



## Health service facilities are positively linked with outcome of COVID-19 patients in majority of the countries: The global situation

Md. Taimur Islam<sup>1\*</sup>, Anup Kumar Talukder<sup>2\*</sup>, Muhammad Badruzzaman<sup>3</sup>, Md. Abu Hadi Noor Ali Khan<sup>4</sup>

<sup>1</sup>Department of Pathobiology, Faculty of Veterinary Medicine and Animal Science, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706, Bangladesh

<sup>2</sup>Department of Gynecology, Obstetrics and Reproductive Health, Faculty of Veterinary Medicine and Animal Science, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706, Bangladesh

<sup>3</sup>Department of Biochemistry and Molecular Biology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706, Bangladesh

<sup>4</sup>Department of Pathology, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh

### \*Corresponding author

Md. Taimur Islam, PhD  
E-mail: [taimurpl@bsmrau.edu.bd](mailto:taimurpl@bsmrau.edu.bd)  
&  
Anup Kumar Talukder, PhD  
E-mail: [anupbau@bsmrau.edu.bd](mailto:anupbau@bsmrau.edu.bd)

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### ABSTRACT

Since emergence, coronavirus disease-19 (COVID-19) has extensively spread to >210 countries. Till date, no specific drug or vaccine has been developed against this deadly disease. Thus, all affected countries have been struggling to manage their COVID-19 patients. Here, we aimed to report impact of health service facilities on outcome of COVID-19 patients. As of June 28, 2020, the highest number of COVID-19 patients was reported in USA, which sum up to 2,617,847 with 4.9% death. Likewise, Spain, Italy, UK and France were greatly affected by COVID-19 with 10 to 18% death. Notably, Germany has been affected by COVID-19 in similar to UK and France with a total of 194,771 confirmed cases; however, recovery rate is very high (91.3%) with only 4.6% death. Alternatively, India and Bangladesh reported positive cases of 548,817 and 137,787, respectively. The comparison of health service facilities among different countries shows that Germany and also Russia have the highest number of doctors, hospital beds, ICU and ventilators in proportion to their people, which might contribute to restrict death rate only 1.4 to 4.6% with excellent recovery. USA has better health system with compared to that in China, India and Bangladesh; however, the recovery rate is 41.3 %, because the country is dealing with large number of patients. The limited health service facilities in Bangladesh might result in relatively lower recovery rate (40.4%) of COVID-19 patients. Thus, health service facilities of the nations are likely to be associated with successful management of COVID-19 patients.

### INTRODUCTION

A number of pneumonia cases of unknown reason in people, who have relation with the Huanan Seafood Wholesale Market, have been reported in Wuhan City of Hubei Province, China on December 31, 2019 [1-5]. The infected patients showed some non-specific symptoms including fever, cough, dyspnea, myalgia or fatigue, headache, hemoptysis, diarrhoea and acute respiratory distress syndrome (ARDS) [5, 6]. The Chinese health authorities have reported the causal agent as a novel

coronavirus by next generation sequencing [3]. On January 7, 2020, the Chinese Centre for Disease Control and Prevention (CCDC) has detected the causative agent from throat swab samples and named Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) [7]. On the other side, world health organization (WHO) named the disease, caused by this novel SARS-CoV-2, as coronavirus disease-19 (COVID-19) [7]. Within the next six months, the infection has spread out to >210 countries including North America, South America, Europe, Asia and Africa. As of June 28, 2020, the disease has affected

at least 10169,380 people and resulted in total 502,802 deaths globally [8]. Similar to developing countries, all the developed countries of the world have also failed to manage this highly contagious COVID-19, even if they have the modern health facilities and sophisticated equipment. In fact, all affected countries of the world have been struggling to deliver necessary support and medical treatment to their COVID-19 patients. The effective therapeutic drugs or vaccines against this deadly disease have not yet been identified, which has made the situation more difficult in treating COVID-19 patients. However, timely supportive and symptomatic therapy to COVID-19 patients may contribute to save the life of patients, which heavily relies on the health service facilities of the country. The influence of health service facilities of a country on management of COVID-19 patients remains to be elucidated. We, therefore, aimed to report the influence of health service facilities on management and consequence of COVID-19 patients.

## GLOBAL DISTRIBUTION OF COVID-19 PATIENTS

The WHO has declared this local ‘Chinese outbreak of COVID-19’ a Public Health Emergency of International Concern on January 30, 2020. According to WHO, countries with vulnerable health systems remain at higher risk for COVID-19. The emergency committee of WHO has announced that the spread of COVID-19 could be discontinued by traces, early detection, isolation, and prompt treatment [7]. Till June 28, 2020, a total of 83,500 cases of COVID-19 were recorded in China with 4,634 deaths (5.6%). As of June 28, 2020, the maximum number of confirmed cases of COVID-19 was reported in USA, which accounts for 2617,847 with 128,243 deaths (4.9%), while 41.3% patients were recovered and rest are currently under treatment. Likewise, Spain, Italy, UK and France have also been highly affected by COVID-19 with higher death rate of 10 to 18% (Table 1). It is important to note that Germany has been affected by COVID-19 in similar to Spain, Italy, UK and France with a total of 194,771 confirmed cases; however, recovery rate is very high (91.3%) with only 4.6% death rate. On the other hand, the developing countries, Bangladesh and India reported 137,787 and 548,817 positive cases of COVID-19. It has to be mentioned that the smaller number of people are tested in these two countries compared to other countries. The death rate of COVID-19 patients is only 1.3% in Bangladesh; however, the most important point is that recovery rate of COVID-19 patients is comparatively low (40.4%) among the severely affected countries (Table 1) [8]. Of note, the social media claimed that many patients have been died regularly after showing symptoms of

COVID-19 in Bangladesh, which are not officially reported [9].

The recovery and death (mortality) rate are often used to express the ability of the healthcare system of a country against severe outbreak of a disease [10]. Germany recorded the highest recovery rate (91.3%) with relatively lower mortality rate (4.6%) among the countries, where more than 100,000 people are COVID-19 positive. On the other hand, Russia reported comparatively lower mortality rate (1.4%) of COVID-19 cases with better recovery rate (62.9%). These findings indicated the potential ability of country’s own health service system for managing COVID-19 patients [8].

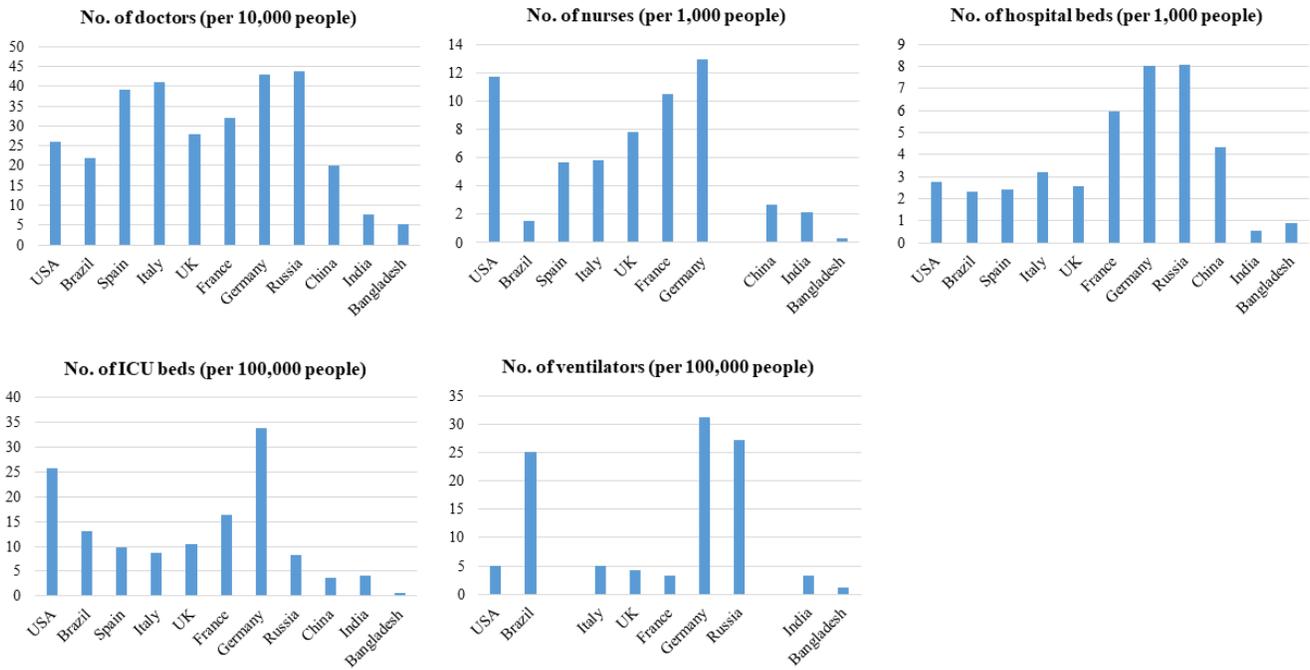
**Table 1.** Distribution of COVID-19 patients with recovery and death rate in different countries (as of June 28, 2020) [8].

Country	No. of COVID-19 patients	No. of people recovered from COVID-19 (%)	No. of people died from COVID-19 (%)
USA	2,617,847	1,082,212 (41.3)	128,243 (4.9)
Brazil	1,344,143	733,848 (54.6)	57,622 (4.3)
Spain	295,549	146,255 (59.6)	28,341 (9.6)
Italy	240,310	188,891 (78.6)	34,738 (14.5)
UK	311,151	-	43,550 (14.0)
France	162,936	75,649 (46.4)	29,778 (18.3)
Germany	194,771	177,700 (91.3)	9,026 (4.6)
Russia	634,437	399,087 (62.9)	9,073 (1.4)
China	83,500	78,451 (93.9)	4,634 (5.6)
India	548,817	321,641 (58.6)	16,485 (3.0)
Bangladesh	137,787	55,727 (40.4)	1,738 (1.3)

## IMPACT OF HEALTH SERVICE FACILITIES ON MANAGEMENT OF COVID-19 PATIENTS

The pandemic COVID-19 has already overwhelmed the health care systems of most of the countries in the world. This deadly viral disease, COVID-19 has challenged the ability of the healthcare system of all countries to treat the infected patients. In this critical situation, almost all countries are demanding to (i) increase number of healthcare service providers (doctors, nurses, technicians and pathologists etc.), which is extremely required to perform test and care for the infected patients, as well as (ii) to increase number of health support equipment and accessories such as hospital beds, ICU and mechanical ventilators required for critically ill patients [11].

USA has 26 doctors per 10,000 people. Russia and Germany have the highest number of doctors, 43.8 and 43 per 10,000 people, while Brazil, Italy, Spain, UK and China have 21.8, 41, 39, 28 and 20 doctors per 10,000 people, respectively (Figure 1) [10, 12]. Furthermore, USA has 11.7 nurses per 1,000 people, whereas Germany has the highest number of nurses that is 12.9 per 1,000 people. Bangladesh has the lowest number of doctors (5.3



**Figure 1.** Health service management facilities in different countries of the world. The data show that Germany has very improved health care facilities for their people among the developed countries. On the other side, the developing countries such as Bangladesh and India have relatively poor health management services.

per 10,000 people) and nurses (0.3 per 1,000 people) in comparison to other countries presented in Figure 1 [10, 13, 14].

The number of acute hospital beds in Germany and Russia is 8 per 1,000 people. In contrast, USA has 2.77 acute hospital beds per 1,000 people. Brazil, Spain, Italy, UK and China have 2.3, 2.4, 3.18, 2.54 and 4.34 hospital beds per 1,000 people, respectively (Figure 1) [10, 15]. In Germany, the number of intensive care unit (ICU) beds is 33.9 per 100,000 people, which is far above in comparison to other countries (Figure 1). USA has 25.8 ICU beds per 100,000 people. On the other hand, Brazil, Spain, Italy, UK, France and China have only 13, 9.7, 8.6, 10.5, 16.3 and 3.6 ICU beds per 100,000 people, respectively [10, 15, 16]. Bangladesh has only 0.87 hospital beds per 1,000 people and 0.72 ICU beds per 100,000 people [16]. In a similar trend, Germany and Russia have the highest proportion of ventilators in comparison to other countries, which is 31.2 and 27.3 per 100,000 people, respectively, whereas USA and Italy have 5 per 100,000 people. Brazil, UK, France and India have 25, 4.3, 3.3 and 3.3 ventilators per 100,000 people, respectively [10, 16, 17]. Bangladesh has only 1.1 ventilators per 100,000 people (Figure 1) [16, 18].

The above-mentioned comparison of health service facilities among different countries including USA clearly reveals that Germany has the highest number of doctors, nurses, hospital beds, ICU and ventilators (Figure 1). The health management facilities are extremely low in Bangladesh with compared to other developed countries

in the world due to limited number of doctors, nurses, ICU and ventilators in the hospitals.

COVID-19 has been a serious pandemic disease, therefore, almost every country in the world are struggling to treat their patients of this deadly disease. There is no effective drug to treat COVID-19 patients. Thus, to fight against this highly contagious disease, it is highly important to follow test, trace and treatment policies. An essential approach to handle this disease is to diagnose it at an earliest stage. In this way, it could be ensured easily to immediate tracing, isolation of the patient and quarantine of the person(s), who have the chances to come in contact with COVID-19 patients. In our previous study, we showed that when more people are tested, possibility for identification of for COVID-19 positive cases is increased [19]. Therefore, it is crucial to increase the number of tests as much as possible for suspected and asymptomatic people as soon as possible. Then, all identified and suspected cases must be quarantined, and treatment should be provided accordingly. USA is the most affected country in the world; however, they remain in the list of the lower testing countries (97,097/million people) compared to Russia, UK and Spain. Of note, Russia, UK and Spain have tested 130,504, 135,455 and 110,426 samples per million people, respectively [8].

The better health service facilities of Germany and Russia might help to restrict the death rate despite of having a higher number of confirmed cases similar to UK and France. USA has much better health care system with

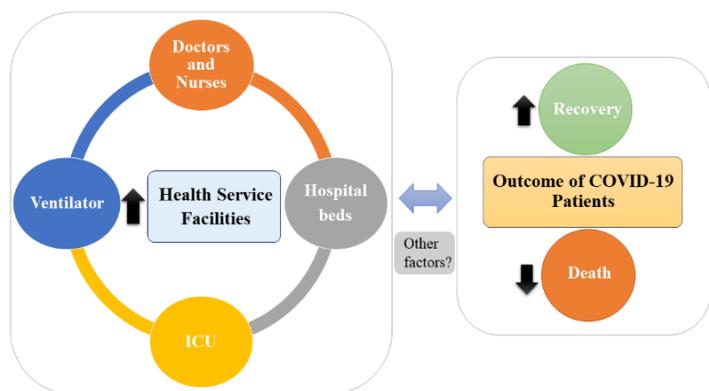
compared to that in China and developing countries like Bangladesh and India; however, the country has been mostly affected by COVID-19 and recovery rate is lower and death rate is higher than India and China. Obviously, it cannot be ignored that the country is fighting for management of highest number of COVID-19 patients in the world, which could be a major obstacle for providing treatment to a large number of people at a time. Nevertheless, failure in taking right decision at the right time and unawareness about COVID-19 has led to the large number of people affected by this pandemic disease in USA. The USA government has ignored the devastating nature of this disease, failed to increase public awareness at the earlier stage and did not enforce total lockdown timely [20]. Furthermore, a larger number of adults in USA have chronic disease burden (28%) and obesity problem (40%) in comparison to other countries [21], which might worsen the situation in the country. Similarly, in Italy and Spain, a greater percentage of population is more than 65 years old (22.7% in Italy and 19.3% in Spain) [13] that might result in higher number of deaths in those countries. Russia recorded the world's third-highest number of COVID-19 cases but has registered about 10 times fewer deaths than UK, France, Italy and Spain. This lower number of deaths might be attributed to the lower number of elder people in Russia (14.6%) compared to Italy (22.7%), Spain (19.3%) and USA (16.0%), who are especially vulnerable to the virus. Again, Russia is one of the highest coronavirus testing country in the world. The high rate of testing has helped the authorities to identify and isolate more COVID-19 positive patients [22]. Of note, the success to control COVID-19 depends on an uncompromising approach involving robust testing, contact tracing and mandatory quarantine of infected persons. Some developed countries have failed to follow this approach at the earlier stage of disease including USA and Italy similar to developing countries like Bangladesh and India. In some countries including China, a large number of asymptomatic or mild cases were tested, that's why recovery rate might be higher.

Overall, Germany has been successful in managing COVID-19 patients as 91.3% patients have been recovered with only 4.6% death [8]. It can be attributed partly to the early and robust testing of a large number of populations nationwide and rigorous contact tracing [23], and very strong health management facilities in the country. In many countries, only high-risk patients and critically ill patients are being tested. Thus, asymptomatic patients increase the chances of community transmission in those countries. Germany is operating the rapid and vigorous testing by use of distributed network of testing through individual hospitals, clinics and laboratories, instead of depending on the test from a centralized

government resource, as the condition in many countries like USA and UK [24]. However, the death rate of COVID-19 patients in Germany is little bit higher in comparison to that in Russia, Bangladesh, and India. Germany has the large number of elderly people (21.4%) compared to Russia (14.6%) and Bangladesh (8.0%) [13, 22, 25]. Moreover, a larger number of adults in Germany have obesity problem (23.6%) [21], which might be responsible for a relatively higher death rate in the country. In Bangladesh, only high risk and critical patients were tested, which might attribute to detection of small number of people positive to COVID-19 (Table 1). The country has relatively very limited health service facilities with compared to other developed countries that might be one of the possible reasons for comparatively lower recovery rate (40.4%) of COVID-19 patients in Bangladesh [26]. However, it should be noted that a large number of population of Bangladesh are suffering from many non-communicable diseases like diabetes, cardiovascular diseases, hypertension, stroke, malnutrition, chronic respiratory diseases and cancer, and communicable diseases including tuberculosis (TB), tetanus, malaria, measles, rubella, and leprosy etc. [27]. This might be attributed partly to the slowing of the recovery rate of COVID-19 patients in Bangladesh.

On the other hand, Bangladesh also encountered lower death rate in comparison to many developed countries with better health service facilities. Several factors might contribute to the lower death rate. Bangladesh is one of the densely populated countries of the world and people get infections by various microorganisms during their lifetime. Therefore, people in Bangladesh acquire heterologous immunity from natural infections [28]. The lower death rate of COVID-19 in Bangladesh could be related to the childhood acquired immunity against a wide range of organisms [28]. It has been reported that countries with high BCG vaccine coverage had lower mortality rate due to incidence of COVID-19, suggesting some protective mechanisms are available in TB endemic areas [29]. Bangladesh introduced BCG mass immunization program in 1985 [30]. Again, the number of young people is higher than elderly people in Bangladesh. The median age of Bangladeshi people is 27.90 years [31], and only 8% of total population is more than 60 years old in Bangladesh [25]. Furthermore, the obesity problem is very low (3.6%) in Bangladesh which is linked to many non-communicable diseases [32]. In addition, food habit of Bangladeshi people might help to boost the immune systems. Seasonal fruits, vegetables and spices like turmeric, garlic, onion, ginger, cloves, cinnamon, cardamom, and black pepper could also play a vital role in decreasing the death rate due to COVID-19 in Bangladesh [28]. Hot temperature might improve COVID-19 scenario in Bangladesh. Surface stability and

viability of SARS-CoV was reported to be decreased at higher temperature and higher humidity [33]. It has been also reported that cold and dry condition increases the stability of the virus and thus promote the spread of the virus. Mortality rate due to respiratory diseases increased at low temperature [34]. Exposure to sunlight during summer season helps to produce vitamin-D and to enhance immunity which is important to fight against COVID-19 in Bangladesh [35]. Robust studies are needed to clarify the role of temperature on the progression of this disease.



**Figure 2.** Association of health service facilities with outcome of COVID-19 patients. In majority of cases, improved health service facilities are likely to enhance recovery and reduce death rate of COVID-19 patients. However, other factors (?) might also be involved on outcome of COVID-19 patients that may include age, food habit and immune status of the patient.

## CONCLUSION

The highly contagious and deadly COVID-19 adversely affects the global human health in the last six months after its emergence in China. To combat this situation, testing, contact tracing and screening, quarantine and isolation and treatment of infected patients are the major steps for prevention and control of COVID-19. Implementation of above-mentioned steps in the country mainly depends on its own health service facilities available. The data presented in this report showed that Germany has the highest number of doctors, nurses, hospital beds, ICU and ventilators in proportion to their people, which might contribute to outstanding recovery of their COVID-19 patients. USA has better health system with compared to that in China, India and Bangladesh; however, the country is struggling to manage the highest number of COVID-19 patients. The limited health care facilities in Bangladesh might result in lower recovery of COVID-19 patients. These results suggest that the health service facilities of the nations are likely to be associated with management and consequence of COVID-19 patients (Figure 2). Thus, COVID-19 affected countries should take necessary initiatives for improving the existing health service

facilities via increasing doctors and nurses and importing ICU and ventilators in the hospital. It should be noted that other factors might also be involved on outcome of COVID-19 patients that may include age, food habit and immune status of the patient. Therefore, a further investigation with comprehensive statistical analysis is required to relate health service facilities of the countries including other possible contributing factors of patients themselves with outcome of COVID-19 patients.

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## AUTHOR CONTRIBUTIONS

MTI conceived the idea, collected all information and drafted the first version of the manuscript, AKT participated in the idea development, analyzed data and edited the manuscript, MB and MAHNAK edited the manuscript.

## CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

## REFERENCES

- [1] Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. *New Engl J Med.* 2020; 382:727-733.
- [2] Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. *Lancet.* 2020; 395:470-473.
- [3] Lu H, Stratton CW, Tang YW. Outbreak of Pneumonia of Unknown Etiology in Wuhan China: the Mystery and the Miracle. *J Med Virol.* 2020; 92:401-402.
- [4] Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet.* 2020; 395:507-513.
- [5] Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet.* 2020; 395:497-506.
- [6] Jiang F, Deng L, Zhang L, Cai Y, Cheung CW, Xia Z. Review of the clinical characteristics of coronavirus disease 2019 (COVID-19). *J Gen Intern Med.* 1-5.
- [7] Sohrabi C, Alsafi Z, O'Neill N, Khan M, Kerwan A, Al-Jabir A, et al. World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). *Inter J Surg.* 2020; 76:71-76.
- [8] Worldometer (2020). COVID-19 Coronavirus pandemic. <https://www.worldometers.info/coronavirus/>
- [9] Akhter F (2020). COVID-19 and healthcare denial. <https://www.newagebd.net/article/103590/covid-19-and-healthcare-denial>
- [10] Tikkanen R, Abouafia GN, Williams RD (2020). How the U.S. Compares to Other Countries in Responding to COVID-19: Populations at Risk, Health System Capacity, and Affordability of Care. <https://www.commonwealthfund.org/blog/2020/how->

- us-compares-other-countries-responding-covid-19-populations-risk-health-system?fbclid=IwAR2MOL7ctDHkqndO0LPhf08VK\_p08W0p wf2f7yjJL2DnbUrZT\_K2tS7Nrr0
- [11] Mina FB, Billah M, Rahman MS, Das S, Karmakar S, Faruk M, et al. COVID-19: transmission, diagnosis, policy intervention, and potential broader perspective on the rapidly evolving situation in Bangladesh. *J Adv Biotechnol Exp Ther.* 2020; 3:18-29.
- [12] Statista (2020). Number of physicians per 1,000 inhabitants in Brazil between 2012 and 2018. <https://www.statista.com/statistics/787553/number-physicians-inhabitants-brazil/>
- [13] Kamal R, Kurani N, McDermott D, Cox C (2020). How prepared is the US to respond to COVID-19 relative to other countries? <https://www.healthsystemtracker.org/chart-collection/how-prepared-is-the-us-to-respond-to-covid-19-relative-to-other-countries/?fbclid=IwAR0qmlI232YhXG7dozRXMTNe0AvlisBF-SFh5IWb2Oyse-rosTVHLj4fRzI#item-start>
- [14] Alam A (2020). Patient, doctors, nurses ratio: Bangladesh lags far behind its neighbours. <https://www.dhakatribune.com/health/2019/07/21/patient-doctors-nurses-ratio-bangladesh-lags-far-behind-its-neighbours>
- [15] OECD (2014). OECD Health Statistics 2014 How does Brazil compare? <http://www.oecd.org/els/health-systems/Briefing-Note-BRAZIL-2014.pdf>
- [16] Wikipedia (2020). List of countries by hospital beds. [https://en.wikipedia.org/wiki/List\\_of\\_countries\\_by\\_hospital\\_beds](https://en.wikipedia.org/wiki/List_of_countries_by_hospital_beds)
- [17] Rhodes A, Moreno RP. Intensive care provision: a global problem. *Rev Bras Ter Intensiva.* 2012; 24:322-325.
- [18] The Daily Star (2020). Bangladesh urgently needs to secure ventilators for Covid-19 patients. <https://www.thedailystar.net/editorial/news/bangladesh-urgently-needs-secure-ventilators-covid-19-patients-1891039>
- [19] Islam MT, Talukder AK, Siddiqui MN, Islam T. Tackling the Pandemic COVID-19: The Bangladesh Perspective. 2020. doi:10.20944/preprints202004.0384.v1
- [20] Haseltine WA (2020). Why America Is Losing To COVID-19. <https://theasianpost.com/article/why-america-losing-covid-19>
- [21] Tikkanen R, Abrams MK (2020). U.S. Health Care from a Global Perspective, 2019: Higher Spending, Worse Outcomes? <https://www.commonwealthfund.org/publications/issue-briefs/2020/jan/us-health-care-global-perspective-2019>
- [22] ET HealthWorld (2020). Why is Russia's coronavirus death rate so low? <https://health.economicstimes.indiatimes.com/news/industry/why-is-russias-coronavirus-death-rate-so-low/75748618>
- [23] Stafford N. Covid-19: Why Germany's case fatality rate seems so low. *BMJ.* 2020;369:m1395
- [24] The Conversation (2020). Coronavirus: why is Germany's fatality rate so low? <https://theconversation.com/coronavirus-why-is-germanys-fatality-rate-so-low-135496>
- [25] Ageingasia (2020). Ageing population in Bangladesh. <https://ageingasia.org/ageing-population-bangladesh/#:~:text=As%20of%202019%2C%20over%2013,will%20be%20a%20senior%20citizen.>
- [26] Sheam MM, Syed SB, Barman SK, Hasan MR, Kumar D. COVID-19: The catastrophe of our time. *J Adv Biotechnol Exp Ther.* 2020; 3:1-3.
- [27] Muhammad F, Chowdhury M, Arifuzzaman M, Chowdhury AA. Public health problems in Bangladesh: Issues and challenges. *South East Asia J Pub Health.* 2016; 6:11-16. doi:10.3329/seajph.v6i2.31830
- [28] Ahmed A, Rahman MM. COVID-19 trend in Bangladesh: deviation from epidemiological model and critical analysis of the possible factors. *medRxiv.* 2020. doi:10.1101/2020.05.31.20118745
- [29] Madan M, Pahuja S, Mohan A, Pandey RM, Madan K, Hadda V, et al. TB infection and BCG vaccination: Are we protected from COVID-19? *Pub Health.* 2020; 185:91-92.
- [30] Banglapedia (2014). Vaccination. [http://en.banglapedia.org/index.php?title=Vaccination&fbclid=IwAR31KJ9AI8Zfnc6AyZs99Bmp96GoOESpJuFIjnkRr3vKsPjCPtkyQ\\_-u7fA](http://en.banglapedia.org/index.php?title=Vaccination&fbclid=IwAR31KJ9AI8Zfnc6AyZs99Bmp96GoOESpJuFIjnkRr3vKsPjCPtkyQ_-u7fA)
- [31] CIA (2020). Country comparison-median age. <https://www.cia.gov/library/publications/resources/the-world-factbook/fields/343rank.html>
- [32] WHO (2017). Prevalence of obesity among adults, BMI  $\geq$  30, age-standardized: Estimates by country. <https://apps.who.int/gho/data/node.main.A900A?lang=en>
- [33] Chan KH, Peiris JM, Lam SY, Poon LL, Yuen KY, Seto WH. The effects of temperature and relative humidity on the viability of the SARS coronavirus. *Adv in virol.* 2011;734690.
- [34] Ghalhari GF, Mayvaneh F. Effect of air temperature and universal thermal climate index on respiratory diseases mortality in Mashhad, Iran. *Arch Iran med.* 2016; 19:9.
- [35] Grant WB, Lahore H, McDonnell SL, Baggerly CA, French CB, Aliano JL, et al. Evidence that vitamin D supplementation could reduce risk of influenza and COVID-19 infections and deaths. *Nutrients.* 2020; 12:988.



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