

Role of Precautionary Measures in Containing the Natural Course of Novel Coronavirus Disease

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Background: The coronavirus disease (COVID-19) pandemic is spreading at an alarming rate. Several health authorities have implemented specific precautionary measures worldwide to combat the spread of the disease. The influence of these measures on tackling the spread of the disease remains to be elucidated. Therefore, this study aimed to assess the impact of precautionary measures to contain the COVID-19 outbreak.

Methods: Data for this study were gathered from publicly available data sources such as the Worldometer and World Health Organization websites. The expected number of new cases is calculated using a mathematical formula to assess the difference between the observed and expected number of cases, thus indicating the impact of precautionary measures on the spread of COVID-19.

Results: The preventive measures massively impacted the reduction of COVID-19 cases in Saudi Arabia from the expected number of 437,097 accumulated cases by May 4, 2020, to the observed number of 28,656 accumulated cases. Thus, the fatality rate is reduced from the expected 15,735 accumulated deaths by May 4 to 191 accumulated deaths.

Conclusion: Precautionary measures adopted by the Saudi Arabian health authorities were evidently effective in controlling the spread and further burden of COVID-19.

Keywords: COVID-19, precautionary measures, prevention, quarantine, public health

Introduction

The coronavirus disease (COVID-19) outbreak that first occurred in China in December 2019 has become a worldwide pandemic. Several community-based recommendations have been implemented worldwide through healthcare providers. Some of the most common recommendations are social distancing, frequent hand-washing, avoiding touching of the face, and wearing masks in public.

The first case of COVID-19 in Saudi Arabia was reported on March 2, 2020. Since then, several precautionary measures have been implemented by the Saudi Arabian health authorities to prevent the anticipated spread of the disease based on international forecasts about the spread of COVID-19 in different countries globally.

An outbreak has a reproductive value, which is the transmission capacity of the infecting agent. This is called R_0 (R nought). An R_0 value less than 1 indicates that the outbreak will gradually disappear. An R_0 value greater than 1 indicates the need for control measures to combat the spread of an outbreak. According to Trilla,¹ there is a need to exercise caution with controlling the spread of the COVID-19 outbreak.

Reporting an exact R_0 of an epidemic outbreak is challenging, and several studies worldwide have attempted to estimate the reproductive value of COVID-19. Zhang et al² estimated the R_0 of COVID-19 to be 2.28 (2.06–2.52). In addition,

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according to the WHO report³ in February 2020 about the early stages of the outbreak in Wuhan, the R_0 of COVID-19 was 2–2.5. There have been studies that have estimated much higher R_0 values; one study estimated the R_0 of COVID-19 between 3.6–4.0,⁴ while preliminary estimation of R_0 of COVID-19 in China is at ranges from 3.30 (95% CI=2.73–3.96) to 5.47 (95% CI=4.16–7.10).⁵ Because the exact assessment of R_0 of COVID-19 is challenging, based on estimations from the previously mentioned studies, it is safe to say that the R_0 of COVID-19 is approximately between 3 and 4.

The serial interval (S_i) of any infection is defined by Fine⁶ as “the time from illness onset in a primary case (infector) to illness onset in a secondary case (infectee).” Several studies assessed the serial interval of COVID-19; researchers in Hubei estimated the mean S_i of COVID-19 to be 7.5 days.⁷ Another study estimated the mean S_i of COVID-19 to be 4 days.⁸ Determining S_i is a task as it can only be obtained by linking the date of onset from the infector to the infectee.

Once the first case of COVID-19 was confirmed in Saudi Arabia, the health authorities implemented strict precautionary measures to combat the outbreak. The first set of precautions were taken from March 2, stricter precautions from March 8, curfew started from March 25, and finally active screening of asymptomatic cases started from April 18.

These measures started with moderately lenient methods including no Umrah, shutting down of the Holy Mosque when there were no prayers, no crowds for any sporting or recreational events, no community-based events, only take-away orders from restaurants, and crowd control in public places. Following this, more robust methods such as shutting down schools in quarantine-infected districts; discontinuing travel from or to infected countries; and suspension of international flights, mosque prayers, and domestic travel were implemented. Finally, some extreme measures were implemented, including shutting down workplaces, except those that were essential, then partial curfew (from 7 pm or even 3 pm in districts with a high number of cases), then 24-hour curfew across the country, and finally active screening of asymptomatic patients. Using school buildings and hotels as quarantine areas is another method that was adopted by the Saudi Arabian health authorities to control the spread of the disease.

Active mass screening of asymptomatic subjects was carried out as part of a major campaign conducted by the

Health authorities in the country. The target of these campaigns was to relieve the spike in the cases, and thus control the epidemic from spreading further. According to the MoH,⁹ in the period of the study, from March 2 to May 1, 2020, 364,561 cases were screened.

Available data on the impact of precautionary measures on the spread of COVID-19 is scarce. This study is an attempt by the author to assess the impact of precautionary measures to contain the COVID-19 outbreak, thus reducing the mortality rates in Saudi Arabia. It is important to note that assessing the financial burden of these measures is outside the scope of this article.

Methods

Publicly available information about the number of new cases, the number of recovered cases, and the number of deaths in Saudi Arabia was gathered from the COVID19 dashboard provided by the Saudi Ministry of Health website MoH⁹ and from WorldMeter.¹⁰

Precautionary measures in Saudi Arabia were collected and followed up through local newspapers and official announcements. The expected number of cases and case fatality rate are calculated using the estimated R_0 of COVID-19. As the pandemic continues to grow beyond the data collection date (May 1, 2020), the expected number of cases (without precautionary measures) is expected to increase.

There are many estimations of the S_i of COVID-19, as previously mentioned. For the sake of this study and to be more conservative in the calculations, the S_i in the mathematical formula was set to 6 days. Owing to the debate regarding the appropriate R_0 estimation of COVID-19, as previously mentioned, an R_0 of 2.5 was used to calculate the expected spread of the infection in Saudi Arabia. The mathematical formula that was used in the study is:

$$N = \sum_{m=59}^{m=1} n(m+6) = [n(m) \times R_0] + n(m)$$

where N is the total number of expected cases at the time when the study ended, m indicates the day number, and n indicates the number of expected cases per day.

The expected number of deaths from COVID-19 in Saudi Arabia is calculated using the international estimation of the death rate of COVID-19, that is 3.6%.¹¹ The international case fatality rate of COVID-19 is set regardless of the influencing comorbidities and age distribution of the population.

Results

The first case of COVID-19 in Saudi Arabia was reported on March 2, 2020. This was followed by a series of cases in the following days. The population estimation of the Kingdom of Saudi Arabia in 2020 is 34,713,236, according to the General Authority for Statistics.¹²

Table 1 shows the accumulated observed number of cases and the accumulated expected number of cases at each precautionary measure implementation stage. Further, the total number of observed deaths from COVID-19 as well as the expected number of deaths is shown in Table 1.

Figure 1 depicts the exponential curve that shows the expected number of cases if precautionary measures were not implemented in Saudi Arabia. Figure 2 shows the exponential expected growth in terms of the number of deaths from COVID-19 if precautionary measures were not implemented.

One of the first measures implemented by the Saudi Arabian health authorities was a travel ban, crowd control, and social distancing on March 2, 2020. Following this, more extreme measures were adopted by the Saudi Arabian health authorities on March 8, such as sealing specific geographical locations with a large number of infected cases and shutting down schools and workplaces. Further, extreme measures followed at later stages from March 25, including partial (until 3 or 7 pm) and 24-hour curfews. The last measure implemented by the health

authorities in Saudi Arabia was the active screening of individuals in specific neighborhoods, which started on April 18.

The number of COVID-19 cases in Saudi Arabia was expected to reach 258,283 cases by May 1, 2020 (ie, within 2 months of the onset of outbreak in Saudi Arabia) if precautionary measures had not been implemented in the country. This number is predicted according to the internationally estimated R_0 of COVID-19. The total number of deaths was expected to reach almost 9000 by May 1, 2020, according to the international case fatality rate of COVID-19. As shown in Table 1, since the start of active screening by the Saudi Arabian health authorities, the number of new cases increased at an alarming rate.

Discussion

To the author's knowledge, this is the first study to assess the impact of precautionary measures in Saudi Arabia on combating a pandemic. The study resulted in interesting findings that support the huge impact of precautionary measures during a pandemic outbreak. The number of new cases in Saudi Arabia drastically reduced after the implementation of extreme precautionary measures.

Similar to this study's results, a study in Italy highlights the importance of country lockdown in controlling the spread of the disease.¹³ Country lockdown is one of the extreme measures adopted by the Saudi Arabian health

Table 1 Number of Observed vs Expected Cases of COVID-19 in Saudi Arabia at Each Precautionary Measure Stage

Day	Date	Precautionary Measure	Susceptible Population	Cumulative COVID-19 Positive Cases		Cumulative Number of Relevant Mortality		Cumulative Observed Recovered
				Observed	Expected	Observed	Expected	
1	Mar 2	No travel	34,713,235	1	1.00	0	0.03	0
4	Mar 5	Social distancing	34,713,233	5	4.00	0	0.14	1
6	Mar 7	No crowding	34,713,234	7	7.50	0	0.26	1
7	Mar 8	Quarantine infected areas	34,713,232	11	10.00	0	0.34	1
8	Mar 9	Schools shut down	34,713,232	15	12.50	0	0.43	1
14	Mar 15	Governmental workplaces shut down	34,713,221	118	42.50	0	1.45	1
17	Mar 18	Private workplaces shut down	34,713,169	238	80.00	0	2.72	6
24	Mar 25	Partial curfew	34,713,103	900	283.13	2	9.63	29
37	Apr 7	24-hour curfew	34,712,964	2795	3251.88	41	110.56	615
48	Apr 18	Active screening	34,712,104	8274	24,156.42	92	821.32	1329
60	Apr 30	Active screening	34,713,236	21,402	198,678.82	157	6755.08	3163
64	May 4	Active screening	34,711,591	28,656	59,604.64	191	15,735.51	4476

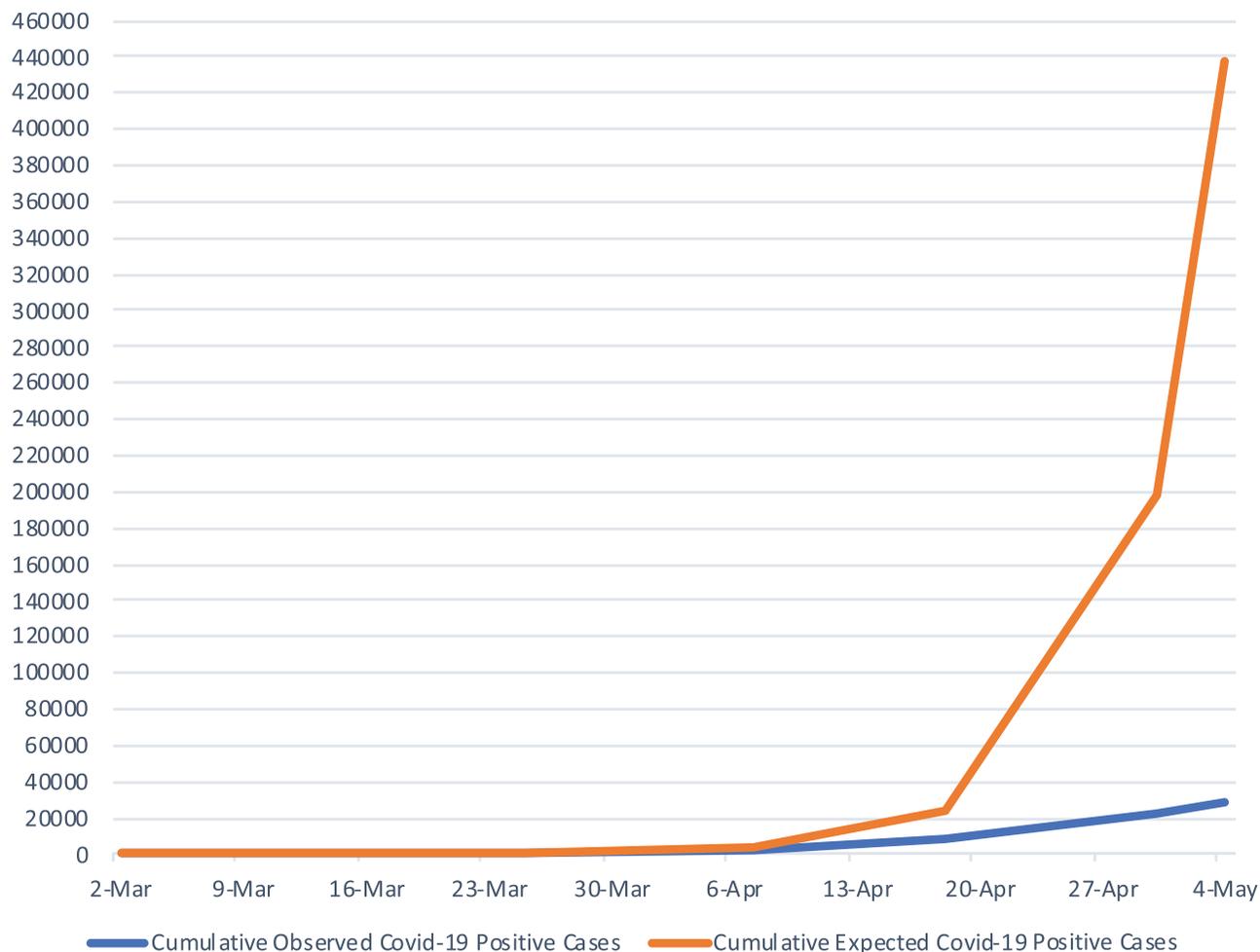


Figure 1 Number of observed vs expected coronavirus disease cases in Saudi Arabia.

authorities to control the spread of the disease. Evidently, this is one of the most effective measures to combat an outbreak.

Dowd et al¹⁴ believe that governments worldwide must adopt strict precautionary measures to mitigate the COVID-19 pandemic. This is also advocated by Li et al,⁷ who believe that preventive measures need to be implemented for populations at risk. A study forecasting the outbreak of COVID-19 in India indicated that if the outbreak is not controlled within a short period of time, India will face severe shortage of healthcare settings, which will worsen the impact of the outbreak.¹⁵

A study conducted in Hong Kong in 2003 regarding the effectiveness of precautions against contaminated droplet-induced infection and contact with an infected person in the prevention of nosocomial transmission of severe acute respiratory syndrome found that precautions such as using masks and other practices to prevent

droplet infection significantly reduce exposure to the virus.¹⁶ This is consistent with the findings of the current study, where social isolation played a favorable role in the control of further spread of COVID-19 in Saudi Arabia.

Awareness campaigns are one of the most important precautionary measures adapted by the Saudi health authorities since the onset of the epidemic in the country. According to Roy et al,¹⁷ public's awareness influences their adherence to precautionary measures and eventually the clinical outcome. With a lack of awareness people may violate the quarantine or any other precautionary measure by behaving irresponsibly which will eventually have a negative impact on their health.¹⁸

It is important to note that Saudi Arabia adopted an out-reach program to screen susceptible asymptomatic patients, in contrast to other countries where positive cases reflect testing of only symptomatic patients. The

Observed vs. expected number of deaths from Covid19 in Saudi Arabia

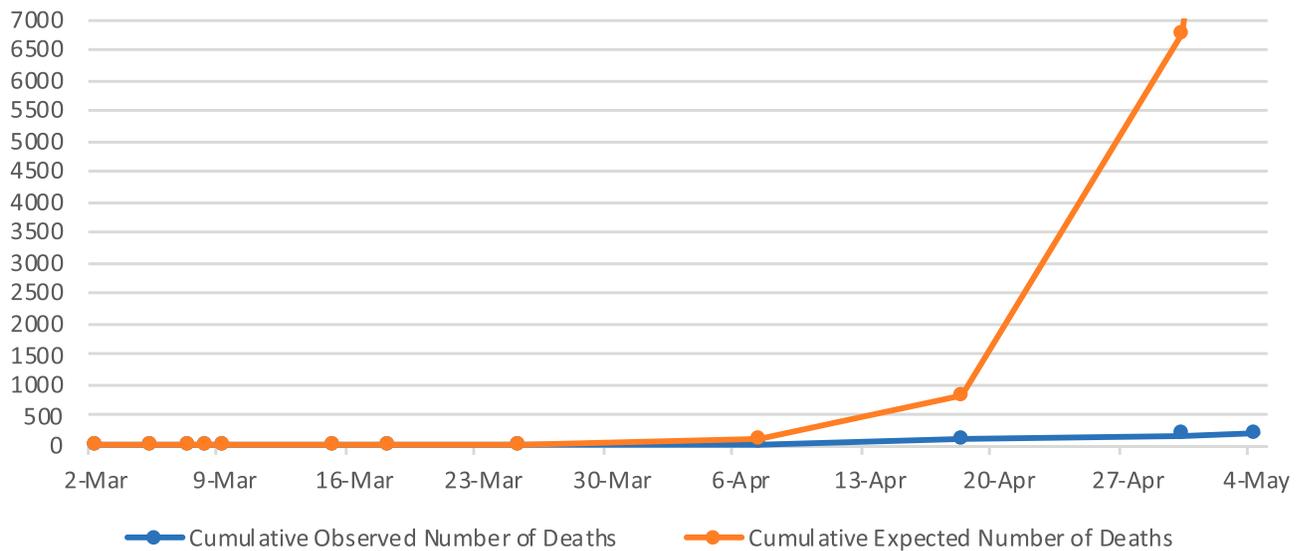


Figure 2 Observed vs expected number of deaths from coronavirus disease in Saudi Arabia.

total number of screened cases in Saudi Arabia is 364,561 cases.⁹ This is one of the most effective methods for combating the spread in the earlier stages.

The age-distribution of the community has a significant impact on the case fatality rate of COVID-19. For instance, a higher burden of mortality is more apparent in countries with a higher percentage of older population.¹⁴ The median age in Saudi Arabia is 31.8 years.¹² This should be taken into consideration when estimating the relevant case fatality rate of COVID-19 in Saudi Arabia; however, age distribution in Saudi Arabia is not taken into consideration when estimating the expected number of cases of COVID-19 or the relevant mortality rate.

Lastly, it is worth mentioning that, as the data used in the study is from governmental sources, there was no stratification of cases by gender, age group, or any other demographic characteristics.

Conclusion

The COVID-19 pandemic can be controlled if extreme precautionary measures are implemented in the earlier stages of the outbreak in a country. The Kingdom of Saudi Arabia adopted several precautionary measures to contain the spread of COVID-19, starting with some lenient measures and ending with extreme measures and active screening of the population.

This is the first study to measure the impact of precautionary measures on combating the spread of a pandemic in Saudi Arabia. The spread of COVID-19 has been controlled in Saudi Arabia after implementing several preventive measures. The daily number of newly confirmed cases in Saudi Arabia is extremely low after implementing these measures compared with other countries with a similar population, such as Spain, Canada, and Peru. Thus, the mortality rate of the pandemic has also been reduced in Saudi Arabia.

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