Spread and Dynamics of COVID-19 in the Kingdom of Saudi Arabia and Four Other Countries in the Early Phase: A Study for the Development of the Advanced Health System

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Abstract

Background

The epidemic of 2019 novel coronavirus (SARS-CoV-2) is challenge to the world which was at first confirmed in the Wuhan city of China in December 2019. It was declared a pandemic by the World Health Organization (WHO) in March 2020. In the current work we evaluated effect of health policy of Saudi Arabia for the management of COVID-19 pandemic in early phase and compared to other four countries.

Method

Based on the Ministry of Health, Kingdom of Saudi Arabia (KSA) data, the summary of daily report of COVID-19 was prepared from 02 March to 30 April 2020. Further, the daily report of enhancement in cases and recovery of the patients was also summarized. Moreover, the incidence, death and recoveries of COVID-19 cases in KSA were compared with major infected country including China, Italy, Spain and United State of America (USA). The important role of artificial intelligence was shown for the development of drug targets against to infectious diseases

Results

In KSA, the first case of COVID-19 was reported on 02 March 2020. Since then, it has affected 22,753 persons till the end of the April 2020. Also, the results showed that the infection rate of COVID-19 increased continuously during the current period of study in KSA. Nevertheless, the rate of death due to COVID-19 is much less with comparison to China, Italy, Spain, and USA due to good medical facilities along with quick action by the government of KSA after the emergence of first case. There is a dire need to develop new platforms and approaches to combat new and old diseases including COVID-19 at warp speed when compared to traditional approaches. DeepDrug's approach to drug discovery and development showed brighter future towards the discovery of novel drugs against infectious diseases including COVID-19.

Conclusion

Currently, there is higher probability of COVID-19 spread at any place. Therefore good health policy, precautionary measures and medical facility of whole nations should be excellent to combat against the COVID-19 pandemic until the reliable vaccine or antiviral drug developed for the proper treatment of virus. The artificial intelligence (AI) based available process might be very helpful for the drug discovery and development against of old and newly discovered diseases including COVID-19.

Background

Infectious diseases such as Zika virus and severe acute respiratory syndrome (SARS), represent an important public health concern (Drosten et al., 2003; Ventura et al., 2016). Currently, an outbreak of novel coronavirus disease (COVID-19) caused by infection with SARS-CoV-2 has spread worldwide from China.

Current reports have shown the high rate of infection of this virus due to person-to-person transmission between family members and hospital staff (Chan et al., 2020). Moreover, reports have shown that infected travelers are carrying COVID-19 from one geographical region to another (Quilty et al., 2020). Considerable effort has been made to understand how, when, where, and why this novel and deadly disease emerged. The origin of COVID-19, like many other infectious diseases, is still unknown (Lu et al., 2020; Lythgoe and Middleton, 2020), although the disease was first reported in Wuhan, Hubei Province, China (Zhu et al., 2020; Zu et al., 2020). The World Health Organization (WHO) officially assigned the name to the disease caused by the novel coronavirus as coronavirus disease (COVID-19) (Zu et al., 2020). The WHO declared COVID-19 a pandemic on March 11, 2020, and subsequently focused on the development of health policies for the management of the pandemic due to unavailability of an effective vaccine or antiviral drug against the disease (Cucinotta and Vanelli, 2020).

Various cases of COVID-19 were reported in Wuhan in late December 2019 which aroused international concern (Wang et al., 2020; WHO, 2020). Sequence analysis of SARS-CoV-2 from the infected patients showed maximum sequence homology (approximately 99.9%) with the SARS-CoV-2 isolated from China (Kim et al., 2020; Sah et al., 2020; Wu et al., 2020; Zhu et al., 2020). Although SARS-CoV-2 has approximately 88% homology with two bat isolates, including bat-SL-CoVZC45 and bat-SL-CoVZXC21, reported from Zhoushan, eastern China in 2018, it has greater distinction with SARS-CoV (approximately 79% homology) and MERS-CoV (approximately 50% homology) (Lu et al., 2020).

Persons of all ages are susceptible to COVID-19 infection. Various studies have shown that most cases of COVID-19 are due to human-to-human transmission in health care, hospital-based clusters, social connection, community settings, and contact with contaminated particles containing virus droplets (Chan et al., 2020; Guan et al., 2020). A previous study also revealed that the virus can be transmitted by aerosols generated through symptomatic patients sneezing and coughing, but can also arise from asymptomatic people before the onset of symptoms (Rothe et al., 2020).

The prevalence of COVID-19 cases and their connected deaths in the different countries worldwide demonstrates that COVID-19 represents a severe threat to the health of the global population. The threat of disease in the Kingdom of Saudi Arabia (KSA) is high due to high number of expatriates arriving from different parts of the world (Ebrahim and Memish, 2020b). After returning home, expatriates often organize a ceremony for relatives and friends, and these mass gathering aid the transmission of COVID-19 and exacerbate the pandemic (Ahmed and Memish, 2020). Moreover, the transmission rate varies by country, as does the fatality rate.

The Ministry of Health, KSA confirmed the first COVID-19 case on 2 March, 2020 (MOH–KSA, 2020; News, 2020). Since then, the eminent authorities of the KSA have continuously monitored the situation of COVID-19. Following identification of the first case, preparations were started to prevent the virus spreading throughout the Kingdom. Provided their possible implication in transmitting of virus of COVID-19, threat appraisal for crowd gatherings and events using a modified Jeddah Tool were performed prior to the confirmation of the initial case of COVID-19 in the KSA (Yezli and Khan, 2020b). The tool comprises

a Health Risk Assessment framework, which uses qualitative and quantitative methods to recognize, evaluate, estimate, and grade threats connected with events and offer advice for mitigation measures and threat management. Several effective actions and plans were implemented, including a curfew, partial lock down, Smart lock down social distancing, and cancelation of religious, cultural, and entertainment events (Ebrahim and Memish, 2020a; Yezli and Khan, 2020a). The KSA is currently drawing on these successful experiences to address the COVID-19 pandemic.

The experiences of COVID-19 pandemic have refocused globally attention on the threats of infectious diseases, in references of world health and the effects on the global economy. Although, the drug resistance infectious diseases burden are unreasonably higher in low- and middle-income countries, but the load of emerging infectious diseases is a worldwide threat as we observed recently in the pandemic of COVID-19 (Alvarez-Uria et al., 2016). Nearly 75 percent of the companies currently developing antimicrobials are considered pre-revenue, meaning that they have no products on the market (PEW-Charitable-Trusts, 2020). The health policies have been found wanting in dealing with the new infectious agent for whole world including high income countries. Novel drugs for the treatment of infectious diseases including COVID-19 will inevitably be needed across the world. Now this is the time to initiate a new, innovative artificial intelligence (AI) based approaches, which are cost effective and can cut down drug development time, which are required for novel drug development. This study compares the current situation of the pandemic in KSA with most four of the most affected countries, including the USA, China, Spain, and Italy. It is important to recognize various enigmatic epidemiological aspects and also decipher the current epidemiological situation of COVID-19 and the fatality risk factors in order to manage, prevent, and anticipate effective interventions in the KSA as well around the globe.

Method

Analysis of the COVID-19 outbreak in Saudi Arabia and the role of social distancing in controlling transmission

COVID-19 data from Saudi Arabia was collected from the daily reports of the Ministry for Health, KSA, and from daily updates of the Saudi Center for Disease Prevention and Control (MOH-KSA, 2020; SaudiCDC, 2020). The data were collected from the inhabitants of different regions of Saudi Arabia, including Makkah, Riyadh, Medina, Jeddah, Dammam, Tabuk, Dharan, Hofuf, Taif, Qatif, Khobar, and Jubail. The data were utilized to analyzed the per day cases vs the increase in total COVID-19 cases. The retrieved data were also used to analyze the total death vs recovery of COVID-19 cases from the first reported case until 60 days later.

Social distancing is important to reduce the transmission of COVID-19. The social distancing strategies is introducing earlier in the KSA prior to report of first case of COVID-19. Social distancing was implemented through different strategies such as restrictions on movement and travel, country lockdown, temporary closure of worship places, and cancelation of non-essential gatherings and events in the country to control the pandemic.

Comparison of the COVID-19 outbreak in Saudi Arabia and four other countries

The comparative study of SARS-CoV-2 infection was performed using data from China, Italy, Spain, and the USA. The data were retrieved from the online web of Johns Hopkins University/coronavirus resource center and the worldometer for the analysis of disease outbreak from the case first of COVID-19 until 60 days later (JHU, 2020; www.worldometers.info/coronavirus/countries., 2020). The data were collected to analyze various factors connected with COVID-19 cases from the above countries.

Analysis of the COVID-19 outbreak in China and the role of social distancing in controlling transmission

The data were retrieved as outlined in 2.2. The study period was from the first case of COVID-19 until 60 days later. The data were used to analyze the per day cases vs the increase in total COVID-19 cases in China. The retrieved data were used to analyze the total death vs recovery of COVID-19 cases in China over the study period.

Analysis of the COVID-19 outbreak in Italy and the role of social distancing in controlling transmission

The data were retrieved as outlined in 2.2. The study period was from the first case of COVID-19 until 60 days later. The data were utilized to analyze the per day cases vs the increase in total COVID-19 cases in Italy. The retrieved data were used to analyze the total death vs recovery of COVID-19 cases in Italy over the study period.

Analysis of the COVID-19 outbreak in Spain and the role of social distancing in controlling transmission

The data were retrieved as outlined in 2.2. The study period was from the first case of COVID-19 until 60 days later. The data were utilized to analyze the per day cases vs the increase in total COVID-19 cases in Spain. The retrieved data were used to analyze the total death vs recovery of COVID-19 cases in Spain over the study period.

Analysis of the COVID-19 outbreak in the USA and the role of social distancing in controlling transmission

The data were retrieved as outlined in 2.2. The study period was from the first case of COVID-19 until 60 days later. The data were utilized to analyze the per day cases vs the increase in total COVID-19 cases in the USA. The retrieved data were used to analyze the total death vs recovery of COVID-19 cases in the USA over the study period.

Artificial intelligence to discover novel therapeutics for COVID-19

In the past 20 years, the pharmaceutical industry has put drug discovery and development for infectious diseases on the backburner. The current COVID-19 pandemic has been a painful reminder of the lack of development of new antimicrobial agents to treat emerging infectious diseases. It is time to start novel, innovative artificial intelligence (AI) based approaches, which are cost effective and minimize the time for drug development. Here we were suggested various AI based approaches for the development of

drugs against COVID-19. The approaches include Atomwise, Insilico Medicine and DeepDrug which might be very helpful.

Atomwise

Atomwise uses convolutional neural networks (CNNs) to analyze the biological activity and predict the binding affinity of small molecules (Wallach et al., 2015). The model was developed by using descriptors acquired from ligand-target complexes for the development of drug molecules.

Insilico Medicine

Insilico provides a unique generative adversarial network (GAN) based approach for synthesizing new drugs for individual diseases (Zhavoronkov et al., 2019). Their network allows for de novo small molecule design, which optimizes synthetic feasibility, novelty, and biological activity.

DeepDrug

The DeepDrug team is a semi-finalist in the IBM Watson Artificial Intelligence XPRIZE competition, for which the team created a time-efficient AI-based platform to discover new drugs or repurpose existing drugs for emerging infectious diseases including COVID-19 (Pu et al., 2019). The DeepDrug was used to identify automatically synthesizing targeted drug molecules through beam search techniques and filtering candidates.

Results And Discussion

Analysis of the COVID-19 outbreak in Saudi Arabia and the role of social distancing in controlling transmission

We collected demographical, epidemiological, and outcome data from the online web of Saudi Center for Disease Prevention and Control. A total of 22,753 COVID-19 cases were reported before 1 May, 2020 from different cities in the KSA, including Mecca, Riyadh, Jeddah, Madina, Dammam, Hofuf, Jubail, Khobar, Baish, and Taif (MOH-KSA, 2020). The cases increased consistently since the first reported COVID-19 case in the KSA (Fig. 1A). The details of the COVID-19 cases in the first 60 days are shown in the Supplementary data (Table S1). The highest number of COVID-19 cases was reported from Mecca followed by Riyadh, which is the capital of the KSA. One possible reason for the large number of cases in Mecca, Jeddah, and Madinah may be the influx of migrants from different parts of the world prior to lock down. Furthermore, the high number of cases in Dammam is due to the arrival of tourists from nearby cities of the KSA. There were no reports of COVID-19 in the KSA prior to 1 March, 2020, and the initial COVID-19 case was identified in a naïve of the KSA who was back home after visiting Iran via Bahrain (Atique and Itumalla, 2020).

Although the KSA is taking all possible measures to combat COVID-19, 162 deaths have still been reported. However, the 3,163 recoveries that were recorded during the study period indicate decent

medical facilities (Fig. 1B). The rate of recovery and mortality of COVID-19 in the KSA was approximately 96% and 4%, respectively. Furthermore, despite the increasing incidence of COVID-19, the death rate has decreased following the implementation of a health policy in accordance with the WHO guidelines. This may be due to the proper treatment procedures, excellent management of medical facility for COVID-19 patients, and good precautionary managements. It was observed that the cases of COVID-19 increase in KSA as **1,351 new cases** and **5 new deaths** have reported on 30 April, 2020.

The WHO has confirmed the extremely high risk of COVID-19 to prepare countries to manage and decrease the rapid transmission of the virus, the number of COVID-19 cases, and related deaths. The implementation of stringent social distancing measures in the KSA faced many social, political, religious, and economic challenges but they have been crucial to control the spread of disease. The health authorities of various countries including the KSA have implemented social distancing through different strategies to fight COVID-19. The KSA took the decision at an early stage prior to the first reported case of COVID-19; this was likely due to the previous successful management of the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) reported in 2012 (Algaissi et al., 2020; Barry et al., 2020). The authorities of the KSA have taken further actions and declared that all games, contests, and activities should be held behind closed doors in addition to suspending the 2020 Saudi Olympics Games. Moreover, on March 8, 2020 the Ministry of Education of the KSA, announced that the universities and schools were to remain closed and teaching work suspended to avoid community transmission of virus.

Although, till March 8, 2020, only 11 cases of COVID-19 were observed but latter on the incidence of cases were increased exponentially in the KSA. Such a high rate of COVID-19 cases was aware to government and health ministry which has suspended the most of the gathering events, celebrations, conferences, unnecessary activities, markets, restaurants, shopping malls, and coffee shops. On 14 March, 2020 the government authorities stated that all games, competitions, and games-related movement were to be suspended, and that all sports centers, gyms, and stadiums were to remain closed. Moreover, crowded places of worship were also closed temporary (including 80,000 mosques) and both the daily and Friday prayer were suspended to control the public transmission of SARS-CoV-2. Despite these stringent measures, community contact and interactions persisted, particularly in the evenings. As a result, the higher authorities of the KSA announced a partial curfew on March 23, 2020. Initially, the public were requested to reside in their homes from 7:00 pm to 6:00 am except for urgent need. However, the curfew was later extended from 3:00 pm to 6:00 am in several cities, including Makkah, Medina, and Riyadh. Although the number of COVID-19 cases has continued to increase in the KSA, reaching 1,012 cases and 3 deaths by March 26, 2020, these figures are significantly lower than various other countries including Italy, Spain, USA, Iran, and France. Therefore, social distancing is playing a significant role in managing the COVID-19 pandemic. At present, the KSA faces important decisions regarding the upcoming Hajj of 2020 during the pandemic; the pilgrimage is an important event for all Muslims who are financially and physically capable to perform it (Gautret et al., 2020).

Comparison of the COVID-19 outbreak in Saudi Arabia and four other countries

Worldwide, the countries most affected by COVID-19 are known to be the USA, Italy, Spain, the United Kingdom, France, China, Germany, and Iran (JHU, 2020). Despite being the origin of the COVID-19 outbreak, China now has the disease under control. Here we analyzed COVID-19 in China, the USA, Italy, and Spain and compared the data with those of the KSA.

Analysis of the COVID-19 outbreak in China

COVID-19 originated from China in December 2019 and has since spread worldwide (Wang et al., 2020). The first 3 cases were reported on 27 December, 2019, and 77,658 cases were reported within 60 days of this (Fig. 2A). The maximum number of cases of COVID-19 was reported on 12 February, 2020 in China. Details of COVID-19 cases in the initial 60 days in China are shown in the Supplementary file (Table S2). COVID-19 cases increased in China until 20 February, 2020, but later came under control as quarantine and lockdown started to take effect.

In the 60 days since the first reported case in China, 2,663 deaths and 27,230 recoveries were observed until 24 February, 2020, with a recovery and mortality rate of approximately 94% and 6%, respectively (Fig. 2B). Initially, the virus was relatively unnoticed globally, and even the Ministry of China did not warn their residents until the end of January 202. Despite scientists warning of the possibility of a novel epidemic at the beginning of December 2019, and that transmission of the virus could be reduced with action, the virus spread worldwide and became a global emergency. The government of China imposed immediate action to combat COVID-19 and used advanced medical facilities to control the disease (Fu and Fu, 2020). COVID-19 tends to spread by human-to-human contact, predominantly nasal droplets, or contaminated hands or surfaces, and has a high transmission rate with an incubation period of between 2–14 days. This is the crucial reason of exponentially transmission of pandemic.

Analysis of the COVID-19 outbreak in Italy

Italy has suffered immense burden as a result of COVID-19. The initial report on COVID-19 cases emerged in the mid of February 2020 in the northern part of Italy in Codogno, a small village in Lombardy when a Chinese couple visited on holiday (Armocida et al., 2020; Placella et al., 2020). Subsequently, the virus reached other regions, such as the coastal region of Liguria, central Tuscany, and Sicily in the south, as well as other European countries (Day, 2020). Nevertheless, a report showed that the infection of COVID-19 had been spreading since the start of January. Indeed, this investigation showed that there had been 162,488 cases of COVID-19 within 60 days of the initial report (Fig. 3A). The new cases of COVID-19 on date 14 April were reported 2972 in Italy. The highest number of COVID-19 cases in Ital was reported on 21 March, 2020 (6,557), followed by March 26, 2020 (6,203). Further details on the COVID-19 cases in the first 60 days are shown in the Supplementary file (Table S3). The cases reportedly increases until the end of March 2020, thereafter they were controlled to a certain extent as quarantine and lockdown measures started to take effect.

In the 60 days since the first reported case in Italy, we observed 21,067 deaths and 37,150 recoveries until 14 April, 2020, with a recovery and mortality rate of approximately 74% and 26%, respectively (Fig. 3B).

The mortality rate in Italy was far higher than that reported in China. However, this may be somewhat unreliable due to inadequate testing and constraints relating to test kits and materials, including personal protective equipment (PPE) for testers and nasopharyngeal (NP) swabs. Although, the government of Italy acted immediately to fight COVID-19 using their advanced medical facilities to control the disease, they faced extra pressure due to the high number of cases, particularly in the medical fraternity (Armocida et al., 2020). Indeed, the National Healthcare Service of Italy almost collapsed due to the burden of COVID-19.

Analysis of the COVID-19 outbreak in Spain

Two case of COVID-19 were reported in in Spain on January 31, 2020, while a German traveler tested positive for SARS-CoV-2 at La-Gomera, Canary Islands. Four novel cases of COVID-19 were confirmed positive in Spain, and were found to be associated with the Italian cluster on 25 February, 2020. A total of 174,060 COVID-19 cases were reported within the 60 days from the initial report (Fig. 4A). Although the number of cases of COVID-19 fluctuated in the online data, they were reported to increase until 20 February, 2020. The highest number of cases (8,271) was reported on 26 March, 2020 in Spain, while the infection rate gradually slowed in April 2020 (Table S4). Further details of the initial COVID-19 cases in Spain are shown in the Supplementary file (Table S4).

In the 60-day study period, we observed 18,255 deaths and 66,041 recoveries in Spain until 24 February, 2020, with a recovery and mortality rate of approximately 86% and 15%, respectively (Fig. 4B). Although the virus has been transmitted worldwide, Spain was affected particularly badly. On 7 March, 2020, the government of Spain implemented lockdown in Haro town due to the rapid increase in COVID-19 cases (Jones, 2020). However, the delay in executing lockdown allowed the movement of infected people in different places of Spain, which subsequently increased the spread and death rate.

Analysis of the COVID-19 outbreak in the USA

The first case of COVID-19 was identified in the USA on 21 January, 2020 in an individual who entered Washington State on 15 January after visiting Wuhan, China (Holshue et al., 2020). The U.S. Centers for Disease Control and Prevention (CDC) validated the oropharyngeal and nasopharyngeal swab samples of the patient and confirmed a positive SARS-CoV-2 result through rRT-PCR assay. Further details on the COVID-19 cases in the initial 60 days (total 19,551 cases) in the USA are illustrated in Supplementary file (Table S5, Fig. 5A). The cases of COVID-19 constantly increased from 1 March, 2020 in the USA. The COVID-19 community transmission was initially identified in the USA in February 2020. Out of 50 states, New York City, the District of Columbia, and four U.S. territories identified COVID-19 cases (CDC, 2020). During the study period, we observed 309 deaths and 880 recoveries until 20 March, 2020 (Fig. 5B). Although the death rate in the USA was initially low, it later escalated rapidly and has been USA the worst affected country in the world. The highest number of COVID-19 cases (1,095,023) and deaths (63,856) was observed until 30 April, 2020. Various recent studies confirmed the person-to-person transmission of COVID-19 in the USA (Ghinai et al., 2020). The current data support the CDC recommendations regarding social distancing to decrease the transmission of SARS-CoV-2.

Artificial intelligence to discover novel therapeutics for COVID-19

The available approaches are slow, inefficient, and more costly for the discovery and development of novel drugs. Nonetheless, recent advances in high-throughput experimental techniques and computational modeling promise reductions in the costs and development times required to bring new drugs to market. There is a dire need to develop new platforms and approaches to combat new and old diseases. The following AI based approaches BenevolentAI, Atomwise, Insilico Medicine might be effective for drug development and research.

Atomwise

To predict the biological activity of small molecules for drug discovery, Atomwise's networks apply feature locality and hierarchical composition to the modeling of pharmacological activity and chemical interactions. In particular, a molecular shape analysis with CNNs predict binding affinity measurements of small molecules to protein structures. Their networks did extremely well on the DUD-E dataset, achieving an AUC greater than 0.9 on 57.8% of the targets (Wallach et al., 2015).

In silico Medicine

In silico provides a unique generative adversarial network (GAN) based approach for synthesizing new drugs for specific diseases including viral diseases (COVID-19) (Ibrahim et al., 2020; Li et al., 2021; Lin et al., 2020). Their network allows for de novo small molecule design, which optimizes synthetic feasibility, novelty, and biological activity. Insilico's networks can generate molecules with certain properties or activity against a certain target, making the network extremely useful for initial discovery (Lin et al., 2020). However, few examples of generative drug design have achieved experimental validation in vitro or in vivo. The *in silico* approaches recently published 10 representative structures of protease inhibitors for their potential development against COVID19 (Keretsu et al., 2020; Li et al., 2021).

DeepDrug

The DeepDrug pipeline is capable of automatically synthesizing targeted drug molecules using beam search methods, filtering candidates based on chemical criteria (e.g., Lipinski's Rule of Five), toxicity, and side effects to predict the candidates that are most likely to succeed (Zhu et al., 2021). It is modular in nature and is currently comprised of eMolFrag (Liu et al., 2017), eSynth (Naderi et al., 2016), eToxPred (Pu et al., 2019) and several other AI based filters. A new module eVir has recently been added to DeepDrug for determining viral specificity of drugs and for drug repurposing. eVir uses embeddings of drugs to capture their drug-protein interactions, which are compared against embeddings of known antiviral peptides. Recently transferable deep learning approach utilized for fast screening of antiviral compound for the management and treatment of COVID-19 (Wang et al., 2021).

There are some specific limitations to every approach such as the Atomwise approaches can only repurpose molecules. This approach requires a large volume of specialized experimental data. The Atomwise approach predicted the binding affinities of millions of small molecules to potential targets on

SARS-CoV-2. Many teams are working *in silico* on extremely specific problems. For instance, the Insilico team is working with GANs, which are disadvantageous as the system acts as a black box. When applied in the context of COVID-19, the *in silico* team identified 10 molecules (proteasome inhibitors) that scientists are currently testing in lab. DeepDrug can not only synthesize new molecules using the building blocks obtained by decomposing existing drugs but also repurpose existing FDA approved drugs for emerging infectious diseases. DeepDrug can predict the toxicity profile of the synthesized or repurposed molecules, as well as the ease of manufacturing it in the laboratories. DeepDrug was utilized to identify nutraceuticals that support the immune system against COVID-19. Specifically, it identified cholecalciferol (Vitamin D3), panax ginseng, and levomenol (bisabolol), which have all demonstrated efficacy *in vitro*. DeepDrug's approach to drug discovery and development points towards a brighter future and we need to embrace this new strategy amidst the turmoil of this current pandemic.

Conclusions

The COVID-19 pandemic is a major public health concern globally. As such, a combined multinational coordinated effort is necessary to combat COVID-19. Although the cases of COVID-19 have increased continuously in the KSA, the death rate has been controlled due to the rapid action of the government since the first recorded case compared to other countries such as China, Italy, Spain, and the USA. Moreover, the recovery from COVID-19 has been very good due to the excellent medical facilities and quarantine centers. Detection of the virus at an early stage is crucial for proper treatment and management to control the spreading of the virus and to decrease the economic impact of COVID-19 in the KSA. Another important factor may be the strong immune system, which has played an important role in fighting the virus.

The current COVID-19 pandemic has prompted various authorities to alerting the healthcare system and animal healthiness inspection systems which plays a crucial role in expecting, identifying, and holding outbreaks. The outbreak of coronavirus infections has alerted us from the earlier outbreak in animals. This is the high requirement to prevent the all erroneous activity of human beings. Indeed, the pandemic of 2009–2010 was caused by a virus of swine origin, H1N1, which was responsible for a high number of fatalities worldwide with approximately 220,000 deaths. Similarly, the current COVID-19 pandemic has been emerging the issue that how the origin of this virus in human. Health policies including social distancing, isolation of patients, and proper quarantine are achieving remarkable results given the lack of antiviral drugs and vaccines. Therefore it is essential to analyze the molecular mechanism of transmission of COVID-19 and develop the reliable vaccines and effective drugs against to the COVID-19 as early as possible. Our team is also working rapidly to develop a unique reliable and efferent drugs/vaccine against the family of coronaviruses using highly efficient DeepDrug pipeline approach artificial intelligence technology.

Declarations

Ethics approval and consent to participate

Not applicable. No human samples or clinical data were used.

Consent for publication

All authors have reviewed the read the final version of the manuscript for publication.

Availability of data and materials

Appendix A showed the data.

Competing interests

The authors have declared that no any competing interests in current study.

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Authors' contributions

SK, manuscript writing, idea of project and data analysis; AI, manuscript review, manuscript review, and advice on interpretation; AF, AAC and MAK, manuscript review, advice on interpretation; AM, data analysis, funding for research and manuscript drafting.

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Figures

Figure 1

Image showing the COVID-19 case information from the initial 60 days in KSA. (A) Graph indicating the increase in cases and the daily number of cases reported in KSA. (B) Graph indicating the daily increase in deaths and the recovery from COVID-19 in KSA.

Fig. 2A

Fig. 2B

Figure 2

Image showing the COVID-19 case information from the initial 60 days in China. (A) Graph indicating the increase in cases and the daily number of cases reported in China. (B) Graph indicating the daily increase in deaths and the recovery from COVID-19 in China.

Fig. 3A

Fig. 3B

Figure 3

Image showing the COVID-19 case information from the initial 60 days in Italy. (A) Graph indicating the increase in cases and the daily number of cases reported in Italy. (B) Graph indicating the daily increase in deaths and the recovery from COVID-19 in Italy.

Fig. 4A

Fig. 4B

Figure 4

Image showing the COVID-19 case information from the initial 60 days in Spain. (A) Graph indicating the increase in cases and the daily number of cases reported in Spain. (B) Graph indicating the daily increase in deaths and the recovery from COVID-19 in Spain.

Fig. 5 A

Fig. 5 B

Figure 5

Image showing the COVID-19 case information from the initial 60 days in the USA. (A) Graph indicating the increase in cases and the daily number of cases reported in the KSA. (B) Graph indicating the daily increase in deaths and the recovery from COVID-19 in the USA.

Supplementary Files

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