

REVIEW ARTICLE

## Coronavirus Disease 2019 (COVID-19) pandemic, lessons to be learned!

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### ABSTRACT

Coronavirus Disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has been reported as a worldwide emergency. Due to the extensiveness of spread and death, it has been declared as a pandemic. This review focused on the current pandemic situation and understanding the prevention and control strategies of COVID-19. Data presented here was by April 3, 2020. A total of 1,016,399 cases of COVID-19 with 53,238 deaths was reported from 204 countries and territories including two international conveyances over the world. After China, most of the new cases were from Europe, particularly Italy acting as the source of importation to many of the other countries around the world. China has obtained success by ascribing control strategies against COVID-19. The implementation of China's strategy, as well as the development of a vaccine, may control the pandemic of COVID-19. Further robust studies are required for a clear understanding of transmission parameters, prevention, and control strategies of SARS-CoV-2. This review paper describes the nature of COVID-19 and the possible ways for the effective controlling of the COVID-19 or similar viral diseases that may come in the future.

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### Introduction

Under the *Coronaviridae* family, coronavirus possesses enveloped, single-stranded Gram-positive RNA genome which has been detected in avian hosts and mammals, including bats, camels, civets, dog, and cats [1–3]. Among previously known several coronaviruses, most are mild pathogenic to humans [1], but Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) and the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) caused severe human infection [4]. In Guangdong, Southern China, a betacoronavirus: SARS-CoV arose in November 2002 [5] and caused 774 deaths in 37 countries with more than 8,000 human infections [6]; and MERS-CoV first emerged in Saudi Arabia in 2012 [7] with 2,494 human cases constituting 858 deaths, besides, 38 deaths were recorded in South Korea through a single introduction [8,9]. Several patients with pneumonia-like respiratory illness were recognized in late December 2019 in Wuhan, Hubei (a province of China) [4,6]. Epidemiologically, they were connected with Hunnan

wet market where multifarious non-aquatic birds and rabbits were sold [6]. Although doctors couldn't trace the cause at the beginning, a novel human infecting coronavirus was identified as the etiology in the first week of January 2020 [4,10–15] using next-generation sequencing [10,16]. WHO named the virus provisionally as 2019 novel coronavirus (2019-nCoV) [17], followed by renaming as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) based on the rule of international committee on taxonomy of viruses (ICTV) [18,19]. Before that, the virus was recognized as a sister to SARS-CoV [19]. The name SARS-CoV-2 was approved by ICTV based on the similarities of genetic characteristics with the previous coronavirus that caused the outbreak of SARS, 2003 [18]. Finally, based on severity, spread, transmissibility, prevention, and treatment, WHO named the disease as Coronavirus Disease 2019 (COVID-19) in the international classification of diseases [15,18].

Due to the importation of COVID-19 from epidemic states and countries to different states and countries, the disease

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has spread throughout China and all over the world in a short time, though the outbreak was recognized in Wuhan [19–26]. Because of fast-spreading, COVID-19 has affected 204 countries and territories including two international conveyances [27]. WHO declared the COVID-19 disease as a global pandemic by observing the enormous number of cases and colossal deaths with the concatenate of social operations and huge economic losses throughout the world [27,28]. Furthermore, WHO also declared that Europe has become the new epicenter of COVID-19 on March 13, 2020, due to the deadly run throughout the European countries [29]. An implausible number of deaths has made the coronavirus pandemic as death toll over the world.

Human-to-human transmission among a cluster of people including doctors and healthcare workers is augmenting the piquancy of COVID-19 with the mild-to-severe sign-symptoms [14,23]. Although the extensiveness of spread and death rate has differed among SARS, MERS, and COVID-19 outbreak, the sign and symptoms with transmission patterns are similar [30]. Several studies found the similarities in the transmission pattern by droplet and contact (direct and indirect) transmission among the SARS-like viruses [31–33]. The transmission of viruses is under the influence of many factors, such as environmental temperature, humidity, and population density [11,12]. However, no effective medications and vaccines are developed against SARS-CoV-2 though different research groups over the world are trying to develop vaccines and antiviral drugs [34]. Thereafter, every nation is providing their best endeavors to alleviate the extensiveness of COVID-19.

As a strategy to prevent and control the intensification of COVID-19, China started to take an extreme level of strategies such as extreme lockdown, transmission route blocking, and susceptible population protection, followed by other nations are trying to follow China's strategies [35,36]. However, the present review focused on the current outbreak situation of COVID-19 and described the prevention and control strategies.

### **Selection criteria**

The current review included peer-review articles focusing on human coronaviruses, including SARS, MERS, and COVID-19 virus with their epidemiology, transmission dynamics, and current situation of the outbreak, and prevention and control measures. We also extracted the information from relevant websites for current situation reports of the outbreak. No language limit was for information acquisition. There was a strong focus on the most recent published data.

### **Information sources and search strategy**

The present review was conducted using PubMed, Scopus, Google Scholar, Research Gate, Web of Sciences, Elsevier,

Nature, WHO, and Worldometer. The keywords used here were: "COVID-19," "SARS," "MERS," "SARS-CoV-2," "Coronavirus," "2019 nCoV," "Pandemic," "Wuhan coronavirus," "First New Case," "Prevention," "Control," and "China's Control Strategies" or a combination among these. The searches were between March 29, 2020, and April 3, 2020, by individual researchers, and then all the collected data were coordinated.

### **Data incorporation**

The searched articles were screened initially by title and abstract in context to the interest of the study. To find out the current scenario of COVID-19 outbreak, prevention, and control strategies across the globe, the total number of confirmed cases, death cases, and recovery cases [27,37] were documented in Supplementary Table 1. To analyze the first imported case in countries, importation sources [27,37] were listed in Supplementary Table 2.

### **Epidemiology**

There were so many lessons for China during and after the SARS outbreak in the Southern part of the country in 2002. As a part of continuous research, in March 2019, research studies from China warned about the possible future SARS- or MERS-like outbreak in China from bat [38]. Wild animals including bats, snakes, and others were sold in a seafood market at Huanan in Wuhan, primarily was declared as the source of infection but environmental specimens from the market were found to carry SARS-CoV-2 [39]. But the animal association is not confirmed yet. Initially, snake was thought to be a potential reservoir but researchers rejected the option [40]. The whole-genome sequence of SARS-CoV-2 and other available Betacoronavirus revealed a close relation with BatCov RaTG13 with 96% similarity [11,41–44]. In the beginning, confirmed patients had a history of working in the market [45]. Human-to-human transmission through droplets and fomites was noticed in many patients having no association with the market. Besides, the infection to healthcare workers strongly indicated the high human-to-human transmission through droplets and fomites and direct contact [46–48]. The other provinces of China were infected through the importation of cases from Hubei province. Initially, some countries reported imported cases, later on, local transmission. Finally, importation among the countries and to new countries continued sharply, leads the outbreak towards pandemic. From the outset, newly infected countries reported their first case was imported from China as expected, thereafter, most of the countries announced their first patient traveled from Europe particularly, Italy (Supplementary Table 2). Besides, the neighboring country was also the source of importation in some cases (Supplementary Table 2). Europe has been declared as the epicenter of the pandemic

by WHO [29], data of Supplementary Table 2 suggested the same.

### Current case reports

A total of 1,016,399 cases of COVID-19 with 213,133 (80%) recovered and 53,238 (20%) deaths have been reported from 204 countries and territories along with two international conveyances all over the world by April 3, 2020 (Supplementary Fig. 1) [49]. USA reported the highest 245,373 number of cases, whereas Italy (115,242), Spain (112,065), Germany (84,794), China (81,620), France (France), Iran (50,468), and UK (33,718) were mostly affected [37]. The active cases are 750,028 where 712,373 (95%) were mild and 37,655 (5%) were serious or critical cases. The critical cases were mostly in France (6,399) followed by Spain (6,092), USA (5,421), Italy (4,053), Iran (3,956), and Germany (3,936). Although critical cases were high in China, the numbers are now decreasing in the prospected way but increasing outside China particularly, in the USA and most European countries [37]. The numbers of new cases were always more than the recovery number. Since China has managed to prevent the spread of the virus and was discharging a large number of recoveries every day, the daily recovery number increased over the new cases. However, the number of confirmed cases is augmenting day by day. This is due to the huge number of new patients in the USA, European countries, Iran [37]. Overall, the number of confirmed cases was reported more in Europe than in other regions of the world (Supplementary Fig. 2) [50].

### Viability, incubation period, and symptoms

Although viruses need a living host to survive and replicate, SARS-CoV-2 remains viable outside the living body and persist on different environmental conditions for several hours to days (Table 1). This virus remains more viable on stainless steel and plastic compared to aerosols, copper, and cardboard [51]. That's why the way of transportation, food products, food containers, house doors, elevator buttons, cellphone screens, glass windows,

hospital beds, etc. can act as the source of indirect contact transmission of SARS-CoV-2 [52].

Although COVID-19 produces signs and symptoms in the infected individuals within 1–14 days, the average period is 5–6 days. Within this average time, fever and mild respiratory symptoms may be developed in affected individuals [43].

The WHO-China Joint Mission has reported on signs and symptoms of COVID-19 and they revealed that the disease can cause non-specific symptoms, including asymptomatic to severe pneumonia, followed by death [53]. The joint mission indicated that the signs and symptoms can vary according to their laboratory findings collected from 55,924 confirmed cases by 20 February 2020 [53]. The signs and symptoms with their occurrence are shown in Figure 1.

### Mortality

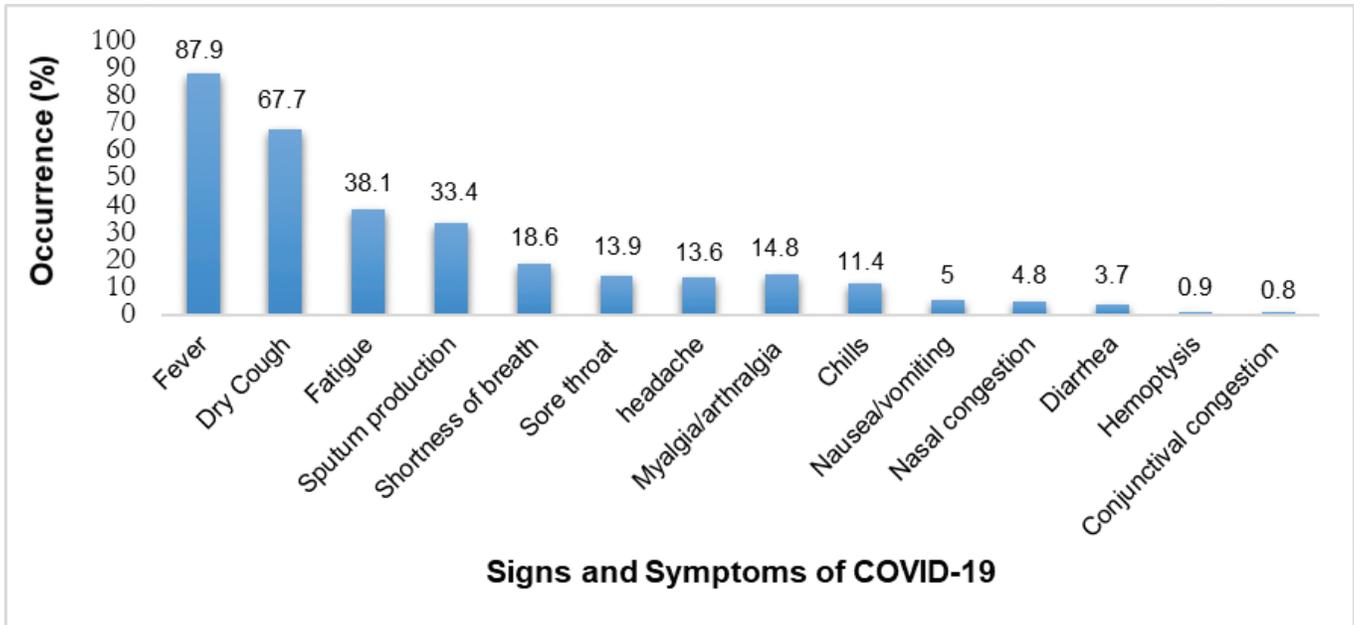
Among total cases, the mortality of COVID-19 was 5.2% (total death/ total confirmed cases) quite lower than SARS (9.6%) and far away from MERS (34%) and Ebola (65.7%) [30,37,54]. The highest deaths were in Italy (13,915) followed by Spain (10,348), USA (6,095), France (5,387), China (3,322), Iran (3,160) and UK (2,921) (Supplementary Fig. 3) [55]. Daily new deaths are increasing in these countries except China (Supplementary Fig. 4) [37,55]. There are fluctuations of death based on age, country, and date. In context to sex, male death (2.8%) was higher than female (1.7%) among all cases and males were infected more than female [56]. The SARS study also revealed similar findings in relation to sex [57]. This may be due to the presence of gene for angiotensin I converting enzyme-2 (ACE-2) receptor and the host receptor for SARS found on the X chromosome and more tendency of males to smoke which results in lung damage [58–60]. Patients suffering from cardiovascular disease, diabetes, chronic respiratory disease, hypertension, cancer and elderly immunosuppressed people [61], are the most susceptible to critical cases of COVID-19 and death (Table 2) [56]. Only 0.9% of death was not associated with any pre-existing medical conditions [56].

### Is there any effect of temperature and humidity on COVID-19 transmission?

There is speculation that climatic factors, such as temperature and humidity can affect the transmission of SARS-like viruses. Recent several studies indicated the effectiveness of temperature and humidity on SARS-CoV-2 though the data were collected during the pre-stage outbreak [62–64]. In the progression of pandemic, the outbreak is occurring in a few countries having high temperature, such as India, Malaysia, and Brazil, etc. On the other hand, some

**Table 1.** Viability of SARS-CoV-2 in different environmental conditions.

Environmental conditions	Viability time	Median half-life	References
Aerosol	Up to 3–4 h	1.1–1.2 h	[51,52]
Plastic	Up to 72 h	6.8 h	
Stainless steel	Up to 72 h	5.6 h	
Copper	Up to 4 h	0.8 h	
Cardboard	Up to 24 h	3.5 h	
Glass	Up to 96 h	–	



**Figure 1.** Signs and symptoms of COVID-19 with their occurrence according to WHO-China joint mission, 2020 (reproduced from WHO [53]).

**Table 2.** The mortality rate of COVID-19 based on age (reproduced from Worldometer [56]).

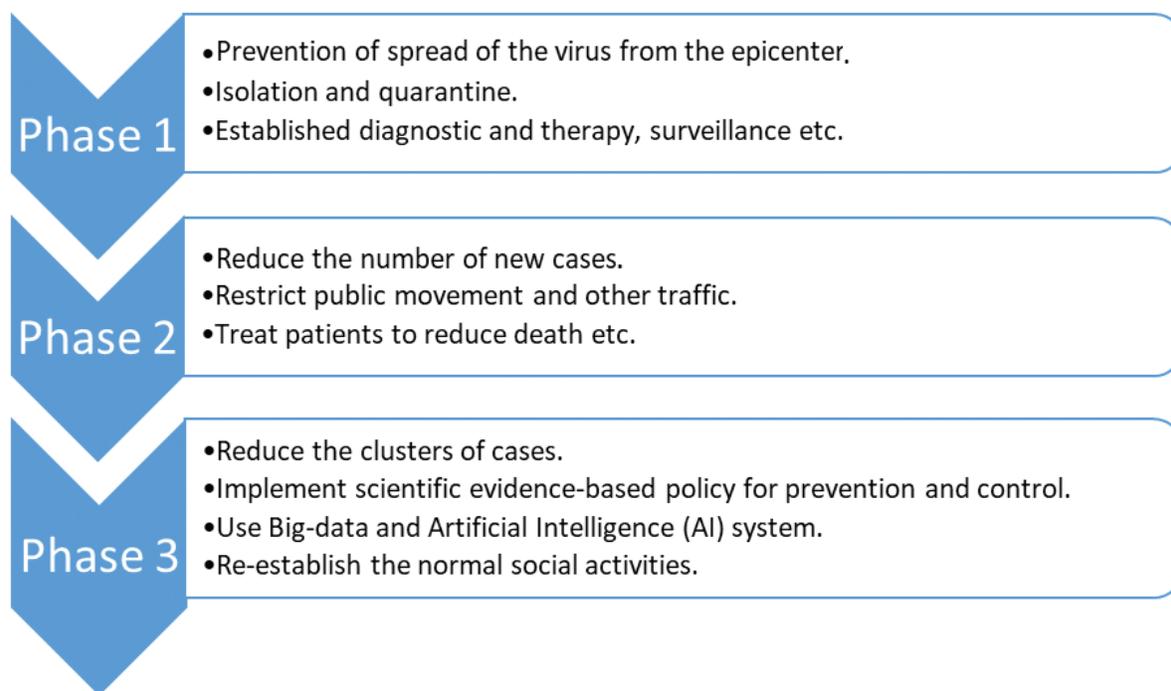
Age (Year)	Death rate(confirmed cases)	Death rate(all cases)
80+	21.9%	14.8%
70-79		8.0%
60-69		3.6%
50-59		1.3%
40-49		0.4%
30-39		0.2%
20-29		0.2%
10-19		0.2%
0-9		No fatalities

countries, such as Japan and South Korea having low temperatures showed a limited outbreak [37]. These exceptions interpret that the virus transmission may depend on the taken interventions by governments. Besides, the transmission can be influenced by population density, awareness of people, economic strength, and health system of a country. Therefore, we can't directly relate the influence of temperature on the transmission of SARS-CoV-2. Robust studies should be taken to clarify this vague situation.

#### Prevention and control

To limit the loss associated with COVID-19 and stop its spread, immediate control measures are crucial [65].

Travel history is very important for the early detection of SARS-CoV-2 to prevent the local transmission [66]. In the present situation, travelers from the infected areas are the main route of virus entry to a new country. WHO stated several recommendations for travelers' particularly international passengers in relation to the current outbreak [67]. WHO suggests only temperature screening at entry or exit, is always not enough to prevent international spread, since infected people may be in the early stage of the disease (incubation period) and may not show apparent symptoms, or may use antipyretics to dissimulate fever. In the current situation, it is better to collect contact details of passengers, detailed information where to move for contact tracing and provide a health card with details of what to do if the individual feels to notify authority, and best to quarantine individuals who came from the affected areas. Individual country can discourage their people to travel to an affected area if not emergency [67]. Many of the countries have already restricted the entry of flights from COVID-19 affected countries and issuing an on-arrival visa. Force institutional and home quarantine is also in function where required. Besides, universities, schools, and collages are now closed in many parts of the world to combat COVID-19. To control the local transmission, reducing human-to-human transmission through droplets and contact is crucial. WHO recommendations on virus control interventions to lower the general risks of spread includes avoiding close contact with confirmed or suspected patients or a traveler from the infected area; hand hygiene through the frequent wash with sanitizer



**Figure 2.** Major steps of the China strategy in brief (reproduced from WHO [53]).

particularly after exposure with affected people or with their environment. Besides, affected people should use protective devices during coughing, keep up a distance, and follow the nation's health tips. Following other updates and recommendations of WHO is important. Previous knowledge of MERS and SARS control is also useful [67], since COVID-19 is a member of the same group of viruses. Although knowledge dissemination is needed, the government should be careful about the misinformation and clarify them. Finally, the sharing of authentic knowledge and technologies, and health care facilities among the countries will be helpful.

Coronavirus changes its immunogenic structures frequently as COVID-19 has emerged after changing its antigenic structures several times. Thus, targeting a protein structure present in the virus that is comparatively stable can be a possible way for developing vaccine against COVID-19. Recently, Ahmed et al. [68] identified a set of B cell and T cell epitopes in the spike (S) and nucleocapsid (N) proteins that potentially offer protection against this novel virus. Interestingly, there was no mutation found in these epitopes considering the 120 available SARS-CoV-2 sequences [68].

#### **China strategy**

China aimed at COVID-19 control as the priority at all levels of government. China already has proved that COVID-19 is controllable and they reported only 31 cases on April

3, 2020. To control the disease, China undertook three phases that could be adopted by other countries currently having COVID-19 outbreaks (Fig. 2) [53]. Here, we focused on China strategy because it was the country where the first epidemic started. It was also the the first success story too. Moreover, compare to other countries, much more people were affected in China. Basic approaches in Korea, Japan, and Norway who also controlled COVID-19 epidemic later were quite similar to China primarily focusing on test, isolation, and quarantine.

#### **First phase**

The first phase focused on the prevention of the spread of the virus from the epicenter Wuhan and other infected areas of Hubei to other provinces, therefore, aimed to control the infection source, stop transmission, and prevent further spread. Multi-sectoral approaches were taken for the prevention and control of the disease. Wet markets were identified and closed and necessary steps were taken to identify the zoonotic connection; strict supervision, and control measures were also made for live poultry and wildlife markets. They informed WHO about the epidemic on January 3, 2020, and also shared the whole genome sequence of SARS-CoV-2 on January 10, 2020. Besides, they established diagnostic and therapy, surveillance, management of exposure and laboratory detection protocols for COVID-19 and developed diagnostic kits for the test.

## Second phase

The second phase aimed to reduce the number of new cases as well as to treat patients, reduce deaths, and prevent explorations in Wuhan and nearby priority areas in Hubei province. The main focus of the other provinces was to prevent importations, curb the spread, and implement the joint control measures. The Chinese government categorized the COVID-19 as two types: Class B infectious disease and border health quarantine infectious disease based on the notifiable report on January 20, 2020. They attributed strong transportation law to prevent the transmission of disease by checking body temperature, declaring health care approbation, and practicing quarantine at the transportation depots. Moreover, on 23 January 2020, the Wuhan government implemented strict traffic restrictions. With the progress of the disease, diagnostic, treatment, and other associated protocols were improved; isolation of case and treatment of patients were strengthened. The public movement was restricted. Medical knowledge dissemination was strengthened and prevention and control measures were regularly released. New hospitals were built, medical supplies were coordinated and the best use of all other resources was done. The supply of daily needs and their prices were strictly monitored to make sure smooth daily operation of society.

## Third phase

This stage focused to reduce the clusters of cases, introducing a scientific evidence-based policy for prevention and control. Patients in Wuhan and other potentially risky areas of Hubei province, patients were treated carefully to reduce virus transmission. A differentiated prevention and control measures were adopted for different regions of the country and provinces based on the level of risk they were exposed. Sophisticated hitch technologies, such as Big-data and artificial intelligence were used for strengthening contact tracing along with the management of priority populations. Health insurance payment, off-site settlement, and financial compensation were promulgated as a part of the better health management system. Other provinces supported in all ways to curb quickly the spread of the disease. Steps were being taken to re-establish the normal social activities in a stepwise fashion along with improving public awareness on disease prevention and control, and public health. Besides, research and development activities focusing on development of diagnostics, therapeutics, and vaccines were adopted.

## **Why European countries including the USA failed to control COVID-19?**

A collective failure in taking swift measures in time and being unconcerned leads to enormous and unnecessary deaths to the public due to the coronavirus disease. Among European countries, Italy first faced the serious and disastrous outbreak of COVID-19. For the severity of the disease, lacking concern along with having a huge aged population are considered as foremost causes. The government failed to enforce full lockdown in time. Furthermore, the decision to lockdown northern Italy was leaked before being approved and the people started to escape from North to South. This may have caused the rapid spread of the virus. Besides, failure to rule proper social distance also made a big role in the spread of COVID-19. They failed to track contact tracing, comprehensive testing, and self-isolation.

Like Italy, most of the European countries also couldn't control the severity of COVID-19 because of waiting for long to enforce the lockdown and failure to maintain social distance. Even the USA is being exploded by COVID-19 due to the failure in pursuing widespread testing, maintaining contact tracing, and ascribing mandatory quarantine for risk individuals. Almost all countries, around the world where the COVID-19 is highly prevalent, faced the severity due to the lack of concern and failure of maintaining social distancing (Table 3).

## **Knowledge gap**

There is evidence of SARS-CoV-2 presence in patient stools [25]. However, fecal-oral route transmission is still unclear. Previous reports revealed the capability of SARS and other coronaviruses of surviving on an inanimate object and environmental surfaces [69,70]. However, there is no report of SARS-CoV-2 presence in the environment except Hunan Market. The effectiveness of travel restriction, maintaining social distance, wearing a mask in the general public, home, or self-quarantine is not clear. Although there are some studies on the treatment of COVID-19, more study needed [25,71,72]. Several studies are focusing on the influence of environmental parameters, such as temperature and humidity, on SARS-like virus transmission [69,73]. The seasonality of the outbreak is also required to study. More studies are needed to explore the role of environment in the spread of the virus and its viability that are crucial for adopting strategies to control COVID-19 outbreaks. Besides the environment, more studies are required to identify the intermediate host(s) of COVID-19, because bats are known to be a reservoir of SARS-CoV-2 [38].

**Table 3.** Causes of being failed to control of COVID-19 in few countries.

Country	Limitations	References
USA	Failed to Deciding in time; Widespread testing; Contact tracing; Attribute mandatory quarantine.	[74]
Spain	Failed to Enforce lockdown in time; Maintainsocial distancing. Political issue	[75,76]
Italy	Fail to Enforce lockdown in time; Maintain social distancing. Having a huge old population Lack of concern Playing football matches with huge supporters during the COVID-19 outbreak.	[75,77]
France	Failed to Maintain social distancing; Enforce lockdown in time; Take effective quarantine measures.	[75]
Switzerland	Limitation in The capacity of test centers and existing diagnostic laboratories interms of personnel and reagents; Maintaining social distancing.	[78]
Iran	Failed to Take effective quarantine measures; Disinfect the cities. Political issues	[79,80]
UK	Failed to Maintain social distancing; Track contact tracing.	[75]
Turkey	Failed to track the contact tracing Lack of seriousness among people of government.	[81]
Netherlands	Failed to implement restrictions timely Tried to adopt an “intelligent lockdown” but failed.	[82]

## Conclusions

COVID-19 outbreak in China has been declared as pandemic due to its rapid and extensive spread in at least 204 countries and territories. After China, Europe is the new epicenter of the outbreak. The importation of infected individuals to uninfected countries was the main cause of the current pandemic and most of them occurred from Europe, especially Italy. More than 1 million people have been affected by the COVID-19 virus with more than 50,000 mortality until today. The number of new cases and death are increasing every day sharply. Earlier study and current data suggest that the transmission of SARS-CoV-2 can be influenced by some metrological parameters, population density, droplet, and direct-indirect contact; however, further study should be undertaken. In context to control the current outbreak, China’s strategy is a role model for the world. Besides, an effective vaccine will be a permanent

solution along with the development of SARS-CoV-2 specific antiviral therapy.

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## Conflict of interest

All the authors report no conflicts of interest in this paper.

## Author’s contribution

MTR and MAS designed the study. MSI and MA collected data. MSI and MAS analyzed and interpreted the data. MSI, MAS, AT, and MA drafted the manuscript. MAS, AT, KHMNH, and MTR critically reviewed and updated the

manuscript to its final version. The final version of the manuscript was approved by all authors.

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## SUPPLEMENTARY MATERIAL

**Supplementary Table 1.** The total number of confirmed cases, death cases, and recovery cases.

Reporting Country/ Territory*/Area†	Total confirmed cases	Total deaths	Total recovery
<b>Western Pacific Region</b>			
China	82724	3327	76,571
Republic of Korea	9976	169	6,021
Australia	4976	21	585
Malaysia	2908	45	827
Japan	2384	57	514
Philippines	2311	96	52
Singapore	1000	3	282
New Zealand	723	1	103
Viet Nam	218	0	85
Brunei Darussalam	131	1	65
Cambodia	109	0	35
Mongolia	14	0	2
Lao People's Democratic Republic	10	0	0
Fiji	5	0	0
Papua New Guinea	1	0	0
Guam*	77	3	0
French Polynesia*	37	0	0
New Caledonia*	16	0	1
Northern Mariana Islands*(Commonwealth of the)	6	0	0
<b>European Region</b>			
Italy	110574	13157	18,278
Spain	102136	9053	30,513
Germany	73522	872	22,440
France	56261	4019	12,428
The United Kingdom	29478	2532	135
Switzerland	17070	378	4,846
Turkey	15679	277	415
Belgium	13964	828	2,872
Netherlands	13614	1173	250
Austria	10711	146	2,022
Portugal	8251	187	68
Israel	5591	21	338
Sweden	4947	239	103
Norway	4665	32	32
Czechia	3589	39	71
Ireland	3447	85	5
Denmark	3107	104	1,193
Russian Federation	2777	24	281
Poland	2554	43	56
Romania	2460	85	283

*Continued*

Reporting Country/ Territory*/Area†	Total confirmed cases	Total deaths	Total recovery
Luxembourg	2319	29	80
Finland	1446	17	300
Greece	1375	50	61
Iceland	1220	2	309
Serbia	1060	13	42
Croatia	963	6	92
Slovenia	841	15	70
Ukraine	804	20	19
Estonia	779	5	48
Lithuania	581	8	7
Armenia	571	3	43
Hungary	525	20	43
Bosnia and Herzegovina	464	13	27
Latvia	446	0	1
Republic of Moldova	423	5	26
Bulgaria	422	10	30
Slovakia	400	0	10
Andorra	396	13	16
Kazakhstan	386	3	29
Azerbaijan	359	5	30
North Macedonia	354	11	17
Cyprus	320	9	28
Albania	277	15	89
San Marino	236	28	21
Belarus	192	2	53
Uzbekistan	190	2	25
Malta	188	0	2
Georgia	121	0	27
Montenegro	120	2	0
Kyrgyzstan	115	0	5
Liechtenstein	72	0	0
Monaco	37	0	2
Holy See	6	0	0
Faroe Islands*	173	0	91
Kosovo*	125	1	0
Gibraltar*	69	0	46
Jersey*	81	2	0
Guernsey*	78	1	0
Isle of Man*	65	0	0
Greenland*	10	0	3
<b>South-East Asia Region</b>			
Thailand	1771	12	581
Indonesia	1677	157	134
India	1636	38	192

*Continued*

Reporting Country/ Territory*/Area†	Total confirmed cases	Total deaths	Total recovery
Sri Lanka	143	2	24
Bangladesh	54	6	26
Maldives	18	0	13
Myanmar	15	1	0
Nepal	5	0	1
Bhutan	4	0	2
Timor-Leste	1	0	0
<b>Eastern Mediterranean Region</b>			
Iran (Islamic Republic of)	47593	3036	17,935
Pakistan	2291	31	126
Saudi Arabia	1720	16	351
Qatar	835	2	72
United Arab Emirates	814	8	96
Egypt	779	52	201
Iraq	728	52	202
Morocco	676	39	49
Bahrain	569	4	382
Lebanon	479	12	46
Tunisia	423	12	5
Kuwait	317	0	82
Jordan	278	5	45
Afghanistan	235	4	10
Oman	231	1	57
Djibouti	34	0	8
Libya	10	0	0
Syrian Arab Republic	10	3	0
Sudan	7	2	2
Somalia	5	0	1
Occupied Palestinian territory*	134	1	18
<b>Region of the Americas</b>			
United States of America	187302	3846	10,411
Canada	9005	105	1,979
Brazil	5717	201	127
Chile	3031	16	335
Ecuador	2372	146	65
Peru	1323	24	537
Dominican Republic	1284	57	16
Mexico	1215	29	633
Panama	1181	30	9
Argentina	1054	27	256
Colombia	906	16	55
Costa Rica	347	2	6
Uruguay	338	2	86
Cuba	212	6	13

*Continued*

Reporting Country/ Territory*/Area†	Total confirmed cases	Total deaths	Total recovery
Honduras	172	10	3
Venezuela (Bolivarian Republic of)	143	3	43
Bolivia (Plurinational State of)	115	7	1
Trinidad and Tobago	89	5	1
Paraguay	69	3	4
Guatemala	39	1	12
Jamaica	38	1	2
Barbados	33	0	0
El Salvador	32	1	0
Guyana	19	2	0
Haiti	16	0	1
Bahamas	15	0	0
Saint Lucia	13	0	1
Dominica	11	0	0
Grenada	9	0	0
Saint Kitts and Nevis	8	0	0
Suriname	8	0	0
Antigua and Barbuda	7	0	0
Nicaragua	5	1	0
Belize	3	0	0
Saint Vincent and the Grenadines	1	0	1
Puerto Rico	286	11	0
Martinique	128	3	27
Guadeloupe	125	6	24
Aruba	55	0	1
French Guiana	51	0	15
United States Virgin Islands	30	0	0
Bermuda	32	0	0
Sint Maarten	6	0	6
Cayman Islands	14	1	0
Curaçao	11	1	3
Saint Barthélemy	6	0	1
Saint Martin	21	2	2
Montserrat	5	0	0
Turks and Caicos Islands	5	0	0
British Virgin Islands	3	0	0
Anguilla	2	0	0
<b>African Region</b>			
South Africa	1380	5	95
Algeria	847	58	61
Burkina Faso	261	14	50
Ghana	195	5	31
Côte d'Ivoire	190	0	15
Senegal	190	1	66

*Continued*

Reporting Country/ Territory*/Area†	Total confirmed cases	Total deaths	Total recovery
Mauritius	154	5	
Cameroon	139	6	10
Nigeria	139	2	20
Democratic Republic of the Congo	123	11	3
Rwanda	82	0	0
Kenya	81	1	4
Niger	74	5	0
Madagascar	53	0	0
Uganda	44	0	0
Togo	36	2	17
Zambia	36	0	2
Guinea	30	0	0
Mali	28	0	0
Ethiopia	26	0	0
Congo	22	2	2
United Republic of Tanzania	20	1	3
Eritrea	15	0	0
Equatorial Guinea	14	0	1
Benin	13	0	1
Namibia	11	0	3
Mozambique	10	0	0
Seychelles	10	0	0
Eswatini	9	0	0
Guinea-Bissau	9	0	0
Angola	8	2	1
Central African Republic	8	0	0
Zimbabwe	8	1	0
Chad	7	0	0
Gabon	7	1	1
Liberia	6	0	0
Cabo Verde	5	1	0
Mauritania	5	0	2
Botswana	3	1	0
Gambia	3	1	2
Burundi	2	0	0
Sierra Leone	2	0	0
Reunion	281	0	40
Mayotte	116	2	10
<b>Others</b>			
International conveyance (Diamond Princess)	712	11	619

**Supplementary Table 2.** Data on imported cases.

Reporting Country/ Territory*/Area	Imported from	Border Transmission	Local Transmission
<u>China</u> (Except Hubei)	Wuhan, <u>Italy</u>	Yes	Local transmission
Taiwan	<u>China</u> , Hongkong, UK	Yes	Local transmission
Hong Kong	<u>China</u>	Yes	Local transmission
<b>Western Pacific Region</b>			
Republic of Korea	<u>China</u> , Singapore	No	Local transmission
Japan	<u>China</u> , USA	No	Local transmission
Singapore	<u>China</u>	No	Local transmission
Australia	<u>China</u> , Japan, <u>Iran</u> , <u>Italy</u>	No	Local transmission
Malaysia	<u>China</u>	No	Local transmission
Philippines	Japan, Taiwan, USA, South Korea	No	Local transmission
Viet Nam	<u>China</u> , France/ UK, <u>Italy</u> , South Korea	No	Local transmission
Brunei Darussalam	Malaysia	No	Imported cases only
Cambodia	UK	No	Local transmission
New Zealand	<u>Iran</u> , <u>Italy</u>	No	Local transmission
Mongolia	France	No	Imported cases only
French Polynesia*	France		Imported cases only
<b>European Region</b>			
<u>Italy</u>	<u>China</u>	No	Local transmission
Spain	<u>Italy</u> , <u>Iran</u>	No	Local transmission
France	Singapore, <u>Italy</u> , <u>China</u>	Yes	Local transmission
Germany	Singapore, <u>Italy</u> , <u>China</u>	No	Local transmission
Switzerland	<u>Italy</u>	Yes	Local transmission
Denmark	<u>Italy</u>	No	Local transmission
Sweden	<u>Italy</u> , Germany, <u>Iran</u>	No	Local transmission
Netherlands	<u>Italy</u>	No	Local transmission
The United Kingdom	France, <u>China</u> , Japan, <u>Italy</u> , <u>Iran</u>	Yes	Local transmission
Austria	<u>Italy</u>	Yes	Local transmission
Belgium	<u>China</u> , France, <u>Italy</u>	Yes	Local transmission
Norway	<u>China</u> , Italy, <u>Iran</u>	No	Local transmission
Czechia	<u>Italy</u>	No	Local transmission
Finland	<u>Italy</u>	No	Local transmission
Greece	<u>Italy</u> , Israel or Egypt	Yes	Local transmission
Israel	Japan, <u>Italy</u> , Germany, France, Spain, Switzerland	No	Local transmission
Ireland	<u>Italy</u>	No	Local transmission
San Marino	<u>Italy</u>	Yes	Local transmission
Iceland	<u>Italy</u> , Austria	No	Local transmission
Slovenia	<u>Italy</u>	Yes	Local transmission
Poland	Germany	Yes	Local transmission
Romania	<u>Italy</u>	No	Local transmission
Portugal	<u>Italy</u>	No	Local transmission
Russian Federation	<u>China</u> , <u>Italy</u>	Yes	Imported cases only
Georgia	<u>Iran</u> , <u>Italy</u>	No	Imported cases only
Albania	<u>Italy</u>	Yes	Imported cases only

*Continued*

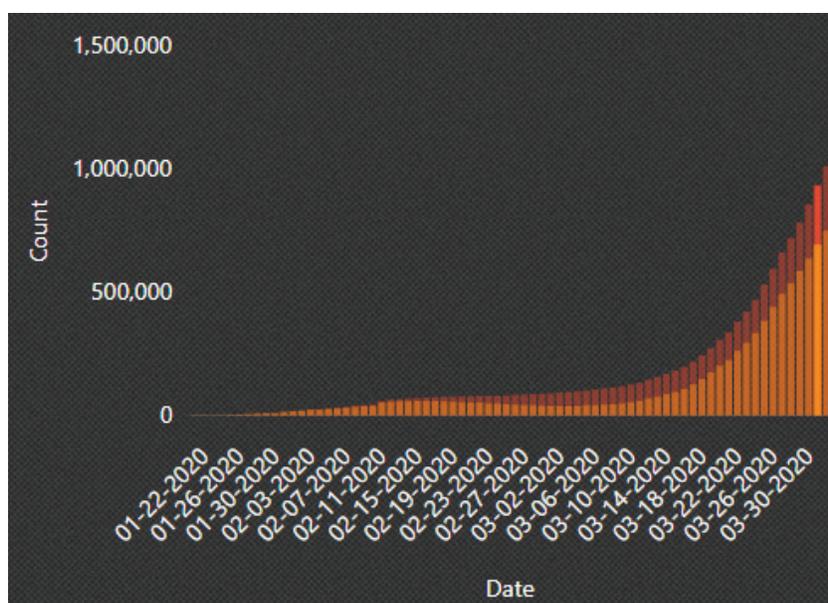
Reporting Country/ Territory*/Area	Imported from	Border Transmission	Local Transmission
Slovakia	<u>Italy</u>	No	Local transmission
Serbia	Hungary	Yes	Under investigation
Luxembourg	<u>Italy</u>	No	Imported cases only
Croatia	<u>Italy</u>	Yes	Local transmission
Hungary	<u>Iran, Italy</u>	No	Local transmission
Latvia	Germany	No	Imported cases only
Estonia	<u>Iran, Italy</u>	No	Imported cases only
Belarus	<u>Iran</u>	No	Local transmission
Azerbaijan	<u>Iran, Italy</u>	Yes	Imported cases only
Malta	<u>Italy</u>	Yes	Imported cases only
Bulgaria	<u>Italy</u>	No	Local transmission
North Macedonia	<u>Italy</u>	No	Local transmission
Cyprus	UK	No	Imported cases only
Bosnia and Herzegovina	<u>Italy</u>	No	Local transmission
Liechtenstein	Switzerland	Yes	Imported cases only
Republic of Moldova	<u>Italy</u>	No	Imported cases only
Lithuania	<u>Italy</u>	No	Imported cases only
Ukraine	<u>Italy</u>	No	Imported cases only
Andorra	<u>Italy</u>	No	Imported cases only
Armenia	<u>Iran</u>	No	Imported cases only
Monaco	<u>Italy</u>	Yes	Under investigation
Turkey	<u>Italy</u>	No	Imported cases only
Kazakhstan	Germany	No	Imported cases only
Vatican City	<u>Italy</u>	Yes	Under investigation
Faroe Islands*	<u>Italy</u>	No	Imported cases only
Gibraltar*	<u>Italy</u>	No	Under investigation
Guernsey*	<u>Italy</u>	No	Imported cases only
Jersey*	<u>Italy</u>	No	Imported cases only
<b>South-East Asia Region</b>			
Thailand	Japan, <u>Iran, Italy</u>	No	Local transmission
India	<u>Italy, Iran, Thailand/ Malaysia, Greece</u>	No	Local transmission
Indonesia	<u>Italy</u>	No	Local transmission
Maldives	<u>Italy</u>	No	Local transmission
Bangladesh	<u>Italy, Germany</u>	No	Local transmission
Sri Lanka	<u>Italy</u>	No	Imported cases only
Bhutan	USA/India,	Yes	Imported cases only
Nepal	<u>China</u>	Yes	Imported cases only
Réunion*	USA/ France	No	Imported cases only
<b>Eastern Mediterranean Region</b>			
<u>Iran</u> (Islamic Republic of)	<u>China</u>	No	Local transmission
Qatar	<u>Iran</u>	No	Imported cases only
Bahrain	<u>Iran</u>	No	Local transmission
United Arab Emirates	<u>China, Iran</u>	Yes	Local transmission
Kuwait	<u>Iran</u>	Yes	Imported cases only

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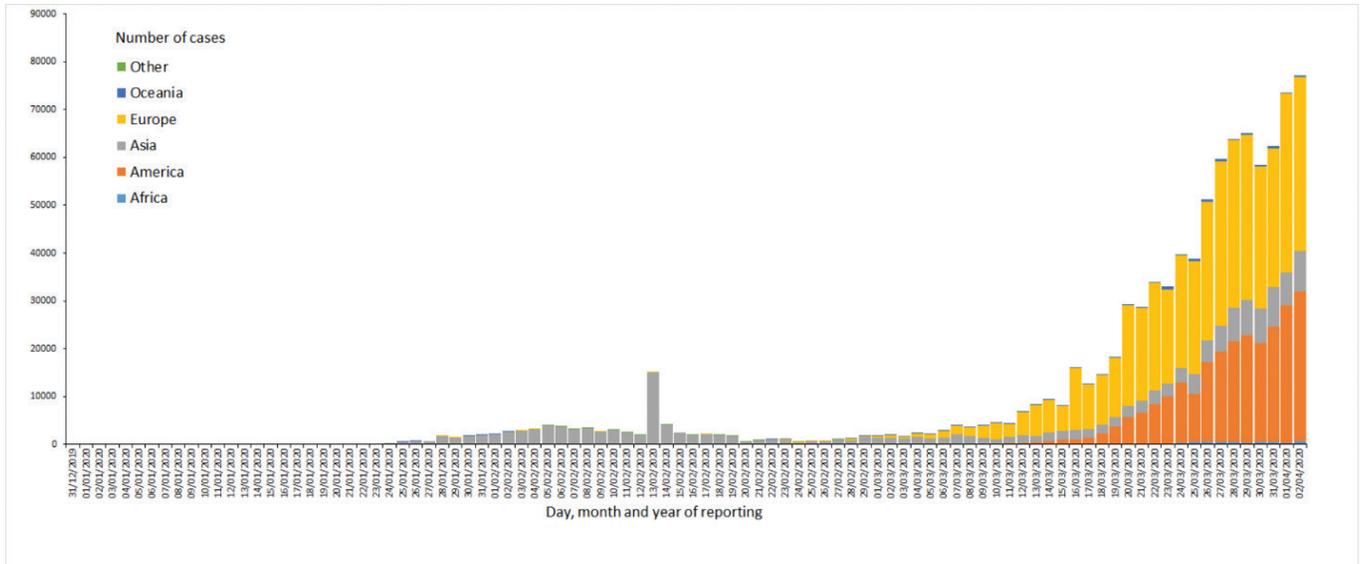
Reporting Country/ Territory*/Area	Imported from	Border Transmission	Local Transmission
Iraq	<u>Iran</u>	Yes	Local transmission
Egypt	<u>China, Italy</u>	No	Local transmission
Lebanon	<u>Iran</u> , UK	No	Local transmission
Saudi Arabia	<u>Iran</u>	No	Imported cases only
Pakistan	<u>Iran</u>	Yes	Local transmission
Oman	<u>Iran, Italy</u>	No	Imported cases only
Afghanistan	<u>Iran</u>	Yes	Imported cases only
Tunisia	Italy, France	No	Imported cases only
Morocco	<u>Italy</u>	No	Imported cases only
Jordan	<u>Italy</u>	No	Imported cases only
Occupied Palestinian territory*	Greece	No	Local transmission
<b>Region of the Americas</b>			
United States of America	<u>China</u> , Japan, South Korea, <u>Iran, Italy</u>	No	Local transmission
Canada	<u>China, Iran</u> , Egypt, <u>Italy</u>	No	Local transmission
Brazil	<u>Italy</u>	No	Local transmission
Chile	South-East Asian country, <u>Italy</u>	No	Local transmission
Argentina	<u>Italy</u>	No	Imported cases only
Costa Rica	<u>Italy</u>	No	Local transmission
Peru	Spain/ France	No	Local transmission
Ecuador	<u>Italy</u>	No	Local transmission
Panama	Spain, <u>Italy</u>	No	Imported cases only
Mexico	<u>Italy</u>	No	Imported cases only
Colombia	<u>Italy</u>	No	Imported cases only
Dominican Republic	<u>Italy</u> , Canada	No	Imported cases only
Paraguay	<u>China</u>	No	Imported cases only
Bolivia (Plurinational State of)	<u>Italy</u>	No	Imported cases only
Cuba	<u>Italy</u>	No	Imported cases only
Honduras	Spain, Switzerland	No	Imported cases only
Guyana	<u>Italy</u>	No	Imported cases only
Jamaica	UK	No	Imported cases only
St. Lucia	UK	No	Imported cases only
Suriname	Netherlands	No	Imported cases only
Saint Vincent and the Grenadines	<u>Italy</u>	No	Imported cases only
Trinidad and Tobago	Switzerland	No	Imported cases only
Uruguay	<u>Italy</u>	No	Imported cases only
Guatemala	<u>Italy</u>	No	Imported cases only
French Guiana*	France	No	Imported cases only
Martinique*	France	No	Imported cases only
Saint Martin*	France	No	Under investigation
Saint Barthelemy*	France	No	Under investigation
<b>African Region</b>			
Algeria	<u>Italy</u>	No	Local transmission
South Africa	<u>Italy</u> , Germany, Portugal	No	Imported cases only
Senegal	France	No	Imported cases only

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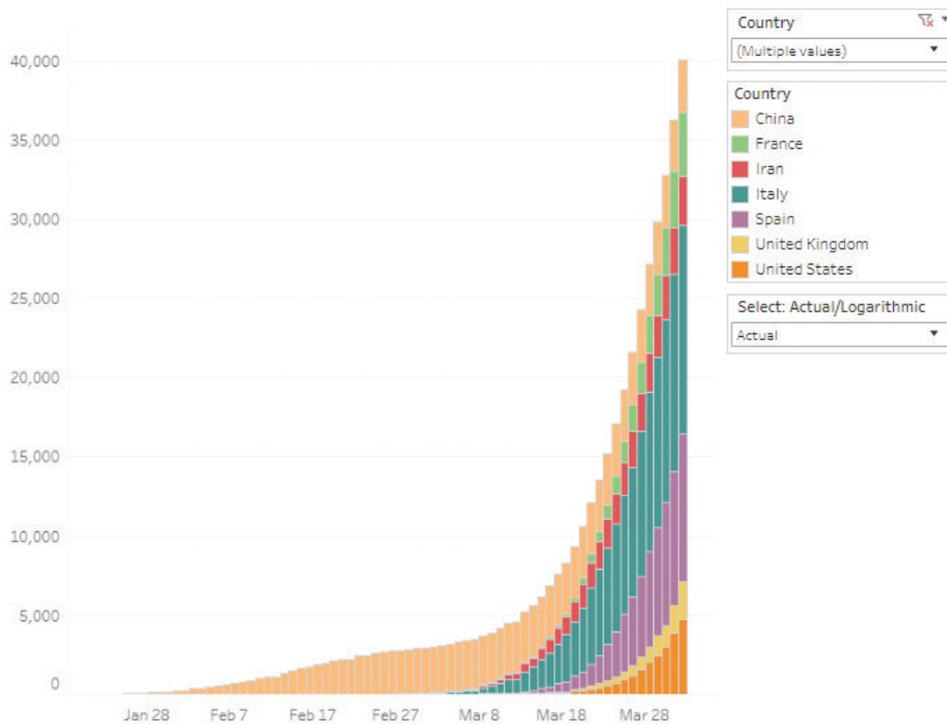
Reporting Country/ Territory*/Area	Imported from	Border Transmission	Local Transmission
Burkina Faso	<b>Italy</b>	No	Imported cases only
Cameroon	France	No	Local transmission
Nigeria	<b>Italy</b>	No	Imported cases only
Ivory Coast	<b>Italy</b>	No	Imported cases only
Kenya	USA	No	Imported cases only
Guinea	<b>Italy</b>	No	Imported cases only
Sudan	UAE	No	Imported cases only
Ghana	Norway, Turkey	No	Imported cases only
Ethiopia	Japan/ Burkina Faso	No	
Democratic Republic of the Congo	Belgium	No	Imported cases only
Togo	Germany/ France/ Turkey	No	Local transmission
Namibia	Spain	No	Imported cases only
<b>Others</b>			
International conveyance (Diamond Princess)	<b>China</b> , Japan	Yes	Local transmission



**Supplementary Figure 1.** Distribution of daily cumulative count of COVID-19 cases as of 22 January to 2 April, 2020 (reproduced from [49]).

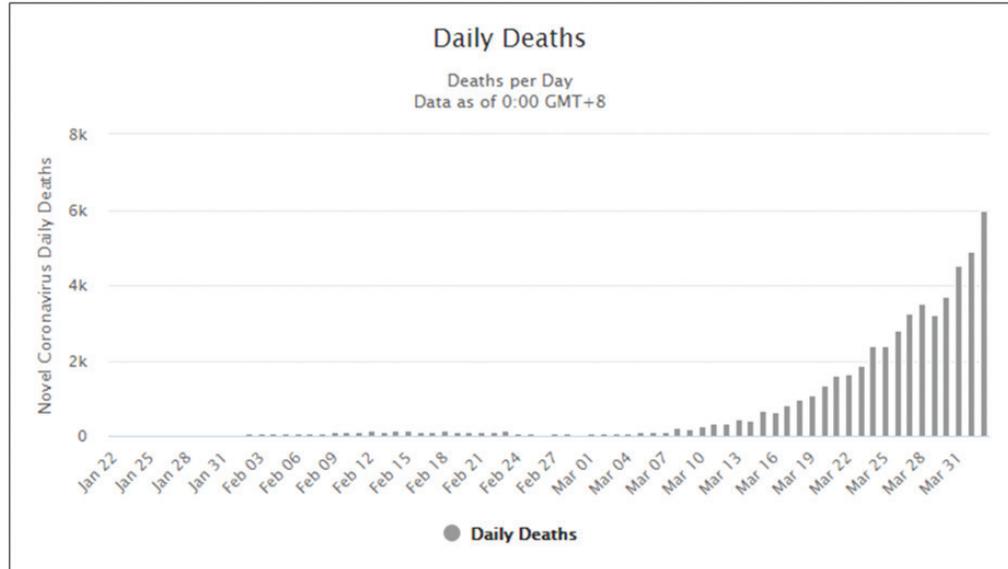


**Supplementary Figure 2.** Worldwide distribution of daily new cases of COVID-19 (reproduced from [50]).

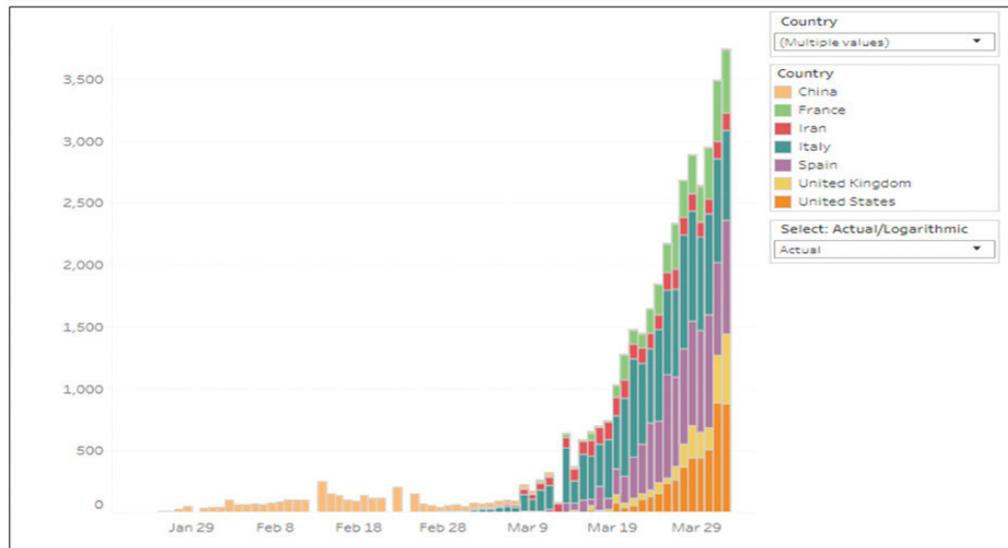


**Supplementary Figure 3.** Distribution of cumulative deaths by COVID-19 in some countries (reproduced from [55]).

**(A)**



**(B)**



**Supplementary Figure 4.** Distribution of daily new deaths by COVID-19; (A) Worldwide (reproduced from [37]), (B) Selective countries (reproduced from [55]).