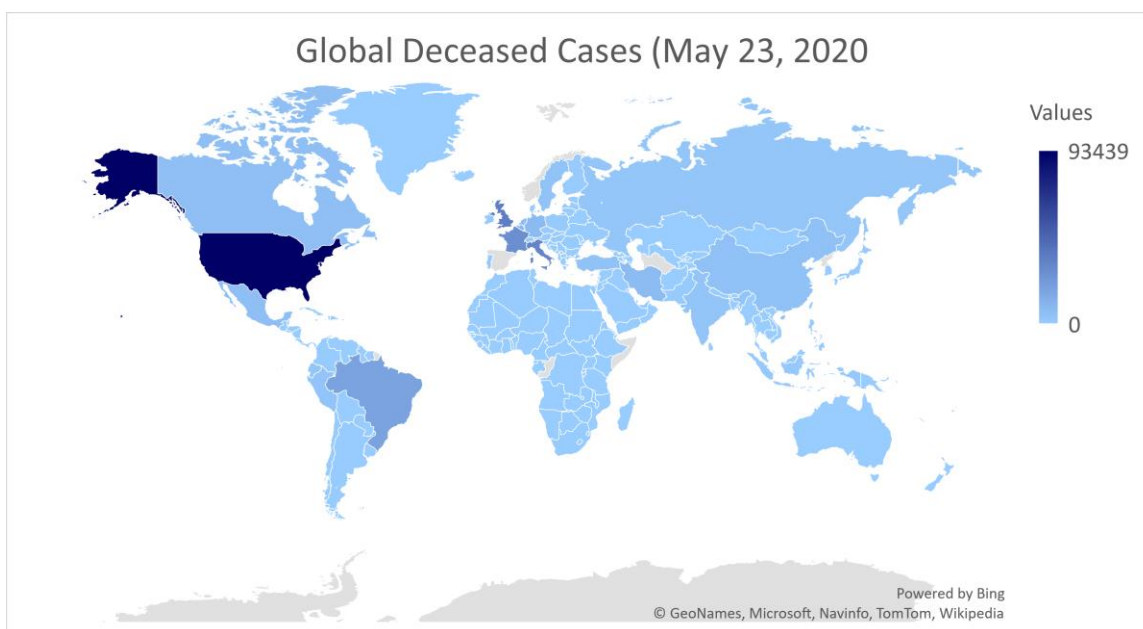


Fig. 18.c: Global Distribution of number of Deceased cases (May 23, 2020).

India was tenth, in terms of total confirmed cases on May 23, 2020, USA being the most affected country, India also stood twelfth in the number of recovered cases, whereas when it comes to deceased cases India has witnessed far less deaths than several high income countries and was at sixteenth position.

COUNTRIES	CASES PER MILLION	MORTALITY RATE PER 100	RECOVERY RATE PER 100
BRAZIL	1634.36	6.34	41.04
CHINA	58.42	5.52	94.35
GERMANY	2148.22	4.59	88.74
SPAIN	5005.39	12.19	63.91
FRANCE	2788.82	15.50	35.15
UK	3807.91	14.22	0.44
INDIA	95.23	2.94	41.38
IRAN	1589.67	5.51	77.94
ITALY	3792.92	14.27	60.54
RUSSIA	2301.59	1.01	32.14

USA	4902.11	5.98	22.26
TURKEY	1845.95	2.77	75.54
BELGIUM	4901.80	16.26	26.68
MEXICO	510.78	10.90	67.46

Table 2: Comparison of India with other severely affected countries due to COVID-19 (May 23, 2020).

Table 2 shows the India's situation with respect to countries severely affected by COVID-19. India has 95.23 cases per million which means that out of 1 million population in India about 95 are affected. This is much lower than the European Countries and USA, but China has a lower rate of cases per million at 58.42. At 2.94, India's death rate is almost half of China and USA, and one-fifth of the European countries. Only Russia and Turkey have lower mortality rates than India at 1.01 and 2.77, respectively. But the recovery rate of India is not said to be that impressive at 41.38. However, USA (22.26), Belgium (26.68), Russia (32.14), and France (35.15) have lower recovery rates than India.

D. GLOBAL TRENDS:

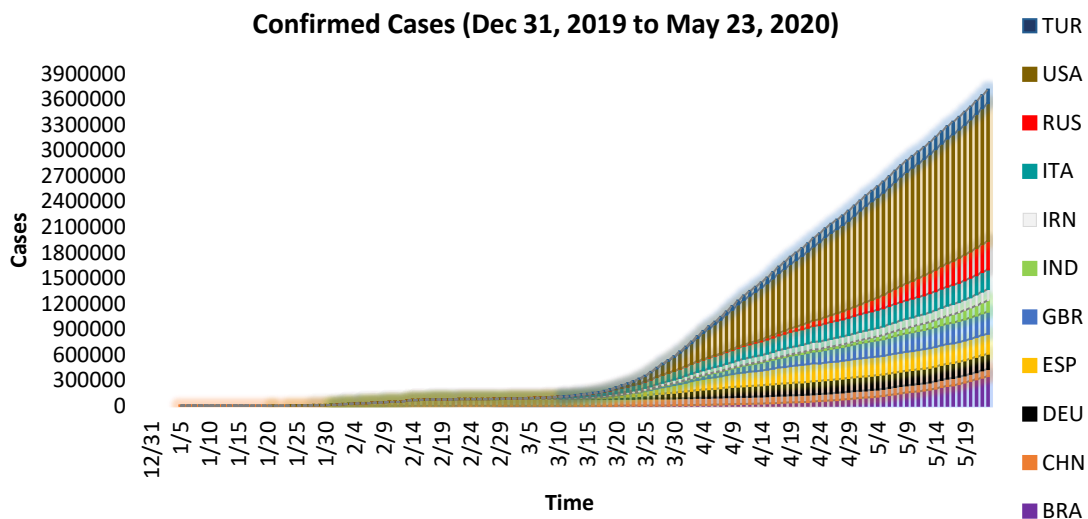


Fig. 19.a: Global trend showing number of Confirmed cases for top ten countries and India (Dec 31, 2019- May 23, 2020). "TUR=Turkey, USA=United States of America, RUS=Russia, ITA=Italy, IRN=Iran, IND=India, GBR=United Kingdom, ESP=Spain, DEU=Germany, CHN=China, BRA=Brazil."

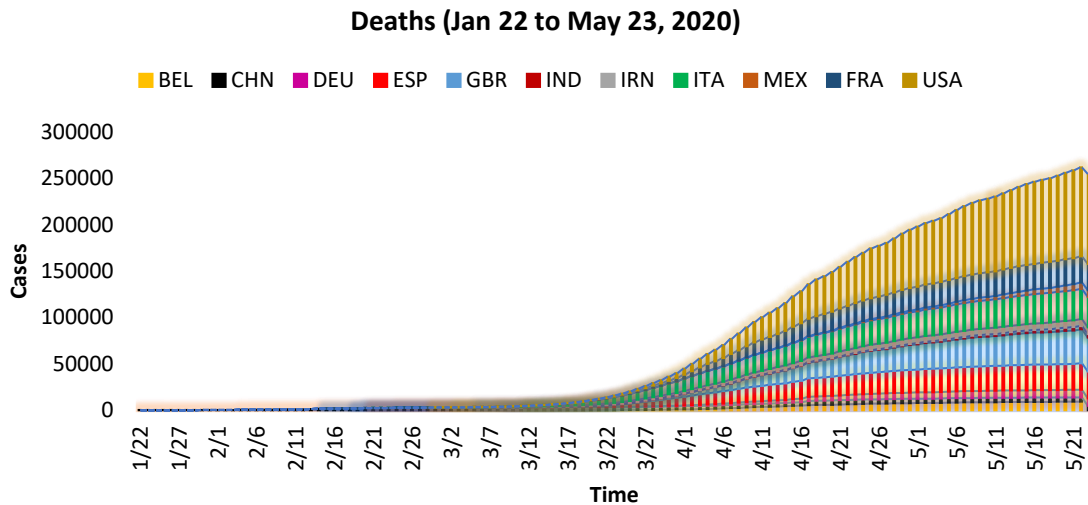


Fig. 19.b: Global trend showing number of Deceased cases for top ten countries and India (Jan 22- May 23, 2020). “USA=United States of America, ITA=Italy, IRN=Iran, IND=India, GBR=United Kingdom, ESP=Spain, DEU=Germany, CHN=China, BEL=Belgium, MEX=Mexico, FRA=France.”

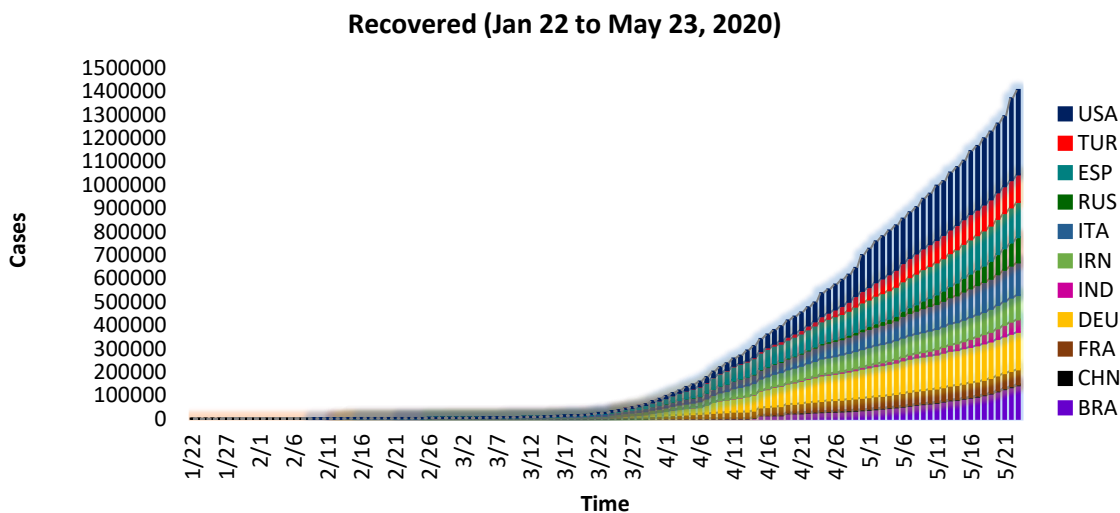


Fig. 19.c: Global trend showing number of Recovered cases for top ten countries and India (Jan 22- May 23, 2020). “TUR=Turkey, USA=United States of America, RUS=Russia, ITA=Italy, IRN=Iran, IND=India, FRA=France, ESP=Spain, DEU=Germany, CHN=China, BRA=Brazil.”

USA shows highest increase in COVID-19 cases globally, while China demonstrates no change in the pattern indicating that COVID-19 cases are on the decline. India shows sudden increase in the number of cases from April 29, 2020, and the curve continues to slope upwards [Fig. 19.a]. USA and European countries like Italy, France, and United Kingdom show increase in deceased cases over time, most prominent in April-May period. Although India has witnessed an increase in deaths due to COVID-19, its much less compared to other countries.

China is the only country to show a decline in total deceased cases, and after May 15, no new cases have been reported [Fig 19.b] the number of recovered cases increased substantially after April 16, 2020 globally. USA show highest number of recovered cases even though its recovery rate remains low. India has shown notable increase in recovered cases along with several European countries like Germany and Italy, and Russia and Turkey. This growth is more prominent in May than previous months [Fig 19.c]

OBJECTIVE 2: To enumerate Indian government's mobilization and response approach strategies on "WHO Health Emergency and Disaster Risk Management Framework" parameters up to May 23, 2020.

The WHO Health EDRM Framework is built upon a comprehensive approach to disaster and risk management. It provides an overview of risk management concepts, guiding principles, the components, and functions of effective health EDRM ^[16]. The components which constitute the Health EDRM Framework have been used to describe Indian Government's mobilization, response, and risk management strategies further.

A. POLICIES, STRATEGIES AND LEGISLATION:

- According to WHO situation report dated January 30, 2020, Indian Government had developed response strategies for COVID-19 even before the first case appeared in India. The various steps taken by the Indian Govt. were:

POLICIES	STRATEGIES	LEGISLATION
•Disease containment. •Intersectoral collaboration^[20]. •Capacity building. •Information and risk communication.	•Surveillance and contact tracing^{[25][27]}. •Cluster containment through isolation and quarantine. •Travel restrictions^[18]. •Setting up of additional testing and treatment facilities^[20]. •Closure of public, religious, private, and educational establishments and tourist places. •Cancellation of exams and religious gatherings. •Imposing nationwide lockdown in four phases^{[24][25][26][27]}.	•Wearing face masks were made compulsory in highly populous cities^[21]. •States invoked provisions of Section 2, Epidemic Disaster Act, 1897^[22]. •COVID-19 declared a "notified disaster" under Disaster Management Act, 2005^[23]. •Essential Commodities Act, 1995, declaring facemasks, and hand sanitizers as essential commodities upto 30th June ^[96].

B. PLANNING & CO-ORDINATION:

Civil Aviation Ministry-DGCA:

- Thermal screening at seven major airports, Delhi, Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, and Cochin which were identified based on the previous incidence of cases ^[28].
- DGCA on February 15, extended thermal screening to 21 airports for passengers flying in from Japan, and South Korea, in addition to Thailand, Singapore, China, and Hong Kong ^[29].

Union Health Ministry of India:

- A travel advisory was issued by Union Health Ministry of India and people with history of fever, cough, and/or travel to Wuhan city, were requested to sign a self-declaration form. This facilitated early detection and isolation of the infected cases ^[28].
- Ministry of Health and Family Welfare issued an advisory for Uttarakhand, UP, Bihar, West Bengal, and Sikkim bordering Nepal to strengthen disease surveillance ^[29].
- Health Secretary asked States/UTs to reinforce their preparedness, gap identification, and strengthening of core capacities with respect to surveillance, laboratory allied infection prevention & control, logistics, risk communication and particularly, hospital preparedness in terms of isolation and life-support care of critically ill patients of COVID-19.
- Medical Stores Organization maintained an adequate stock of PPEs for health professionals ^[95].

National Institute of Virology, Pune:

- National Institute of Virology, Pune was tasked with coronavirus sample testing.
- 12 additional labs became functional from Jan 31, 2020. These were: “(1) NIV Bengaluru, (2) Victoria Hospital Campus, Bengaluru (3), AIIMS, New Delhi (4), NCDC, New Delhi (5) Kasturba Hospital for Infectious Diseases, Mumbai (6) NIV Kerala, (7) ICMR – NICED, Kolkata (8) GMC, Secunderabad (9) KGMU, Lucknow (10) SMS, Jaipur (11) IGGMC, Nagpur and (12) KIPMR, Chennai” ^[30].

Ministry of Tourism-Hotels Association in India:

- Encouraging self-reporting for tourists visiting religious and other tourist places in identified states ^[31].

Armed Forces-ITBP:

- Armed Forces and ITBP set up quarantine camps, where people rescued from Wuhan, a total of 645 citizens were kept.
- A fully operational 24x7 control room was activated for monitoring and command operations ^[32].
- The “Central Armed Police Forces (CAPF)” were directed to get into a ‘battle mode’, and to avoid domestic, and international travel of any means unless absolutely necessary ^[36].

Government of India:

- By, mid-March, the government, anticipating a worsening of COVID-19 pandemic moved towards a “*containment plan*”.
- Seven ministries were roped in to set up additional quarantine and treatment establishments ^[33].
- ‘Social distancing’ measures were advised by the Central government, as the primary preventive strategy, and State governments were asked to implement it till March 31 ^[34].
- An Economic Response Task force was created under the Union Finance Minister Nirmala Sitharaman, to deal with economic challenge arisen due to COVID-19 pandemic ^[35].

Ministry of Commerce and Industry:

- “Department for Promotion of Industry and Internal Trade” was responsible for monitoring the status of transportation and delivery of goods, manufacturing, delivery of essential commodities to the public and addressing issues of the various stakeholders during the lockdown period ^[98].

C. HUMAN RESOURCE:**Gram Panchayats:**

- Organized, in villages bordering Nepal to spread awareness about COVID-19 measures taken by the State Govt ^[30].

Nodal Officers:

- States were instructed to appoint a nodal officer and set up a control room to strengthen co-ordination ^[30].

Ex-Servicemen Community:

- An initiative to deploy ex-servicemen belonging to Ex-Servicemen Community, was adopted by the Department of Ex-Servicemen welfare, Ministry of Defense ^[100].

Reinforcing Professional Bodies:

- In Kerala, efforts were undertaken to reinforce professional bodies like “Indian Medical Association”, “Indian Academy of Pediatrics” and “Private Hospitals Association” on surveillance, infection prevention and control, and case management.

Specialized Panels:

- A Medical Board was constituted at each district consisting of specialized panel to provide prompt and effective treatment. Ambulances were prepared to be on call after identification ^[32].

Public-Private-Partnerships:

- Health and Family Welfare Minister hosted a meeting on March 06, 2020, discussing a private sector alliance with the private hospitals of Delhi-NCR. The core issue was preparation for surge in bed capacities for infected cases, isolation wards etc.
- The State and Union Govt. was also maintaining a buffer stock of PPEs (personal protective equipment) and N95 masks for the frontline workers ^[37].

Training of Health Professionals:

- Medical officers and junior nursing staff went under training for surveillance and contact tracing, in Kerala ^[32].
- Andhra Pradesh, Bihar, Jammu and Kashmir, Jharkhand, Madhya Pradesh, Manipur, Odisha, Punjab, Uttar Pradesh, and Uttarakhand conducted a mock drill on COVID-19 management ^[38].
- On March 27, MoFHW conducted a nationwide training program (National Training of Trainers), where 546 trainers from 37 states and union territories were given training for frontline healthcare workforce strengthening in response to COVID-19 ^[39].

Ordinance:

- An ordinance to protect healthcare workforce against violence during the pandemic, was announced by the President of India, bringing an amendment to the Epidemic Disease Act, 1897 ^[40].

Deployment of Central Manpower:

- Central teams were deployed to states witnessing high growth/spurt of COVID-19 cases. These contained a public health expert, a clinician and a microbiologist.
- More than 1300 participants attended a webinar on 'IPC for private sector' organized by WHO and other national agencies ^[41].

Deployment of Indian Railways Health Staff:

- Indian Railways prepared to deploy 2,546 Doctors and 35,153 Paramedics, which constituted Nurses, Pharmacists, and others, to deal with the spreading pandemic. Moreover, recruitment was done on a temporary basis to address the rising demand of health professionals ^[101].

National Cadet Corps:

- Approximately 50,000 cadets volunteered out of which 2000 National Cadet Corps volunteer were working with civil, defense and police departments in 'Exercise NCC Yogdan' ^[102].

D. FINANCIAL RESOURCES:**Central and State Funds:**

- A "one-time special dispensation" was promulgated, with funds from SDRF to provide aide to infected people and their families ^[42].
- An investment of Rs 15,000 crores, for "*India COVID-19 Emergency Response and Health System Preparedness Package*" was announced by the Central Govt. ^[45].
- An amount of 3,100 crores, was released by PM-CARES fund trust to enhance response against COVID-19 ^[56].
- 25 crores were issued to the North Eastern States by Ministry of DoNER in a fight against COVID-19 ^[44].
- Through private bonds, NHPC was able to raise 750 crores at 6.80% p.a. interest rate, for ten years ^[53].
- To provide relief to the construction workers, States were directed to utilize Building and Construction Workers Welfare Fund ^[99].

Funds Through International Agencies:

- To Facilitate India's response against COVID-19, ADB issued a loan of 1.5 billion US dollars to GoI ^[55].
- World bank granted an amount of 1 Billion US dollars to GoI, for 'Accelerating India's COVID-19 Social Protection Response Program' ^[57].

Central Government Schemes:

- Under "Pradhan Mantri Garib Kalyan Package" MoFHW issued an order to cover all healthcare workers fighting against COVID-19 for a period of 90 days ^[43].
- Under PMGKY, 1.51 crore free LPG gas cylinders were distributed among PMUY beneficiaries ^[49].
- 8.89 crore farmers benefited under PM-KISAN scheme were transferred 17,793 crores by Dept. of Agriculture, Cooperation and Farmers Welfare, GoI ^[52].
- 481.63 crores were disbursed to 40,826 PF members as a special with-drawl under EPF scheme ^[51].
- An additional 40,000 crores of 'stimulus package' was announced for MGNREGA to address the increased demand for employment among laborers ^[58].

Compensation to Frontline Workers:

- A compensation of 10 lakhs was issued to the employees of Indian Postal Services, fallen prey to the pandemic ^[50].
- An ex-gratia compensation was issued to each FCI member engaged in food grain transportation. This included 1,08,714 permanent and contractual labors whole compensation was decided based on their class ^[48].
- In case of death caused by COVID-19, Ministry of Shipping decide to compensate all port employees with a sum of 50 lakh rupees ^[54].

Tax Exemptions and Returns:

- To Provide immediate relief to the taxpayers, the IT department decided to refund tax returns up to 5 lakhs, and all GST and Customs refunds, adding upto 18,000 crores ^[46].
- EPFO, disbursed an amount of 279.65 crores in response to 1.37 lakh claims, to facilitate employees to fight against the pandemic ^[47].

E. INFORMATION AND KNOWLEDGE MANAGEMENT:

Strengthening Surveillance:

- Surveillance was strengthened at the early stages of the pandemic. Ministry of Aviation had initiated flight announcements and issued travel advisories ^[30].
- The chief government bodies involved were MoFHW including NCDC, ICMR, and Ministry of Information and Broadcasting ^[59].
- WCO, a subsidiary of WHO in India, provided Kasargod district with additional support for disease surveillance, contact tracing, and data analysis.

Information Sharing:

- As per the International Health Regulations, India had shared information on suspected and confirmed cases with the global community through IHR National Focal Point ^[32].
- Led under the chair of Health and Family Minister, a group of ministers were engaged in reviewing the progress and measures taken for containment ^[37].
- International passengers were mandated to present the airport authority with a duly filled 'self-declaration form' and undergo screening ^[42].
- GoI made it compulsory, for all medical practitioners and treatment facilities to notify the concerned authorities of any COVID-19 affected/suspected patients ^[38].

Risk Assessment and Capacity Building:

- To enable risk assessment among citizens, GoI launched 'Aarogya setu app' through a PPP. ICMR, in collaboration with WHO was engaged in WHO Solidarity Trial- for treatment in hospitalized patients ^[60].
- AIIMS Delhi in collaboration with WHO and partners had been engaged in training frontline workers on capacity building. This step has been commissioned by MoHFW and is under its monitoring ^[61].

F. RISK COMMUNICATION:

Issuing Advisory:

- For travelers returning from China, a detailed advisory was issued, and a helpline number was activated for assistance, at MoFHW control room ^[62].
- The PA system of Railway platforms and Trains began broadcasting 'Do's and Don'ts of COVID-19 practices' announcements to sensitize passengers ^[63].

- The universities were instructed to follow a set of precautionary measures by the MHRD, in the face of COVID-19 ^[64].
- In addition to this, Ministry of Information and Broadcasting issued another set of advisory to mitigate the effect of COVID-19 among citizens. This included, suspension of non-essential travelling, advisory for elders and children to remain at home, and alternate workdays for Govt. employees to reduce workplace crowding ^[65].

Janta Curfew:

- The Prime Minister on March 20, 2020 initiated a request for a 14 hour 'Janta Curfew' and asked citizens to refrain from stepping out of their homes during that period ^[66].

Busting Myths and Rumors:

- In an interaction with the print media journalists and stakeholders, PM of India, highlighted the importance of well-placed information in the face of the epidemic. He also mentioned the role of print media in mitigating pessimism and false rumors ^[67].
- MoHFW with the assistance of WHO and UNICEF had been engaged in multimedia mass communication campaigns covering a wide array of operations. Its focus was on different aspects of communication such as preventive measures, busting myths, equipping the masses with information on guidelines, advisories, testing labs, etc. ^[38].

Raising Community Awareness and Addressing 'COVID-19' Stigma:

- To establish direct channel of communication with the population, Union Minister MoFHW, launched 'COVID India Seva' on April 21 ^[68].
- Additionally, MoHFW in partnership with WHO, had been working on a campaign to address social stigma associated with COVID infected patients and medical community ^[40].
- For educating frontline workers, MoFHW launched 'awareness materials for frontline workers of COVID-19' in multiple Indian languages ^[69].

G. HEALTH INFRASTRUCTURE AND LOGISTICS & HEALTH AND RELATED SERVICES:

Identification of Health Infrastructure:

- The existing public health facilities utilized for COVID-19 management were categorized as DCH, DCHC or DCCC. There were 7,740 establishments in 483

districts with 6,56,796 isolation beds (3,05,567 for confirmed and 3,51,204 for suspected cases), 99,492 Oxygen supported beds, and 3,406 ICU beds identified in all State/UTs ^[103].

Construction of Isolation/Quarantine Units:

- 285 beds were designated, by Ordnance Factory Board for COVID-19 isolation wards across various hospitals under its management ^[73].
- Indian Air Force had also set up 9 quarantine facilities with a capacity of 200-300 personnel capacity each. These facilities were established at major nodal centers of Air force ^[74].
- The Southern Naval Command headquarters converted one of its training units into Corona Care Center catering to 200 Indian citizens being rescued from different countries. An additional facility was set up with a 200 personnel capacity for the service personnel and their families ^[76].
- All the National Skill Training Institutes and allied hotels under Ministry of Skill Development and Entrepreneurship were converted into isolation/quarantine facilities ^[79].
- To supplement the MoFHW, Indian railways geared up for a major haul in its existing infrastructure. More than 5,000 coaches were modified into isolation wards initially. Moreover, out of its 125 hospitals more than 70 were being identified for establishing a dedicated COVID-19 ward/floor ^[81].
- Mumbai Port Trust started a new hospital with 50 beds and two separate ICUs. One ICU was designated for COVID suspected cases while the other was for confirmed cases. This hospital was established specially in lieu of the pandemic ^[89].
- NTPC, PSU under Power Corporation India, geared up to utilize its 45 hospitals for preparation of 200 isolation beds ^[92].

Testing and Sample Collecting Units:

- NIV Pune, along with 15 prominent labs was designated for initial testing of the infection. Later, 52 laboratories were made fully functional for COVID-19 testing ^[70].
- “*Command Hospital Air Force Bangalore (CHAFB)*” was designated as the first laboratory in the IAF to undertake COVID-19 testing ^[74].
- To support the overwhelming need for prompt and large-scale testing, CSIR-IMTECH took up sample testing for COVID-19 ^[87].
- On April 23, 2020, Defense Minister Sh. Rajnath Singh launched India’s first mobile testing lab (Bio-Safety Level 2 and 3), developed by DRDO in collaboration with ESIC

Hospital Hyderabad, and private industry. This lab could test up to a thousand samples per day ^[93].

- As of May 6, 2020, there were ^[94] 327 govt. labs and 118 private ones to conduct more than 95,000 tests per day.

Guidelines to Healthcare Establishments:

- A detailed advisory was issued to all health establishments to postpone non-urgent hospitalizations and elective surgeries.
- To identify beds in hospitals/health centers and guest houses, 62 Cantonment Boards from 19 States/UTs had been issued a detailed guideline ^[77].

Health Service Delivery:

- To meet the increasing demand and patients' needs approximately 6500 beds were prepared by the Indian Railways ^[81]. This was increased to 20,000 coaches amounting to 3.2 isolation beds later, considering the growing demand for isolation units. Each coach was equipped with a paramedic area, a bathing room, charging points, and proper isolation measures. It was proposed that all coaches will be equipped with all medical and general amenities as well ^[82].
- Under Pradhan Mantri Janaushadhi Pariyojana, 'Swasth ke Sipahi' the pharmacists provided doorstep delivery of essential services and medicines to patients and elderly ^[91].

Sanitization of Public Places/Health personnel:

- For effective sanitation of public places DRDO developed two configurations of sanitizing equipment namely – "*Portable Backpack Area Sanitisation Equipment and Trolley Mounted Large Area Sanitisation Equipment*" ^[86].
- For the protection of health professionals amid pandemic, special personnel sanitation enclosures and face shields were developed by DRDO ^[88].

Transportation of Medical Supplies/Essential Goods:

- The Airforce aircrafts had also been engaged in flying medical equipment to remote areas and flying in blood samples to testing centers ^[74].
- Indian Navy also played a major role in transporting a medical team, for setting up testing facility at Goa ^[75].

- 8 special parcel trains were functioning to ensure that an uninterrupted and seamless transportation of goods and essentials is maintained ^[76].
- Cargo flights named “Lifeline Udan” were initiated from MoCA for transporting medical goods to various parts of the country ^[80].
- CSIR was also engaged in providing PPEs to health professionals as well as giving logistics and infrastructure support to local administration and Red Cross Unit, Chandigarh ^[87].

Guidelines to Pharmaceutical Industry:

- Ministry of Pharma and Consumer Affairs was instructed on price regulations of health-related commodities and ensure availability at hospitals and to the masses ^[71].
- Leaders of Pharma Industry, in a conference with PM Narendra Modi were implored to mass manufacture RNA-Testing kits for COVID-19 ^[72].

Manufacturing Units/Workshops:

- Indian railways established 17 workshops for manufacturing PPE overalls to be supplied to 50% of the health professionals across country. These overalls were approved by DRDO ^[90]. As of May 6, 2020, there were ^[94]:
 - 39 factories manufacturing and stitching PPEs.
 - Around 8 million masks distributed, as well as manufacturing N95 masks and small units making homemade masks.

Community Support:

- Railway organizations such as IRCTC and RPF were directed to provide free meals to the underprivileged ^[83].
- Supreme Court issued orders to provide psycho-social support to the migrants through trained counsellors and community leaders.
- In addition, an email id (technicalquery.covid19@gov.in) was provided by MoFHW where technical guidance was given by elite institutions like AIIMS, New Delhi ^[84].
- TRIFED under Ministry of Tribal Affairs, wrote a letter to the States/UTs to take precautionary measures in the interest of Tribal gatherers. They annexed a list of Do's and Don'ts regarding Tribal and NTFP, to reach the concerned authorities amid COVID-19 scare ^[85].

H. COMMUNITY CAPACITIES FOR HEALTH EDM:

A lot of efforts were undertaken to support the community at the helm of pandemic.

- **Surveillance:** Proper guidelines were issued for surveillance measures and screening procedures along with contact tracing for disease transmission. People who were suspected were quarantined for 14 days and discharged only when tested negative.
- **Strengthening Testing Capacity:** Testing capacity was built to accommodate 1,00,000 tests per day.
- **Establishment of Isolation/Quarantine Units:** Isolation wards and special ICU units were established in consideration with the growing number of cases. It was ensured that these facilities were properly staffed and equipped for patient management.
- **Sanitization Measures:** Sanitization measures were adopted to combat fomite infection. This involved sanitizing public areas through sprays, mists, and other methods. Special sanitizing units were created for health professionals too.
- **Supply Chain Management:** A continuous supply of face masks, hand sanitizer and PPE coveralls were maintained for citizens as well as health professionals under price regulations. IAF and MoCA initiated flights to transport medical equipment and essentials across country.
- **Mass-Production of Essentials:** Factories were established for mass productions of hand sanitizers, masks, and PPE coveralls.
- **Information Sharing and Communication:** Helpline numbers were activated to resolve queries, myths and provide information.
- **Community Participation amid Social Distancing:** Community participation was encouraged through 'Janta Curfew' for 14hrs. People were advised to follow social distancing measures, postpone non-essential travels, and opt out of elective surgeries. Public establishments were closed, examinations cancelled, and a nationwide lockdown was imposed on the country. Under the DAY-NULM scheme, Self Help Groups across the country prepared more than 1 crore homemade facemasks.
- **Community Relief:** During this period, measures were adopted to provide relief to the underprivileged, in the form of relief packages, free meals and economic assistance. With the progression of epidemic, relaxations were made for public. Govt. defined three zones of epidemic: Red, Orange, and Green, and specified measures accordingly. Transportation was availed for people stranded amid lockdown. Govt. urged the private industry and self-help groups to come forward and contribute to the cause of COVID-19.

- **Financial Resources:** A trust fund in the name of PM-CARES was established, and people from various factions of the country were asked to contribute in it. In addition, the Union Finance Minister announced an economic stimulus to boost Indian Economy.
- **Research & Development:** Research was given highest priority, in terms of developing vaccines, drugs, sanitation devices, PPE coveralls and other effective equipment.
- **Training:** Health professionals were trained in management of COVID-19 patients.

I. MONITORING & EVALUATION:

- **Joint Monitoring Group:** A Joint Monitoring Group was created with the first evidence of epidemic in Wuhan, China. Major stakeholders of this committee included WHO India, MoHFW, Prime Minister's Office, NCDC, ICMR and Ministry of Information and Broadcasting. The committee continuously kept an eye on the situation and review preparedness and response plan. Major emphasis was on disease surveillance and contact tracing.
- **Inter-Ministerial Teams:** Ministry of Railways was engaged on constant evaluation on various fronts in co-ordination with MoFHW, ICMR and others. Each change in epidemic progression and its impact on the nation, was monitored by the Prime Minister's Office. PM was constantly receiving reports on the situation, and constant evaluation was in progress through 24*7 control rooms. 6 inter-ministerial teams were constituted for risk assessment, evaluation, and augment state level response ^[95].
- **Pharmaceutical Regulatory Authorities:** Department of Pharmaceuticals, Ministry of Chemical and Fertilizers, was constantly monitoring the availability of medicines, and other medical essentials across States/UTs. National Pharmaceutical Pricing Authority (NPPA) was watchful of the price regulations of masks, hand sanitizers, and medicines.
- **Ministry of Textiles:** Set up monitoring control rooms for regulating production and supply of medical textiles viz. N-95 masks, body coveralls and meltdown fabrics ^[97].
- **Aviation Ministry:** Ministry of Civil Aviation was reviewing screening status of international flights. It was also responsible for aiding MoFHW for the uninterrupted supply of medical supplies across countries.
- **Ministry of Information and Braodcasting:** Ministry of Information and Broadcasting was constantly involved in risk communication through media houses and print media.
- **MHRD:** MHRD was engaged in reviewing the academic progress of the universities. It also issued guidelines to address the issue of discontinuity of education amid lockdown. Constant evaluation was done, and directions were given accordingly.

- **Finance Ministry:** Finance Ministry, was involved with major stakeholders in evaluating the impact of epidemic on the nation's economy, providing relief packages, and formulating future roadmap.

CONCLUSION AND RECOMMENDATIONS:

COVID-19 has emerged as a major threat to global population on various fronts. Many countries are still struggling with controlling the spread of the disease. These are the countries which have shown high casualties.

India initially seemed to be on a better footing concerning the spread. But the rapid disease progression in some of the states accompanied with high casualties point towards the gap in implementation of the preparedness and response plan on some level.

A comparison of India's epidemic curve with China, also points towards the same observation. However, the epidemic is still in progress, and it would be too soon to reach to a final conclusion regarding the disease development in the country.

This study provides an initial description of the epidemiology of COVID-19. It also gives a description of the efforts taken by GoI, for the specified time-period. The strength of the study is the data collected across a relatively long period (Jan 30- May 23). In addition, attempt for a comprehensive global comparison was also made.

The weakness of this study is that it is a secondary review, therefore, data collection was from secondary sources. The data released was incomplete and accounted for only those details which were disclosed publicly.

Hence it is recommended that another study be undertaken after the epidemic curve has flattened or declined. Also, it would be more suitable to collect data through primary sources to provide a detailed comprehensive analysis of COVID-19.

To efficiently assess the preparedness and mobilization approach strategy of Indian Government during COVID-19, it is recommended that evidence-based gap identification must be carried out. It would also be noteworthy to evaluate the social determinants, demographic distribution, and regional influence on the implementation of COVID-19 mobilization and response approach strategies. Therefore, another study in the light of current situation is highly recommended.

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<https://pib.gov.in/PressReleasePage.aspx?PRID=1622631>"

Summer Training Report
Part-2 (Online Course Report)
Essential of Global Health
Yale University

COURSE DESCRIPTION:

Essentials of Global Health is an online course designed by Yale University, New Haven, Connecticut, USA. It is available for enrollment through Coursera (www.coursera.org). Essentials of Global Health is conceived to introduce the concepts which comprise Global Health. It covers key concepts and frameworks of global health, focusing on the practical implementation of the theories. The main focus of the course lies in the health disparities of “low- and middle-income countries”, and the health of the poor in the society. It also highlights the health system issues, interrelationship between health and development, and how global interdependence is essential to health-related concerns. The course revolves around five major questions:

1. What causes sickness, disability, and death in people?
2. What are the factors due to which these people suffer?
3. What part of the population is affected the most?
4. Why is it important to address these key issues?
5. What are the most sustainable, cost-effective, and prompt solutions that can address these key health issues efficiently?

The primary language of the course was English and covered a duration of 56 hours spread across 32 sessions. The course instructor was *“Richard Skolnik, Former Lecturer, Department of Health Policy and Management, Yale School of Public Health and Lecturer in the Practice of Management, Yale School of Management, 2012-2016.”*

OBJECTIVES OF THE COURSE:

- Define global health; why is it important to study global health; and why is it important to achieve global cooperation regarding key public health issues.
- To align the major and critical concepts of public health in relation to global health.
- To employ a wide range of perspectives when analyzing the key global health issues.
- To be able to discuss the burden of disease by region, sex, and age. To assess the risk factors which affect this burden and what are the most cost-effective ways to address them.
- To understand and evaluate major health disparities, and how they relate to health especially among the poor and marginalized in “low and low-middle-income” countries.

- To understand the roles, responsibilities, functions, and importance of key actors and organizations in global health in addressing critical global health concerns.
- To highlight the major challenges that have the highest probability of arising in the near future.

COURSE CONTENTS:

The course was distributed over 10 modules in 32 sessions. The contents of the course as listed module-wise, as follows:

- I. Introduction:
- II. The Burden of Disease:
- III. Health Systems and Value for Money in Health.
- IV. Cross-Cutting Themes in Global Health-Part I:
- V. Cross-Cutting Themes in Global Health-Part II:
- VI. Cross-Cutting Themes in Global Health-Part III:
- VII. Critical Causes of Illness and Death-Part I:
- VIII. Critical Causes of Illness and Death-Part II:
- IX. Critical Causes of Illness and Death-Part III:
- X. Looking Forward:

LEARNING METHODOLOGY:

The course was presented in the form of video lectures. In addition, there were interviews (videos) with some of the renowned and esteemed people working in various sectors of health and related organizations. There were a set of required and optional reading material provided at the end of each lecture. At the end of each session there were assessment quizzes that were mandated to be passed for course completion.

KEY LEARNINGS FROM THE COURSE:

1. Introduction:

- **Course overview and getting started.**

“Global health is an area for study, research, and practice that places a priority on improving health and achieving equity in health for all people worldwide. Global health emphasizes transnational health issues, determinants, and solutions; involves many disciplines within and beyond the health sciences and promotes interdisciplinary collaboration; and is a synthesis of population-based prevention with individual-level clinical care.”

“Jeffrey P Koplan, T Christopher Bond, Michael H Merson, K Srinath Reddy, Mario

Henry Rodriguez, Nelson K Sewankambo, Judith N Wasserheit, Towards a

common definition of global health, The Lancet, Volume 373, Issue 9679,

2009, Pages 1993-1995, ISSN 0140-6736, [https://doi.org/10.1016/S0140-](https://doi.org/10.1016/S0140-6736(09)60332-9)

[6736\(09\)60332-9](https://doi.org/10.1016/S0140-6736(09)60332-9).

(<http://www.sciencedirect.com/science/article/pii/S0140673609603329>)”

- **Key perspectives of global health.**

- “Social determinants of health” are the broader forces that shapes the ability of a person to grow/stay health in life.
- There is a human rights approach to how an individual accesses healthcare and interacts with the system to form a relationship.
- Ethical considerations pertaining to in particular, poor, and marginalized, need to be acknowledged when spending public funds to buy maximum value (health) for least price.
- There are certain arrays of global forces which might not be within the ability of individual countries’ jurisdiction and should be considered when we think about globalization and health.

- **The global health context and who plays.**

- Why is global cooperation among various actors around the world important?
- To create a consensus around, promote health and advocate to address key health issues.

- To share knowledge among communities and set a global standard to achieve desired health outcome.
- Production and sharing of “public goods”.
- Surveillance.
- Financial aid.
- Who are the major actors working for the cause of global health?

United Nations Agencies	National Scientific Organizations	International Health Programs
NGOs	Multilateral Development Banks	Advocacy Organizations
Technical Organizations	Bilateral Development Agencies	Foundations
Consulting Firms	WHO-Related Partnerships	University-Affiliated Programs
Think Tanks	PPPs for Product Development	Human Rights Organizations

2. The Burden of Disease:

- **The state of the World’s health:**

Two of the World Bank regions, Sub-Saharan Africa, and South-Asia region lag in key health indicators (Life Expectancy, MMR, IMR, Neonatal Mortality Rate, Under 5 death Rate) than rest of the world.

- **Demography and global health.**

- Major population growth would occur in “low- and middle-income countries” up to 2050.
- Demographic divide can be observed not only between different countries but within countries as well.
- Each country at a certain Demographic Transition Phase, has a different demographic profile. The countries with better demographic profiles have better health indicators and health outcomes.
- Health implications of ‘ageing population’, ‘urbanization’ and ‘women’s age at 1st childbirth’.

- **The burden of disease-The DALY.**

“DALYs or Disability Adjusted Life Years” is an important if not perfect measure to determine the burden of disease a country face.

- **What do people get sick, disabled, and die from?**

→ The global burden of disease studies divides the causes of illness and deaths into three broad groups:

Group 1: Communicable, maternal, neonatal, and nutritional disorders.

Group 2: Non-communicable diseases.

Group 3: Injuries.

→ Studying the Burden of Disease trends for a country illustrates the ‘Epidemiologic Transition’ showing the shift in disease profile of the country as well the world.

- **Key risk factors for Deaths and DALYs.**

Attributable risk factors for deaths and DALYs vary according to country, region, gender, and age group. IHME website holds all the information on risk factors for deaths and DALYs in the form of an interactive database.

3. Health Systems and Value for Money in Health.

- **Value for money in global health.**

Cost-effectiveness analysis can be useful in determining an investment’s cost and the health benefits that can be bought in exchange. The amount of health can be measured through deaths and DALYs averted and other outcomes achieved such as number of children immunized, or TB patients cured. WHO recommends an intervention to be cost- effective if it is less than three times the GDP per capita of a country. When making a health investment, governments should also consider equity, the burden of disease and the extent to which it serves the community.

- **The organization and aims of health systems.**

→ According to WHO, health systems have three goals: 1. Good health. 2. Responsiveness to the expectations of the population. 3. Fairness of financial contribution.

→ Health systems are organized broadly into three types:

National Health Service: UK, Cuba.

National Health Insurance: France, Canada, Japan, Germany, Brazil, Mexico, Thailand.

Pluralistic: India, Nigeria, USA.

→ In addition, health systems are divided into three levels of care: 1. Primary, 2. Secondary, 3. Tertiary.

- **Health expenditure, the quest for UHC and Pharmaceuticals.**

→ The countries with high GDP per capita have larger budget share for health expenditure as compared to low income countries. Low income countries have a higher 'out of pocket' expenditure on health services as well. Achieving better outcomes, at least cost and in most efficient manner becomes a priority for countries who do not have sufficient funds for health services.

→ Contracting out and Result based financing such as CCTs are the newer approaches the governments take to deliver quality care and ensure access to healthcare services to the community.

→ WHO's framework for Universal Health Coverage considers three important questions: a. Who is to be covered? b. What services are to be covered? c. What proportion of program costs should be covered?

4. Cross-Cutting Themes in Global Health-Part I:

- **Health disparities.**

→ Health disparities need to be discussed with following considerations in mind: a. Health status, b. Access to health services, c. Coverage of health services, d. Protection from financial risks due to health costs, e. Financial fairness, f. The distribution of health benefits.

→ The factors because of which health disparities occur are-i. Social and economic status, ii. Health status and whether a person is disabled or not, iii. Ethnicity, iv. Gender, v. Religion, vi. Location, vii. Occupation, viii. Social Capital, ix. Sexual Orientation, x. Income quintile.

- **The environment & health; and Climate change & health.**

→ According to WHO, *"Environmental health comprises those aspects of human health, including quality of life, that are determined by physical, chemical, biological, social, and*

psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of present and future generations.”

→ The determinants of common environmental health issues are organized in three levels:

Household: Unsafe water, inadequate sanitation and solid waste disposal, improper hygiene, poor ventilation, toxic exposure.

Community: Improper water resource management, poor drainage, air pollution.

Global: Climate change, Ozone depletion.

→ As per Institute of Health Metrics (IHME) 15% of all deaths in all age groups for both sexes attribute to five major environmental risk factors: 1. Unimproved water, 2. Poor Sanitation, 3. Ambient air pollution, 4. Household air pollution, 5. Lead.

→ The domain of action for reduction of environmental risk factors are- a. Water and sanitation, b. Indoor and outdoor air pollution, c. chemical contamination, d. Lead exposure, e. global climate change.

- **Nutrition and global health.**

→ Southeast Asia, Sub-Saharan Africa and Eastern Mediterranean regions have highest rates of stunted, wasted, underweight and low birthweight children in the world. In comparison European and American countries have larger share of overweight and obese children globally. Adult females have higher rates of obesity than male counterparts.

→ To address the issue of malnutrition, the interventions are categorized into three parts:

- I. Nutrition specific interventions.
- II. Nutrition sensitive interventions.
- III. Enabling environment for nutrition interventions.

5. Cross-Cutting Themes in Global Health-Part II:

- **Women's health.**

→ Why is it important?

- i. Women are victims of discrimination.
- ii. They face many unique health problems.
- iii. There is unjustifiable difference between a man's and a woman's health.

- iv. There are enormous socio-economic consequences on those women who are affected due to the discrimination. It also has major influence of the family as well as the community as a whole.
 - v. Low cost interventions can lead to many deaths and DALYs averted.
 - vi. Investing in the health and education of women can lead to overall socio-economic development.
- Specific health burdens for women are: 1. Sex-selective abortion, 2. Female genital mutilation, 3. STIs, 4. Violence and sexual abuse against women, 5. Maternal morbidity and mortality, 6. Unsafe abortion, 7. Obstetric fistula.

- **Child health.**

South Asia and Sub-Saharan African region have highest rates of neonatal, infant and under-five mortality rates. The main causes of deaths in these countries are communicable diseases, malnutrition, congenital anomalies, and preterm birth complications. In comparison, higher income countries have under-five deaths due to neonatal causes predominantly, followed by accidents and injuries.

- **Childhood immunization.**

- Benefits of childhood immunizations are- a. Herd immunity, b. Communicable disease prevention, thereby reducing antimicrobial resistance, c. Provides immunity against a range of communicable disease, resulting in a productive life, d. Reduces indirect cost of treatment for vaccine preventable diseases.
- The EPI program of 1974 provided immunization against 6 diseases with 4 vaccines in children. In 1999, GAVI alliance was formed to enhance the coverage of the original vaccines as well as newer vaccines such as Hepatitis B, Yellow fever, and Tamiflu Influenza B. It also focuses on development of better and more stable vaccines. Nowadays, GAVI is promoting a 'pentavalent' vaccine to provide coverage against 5 diseases- Diphtheria, Tetanus, Pertussis, HiB, and Hep B.
- According to an estimation 84% of the children were immunized globally in 2013. Deaths due to vaccine preventable diseases fell to 400,000/ year in 2010 from 900,000/year in 2000 globally.

6. Cross-Cutting Themes in Global Health-Part III:

- **Adolescent health.**

- The leading causes of deaths and DALYs in adolescents are- 1. Early pregnancy and childbirth (females of low-and-middle-income countries), 2. Iron deficiency anemia, 3. HIV/AIDS and other STIs, 4. Other communicable diseases, 5. Non-communicable diseases, 6. Mental illness, 7. Road traffic injuries, 8. Interpersonal violence and self-harm.
- Focusing on Adolescent health is important to preserve the progress made in child health as well as laying a concrete foundation for healthier and productive adult life.

- **Complex humanitarian emergencies.**

- Natural disasters and complex human emergencies can lead to increased deaths and disabilities and have high economic costs when it comes to health. In addition to directly causing deaths and disabilities, natural disasters such as earthquake, drought, flood, cyclones, and hurricanes can cause damage to infrastructure, roads, and housings. They can also give rise to epidemics linked with lack of food, water, sanitation, and access to health services.
- Complex humanitarian emergencies, such a political conflict, civil wars, terrorist attacks and such, can result in internal displacement of citizens, injury, and death. There is human rights abuse, destruction of public infrastructure including health facilities, food shortages and forced migration. One cannot ignore the enormous health impacts these complex humanitarian emergencies have on the livelihood of affected people.
- In many instances, countries do not have sufficient resources to cope with these emergencies and require external assistance. To address these emergencies, the following needs to be done:
 - i. Include all external partners.
 - ii. Establish cooperative relationship between different actors,
 - iii. Be evidence based and transparent.
 - iv. Involve affected communities.
 - v. Assessment and surveillance.
 - vi. Create a safe and healthy environment.

7. Critical Causes of Illness and Death-Part I:

- **Emerging and reemerging Infectious Diseases and anti-microbial resistance.**

- Key factors that contribute to the emergence and reemergence of infectious diseases are-
 - a. Microbial adaptation and change, b. Human susceptibility to infections, c. Climate and

weather, d. Changing ecosystems, e. Economic development and land use, f. Human demographics and behavior, g. Technology and industry, h. International travel and commerce, i. Breakdown of public health measures, j. Poverty and social inequality, k. War and famine.

- The factors that contribute to anti-microbial resistance include- a. Increasing use of antibiotics, which is often inappropriate and in incorrect dosages, b. Poor prescription and dispensing practices, c. Taking poor quality or counterfeit drugs, d. Weak health systems and poor lab capacities to test drug susceptibility.
- To address the emergence and reemergence of infectious disease, countries need to improve land use planning and put less pressure on environment. Public needs to be educated about these infectious diseases and a global surveillance system need to be developed. Human behavior needs to be shaped and international health regulations implemented effectively.
- To reduce the burden of anti-microbial resistance, judicious use of antibiotics for treatment of sick animals and not to promote animal growth should be encouraged. New research and development model for better antibiotics needs to be conceptualized. National and state level drug regulatory authorities need to be strengthened. In addition to that improved infection control and disease prevention need to be encouraged to reduce the usage of antibiotics in the first place.

- **HIV.**

- Currently there are 35 million people living with HIV infection in the world. Major share of these cases come from Sub-Saharan African region. Countries which have more than 1% of HIV prevalent cases include Haiti, Belize, Guyana, Suriname, Djibouti, and Thailand.
- HIV is the sixth leading cause of death globally whereas in Sub-Saharan Africa it is the second leading cause for all age groups.
- HIV can have major socio-economic consequences in terms of decreased productivity, poor child health, social stigma, HIV orphans, and enormous economic burden.
- The current target for set for HIV globally is- i. 90% of HIV infected will know of their HIV status, ii. 90% of those with HIV will be receiving anti-retroviral therapy, iii. 90% of people on anti-retroviral therapy will have suppressed viral loads.

- **Tuberculosis.**

- WHO reported that in 2013, there were 11 million people living with TB. Out of these 5% of the cases have drug-resistant TB. Nearly 35% of global TB cases are from India and

China. 60% of the active TB cases are men, but deaths occur more in women. Also, 13% of new TB cases were HIV+. Almost 10% of the 1.5 million people who died of TB in 2014 were children.

- TB has huge social and economic consequences, and it affects the poor and marginalized, immunocompromised and those who live in crowded circumstances.
- DOTS therapy for six months duration is the recommended regimen for drug susceptible TB, by WHO. The major challenges in reduction of the burden of disease are- a. Treatment and follow-up by private practitioners, b. Development of simple non-invasive diagnostic tools, c. Drugs for MDR-TB, possibly of shorter duration, and d. Reducing the social and economic impact on the patient and his family.

- **Malaria.**

- 3.3 million people were at risk of malaria infection in 2013 and 550,000 deaths occurred due to malaria globally. 90% of the deaths were in Sub-Saharan Africa, and 80% of them were children below 5 years of age. Malaria is the tenth leading cause of death for both sexes of all age groups globally, whereas it is the third leading cause for children below 5 years of age. Malaria has huge health, social and economic consequences apart from the direct cost of the treatment.
- Key malaria interventions consist of- i. Treatment based on confirmed diagnosis, ii. Long lasting insecticide treated bed nets, iii. Indoor residual spraying, and iv. Reduce mosquito breeding.

8. Critical Causes of Illness and Death-Part II:

- **Neglected tropical diseases.**

- More than one billion people globally are affected by one of the 17 classified neglected tropical diseases. The poor and marginalized population in the G20 countries, along with Sub-Saharan Africa have the highest share of NTDs around the world, and are associated with high burden of DALYs, if not deaths.
- Community based mass drug administration has been the basic principle of treating NTDs. There has been collaboration between countries, global development partners and pharmaceutical companies to deliver rapid impact packages. It is a cost saving model that delivers the package at 50 US cents per person, per year.

- **Overview of non-communicable diseases, cardiovascular diseases, and diabetes.**

- Non-Communicable diseases or NCDs make up a large share of deaths and DALYs globally, except for Sub-Saharan Africa. 64% of deaths and 53% of DALYs in low-and-middle-income, and 88% of deaths and 85% of DALYs in higher income countries are caused by NCDs.
- The leading NCDs which cause death globally are IHD, Cerebrovascular disease, COPD, Alzheimer's, Lung Cancer, and Diabetes. Low back and neck pain, and depressive disorders in addition to IHD, COPD, Cerebrovascular disease, and Diabetes are the leading cause of DALYs globally.
- NCDs affect younger age group in low- and middle-income countries compared to higher income countries. The Global Action Plan has proposed following measures to control the prevalence of NCDs and reduce the economic burden it causes. These are:

Reduce tobacco consumption	Reduce alcohol consumption	Encourage physical activity
Regulate unhealthy diet	Immunization for cancers	Adequate drug therapy and counselling.

- **Cancer and diabetes.**

- 15% of total deaths and 8% of DALYs occurred due to cancer in 2010, globally. In 2012, there were 14.1 million cancer cases and 8.4 million deaths.
- Low- and middle-income countries are mostly affected with cancers due to infectious causes, as compared to high income countries.
- The Disease Control Priorities Project- Cancer volume, 3rd edition, mention some key recommendations in the form of an intervention package to address this issue. Cancer-education, tobacco control, immunization, and cost-effective treatment are some of the steps recommended by them.
- Diabetes was the eighth leading cause of deaths and DALYs for high income countries in 2010. As per International Diabetes Federation, 5-11% of adults have diabetes in low-and-middle income countries.
- To address the issue of diabetes, following measure could be taken:

Avoid being overweight	Adopt healthier lifestyle	Drug and insulin therapy
Managing long-term complications	Managing co-morbidities	Counselling

9. Critical Causes of Illness and Death-Part III:

- **Tobacco and alcohol.**

→ According to an estimation, 5 million annual deaths are due to tobacco related causes, half of them in low-and-middle income countries. 1 in 5 males and 1 in 20 females above 30 who die, die due to tobacco related causes. Half of the tobacco related deaths occur between the age of 35-69 years. About 1.5 billion people smoke tobacco globally. Russia at 39% and Indonesia at 35%, have highest prevalence of tobacco consumption. The prevalence among men was 67% in Indonesia and 60% for Russia respectively (WHO review).

→ WHO in its program call Mpower, outlines steps taken to regulated tobacco consumption. These are:

Monitoring consumption	Smoke-free zones	Bans on promotions and advertising
Raising taxes	Warning labels	Counselling and therapy

→ Alcohol is the sixth leading attributable risk for deaths and fourth for DALYs in high income countries. Males in Europe and Central Asia have high prevalence of high-risk drinking, 21% being in the age group 45-59 years of age. Countries especially low-and-middle income countries which have low resources must take stepwise approach to address this issue. Starting with increasing taxes and reducing availability, counselling, ban sales, and regulate discounts, and then set a high minimum price and ban promotion and sponsorship.

- **Mental Health.**

→ Globally, in 2013, Depressive disorders, Anxiety, Schizophrenia, and Bipolar disorders comprise 2.5%, 1%, 0.64%, and 0.4% DALYs, respectively. Moreover, the share of DALYs is greater in females than males. As per a projection made by WHO, by 2030, mental disorders would become the second leading cause of DALYs in low income, 3rd in low-middle income, and highest in upper middle-high income countries.

→ To lay a foundation for addressing the burden of mental disorders WHO recommends some fundamental steps. They include separate governmental unit, policies and budgeting for mental health, training, drug procurement and program development, and integration of these services at community level through national health programs. Through its Mental Health Gap program, WHO recommends the availability of mental health intervention package in each country.

→ Additionally, building social and emotional competencies, providing psychosocial support, attentive care and counselling might prove useful in addressing these issues.

- **Unintentional injuries.**

→ Unintentional injuries comprise 4-11% deaths and 7-14% DALYs globally for 2010. Road traffic accidents are leading cause of the burden of unintentional injuries, followed by falls, drownings, fires, and poisonings in low-and-middle income countries. Road traffic accident have smaller share of deaths in higher income countries as compared to low-middle income countries.

→ Steps taken to address the issue of unintentional injuries would include better licensing laws for road traffic, signages, road safety measures and rules and regulations. Packaging and labeling of poisonous chemicals, proper storage, and community education on the risks of poisoning might be useful. Keeping children away from large water sources, providing safety measures and removing hazards for the elderly can be beneficial to address the issues of drownings and falls.

10.Looking Forward:

- **Intersectoral approaches to enabling better health.**

To ensure a sustainable health and livelihood for an individual, policymaking needs not only involve the Ministry of Health, but requires an intersectoral approach involving other ministries and community as well. This is called a 'Health in All' or a 'Whole of Government Approach'.

- **Science and technology for global health.**

Science and Technology have been very useful in addressing a wide range of communicable diseases. For example, development of 'bifurcated needle' and 'freeze dried vaccine' for smallpox. However, there are large gaps between current capacities of technological innovations and the ideal state, when it comes to a large number of diseases. Therefore it becomes imperative to promote research, encourage new product development, and bring together the global community to shape up the market that encourages availability of better diagnostics, better vaccines, better drugs and other innovative products to enable an individual to live a healthier and productive life.

- **Key challenges for the future.**

Unfinished agenda of undernutrition, maternal health, child health and communicable diseases.

Addressing the growing burden of non-communicable diseases.

To make the health system work effectively and efficiently, and in the interests of the poor and marginalized.

Collaborating to address the burden of emerging and reemerging infectious diseases and anti-microbial resistance.

Working together to develop better drugs, diagnostics, and vaccines, needed to address the key issues and unfinished agendas.