

SUMMER TRAINING REPORT

**Successful Models to Combat with
COVID19: A Study**

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MBA Hospital and Health Management
2019-21



Institute of Health Management Research
The IIHMR University,
Jaipur 2019

ACKNOWLEDGEMENTS

I express my sincere thanks to Dr. Nutan P. Jain (Faculty Mentor, IIHMR University) for her guidance and kind supervision for this report. The inspiration, encouragement and timely suggestions given by her has helped me to shape and deliver my report.

I would like to pay my deep sense of gratitude to IIHMR University and its faculty for imparting knowledge and values. The learnings imparted during module delivery by the faculty has helped me sculpt the report to a great extent.

Lastly, I would like to thank my family and the Almighty for supporting me daily despite the hard times brought in by the pandemic situation.

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ABBREVIATIONS

ASHA	Accredited Social Health Activist
ANM	Auxiliary Nursing Midwifery
AWW	Anganwadi Worker
CB NAAT	Cartridge Based Nucleic Acid Amplification test
CDC	Centers for Disease Control and Prevention
CFR	Case Fatality Rate
GIS	Geographic Information System
GPS	Global Positioning System
HCW/HCP	Health care workers/Health care practitioners
IDSP	Integrated Disease Surveillance Programme
ICMR	The Indian Council of Medical Research
IEC	Information, Education and Communication
IHR	International Health Regulations
IPC	Infection prevention and control
MERS	Middle East Respiratory Syndrome
MoHFW	Ministry of Health and Family Welfare
MNERGA	Mahatma Gandhi National Rural Employment Guarantee Act
NAAT	Nucleic Acid Amplification Test
PHEIC	Public Health Emergency of International Concern
PPE	Personal protective equipment
rRT-PCR	Real-time reverse transcriptase polymerase chain reaction
RDks	Rapid diagnostic kits
Ro	Reproduction number
SARS	Severe Acute Respiratory Syndrome
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
SOPs	Standard Operating Procedure
WHO	World Health Organization
WMHC	Wuhan Municipal Health Commission

BACKGROUND

The World Health Organization declared the coronavirus outbreak of 2019 a Public Health Emergency of International Concern (PHEIC) on January 31, 2020, and a pandemic on March 11, 2020. On 12th December 2019, Wuhan Municipal Health Commission (WMHC) reported 27 cases of viral pneumonia with seven of them being critically ill. Most patients had a recent history of exposure to wildlife animals at the Huanan Sea- food wholesale market in Wuhan, China. This was identified to be caused by a new type of coronavirus which was later identified as SARS-CoV-2.

The coronavirus disease 2019 (COVID-19) outbreak, which originated in Wuhan, China, has now spread globally infecting approximately 10,360,822 cases as of June 30, 2020. The top three countries with respect to highest number of COVID-19 cases are United States (2,606,211 cases), Brazil (1,368,195 cases) and Russia (6,46,929 cases). The global death burden is approximately 507,014 as on June 30, 2020, with the highest in United States (1,23,360 deaths), Brazil (58,314 deaths) and United Kingdom (43,815 deaths). In India, the total number of coronavirus cases are 5,66,840 which includes 2,15,125 active cases, 3,34,821 cured/discharged/migrated and 16,893 deaths as per the Ministry of Health and Family Welfare (MoHFW) on June 30, 2020. On a global level India stands fourth with respect to highest number of COVID-19 cases with United States, Brazil and Russia being the top three countries.

The public health response throughout the world has been focused on ‘flattening the curve’, through the dual ideas of containment and preventive measures. The basic idea of containment is to reduce exposure of healthy subjects to the disease, through contact tracing and isolation of COVID-19 patients, and simultaneously reduce the spread of disease through preventive measures like regular hand washing and social/physical distancing. It is important to understand the spread of the pandemic and the control measures used by various parts of India, to form a lesson in the continued fight against the disease. Therefore, we will be focusing on the concentrated efforts of varied regions like Kerala (state level) along with Bhilwara and Agra (district level); to review their challenges and control strategies against the ongoing pandemic.

OBJECTIVES OF THE STUDY

- ✓ To review the epidemiology of COVID-19;
- ✓ To study various efforts made by Government of India to curb COVID-19; and
- ✓ To review some of the effective models like Agra, Bhilwara and Kerala used to overcome COVID-19

METHODOLOGY

The following steps were taken to conduct this study:

Step 1: In order to understand the epidemiology parameters of COVID-19 an extensive secondary data search was done which included sources like academic articles, literature search, soft copies of newspaper, and websites like WHO, CDC (Centers for Disease Control and Prevention) and wordometer.info etc.

To study the efforts and interventions made by Government of India secondary data was sourced from official websites of MoHFW, state government portals, soft copies of news articles, interviews of government authorities. Also, infographics shared on official government websites were reviewed.

Out of 28 states and 8 union territories, one state and two districts were selected for this study basis their cases of COVID-19 are stable or without any significant increase. To study the models of Bhilwara, Agra and Kerala secondary data was sourced from their respective state portals, MoHFW website, soft copies of news articles and interviews of their state government authorities. Also, infographics and IEC material were reviewed as shared on their state government websites.

Step 2: The data sourced from guidelines given by WHO and MoHFW was used to build a public health intervention framework so as to control the spread of COVID-19.

Step 3: This framework has been used to compare the three models of Bhilwara, Agra and Kerala. To understand and review the effective measures taken, strengths, and shortfalls of the models the framework was used for comparison.

LITERATURE REVIEW

The incidence of emerging infectious diseases in humans has increased within the recent past and threatens to increase in the future. According to Dikid et al, in the past three decades around 30 new infectious agents have been detected worldwide out of which 60 percent of them are of zoonotic origin. Epidemics or pandemics have taken a heavy toll of life, health and has presented economic, developmental and security challenges. Untold morbidity and mortality, disruption of trade and travel and negative effect on countries economy at a global level are some of the challenges caused due to epidemics. Morse et al, described 3 stages in emergence of zoonotic diseases: stage one- pre-emergence (encroachment into wildlife habitat and change in land use); stage two- localized emergence (expansion of the wildlife–human being interface) and stage three- pandemic emergence (international travel, for example SARS).

Three global viral infectious diseases namely severe acute respiratory syndrome (SARS), middle east respiratory syndrome (MERS) and current COVID-19 have been seen just in the span of past two decades. Since COVID-19 resembles SARS and MERS to some extent the various public health interventions need to be studied which were used to curb their outbreaks.

Severe Acute Respiratory Syndrome (SARS)

The pathogen causing SARS is called SARS-CoV which originated in Guangdong province, southern China in November 2002. As per the data given by WHO, 8096 cases were reported with 774 deaths across 26 countries and 5 continents during the SARS epidemic. The CFR stands at 9.56 per cent. WHO reported 1706 healthcare workers (HCW) were infected cases during the outbreak which is 21.27 per cent of the total infections.

Epidemiology of SARS-CoV:

SARS is caused by novel coronavirus SARS-CoV which was detected in Himalayan palm civets and a racoon dog in a market in southern China. The reservoir is considered to be Chinese horseshoe bat. The incubation period is 4.6 days (range of 2-8 days) and the transmission is human-to- human via droplet route and contact. Signs and symptoms caused in SARS are high fever, dry cough, shortness of breath, pneumonia, headache, loss of appetite, muscle pain, diarrhoea, and confusion. Laboratory abnormalities like lymphopenia, decreased platelet count, prolonged coagulation and mildly elevated serum hepatic enzymes are seen.

Public health interventions for SARS:

Singapore SARS outbreak: Lipsitch et al, in their study analysed data on 205 probable cases of SARS in Singapore by mathematical models in which they found a decline in

secondary cases coincided with application of control measures like isolation of cases and quarantine of their asymptomatic contacts. Also, an enhanced surveillance of contacts for development of symptoms showed a decline in time from symptom onset until hospital isolation. Main measures to contain SARS were isolation of symptomatic cases to prevent transmission and quarantine of close and asymptomatic contact. In this study the estimated for R_0 suggested that combination of control measures like shortening the time from symptom onset to isolation of patients, effective contact tracing and quarantine of exposed persons can be effective in containing SARS. Similar measures appeared to have formed the basis of effective control regiments in Singapore and Vietnam too.

As mentioned in a study done on SARS outbreak by Goh et al, rapid containment was due to the strong political commitments and robust leadership, effective command, control and coordination at all levels, high level of professionalism and dedication of HCWs, and strong community support. Also, the collaboration with international agencies such as the US CDC and WHO, led to prompt and coordinated inter- agency response. The experts worked hand-in-hand with the Singaporean counterparts right from the beginning of the outbreak, which additionally contributed to this success.

China SARS outbreak: A study done by De Vlas et al, showed the changes with respect to reproduction number in relation to various public health measures made by China in Guangdong. It showed measures like isolation and contact tracing largely interrupted the transmission. Later, Chinese authorities gained full control of activities to combat SARS by using stringent control measures to prevent human contact, quarantine in airports and stations, closure of schools and public places, cancellation of public holiday, which cumulatively further decreased the R_0 dramatically. Overall, the measures taken were certainly effective, as the epidemic was fully controlled within 200 days after the first case emerged in Guangdong Province on 16 November 2002.

As described by Cao et al, lessons learnt by China in public health interventions included the need for surveillance improvement, better laboratory facilities and optimized case management to control and limit the SARS outbreak. Also, community risk communication and engagement was needed. The study also concluded that strong political commitment and centrally coordinated response were important factors in control of SARS in mainland China.

Overall control of SARS outbreak:

Anderson et al, describes that SARS outbreak the intervention within a country were limited to public health measures, in the absence of a vaccine or effective therapies. Six interventions were mainly used to control SARS by screening at point of arrival and restriction of entry in the country, encouraging rapid reporting to healthcare setting with the onset of symptoms and related isolation, rigorous infection control measures in healthcare setting, isolation of suspected cases, restrictions on movement within the country, contact tracing and overall restriction of mass gatherings, schools etc. The results from the published analyses (largely from Lipsitch et al. (2003), Lloyd-Smith et al. (2003) and Riley et al. (2003)), concluded that isolation and quarantine, contact tracing,

improved infection control procedures and self-imposed movement and mixing restrictions that limited contact were very effective in combination.

Middle East Respiratory Syndrome (MERS):

The pathogen causing MERS is called MERS-CoV and was isolated from a patient who died of the disease in June 2012 in Jeddah, Saudi Arabia. Data from WHO shows by January 2020, 2519 confirmed MERS cases had been seen with 866 associated deaths. The CFR stands at 34.38 per cent globally. Since 2012, MERS has been reported in 27 countries with approximately 80 per cent of human cases reported by the Kingdom of Saudi Arabia. Cases identified outside the Middle East are people who were infected in the Middle East and travelled to areas outside the Middle East. According to latest MERS situation update from January 2020 given by WHO 19.1 per cent of 2121 MERS cases are healthcare workers (HCW) which is about 450 cases.

Epidemiology of MERS:

MERS-CoV is a zoonotic disease transmitted from animals to humans with dromedary camels as the major reservoir host. It can be transmitted from person to person and mostly seen in close contacts such as providing unprotected care to an infected patient. The clinical spectrum of MERS-CoV infection ranges from asymptomatic to severe pneumonia presenting acute respiratory distress syndrome (ARDS) and other life-threatening complications such as septic shock and multiorgan failure. The clinical spectrum of MERS infection ranges from asymptomatic or mild respiratory symptoms to severe acute respiratory disease and death. Risk factors for more severe disease include older age, comorbidities (eg, chronic lung diseases, diabetes), and immuno-suppression. The incubation period is approximately 5 days (ranges from 2-15 days) with a $R_0 < 0.7$. Studies of HCP (healthcare practitioners) and family clusters show low transmission (1-3 per cent); however, show increased transmission in healthcare settings with limited infection control procedures. In a study done by Al-Taqqi and Perl they reported 952 cases in Saudi Arabia in the period of June 2012-September 2014 which showed 27 per cent of cases were healthcare practitioners. The main factors contributing to intrahospital transmission include failure to isolate patients with initial symptoms of MERS, inadequate compliance with IPC (Infection Prevention and Control) practices, overcrowding, close proximity of patients in healthcare settings and use of aerosol generating procedures.

Public health interventions for MERS:

As per CDC, prevention of transmission of MERS in healthcare settings includes surveillance on travel to Middle East if showing signs and symptoms of MERS, strict adherence to respiratory hygiene in healthcare settings, prompt institution of contact and airborne isolation for cases.

According to Widagdo et al, MERS patients should follow proper quarantine measures to curb the spread to other susceptible individuals. Even if human-to human transmission is limited the transmission is seen in hospital settings due to lower respiratory tract tropism

in MERS patients. Other groups at risk are slaughterhouse workers and camel shepherds according to studies. Data from outbreak in South Korean shows viral shedding in severe cases peaked in the second week after onset of disease. Hence, rapid identification of patients, proper quarantine measures should be followed to significantly limit the spread of the virus in hospital settings (has been proved to be effective in South Korea outbreak). Also, prophylactic drugs should be used for immediate protection to limit the spread of virus. Camel contacts which are high risk groups should be vaccinated (vaccine development in process) for long term protection induced by vaccination.

Public health intervention given by WHO includes surveillance, identification of cases based on clinical symptoms, travel history, animal exposure, laboratory diagnosis, contact monitoring of close, probable and confirmed contacts and monitored for appearance of respiratory symptoms for 14 days after exposure with case. Also, regardless of symptoms, HCW and inpatient hospital contacts to be tested for MERS infection. Also, active monitoring by telephone or daily visits to be done for contacts. Infection control and prevention practices to be followed in healthcare setting as the transmission is highest in such places.

Overall Public health interventions in SARS and MERS:

Coordinated inter- agency response, robust political leadership, effective control-command-coordination at all levels, strong community support and a unified front is much needed to plan and implement public health interventions in outbreaks. Measures of intensive contact tracing, surveillance, isolation, quarantine plays a vital role in controlling the spread of the virus. Measures like restriction of travel, screening when entering countries, rapid reporting of cases, isolation of cases and quarantine of contacts at a faster pace help to control the entry of outbreaks in various locations. Risk communication and community engagement in order to improve rapid reporting of cases to healthcare settings. Measures like restriction of movements, cancellation and avoidance of mass gatherings, use of masks and social distancing helped in controlling community level transmission.

Overall for MERS and SARS outbreaks nosocomial transmission from patient to HCW and vice versa can be controlled by physically separating the patients and setting up isolation wards or establishing isolation hospitals to avoid patient to patient transmission. Measures like proper infection prevention and control measures, awareness and preparedness in the early stage of disease outbreaks, and usage of personal protection equipment to be practiced. Hand hygiene and usage of masks is key for prevention of infections and transmission. An important factor to be considered during outbreaks is to ease stress and psychological distress on frontline HCWs and workers by psychological support.

RESULTS

The results are presented in three sections. Initially epidemiological aspects of the COVID-19 were presented followed by efforts made by the Government of India and the state governments. In the last section, some models were discussed which have been able to keep the spread of COVID-19 in check.

Epidemiology of COVID-19

Coronaviruses were initially discovered in 1930s; when an acute respiratory infection of domesticated chickens were shown to be caused by infectious bronchitis virus (IBV). Along with SARS-CoV-2, there are six known coronaviruses in humans: HCoV-229E, HCoV-OC43, SARS-CoV, HCoV-NL63, HCoV-HKU1, and MERS-CoV. (Adhikari et al., 2020)

The timeline of coronaviruses is depicted in figure 1.

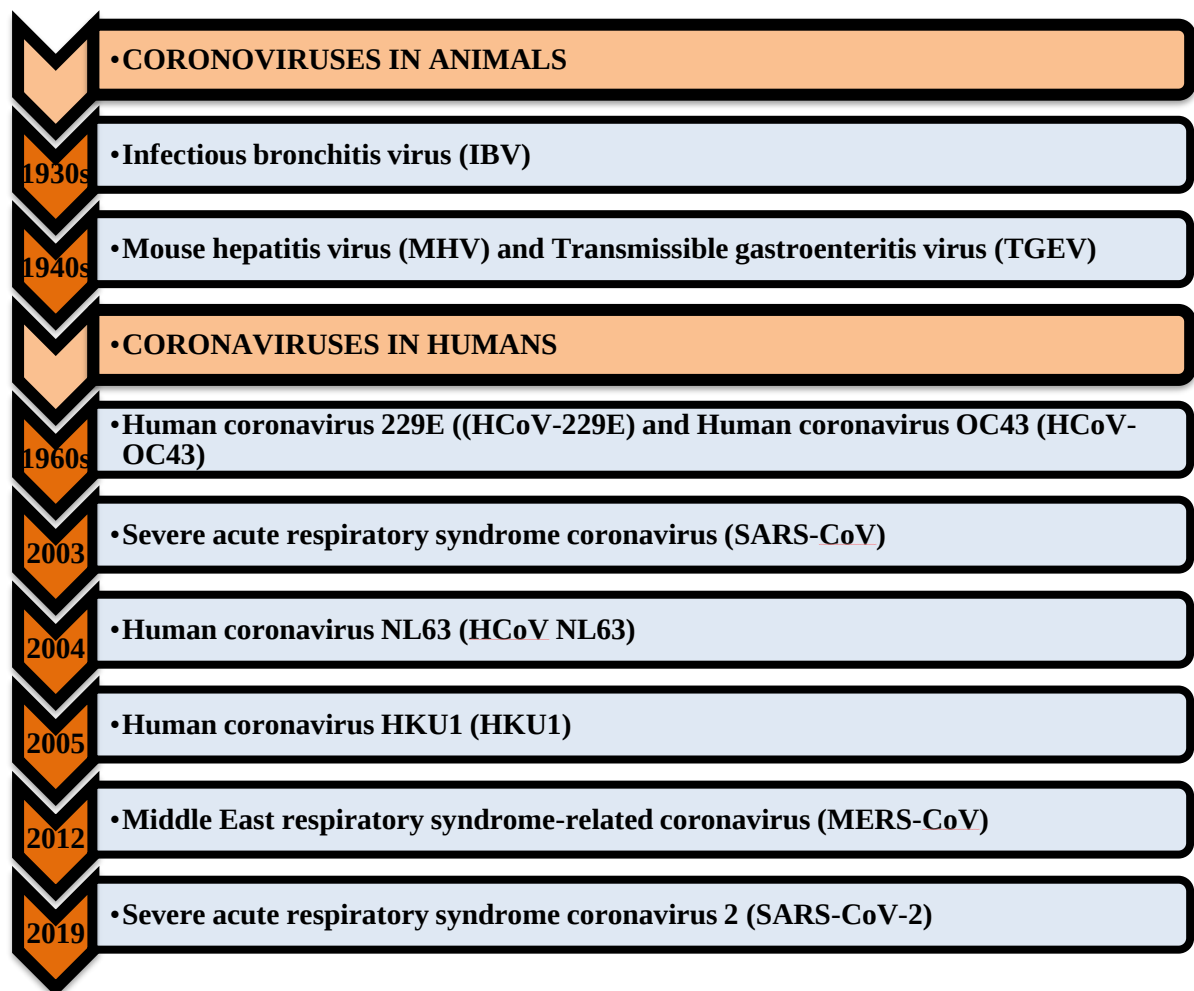


Figure 1: Timeline of coronaviruses.

Nomenclature:

The Severe Acute Respiratory Syndrome Coronavirus 2 (Sars-Cov-2) virus is a single-stranded RNA virus. The name “Corona” means “crown” in Latin and has been given due to the similarity of its spikes to a crown. The disease caused due to the SARS-CoV-2 virus was named as COVID-19 by the WHO on February 11, 2020.

Source of origin:

The virus is likely of zoonotic origin as the infected people in Wuhan were exposed to the wet animal market in Wuhan, China where live animals were sold.

For further study, China CDC collected 585 environmental samples from the Huanan Seafood Market in Wuhan, Hubei Province, China on 1 January and 12 January 2020. They detected 33 samples containing SARS-CoV-2 and indicated that it originated from wild animals sold in the market. Laboratory results also indicated that SARS- CoV-2 is similar to some of the beta (β) coronaviruses genera identified in bats.

Genome type:

It has been found that the genetic sequence of SARS-CoV-2 is 80 per cent identical to SARS-CoV and 50 per cent to the MERS- CoV. Also, both SARS-CoV and MERS-CoV originated in bats. The phylogenetic analysis indicated it belongs to genus betacoronavirus, that infects humans, bats, and wild animals (similar trait seen in SARS-CoV too).

Signs and symptoms:

The common signs and symptoms are fever, fatigue, chills, myalgia, headache, cough, loss of taste or smell, difficulty breathing, sore throat, congestion or runny nose, nausea, vomiting or diarrhoea. According to CDC guidelines emergency medical attention must be sought if one has trouble breathing, persistent pain or pressure in the chest, new confusion, inability to wake or stay awake or have bluish lips or face.

While some people develop signs and symptoms, some people are completely asymptomatic and are also termed as ‘carriers’.

Risk factors:

According to CDC, risk factors mainly include pre-existing medical conditions, co-morbidities and old age (>65 years of age). People with travel history, people who are in direct contact with the infectious people or confirmed cases (family members or Healthcare staff) are also at risk.

Diagnosis:

For diagnosis, RT-PCR (polymerase chain reaction) test is done which helps detect RNA of the virus. To detect past infections mainly in asymptomatic cases antibody tests are used to detect antibodies in blood. The swabs are taken from respiratory tract sites like nose or throat. In order to test persons in quarantine camps of migrant workers or those

international passengers returning home, RT-PCR test based on pooled sampling is used as per guidelines issued by MoHFW, Government of India.

Transmissibility indicators

Mode of transmission:

In humans, the transmission of SARS-CoV-2 can occur via respiratory secretions (directly through droplets from coughing or sneezing, or indirectly through contaminated objects or surfaces as well as close contacts). These droplets land on objects and surfaces around the person. Therefore, it is important to stay more than 6 feet away from a person who is sick.

Most of the viruses can live on the surfaces for several hours. SARS-CoV-2 can live on copper surface for 4 hours, cardboard up to 24 hours and on plastic or stainless steel for 2-3 days. Other people then catch COVID-19 by touching these objects or surfaces, then touching their eyes, nose, or mouth. Therefore, handwashing practices, respiratory etiquettes and disinfection should be done on as preventive personal measures.

Some peoples who have the infection but do not shows symptoms are called as ‘reservoir or carrier’ of the virus and they can spread the virus to others. Transmission can be escalated in congregate housing, close contacts, crowded closed spaces or workplaces, close contacts with patients. Therefore, quarantine and social distancing norms should be practices as needed.

Also, airborne transmission may be possible in specific settings in which procedures or support treatments that generate aerosols are performed (like endotracheal intubation, bronchoscopy, open suctioning, administration of nebulized treatment etc.) Therefore, proper IPC measures to be followed in hospital and healthcare settings.

Epi-curve:

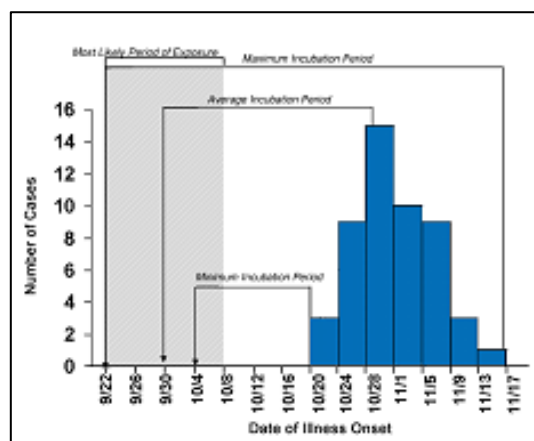


Figure 2: Ideal Epi-curve depicting index case, with rise and fall in number of cases (y-axis) shown against time (x-axis).

An Epi-curve is a visual display of the onset of illness/disease among cases associated with an outbreak. It shows progression of illness in an outbreak over time. It helps us understand the outbreaks' time trend, distribution of cases, its magnitude, pattern of spread and time period of exposure. Currently at a global level all the countries have a goal of flattening the curve with respect to COVID-19 cases.

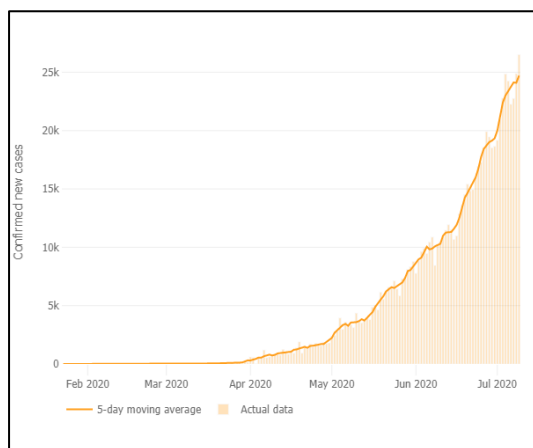


Figure 3: Epi-curve of India showing COVID-19 cases. Source: John Hopkins University website

The first case of COVID-19 in India was reported 161 days ago on January 30, 2020. Since then, the country has reported 793,802 cases, and 21,604 deaths as on July 10, 2020, which has been depicted in figure 3.

Incubation period:

Incubation period refers to the period between the infection of an individual by a pathogen and the manifestation (signs and symptoms) of the illness or disease it causes. As mentioned by Park et al, the current estimates for the mean or median incubation period range from 4 to 6 days. Incubation period for SARS-CoV was 4.4 days and for MERS-CoV was 5.5 days worldwide. The current estimation of incubation period for SARS-CoV-2 is from 2-14 days from the day of infection.

Serial interval:

Serial interval also called as generation time is the time taken by a person from exhibiting symptoms to infecting others. As described by Park et al, the serial interval of COVID-19 ranges between 4-8 days.

Basic Reproduction number (R₀) and reproduction number (R):

Basic reproductive number is the number of susceptible people one infectious person will infect given a susceptible population. Reproduction number is the number of people one infectious person will infect given the population has immune people. $R = R_0$ at the start of an epidemic. $R_0 > 1$ means the number of cases is on the rise due to transmission and is depicted by increasing rise on an epi-curve. $R_0 < 1$ means the number of cases is declining and is depicted by fall in the epi-curve. According to a review done by Park et al, the estimates of R_0 globally for COVID-19 ranges between 1.9 to 6.5.

Recovery rate:

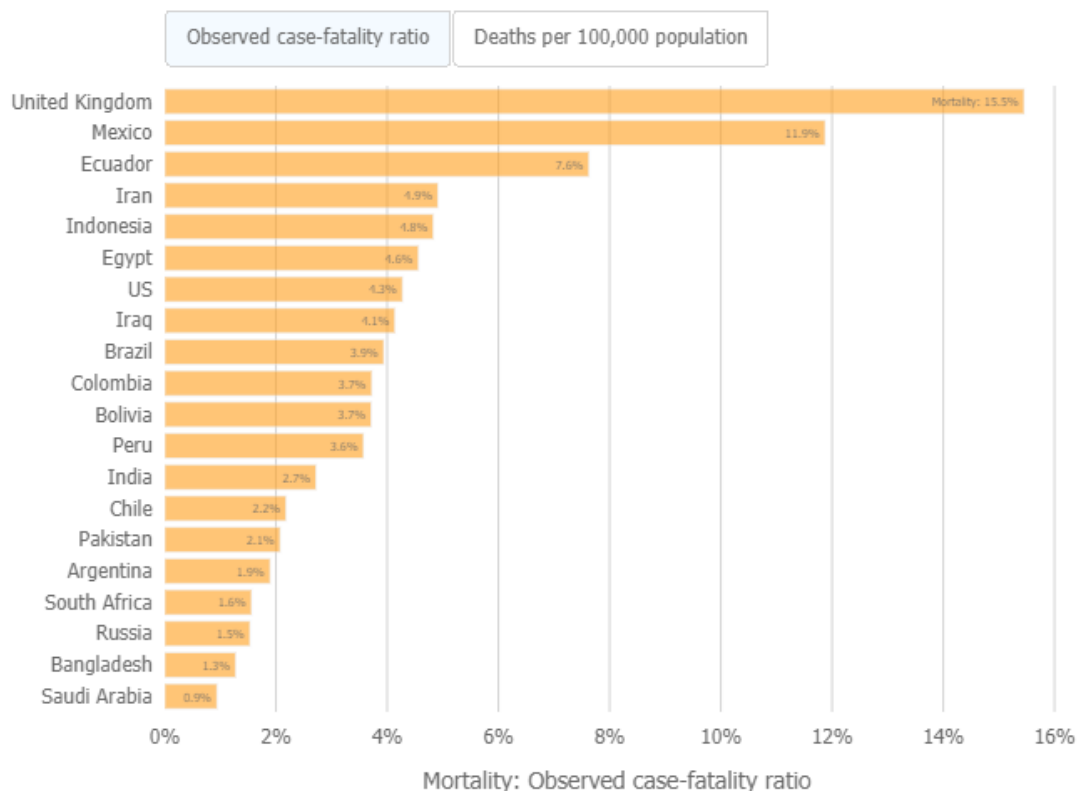
The rate of transition from the state of infected with the disease to recovered from disease is called the recovery rate. India's recovery rate was merely 7 per cent by the end of March and was at 59.01 per cent by June 30, 2020.

Doubling time:

Doubling time refers to time taken by the number of cases to double in number. The doubling time was 3.4 days in March 2020 and was 17.4 days in mid-June 2020 in India.

Mortality Indicators:

A mortality rate is a measure of the frequency of occurrence of death in a defined population during a specified interval.



*Figure 4: Horizontal bar chart showing the number of deaths per 100 confirmed cases.
Source: <https://coronavirus.jhu.edu/data/mortality>*

Deaths per million:

Globally deaths per million population is 68.29. The WHO Situation Report shows that India has one of the lowest deaths per million population due to COVID-19. India's cases of death per million population is 14.27 by June 2020.

Case fatality rate (CFR):

The case fatality rate (CFR) is referred to as number of deaths divided by the number of confirmed cases. This indicator varies as the outbreak is in motion and countries have differences in testing rates, demographics, characterises of healthcare systems etc. The CFR for China ranged from 5.3 per cent to 15.93 per cent in earlier studies as described by Park et al. India's CFR by end of June 2020 was 2.95 per cent.

CFR variation by age and underlying health conditions are shown below:

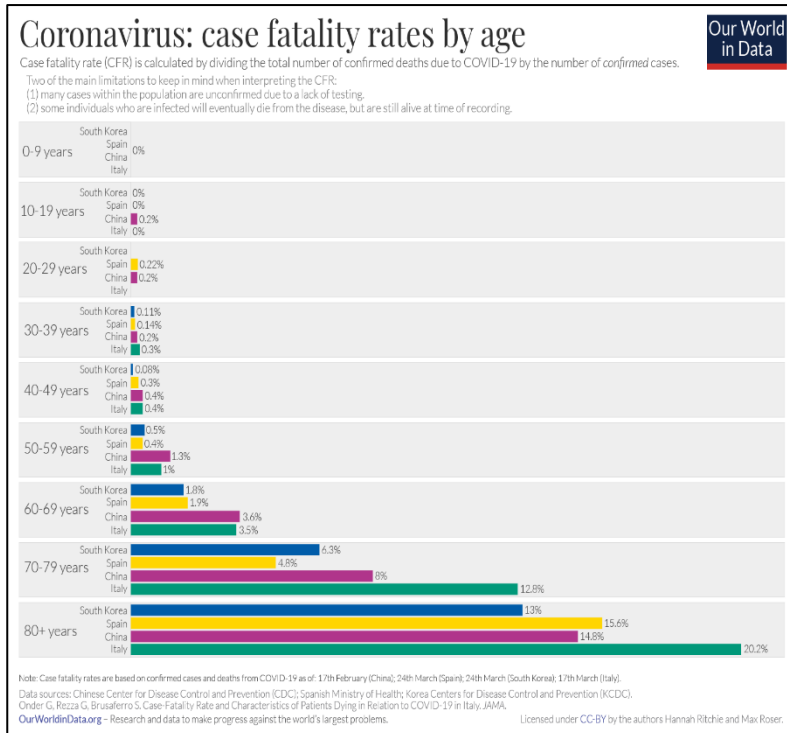


Figure 5: Bar chart showing CFR amongst various age groups. Source: <https://ourworldindata.org/>

As shown in figure 5, the data is based on the number of confirmed cases and deaths in each age group as reported by national agencies as presented by Onder et al. (2020) as of 17th March. It has been observed that the CFR is high in old age groups. It can be further co-related with underlying health conditions (co-morbidities) and lower immunity in comparison to lesser age groups.

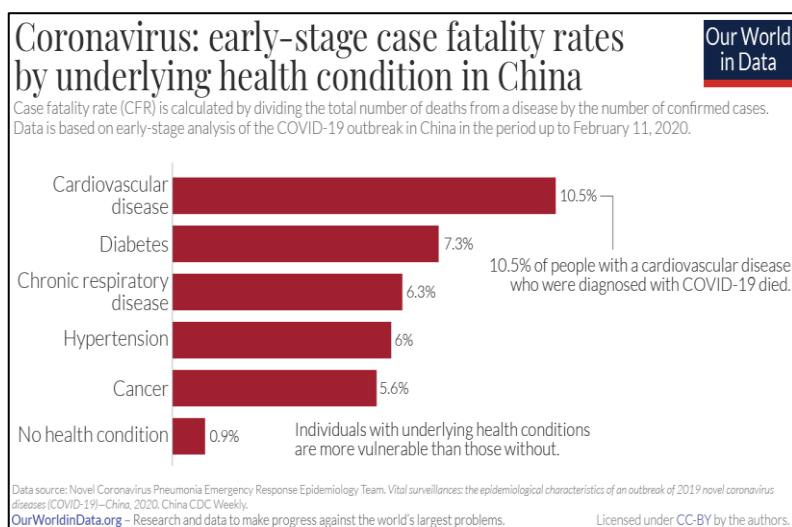


Figure 6: Graph showing early-stage CFR rates by underlying health conditions in China. Source: <https://ourworldindata.org/>

The graph shown in figure 6 is based on data from CDC and the analysis was based on recorded deaths and cases in China (February 2020). It depicts patients with no underlying conditions have a CFR as low as 0.9 per cent compared to patients with underlying conditions having CFR as high as 10.5 per cent.

Epidemiology of COVID-19 and public health interventions

By knowing the epidemiological indicators of COVID-19, the planning and implementation of public health interventions can be done accordingly at country, state and district levels.

Since the incubation, infectious period and generation time is known the calculation of period of isolation and quarantine is possible. In terms of calculation of the isolation period a case if showing symptom on day X has to continue with isolation for 10 days or more or until the symptoms are not seen for past three days without medication. In terms of calculating the quarantine period for a contact, the day of contact+14 days should be the ideal quarantine period. If a continuous contact is seen, as in cases of providing care then a period of X+3 weeks is considered ideal. This can be implemented in planning the public health intervention and upscaling of healthcare facilities, isolation and quarantine centres as needed.

Contact tracing and surveillance can help curb the transmission cycle and reduce increase in cases to a great extent. The early detection of cases and their respective contacts can help limit the spread as the cases and contacts can be isolated and quarantined, respectively. The contacts with high risk situations should be looked into carefully to avoid super spreading incidents.

The signs and symptoms are such that if risk communication and awareness is done on a large scale, the public can themselves detect it. This will ensure self-reporting and can play a crucial role in early detection of the disease and, hence curbing its infectivity. Also, active-passive-sentinel surveillance and aggressive contact tracing can be used accordingly for quick detection of cases. As the risk factors are known boosting immunity in general and isolation/quarantining of such groups can be considered in planning the public health interventions. Movement restrictions, avoiding mass gatherings and participation, social/physical distancing measures are some of the measures to be followed by high risk groups. Since there are asymptomatic cases too who are infectious self-isolation or limiting contact by being 6 feet away and using masks can be good preventive measures.

The R₀ and doubling time go hand in hand. If the R₀ is limited by reducing contact (by isolation or quarantine) or vaccination, then the doubling time of cases further increases. This can be implemented in public health intervention planning as generation time, incubation and infectious period give us a glimpse of how widely the disease can spread and the intervention planning can be hence directed towards stopping the transmission and breaking the chain. Indicators like increase in doubling time and recovery rate and decrease in case fatality rates can help the governments devise the changes in the lockdown periods.

The need to understand *transmission* is that it can be intervened by surveillance, contact tracing, law enforcement with respect to distancing, implementation of IPC measures, awareness of personal hygiene measures and respiratory etiquettes etc. which will slow the chain of transmission.

Efforts made by Government of India to curb COVID-19:

In India, the first case was confirmed in the state of Kerala on January 30, who was a student returnee from Wuhan University for the vacation break. From that day until June 30, the central government has issued lockdowns, law enforcements, economic packages, risk communication measures for awareness, evacuation measures for Indians abroad and other public health interventions etc. have been implemented. The efforts made by Government of India (GOI) are in coordination with the guidelines and announcements made by WHO and were implemented in India in the following ways:

Progression of cases in various states and key landmark announcements by Government of India:

January 30, 2020: India confirms first case of COVID-19: a student returnee from Wuhan University of China came home for vacation. The student was from Kerala's Trissur district.

February 2, 2020: 323 citizens rescued from Wuhan city and kept in observation/quarantine facilities.

February 4, 2020: Kerala declared COVID-19 a state calamity; this came in after a third case was positive in Kerala.

March 2, 2020: Two more cases were reported in Delhi and Hyderabad with a travel history to Italy and UAE respectively.

March 4, 2020: Total cases in India stand at 29.

March 10, 2020: Public gatherings restricted in Kerala and schools up to class 7 closed. Three people in Pune test positive, who were in contact with initial cases.

March 11, 2020: Suspension of all tourist visas until April 15.

March 12, 2020: First coronavirus death in India. Karnataka government announced public places like malls, cinema halls, educational institutions, etc. to be closed for a week and puts prohibitor orders on public events. This was followed by Odisha government who declared the outbreak a "disaster".

March 13, 2020: All schools were ordered to be remained closed till march 31 by governments of Punjab, Chhattisgarh and schools which were not conducting exams were closed till march 31 by Manipur government.

A Tablighi Jamaat religious congregation took place in Nizamuddin markaz where around 3400 people gathered.

March 14, 2020: With positive cases reaching 22 in Kerala the central government declared COVID-19 a notified disaster. Delhi reported second death in India, governments of Himachal Pradesh, Maharashtra, West Bengal declared that schools,

malls, theatres, gyms and swimming pools will remain shut. Ongoing school and college exams continued in Rajasthan.

March 16, 2020: Odisha reports its first case in Bhubaneswar where the man had a travel history to Italy. Delhi CM Arvind Kejriwal announces that no religious, social, political gatherings of more than 50 people are allowed in Delhi till March 31. People at the Nizamuddin Markaz still continue to stay put in Delhi.

March 17, 2020: Total cases at 137 with three deaths. In Karnataka, 63-year-old doctor was tested positive. West Bengal reported its first case: case has travel history from UK.

March 19, 2020: Indian government bans exports of masks, ventilators, as well as certain medications and supplements.

All incoming international flights banned.

March 20, 2020: Gujarat reports its first cases and Telangana reports 10 new cases.

March 22, 2020: All international flights arriving and departing from India suspended. India observes a 14-hour voluntary Janta Curfew on the appeal of the Prime Minister. Cases stand at 360 been infected till date out of which 24 have been discharged and 7 deaths.

March 23, 2020: 1500 people vacate the Markaz.

March 24, 2020: Lockdown 1.0: 21- day lockdown announced to contain spread of coronavirus by the Prime Minister. No public gatherings, any kind of non-essential movement outside residences allowed. Only essential services allowed to remain functional.

March 25, 2020: Mass movement by migrants: India sees large-scale movement of the urban poor as they head for their homes in rural areas.

India reported over 600 cases. Domestic flights banned in India.

March 26, 2020: A preacher part of Tablighi jamaat congregation tested positive in Srinagar.

The government announced 1.70 lakh crore relief package for the poor which included insurance cover of Rs. 50 lakh per health worker, 80 crore poor people to receive benefit of 5 kg wheat or rice per person and 1 kg pulses.

March 31, 2020: Delhi's Nizamuddin arises as a coronavirus hotspot, with a large number of attendees at a religious congregation held at the headquarters, or Markaz, of the Tablighi Jamaat, being tested positive. India had total of 1,397 cases and 35 deaths.

April 1, 2020: new cases emerged in Delhi and Tamilnadu linked to congregation 129 and 74 respectively and 9 died in Telangana who attended the event

April 5, 2020: as a sign of fight against pandemic and show solidarity to those in the frontline battling the virus entire country lighted diyas at 9pm for 9 minutes.

April 14, 2020: Lockdown 2.0 extended till May 03. Cases stand at more than 10,000 confirmed cases. All states/union territories reported at least one case barring Dadar Nagar Haveli. And Sikkim.

April 16, 2020: e commerce and few industries in rural areas were allowed to start from April 20.

Out of total 14,378 positive cases, 4,291 that is 29.8 percent related to the event held at Markaz, Nizamuddin in the national capital and has affected 23 States and Union Territories including Tamil Nadu, Delhi, Uttar Pradesh, Telangana, among others. Among them, 84 per cent cases in Tamil Nadu, 63 per cent cases in Delhi, 79 per cent cases in Telangana, 59 per cent cases in UP and 61 per cent cases in Andhra Pradesh are related to the event.

April 22, 2020: Union Cabinet approves ordinance in Epidemic Act which states violence towards doctors is nonbailable offence.

April 30, 2020: migrants, students and pilgrims who were virus free were allowed to return to their homes by central government. 33,050 have been tested positive, with 1074 deaths and 8,324 been cured.

May 1, 2020: Shramik Special trains started for migrants to take them to their native states.

May 4, 2020: Lockdown 3.0 initiated:

Total cases at 42,533 with 1,391 deaths till date. According to MHA guidelines, there will be considerable relaxations starting today in districts that fall in the Green and Orange Zones. States hit with most cases in India at present are Maharashtra (12,974), Gujarat (5,428), Delhi (4,549), Madhya Pradesh (2,846), Rajasthan (2,886), Tamil Nadu (3,023), and Uttar Pradesh (2,645).

May 7, 2020: Indians stranded in UK, the UAE, the US, Maldives, Bahrain and Singapore were brought home through Vande Bharat mission

May 12, 2020: Prime Minister announced Rs. 20 lakh crore economic package under 'AatmaNirbhar Bharat Abhiyan'.

May 13, 2020: A second set of measures, part of 20 trillion fiscal and monetary package announced by PM to support Indian economy. Measures worth 5.94 trillion announced to provide relief for taxpayers, small businesses, real estate, contractors working with government, power distribution companies and organised sector employees.

May 15, 2020: The third set of stimulus measures focussing on agriculture and allied activities announced.

May 16, 2020: The fourth part of stimulus measures to bring structural improvements in coal, minerals, defence production, aviation, power discoms in UTs, space and atomic energy sectors announced.

India stands at 85,940 cases and overtakes China in terms of the total number of cases reported.

May 17, 2020: Lockdown 4.0 extended till May 31 making it one of the longest lockdowns any country has imposed ever. Cases stand at 90,927 with 53,946 active infections, 34,108 recovered cases, 1 migrant patient, and 2,872 deaths.

May 31, 2020: 1,82,143 cases which includes 89,995 active cases, 86,984 cured/discharged/migrated and 5,164 deaths.

June 01, 2020: Unlock 1.0 from June 01 to June 30 with phased openings.

The total coronavirus cases in India now stand at 260,093 with 7,263 deaths. India takes 5th position on worst hit nations across the globe.

June 15, 2020: 1.7 lakh people cases recovered, 1.5 lakh active infections and 9520 deaths in the country.

June 30, 2020: PM's address to the nation: there was an increased negligence and social behaviour in unlock 1.0. PM said to follow norms and be alert as was during lockdown to prevent spread.

Total cases stand at 5,66,840 with active cases at 2,15,125, recovered cases at 3,34,821 and 16,893 deaths.

Interventions taken by Government of India to fight against COVID-19:

1. Lockdowns:

On 22 March, India observed a 14-hour voluntary public curfew on the appeal of The Prime Minister. It was followed by mandatory lockdowns in COVID-19 hotspots and all major cities in later phases. Lockdowns were called upon under the Section 10 (2)(I) Disaster Management Act, 2005 by the Government of India.

Lockdown 1.0 started on March 24 midnight and continued up to April 14. India went into a 21-day lockdown with complete restrictions over movement of people via rail, air or road. All the government offices, educational institutions, government and private industries, religious places and functions, farming and agriculture, training and coaching centres, commercial activities, public places, hospitality services etc. all were closed during this period. Complete restriction of movement of people and goods was imposed with the exception only for transportation of essential goods and services. Medical services like hospitals, clinics, chemists, ambulances were working along with frontline workers on duty. Essential goods shops like groceries, fruits, food, and meat etc. were open; however, it was circulated with following a social distancing protocol.

In **lockdown 2.0 phase** which was from April 15 to May 03, with an aim to mitigate the hardships of public few services were allowed to be followed by Standard Operating Procedure (SOPs) given by MoHFW from April 20, 2020. These services were allowed only in areas which were not containment zones. The above already open activities plus pharmaceutical and medical research labs, authorised establishments which support essential services, manufacturing units of drugs, pharmaceuticals, medical devices, construction of medical health infrastructure were allowed. Also, agricultural activities, horticulture activities, mandis or markets, shops related to agriculture machines, poultry and animal husbandry, financial sector, government offices, MNERGA workers were allowed. Other services were closed as in the lockdown 1.0.

In phase of **lockdown 3.0** which was from May 04 to May 17, zoning of districts was done into red, green and orange zones basis on the number of coronavirus cases, doubling rate, extent of testing etc. In India as of May 03, 130 districts were in red zone, 284 districts in orange zone and 319 districts in green zone. Certain activities were allowed in orange and green zones like taxis and cabs with one driver and two passengers. 15 trains

were started in all three zones to be resumed in a gradual manner. Also, sale of liquor, cigarettes and pan shops were resumed in all three zones. Movement in four wheeler or two wheeler vehicles for essential services was allowed in all three zones. In red zone private offices could operate at 33 per cent strength, government offices with senior officers and above functioned at full strength and one-third of remaining staff.

Manufacturing or urban constructions, e-commerce essential goods, domestic help, banks, agriculture activities etc was also started in all zones. However, inter and intra bus movement was only restricted to green zones. In the containment zone no activities were allowed. Activities like air travel, inter-state movement, educational institutions, hospitality, religious places, cinemas, restaurants, roaming post 7 pm until 7 am, movement of people >65 years, <10 years and pregnant women, etc. was still restricted in all three zones.

In **lockdown 4.0** which was from May 18 to May 31, there was no zone-wise restriction. The authority to decide zones was given to state/union territory authorities to decide which wards were under which zones. Only the activities in containment zone were still restricted. Now, activities like public transport to markets, factories, manufacturing units, supply line and offices could function. Buses and private vehicles allowed to roam without special conditions. Also, interstate movement was allowed. The activities mentioned in other lockdowns were all permitted except domestic and international travel, rail and metro services, schools and educational institutions, restaurants, social political and religious functions and gathering. However, the state/union territory government held the decision-making power to suspend or resume the activities as needed.

Lockdown 5.0 which is also called as Unlock 1.0 was from June 01 to June 30. The Unlock focused on re-opening in a phased manner. It was initiated to focus on the economic aspect. All activities that were prohibited could in a phased manner but by following SOPs as prescribed by Health Ministry. The only activities still prohibited were international air travel, metro rails, cinema halls, gyms, swimming pools, theatres, bars, assembly halls, social-political events, sports, entertainment, academic, cultural and religious functions. However, like lockdown 4.0 the state/union territory government held the decision-making power to suspend or resume the activities as needed.

Following are lockdown-wise changes in some indicators:

Table 1: Lockdown-wise coronavirus cases in India and its related testing, recovery rate, doubling time and case fatality rate

Phase	Total Number of cases	Active Number of cases	Recovered Number of cases	Total Number of deaths	Number of Tests conducted	Recovery rate (%)	Doubling time (In days)	Case fatality rate (%)
Pre-lockdown	468	424	35	9	14,915	7.47	3.4	1.92
Lockdown 1.0	10,376	8988	1035	353	401,586	19.36	8.6	3.30
Lockdown 2.0	41,656	29381	10886	1389	1,046,450	27.41	11.5	3.25
Lockdown 3.0	128,172	90927	34224	3021	2,279,324	37.5	13.8	3.1
Lockdown 4.0	182,143	89995	86984	5164	41,032,300	47	15.4	2.83
Unlock 1.0	566,840	215125	334821	16893	90,561,700	59.1	19	2.78

2. *Travel and entry restrictions:*

Around last week of January 2020, international passengers travelling only from China were screened at the airports. By February 23, India was screening passengers from Nepal, Vietnam, Indonesia, Malaysia, Hong Kong, Japan, South Korea, Thailand and Singapore. On 3 March 2020, the Indian government stopped issuing of new visas. Previously issued visas for the nationals of Italy, Iran, South Korea, and Japan were suspended.

On March 4, 2020, advisory was given to screen all international passengers with information like their travel history been recorded. This was issued in accordance with a man who travelled from Italy via Vienna (February 25, 2020) and entered the country without any screening at the Delhi airport was tested positive for the coronavirus. All the international flights were banned on March 22, 2020. Shortly on March 25, 2020, domestic flights were also banned in India and was later uplifted on May 25, 2020.

3. *Evacuation of Indian passengers from abroad:*

India launched “Vande Bharat” mission on May 07, 2020, and successfully returned 364,209 lakh Indians from abroad as of June 2020 as per Ministry of External Affairs. Whereas 3992 Indian citizens were brought back via sea under the “Operation Samudra Setu” which included India Naval Ships Jalashwa, Airavat, Shardul and Magar which travelled over 55 days for more than 23,000 kilometres by sea.

4. *Issuance of guidelines:*

The Ministry of Health and Family Welfare issued guidelines to be followed for the citizens, state governments, healthcare professionals, frontline warriors etc. The guidelines ranged from containment plan, case management, dead body management, IPC, travel advisories, training materials, various SOPs (for workplace, public places, religious places, restaurants etc), preventive measures, awareness material etc.

The containment plan issued by the central government included guidelines on travel related spread, local and community transmission of COVID-19. The plan included guidelines in detail on identification and mapping of clusters, surveillance, contact tracing, perimeter control, laboratory support, case management, surge capacity building, communication, training, pharmaceutical and non-pharmaceutical measures, and information management in the given areas. Its implementation was however subjected to governments of state and union territories.

5. *Upscaling healthcare facilities:*

Personal Protective Equipment (PPE) kits and ventilators:

Earlier when the coronavirus outbreak started, India had to import Personal Protective Equipment (PPE) kits and ventilators. As of June 2020, India produced 4.5 lakh to 6 lakh PPE suits daily, and over 600 companies in the country were certified to manufacture

PPEs. Also, the production of ventilators was upscaled to 1,000 ventilators daily. Over 21.3 crore N95 masks and 1.2 crore personal protective equipment (PPE) kits were distributed as of June end.

COVID-19 hospitals, centres and beds:

As of March 2020, India had 15,980 isolation beds and 37,326 quarantine beds available. As of June 09 the infrastructure was ramped up to 958 dedicated Covid-19 hospitals with 1,67,883 isolation beds, 21,614 ICU and 73,469 oxygen supported beds. Also, 2,313 dedicated COVID Health Centres with 1,33,037 isolation beds, 10,748 ICU beds and 46,635 oxygen supported beds were operationalised. The ventilators available for COVID beds were now at 21,494, and an order of 60,848 more ventilators were placed.

In March, Railways were announced to be used as last resort to keep isolated patients and then a total of 5,231 coaches have been modified to be used as Covid Care Centres. So far, 5,321 non-AC sleeper class coaches of ICF variety (older design) have been converted by the 16 zonal railways through their workshops spread across India. These are developed as COVID Care Level 1 centres to keep suspected cases or those with mild symptoms.

6. Research and vaccine development:

PM CARES Fund Trust was to allocate Rs 100 crore in support of development of coronavirus vaccine. The Department of Biotechnology has been made a central coordination agency to identify pathways for vaccine development. In India, following vaccines are in progress:

- a) COVAXIN, produced by Hyderabad based Bharat Biotech and was pushed for regulatory approvals by the Drug Comptroller of India (DCGI) to start clinical trials in phase I and II. The vaccine's workability has been found to strengthen the body's immunity and spike up production of antibodies, which could defend the body against such viral agents.
- b) CoroFlu, developed by Bharat Biotech already started the testing phase and has been developed from an influenza strain.
- c) ZyCOV-D, developed by Ahmedabad-based Zydus Cadila has secured clearance from the regulatory board to start clinical trials.
- d) Major vaccine production companies have also inked deals with leading vaccine firms, including the one produced by Moderna Inc. and AstraZeneca. Mynvax, who is currently testing their innovative protein-based vaccine in a laboratory based out of Indian Institute of Science, Bengaluru. Another group overseeing the development of a COVID-19 vaccine is Indian Immunologicals Limited, working on the development of a unique vaccine modelled from codon-deoptimization technology to target the coronavirus infected cells.

7. Legal front:

The Government of India has institutionalized various laws to curb the spread and transmission of the COVID-19 disease; few of them are as follows.

Disaster Management Act of 2005: In India, lockdown has been carried at state and districts levels as directed by Union Ministry of Home Affairs under the Disaster Management Act of 2005. It refers to 'provide for the effective management of disasters and for matters connected therewith or incidental thereto'.

The Epidemic Diseases Act, 1897: The Epidemic Diseases Act, 1897 provides the central and state governments the power to take special measures and prescribe regulations in dangerous epidemic disease. It lets the authorities take necessary actions to control the disease. Any person disobeying any regulation or order made under this Act shall be deemed to have committed an offence punishable under section 188 of the Indian Penal Code.

On April 22, 2020, an amendment was made to the Epidemic Diseases Act as 'The Epidemic Diseases (Amendment) Ordinance 2020', which added provisions to punish those attacking doctors or health workers. The ordinance allows for up to seven years of jail for attacking doctors or health workers (including ASHA workers). The offense will be cognizable and non-bailable among other things.

At district levels the Commissioner of Police can impose Section 144 of the Criminal Procedure Code in public places to ensure protocols are being followed by the public.

Laws for misinformation, rumours and false news circulation: To avoid circulation of misinformation, rumours and false news regarding COVID-19 these laws are enforced leading to imprisonment or payment of fine:

- a) Section 505(1) of Indian Penal Code, 1860: The punishment for making, publishing or circulating any statement, rumour or report which may cause fear or alarm to the public, or to any section of the public
- b) Section 66D of Information Technology Act: Whoever, by means for any communication device or computer resource cheats by personating.
- a) Section 54 of the Disaster Management Act, 2005: Whoever makes or circulates a false alarm or warning as to disaster or its severity or magnitude, leading to panic.

In Maharashtra 51 such cases for spreading fake news, rumours, fraudulent claims were registered. One such case in Odisha led to imprisonment of a man for posting false information on Facebook regarding a Kerala-return person who had tested positive and was under treatment in Rayagada.

Other Legal Acts to ensure the protocols are being followed:

- a) Section 188 of Indian Penal Code- Punishment for disobeying an order duly promulgated by a public servant. This is also implemented in accordance with mandatory wearing of masks in public places.
- b) Section 271 of the Indian Penal Code, 1860- For whosoever disobeys the quarantine rule shall be punished with imprisonment or fine or both.
- c) Section 269 of the Indian Penal Code, 1860- For negligent act likely to spread infection of disease dangerous to life.
- d) Section 270 of the Indian Penal Code, 1860- This law is for those who know the consequence of their actions could lead to the spread of the virus and still choose to do such an act shall be penalized.

8. Socio-economic front:

To tend to the economic impact amidst the pandemic the government called in for various measures like funding, announcing packages, making changes in the reverse repo rate policies, looking into wages and labour enhancement, and feeding the needy and poor.

PM-CARES fund:

In the light of COVID-19 pandemic, PM-CARES fund was initiated which aimed at strengthening the fight against COVID-19. It further has objectives of dealing with emergency situation, provide relief to the affected, upgradation of healthcare facilities, funding research, render financial assistance etc.

PM CARES Fund Trust has decided to allocate Rs 100 crore for support to coronavirus vaccine development efforts.

Relief packages:

- a) On March 26, 2020, the government announced 1.70 lakh crore relief package for the poor which included insurance cover of Rs. 50 lakh per health worker, 80 crore poor people to receive benefit of 5 kg wheat or rice per person and 1 kg pulses. This distribution will be done through Public Distribution Scheme (PDS). This scheme has now been extended until November with an additional outlay of Rs. 90,000 crore under PMGKAY to benefit 80 crore people.
- b) Also, state governments announced packages at their levels like Kerala government on March 20, announced a package of Rs 20,000 crore to tide over the coronavirus situation and Telangana government announced that the government would supply free rice and Rs. 1,500 cash to purchase essential commodities for 87.59 lakh white ration card holders on March 22, 2020.
- c) 20-crore woman Jan Dhan account holders got Rs. 500 per month for 3 months.
- d) Free gas cylinders to 8 crore poor families- Women in 83 million families below poverty line covered under Ujwala scheme will get free LPG cylinders for 3 months.
- e) Ex-gratia of Rs. 1,000 to 3 crore poor senior citizens, poor widows and poor Divyang.

- f) Under existing PM-KISAN scheme and PMGKP Rs. 2000 paid to 8.7 crore farmers.

Healthcare workers related:

2.2 million health workers fighting COVID-19 will get an insurance cover of Rs. 50 lakhs.

Labour related:

- a) Increase in MNERGA wage to Rs. 202/day (was Rs. 182) for 13.62 crore families
- b) Building and construction workers: State governments have been directed to use the welfare fund for building and construction workers (District Mineral Fund worth about INR 310 billion).
- c) 24 per cent monthly wages credited to PF accounts for wage-earners below 15,000 per month in businesses having less than 100 workers. Wages under job guarantee program increased to provide annual benefit of Rs 2,000 to a worker.
- d) 5-crore workers under Employee Provident Fund to get non-refundable advance of 75 per cent of amount or three months of wages (whichever is low) from their accounts.
- e) For Women Self Help Groups which supports 6.85 crore households the limit of collateral free lending updated to Rs. 20 lakh (was 10 lakhs).

Aatma Nirbhar Bharat Abhiyan /Self-Reliant India:

On May 12, 2020, Prime Minister announced Rs. 20 lakh crore economic package under “AatmaNirbhar Bharat Abhiyan” which focuses to aid our country out of the coronavirus crisis. The main pillars of the program are economy, infrastructure, system, vibrant demography and demand. The program is not about being self-contained or closed but about being self-sustaining and self-generating as said by Prime Minister.

Relief for Micro, Small, and Medium Enterprises (MSMEs):

Rs. 3 Lakh crore collateral free loan with 100 per cent credit guarantee, Rs. 20000 crore subordinate debt for stressed MSMEs and Rs. 50000 crore equity infusion for MSMEs with growth potential and viability through Fund of Funds.

Special Refund and Drawback Disposal Drive:

Issuing all pending income-tax refunds up to Rs. 5 lakhs hence benefitting around 14 lakh taxpayers.

Loan freeze: All lenders to free repayments for three months on term loans outstanding March 01. Also accumulated interest can be paid later (allowed to suspend interest payments on working capital facilities).

9. Risk Communication and Community Engagement:

Appeals by the Prime Minister: Prime Minister addressed the community on various occasions and spoke about adherence to lockdown, limiting community spread of disease and gearing up India from economic point of view in his talks. Various tasks like Janta Curfew task, cheering healthcare workers by clapping, lamp lighting for 9 minutes at 9 pm, showering of petals etc, were some other initiatives. Various Pledge campaigns included Janta Curfew Pledge, stay home stay safe pledge, Fight against Corona gained participation from citizens.

Mobile application: The Ministry of Electronics and Information technology launched The Aarogya Setu App which was made mandatory for all to be installed in their phones. It aimed to help in contact tracing, self-assessment of symptoms, awareness information circulation, thereby containing the spread of coronavirus. The app has a feature with Bluetooth and GPS tracking which helps trace the routes taken and shows if a positive case had come in contact with the person. As of June, 12 crore people have downloaded the app and used it. The government also roped in celebrities to push the messages forward.

Digital platforms: The Department of Science and Technology (DST) launched 'Year of Awareness on Science and Health (YASH)' with focus on health and risk communication. MyGov and community.data.gov.in were platforms used to bridge the gap between citizens and government and ensure citizen participation along with dissemination of information. Awareness material with respect to hygiene, protective measures, infographics about covid situation etc was uploaded on the platform. Other IEC materials addressing stigma, making of homemade masks, general public use of medicines, facts related to COVID-19, isolation, quarantine, materials for frontline workers, COVID warriors and citizens were also published on these platforms. MyGov India also published data on Dos and Don'ts for preventing spread of virus, busting fake news and myths, explaining about social distancing, lockdowns etc. for easy and reliable communication with the public. It had presence on Facebook, Instagram, twitter, YouTube, LinkedIn, Telegram etc. to reach all sections of society. Content was created in multiple languages to ensure proper communication.

Door-to-door risk communication: ASHA, ANM and AWW workers who are a part of frontline workers went door-to-door to spread awareness and were facilitated by digital pocket books and IEC materials for risk communication by MoHFW. Also, volunteers were called out for help under the tag of "Corona Warriors".

Other measures: Initiatives like "Maan ki Baat" were focused on asking the public about the pandemic situation so as to build a rapport. Conducting tasks, polls, quizzes and pledges on mygov.in official portal was an initiative for community engagement. My Gov collaborated with Google Maps and put details of shelters and feeding homes of around 750 cities to be easily located by migrant workers and needy people.

Podcasts were started as part of MyGov Samvaad and were shared with 200 community radio stations and translated in various languages. An initiative named Positive Harmonies launched on their portal has musicians making special numbers for risk communication.

Limitations in implementation of public health interventions:

Country level preparedness with respect to healthcare facilities should have initiated when the first case of coronavirus was detected in India (January 30) or at least when WHO announced it as Public Health Emergency. The ramping of healthcare infrastructure, management of beds, manufacturing of PPEs and ventilators all started by March end. The *timings of the lockdown* were also criticised by various experts and should have been done at an earlier stage. *State borders* if closed when the cases were in Kerala itself would have helped to control progression in other states. Moreover, *sealing of borders and the bans on international flights* came in very late by end of March and should have been done in January or early February to curb the transmission and spread across states in India. Also *screening of passengers* deliberately was initially only focused at travellers from China and was later expanded to other travellers as claimed by the government. However, allegations of not screening had been making rounds. Also, domestic flight travellers were not screened at all, which again might be a potential thread in spreading cases among various states.

Despite the *communication protocols* followed, the government or the Prime Minister did not communicate about why the lockdowns were imposed initially, how the legal acts work and how panic buying, and hoarding was not necessary. The communication gap in how long the lockdowns will last and things to be expected were not communicated properly. Also, announcements of lockdown were so abrupt that it did not give the public any time to prepare themselves or relocate to comfortable zones as a large proportion of Indian citizens migrate to other states and cities for jobs and education purposes. Moreover, many of them were daily wage workers and their sustainability was not well thought of. If the lockdown would have been phased or informed in a proper manner the situations faced due to panic buying, hoarding and intense struggles of worker class and migrant workers would have been completely avoided. The India scenario of not knowing and understanding what distancing, quarantine etc. is lead to fear and confusion amid the masses initially. Migrant workers and daily wage workers did not know where to go and what to do so they started flocking towards their homes. A prime example being the inability of the Delhi government to stop the mass exodus of migrant workers to UP exposed the glaring failure of its communications strategy. On the contrary in Maharashtra timely inclusive personal communication from the Chief Minister assured the migrant community in Maharashtra of their safety and wellbeing.

Consideration that the cases were limited to urban places initially a stringent lockdown there should have been placed and the other rural areas should have been allowed to function to at least keep up the economy from the manufacturing-production and

agriculture and animal husbandry point. A phased lockdown would have always fared well as opposed to a sudden announcement.

Also, *unlock 1.0* at a stage where the cases were 182,143 in number, relaxations and reopening in the context of immediate economic revamping was a bold step taken by the government of India which was not seen with other governments worldwide. Moreover, by the end of the unlock (June 30) the cases almost grew by three times (566,840) as on June 01.

The lockdowns 1.0 to 4.0 saw a slow rate of growth in cases and bought in ample of time to ramp up the healthcare setting. Also, the naturally strong immunity of our country's citizens can be a boon in upscaling the recovery rate further. The lockdown in its nature was a good measure had it been implemented in a proper fashion with the involvement and confidence of the public, it would fair out better in economic matters as well as nullifying the miseries of the common masses. Both the government and the community failed in following the stringent protocols and led to a downfall of the lockdown measures. This was further worsened by the unlock put into place. Had the economic revival continued in the rural and semi-urban regions when no cases were present it would have fared out well in the later run. Since the preventive measures have failed miserably on account of negligence of country/state level preparedness, economic upscaling, risk communication to control the transmission; therefore, moving forward the governments needs to focus on curative and therapeutic measures.

Various Models to overcome COVID-19:

In order to control COVID-19 public health interventions at country level are vital. As of now the goal for all the countries globally is to control, slow down the transmission, control its mitigation and avoid mortalities as well as socio-economic disaster due to COVID-19. In order to achieve this, a set of measures should be followed at country, state, district and local levels in order to suppress and stop the community spread.

Following is a framework which is devised with cumulative information sourced from WHO advisories/guidelines and Containment plan given by Government of India. The framework has been used to study and understand the concentrated efforts in public health interventions of varied regions like Kerala (state level) along with Bhilwara and Agra (district level) against the COVID-19 pandemic.

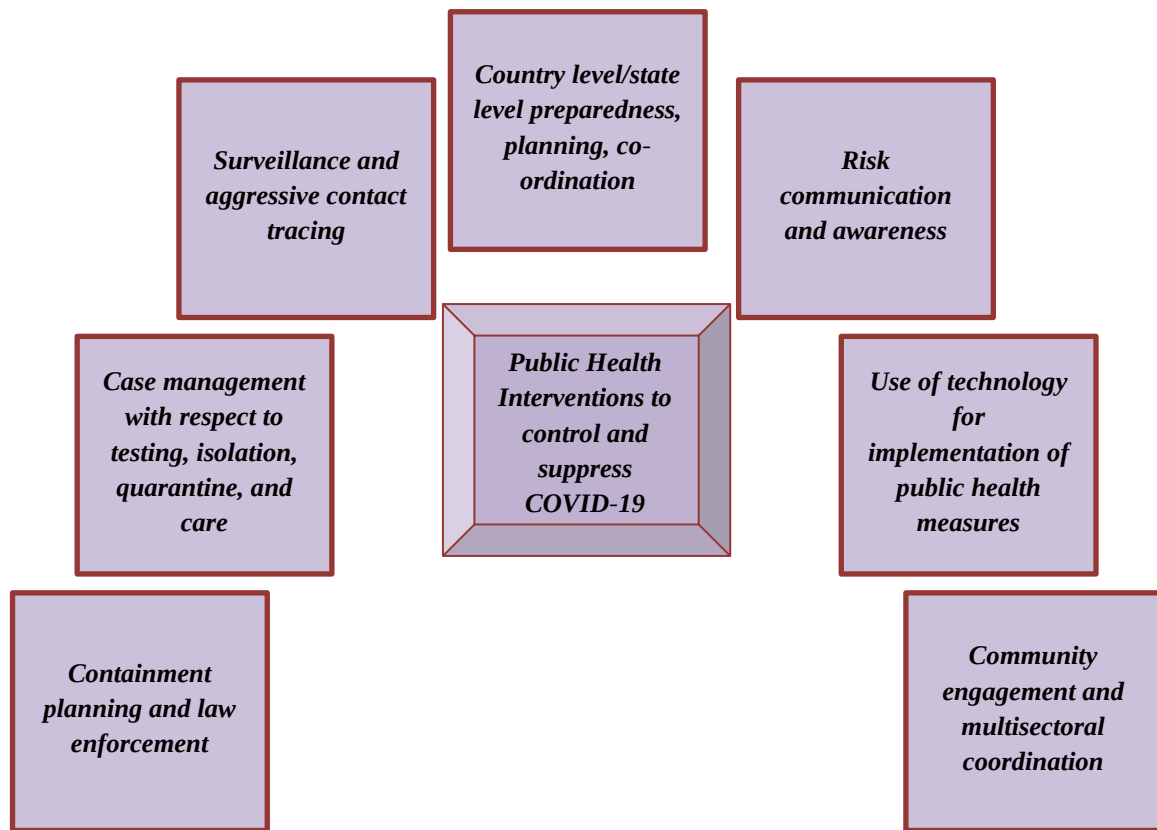


Fig 7: Framework in accordance with public health interventions to control and suppress COVID-19

Agra Model:

With a total of six confirmed coronavirus cases on March 3, 2020, known as the Taj City, Agra setup the Agra model. The model was formulated and led by Agra's District Collector and Integrated Disease Surveillance Programme personnel. The model was celebrated and received praise by the first week of April itself from the central government. Agra model was referred to as "Cluster Containment model" and focused on localised yet massive combing operation for contacts, identification of clusters and marking off a three kilometre radius from the epicentre, prompt sensitization of every household in the said area, door-to door survey aggressive contact tracing in the area and placing the cases and contacts in isolation and quarantine, and setup of COVID war rooms. By April 10, the cases spiked to 80 with 30 hotspots in the city being detected and by June 28, the city had 1210 cases with 85 deaths and 111 active cases. By then, the city with 22 lakh people had 56 containment zones. The cumulative cases in the state of Uttar Pradesh stood at 23,492 as of June 30, 2020.

Led by the states' Chief Minister and local administration authorities of Agra the model had its mixture of victories and failures going forward. Following is the model devised as cluster containment model of Agra:

State/district level preparedness:***Administrations' call and leadership:***

As soon as the cases popped up, the local administration along with IDSP (Integrated Disease Surveillance Programme) official immediately sealed a 3 km radius around the epicentre or the cases' households. Under the cluster containment and outbreak containment plans, the district administration identified epicentres, delineated impact of positive confirmed cases on the map and deployed a special task force as per the micro-plan made by the district administration. Hence, massive surveillance and contact tracing actions took place limited to the containment zones marked.

Strengthening of healthcare setting:

The local administration set up isolation and quarantine facilities using PPP model (Public-private-partnership). The local administration acquired some 3-star hotels as paid quarantine centres, 566 beds as paid quarantines, apart from 3,000 beds for free for health workers, among others. By June 28, the city had 2,241 beds.

Training and surge capacity building of human resources:

Teams were formed to do door-to-door surveillance in which each team had two workers including auxiliary nurse and midwife. Doctors were stationed at nearby dispensary in Agra so that people with symptoms could come ahead and seek early treatment. In one incident infection spread was seen in a hospital (Paras hospital) and hence the administration arranged for more medical staff to be trained in COVID-19 management.

Containment planning and law enforcement:

Containment and infection control at the epicentres and hotspot: On detection of case, a rapid response team screened the contacts and took samples for testing. The RRT picked up the COVID-19 cases and shifted them to isolation facilities for further treatment. This was followed by disinfection team which cleaned the infected house for three days. After that, the surveillance health team came for door-to-door check-ups and conducted screening through thermal guns and pulse oximeters. After this, entry and exit points are cut off by a barricading team, while a police unit was deployed at the spot. Then, a fire brigade team mopped the area again which is inspected by a third-party team. The area then turned into a containment zone yet again, following which there was a third-party inspection between 4-6 pm and a daily review with officials. The area was then declared as containment zone for three weeks.

An area of three kilometres was sealed with a five-kilometre buffer zone which made up one containment zone in the view of containing the spread of the virus.

Law enforcement:

The containment zones were completely sealed and no public movement was allowed. However, no lockdown or curfew was announced by the local administration in Agra. The lockdowns as announced by the central government were followed.

Surveillance and aggressive contact tracing

At the start of the model deployment, almost 1,248 teams carried out intensive contact tracing which covered 1.63 lakh households in few days and up to 9.3 lakh people. These teams worked on a war-footing and carried out a massive screening exercise. Moreover, the authorities carried out prompt and effective contact tracing as a part of its thrust to effectively track down those who could have been affected by the virus. However, mass screening of the whole population was not seen in the city and the surveillance and contact tracing was limited to the containment/clusters only.

Case management with respect to testing, isolation, quarantine and care:

The RRTs were responsible to take the cases and contacts to isolation and quarantine centres respectively. However, when a rise in infections at quarantine centres were seen, the strategy was shifted and asymptomatic positive cases were home quarantined. Due to timely door to door surveillance and tracing the ones who were later turned positive in the containment areas were already in the quarantine centres.

Initially the reports of testing would come late as they were done in Lucknow and Pune. This was overcome by local testing setups and launching aggressive testing drives and random pool testing. By June 28, total number of tests done in Agra were 21, 541.

Use of technology for implementation of public health measures:

The local administration, frontline workers and police personnel used their existing Smart City Integrated with Command and Control Centre (ICCC) as war rooms. Agra model used technology to a great extent from their control or war rooms. GPS (Global positioning system) tracking, drones and CCTV cameras were used heavily to keep a check on movement of people. Drones helped keep a check on any large gatherings and ensured food distribution to needy people. By keeping an eye via using technology, social distancing was ensured to a great extent. Also, loudspeakers were used to tell residents to stay indoors.

The mobile tracking GPS tech was heavily used in identifying and locating members who were a part of the Tablighi Congregation.

Risk communication and awareness:

Establishment of central helplines to reach out to the citizens and teams for coordinating the responses were set up in a view to ensure risk communication. Around 3,000 ASHA workers (village volunteers) were responsible for the outreach and risk communication to the community along with the task of door-to-door surveying.

Community engagement and multisectoral coordination:

Multifunctional district teams were setup for centralised and coordinated response management. The State, district administration and frontline workers including police officers, ASHAs, ANMs and AWW coordinated to ensure multisectoral coordination to effectively implement the Agra model. The coordination was ensured by utilising their existing Smart City Integrated with Command and Control Centre (ICCC) as war rooms.

Strengths of the model:

Agra model seems practicable as it only targets and aggressively screens the vulnerable 3 km-radius and the buffer zones. This ensures quick screening, identification of the contacts and suspects at a faster pace. Hence mobilization of the suspected cases and contacts to isolation and quarantine centres are quick which therefore helps to avoid community transmission. Also, screening of the entire district especially in densely populated areas takes up ample amount of time as opposed to the cluster containment plan. The model efficiently uses technology to help with contact tracing and also ensures discipline among the masses during the lockdown.

Limitations of the model:

Too good too soon approach: The model was praised way too early in the start of April itself when it trended as a hashtag on social media, and praises constituted of success credits to the state Chief Minister. This was followed by various spikes of clusters and cases mainly due to 104 Jamaat members being positive and infection spread in Paras Hospital which led to 92 cases. Also, the administration blamed the cases on influx of migrants and people coming in from Delhi, Haryana and Rajasthan for treatment in Agra. The people from adjoining districts of UP also came in for treatment which were often late and reached in poor prognosis stages which also gave rise to the death toll taking the mortality rate as high as 7.25 percent (National average mortality rate was 3.18 percent).

Lack of unified front: The model deemed to flourish on paper; however, testimonials from people and opposition leaders accused the government saying inadequate or no testing was done in hotspots, food and other essentials were not provided, cases were dying because of no treatment etc. Allegations of heavy death rates being an issue and private hospitals only doing paperwork were also brought forth. Amidst all these allegations, the unified front of local or state government was absent in Agra/UP as there was a constant tuff between the elected government and opposition.

Community adherence: The model further deemed to show signs of failure as people broke the social distancing norms and did not practice use of masks in public places as the relaxations in lockdowns came up.

PPP model failure: The private labs, nursing homes and private hospitals started showing reluctance due to the rates fixed by the state government and didn't find the rates reasonable/justifiable as the risks were too high in the treatment or testing of the cases.

Law enforcement: Despite cases being detected since March 03, 2020, no curfew or law enforcement was seen at the district level except the containment zone areas.

Bhilwara Model:

The state of Rajasthan saw its first confirmed coronavirus case in Jaipur on March 02, 2020, who was a 69-year-old tourist from Italy. The patient was admitted in Sawai Mansingh Hospital, Jaipur on February 29 complaining of cough and cold. In order to combat the spread of virus, on March 14, Rajasthan's Chief Minister announced a lockdown after WHO and central government advisories on coronavirus being a pandemic were declared. This came in with closure of schools, colleges, theatres, musical and cultural programmes etc. with the continuation of ongoing board examinations. Later, on March 22, there was a complete state lockdown with closure of malls, government and private offices, transport facilities, shops etc. barring only the essential services. This was followed by lockdowns imposed by the central government all over India. Going forward as of June 30 the total confirmed cases in Rajasthan stand at 18014, active cases at 3381, recovered cases at and the death toll stands at 413. As on June 30 a total of 8,24,213 samples were tested across the state.

Amidst the rising number of cases across the state, cases popped up in states' textile city- Bhilwara around March 19, 2020. The first known case was a doctor from Brijesh Bangar Memorial Hospital. On March 20, prohibitory orders under Section 144 of the Criminal Procedure Code (CrPC) were imposed across the district by Bhilwara's Collector which was later scaled to Maha curfew on April 03. The district boundaries of the entire district were sealed off to prevent the spread of COVID-19.

The model formulated comprised of these crucial steps: Isolating the district; mapping the hotspots; door-to-door screening of the whole district; aggressive contact tracing; ramping up quarantine and isolation wards; and readying a monitoring mechanism for rural areas. By March 23, 27 cases were reported, and the next case was reported one on April 4 and another on April 9. For many days no new cases were detected owing to the stringent model, however, a rise was seen with an influx of migrants later around mid-May. By May 14, a total of 43 cases were detected with 36 recoveries and two deaths (due to co-morbidities). As of June 30, Bhilwara had 252 total cases as opposed to 3303 total cases in Jaipur.

Led by the states' Chief minister, state's additional secretary (health) along with a determined and capable local district administration, aided ably by health care professionals and police personnel, Bhilwara's "ruthless containment" model was able to contain the virus to a great extent compared to other parts of India. So what did they do

differently? Moreover, what did they do ably? Following are the measures taken by the ruthless containment model of Bhilwara district headed by the District Collector.

State/district level preparedness:

Administration's call and leadership:

Led by District Collector, Bhilwara went into immediate curfew following just one case of COVID-19. The surveillance picked up the pneumonia like cases in the district and the samples were sent for testing on an immediate basis on March 18. Needed actions like containment plan, sealing off borders and isolating the district, ensuring supply of essential services were called in within few hours of the first case by the district administration. RRTs, doctors, police personnel, healthcare workers, local vendors etc. were roped in to make an action plan for running the essential services and containment of the spread.

Strengthening of healthcare setting:

The district administration converted 1,541 rooms of 27 hotels as quarantine centres. Besides, it also had 11,659 quarantine beds in 22 institutions and hostels with around 13,000 beds for admission of suspects and mild symptomatic cases. Bhilwara's district hospital had a capacity of 200 beds and was further expanded to 400 beds. 4 other private hospitals were converted to dedicated COVID hospital for management of moderate-to-severe cases.

Training and surge capacity building of human resources:

The local government had an uphill task ahead of them assembling the teams of doctors, auxiliary nurses and midwives and nursing students who went to conduct the house-to-house surveys. In the first week itself 1937 teams were made which were later expanded to almost 3000 teams in the city area and 2000 teams in the rural areas to do door-to-door survey. RRTs of health experts from state including specialists from public health, epidemiologist, paediatrics, microbiology, otorhinolaryngology, respiratory medicine, general medicine, IDSP epidemiologist, surveillance medical officer of National Polio Surveillance programme WHO India were all mobilized for situational analysis. Trainings for police, ASHA, ANMs and frontline workers etc. were conducted. Training for use of personal protective equipment including facemasks and effective hand hygiene practices were conducted. Training of all the medical, paramedical, administrative staff as well as the police workforce working at the grass-roots level was conducted by the State and District RRTs.

Containment planning and law enforcement:

Containment at the epicentre and hotspot:

In Bhilwara, the Brijesh Bangar Memorial Hospital became the epicentre and hence 1-kilometre area was sealed around it and declared zero mobility zone. Immediately 25 suspected patients were admitted and kept in isolation who were in contact with the

doctors and staff. Intense contact tracing was also carried out of those patients who tested positive, with the Health Department preparing detailed charts of all the people whom they had met since being infected. Since the doctors and healthcare providers were tested positive an estimated 15,000 to 20,000 people had direct contact with the staff. Listing, tracking and isolation of other 36 patients who relocated themselves in 4 other states (Himachal Pradesh, Madhya Pradesh, Uttar Pradesh and Gujarat) and 498 in 15 other districts of Rajasthan in the last 28 days, was also done in order to contain the disease transmission.

Similar, containment and buffer zones were also created around the house of a positive patient. Special teams were deployed for continuous screening of suspected cases in these areas.

Infection control at the epicentre and district:

Alongside the aggressive testing and contact tracing, the district administration went about disinfecting every nook and corner of the city including all containment, buffer zones, localities where positive cases have been detected, ambulances and police vehicles, screening centres and quarantine centres, police stations and other public dealing offices. Also, police line and other public-dealing offices were disinfected on a daily basis.

Law enforcement:

On March 20, prohibitory orders under Section 144 of the Criminal Procedure Code (CrPC) were imposed across the district by Bhilwara's Collector. The district boundaries of the entire district were sealed off to prevent the spread of COVID-19. The initial phase of the curfew allowed the residents to come out of their houses only for availing essential items. Movement using vehicles, public or private buses, or any unnecessary movement was banned and breaking the rules would lead to getting booked under the Rajasthan State Epidemic Disease Act, 1957. Later from April 03, the district went into 'intense curfew or Maha Curfew' where even the essential services like pharmacies and grocery shops remained closed. The curfew was lifted after 55 days although prohibitory orders under CrPC section 144 continued with activities allowed as permitted by the central government with regard to orange zone (classified in lockdown 3.0). Although the activities were only permitted between 7 am to 6 pm.

A surge in cases was seen in Bhilwara due to a marriage function organized on June 13 which had over 250 guests clearly putting the restriction of up to 50 guests at bay. Due to the event one case succumbed to death and 15 tested positive. The state incurred monetary loss of Rs. 626,600 for arrangement of isolation, testing, food, ambulance etc. for the guests and hence fined the family for the same by asking to donate the amount in CM Relief fund.

Surveillance and aggressive contact tracing:

After the first case was detected on March 19, it followed by five more cases on March 21 and 13 more cases by March 23. Immediately 25 suspected patients were admitted and kept in isolation who were in contact with the doctors and staff. Aggressive contact tracing of the patients who visited the private hospital was done as mentioned above. Apart from the epicenter, the whole district was screened by going door-to-door. The Health department and district administration constituted almost 850 teams within three days which surveyed door-to-door in 56,025 houses and of 280,937 people by March 22. By April 02, 1,937 teams were set up in the district, which surveyed 4.41 lakh houses. More than 3,000 teams carried out door-to-door surveys in three rounds, screening close to 11 lakh people in Bhilwara city. In the rural areas, two rounds of screening were carried out by around 2,000 teams, and they surveyed close to 23 lakh people. By March 31 itself almost 30 lakh people were screened and once the survey of an area was completed, the health teams visited the place once again after a few days in order to see if there was any fresh development or rise in symptomatic people.

Case management with respect to testing, isolation, quarantine and care

Due to aggressive door to door screening of every individual in continuous phases, the suspected cases and cases with mild symptoms were detected at a very fast pace. By March 26, 6,445 people, who were suspected to have been infected, were kept in home quarantine and isolation facilities.

Initially Bhilwara district did not have laboratory facilities which was set up later pertaining to a request made to the CM of the state. Around 160 samples were then tested on a daily basis. By April 13 (within almost a month) 3,800 coronavirus tests were conducted, and the total number of cases reported then was 28, of which two died. Incorporation of rapid test kits aimed to conduct mass testing followed by quarantining of the infected, and hence attempting to break the chain.

The patients at the district hospital were treated with hydroxychloroquine (HCQ), Tamiflu and HIV drugs which resulted in recovery of several people. Rotational duties were given to medical staff providing health care including one week of duty in the health-care facility followed by two weeks of quarantine. This was done to minimize the infection among them.

Use of technology for implementation of public health measures

A war room was set up in the district comprising of representatives of the health department, the local administration and the police to coordinate the containment efforts. A 24 × 7 helpline was established at various offices including Collectorate, CM&HO Office for round the clock support.

The state Health Department also took the help of technology, using The Rajasthan Social Media Platform application, available on both Android and iOS devices to monitor the conditions of those under home quarantine on a daily basis along with keeping a tab on them through the geographical information system (GIS).

Risk communication and awareness:

When initially media pointed out that Bhilwara could be the next Italy, a sense of fear psychosis was instilled amid the masses. However, the local authorities stepped in and via risk communication ensured that the people had this feeling of responsibility, followed all the preventive measures, and therefore, their active participation with the state government is what led to a successful containment of the virus.

A team of nearly 6,000 people was deployed in the rural area of the district which constitutes 1,910 villages. The team was timely scheduled and was responsible for performing tasks like aggressive tracing, testing, and quarantining suspected people and to ensure distancing. They also spread awareness about the protective measures that were needed to be taken.

At city level, the sub-divisional magistrate (SDM) was the corona captain and ASHA/ANM were the corona fighters. At village levels, block development officers (BDO) and tehsildar were corona captains and at the level of panchayat samitis the sarpanch, panchayat sahayak, teachers and ASHAs were corona fighters. The captains and fighters were responsible to ensure monitoring and spread of awareness among the people.

‘Corona Fighter’ designation was also given to the neighbours of the quarantined people who were responsible to ensure that the infected stay isolated, their daily requirements get fulfilled, and keep reporting the authorities with updates on them.

Community engagement and multisectoral coordination:

A vast multisectoral coordination was used right from local administrative authorities (both city and rural levels), ASHAs, ANMs, medical workers, frontline workers, police personnel, corona captions, corona fighters and public participation.

Ensuring door-to-door supply of essential groceries, fruits, vegetables and milk, addressing the issue of migrant workers, keeping essential services running, and ensuring that those in need of emergency medical care had access to it was all achieved based on the multisectoral entanglement and coordination model.

To keep local officials motivated, teams of elected village representatives right up to the sub divisional magistrates, were given special and specific responsibilities. The leaders

with roots in the community who have legitimacy with the people were also roped in and participation of public was maintained by designating them as corona fighters.

Sub divisional Magistrate, Block Development Officers, CM&HO monitored and empowered staff of the ground level corona fighters with the help of video conferencing and sharing of all the containment guidelines, roles and responsibilities.

Strengths of the model:

The immediate call of the local government authorities and swift planning and law enforcement makes the model a stand-out. The planning was done taking into account all the stakeholders and ensuring delivery of essential throughout, which roped in the public adherence and participation to a great extent. The model focused on active surveillance of each and every individual present in the district at both urban as well as rural level and was not limited only to the containment zones. Multisectoral coordination at all levels ensured the planning as well as implementation aspects were taken care of.

Limitations of the model:

The model comprised of door to door screening of the entire district which is very difficult to achieve in densely populated areas. Also, in clusters with larger populations scarcity of trained human resources can be an issue.

The model had law enforcement in place and isolated the district which kept the cases low; however, with the relaxations and influx the picture might change altogether.

The unified front and multisectoral coordination can be a miss in many parts of the country owing to the elected government and the opposition parties playing major role in the administration.

Kerala Model:

Kerala's progressive policies since decades, investment in public health and education, robust local government institutions, a well-functioning public distribution system in urban and rural areas has always being praised and makes the state a stand apart in India itself. The first case in Kerala was reported on January 30, 2020, a student who had returned from Wuhan University for vacation. From the first day until June 30, Kerala has reported a total of 4189 cases with a death toll of 23 and recovery rate of 51.7 per cent. On the contrary by June 30, another state Maharashtra in the same country has registered a total of 1,74,761 cases with 7855 deaths.

Kerala government declared a health emergency in the state as soon as three cases were confirmed by February 3, 2020. Apart from the immediate response Kerala has owed the models success to its surveillance, testing-trace-isolate-care methods, capacity building of workers, risk communication, strong community engagement, addressing psychological needs of the population as well as taking care of its vulnerable population across the course of the pandemic.

Led by the states' Chief Minister and Health minister of Kerala the model relied on Trace-Test-Contain via isolation and quarantine-Treat model.

State/district level preparedness:

Administration's call and leadership:

The leadership and governments' call of declaring a health emergency in the state was done with a robust response when three cases tested positive by February 03. The office of Kerala State Disaster Management Authority and State Emergency Operations Centre (SEOC) provided support to the Health Department for actions needed to curb the COVID-19 outbreak. As soon as cases emerged in Wuhan, the state minister consulted medical experts and rapid response team proceeded to setup set up a control room and instructed medical officers in the state's 14 districts to do likewise by January 24, way before cases were detected in Kerala.

Training and surge capacity building of human resources:

Kerala has 1.68 registered doctors per 1000 population and 8.52 nurses per 1000 population (WHO has a norm of one doctor per 1000). Intensive training was provided to health workers comprising from doctors to ASHA workers to identify the Covid-19 symptoms. Also, the SannadhaSena volunteers were roped in and were given training as needed to carry out various activities.

Strengthening of healthcare setting:

Kerala has done timely investment in public health setting and has an experience in emergency preparedness and outbreak response owing to the floods in 2018 and Nipah virus outbreak from 2019. This has enabled the state to quickly manage and deploy resources, set up a comprehensive response with multisectoral coordination with key stakeholders. At least two COVID-19 dedicated hospitals were setup in each of its district to treat the cases. The hospitals were ensured of well-trained staff and teams from all specialities. Also, almost 4600 relief centres housed 1.5 lakh migrants across Kerala who were stranded during the lockdown. Infrastructures were ramped up for isolation and institutional quarantine of cases and contacts. Isolation wards were set up in all medical colleges, general and district hospital along with corona care centres created from hostels, educational institutions and unoccupied buildings.

Containment planning and law enforcement:

Containment at the epicentre and hotspot:

Containment was carried out in three tiers namely red zone, hotspot and containment zone. The red zone covered the entire district, the hotspot had several cases and the containment zone was the epicentre of the virus spread. The containment zones followed similar guidelines given by the central government and would remain as containment zone for a minimum of seven days in case no new cases were seen in that area.

Law enforcement:

By the start of March, government shut down schools, religious places and cancelled all public gatherings and marriages to ensure social distancing. Awareness campaigns like 'Break the Chain' to create awareness and promote social distancing were started as early as March 15. Later several districts were put under lockdown owing to the cases spike. Complete state lockdown was in place as advised by the central government going forward.

Surveillance and aggressive contact tracing:

Kerala initially focused on screening and surveillance of all incoming passengers from China and the ones in close contact with the travellers. Later, all incoming passengers were screened irrespective of them coming via flight, interstate buses, or trains.

Health check-up booths were established in all railway stations, state borders and airport to check and guide the people coming from outside.

Contact tracing was conducted mainly by local government bodies along with SannadhaSena volunteers who were trained for contact tracing. The contact tracing done was fool-proof and was supported by releasing route maps which was route taken by the confirmed COVID-19 case, on the official website case-wise. This ensured self-reporting and keeping a tab on one's own symptoms by the public who came in contact with the case according to these maps. By April for 300 cases in Kerala almost 1.75 lakh people were traced and quarantined.

Case management with respect to testing, isolation, quarantine and care

Initially in March, mandatory quarantine of 28 days was conducted for anyone who entered the state be it national or international origin. High risk people in contact with positive cases were tracked and kept in quarantine immediately.

Kerala model focuses on isolation and quarantine (institutional as well as home quarantine). When entering the state the government puts everyone in mandatory quarantine either in free institutions, paid institutions or home quarantine in case where the person is completely asymptomatic. As on June 29, 180,617 people were under surveillance including 177,955 under quarantine and 2662 in isolation facilities. Regular monitoring of all was done via phone calls or home visits to ensure strict adherence. The calls were not only made to ask for symptoms when in quarantine but also to ask about the mental health of the person.

Kerala model followed robust testing mechanism. Initially testing was done based on selective approach due to factors like cost (Rs. 4500), PCR equipment, availability of reagents etc. ICMR gave out 100,000 rapid diagnostic kits to the state which were used for four main focus groups- 1. healthcare workers who served COVID-19 patients, 2. government staff with public contact including police, ASHAs, Anganwadi workers,

essential service provides and local government staff, 3. People quarantined at home and 4. All senior citizens. By the first lockdown one active case per 34 tests was reported due to the appropriate use of the testing kits and was praised as a formidable step. Kerala was also the first state to use rapid test kits from the Pune-based Mylab and use walk-in kiosks to increase its testing capability. In April walk-in-kiosks named WISK were setup to ensure testing which was made of glass wall on four sides with an opening attached with rubber gloves to collect swaps and blood samples from patients.

By June 30, Kerala had tested 171,846 samples along with 46689 samples of high risk groups as a part of sentinel surveillance done across 14 districts in the state. This ensured a check on the prevalence of disease in the community. As a part of CIMR institutes' sero-surveillance study 1193 samples were tested. To test samples from patients undergoing emergency surgery, symptomatic health workers or COVID suspected deaths true NAAT and CB NAAT (Xpert-SARS-CoV testing) were done across eight government institutions and nine private institutions in the state.

Use of technology for implementation of public health measures

Kerala model relied heavily on technology to implement public health measures. When a case turned positive for COVID-19 a route map of the routes taken by the case was made and released daily. Others coming in contact with the route would then monitor themselves and self-report as needed. Nevertheless, a daily bulletin and COVID-19 related information was released by the state government on websites like dashboard.kerala.gov.in and Directorate of Health Services Website

For psychological support calls were given daily as reassurance calls, as well as follow-up calls in quarantine. By June end, approximately 15 lakh such calls were made. GIS tracking was used to track people in isolation and quarantine centres so that no breach would happen in the process.

Kerala State Disaster Management Authority and health department officials had begun collating disease surveillance data separately, with primary and secondary contacts of confirmed patients, traced and identified on a live geo-map. Also, a database of all cases was created to be used as needed and shared across the state.

Innovative ideas like use of robots to greet visitors with a tray of sanitizers and providing information on COVID-19 was used in Kerala. One such robot named 'Crony' was used in Vaikom government taluk hospital, Kottayam district to help doctors. A dedicated app to track ambulances, police vans and supply trucks was also used.

Risk communication and awareness:

Initially the government held press conference daily in the evening to answer queries related to COVID-19.

‘Break the Chain’ awareness campaign was used to promote importance of hand hygiene, respiratory etiquette, physical distancing measures. In public places, hand washing stations were installed to ensure the personal hygiene measures of the public. Also, people were encouraged to carry umbrella when going out to ensure involuntary social distancing.

Kerala Arogyam Portal, Covid Jagratha portal and Directorate of Health Services Website was launched which gave comprehensive information about COVID-19.

Dashboard.kerala.gov.in was one such website which provides timely day to day information about cases, testing, isolation and quarantine, emergence of hotspots, volunteer and psychological support details.

To tend to psychological support, telemedicine portal e-sanjeevani across the state was in place which had 1143 mental health professionals (psychiatric social workers, clinical psychologist and psychiatrists and counsellors). They were mainly deployed for psychological support to people in quarantine. Special needs of children, migrant labourers, elderly and mentally ill patients were catered. Across the state the services were ensured to almost 1168950 people and counselling sessions were provided for frontline workers too.

Community engagement and multisectoral coordination:

Hon’ble CM and Health Minister led from the front in the Kerala model and facilitated inter-sectoral coordination with local government authorities, police personnel, volunteers, as well as community participation.

SannadhaSena a social volunteer force with expertise in relief operations came forward for help. It included volunteers from every age group (aged 16 to 65) and every gender. They ensured help in activities like identification of the needy, delivery of food and essential items, procurement of locally produced goods, emergency assistance at homes and call centre operations, helping in hospital settings and communicating alerts. By June end more than 3.5 lakhs of volunteers were engaged in activities across the state.

Kudumbashree-empowered women self-help groups formed as much as 1.9 lakh WhatsApp groups with 22 lakh neighbourhood groups to spread awareness and educated on key safety measures.

With the support of volunteers and Kudumbasree community kitchen initiative via Local Self Government Department (LSGD) provided free meals to labourers, and for people in isolation and quarantine, and needy people. They provided up to 8,651,627 free meals to all. Kerala has 33,115 Anganwadi centres in Kerala (for kids aged 3 to 6) which continued to deliver free mid-day meals to children at their homes, benefitting around 3.75 lakh Anganwadi kids.

Strengths of the model:

The strength of the model lie by its enabling environment owing to the high literacy rate, excellent healthcare investment and setting, high-level political and administrative commitment, excellent mass awareness campaigns, community participation provided the much-needed impetus in the fight against this pandemic.

The models aggressive actions taken in an immediate and timely manner owing to protocols like ramping up the healthcare infrastructure, announcements of partial lockdowns where needed, formulation of a line of action right from the first case and aggressive screening since the start of the outbreak has helped restrict and attack the transmission of the virus in the earlier phase itself.

The model of trace-test-isolate and treat has made sure no case goes undetected and unmanaged. The Mental health support given at the large scale through the state definitely deserves praises.

The robust grass root level primary health care system, expertise in disaster management and experience from Nipah outbreak and floods in the past were useful factors in managing the COVID-19 outbreak.

Limitations of the model:

Application of the trace-test-isolate and treat model needs a good infrastructure, investment in healthcare settings, huge numbers of human resources, and availability of testing facilities which can be a miss in the country.

Community participation and literacy plays a vital role in public adherence to any model, which yet again can be limited in other parts of the county.

DISCUSSION

The models hereby discussed have its own flavours based on its location, healthcare infrastructure, government bodies and local administration, varying leaderships, population density, literacy rate and community participation. Directly copy-pasting any model in a given part of India would not yield similar results and hence a tailor-cut approach can be taken out of these models for implementing public health interventions to control and mitigate COVID-19.

The state or local preparedness, leadership and taking timely calls all boils down to the prior investments in the healthcare setting, ability to expand and ramp up facilitates during outbreaks, understanding of the outbreak and having a unified front to plan, execute and implement the ideas. Kerala and Bhilwara both showed timely actions and excellent leaderships by the governing bodies in the hard-hitting times of the outbreaks.

Going forward lessons of investing in healthcare infrastructure and healthcare workers is the need of the hour for our country.

The containment planning and law enforcements when put in place at the earliest helps to manage and break the transmission chain of the virus in public health interventions. This was done in the Bhilwara model the moment the cases popped up. A curfew/Maha curfew of this scale was only implemented in Bhilwara which kept its cases to minimum and stopped community transmission. Agra's cluster containment plan deemed to be excellent in containment of transmission at faster pace as it primarily focused on the epicentres with its additional regimens of screening, contact tracing, disinfection which attacked the transmission on the spot and within the said area.

Surveillance and aggressive contact tracing were done efficiently in all the three models. While Kerala focused on active as well as sentinel surveillance, Bhilwara covered its entire population via surveillance and contact tracing actions. Agra's surveillance was limited to the containment zones. As far as contact tracing is concerned Kerala combed in each and every case for its contact and isolated or quarantined as necessary. This puts in light on the need of timely and robust surveillance mechanism across the country going forward.

Case management with respect to testing, isolation- quarantine and care deliberately focuses on reducing the case fatalities and enhances recovery rates of COVID-19 patients. Kerala and Bhilwara have followed testing and isolation- quarantine model robustly which has kept their fatalities to minimum. Also, investment in healthcare setting as done by Kerala takes care of the care and treatment part. In models of Agra and Bhilwara a spike in cases was likely due to breach of IPC measures in hospitals so planning IPC measures along with making PPE kits and other protective measures available is necessary too.

Use of technology for implementing the interventions as well as awareness was an excellent was to upscale the public health regimens. All the models fared well in this area, and Agra and Kerala extensively used it in contact tracing, surveillance, awareness generation and law enforcements.

Risk communication plays a vital role in public health interventions and works as a backbone of the interventions. The models can have all the things in place but without awareness and risk communication the models are deemed to fail. Kerala's literacy and voluntary community participation helped them in the awareness or rather knowledge, attitudes, and practice part of COVID-19. In Bhilwara, the way city and rural areas were educated and made aware by the on-foot corona captions and corona fighters deserves all the praises.

Community engagement and multisectoral coordination helps the models to thrive and ensures maximum public adherence to the interventions. Kerala and Bhilwara used community engagement and coordination at all levels to instil the models. Public adherence comes with community engagement and is of importance as without it the measures in place are fruitless and futile.

All the models fared well and kept the COVID-19 cases to minimum compared to the uncontrollable spikes seen across the country. Hence a tailor-made approach should be used to implement public health interventions in given segments of society at country, state, district or rural levels as needed.

CONCLUSION:

The COVID-19 pandemic has brought upon the countries and healthcare systems an immense challenge: to control spread of the virus, nullify the mortality and reduce the morbidity, flatten the epi-curve, maintain the socio-economic and developmental status, to support the vulnerable population and many more. Understanding the epidemiology of the new virus helps formulate and implement public health interventions in the outbreaks or pandemics. Epidemiological indicators like signs and symptoms, case type and risk factors help to put the preliminary measures in place. This can be backed up by preventive measures like social distancing, implementation of IPC measures, personal hygiene measures like hand-washing, usage of masks, respiratory etiquette etc. The understanding of indicators like incubation, generation period and infectious period helps to indicate and forecast the necessary healthcare infrastructures and manpower needed to break the transmission chain. Also keeping an eye on indicators like CFR, doubling time and recovery rate helps in deciding the upscaling or downscaling of the public health interventions as needed.

Nevertheless, both data analysis and public health expertise should be used wisely while implementing the interventions as India is a country of geographical and cultural diversities. Our government has put in various interventions like lockdowns, law enforcement, ramping up the healthcare facilities, setting up economic packages and providing aid to the vulnerable population in the times of hardships brought in by the pandemic. Going forward the governments needs to focus on improving the surveillance of the country along with improvising and investing in Healthcare. Also, focus is much needed on improving the awareness and risk communication among public as it inculcates confidence in them to face the challenges. This further enforces the factor of assurance, reliability, and trust on governments' interventions.

Public health professionals have been a backbone in planning and implementation of the interventions during the COVID-19 pandemic. Hence strengthening of public health workforce becomes the need of the hour. More or less, all the models and public health interventions fair out for success only when the pillars of unified governance and multisectoral coordination, immediate and timely actions under good leaderships, prompt

surveillance systems, good healthcare infrastructure and investment, and lastly public and community adherence are in place.

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PART TWO: REPORT ON ONLINE COURSE

Student's Name	Aishwarya L. Shityalkar
Roll No	0868
Course Name	COVID-19 contact tracing offered by Johns Hopkins University
Website	www.coursera.org
Number of Hours	Approx 10 hours
Course Instructor	Emily Gurley (Associate Scientist) Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health
Objective(s) of the course	▪ To learn about SARS-CoV-2, its natural history, incubation period, infectious period and clinical presentation of the disease caused along with its transmission. ▪ To understand contact tracing and its steps/protocol to be followed with respect to a case and a contact to curb the transmission of COVID-19 in community. ▪ To understand ethical considerations of the same. ▪ To identify some of the barriers in contact tracing and understand strategies to overcome the same.

Learning Methodology:

The course is available on Coursera platform. The lectures were delivered via videos with the help of PowerPoint presentations as resources. For application of the concepts videos/call recordings were demonstrated in a simulation kind of setting.

Module	Objectives	Content	Key learning	Application
Basics of Covid-19	- To understand origin of the virus causing Covid-19. - To identify clinical signs and symptoms and its diagnosis. - To understand the transmission pattern of the virus.	- Introduction to SARS-CoV-2 virus - Natural History of SARS-CoV-2 - Risk Factors for severe disease - Diagnosing Covid-19 - Transmission and why stopping the transmission is important.	The causative virus for Covid-19 is named as SARS-CoV-2 which has caused the pandemic worldwide. As of now the origin has been found to be bats and has jumped species. Previously known human coronaviruses are SARS (Severe Acute Respiratory Syndrome and MERS (Middle Eastern Respiratory Syndrome). While some people develop signs and symptoms, some people are completely asymptomatic. The common signs and symptoms are fever, fatigue, chills, myalgia, cough, loss of taste or smell, difficulty breathing, sore throat. Severe cases have chest pain, shortness of breath, bluish face or lips like symptoms. The incubation period is 2 to 14 days. Risk factors mainly include pre-existing medical conditions, co-morbidities and old age (>65 years of age). As of now the only treatment is supportive and based on body's immunity system to fight the infection. People can be infectious before showing signs and symptoms and the asymptomatic ones too are infectious.	The understanding of incubation and transmission of the virus can be used to design public health interventions to control the spread. Since the incubation is known the isolation /quarantine period of individuals is understood. The transmission chain can be broken as we know the reason of it is mainly close contact with the infected ones. Since there are asymptomatic cases too who are infectious self-isolation or limiting contact by being 6 feet away and using masks can be good preventive measures. As the risk factors are known boosting immunity in general and isolation of such groups can be considered. The signs and symptoms are such that layman can understand and hence self-reporting can play a crucial role in early detection of the disease and

			For diagnosis, PCR (polymerase chain reaction) test is done which helps detect RNA of the virus. To detect past infections mainly in asymptomatic cases antibody tests are used to detect antibodies in blood. The swabs are taken from respiratory tract sites like nose or throat. The main mode of transmission is via respiratory droplets from coughing, sneezing or coming in contact with surfaces infected. Transmission can be escalated in congregate housing, close contacts, crowded closed spaces or workplaces, close contacts with patients. The need to understand transmission is that it can be intervened by identification of cases or exposed cases and control transmission by limiting contact hence slowing the chain of transmission. Reproductive number is the number of susceptible people one infectious person will infect (hence should be declined by	hence curbing its infectivity.
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Basics of Contact Tracing for Covid-19	▪ Introduction to contact tracing and application in covid-19. ▪ Define a case of covid-19 and a contact. ▪ Understand isolation and quarantine and its purpose along with its calculations. ▪ Describe connection between infectious period, isolation, and quarantine. ▪ To identify high-risk settings for transmission that require extra action.	▪ Contact Tracing for Covid-19 Prevention ▪ Defining case, contact, isolation, and quarantine. ▪ Calculating isolation and Quarantine duration. ▪ Identifying high-risk situations	breaking the transmission chain). A case should be identified to facilitate access to treatments, to limit their contact with other people and hence reduce transmission, and to identify the ones who have been exposed so as to change their behavior and further contact to limit the spread. Hence contact tracing plays a crucial role in prevention of covid-19. Case is someone who has covid-19 and has a laboratory diagnosis of the same. Contact is someone who has had contact with a case during their infectious period. Contact can be of three types; physical contact, close contact (within 6 feet) or proximate contact. Isolation refers to keeping sick ones separate from healthy ones. Ideally 2 days before onset, last for 10 days post having symptoms and have no fever in past three days without use of medication. Quarantine refers to restriction of movement for healthy ones or exposed ones. It is done for people	Contact tracing can help curb the transmission cycle and help reduce increase in cases to a great extent. The early detection of cases and consideration of exposed ones or contacts can help limit the spread as the cases and contacts can be isolated and quarantined respectively. As per the norms of calculation for isolation and quarantine the approach to the case and contact changes depending on the duration of infectious period as well as the type of contact with the case. The contacts with high risk situations should be looked into carefully to avoid super spreading incidents.
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			who are contacts to a case. Ideally to be followed for 14 days after contact. To identify a contact, if a case is symptomatic on day X then the contacts from 2 days prior to day X have to be considered. In terms of calculation of isolation period a case if showing symptom on day X has to continue with isolation for 10 days or more or until the symptoms are not seen for past three days without medication. Hence ideally the isolation will last for X+10 days. In terms of calculating the quarantine period for a contact, the day of contact+14 days should be the ideal quarantine period. For a contact who was in constant contact during the cases' infectious period will have to get quarantined from day X+three weeks (i.e. 14 days after the case ends isolation). These high-risk situations need special attention. Dense contact environment	
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			including close contact interaction, larger crowds can lead to super spreading events. Difficult to trace contact and identify exposures can happen in cases of homeless shelters and can add to difficulty. Difficult to isolate or quarantine can be seen in cases of housing design issues, developmental; disabilities, unwillingness etc. Higher risk of infection or death can be seen in infections due to close contact, exposed to virus multiple times and with people with underlying medical conditions. The above situations need to be considered when asking for information as they are important for contact tracing.	
Steps to Investigate Cases and Trace their Contacts	- Identify steps to investigate cases and trace contacts. - Describe kinds of social support that case and contacts need for isolation and quarantine. - Example of simple case	- The Basic Steps - Observing basic case and contact calls	The <i>framework of investigating case</i> and <i>tracing the contacts</i> are inclusive of- Calling the case (introduction, inquire about infectious period, identify contacts, give isolation instructions), calling the contacts (initiate contact tracing), and	The steps explained help us have the right approach towards both case and contact, focuses on risk communication as well as helps prevent further adversities for the them.

	investigation and contact tracing call.		implement regular check-ins with the case and contact. The steps include introducing yourself to the case, inquiring about the cases' infected period and the ones they came in contact with. Further instructions regarding medical care and isolation should be provided. This is followed by calling the contacts and informing them regarding their contact with the case hence the exposure caused to them. You should now ask if they have had any symptoms, issue them the quarantine instructions along with identification of challenges. Also, inform about medical care and other resources to be contacted as needed. Both in cases and contacts, regular check-ins should be practiced.	
Ethics of Contact Tracing and Technological tools	▪ Understand and define terms like privacy, autonomy etc. ▪ Define balance in protecting public health and limits to privacy and autonomy ▪ Identify a selection of	▪ Contact tracing as a common public health tool ▪ Defining privacy, confidentiality, and other terms about Ethics ▪ Balancing public good with privacy,	Contact tracing protects health of public by limiting contact between infectious people and others in order to limit the virus transmission. For example, it was done to curb Ebola in West Africa.	The community/people need to understand that to curb Covid-19 a wholesome approach needs to be taken where they need to be communicated of the positives of self-reporting or

	technological tools to be used at every step of case investigation and contact tracing.	autonomy, and confidentiality ▪ Rationale for using technology for contact tracing and examples of techs used at each step.	Privacy refers to the right of a person to be free from intrusion or publicity concerning personal matters. A contact tracer needs to ask private information; however, should be limited to the tracing purposes. Confidentiality refers to the right of an individual to have personal, identifiable medical information kept private and not released without their consent. A contact tracer can ask the relevant medical information for contact tracing purposes as it is used to protect public health. Autonomy refers to right of a person to make their own decisions (right to self). In case of contact tracing, the autonomy has limits as isolation or quarantine is important and has to be done to protect public health. Justice refers to receiving the same treatment regardless of who they are, what community they belong to or what wealth they possess. A contact tracer has to trace contact and case regardless of	using technology to help trace the transmission chain. Contact tracing must hence strike a balance between individual rights and public good. Assurance should be given regarding autonomy, privacy, confidentiality by the government or public health body so as to instill confidence in the public. Usage of technology is a greater boon in terms of contact tracing. In India, Arogya Setu App is one such example of mobile application. In Agra (India) the local government authority used mobile numbers and GPS to help trace contacts at a faster pace. It all boils down to effective public health interventions depend on public trust, risk communication, cue for action (to isolate or quarantine and its implication) and
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			their religion, race, sexual orientation, community, wealth etc. <i>Public good</i> refers to anything that benefits the well-being of the public. Hence contact tracing programs are a public good. <i>To strike a balance between public good, privacy, confidentiality and autonomy following needs to be taken into consideration:</i> ▪ Autonomy should be revised as the self to right in case of declining an intervention can cause harm to public health. In such cases it can be overruled and interventions can be made mandatory. ▪ For all cases and contacts they should be assured that their information will be kept confidential and will be used for public health investigation purposes and will not be shared. ▪ For all cases and contacts their information will be kept private, the contacts will be informed of the exposure however	usage of trusted technologies.
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they will not be informed of the infectious case private information.

- Under any given situations, personal connections etc. with the case or contact, the contact tracer still must maintain privacy, confidentiality etc. and not discuss about it outside the limits of investigation.

Technology helps improve efficiency and speed of the contact tracing process as the process has to be quick to break the transmission chain. Following technologies can be used to speed up the be efficient with the contact tracing process:

- Electronic case reporting can be used to create a database of the cases. Also, reporting of positive tests to case investigators can be made automated and standardized to speed up the process.
- For tracking symptoms of cases and contact

an application can be used where they can themselves enter their symptoms directly into the database. Further text messages can be sent to them daily to remind them of tracking their symptoms and self-reporting.

- For support in isolation and quarantine can be guided for sending text messages to remind to limit contacts and also send information about additional resources.
- For identifying contacts closely centralized databases of phone numbers and tracked locations can be used to trace contacts. Hence contact traces can link positive test results with the recent contacts and locations via GPS and hence text messages can be sent to everyone present there. This speeds up the process to a great extent.
- An application can be installed in the phone with GPS and Bluetooth tech to

			identify if anyone was in your contact (within 6 feet for 15 plus minutes). Later if anyone is diagnosed with covid-19 they enter the information on the app and the others in contact (physical and close contact) will get notified immediately.	
Skills for effective communication	▪ Understand rapport and its importance. ▪ How to have effective communication with cases and contacts ▪ Understand difference between the types of questions (open versus closed etc.) ▪ To be an active listener ▪ Explain four basic types of human communication and its application with respect to contact tracing ▪ Describe and overcome common difficulties with case and contact investigation and tracing.	▪ Importance of rapport ▪ Tips for effective communication ▪ Question types and when to use them ▪ Active listening ▪ Bringing it all together into one communication framework ▪ Common issues and tips ▪ Embracing complexity ▪ Addressing process complexities ▪ Addressing people complexities ▪ Addressing context complexities	Rapport refers to a feeling of mutual understanding, trust and agreeableness between people. Rapport is needed in contact tracing as it enables us to ask and get accurate information from the case or contact, educate regarding covid-19 and persuasively ask about isolation and quarantine. Some tips for effective communication are as follows: ▪ Be assertive (confident, direct and reassuring). ▪ Use simpler words like sick, being around someone sick etc. as opposed to technical words like case, contact etc.	Rapport creates mutual understanding between contact tracer and the case or contact. This helps instill confidence and trust hence enabling cooperation from their side. The better the communication by the contact tracer the better is the cooperation and help with respect to curbing the transmission chain. Knowing the local practices, local situation and culture can help improve the conversation and yield effective communication.

			▪ Communicate one question or message at one time for better clarity and flow of conversation. ▪ Do not offer personal opinions and instead redirect them to the concerned people. <i>Types of questions to be asked</i> ideally during a conversation with a case or contact are as follows: ▪ Close ended- to get a yes or no, open ended- to know more and in detail, probing-to get the flow of the conversation and extract more information, checking-to probe further and see the response, leading-to be generally avoided as it can lead to false answers. ▪ When asking about symptoms leading questions should be completely avoided as they can give rise to false answers. ▪ When talking to a case about their contacts asking open or probing and checking type of questions to get more information.	
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			Active listening imparts a feeling that they are being heard and hence instills a rapport and further trust with the case and contact. During the conversation use paraphrasing, reflecting and at times silence as needed. The response of questions should be basis the observation, feelings, needs or requests of the case or contact. While having a conversation as a contact tracer you must practice empathetic listening, active listening and honest expression while keeping in mind of the cases' expression. Contact tracing requires skill, attention to detail, problem solving and creativity. If you come across a certain complex situation you can always reach out to your supervisor. Common process complexities can be if contacts become ill, longer time to find contacts, migration, incorrect information about the case or contact or facing technical issues. To overcome them be organized, record data carefully and practice	
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			writing detailed notes. Follow protocol and escalate as needed to the supervisor. Also emphasize with the case or contact. Common person complexities can be unable to reach case or contact, unable to reach due to quarantine, due to language barriers, age of the case or contact or deteriorating health status of the case or contact. To overcome some of these, involve the case or contact in the problem solving process, actively listen, empathize, use secondary data by talking to a family member of theirs or via lab or medical records, using an interpreter for language barriers. If the case or contact is deceased ask to speak to close relative or associate and understand if they had covid-19 symptoms, acknowledge their loss and empathize when talking in such cases. Common context complexities can be testing difficulties, changing protocols due to pandemic situation. Also, case or contact are unable to isolate or	
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			quarantine as they cannot completely limit the people coming in contact or have children to take care of. <i>To overcome</i> such situations, identify and communicate community resources, help with potential solutions and follow protocol and do not hesitate to contact supervisor as needed.	
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Conclusion:

The course on Contact Tracing offered by Johns Hopkins University enables us to understand the basics of COVID-19 with respect to the clinical manifestations and its transmission in the community. It delivers the importance of contact tracing, its role in inhibiting the transmission of the virus, and the protocols/framework to be followed in investigating a case and finding the contact. The course teaches us the ways to balance the strike between public good and the factors like privacy, autonomy, confidentiality etc. and teaches us ways to handle complexities and challenges in the procedure of contact tracing. The entire course is laid down in a proper framework and address the chronology of protocols and has crisp and clear teachings to formulate them in actual contact tracing scenarios.

Student's Name	Aishwarya L. Shityalkar
Roll No	0868
Course Name	Market Research and Consumer Behavior offered by IE Business School
Website	www.coursera.org
Number of Hours	Approx 15 hours
Course Instructor	Shameek Sinha
Objective(s) of the course	▪ To understand consumer behavior and the process a consumer goes through from identifying a need to buying the said product/service. ▪ To understand the consumer behavior pattern and help take sound marketing decisions or build strategies oriented to marketing. ▪ To understand the need of Market Research and its applications. ▪ To study the process of Market Research and its implications on decision-making.

Name of Course:

Market Research and Consumer Behavior offered by IE Business School

Course Description (as given on the official Coursera website):

The Market Research and Consumer Behavior course offered by IE Business School on the Coursera platform lays the necessary groundwork for an overall successful marketing strategy. It is separated into two sections: Market Research and Consumer Behavior.

The course helps us gain the tools and techniques to translate a decision problem into a research question in the Market Research module. We learn how to design a research plan, analyze the data gathered and accurately interpret and communicate survey reports, translating the results into practical recommendations.

The Consumer Behavior module does focus in on the consumer decision-making process, highlighting the key moments from identifying a need to buying and consuming a product. The course helps us adopt a true “consumer focus” in the managerial decisions by analyzing how consumers make decisions, what happens (in their hearts and minds) at different stages of the decision making process, and the variables that influence those decisions. This course helps us equip the knowledge required to understand the state of the product before approaching the market strategy.

Objectives of Course:

- To understand consumer behavior and the process a consumer goes through from identifying a need to buying the said product/service.
- To understand the consumer behavior pattern and help take sound marketing decisions or build strategies oriented to marketing.
- To understand the need of Market Research and its applications.
- To study the process of Market Research and its implications on decision-making.

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CONCLUSION

Learning Methodology:

The delivery of course was via online platform named Coursera. The course consisted of 29 videos and three readings. The lectures were delivered using video format supported by PowerPoint presentations.

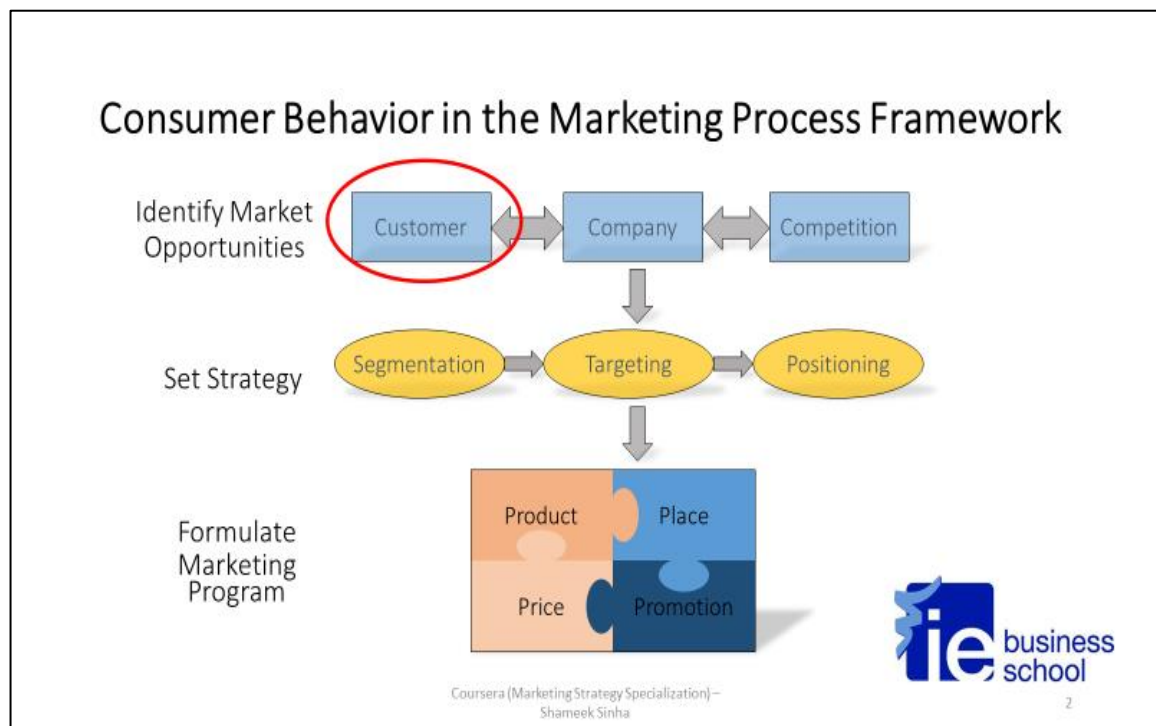
Please note for this report few slides have been used for pictorial understanding of the concepts. The slides are from the resources section available on the Coursera platform.

Key Learnings:

MODULE ONE: CONSUMER BEHAVIOR

1. Consumer Behavioral Fundamentals

1.1. The Building Blocks

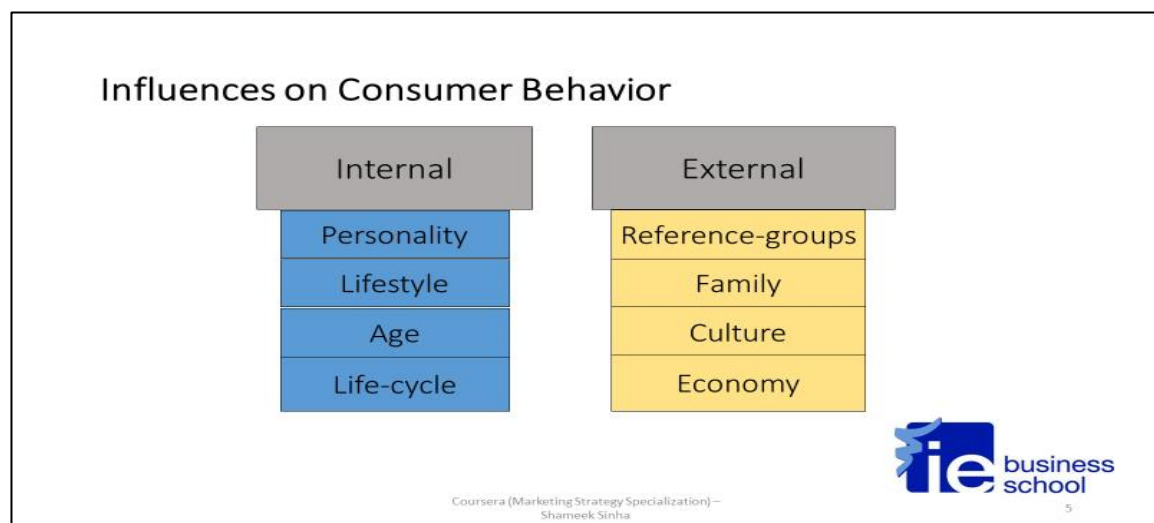


The flow of marketing for a product or service is identifying the market opportunities, setting strategy, and formulating the marketing plan or mix. The 3Cs namely consumer, company and competition are looked upon in the first step of identifying market opportunities. At the second step STP i.e. segmentation, targeting and positioning is decided. The third step is formulation market plan for the 4Ps namely product, place, price, and promotion. ***The marketing framework starts at the consumer/customer and hence should be studied in detail via a market research as the marketers need to know who these consumers are in order to satisfy their needs, while at the same time, as a marketer, the objective should be to maximize profitability.***

What is consumer behavior?

The psychological and behavioral processes involved when individual or groups search, select, purchase, use, evaluate or dispose of products, services, ideas or experiences to satisfy their expected needs and desires.

The consumer behavior is influenced by both internal and external factors as follows.



Internal factors:

- **Personality:** Refers to how the person is- is he risk taking or is he risk averse.
- **Lifestyle:** Is he from an affluent family or relatively poor.
- **Age/Gender:** Both age and gender influence the type of products they buy.
- **Lifecycle:** Whether the consumer is old or young will influence the product they buy.

External factors:

- **Reference groups:** As consumers we often talk to our friends which is possibly a reference group. We look at other consumers with their reviews, understand their expert opinion and these are also reference groups.
- **Family:** If the product is bought by one of the family members like brother, sister, cousins etc., it influences your purchases too.
- **Culture:** Western cultures' buying pattern varies from Eastern cultures.

- **Economy:** In case of regular economy without any economic fluctuations, the consumers will have more disposable income and hence will buy better products. In economic recessions or downturns consumers will buy daily essential products; however, will not be keen to buy durable products like laptop, cars etc.

1.2. Attitudes And Thought Process:

1.2.1. The Consumer Behavior Process: This describes the factors which affect consumer behavior

- Marketing stimuli: Products and services, Price, Distribution and Communications
- Other stimuli: Economic situation, technology, political and cultural factors
- Consumer Psychology: Motivation, Perception, Learning and Memory
- Consumer characteristics: Cultural, Social and Personal
- Buying decision process: Problem recognition, information search, evaluation of alternatives, purchase decision, post-purchase decision.
- Purchase decision: Product choice, brand choice, dealer choice, purchase amount, purchase timing, payment method

Psychological processes:

1. Motivation:

- **Freud's theory: Laddering and projective techniques**

Basically, every consumer, when they purchase a product, go through different stages of the decision in order to eventually arrive at the product they want to purchase. This is known as the laddering technique.

- **Maslow's theory: Hierarchy of Needs**

According to the theory every one of us has these needs in the following order; physiological needs (food, shelter), safety needs (security, protection), social needs (sense of belonging, love), esteem needs (self-esteem, status) and self-actualization needs (self-development).

For example, purchasing a branded phone like Apple iPhone. A mobile can provide some needs which arise out of necessity; however, none of the needs of purchasing an Apple iPhone comes from a physiological need. They are more like esteem needs or self-actualization needs.

- **Herzbergs theory:**

Your purchase decision is driven by the fact that whether you are satisfied by a particular product or not satisfied by a particular product.

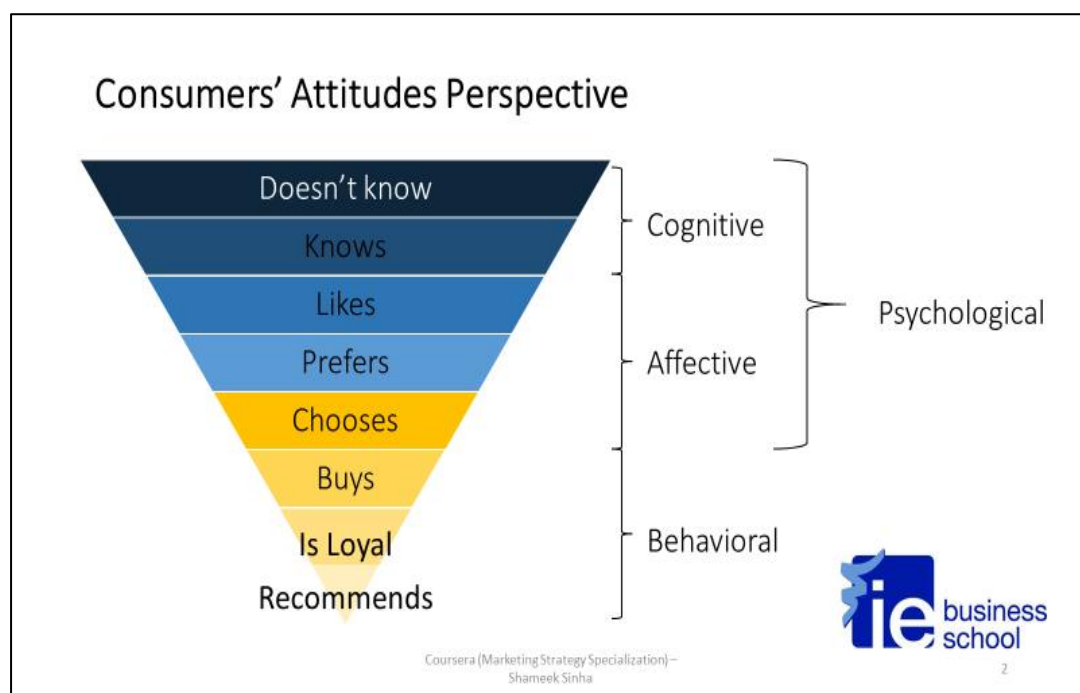
2.Learning: In learning, the consumer will over time, learn about a particular product and then discriminate between different products based on their learning mechanism.

3. Memory: Every consumer has certain ingrained memory in their mind. Some of these memories are short-term, some of them are long-term.

Perspectives of consumer behavior: Different perspectives of consumer behavior which marketers think about are:

- **Behaviorist perspective:** It looks at how consumers respond to different stimulus.
- **Information processing perspective:** How the consumers go through a problem-solving mechanism and use their cognition in order to understand the perspectives.
- **Emotional perspective:** It is driven by how the consumer is emotionally active when purchasing a particular product.
- **Multi-perspective approach:** In this approach various perspectives are combined to arrive at the final purchase decision.

1.2.2. Consumers attitudes perspective:



The following shows consumers attitude and thought processes which go behind their decision-making behavior. As mentioned earlier, consumer behavior comprises of two main structures: psychological and behavioral.

Psychological aspect of consumers' attitude: The psychological aspect consists of cognitive and affective part.

- **The cognitive aspect:** At this stage the consumer doesn't know about the product, so he goes ahead and finds related information about the product; for example, its price, characteristic etc.
- **The affective aspect:** Under this the consumer collects relevant information about the product and knows, like or prefers the product. Thus, the consumer starts liking certain features of the product, certain prices, and characteristics of the product, and develops his preferences.

Behavioral aspect of consumers' attitude:

Once the preferences are developed this is where the consumer is ready to go to a store, maybe a physical store or maybe online, to make the actual purchase. Therefore, the consumer chooses and buys the product. This is extended to being loyal to the brand or recommending the product to others basis on the satisfaction of the consumer.

1.2.3. The Continuum Of Consumers' Thought Process:

This explores consumer's attitude and perspective which basically takes you from the psychological sides of a consumer's decision-making process to the behavioral side of the consumer decision-making process. *The continuum of consumer's thought processes, investigates what different approaches a consumer takes in order to decide on the product he finally decides to purchase.*

Rational approach: Rational approach is essentially driven by standard economic theory where consumers assess their different options of purchases relative to their net worth. That is, they have a particular budget in mind based on which, they like to buy something or not.

Motivational approach: In this approach consumers are not rational at all and they have some unconscious and uncontrollable urges which drive their purchase behavior. In this approach, there are three main types of appeals which marketers mainly target.

- **Emotional:** Emotional appeal is the inherent emotions which consumers feel while buying the product. Example, buying gifts for mothers has been harnessed as an emotional approach by Saregama Carvaan.
- **Sex appeal:** Sex appeal is how consumers feel about the different aspects of more explicit sexual characteristics of the product. Example, how AXE deodorants place their product around magnetic sexual appeal for men.
- **Fear appeal:** Fear appeal is used by marketers when they are trying target consumers for certain public service announcements. Example, anti-smoking campaigns.

Bounded rationality: Neither completely rational nor completely into motivational approach (discussed in detail later).

1.3. Behavioral Approaches: Prospect theory/bounded rationality:

1.3.1. How Your Customers' Rationality Affects Their Decisions:

Following is a set of rationalities that consumers go through while buying various products or services.

Reference pricing: The value of the price of this product is judged with respect to a reference point. Example, product comparison with the price at which it was bought by your friend, or at the price you bought it in the past

Framing: The consumer evaluates losses more than the gains. Hence, paying slightly more for a product hurts as compared to paying less.

Risk profiling: Consumers usually have a diminished sensitivity and somewhat differential reaction to gains versus losses. When consumers are in the loss frame of

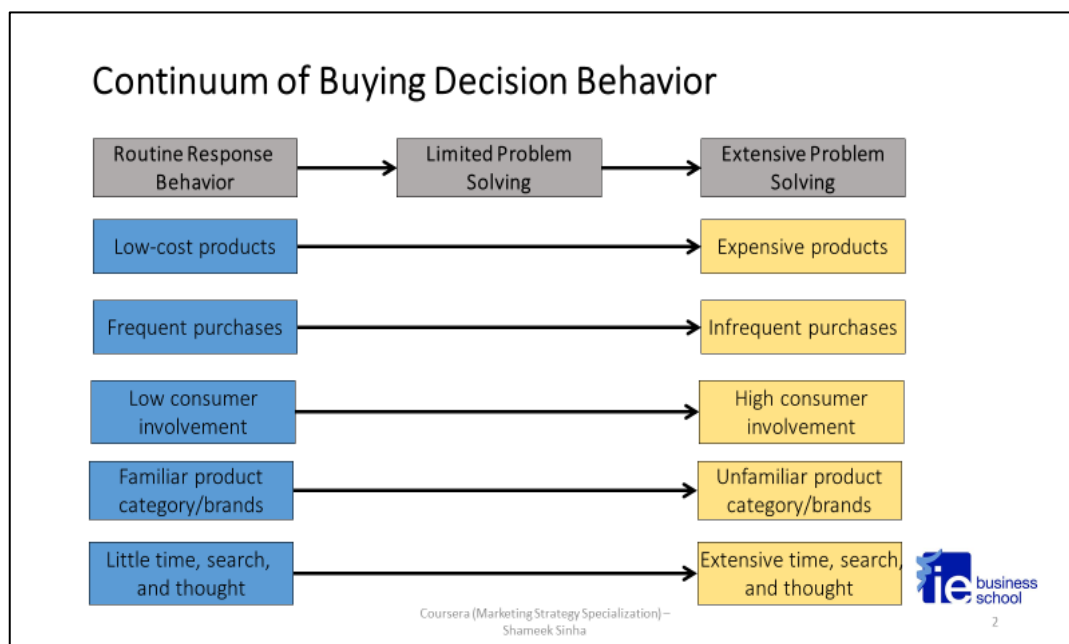
mind, they are willing to take somewhat of a risk and this basically means that you are willing to sacrifice some amount of money if you're getting a better product. On the other hand, in a game frame of mind, here consumers are usually risk neutral, that is consumers are not willing to take any kind of risk.

Risk aversion: Consumers feel if they are paying a little bit more that is much worse to them as a consumer than if you, they are paying a little bit of a lower price.

Mental accounting: This boils down to temporary satisfaction gained while making the purchase. Example, paying via a credit card rather than cash, hence postponing the actual payment.

Disposition effect: Consumers somehow hold on to their losses and gains, hence maintain a status quo.

1.3.2. The Continuum Of Buying-Decision Behavior:



The continuum of the consumer's buying decision process can be categorized in terms of three types of responses which consumers can make when purchasing their product; ***Routine response behavior, limited response behavior and extensive problem-solving behavior.*** The behaviors are associated to various factors ranging from price, purchase, consumer involvement, familiarity with category/brands and involvement with the product. These factors influence the kind of response a consumer would give to a product. Example, basis on the factors mentioned, buying a consumer-packaged goods like milk would lead to routine response behavior, whereas buying a durable product like laptop would exhibit extensive problem solving behavior. In the interim lies limited problem-solving behavior which can be seen in buying products related to fashion.

2. The Consumer Decision Process

2.1. The Decision Sequence: Stages Of Consumer Decision-Making Process:

The stages of consumer decision making are as follows:

1. *Need recognition*
2. *Information search*
3. *Evaluation of alternatives*
4. *Purchase*
5. *Post-purchase evaluation*

The consumer decision sequence as per continuum of buying decision behavior for three different types of products are as follows. As explained in the course, a consumer goes out to buy three different products: groceries, clothing, and a laptop. The short movie kind of simulation shows the thought process the consumer goes through during the purchase which has been summarized in the following table. The following table depicts the variation in the consumer decision process pertaining to the type of product bought.

CONTINUUM OF BUYING DECISION BEHAVIOR 	<i>Low response behavior</i>	<i>Limited problem solving</i>	<i>Extensive problem solving</i>
TYPES OF PRODUCT 	<i>Groceries (milk) / Frequent purchase, low involvement, simple decisions</i>	<i>Clothing/ Intermediate</i>	<i>Electronics (laptop) / Infrequent purchases, high involvement, complicated decisions</i>
DECISION PROCESS 			
<i>Need recognition</i>	▪ Routine milk product used in the house. ▪ Need: Low fat milk	▪ Exhausted current options of clothes in her closet and hence decided to buy newer ones. ▪ Need: Consumer has to attend office party hence needs a dress as well as a pair of formals for daily use.	▪ The current computer has been out of service/not functioning. So the need recognition is instilled as office work is hampered. ▪ Need: Good computing power, good RAM, and a lightweight product.
<i>Information search</i>	▪ No prior research as she knows her exact brand of milk.	▪ The consumer searched online for some known stores as well as stores	▪ The consumer searched online, read reviews, looked in specialized magazines. Also

		recommended by her friends. At times the consumer checks the different types of body types that fit the clothing well and what type of materials made out of.	asked peers and friends.
Evaluation of alternatives	Consumer did not consider evaluating the alternatives as she was looking for low fat milk and is satisfied with the taste.	- Consumer screened the clothing based on color, fit and material of the two dresses. - Screening was minimal and was based around these factors.	Consumers' process of evaluating alternatives was based on screening out multiple laptops based on the RAM, then the weight of the laptop, and then bought the one she found fit her category.
Purchase	The regular routine purchase was made.	- Slightly different purchase pattern was made as the party dress had bold colors as opposed to the ones she wears regularly to the office. - Consumer bought both the clothing she was looking for.	Consumer bought the laptop after extensive research, screening based on her needs, and post evaluating all the alternatives.
Post-purchase evaluation	Consumer is satisfied with the milk she purchases on routine basis; therefore, continues to buy the same brand, same packet size	Consumer was not satisfied as the threading was coming out and she overall did not feel it added any value against the cost she paid.	Post a month the consumer is satisfied with the laptop and would recommend it to peers.

	and the same type.	▪ Hence, the consumer will choose not to recommend the shop to her peers.	
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2.2. Constraints On Decision Process:

Overload of information: Consumers usually have a limited capacity to attain, receive, perceive, process, as well as interpret marketing stimuli. Hence, at times an overload of information can constraint the buying decision process.

Example, consumer goes to a supermarket to buy a shampoo. Looking at the stacks of various brands and types the consumer might get confused, overwhelmed, and overloaded with information due to the exposure. In some cases, the consumer might switch from buying a shampoo to buying a dry shampoo.

Attention: The consumer decision process might be influenced if the marketer is able to grab the attention. It can be done in the following ways.

- **Unexpectedness:** If the advertisement depicts a twist, or an idea which is not normal it might grab the attention of the consumer and alter their decision process. Example, if a sports car brand shows a child driving the car with ease as opposed to the normal adult driving the car it can grab the consumers attention.
- **Personal relevance:** If the advertisement endorses something relevant to you personally, your decision process is affected. Example, you might look at an advertisement which shows a car can fit a family of six versus a car which fits a family of four. In case, you have a family of four you will simply choose the four-seater car for buying.

3. Learnings of Consumer Behaviour Module:

By the end of the Consumer Behavior module the following learnings are obtained:

- Understanding that consumer is the first and most important aspect of marketing.
- Consumer behavior with respect to various influences (both internal and external factors).
- How attitudes and thought process of consumers are important to be understood for any product or service to be a successful model. This was backed by various behavioral theories like Maslow's theory, Herzberg's theory etc.
- It helped us understand the stages of consumer decision process and continuum of buying behavior of the consumers based on different categories of products like durables., clothing and daily consumer packaged products.

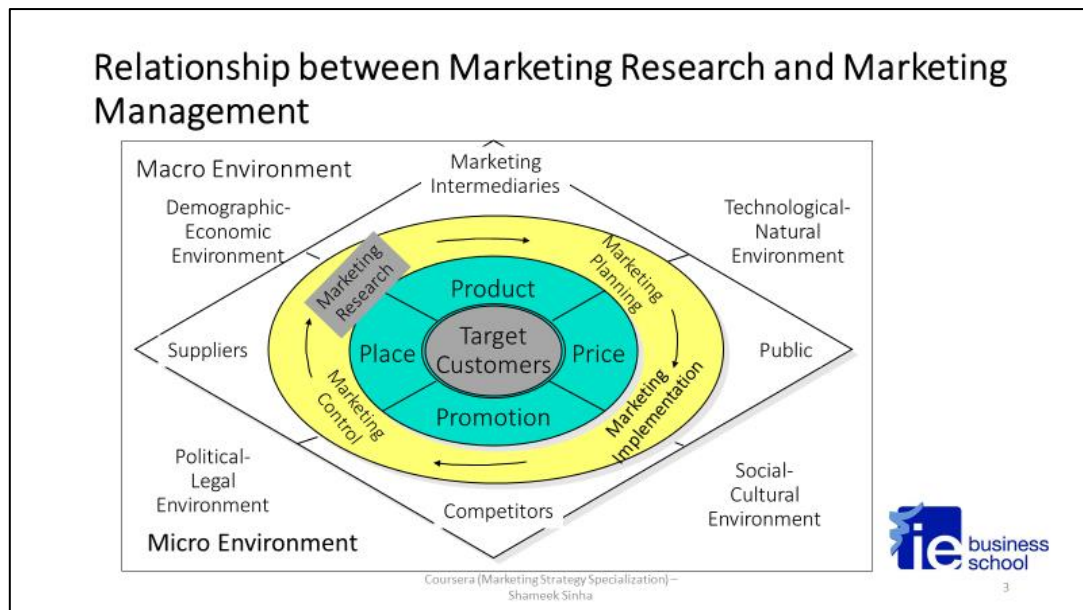
MODULE TWO: MARKET RESEARCH

MARKETING RESEARCH FUNDAMENTALS

According to Philip Kotler “Marketing research is a systematic problem analysis, model building and fact finding for the purpose of improved decision-making and control in the marketing of goods and services.

1. Marketing Research and Its Role In An Organization:

The following diagram has been explained from outer circle going towards the inner circle.



As the diagram depicts; there is the **microenvironment, and macroenvironment**. Now, in terms of the microenvironment, we can think about the political, legal, or sociocultural environment. From the perspective of the macro environment, we can look at demographics, or the economic environment, or even the technological side. **Marketing actors:** Marketing actors are the relevant people in this entire marketing structure. They can be suppliers, consumers, intermediary, stakeholders etc. **Interaction plan of marketing is determined by planning, implementation, control, and market research.** Also, the main and crucial role is combining all of the elements of marketing management, and then coming up with the most important conclusions which are relevant to the company.

The marketing research can help in various aspects of Economic Environment, Internal Corporate Structure, Competition, Pricing, Product, Distribution, Promotion, Buying Behavior, so on and so forth. Nevertheless, it helps us understand about the target customers.

Organization structure of marketing research:

Marketing research can be done at two levels in the organization namely centralized marketing research and decentralized marketing research.

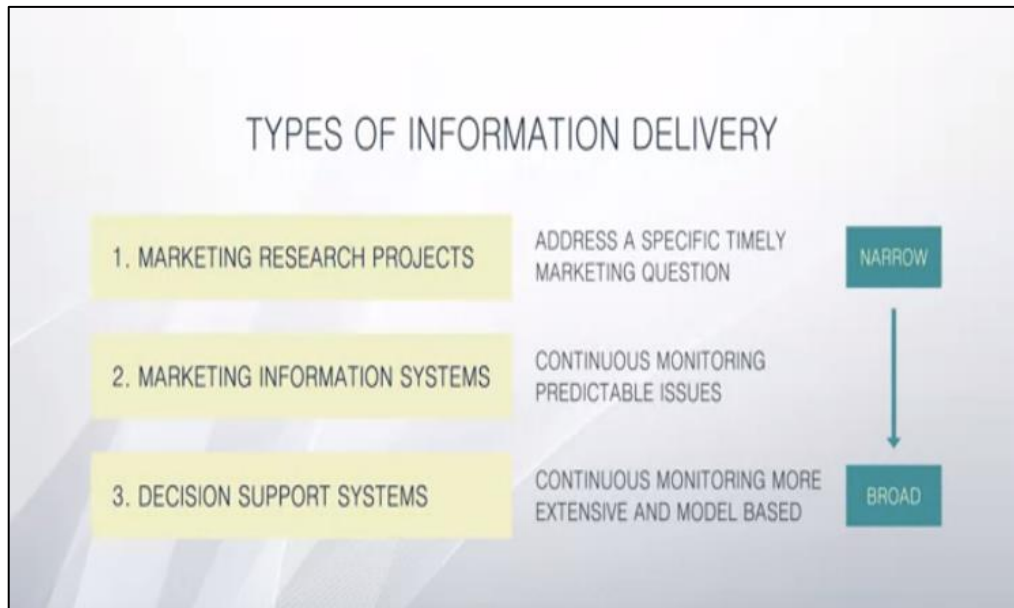


Centralized marketing research: If the company follows centralized marketing research then the pros can be the benefits of economies of scale, and a better control over the entire marketing research process.



Decentralized marketing research: If the company follows a decentralized marketing research then the pros can be focus on individual markets, the practices, and problems as it is done on specific unit levels rather than the company as a whole.

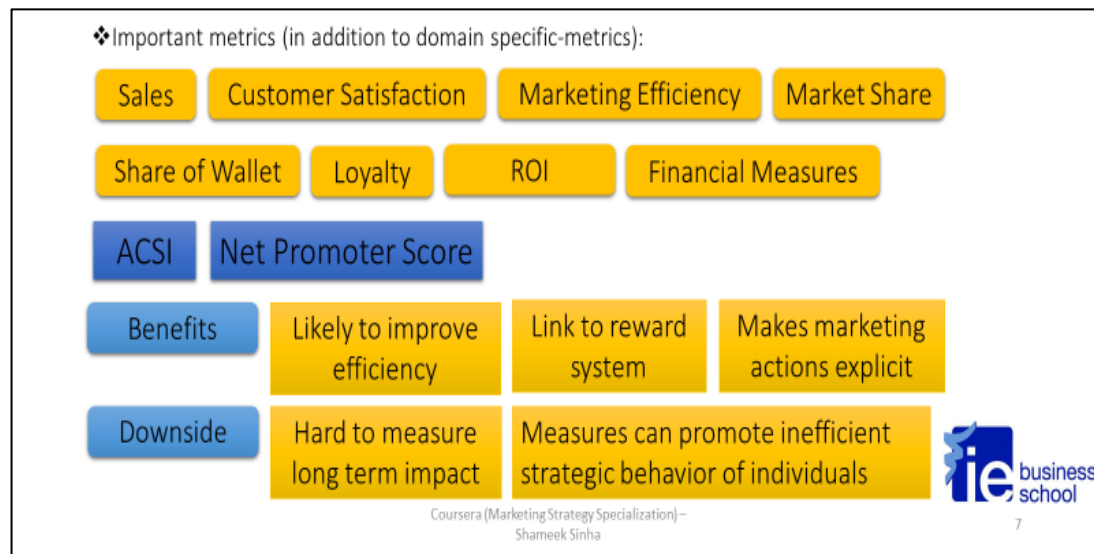
1.1. Types of Information Delivery:



This is an element of marketing research which deals with information delivery. Broadly, it has three categories as follows;

1. **Marketing research projects:** The projects address a very specific marketing question. Those are probably small marketing research issues, but still very important to address.
2. **Marketing information systems:** These are more continuous monitoring processes, for more bigger marketing research questions. These are done over a period and by a lot of people being involved.
3. **Decision support systems:** These are more extensive issues being addressed, more challenging ones, and these are probably the most relevant ones, when you think about a company as a whole.

- 1.2. **Marketing Dashboards:** These are simple and coherent set of information that allows marketers to assess the client situation, and they can act quickly based on that. Various metrics are used to use this marketing dashboard like share of wallet, loyalty, ROI and financial measures along with domain specific measures.

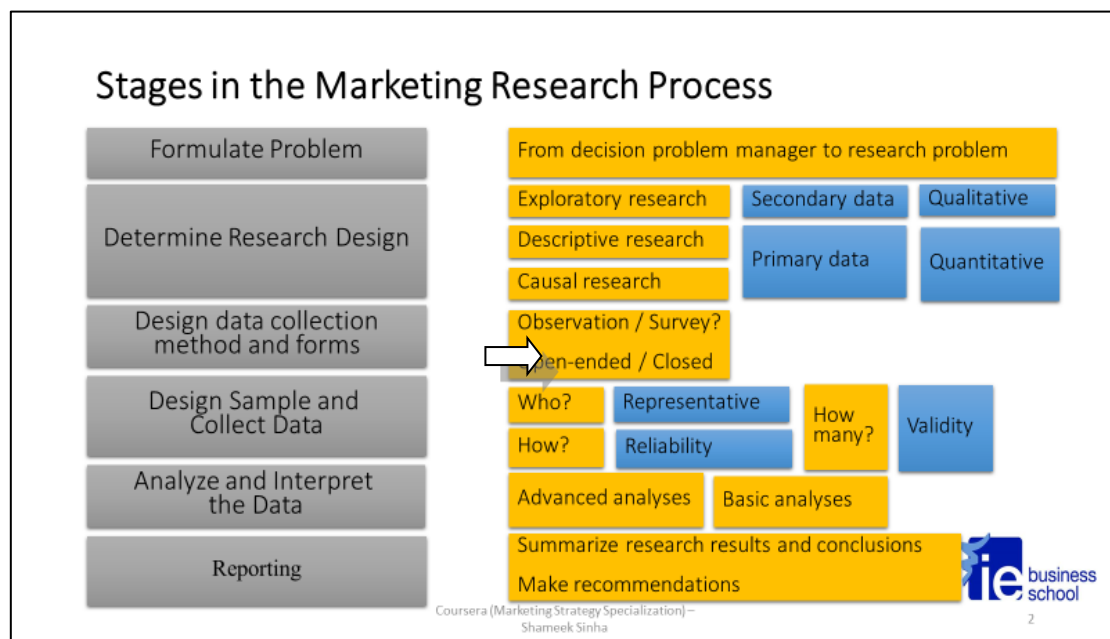


Pros: Improves efficiency, link to reward system and makes marketing actions explicit.

Cons: Hard to measure long-term impact, measures can promote inefficient strategic behavior of individuals (Because you are providing certain very specific matrix but they are not relevant to the changing environment of the company or changing environment of the full industry).

2. Stages In Market Research Process

2.1. Steps in Market Research



The course coordinator explained the diagram in the upcoming lecture video extensively as follows: The market research process comprises of the following six steps:

- 1. Formulation of problem:** In an organization a manager has certain decisions to take and hence they are viewed as marketing problem formulation.
- 2. Determine research design:** According to the problem at hand the research design is used which can be of three types; Exploratory research, Descriptive research, and Causal research.
- 3. Designing of the data collection method and different forms of data collection:** In this approach following ways are used for data collection;
 - Observational or survey method: Potential consumers are asked different questions based on their opinions and their preferences to know about their wants.
 - Open-ended or close-ended question design: In the open-ended approach we do not give the consumers or the potential survey respondents an option. They tend to express their opinions freely, and later we can decipher the information from their response. In close-ended survey certain set of options are given to the potential respondents and based on them conclusions are drawn.
- 4. Designing sample and collection of data:** At this stage selection of sample should be such that it should be a representative of the actual customer population base we are interested in. Also, the sample should be reliable and valid.
- 5. Analyzing the data and interpreting the data:** Initially a basic analysis should be done at the fundamental level like descriptive or correlation analysis to get a basic overview. Next an advanced analysis can be done using statistical models or econometric models, which gives us much more insightful result.
- 6. Reporting of results:** The analysis done should be reported as the key role of the marketing research and its stages was to help understand and solve the problem at hand. This further *helps the manager in taking the needed decisions from the conclusions and recommendations explored from the market research process.*

Few concepts are explained in detail as follows.

2.2. Research designs:

The research designs help us understand the consumers and take decisions accordingly. Three main type of research designs are as follows;

2.2.1. Exploratory Research:

Exploratory research helps us to observe different deals and eliminate impractical ideas based on the feasibility indicator. It helps the researcher to

refine a particular problem. It helps clarify the concepts and increases familiarity with the problem at hand.

Exploratory research can be done using the following tools:

- **Literature research:** It helps understand what kind of features consumers like. You can see some market research surveys on the consumer's preferences as literature research.
- **Experience surveys:** Using these surveys, consumers preferences or experiences are studied with respect to their previous buys.
- **Focus group surveys:** Focus groups are collection of potential consumers (their opinions about specific characteristic of product are taken into consideration).
- **Personal in-depth interviews:** In this a specific group of consumers are spoken to face-to-face, either online or offline, and their perceptions about product and its characteristics are noted.

2.2.2. Descriptive research:

Descriptive research deals with frequencies and relationships between variables and is typically guided by the hypothesis. In this research approach, based on hypothesis data is collected, analyzed in order to validate the hypothesis.

The steps followed in this approach are: hypothesis generation or defining the problem- identification of the information to address the specific question- selection and development of data gathering instruments-identification of target population and a sample- data collection method and collection- analyzing the data and drawing conclusions or predictions to validate the hypothesis.

Descriptive research can be done using; Surveys, developmental research including longitudinal approach or cross-sectional approach, case study, correlational or qualitative data which helps understand perceptions of consumers via the research.

2.2.3. Causal research:

The next step or type of approach in market research is causal research. ***It helps us build a cause and effect relationship which is done using a controlled experiment.***

Experiment: It is the manipulation and control of one or more variables and based on the effects of those variables, the observed outcomes. It is used to test the evidence of causality. Certain elements named variables are an important aspect of experimentation. Thus, by manipulation them, we can change the different levels of variables and see the effects. Various types of variables are taken into consideration which are as follows;

- **Dependent variable:** It measures the effect of manipulation, also called as the ***outcome variable***.
- **Independent variable:** The variable of interest is called independent variable and is manipulated during the research. They are also termed ***as treatment variable***.
- **Control variable:** These are not intended to measure effects but are used to keep other conditions constant. These are ***controlled by the researcher***.

- **Extraneous variable:** These variables *cannot be controlled* and must be accepted by the researcher as they are.

2.2.4. Measurement of research:

Using these variables, the causal research or experimentation is done. There are two basic ways in which the effect of the treatment can be measured so as to validate the hypothesis or problem at hand namely within subject variation and between subject variation.

- **Within subject variation:** In this approach, an individual or group is first measured in terms of outcome variable. Then a manipulation is implemented, and the variables are measured again. Hence the difference of earlier outcome and the effect of manipulation is measured to validate the research.
- **Between subject variation:** In this approach, two groups or two individuals are subjected to same manipulation differently. Hence, the between subject variation is measured.

2.3. Types Of Experimental Design:

- 2.3.1. **Pre-experimental design:** In this design the researcher does not have control over subjects, the outcomes, as in no control over randomization or matching.
- 2.3.2. **True experimental design:** In this design the researcher has total control over who is exposed to marketing or stimuli. Other controls like randomization or matching is done; however, the researcher cannot choose the subjects.
- 2.3.3. **Quasi-experimental design:** In this design, the researcher has complete control over the subjects and can decide whom who the potential subjects are and how they will be measured.

3. Marketing Research Data Collection And Analysis

3.1. Types of Marketing Data:

Data collection and its analysis is the crucial part of market research. As discussed earlier the type of research design leads the kind of data needed for the research. Following are the two types of data collected to be further analyzed and used in Market Research.

3.1.1. Primary data in Market research:

Primary data is collected for specific study or specific question at hand. The data is collected solely by the researcher in the field. The different types of primary data pertaining to market research in the field of marketing are;

- **Demographics or socioeconomics:** Demographic data of age, gender, marital status etc. Socio-economic data like income levels are collected.
- **Psychographics or lifestyle variables:** This data includes activities, hobbies, opinions etc. on certain subjects pertaining to social or even politics.

- **Personal values:** This data includes if the consumer has positive, altruistic or other kinds of values.
- **Awareness of knowledge:** This data includes awareness regarding the question at hand, about the product, the market etc.
- **Attitudes, motivation and benefits:** This data includes the attitudes, motivation and perception or benefit the consumer perceives from the product.
- **Actual behavior:** This data can be the past behavior of the consumer pertaining to the marketing or purchase behavior.

3.1.2. Secondary data in Market research:

Secondary data is not collected actively by the researcher, rather it is the data collected and used by someone else for their study. The researcher now obtains the already collected data and uses it for their own study or problem in hand.

The different measurement scales of secondary data are nominal, ordinal, interval and ratio scale.

3.2. Data Collection in Survey Research:

3.2.1. Designing questionnaire:

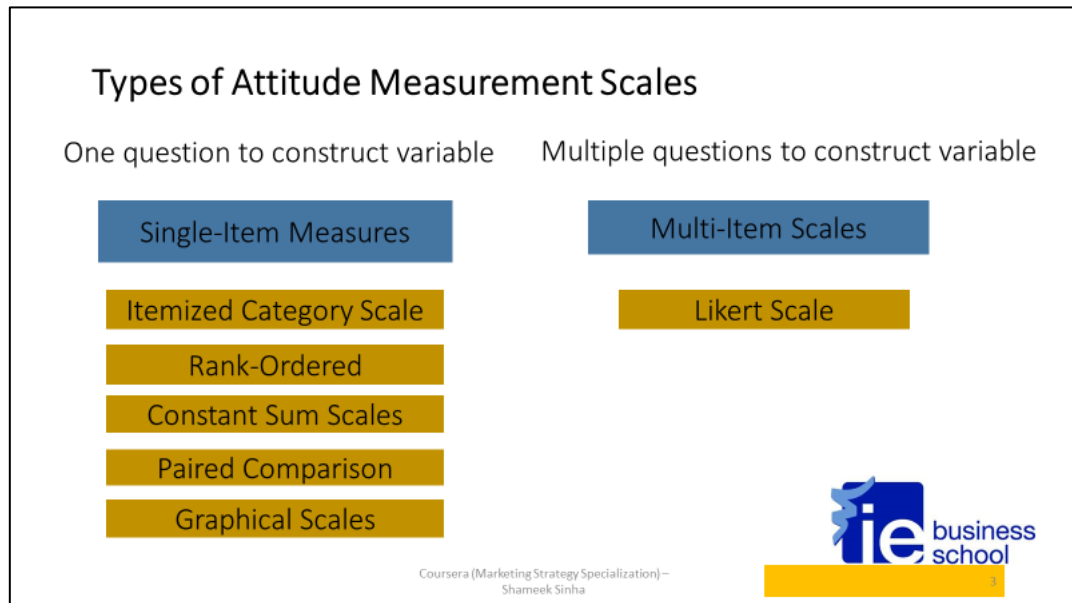
Questionnaire is used as data collection tool which helps collect primary data in surveys. Following are the parameters to be kept in mind while designing the questionnaire.

- You need to have a specific objective to facilitate what kind of data you want to collect
- Determine the type of questions you want to have; is it open ended or close ended.
- Determine if the survey will be conducted online or offline. Later determine the background, paper quality, background color etc. for the same.
- The questions be it open ended or close ended should be precise and concise.
- The form of response that is the scale of measurement should be taken in consideration like if the question should be a Likert scale or a nominal scale.
- Wording of the question should be looked into, like avoiding incentive words in the question.
- The questionnaire sequence should be such that the start and end should contain easier questions and the middle part can have tough questions if the questionnaire is close ended. For open ended questions funnel technique is used. In this broad question are asked in the start and later narrowing down to specific questions which are more related to the study.
- Avoid using ambiguous words. Do not have leading questions.
- ***Please remember, as the marketing research includes behavioral and psychological aspects of consumers, the design of the questions has to be simple and sensitive as biasness or unresponsiveness will tend to yield poor data in the end.***

3.2.2. How to measure and scale our Consumers' Attitudes:

Attitudes: As discussed earlier attitudes are mental states used by individuals to structure the way they perceive the environment and guide the way they respond to it.

Types of Attitude Measurement Scales: With respect to psychometrics (measurement of attitudes of the consumers) following scales are used for measurement of the same.



Single Item Measures:

- **Itemized Category Scale:** Respondent selects from a limited number of categories which do not have any ordering.
- **Rank-Order Scales:** Ordinal data is used in questions and limited number of items which are rank-ordered.
- **Constant Sum Scales:** The score needs to add up to a number. It contains limited number of items and can be used to measure interval or ratio scale.
- **Paired Comparision:** It is used to compare two brands at a time. Limited number of brands since otherwise the number of comparisons increase rapidly.
- **Graphical Scale:** Measured using a graphical slider mechanism. The consumer or respondent has to slide through the questions to make your attitude clear.

Multi-Item Scales: Likert scale is a prime example of multi-item scale. It helps us calculate optimum stimulation level of a consumer.

3.3. Data Analyses Fundamentals: and Hypothesis Testing:

3.3.1. Data Types: Categorical Data and Metric data

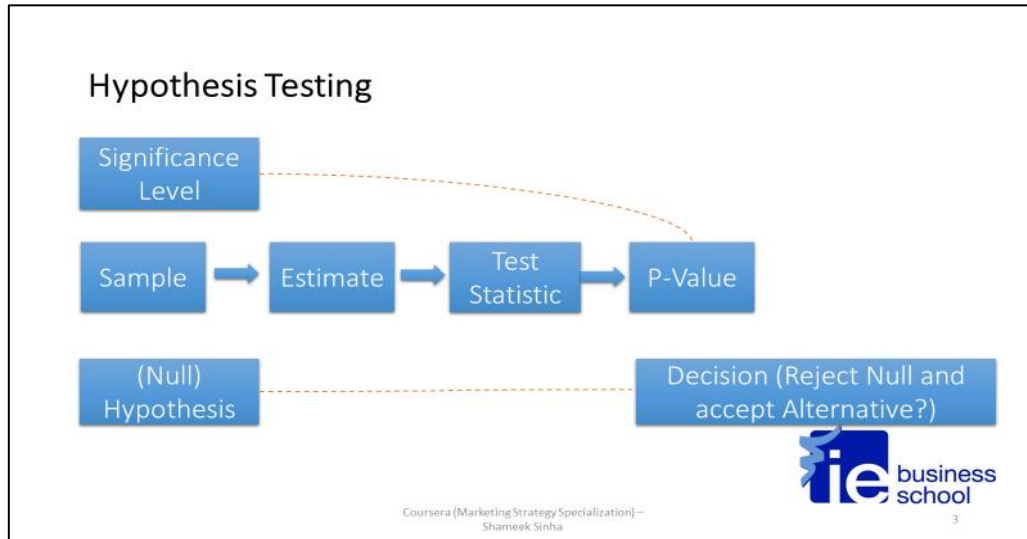
1. **Categorical Data:** This type of data takes discrete values.
 - **Nominal data:** It has values that can be distinguished from each other, but these values do not have an individual significance.
 - **Ordinal data:** Values can be in a meaningful ordering.

2. Metric/interval Data:

- **Discrete data:** The variables are countable.
- **Continuous data:** The variables can be measured to any degree of accuracy.

3.3.2. Hypothesis Testing:

Hypothesis testing is done to specify a null hypothesis in terms of certain statistical quantity of interest. The following flowchart shows the steps of hypothesis testing:



1. *Specify null-hypothesis in terms of quantity of interest*
2. *Determine significance level (α /alpha; often $\alpha=0.05$)*
3. *Estimate quantity of interest*
4. *Compute the Test statistic using t-test, F-test or chi-square test as needed.*
5. *Compute p-value: p-value measures the probability that an observed effect is there in the sample given that the null hypothesis is true.*
6. *Compare p-value and alpha value and accept the null hypothesis or accept the alternate hypothesis. If p-value is greater than alpha we accept the null hypothesis and if p-value is less than alpha we reject null hypothesis.*

Hypothesis testing errors: In hypothesis testing two types of errors can be seen. They are explained in the following diagram using the example, to test whether a specific advertisement has any significant effect on the sales or not.

Type I and Type II Errors

Decision	True State of the Null Hypothesis	
	H_0 True	H_0 False
Reject H_0	Type I error	Correct
Do not Reject H_0	Correct	Type II error

Decision	True State of the Null Hypothesis	
	Ad Has No Effect	Ad Has An Effect
Select Ad	False Positive - Wasted Resources	Correct
Do Not Select Ad	Correct	Missed Opportunity



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4. Learnings of Market Research Module

By the end of the market research module the following learnings are obtained:

- Market research, its role in an organization and marketing as a whole concept.
- The positive relationship between market research and taking marketing-oriented decisions.
- The stages of market research process: right from formulation of the problem, determining the research design, the variables of the research, designing data collection methods and data collection tools, collecting the data, analysing the data and coming to a decision based on hypothesis testing at the end.
- Market research is a fundamental and crucial step at any stage of marketing or taken a decision related to marketing of the service or product as it facilitates the manager with meaningful insights to help take decisions at hand.
- The step of marketing research can be applied not only to know the consumers but also to understand the 3Cs and 4Ps of marketing.

CONCLUSION:

The course Consumer Behaviour and Market Research helps in beginner level understanding of the concepts of marketing. The course is well structured and ample examples were given to help understand the facts. However, the teachings were already delivered in depth by my professor in college during the first year of academic. Therefore, no such additional gain of knowledge post the course; however, it helped in revising the topics.

Thank you