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Original article

Projections for novel coronavirus (COVID-19) and evaluation of epidemic response strategies for India

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ABSTRACT

Background: The World Health Organization on 11 March 2020, declared COVID-19 as a pandemic. India initiated social distancing measures to combat the epidemic of COVID-19. The course of the epidemic of COVID-19 for India was predicted using stochastic probability–based mathematical modeling.

Methods: Data synthesis for the top few countries affected was studied for various factors affecting the epidemic. For projections of infected cases for India, the modified susceptible-exposed-infectious-removed/recovered framework modified for the effect of social distancing (Rho) was used. Simulation was carried out for 10,000 runs using python. Projections for infected cases and hospitalization requirement were estimated.

Results: The epidemic curve will peak in the third week of June in India with 17,525,869 and 2,153,200 infected people with reproduction number of 1.8 and Rho of 0.7 and 0.6, respectively. Compared with the baseline scenario of no social distancing, for transmissibility with R0 = 1.8, the reduction in infections due to social distancing measure is 78% (Rho = 0.7) and 97% (Rho = 0.6). Similarly for R0 = 2.2 and 2.4, the reduction in infected numbers slightly lowers to 62% and 66% with Rho = 0.7 and 92% and 75% with Rho = 0.6, respectively. With R0 = 1.8 and Rho = 0.6, the Intensive Care Unit (ICU) bed requirement is 107,660, whereas if transmissibility is high, the ICU bed requirement would increase to 1,994,682.

Conclusions: The social distancing measures seem to have been working for India in absence of treatment in sight for COVID-19. Although with the government's response strategy of social distancing, the peak of the epidemic is extended giving more months for preparedness to the country; however, the sustainability of these measures is uncertain.

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Introduction

An epidemic is any sudden outburst of a disease within a given population and a pandemic (originating from Greek word pan meaning “all” and *demos* meaning "people") is an epidemic that spreads across regions, which could be countries, continents, or the entire world.[1] Pandemics have a devastating effect on the morbidity and mortality causing huge public health concern along with economic, social, and political disruption for country. Throughout history, mankind has witnessed many pandemics including plague, influenza pandemic (Spanish flu), and 2009H1N1 and many more. Recently, on 30 Jan 2020, the World Health Organization (WHO) declared a global public health emergency for coronavirus (COVID-19) and subsequently on 11 March 2020, COVID-19 was declared as a pandemic.[2] The infectious disease which started with a mysterious pneumonia in 41 patients connected to Huanan seafood market in China on 3 December 2019 had within its grips 1,956,457 cases and 123,481 deaths worldwide till 13 April 2020. COVID-19 affected 210 countries around the world along with two international conveyances. India reported its first case on 30 Jan 2020; however, the steady increase in cases was witnessed from 02 Mar 2020. As of 13 April 2020, India had a total of 10,941 positive cases with 368 deaths.[3,4]

The situation of coronavirus is changing almost every day in every country. Many administrators and planners of countries are trying to know the magnitude of the infection to prepare the country accordingly. As recognized by the WHO, mathematical models can play vital roles in providing health decision makers and administrators regarding transmission of disease, when the epidemic will peak, and how effective interventions have been and ought to be so as to prepare the hospitals and plan for the emergency. Mathematical modeling contributes to the understanding of the complexities of the infectious disease epidemics and offers solution to control them. The course of epidemic is influenced by many factors, and assumptions regarding these factors in the mathematical model affect the accuracy of the predictions. Models are only as good as the assumptions on which they are based. The transmission potential, that is, the basic reproduction rate along with the response by the government in terms of various non-pharmaceutical interventions (NPIs) such as closure of schools and teaching institutes, banning of mass gathering, closure of gyms, cinema halls, and malls, Janata curfew and lockdowns of cities and districts, intensive contact tracing, quarantine of exposed, and isolation of infected patients changes the course of the epidemic. Different countries have responded differently to COVID-19. The article aims to synthesize available data for few of the top affected countries by COVID-19 and project the estimates of COVID-19 for India and the impact of the public health interventions using the modified susceptible-exposed-infectious-removed/recovered (SEIR) model. No study has focused on this aspect, and the present study fills this gap in literature.

Material and methods

We used a modified SEIR framework for predicting the COVID-19 epidemic for India which modified for the effect of social distancing[5,6] as is the response implemented by the Indian government.

Social distancing, also called physical distancing, is a set of NPIs or measures taken to prevent the spread of a contagious disease by maintaining a physical distance between people and reducing the number of times people come into close contact with each other.[7] It involves keeping a distance of six feet or two meters from others and avoiding gathering together in large groups.[8]

The SEIR model is a compartmental model for modeling how a disease spreads through a population. When a disease is introduced to a population, the people move from one of these classes (or compartments) to the next. When they reach the R state, they are no longer able to infect. R in our case represents the removed population (recovered + dead). It is assumed that this R population does not transmit the disease. The model in the time domain is given as follows:

$$S[1] = S[-1] - (\rho*\beta*S[-1]*I[-1])*dt \tag{1}$$

$$E[1] = E[-1] + (\rho*\beta*S[-1]*I[-1] - \alpha *E[-1])*dt \tag{2}$$

$$I[1] = I[-1] + (\alpha*E[-1] - \gamma*I[-1])*dt \tag{3}$$

$$R[1] = R[-1] + (\gamma*I[-1])*dt \tag{4}$$

where, α is the inverse of the incubation period (1/t_incubation), β is the average contact rate in the population (=R0*γ), γ is the inverse of the mean infectious period (1/t_infectious), R0 is the basic reproduction number which defines how quickly the disease spreads, and ρ is the social distancing effect which is a constant term between 0 and 1, where 0 indicates everyone is locked down and quarantined, while 1 is no intervention (the impact of which is captured in Eqs. (1) and (2)).

Equations 1–4 captures the change in people susceptible to the disease moderated by the number of infected people and their contact, change people who are exposed which grows with the contact rate and decreases with the incubation period, change in infected people based on the exposed population and incubation period which decreases with the infectious period moving people to the final stage in Eqn. (4).

There is limited support for many of the key epidemiologic features such as the incubation period, infectious period, and basic reproduction number. The assumptions for the parameters used in the model are based on the synthesis of the available data. The available literature regarding various parameters is summarized in the following paragraphs.

The incubation period is the period between exposure to an infection and the appearance of the first symptoms. The current understanding of the incubation period for COVID-19

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is limited. An early analysis based on 88 confirmed cases in Chinese provinces outside Wuhan[9] indicated a mean incubation period of 6.4 days (95% confidence interval [CI] = 5.6–7.7 days). Another analysis based on 158 confirmed cases outside Wuhan[10] estimated a median incubation period of 5.0 days (CI = 4.4–5.6 days), with a range of 2–14 days. The WHO[11] reported an incubation period for COVID-19 between 2 and 10 days. The United States Centre for Disease Control (CDC) estimates[12] the incubation period for COVID-19 to be between 2 and 14 days.

These findings confirm the current recommendations for quarantine: most patients who become symptomatic do so within 11 or 12 days and the vast majority within 14 days.

The basic reproduction number (R_0) is used to measure the transmission potential of a disease. It is the average number of secondary infections produced by a typical case of an infection in a population where everyone is susceptible. Reproduction number depends on the rate of contacts in the host population, the probability of infection being transmitted during contact and the duration of infectiousness. The median with 95% CI of R0 of COVID-19 was about 2.28 (2.06–2.52) during the early stage experienced on the Diamond Princess cruise ship.[13]

A study from Wuhan[14] where the mathematical model with multiple data sets were combined, the authors found that the median daily R_t of coronavirus in Wuhan probably varied between 1·6 and 2·6 in January, 2020, before travel restrictions were introduced. We also estimated that transmission declined by around half in the 2 weeks spanning the introduction of restrictions. The Imperial College group[15] has estimated R0 to be somewhere between 1.5 and 3.5. A review of 12 studies[16] with high quality estimated basic R0 for the virus in China and overseas. These estimates ranged from 1.4 to 6.49 and had an average of 3.28 and a median of 2.79. The WHO[2] has suggested a R0 value ranging from 1.4 to 2.5.

The response strategies used by the Indian government to combat the epidemic was a step-by-step approach with screening at airports to initiation of travel restrictions, social distancing in form of bans on public gathering, closure of schools, and work from home policy, following a Janata curfew on 22 Mar 2020 and 21-day lockdown of its towns and cities on 23rd Mar 2020. These strategies would affect the contact rate β.

Thus based on the aforementioned facts, the assumptions were made for the mathematical model.

Assumptions for the model

Parameters	Formula	Values
Α	1/time_incubation	1/5 = 0.2
ɣ	1/time_infection	1/7 = 0.14
R0	Basic reproduction number	Three scenario 1.8, 2.2, and 2.4
Β	R0 x Gamma	0.25, 0.31, 0.34
Ρ	Social distancing effect	Ranging from 0 to 1

The model predicts the infected fraction along with the population infected for India. The model was run for varying values of ρ, where ρ = 1 implies no social distancing. The reproduction number ranged between R0 = 1.8 and 2.4, implying low transmissibility to high transmissibility. The aforementioned modified SEIR model was simulated with python for N = 133.92 crores (population of India).

The number of infected persons requiring hospitalization and Intensive Care Unit (ICU) admission was worked out based on the Ministry of Health and Family Welfare (MoHFW) reports, as well as China CDC.[17] The projected infections along with the hospitalization and ICU admission were also age stratified as per Indian age dynamics of coronavirus infection.[18,19] The other sources for data triangulation for this article are from the WHO, CDC, Indian data from MoHFWGovernment of India, and Integrated Disease Surveillance Programme, Government of India. The data are considered as on 14 April 2020 for analysis.

Results and discussion

Data synthesis for top affected countries

Fig. 1 shows the total number of confirmed cumulative cases by countries. As of 14 April 2020, USA, Spain, Italy, Germany, UK China, and Iran were few of the top affected countries with a high total number of infected cases. We considered South Korea as it had controlled the epidemic at an early stage. Of these countries, China and South Korea have flattened the curve, whereas USA, Spain, Italy, Germany, Iran, and UK show that the cases are growing rapidly. Fig. 2 gives the number of cases after first 100 cases by countries. All the countries are having the counts of the lab confirmed cases according to the case definition by the countries and not the number of actual infected people by COVID-19. The confirmed cases depend on the testing strategy. As not all people are tested, this number will be less than the actual number of infected people. Country wise data show huge variability in the proportion of people tested per million populations. Testing is crucial and allows early detection of the case leading to early treatment thereby reducing the probability to infect others. Table 1 shows the testing proportion for the countries. The more the tests the country does, the more close they are to the actual infected numbers. Although Italy had wide testing initially as compared with South Korea which faced the COVID-19 epidemic almost the same time, however South Korea had more aggressive and

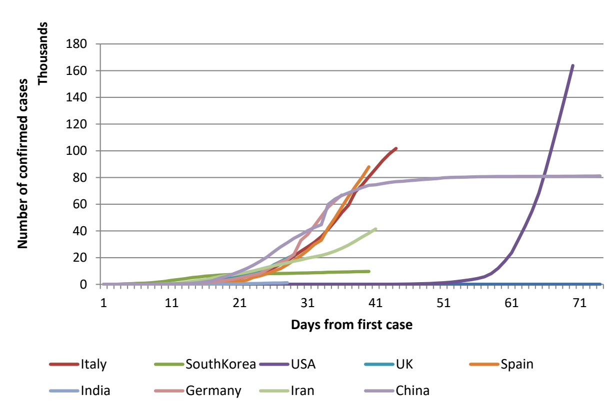

Fig. 1 – Number of confirmed cases by country.

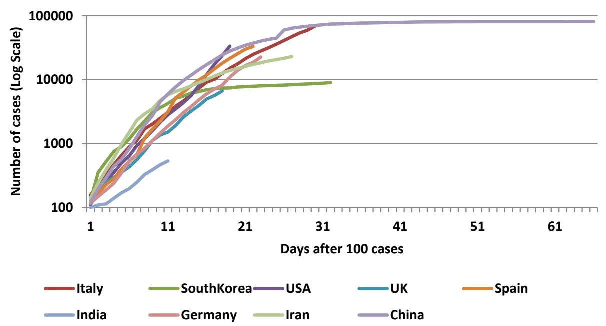

Fig. 2 – Number of cases post first 100 cases.

sustained testing policy early into the epidemic. It is important to look at the doubling time of the cases and deaths for the countries. The doubling time tells us at what speed the outbreak is growing. If the doubling time is constant, the growth rate of the epidemic is exponential. For most of the countries, the growth rate in the early epidemic has been exponential. The doubling time can be reduced by the number of counter measures. China and South Korea have longer doubling time implying early actions by governments. Also the shorter the doubling time implies that the slope of the growth is steeper compared with countries with longer doubling time. Most of the countries have in place some form of NPIs in terms of social distancing, travel bans, and closure of schools and teaching institutes to stringent lockdowns. To cope with the epidemic, China enhanced protection of the medical workers and free treatment for all patients at the fever clinics, banning large gatherings, shutdowns, and upgrading to complete lockdowns and curfews. South Korea acted before it became a crisis within one week by early extensive testing, efficient contact tracing, and isolation. They preferred prioritizing social security over individual privacy where cell phones and websites provided minute to minute update of the new case and case travel timeline. Information Education Communication (IEC) activities were at peak high for awareness and cooperation from public. The population demographics of each country seem to be playing an important role.[20] Although people of all ages are infected by the virus, the WHO reports the risk to be higher for people aged 60 years and older. Italy with

Table 1 – Data synthesis for top few countries affected by COVID-19.

Country	Population (millions)	Population aged 65+	Test per 1000	Total cases	Doubling time for cases	Total deaths	Case fatality rate (%)	Total deaths compared with population (Deaths/million)	Deaths doubled in (days)	Total recovered
USA	3.31E+08	16.03	8.9	603,488	10	25,194	4.06	71.45	7	38,131
Italy	60461826	21.69	18.2	162,488	19	21,067	12.8	338.48	16	37,130
Spain	46749953	18.15	0.65	172,541	15	18,056	10.32	374.06	13	67,504
Germany	83712332	22.36	2.6	131,170	14	3272	2.37	35.44	8	68,200
UK	67790466	18.19	4.5	93,873	9	12,107	12.78	166.88	7	NA
China	1.44E+09	10.92	2.82	82,249	64	3341	4.02	2.32	58	77,738
Iran	83702404	5.48	0.96	74,877	16	4683	6.25	54.59	18	48,129
India	1.38E+09	6.39	0.2	10,941	7	368	3.27	0.25	5	1295
South Korea	51269185	14.42	10.1	10,564	42	222	2.1	4.33	23	7534

Country	Population density (pop/km^2)	Age at infection	Prevalence of obesity	% population with raised glucose level	% population with raised blood pressure	Age-standardized rate per 100,000 for cancer
USA	34	>50 years (55%)	36.2	9	16	352.2
Italy	200	>50 years (71%) with median age = 63	19.9	9	30	290.6
Spain	93	mostly 50–59 years with 14% > 80 years	28.8	9	25	272.3
Germany	233	Average age 46 years	22.3	7	28	313.1
UK	274	NA	27.8	8	20	319.2
China	145	Average age 46 years with range (35–69) years	6.2	9	21	201.7
Iran	51	Average age 60+	17.4	10	17	127.7
India	414	Range 21–70 years with most affected 31–40 years	3.9	8	24	89.4
South Korea	517	Only 23.8% > 50 years	28.3	10	13	313.5

Source: World Health Organization, Noncommunicable diseases country profiles 2018, https://www.who.int/nmh/publications/ncd-profiles-2018/en/.[20]
Raised blood pressure (2015): the percentage of the population aged 18 years and older having systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥90 mmHg.
Raised blood glucose (2014): the percentage of the population aged 18 years and older who have fasting plasma glucose of 7.0 mmol/L or higher, or a history of diagnosis with diabetes, or use of insulin or oral hypoglycaemic drugs.
Obesity is defined for adults as the percentage of the population aged 18 years and older having a body mass index (BMI) ≥30 kg/m2 and for adolescents as the percentage of the population aged 10–19 years who are more than 2 SD above the median of the WHO growth reference for children and adolescents.

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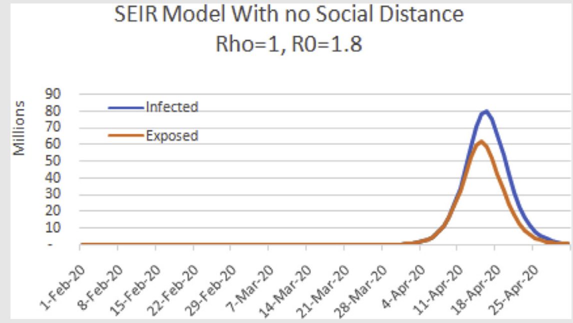
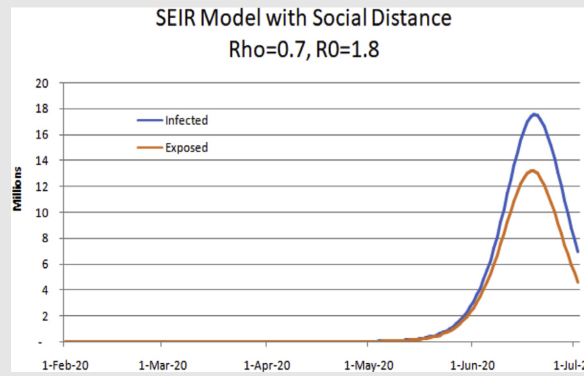
Table 2 – SEIR model projections for various combinations of (Rho) ρ and R0.

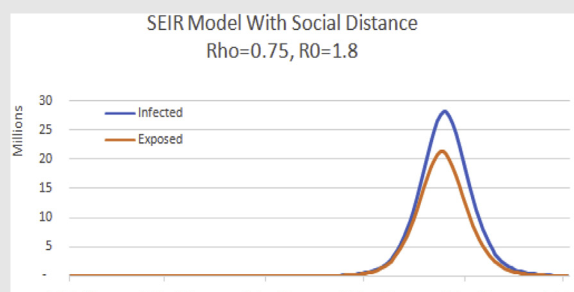
Population	1,339,200,000
Parameters	Rho = 1; R0 = 1.8
Population fraction	0.059864785
Infected population per thousand	60
Peak infected number	80,170,920
Peak date	Thursday, April 16, 2020



Population	1,339,200,000
Parameters	Rho = 0.7; R0 = 1.8
Population fraction	0.01308682
Infected population per thousand	13
Peak infected number	17,525,869
Peak date	Friday, June 19, 2020



Population	1,339,200,000
Parameters	Rho = 0.75; R0 = 1.8
Population fraction	0.02104848
Infected population per thousand	21
Peak infected Number	28,188,124
Peak date	Monday, June 1, 2020



SEIR model, susceptible-exposed-infectious-removed/recovered model.

21.69% of elderly population aged 65 years and older saw a case fatality rate (CFR) of 12.8% followed by the UK (CFR = 12.78%) and Spain (CFR = 10.32%) with 18.19% and 18.15% of elderly population aged 65 years and older, respectively. However, Germany with similar proportion of elderly people saw a very low CFR of 2.37%. The reason may be attributed to the lower age at infection. The age at infection for USA, Spain, and Italy has been mostly 50 years and older, whereas the average age at infection for Germany is much lower at 46 years. Population density is also an important factor as most of the clusters with COVID-19 cases around the world such as New York, Wuhan, Italy, and Mumbai in India have been high population density places. People with preexisting non-communicable diseases (NCDs)[21] also appear to be more vulnerable to becoming severely ill with the virus. These conditions are often associated with the older age group. Table 1 brings out that the prevalence of some of the NCDs that are high in the countries seeing high COVID-19 cases.

Most of the efforts of all the countries have been toward flattening the epidemic curve which translates to lengthening the doubling period. Slower the growth rate of the new infections is crucial to flattening the curve. Increasing the doubling time is achieved by many countries by adopting various epidemic response strategies of social distancing

Table 3 – The projected number of infected, hospitalization, and ICU admission for various modeled parameters.

Reproduction number	Varying effect of social distancing	Infected	% reduction due to social distancing	No/mild symptoms (80%)	Hospitalization (20%)	
					Non ICU beds	ICU beds
					Severe symptoms (15%)	Critical symptoms (5%)
R0 = 1.8 (low infectivity)	Rho = 1 (no social distancing)	80,170,920	Base value	64,136,736	12,025,638	4,008,546
	Rho = 0.75	28,188,124	35%	22,550,499	4,228,219	1,409,406
	0.7	17,525,869	78%	14,020,695	2,628,880	876,293
	Rho = 0.6	2,153,200	97%	1,722,560	322,980	107,660
R0 = 2.2	Rho = 1 (no social distancing)	138,900,929	Base value	111,120,743	20,835,139	6,945,046
	Rho = 0.75	68,441,975	49%	54,753,580	10,266,296	3,422,099
	0.7	53,551,204	62%	42,840,963	8,032,681	2,677,560
	Rho = 0.6	24,521,188	92%	19,616,950	3,678,178	1,226,059
R0 = 2.4 (high infectivity	Rho = 1 (no social distancing)	163,787,406	Base value	131,029,925	24,568,111	8,189,370
	Rho = 0.75	88,767,485	54%	71,013,988	13,315,123	4,438,374
	0.7	72,786,779	66%	58,229,423	10,918,017	3,639,339
	Rho = 0.6	39,893,649	75%	31,914,919	5,984,047	1,994,682

[a]Calculation of hospitalization and Intensive Care Unit (ICU) admission as per.[17]

measures in the form of work from home, closure of schools and educational institutes to travel bans, effective quarantine, and partial to complete lockdowns. Some countries have been aggressive while some have been slow in implementing these measures. Table 1 shows the data synthesis for the countries for various parameters affecting the epidemic.

Mathematical modeling projections of COVID-19 for India

To predict the course of the COVID-19 epidemic of India, the modified SEIR model was used. With the various SEIR model parameters, the data for COVID-19 for India were fitted and simulated with 10,000 runs to forecast population fraction, that is, the proportion of population that got infected, infected population per thousand, peak infected number, and the peak date. Table 2 gives the infected population for different values of ρ and R0. With no social distancing measures as base value, the effect of varying social distancing was analyzed. Accordingly for scenario of ρ of 0.7 and R0 of 1.8, it is estimated that there would be 17,525,869 infected cases of COVID-19 and the peak would be achieved by June 19th. The actual infected numbers and the projected infected number as of 13 April 2020 for this scenario match closely with 10,941 and 9744, respectively. Table 2 gives model prediction with values of R0 = 1.8 and varying values of Rho. Table 3 gives the projected infections and hospitalizations and ICU admission based on the severity of symptoms[16].

For transmissibility with R0 = 1.8, the reduction in infections due to social distancing measure for Rho = 0.7 is 78% and for Rho = 0.6 is 97% compared with the baseline scenario of no social distancing. For R0 = 2.2, the reduction in infections due to social distancing measure for Rho = 0.7 is 62% and for Rho = 0.6 is 92% compared with the baseline scenario of no social distancing. Similarly for R0 = 2.4, the reduction in infections due to social distancing measure for Rho = 0.7 is 66% and for Rho = 0.6 is 75% compared with the baseline scenario of no social distancing. (Table 4)

Considering R0 = 1.8, the Indian government's response strategy by adopting social distancing extends the peak of the epidemic to the third week of June, giving more months for preparedness to the country. The scenarios are depicted in Table 2. For other permutations of the various factors of R0

Table 4 – Age stratified estimated proportion of COVID-19 requiring hospitalization and ICU admission.

Age group	R0 = 1.8, Rho = 0.6			R0 = 2.2, Rho = 0.6			R0 = 2.4, Rho = 0.0.6		
	Infected	Hospitalized	ICU bed	Infected	Hospitalized	ICU bed	Infected	Hospitalized	ICU bed
0–19 (10%)	215,320	32,298	10,766	2,452,119	367,818	122,606	3,989,365	598,405	199,468
20–29 (22%)	473,704	71,056	23,685	5,394,661	809,199	269,733	8,776,603	1,316,490	438,830
30-39 (21%)	452,172	67,826	22,609	5,149,449	772,417	257,472	8,377,666	1,256,650	418,883
40-49 (18%)	387,576	58,136	19,379	4,413,814	662,072	220,691	7,180,857	1,077,129	359,043
50-59 (13%)	279,916	41,987	13,996	3,187,754	478,163	159,388	5,186,174	777,926	259,309
60-69 (12.1)	260,537	39,081	13,027	2,967,064	445,060	148,353	4,827,132	724,070	241,357
70-79 (3.5)	75,362	11,304	3768	858,242	128,736	42,912	1,396,278	209,442	69,814
80+ (0.4)	8613	1292	431	98,085	14,713	4904	159,575	23,936	7979
Total	2,153,200	322,980	107,660	24,521,188	3,678,178	1,226,059	39,893,649	5,984,047	1,994,682

[a]Infected numbers, hospitalization, and Intensive Care Unit (ICU) admission adjusted as per age for Indian populations.[19]

and ρ in the SEIR model, the peak ranges from 14 Apr to mid June 2020 (Table 4).

The Government of India's epidemic response strategy was a step-by-step approach with screening at airports to initiation of travel restrictions, bans on public gathering, closure of schools, and work from home policy, following a Janata curfew on 22 Mar 2020 and a 21-day lockdown of its towns and cities on 23rd Mar 2020 However, strict lockdown is not implemented and essential services are open for general public. Tough travel bans were imposed but movement of migrant people could not be strictly restricted. Besides incidences of people running away from quarantine centers, people stamped for home quarantine getting caught roaming out of their homes, huge mobility of people to rural areas from urban areas, markaz incident, and so on, the common public seems to be non compliant and not serious of the situation. In a country with a huge population of 1.3 billion people, strict enforced closure is a challenge and hence variable values of $\rho = 0.6$, 0.7, and 0.75. The reproduction rate was also modeled as per review of literature values with for R0 = 2.5, 2.2, and 1.8. With some form of social distancing measures in place, we assume that the transmissibility would reduce.

The number of hospitalization and ICU admission is assumed from the WHO reports,[2] as well as China CDC.[17,18] The reported figures of no/mild symptoms not requiring hospitalization are around 80%. Sever cases requiring hospitalization and critical cases requiring ICU admissions are reported to be 15% and 5%, respectively. Table 3 gives the predicted hospitalizations and ICU admission under various situation varying R0 and Rho parameters. With R0 = 1.8 and Rho = 0.6, the ICU bed requirement is 107,660, whereas if transmissibility is high, the ICU bed requirement would increase to 1,994,682. The age stratified hospitalization and ICU bed requirement was calculated by adjusting for age dynamics of the country for COVID-19 infection.[19] As the age at infection in India ranges from 21 to 70 years, with maximum affected in the age group of 20–40 years, the ICU bed requirement is highest for this age group.

Our study has several limitations. Firstly, the epidemiological characteristic of COVID-19 is unclear, and all the parameters for our model were taken from other studies. This may overestimate or underestimate the true numbers of the infections. However, various scenarios for wide range of values for Rho and R0 are modeled. Secondly, the model is based on the numbers positive based on symptomatic testing. Thirdly, social distancing is a complex issue as the contact pattern is dynamic and heterogeneous. How long these interventions need to be implemented needs to be studied. However, our study gives a range of combination of values of Rho and R0 in the absence of true estimated value from the country's own data. Although based on the mathematical model, this study provides the projected estimates of bed requirement and hospitalization for COVID-19 for the country.

Conclusions

Data synthesis reveals that the top affected countries have been implementing some form of suppression to tackle the spread of virus. As far as India is concerned, the daily influx steadily started from the first week of March increasing over time.

For transmissibility with R0 = 1.8 and Rho = 0.7, the reduction in infections due to social distancing measure is 78% and for Rho = 0.6 is 97% compared with the baseline scenario of no social distancing. Similarly for R0 = 2.2 and 2.4, the reduction in infected numbers slightly lowers to 62% and 66% with Rho = 0.7 and 92% and 75% with Rho = 0.6. respectively.

The social distancing measures seem to have been working for India in absence of treatment in sight for COVID-19. Although with the government's response strategy of social distancing, the peak of the epidemic is extended, giving more months for preparedness to the country; however, the sustainability of these measures is uncertain.

Disclosure of competing interest

The authors have none to declare.

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