



Institute of Actuaries of India

COVID -19 – A Study & Projections for India

IAI PANDEMIC RESEARCH GROUP

INSTITUTE OF ACTUARIES OF INDIA

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1. Executive Summary

The Institute of Actuaries of India (IAI) has constituted a Research Group (Group) to conduct research based on the COVID19 related data available in India and globally. The Research will be useful for various stakeholders for developing solutions for serving the public cause.

The Group studied the experience and projections available for South Korea, Singapore, Italy, Germany and USA. Key learnings and takeaways from the Group's analysis and study on development of COVID19 in these countries are:

1. Countries that have been successful in containing the virus have done so with aggressive fast track testing, extensive contact tracing and active quarantining.
2. The governments were supported by the respective citizens who in turn followed social distancing norms and personal hygiene, even without a formal lockdown being imposed on them.
3. Super-spreaders (e.g. Patient 31 in Korea), large events (like soccer matches in Italy) and cluster-infections (e.g. the migrant workers' dormitories in Singapore); can easily derail the best measures followed and unsettle the hard work of governments, medical staff in a matter of days.
4. If the spread of infection is not slowed down, it can cripple even the best-in-class medical facilities, e.g. Italy.
5. Protection of the particularly vulnerable sections of the society can help contain the Case Fatality Rate (CFR), e.g. Germany has been successfully able to contain the number of deaths

Section 3 details the learnings for each of the geographies researched by the Group.

While each country is handling this outbreak in their own way, India has been appreciated for its proactive response. The scale at which it had to act and the urgency and agility at which it put those actions to work is unparalleled. Some of the early measures that we took in January 2020, e.g. screening international passengers even when no single positive case was identified, the criticised decision (that later was accepted as being vital) to suspend visas, tracing those with travel history from China and vigilance of their home quarantine and travel restrictions, etc.

The Central Government activated its crisis management team and intensive surveillance systems to pre-empt widespread transmission, working closely with their counterparts in various states. The decisive Indian measure to "lockdown" was placed on March 25, 2020 which, although continuing to be a challenge to enforce in densely populated localities, received unanimous nationwide compliance thus affirming the "power of the collective". With the nation in complete lockdown, India used this opportunity to enhance medical readiness by increasing isolation beds, ventilators, drugs and test kits. Public health awareness drive and advertising campaigns have been pushed on social media, TV, SMS and radio. What continues to be a challenge is to get the curve to plateau and then start to trend downwards, while we figure out how to tilt the axis from life to livelihood, catalyse the economy, solve the domestic migrants' crisis and mitigate the risk of social unrest.

While some of detailed historical data may not be available to calibrate the models along all these parameters, the Group has considered these multitude of diverse aspects as much as possible while building the models.

Using the knowledge gained and observing the daily reporting of cases, the Group attempted to fit the emerging patterns and project cases, recoveries and deaths using two multi-state models:

- 1) **HIRD** (Healthy, Infected, Recovered Dead) model, detailed in Section 5
- 2) **SEIR** (Susceptible Exposed Infected Removed) model, detailed in Section 6

While SEIR is a known model and has been used by other practitioners, HIRD is something that the Group has built from scratch and tried to calibrate.

Data for the models was collected and cross verified against multiple sources before being used. Individual data was sparse, and cumulative data was found to be more reliable and used to calibrate the models. Further details about the work done on the data can be seen in Section 4. Both the models have been successfully calibrated to within 97%+ accuracy levels, when looking at projection cases. Statistically credible historical data is available for more than two months, since start of March 2020. In order to test the efficacy of the models, the models were calibrated using first 45 days of data and then subsequently projected for the next 20 days. To put things in perspective, data available till April 15, 2020 was used to calibrate the models and then projected the number of cases till June 30, 2020. The Group has tested the actual and expected experience, the projected numbers are within 5% of actuals till May 10, 2020. The results are captured in Appendix B.

While the model may be capable of projecting numbers even beyond Jun'20, there are too many parameters at play, e.g. government actions, policies, individual behaviour, fear psychosis, etc. which are evolving too rapidly and could significantly impact the incidence rates / transmission rates. Further, there is limited, and not very credible information, available in the public domain in order to calibrate models and make stable long-term projections specially regarding mortality and recovery and hence projections are provided till June 30, 2020.

The Group has considered four different scenarios to project the future possibilities as summarised below, details are captured in Section 7.

	Phase	May 4 to May 17	May18 to end-May	June 2020
Worst-case	Lockdown status	Lockdown - with relaxation	No lockdown	
	Social distancing norms	Not followed uniformly	Not followed	
	Transmission Rate for Jun'20	1.143 (7:1)		
Lockdown- ceases	Lockdown status	Lockdown - with relaxation	No lockdown	No lockdown
	Social distancing norms	Followed		Followed partly
	Transmission Rate for Jun'20	1.125 (8:1)		
Best- estimate	Lockdown status	Lockdown – with relaxation		
	Social distancing norms	Followed		
	Transmission Rate for Jun'20	1.100 (10:1)		
Ideal Scenario	Lockdown status	Lockdown – limited relaxation		Lockdown – with relaxation
	Social distancing norms	Strictly followed		
	Transmission Rate for Jun'20	1.067 (15:1)		

Transmission rate is used to estimate the cumulative number of infected people on the following day.

For example, a transmission rate of 1.125 per day would mean for every 1,000 infected people on a given day, there would be 1,125 infected people the next day. It may also be interpreted as that for every 8 infected individuals on a given day, there would be 1 additional infected individual on the next day, taking the tally to 9.

Similarly, a transmission rate of 1.067 per day would mean for every 1,000 infected people on a day, there would be 1,067 infected people the next day. Hence, for every 15 infected individuals on a given day, there would be 1 additional infected individual on the next day, taking the tally to 16.

The transmission rates during the earlier periods are calibrated using the available data for Mar'20 and Apr'20.

The number of cases in Confirmed and Active states projected for May 31, 2020 and June 30, 2020 are depicted below:

	Confirmed Cases		Active Cases	
	31-May-20	30-Jun-20	31-May-20	30-Jun-20
Worst-case	2,01,090	11,08,511	1,23,750	6,87,992
Lock down - ceases	1,66,489	5,21,108	91,808	2,44,931
Best Estimate	1,62,490	3,28,195	87,863	94,381
Ideal Scenario	1,39,557	1,77,425	65,860	14,189

The above models and its results are limited by the information available and model construct. Details of the limitations of these results is given in Section 7.2.

Further, the Group also deliberated on various product ideas and constructs that can be offered under the current scenario to address the emerging gap in insurance needs of the consumers. These suggestions are detailed in Section 8.

This Group aims to periodically review and recalibrate the projections as greater experience emerges in future and continue to develop an understanding of medium to long term impacts of COVID-19 crisis on some of the key risks faced by the insurers.

Any information or question with regards to the analysis and report may be sent to IAI Pandemic Research group at IAIPandemicresearchgrp@actuariesindia.org.

2. Introduction

Corona Virus Disease of 2019 or COVID-19 is a global pandemic that has since the start of 2020 spread across the world. The virus causing COVID-19 is Severe Acute Respiratory Syndrome Corona Virus 2 or SARS-CoV-2. This virus is third zoonotic coronavirus, after SARS-CoV and MERS-CoV, but appears to be the only one with pandemic potential. The disease till date has infected more than ~41.9 Lakh (4 million) people and has caused around ~2.8 Lakh (~284,000) deaths with still ~ 24.1 Lakh (~2.4 million) active cases of which ~ 2% are in serious or critical condition¹.

Given the current global COVID-19 epidemic, IAI has constituted a Research Group (Group) with the following objectives:

- Analysing the experience emerging from COVID-19 in India and relevant overseas markets.
- Drawing inferences from the analysis of incidence and mortality rates
- Suggestions as to the life/health products that can be offered to cover COVID-19.

The Office Order is attached as Appendix A to this report.

As we are yet to reach a steady state of this pandemic, it will be premature to draw a conclusion regarding the mortality and / or incidence rates due to COVID-19. There are so many factors affecting the mortality that are yet to be fully understood. Hence, the Group decided to focus on analysing the emerging situation in India and compare and leverage on insights and learnings from countries that are in various phases of this pandemic, for details please refer Section 3.

Using the knowledge gained and observing the daily reporting of cases, the Group attempted to fit the emerging patterns and project cases using two multi-state models. The approach and outcomes are detailed in subsequent sections. The objective is to project the number of cases that are likely to occur under various lockdown and containment scenarios.

The cases have been projected till end of June 2020. While the model maybe be capable of projecting numbers even beyond Jun'20, there are too many parameters at play, e.g. government actions, policies, individual behaviour, fear psychosis, etc. which are evolving too rapidly and could significantly impact the incidence rates / transmission rates. Further, there is very limited and credible information available in the public domain in order to calibrate models and make stable long-term projections specially regarding mortality and recovery.

The Group also deliberated on various product ideas and constructs that can be offered under the current scenario. These suggestions are detailed in Section 8.

¹<https://www.worldometers.info/coronavirus/> updated as at May 10, 2020

3. Learnings from overseas

To understand COVID-19 spread, the Group studied a few important and relevant countries. The study and analysis included understanding key variables, e.g. age, gender, testing, daily increase in cases, etc. and government's response and the subsequent impact of that response.

The following overseas markets were surveyed:

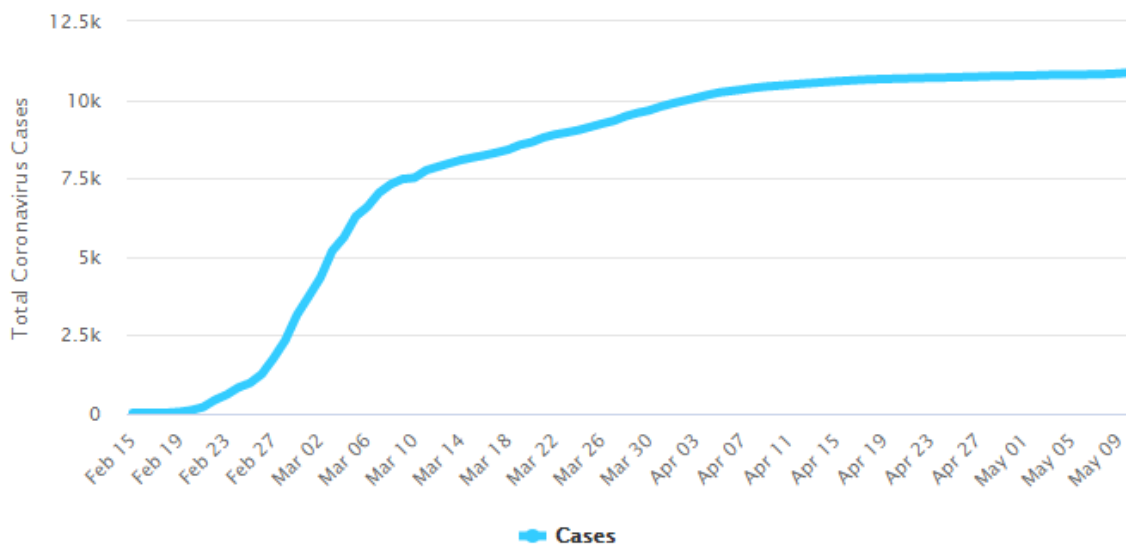
- South Korea
- Singapore
- Italy
- Germany
- USA

Key observations that, we believe, are of relevance to the Indian context are summarized below.

3.1. South Korea's COVID-19 Experience

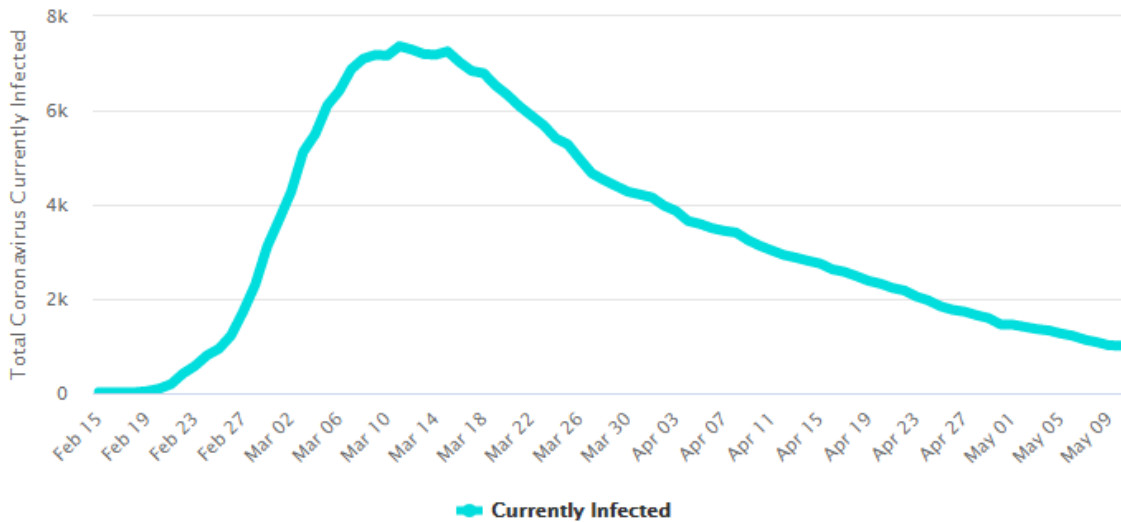
The first case of COVID-19 was confirmed on January 20, 2020, the same day that the USA had confirmed its first case. However, both the countries have had a very different experience of this pandemic, as illustrated here and in Section 3.5. By February 15, 2020, the country had reported 28 cases.

The number of confirmed cases in South Korea is illustrated below², with the total number of infections of 10,909³ cases as at May 10, 2020.

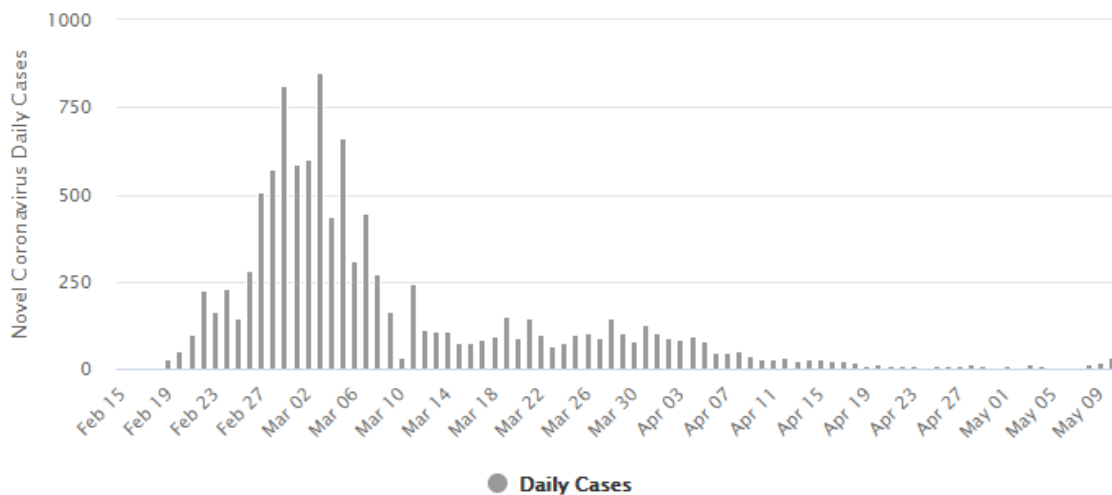


² Source: <https://www.worldometers.info/coronavirus/country/south-korea/>

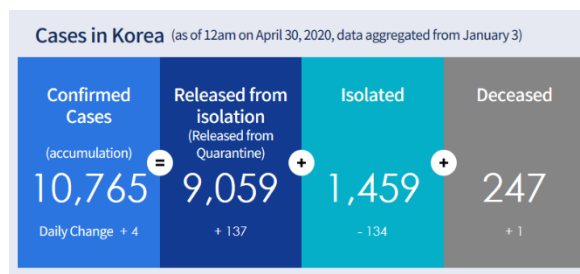
³ Source: <http://ncov.mohw.go.kr/en>



The number of new cases reported on a daily basis⁴ are illustrated below.



Many experts have stated that South Korea is one of the few countries that has managed to flatten the curve. It is even more of a special case within those few countries that has achieved this feat, as it did not enforce a formal lockdown.



There are many lessons that can be learnt ranging from extensive and fast track testing to using smart technology for tracing and quarantining. As a first step, they acted promptly by declaring it an emergency early on and used the window of opportunity to clamp down on the virus by following aggressive measures.

⁴ Source: <https://www.worldometers.info/coronavirus/country/south-korea/>

Important and unique observations

The number of new infections in South Korea rose rapidly in February when one of the infected citizens attended a large church gathering and went to other public places and eventually ended up infecting many people. This person, known as Patient 31 was a “super spreader” and infected about 50% of the individuals who tested positive for COVID-19 in South Korea. Since then, the country has seen the number of new infections fall due to several timely and decisive actions that are outlined below.

For those that were exhibiting any symptoms, testing was made free of charge. For those that were asymptomatic, while the test was chargeable, they were still tested. People behaved with maturity and disciplined themselves by staying indoors voluntarily even without a formal lockdown.

Another important aspect that helped was that the Government was very transparent in sharing information with the general population and gave them regular updates on progress and the steps being taken.

Learnings

South Korea’s experience with the virus has not been as bad as many other countries. The learnings from South Korea are:

Accessibility of Testing: It pioneered different ways of testing like developing drive-through testing facilities that enabled diagnosis of many people. Within a very short time period, their testing capacity reached up to 20,000 per day. Their intensive testing has been vital in identifying many silent carriers.

Testing statistics⁵ as at April 30, 2020.

Tests Concluded				Negative Results	Subtotal	In Progress	Total
Confirmed Cases							
Quarantined	Released from Quarantine	Deceased	Subtotal				
1,459	9,059	247	10,765	600,482	611,247	8,634	619,881

Aggressive Back-tracing contacts: They sent automatic messages with list of infected places and the time that infected people had been to those places and advised people who were at those places around that time to get themselves tested.

Disciplined quarantine: People in self quarantine and those released from hospitals were required to report their movement and symptoms everyday through an app managed by the Government. People who breached quarantine had a strict fine imposed.

⁵ Source: http://ncov.mohw.go.kr/en/bdBoardList.do?brdId=16&brdGubun=161&dataGubun=&ncvContSeq=&contSeq=&board_id=&gubun=

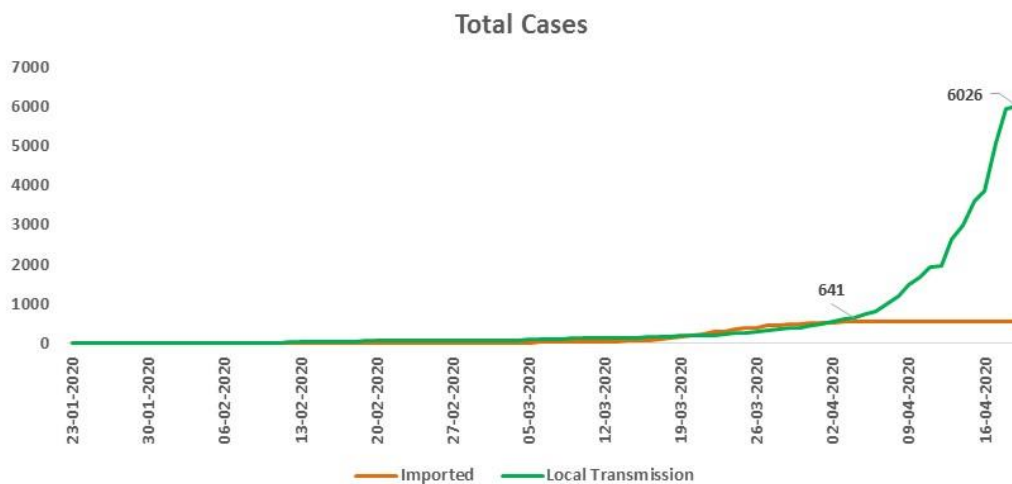
3.2. Singapore's COVID-19 Experience

Singapore is one of the most developed countries in South East Asia. The prosperous city-state with a population of ~ 58 Lakh (5.8 million) won praise as a model of how to control the spread of the virus without lockdowns. Since the infection first broke on January 23, 2020, the country responded with mass testing, quick hospitalization of those infected, aggressive tracing and quarantining of those in contact with infected people that helped in keeping numbers low.

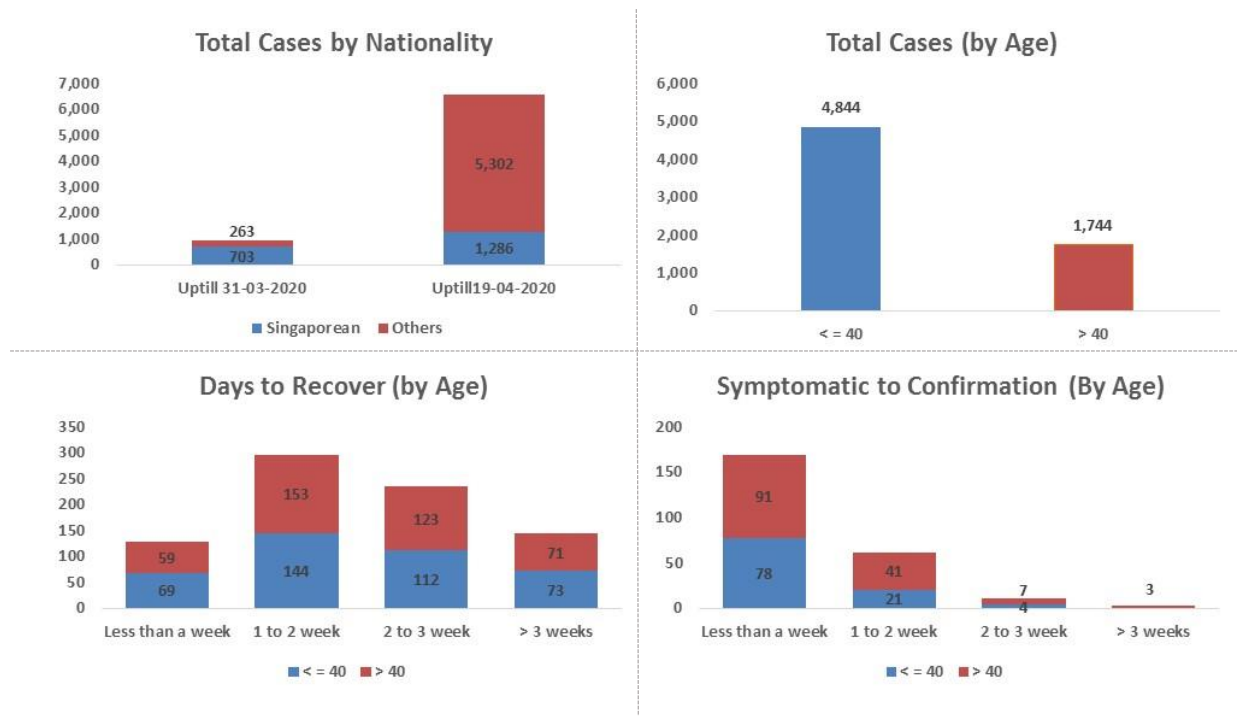
In mid-March, number of new infections started increasing. The city-state responded by tightening entry restrictions and imposed a partial lockdown and strict edicts on social distancing. All the initiatives helped and by end of March 2020, the total confirmed cases in Singapore were only 966.

Since the end of March 2020, the number of cases spiralled and as on May 10, 2020, the total confirmed cases were 23,882 with 20 deaths and 2,721 recovered cases. This has been driven by infection spreading into densely populated dormitories that house migrant workers, highlighted in the graph on cases by nationalities. This cluster impact is one of the main reasons why the age bracket of infected lives is different to what has been witnessed across the world, with younger lives being more affected as shown below.

Analysis based on 6,500 patient level data⁶ are shown below:



⁶ Source: <https://co.vid19.sg>



Extensive tracking, hospitalization and robust health care system also ensured that the mortality rate is significantly low specially given ~ 64% of total population is above the age of 40. Total deaths as at April 29, 2020 were only 14 (0.1% of total cumulative cases).

The case fatality rates are likely to increase since most of the new cases have come in past 3 weeks and there may be some fatalities. Even though they show mild infection and average recovery time is approx. 2 weeks, the total mortality rate is expected to be much lower than the world average.

Important and unique observations

Cluster Impact – Since the start of April, the cases increased significantly. Significant majority of these infections are linked to migrant workers (~ 200,000) living in 43 mega-dormitories across the country. These dormitories house mainly migrants from countries like India, Bangladesh and Indonesia and are mostly left out of the country’s social safety net. This resulted in local officials underestimating the vulnerability of this cohort, who live in cramped dormitories with up to 20 people in a room, resulting in a surge in cases.

To quell the second wave of infection, government has responded with tough new measures involving closure of schools, mandatory face masks, lockdown extension and other policies. These efforts seem to be bearing results, as though the number of infected migrant workers has surged, community-transmitted cases among Singaporeans has been steadily declining.

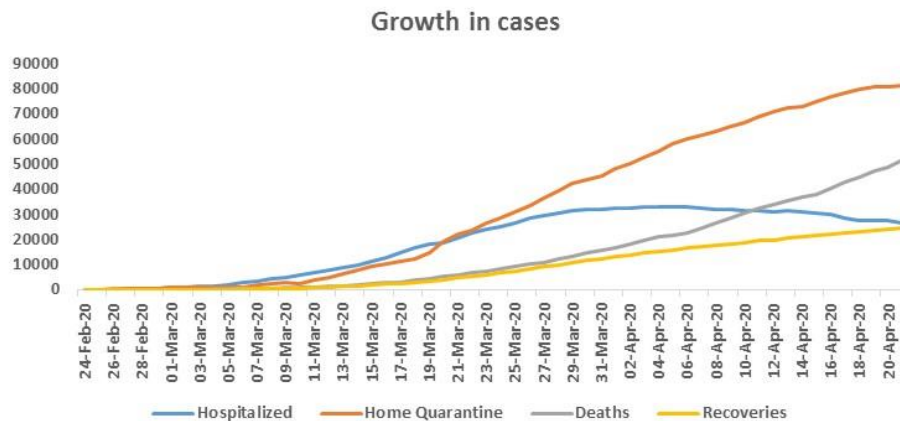
Learnings

Cluster impact is a significant worry for India that has one of the highest population densities globally, especially in migrant population clusters in metro cities. With close to no or very limited social distancing norms being followed and lack of basic hygiene etiquettes, transmission rates could increase significantly.

A single dormitory, S11 Dormitory in Punggol has 2,302 confirmed cases, ~ 12% of total cases, highlights this danger. Indian government’s actions for this section of the society would have a strong bearing on the impact and spread of infection.

3.3. Italy's COVID-19 Experience

As at May 10, 2020, Italy was Europe's centre of active cases with 83,324 active cases. The total of confirmed cases was 219,070 with 30,560 deaths, and 105,186 recoveries or dismissals. The case fatality rate at 13.6%, is almost double of world's average of 7.1%.

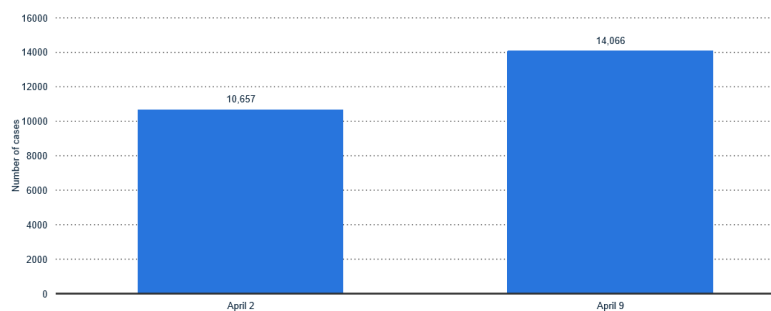


The above chart⁷ shows the progression in Italy. It was one of the first EU nations to ban flights (January 31, 2020) to and from China and also had introduced thermal scanning in airports, yet it is one of the worst affected EU countries. Though officially the spread of COVID-19 began in Feb'20 with its first confirmed cases, some reports claim that the infection in Italy was spreading well before the Government brought in various measures.

It is suspected that as many people got infected with COVID-19 virus during the peak of influenza they were treated for influenza symptoms rather than for COVID 19. This may have resulted in Health facilities treating these patients becoming sites for infection, helping to proliferate the spread of the virus. This along with multiple incidences of crowds at carnivals and soccer matches did not help. It was not until March 12, 2020 that Italy shut all its factories and non-essential production. By that time the infection had spread as can be seen from the above graph. Unfortunately, a significant proportion⁸ (estimated to be around 20%) of the health care personnel too got infected putting further stress on the country's ability to fight the infection.

Number of coronavirus (COVID-19) cases among medical staff in Italy as of April 2020

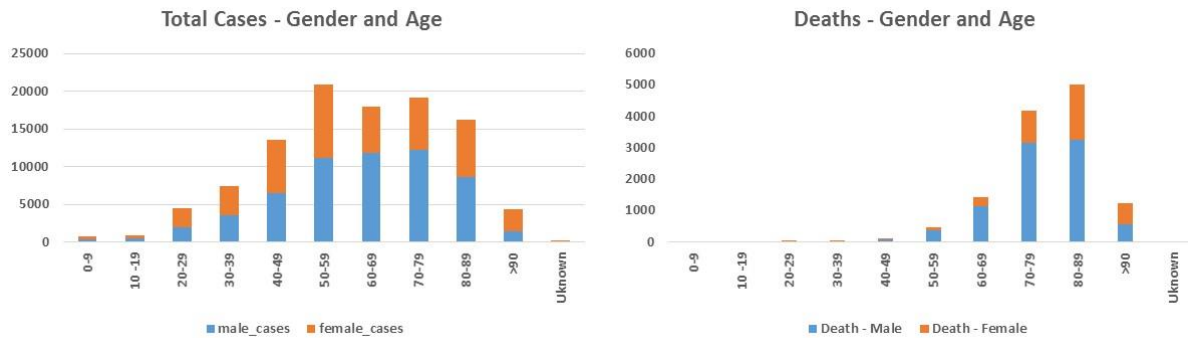
Number of coronavirus (COVID-19) cases among medical staff in Italy as of April 2020



⁷ Source: <https://Kaggle.com> , updated till April 21, 2020.

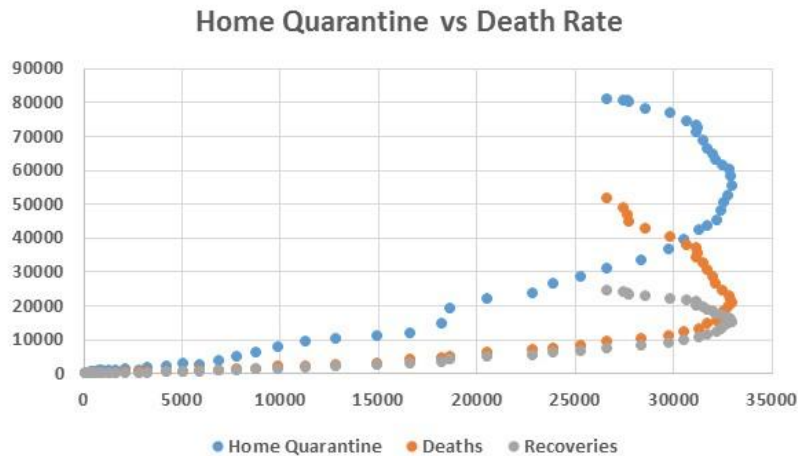
⁸ Source: <https://statista.com>

With Italy having one of the world's oldest populations, it was the age group of 50 years and above that was the hardest hit. Age group of 70+ have contributed to majority of the deaths⁹.



Important and unique observations

Even with one of the world's best healthcare systems, Italy's experience proves that once the system gets stressed and the medical personnel get infected, it can severely affect the country's ability to fight against any pandemic.



As the healthcare system could not cope with increased number of cases, home quarantine cases started increasing. Lack of proper medical care (especially ventilators) started contributing to increase in CFR. Old population was the hardest hit and the graph shows the impact. Lack of social distancing, dense population and testing of only infected cases (initially) also contributed to increasing spread of infection.

Learnings

Though India has a relatively young population, its healthcare system bears no comparison to that of Italy. Any stress on its healthcare system can have a devastating impact on the fight against COVID 19.

Similar to cities like Milan, Indian metros like Mumbai and Delhi are also seeing significant spread of the virus mainly due to the dense population. The problem for India could only worsen, as unlike Italy, the urban population size of India is ~ 12 times that of Italy and density is ~1.75 times. Maintaining social distancing and following lockdown measures, are key in slowing the rate of transmission.

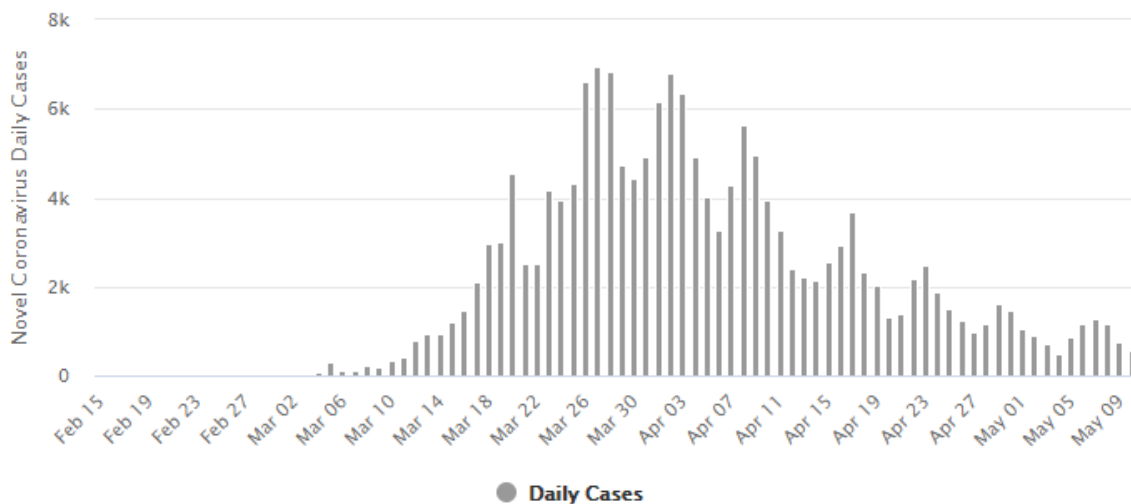
⁹ Source: Kaggle.com. Data until 21st April.

3.4. Germany's COVID-19 Experience

As at May 10, 2020, 171,999 people were infected with 7,569 deaths. Its death rate also known as Case Fatality rate (CFR) of ~4%, is approximately half of the world's average of ~7%. Germany has stood out in its fight and containment of SARS-COV-2 amongst the prominent EU members.

The first case of COVID-19 got confirmed on January 28, 2020 and thereafter the number of infections has followed the graph depicted below with the number of infections as at April 28, 2020 standing at 156,337¹⁰. Daily new cases haven't fallen below 2,000, from the peak of 6,294. Germany appears to be well past its peak. This could be attributed to the high number of tests they have conducted (over 2 million as on April 19, 2020).

Most cases (~67%) are between ages 15 and 59 years old; with women (52%) and men (48%) almost equally affected. 87% of deaths, but only 19% of all cases, occurred in lives aged 70 years or older.



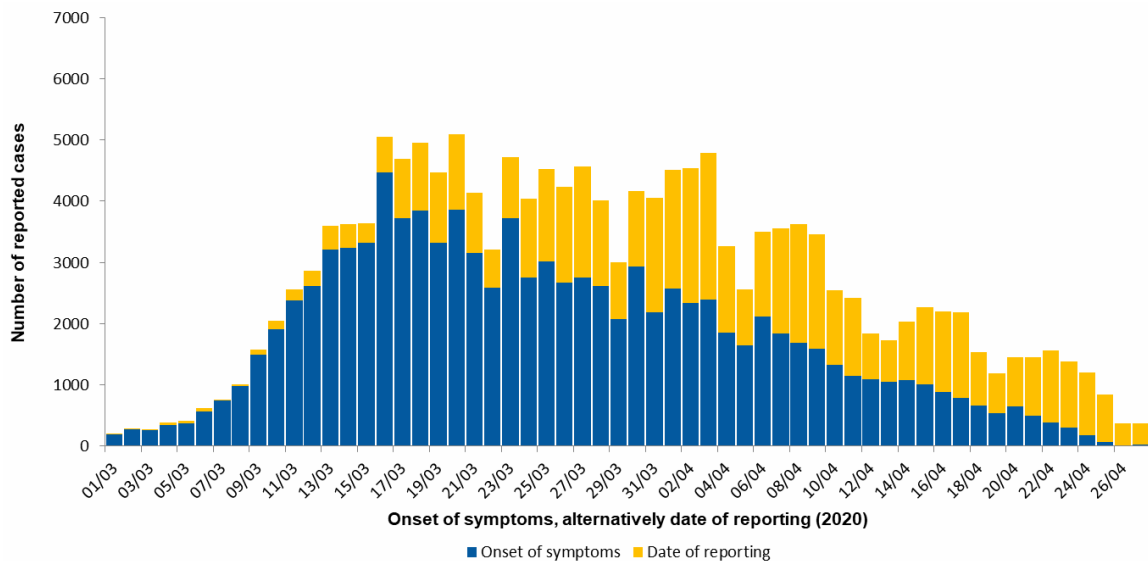
Germany's response had 4 key aspects -

- protection of the particularly vulnerable segments of the population
- diagnostics
- development of drugs and vaccines, and
- information and education.

Important and unique observations

Germany is widely quoted for its high number of testing (over 2 million) and the testing rate is 24.7 per thousand as on April 19, 2020. It is also visible from the gap between onset of symptoms and reporting dates.

¹⁰ Source: www.worldometers.info

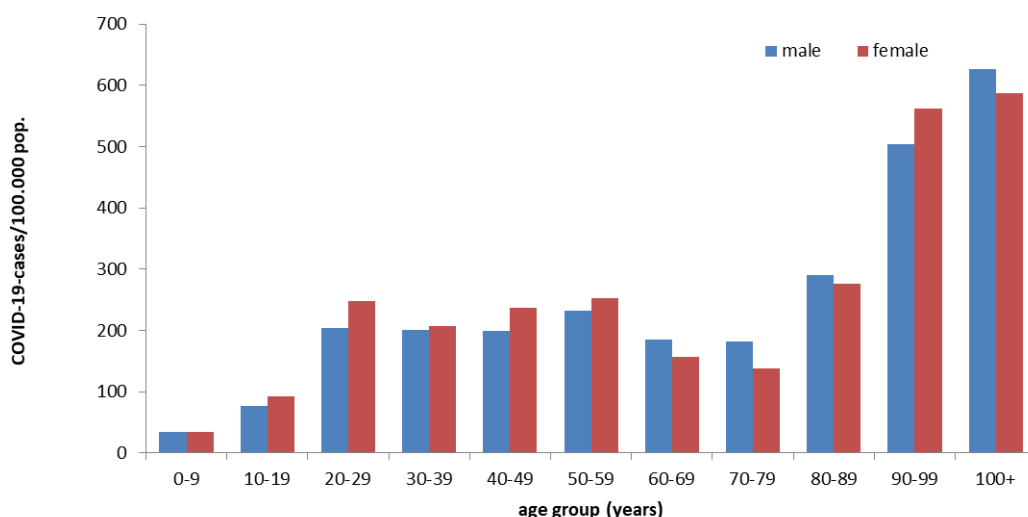


Germany has had remarkably few COVID-19 deaths, which experts attribute partly to its high number of hospital beds and ICU beds. The hospital bed to person ratio is 8.1 beds per 1,000 people and 6.1 ICU beds per 1,000 people as compared to ~ 4 per 1,000 in Italy and USA.

The country was also quick to roll out reliable tests for the COVID -19 coronavirus and initiate strict social distancing measures to prevent the spread. Another reason why Germany was so quick to start testing for COVID-19 is that private labs nationwide were free to offer tests, and as of April 30 have helped the country test 2.5 million people for the disease lagging behind only the USA and Russia.

Learnings

Similar to other countries, observed incidences increase with age¹¹ is provided in the below chart. To illustrate, for ages 20-29 there are ~250 females per 100,000 as compared to ~550 per 100,000 for ages 90-99.



Hospitalisation was reported for 17% of cases. Approximately 75% persons have recovered, based on an Algorithm, as the exact date of recovery is unknown in most cases.

¹¹ Source: https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Situationsberichte/Gesamt.html

The median age of deaths is 82 years. Of the total deaths, 87% were in persons 70 years or older, but only 19% of all cases were from this group.

Gender	Age Group (in years)										
	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100+
Male	0	1	4	8	35	142	394	937	1,437	382	4
Female	1	0	2	4	9	44	132	431	1,250	658	32
Total	1	1	6	12	44	186	526	1,368	2,687	1,040	36

Germany responded to the situation unfolding in China as early as January and had testing established by mid-February. Germany was one of the first few countries to develop a testing system for COVID-19. Its early access to reliable tests for COVID-19 meant that it could get a much better estimate of who was infected, isolate contacts, and treat those who need care. This ensured effective targeted response.

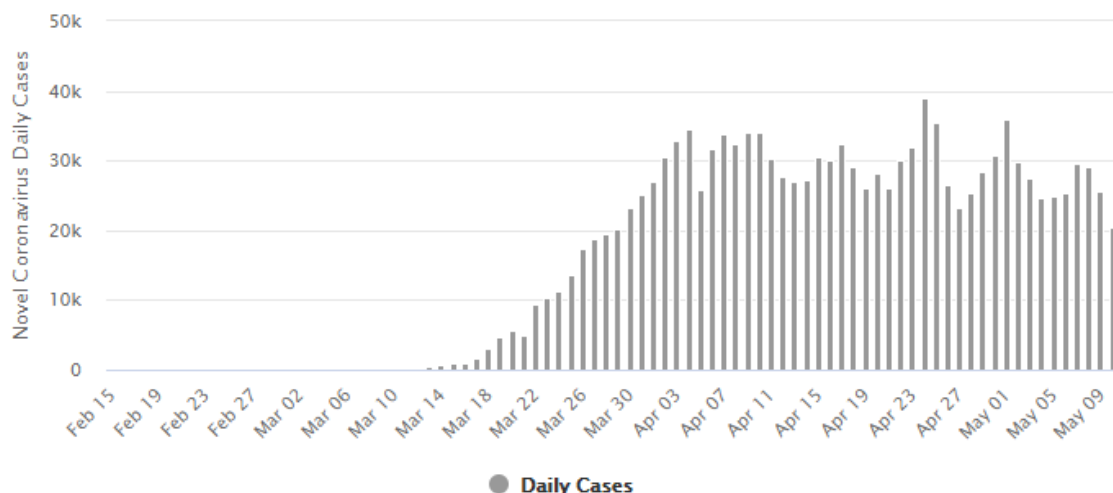
Even with a good bed to person ratio, it ensured that additional beds were available in hospitals for proper care.

India is also revamping the number of beds available as this is key to keep the mortality rates low, but like Germany, more testing post lockdown may be needed to contain the transmission rate.

3.5. USA's COVID-19 Experience

As of May 10, 2020, total number of cases in the USA are 1,369,943, with 1,302,752 Active cases and 80,846 total deaths. Case fatality rate of USA stands at ~6% compared to world average of 7%.

The first case of COVID-19 was confirmed on January 20, 2020 and thereafter the number of cases has increased significantly¹².



The COVID-19 cases in the USA surged past 1,000 on March 9, 2020. This was almost 50 days after the first confirmed case of COVID-19. However, the next 1,000 COVID-19 cases

¹² Source: www.worldometers.info

were recorded within a short period of 3 days till March 12, 2020. Post that, the country has recorded more than 1,000 cases each single day.

In April, the new cases appearing have been around 28,000 each day with the highest of 38,958 cases being recorded on a single day. New York City, the financial capital of the world, has emerged as the epicentre of coronavirus in the world, which has alone contributed to 30% of total cases recorded in the country. Currently, USA became the first country where the virus has infected a sobering number of 1,000,000 lives.

Important and unique observations

Although 17% of the USA population is 65 or older, more than 32% of cases have been recorded for this age bracket. Almost 53% of ICU admissions and 80% of deaths are reported from the older population of the country.

A recent study of COVID-19 cases in the United States estimated a mortality rate of 9% for population aged above 65, 3% for those ages 55 to 64 and less than 1% for those ages 20 to 54. The mortality rates experienced have been lower than Italy's mortality rates but greater than China's mortality rates.

Learnings

As per the editorial article stated in "The Lancet" magazine as on March 28, 2020, the initial slow response has been criticised for the wide spread of the virus.

Many countries including the USA are still not following WHO's clear recommendations on containment (widespread testing, quarantine of cases, lock downs and social distancing) and have not implemented appropriate measures to control the lockdown.

4. Projection Models

One of the core objectives of the Group was to develop a statistical model for projecting COVID-19 scenario in India. The model is expected to give a view on the expected number of cases and deaths / recovery over the next two months.

Though there are many statistical models to model a pandemic scenario, coming from first principles, the Group primarily focused on the following two multi-state models below.

3) HIRD (Healthy, Infected, Recovered, Dead) model

4) SEIR (Susceptible Exposed Infected Removed) model

Both the models have been calibrated and validated on data for COVID-19 cases in India. Further, we have instances of back testing and captured in Appendix B.

The projection accuracy from both the models against the actual data has been in the range of 97% - 99%. High accuracy of both the models also help calibrate the results from two different perspectives.

Given the high accuracy in the projections and estimates from both the models and alignments in the outcome, the Group has used the HIRD model for projecting the Confirmed, Active, Recovered and Death cases up to June 30, 2020.

4.1. Data

Data has been collected from various sources as given below.

- <https://ourworldindata.org/coronavirus-data> - used for getting historical data contains day to day confirmed cases and deaths because this data matches with <https://www.mohfw.gov.in/> daily figures declared at 8:00 am.
- <https://www.worldometers.info/coronavirus/country/india/>- used for getting historical data contains day to day recoveries.
- <https://api.COVID-19 india.org/csv/> - used for patient level data.
- <https://www.mohfw.gov.in/> - used for daily updates.

Since the collected data were in different formats, it was converted into a single format, for which a data dictionary has been developed. Data contains day to day figures for confirmed cases, deaths and recoveries from January 30, 2020 till date. Data is being updated on daily basis.

For the purpose of testing the model's outcome, projections, numbers have been collected from the website of Ministry of Health and Family Welfare (<https://www.mohfw.gov.in/>). On the website, numbers are updated twice daily, once at 8:00 am and the other at 5:00 pm. As the model has been calibrated on the basis of data declared at 8:00 am, for the purpose of testing the similar updates have been used. Back-testing was mainly done for the projected cumulative cases, cumulative deaths, cumulative recoveries and active cases with an acceptable error limit of +/- 5%. Both the models, HIRD and SEIR, have been explained in detail in the following sections.

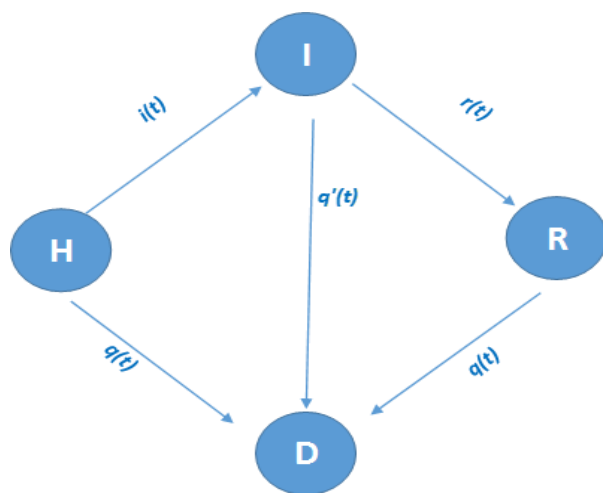
5. Model 1: HIRD (Healthy, Infected, Recovered & Dead) model

The HIRD model is a multi-state Poisson model. Compared to the SEIR model, the HIRD model in addition to the total confirmed cases, also projects expected recovery as well as expected deaths.

5.1. Approach and Assumptions

In this model, 4 states are considered, namely:

1. Healthy (H)
2. Infected (I)
3. Recovered (R)
4. Dead (D).



where,

$i(t)$ -> Probability of getting infected
 $r(t)$ -> Probability of getting cured
 $q(t)$ -> Population Mortality
 $q'(t)$ -> Case Fatality Rate (Death due to COVID 19)

The HIRD model is a basic construct that the Group has come up with, from a basic intuitive perspective. But at the same time, it is difficult to obtain the underlying data of transition from healthy state to infected state and hence there is reliance on back testing and calibration, while determining the state transition probabilities.

It is notable that the data for India contains only 1 case for each of the dates, 30th January, 2nd February and 3rd February. Whereas the numbers from 2nd March onwards appear to be much more consistent. Therefore, for the purpose of calibrating the model data from February 29, 2020 to April 14, 2020 has been used.

What adds credibility to the whole process is the result of back testing that is captured in Appendix B.

5.2. Calibration methodology

The following assumptions were required in order to generate the results. Where possible, data was used to derive the assumptions. However, significant actuarial judgement was required to fine-tune and project most of the assumptions listed below.

Where possible, this has been deliberated in the points below.

Start Date

- Although the first case in India was observed on January 30, 2020, for the purposes of our model, we have assumed a start from February 29, 2020 when the number of cases, started to increase in India.
- While this may have typically led to errors in calibration, we have not seen any outliers as a consequence of this approach.

Transmission rate

This is the rate at which an infected individual could end up infecting another set of healthy individuals daily. While this state is intuitive, no direct data is available to calibrate the parameters. Transmission rate is used to project the expected number of infected cases.

$$\text{Infected (t+1)} = \text{Infected (t)} * (1 + \text{Transmission Rate (t)})$$

However, extraneous factors, e.g. prevailing social distancing norms, active communication from various stakeholders, alertness from the government, lockdown measures taken, etc. would have a significant bearing on the rate of transmission. Hence, the following dates have been considered from differentiating the transmission rates.

- Day 0 to Day 9 -> The start of the pandemic in India on January 30, 2020 to March 9, 2020, when governments across the world were learning the scope of the crisis, and no control measures had been implemented in India. To calibrate the transmission rate for this period, the chi squared total of this period plus 27 days, i.e. from February 29, 2020 to April 5, 2020, has been minimized using Excel Solver.
- Day 10 to Day 24 -> From March 10, 2020, when rigorous monitoring of incoming international flights was done and people were advised to follow social distancing norms till 25th March when complete nationwide lock-down was implemented. Similarly, to calibrate the transmission rate for this period, the chi squared total from 10th March to 24th March has been minimized using Excel Solver.
- Day 25 to Day 45 (Lockdown 1.0) -> Once Lockdown was enforced, it helped in reducing the day to day transmission rate. So, to analyse and incorporate the effect of this in the model, one transmission rate has been introduced for the period from 25th March to 14th April (21 Days) by minimizing the chi squared total.
- Day 46 to Day 63 (Lockdown 2.0) -> the Lockdown was continued even after the 21-days period ended, it helped in further reducing the day to day transmission rate. So, another transmission rate was introduced for next 18-days i.e. from 15th April to 3rd May.
- Day 64 to Day 78 (Lockdown 3.0) -> Lockdown continues after the completion of second phase, it is likely to help in further reducing the day to day transmission rate. So, one more transmission rate has been introduced for next 14-days i.e. from 4th May to 17th May .
- Post 17th May, it is expected that all restrictions are likely to be removed, however, social distancing norms will be maintained. One more transmission rate has been introduced for the period post 17th May which is expected to be the future infection rate.

Detection of infection

- The proportion of asymptomatic cases: Limited information from the government suggests that around 70%¹³ of the infected population may be asymptomatic.
- Average time for asymptomatic cases to stop being infectious: No data from India is available regarding this assumption. However, globally, on an average, 14 days is expected to be adequate quarantine period after getting exposed to the virus, we believe the mean would be around 10 days, so that the probability of being infectious after 14 days is only about 8%.
- Mean of the distribution around the incubation period for the symptomatic lives: International literature suggests this might be around 5.2¹⁴. Since we are using a Poisson distribution, we have assumed a mean of 5.5.

Mortality / Recovery

- Mortality Rate assumptions have been derived by minimizing the chi squared total of death numbers and applied to the cohort of lives that are confirmed as being COVID-19 positive on any given day.
- It has been observed from the experience of the other countries that age and pre-existing conditions (especially cardio-vascular conditions) are highly correlated with death. Given limited information from our market, we have decided to use a single death rate for now.
- The remaining lives are assumed to recover.
- It is assumed that from the date of confirmation of COVID-19, the deaths and recoveries follow a Poisson distribution with a mean of 7 days and 18.25 days respectively.
 - This has been derived by minimizing combined chi squared number total of deaths and recoveries.

5.3. Parameters estimated

The derived parameters are as below:

Transmission rates:

Day (from 29 February,2020)	1 - 9	10 - 24	25 - 44	45 - 63	64 - 77	17 May till end May	June '20
Best Estimate	1.737	1.291	1.178	1.132	1.132	1.120	1.100

¹³<https://timesofindia.indiatimes.com/india/69-of-cases-found-positive-were-asymptomatic-icmr/articleshow/75282825.cms>

¹⁴<https://www.worldometers.info/coronavirus/coronavirus-incubation-period/>

Death and Recovery Rates:

Death Rate	5%
Recovery Rate	95%

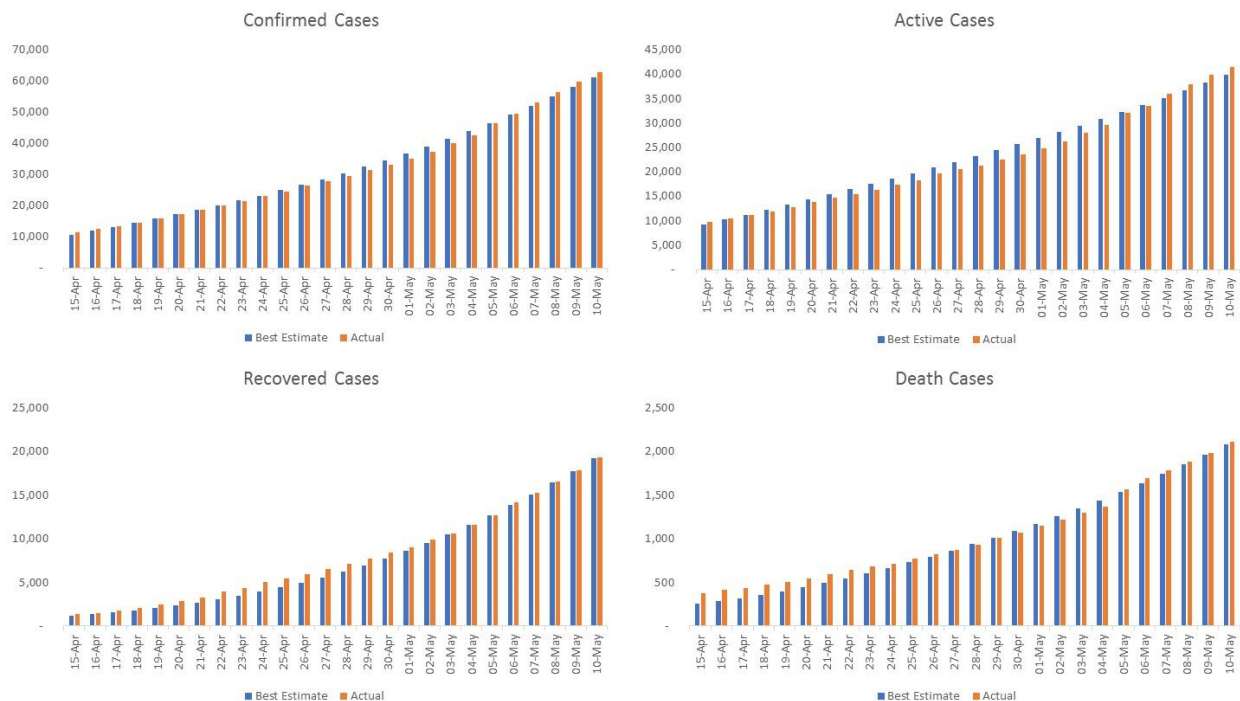
Time – Lag Distributions:

Time-lags such as Incubation Period, Time to Recovery & Time to deceased are not assumed to be constant. Instead it was assumed that all these follow Poisson distribution with different means. All these lambda values have been derived using excel solver by minimizing the respective chi squared totals and then adjusted with the actual scenarios / numbers

- Recovery Period (Asymptomatic) ~ Poisson(10)
- Incubation Period ~ Poisson (5.5)
- Recovery Period (Symptomatic) ~ Poisson(18.25)
- Time to Deceased ~ Poisson (7)

5.4. Modelled vs Actual

Model was calibrated with data available for the first 45 days, i.e. data till April 14, 2020 and then projected till May 10, 2020. The differences between the projected v/s actual cases are depicted below.



The graphs show the model projection (best estimate) vs Actual cases. Given the data availability, the model fit seems reasonable.

The Group also looked at SEIR to independently calibrate the projection (especially confirmed cases)

6. Model 2: SEIR (Susceptible Exposed Infected & Removed) model

SEIR is one of the well-known compartmental models. A compartmental model is a mathematical modeling of an infectious disease, which in this case is COVID-19. It is a multi-state model which models the flows of lives between four states: susceptible (S), exposed (E), infected (I), and removed (R). Each of those variables represent the number of people in those states.

An additional stage “Quarantined” has also been considered. The quarantined stage has been assumed as once an individual is tested positive, he/she will be isolated. Hence, his/her ability to further infect others will significantly reduce. Further, the removed state has been split into recovered and dead.

So in total there are 6 different states that have been modelled.

6.1. Approach and Assumptions

Each individual belongs to any one of the 6 states:

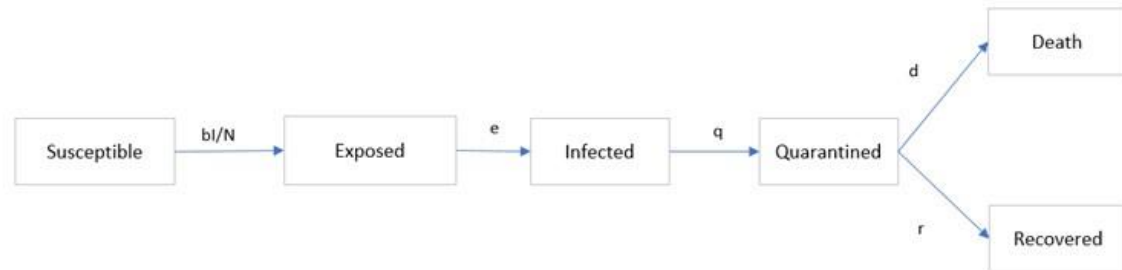
- **Susceptible (S):** Healthy Individuals
- **Exposed (E):** Individuals who are infected but are not yet infectious.
- **Infected (I):** Individuals who are infectious but have not yet been tested. This is the group infecting people from the Susceptible group.
- **Quarantined (Q):** Individuals who have been tested positive and have been quarantined/hospitalized. These individuals are then not able to infect more people.
- **Recovered (R):** Individuals who have recovered.
- **Death (D) -** Individual who have died

Key Assumptions:

- A person is in exposed state for the duration of incubation period.
- To estimate the initial number of exposed, it is assumed that the date on which the person enters the exposed state is the date of admission minus (incubation period +days to testing).
- All demographic changes in the population (i.e., births, deaths, and ageing) are ignored.
- This is a closed system with a constant population size.
- As a person enters the “Recovered” stage, he/she cannot be under “Susceptible” again.
- Exposed, Infected and Quarantined migrate at a constant rate.

6.2. Calibration methodology

Individuals transition between the different states in the following manner:



Here,

- N : total population in which the disease can spread
- S_t : Number of susceptible individuals on day t
- E_t : Number of exposed individuals on day t
- I_t : Number of infected individuals on day t
- Q_t : Number of quarantined individuals on day t
- R_t : Number of recovered individuals on day t
- D_t : Number of individuals died on day t
- b : expected number of people an infected person infects per day (R_0 per day). Hence, $b =$ number of contacts per infected person per day * probability of transmission
- e : Proportion of exposed being infectious per day, $e = (1/\text{incubation period})$,
- q : Proportion of infected quarantined per day. $q = (1/\text{number of days between a person getting infected and diagnosed})$.
- r : Proportion of quarantined recovered per day. $r = (1/\text{time to being recovered})$.
- d : Proportion of quarantined died per day. $d = (1/\text{time to die})$.
- R_0 : the total number of people an infected person infects. $R_0 = b \cdot \text{duration of infection} = b/q$

The model is described by the following differential equations:

$$\frac{dS}{dt} = -\frac{bSI}{N}$$

$$\frac{dE}{dt} = \frac{bSI}{N} - eE$$

$$\frac{dI}{dt} = eE - qI$$

$$\frac{dQ}{dt} = qI - rQ - dQ$$

$$\frac{dR}{dt} = rQ$$

$$\frac{dD}{dt} = dQ$$

This resolves to the following difference equations:

$$S_{t+1} = S_t - \frac{bSI}{N}$$

$$E_{t+1} = E_t - \frac{bSI}{N} - eE_t$$

$$I_{t+1} = I_t - eE_t - qI_t$$

$$Q_{t+1} = Q_t + qI_t - rQ_t - dQ_t$$

$$D_{t+1} = D_t + dQ_t$$

$$R_{t+1} = R_t + rQ_t$$

The total number of confirmed cases at time t is given by $Q_t + R_t + D_t$

S_0 : the entire population is susceptible at time 0

The only reliable data that was consistently and readily available was for cumulative Active, Recovery and Death cases for the country. The granularity of data required to estimate the transition probabilities between the various states was not available.

Hence, it was decided to estimate the population exposed and infected based on the active cases at a given date. So, to forecast the number of individuals under each state, we need to set the start date and calculate the number of lives in each state on that date.

It has been observed that:

- There is a gap of almost a month between the first three and subsequent cases.
- Post March 22, 2020, no international flight landed in India. Hence, people who had got the infection by travelling to other countries came to India till that date.
- Lockdown was enforced from March 25, 2020. The lockdown was enforced relatively early (compared to other developed countries) and the total number of cases were very low. Hence, we decided to have March 24, 2020 as the base date.
- The lockdown measures have since then been largely constant. There were 489 confirmed cases and 33 removed cases reported till then. This gives us the value for Q (456) and R (24) and D (9) on March 24, 2020.
- Using these estimates as the base, we calculated the number of individuals in the Infected state and Exposed state. Assuming an average incubation period of 5 days and average time in Infectious state for 3 days (during the pre-lockdown phase), lives in Exposed and Infected state were estimated.
- The model then projects future values in each stage based on the difference equations and the parameter values provided.

In order to incorporate the impact of lockdown and other measures, the timeframe was divided into three sections:

- Pre lockdown Phase
- Lockdown Phase
- Post lockdown Phase

It is assumed that the parameter values are different for the three phases as:

- Interaction of individuals is limited
- Lockdown slowed the growth of pandemic.
- The number of cases post the second lockdown are dependent on the measures taken (whether there is an extension of lockdown or not).
- Government testing strategies and other measures are changing with time.

Further, it is assumed that N (available population) is a proportion of the total population. This is because it is practically not possible to have the entire population being in the susceptible state. However, for the purpose of this model, since lives in the Exposed and Infected state are estimated based on Active cases as at the base date, lives at Susceptible state has no effect on the modelled and projected cases

6.3. Parameters Estimated

Following parameters have been estimated for the model

Phase	Pre-Lockdown	Lockdown	Post Lockdown
Dates	30 th January – 23 rd March	24 th March – 17 th May	18 th May Onwards (assumed)
Transmission rate per day	0.9	0.72	0.8
Average incubation period (days)	5	5	5
Average lag between infectious & Testing (days)	3	2	1.1
Daily recovery rate	1.43%	3.03%	3.33%
Daily death rate	0.50%	0.36%	0.29%

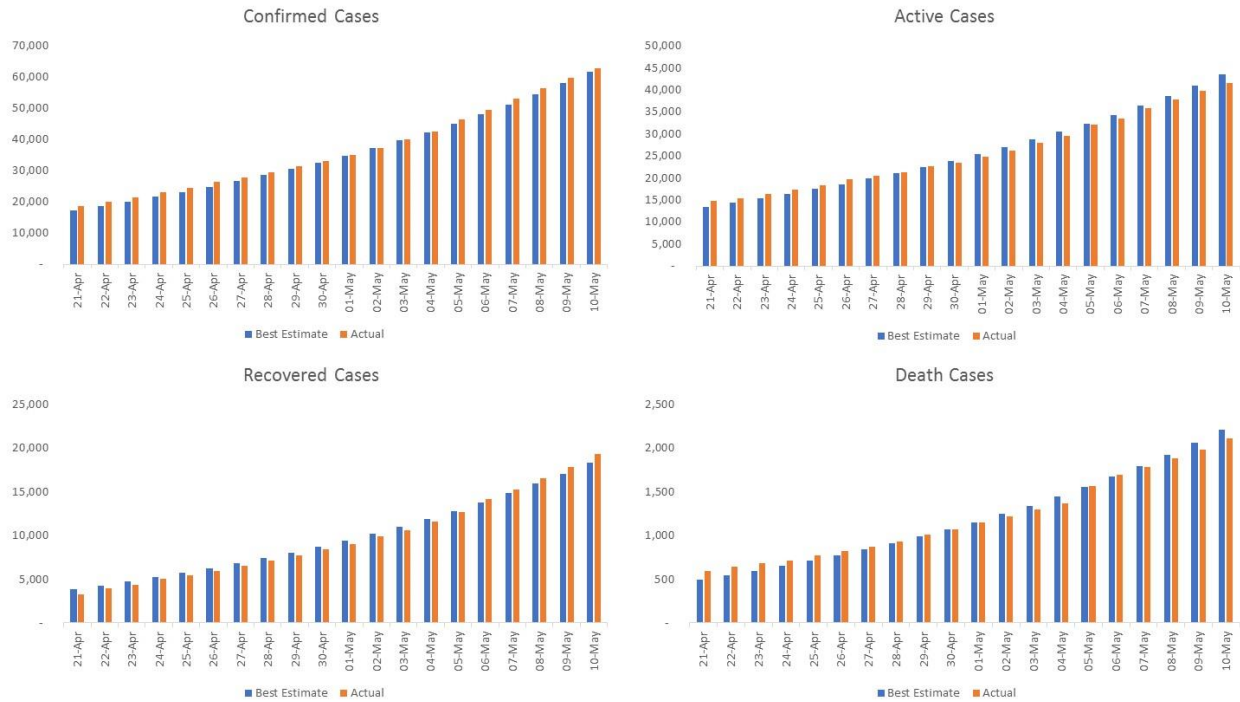
There is no published study, at the time of writing this report, that has empirically established the above parameters and hence, the parameters have been estimated based on anecdotal evidences as well as observing the patterns in the actual data.

Hence, any error in the reporting of the data is also part of the parameters' estimation. We have used actual data till April 20, 2020 to fit the model and rest is used to compare the actual cases vs projected.

While estimating the parameters, it has been ensured the Mean Absolute Percentage Error (MAPE) is within 5% over the modelling period.

6.4. Modelled vs Actual

Model was fitted using data until April 20, 2020 and was validated against the actual data until May 10, 2020. Given the validation results, model calibration seems reasonable.



7. Projections

Both the models have performed well on back testing, with projected results being very close to the actual results over the subsequent fortnight. Subsequently, HIRD model has been used for projection, with the SEIR model proving a sense check on the projected cases.

This projection is highly susceptible to the following:

- Social distancing norms followed, similar to that during the lockdown period
- Contact tracing and the testing capacity to be enhanced
- Availability of quarantine facilities and Intensive Care facilities are increased

The Government has extended the lockdown by 2 weeks till May 17, 2020, with a few relaxations for certain geographies and accordingly permit extent of movement of essential goods within the relevant geographies. As the impact of relaxations will come with a lag, we expect a spike in cases during the latter half of this fortnight, i.e. week commencing May 11, 2020.

Additionally, the confirmed cumulative cases are likely to increase further if the lockdown is fully lifted by May 17, 2020. This is because while individuals may follow social distancing norms and maintain personal hygiene, the extent of social distancing is only going to be adverse once lockdown is lifted and public transport starts. The effect of this would only be amplified for densely populated cities, with a majority of workforce dependent on public transport for travel to work. Hence, we may experience another spike in cases during the week starting May 25, 2020.

In such a scenario, the peak may get further shifted by a couple of weeks. However, if the social distancing norms and actions of individuals appear to be going out of control, the Governments, both central and state, may have to consider a second wave of lockdown. Another measure of this risk could be a significant reversal in the average time taken for the number of cases to double, which is hovering between 11 to 12 days in the first week of May'20.

The testing capacity is also being constantly enhanced. The testing criteria too is being broadened, as the availability of test kits and quarantine facilities improves. While this is likely to increase the daily cases, it will effectively reduce the transmission, facilitate early identification of individuals and their quarantine, hence improving the overall recovery rate. This is because a significant proportion¹⁵ of around 70% are likely to be asymptomatic, i.e. they may not develop any symptoms while testing positive and during the quarantine period.

7.1. Daily projections (cumulative figures)

The impact of trying to move towards the earlier normalcy by re-opening offices and regular markets is likely to be seen in coming days and the intensity of the impact will also depend on how each of the State governments, in conjunction with the Central Government, enforce the conditions for relaxation, and how the citizens of India follow the social distancing norms, with and without the lockdown conditions being imposed.

¹⁵ Source: ICMR

Given the uncertainties and extent to which an assumption could have an impact on the final number, we are projecting cases for 4 different scenarios.

	Phase	May 4 to May 17	May18 to end-May	June 2020
Worst-case	Lockdown status	Lockdown - with relaxation	No lockdown	
	Social distancing norms	Not followed uniformly	Not followed	
	Transmission Rate for Jun'20	1.143 (7:1)		
Lockdown- ceases	Lockdown status	Lockdown - with relaxation	No lockdown	No lockdown
	Social distancing norms	Followed		Followed partly
	Transmission Rate for Jun'20	1.125 (8:1)		
Best- estimate	Lockdown status	Lockdown – with relaxation		
	Social distancing norms	Followed		
	Transmission Rate for Jun'20	1.100 (10:1)		
Ideal Scenario	Lockdown status	Lockdown – limited relaxation		Lockdown – with relaxation
	Social distancing norms	Strictly followed		
	Transmission Rate for Jun'20	1.067 (15:1)		

Even though the data available at the time of finalising the above numbers is as on May 10, 2020, the full impact of the past lockdown is also yet to emerge due to the incubation period of the disease and the asymptomatic carriers.

Therefore, whether the social distancing norms have been followed strictly in the previous lockdown phases can still influence how the future may pan out. The impact of this has been reflected in the model by changing the transmission rates. Transmission rate is used to estimate the cumulative number of infected people on the following day. Historically, the assumption calibrated is as follows (as described in Section 5.3). The assumptions used for the other three scenarios are captured below.

Day (from 29 February,2020)	1 - 9	10 - 24	25 - 44	45 - 63	64 - 77	17 May till end May	June '20
Best Estimate	1.737	1.291	1.178	1.132	1.132	1.120	1.100
Lock down - ceases	1.737	1.291	1.178	1.132	1.132	1.125	1.125
Ideal Scenario	1.737	1.291	1.178	1.132	1.130	1.090	1.067
Worst-case	1.737	1.291	1.178	1.132	1.140	1.143	1.143

The **Best-estimate scenario** and **Lockdown-ceases scenario** assume that the social distancing norms were duly followed during the lockdown. However, in the former it is assumed that the social distancing norms during the lockdown continue to be followed even after May 17, 2020, while in the latter scenario it is assumed that the social distancing norms get relaxed once the lockdown ends on May 17, 2020.

Even if the lockdown ceases, we assume that since people would have inculcated the good habits and will continue to partly follow the social distancing norms, the transmission rates continues to reduce further, albeit at a marginal rate. There could still be some pockets where because of a lack of formal lockdown, untoward incidences lead to an adverse outcome.

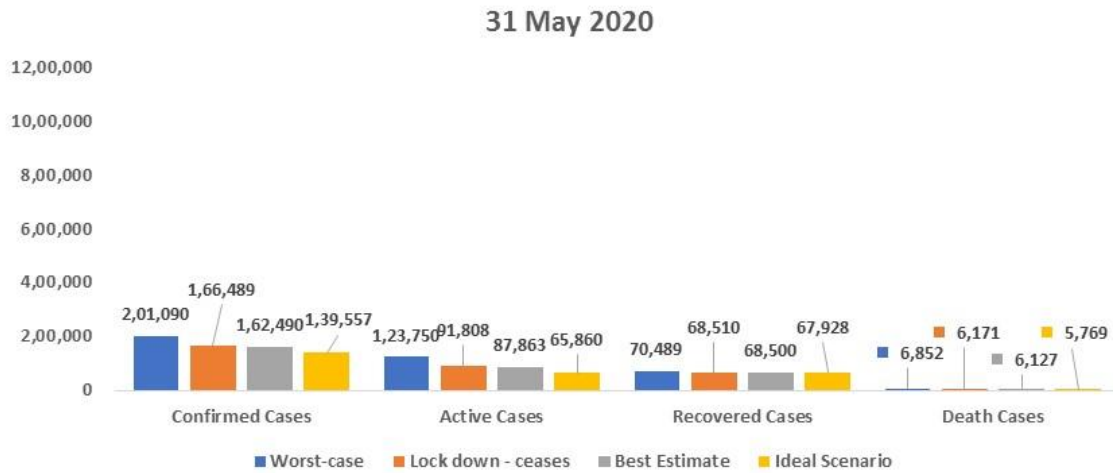
For **Lockdown-ceases scenario**, a transmission rate of 1.125 per day would mean for every 1,000 infected people on a given day, there would be 1,125 infected people next day. It may also be interpreted as that for every 8 infected individuals on a given day, there would be 1 additional infected individual on the next day, taking the tally to 9.

On the other hand, if the social distancing norms like that in a lockdown are followed as they have been in the past, the transmission rate will continue to decrease significantly. In the long run, for the **Best-estimate scenario**, a transmission rate of 1.100 per day would mean for every 1,000 infected people on a day, there would be 1,100 infected people the next day. Hence, for every 10 infected individuals on a given day, there would be 1 additional infected individual on the next day, taking the tally to 11.

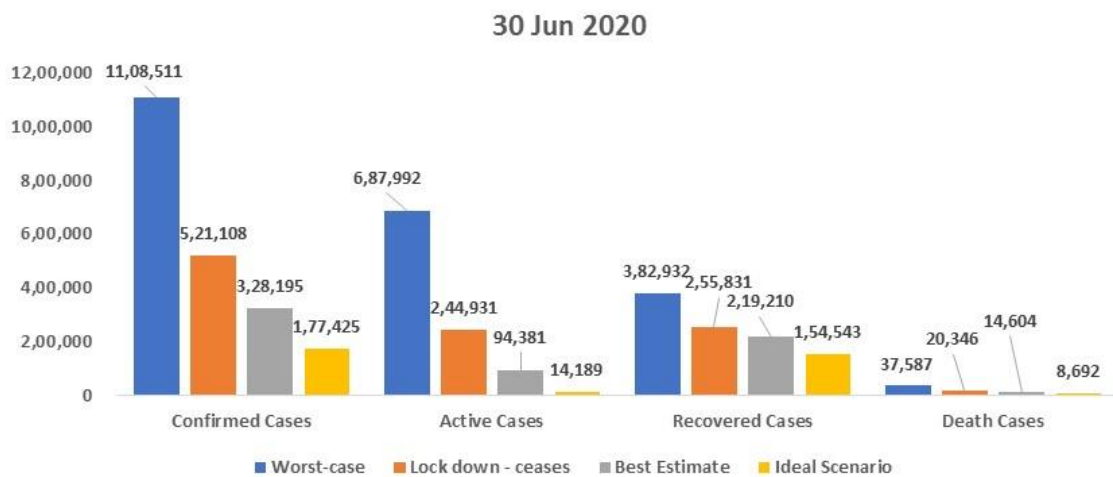
In an optimistic scenario, if the social distancing norms have been very strictly followed, and continue to be done so in the future, this could help significantly reduce the transmission probabilities as modelled in the **Ideal scenario**. This scenario also assumes that the state governments do not offer many relaxations above what have been mandated by the Central government during the third phase of the lockdown, and that the lockdown continues beyond May 17, 2020. Additionally, this scenario assumes that social distancing and maintaining personal hygiene are engrained in individuals, and hence the transmission rate has been taken to be slightly better even in the third phase of the lockdown. This helps in significantly containing the spread in India. In the long run, a transmission rate of 1.067 per day would mean for every 1,000 infected people on a day, there would be 1,067 infected people the next day. Hence, for every 15 infected individuals on a given day, there would be 1 additional infected individual on the next day, taking the tally to 16.

The **Worst-case scenario** is just to illustrate an extreme scenario, wherein people have not been following social distancing norms and guidelines issued by the Government. In this case, the transmission probability is higher than the other scenarios and continue to gradually increase during the projection period. While the social distancing norms may be followed in majority of the districts, there could be a few pockets where these are not adhered to. In order to capture the effect of these localised events and at an aggregate level, a nominal mark-up in the transmission rate is assumed. This causes the peak of active cases to be considerably delayed in India. Under the scenario, a transmission rate of 1.143 per day would mean for every 1,000 infected people on a day, there would be 1,143 infected people the next day. Hence, for every 7 infected individuals on a given day, there would be 1 additional infected individual on the next day, taking the tally to 8.

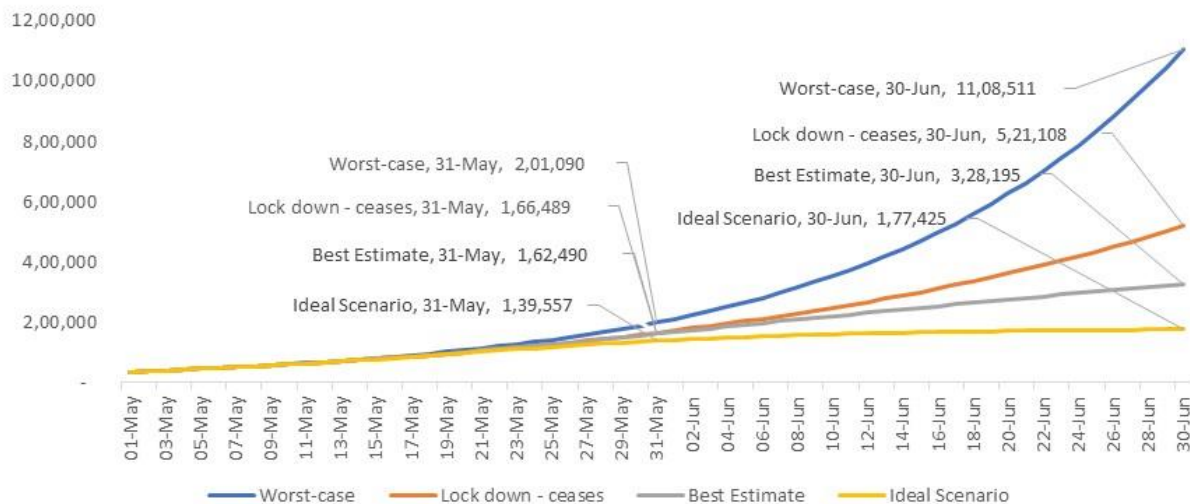
The graph below shows the impact of each of the four scenarios described above, on the projected cases as on **May 31, 2020**.



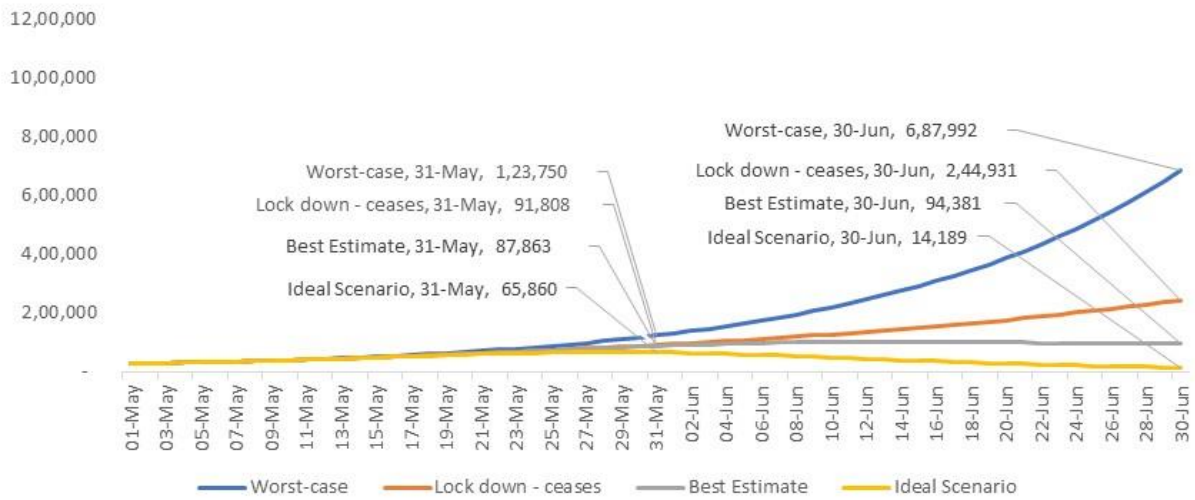
The graph below shows the impact of each of the four scenarios described above, on the projected cases as on **June 30, 2020**.



Confirmed Cases:



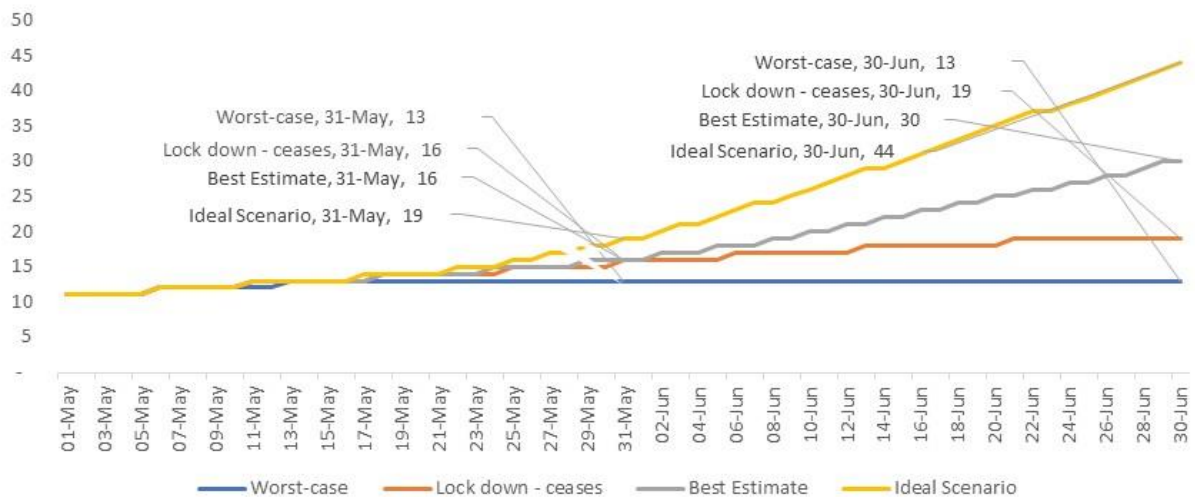
Active Cases:



If the active cases are being analysed, it is very clear that there is no peak in "Worst-case" and "Lockdown ceases" scenarios. Highest number of active cases would be observed in "Best-estimate" and "Ideal" scenarios during mid of June and end of May respectively with numbers around 1,02,000 and 66,000 respectively.

After observing the peak in both the scenarios, active cases start reducing at different paces, faster in case of the "Ideal" scenario.

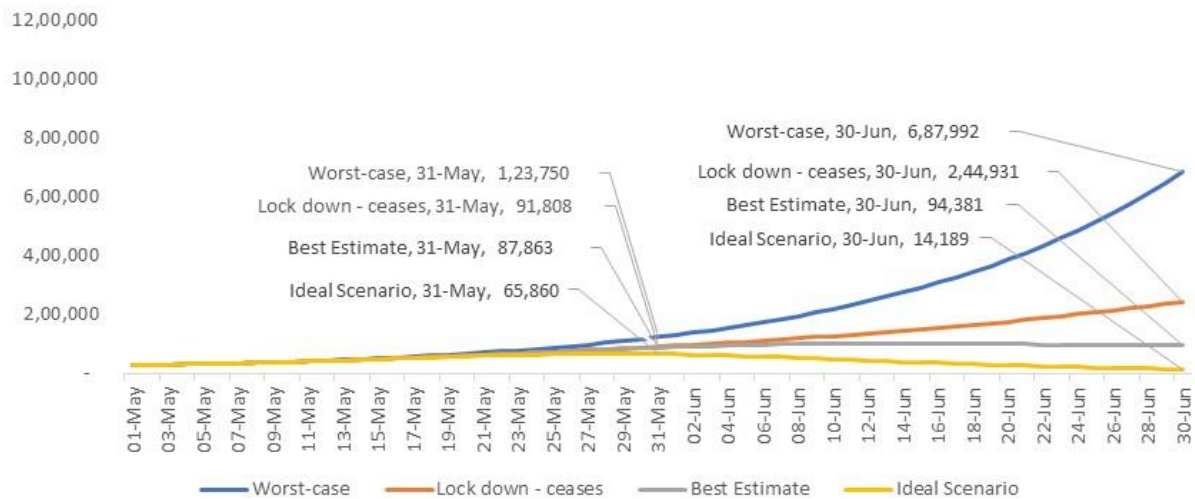
Doubling Rate (in days):



Doubling Rate (in days) can be understood as, on any given day, number of cumulative confirmed cases took x days to get doubled. Current actual doubling rate is around 11-12 days.

In case of "best estimate" scenario, the doubling rate is expected to go up and be around 30 days by end of June, i.e. the cumulative number of confirmed cases as on June 30, 2020 will be approximately double those of May 31, 2020.

Recovered Cases:



Death Cases:



7.2. Limitations of Projections:

- Even when the scenarios estimate the impact of the social distancing norms not being adhered to, they still assume that the general populous follows the norms, and that there are only limited pockets which flout the requirements. The model assumes that the individuals at an overall level continue to behave responsibly and maintain social distancing norms, albeit to different levels, even in the areas where lockdown is lifted.

- The model does not consider “re-infection” as a possibility for now, since data around repeat infections is scarce and unreliable at the time of creating this model and generating the results
- The model does not attempt to anticipate or project the impact on economic conditions.
- The model is only focussed on projecting expected cases from COVID-19 in India in aggregate, and does not work at a state or regional level.
- The model does not take into account the differences in density of populations in urban India and rural India.
- The model does not attempt to project second order impacts of COVID-19 on mortality, such as lack of availability of medical facilities, or increase in suicides etc.
- Though the model makes an assumption with regards to the expected number of days spent in hospital due to COVID-19, this is purely with the intention of calculating the number of live cases on any given day. This assumption has not yet been evaluated or rigorously tested for use in health plans that require morbidity assumptions.
- The model is based on assumptions regarding possible parameters that might reflect the spread of COVID-19. Therefore, it does not “predict” the future, it only details a funnel of possible outcomes.
- The model assumes there are no “super spreaders” people or events, that are outliers and due to which the virus spreads to a lot more people than the average transmission rate indicates.

8. Products: Global trends and coverage

We have studied several products and policy interventions by the insurers across various geographies, with the aim to develop a global perspective and learn from the best practices around the world. This aided us to explore conceivable ideas for new product(s) that may be more amenable to the Indian Insurance sector.

Insurers have recognised the financial hardship faced by their customers during these trying and uncertain times. They resorted to the following major interventions with an aim to soften the financial impact of COVID-19 and to overcome the barriers created by lockdowns:

- Assured the policyholders of non-applicability of force-majeure clause in case of COVID-19 death claims.
- Providing additional time for payment of renewal premium in case of health insurance policies and motor third party insurance.
- Setting alternative modes to continue contactless operations and underwriting practices.
- Reduced or no sharing of costs sharing
- Discounts or relaxation in premium payment terms and extension of coverage.

Although it may be too early to comment, but Insurers as well as reinsurers across the world will be forced to quickly devise new products to cater to the protection needs of the insured in various sectors.

Insurers will have to revisit the existing insurance contracts and make suitable modifications, driven by both consumer demand and risk mitigation.

Some of the measures undertaken by insurers at global level are as follows:

- In the USA, most of the insurers have waived all types of cost sharing on COVID-19 related diagnosis and treatment. To encourage contactless transactions, tele-medication/virtual evaluation and management benefits are offered at zero co-pays.
- In China, one of the major life insurers, has launched a special pre-compensation program for existing policies and provided agents 10 million free policies totalling 1 trillion RMB (about US\$10,000 per policy) to be distributed to customers. Other health insurers have initiated 'Emergency Response Plans' to ensure fast claim settlement for policyholders.
- Insurers in Singapore are offering complementary daily cash benefit and death benefit to all existing and new customers.
- Relaxation in premium payments, extension of grace period is common across geographies.
- In some markets, insurers have offered extension to coverage period without any additional cost for certain categories like travel and marine, to compensate for restriction in movement.
- For motor insurance, discounts, refunds and complementary extensions have been offered on account of people driving less.

In the Indian context, we believe Insurers are likely to evaluate the following ideas -

8.1. Life products

- Life insurers can choose to offer COVID-19 specific benefit plans, as a rider, with a typical benefit of INR 1 lac to INR 5 lacs.
- Many customers may realise that their life cover is inadequate and may wish to opt for enhanced cover. Insurers can offer a limited window for pre-fixed sum insured enhancement subject to underwriting.
- COVID-19 is also leading to complicated health conditions and hence long term health benefit products might also be offered with the option of increasing the benefit to existing policyholders.
- Product offerings with simplified underwriting or deferred underwriting.

8.2. General & Health

- In addition to fixed benefit plans, indemnity covers can be offered on lines of disease specific covers already in the market. Though the traditional indemnity plans will cover the COVID related expenses, these plans can be of use to Seniors/High Risk Group with no cheap access to indemnity cover.
- Many families with floater sum insured, may realise the inadequacy of floater cover, due to high chances of family members falling ill together. Insurers may wish to selectively offer sum insured enhancements to such customers.
- Insurers are expected to exclude, people with travel histories and may have a standard waiting period. Such specific plans/riders can be made more attractive with daily cash, cover for COVID testing, quarantine/nursing/domiciliary charges.
- Customized short-term income protection plans both for formal and informal sectors (self- employed/professionals). There might be a demand from MSME to meet the fiduciary guidelines to offer medical cover to staff. Customized off the shelf products can be designed for such segments.

8.3. Other Segments

In some of the global markets insurers have offered to refund the premium/extend the cover to compensate for the reduction in risk e.g. Motor car Insurance. Indian insurers may consider something similar either in form of higher No Claim discount on renewal or extended cover.

Majority of the corporate covers across various lines are likely to face scrutiny with respect to cover offered in COVID like situation.

Insurers may be required to carefully revisit the terms and conditions, along with the reinsurers.

9. Next Steps

This Group in ongoing consultation with IAI, aims to publish periodical bulletins on emerging COVID19 situation. These bulletins will be aimed at:

- Reviewing and recalibrating the projections provided as greater experience emerges in future
- Providing timely and meaningful updates and studying the impact of COVID19 on the businesses, within the boundaries and given limitations

The Group recognises that COVID-19 crisis is likely to bring in a New Normal both on the economic and social fronts. Everyone will be expected to adjust to the New Normal, including Insurers and Actuaries. Therefore, there will be a need to continuously monitor and study the emerging trends, to help understand, evaluate and mitigate emerging business risks.

In this regard, developing an understanding of the medium to long term impact of the COVID19 crisis on some of the key risks faced by the insurers will be important. In addition to that studying the impact of the New Normal on consumer buying and consumption behaviour, change in attitude towards risk and emergence of new risks will also be essential in this journey.

Appendix A: IAI Office order

16th April 2020

Office Order

Constitution of IAI Pandemic Research Group

(Research work relating to COVID-19 Pandemic)

The Current Pandemic resulting from COVID19 is resulting into massive loss of lives and financial losses across the world. In line with the IAI objective to promote, in public interest, knowledge and research in matters related to Actuarial science its application, the IAI Pandemic research group has been constituted to conduct research based on the COVID19 related data available in India and Globally. The Research will be useful for various stakeholders for developing solutions for serving the public cause.

Composition of the Group:

The group is consisting of the following members.

Sr.No	Name	Designation	Mem.ID	Email_ID
1	Mr. Heerak Basu	Chair & Reviewer	11	Heerak.Basu@milliman.com
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3	Mr. Abhijit Pal	Member	4451	abhijitpal83@gmail.com
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7	Mr. Palash Shah	Member	27228	palashshah39@gmail.com
8	Ms. Swati Gupta	Member	2463	swatigu@deloitte.com
9	Mr. Tanay Chandra	Member	1380	tanay.chandra@gmail.com

Mr. Vinod Kumar (HOET@actuariesindia.org) from IAI will be act as an IAI support to the Group.

Objectives:

- Analyzing the experience emerging from Covid19 pandemic in India and others relevant markets.
- What inference can we draw from the analysis about the Incidence rates and mortality rates
- What Life/ Health products can be offered in India to cover Covid19

This Group will submit its analysis report to President by 3rd May, 2020.

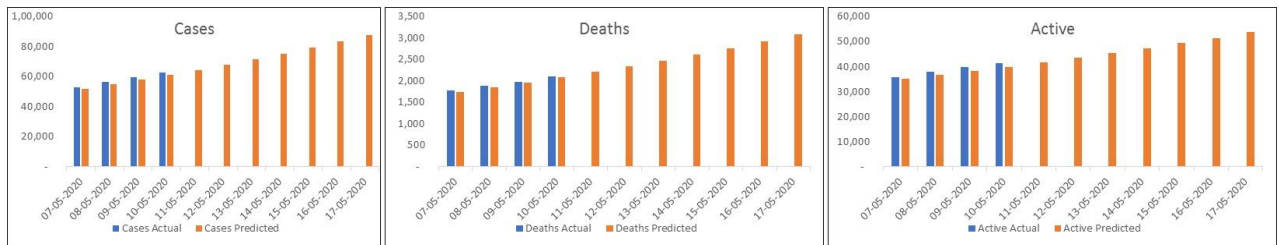
Sunil Sharma
(President)

Appendix B: Back testing outputs

Date	01-May-2020		02-May-2020		03-May-2020		04-May-2020		05-May-2020	
	Actual	Projected	Actual	Projected	Actual	Projected	Actual	Projected	Actual	Projected
Cases Confirmed	35,040	36,701	37,336	38,982	39,980	41,361	42,533	43,843	46,433	46,433
Deaths	1,147	1,172	1,218	1,257	1,301	1,346	1,373	1,439	1,568	1,535
Recoveries	9,060	8,607	9,950	9,531	10,632	10,522	11,588	11,577	12,726	12,697
Active	24,833	26,922	26,168	28,193	28,047	29,493	29,572	30,827	32,139	32,201

Date	06-May-2020		07-May-2020		08-May-2020		09-May-2020		10-May-2020	
	Actual	Projected	Actual	Projected	Actual	Projected	Actual	Projected	Actual	Projected
Cases Confirmed	49,391	49,136	52,952	51,956	56,342	54,899	59,661	57,971	62,939	61,176
Deaths	1,694	1,636	1,783	1,742	1,886	1,851	1,981	1,966	2,109	2,086
Recoveries	14,182	13,878	15,266	15,120	16,539	16,422	17,846	17,784	19,357	19,207
Active	33,515	33,622	35,903	35,095	37,917	36,626	39,834	38,221	41,473	39,883

Projections	Date	11-May-2020	12-May-2020	13-May-2020	14-May-2020	15-May-2020	16-May-2020	
		Actual	Projected	Projected	Projected	Projected	Projected	Projected
Cases Confirmed		-	64,520	68,010	71,652	75,452	79,417	83,555
Deaths		-	2,211	2,341	2,477	2,619	2,767	2,922
Recoveries		-	20,692	22,242	23,858	25,545	27,305	29,141
Active		-	41,617	43,427	45,316	47,288	49,345	51,492



Appendix C: Disclaimer

The information in the document has been printed on the basis of publicly available information; internal data and other external referenced sources believed to be true and are for general guidance only but which may have not been verified independently. While all the efforts are made to avoid errors or omissions in this publication, errors or mistakes, if any, are unintentional.

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