Geographical distribution, transmission dynamics and fatality of an emerging novel coronavirus disease

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ABSTRACT

Following an outbreak of a novel coronavirus disease in Wuhan-China, the reports of the infection and fatalities emanating from over two hundred other countries are worrisome. This study was therefore designed to analyze the geographical distribution, transmission dynamics and fatality of the pandemic from January 21 to April 5, 2020, to serve as a useful guide for other unaffected countries. The primary data on the COVID-19 pandemic during the period under review were accessed online from the WHO and CDC websites. The data were analyzed using the Microsoft Excel software and presented in bar chart, graphs, and tables. Repetition and wrong entries were carefully avoided during the collation of the data. In the first 75 days of COVID-19 outbreak, 1,133,758 people were infected while 62,784 lives were lost to the virus from 210 countries worldwide. United States of America, Spain, Italy, Germany and France were the epi-centers of the infection as at the time of this analysis with confirmed cases of 273,808, 124,736, 124,632, 91,714, and 67,757 respectively. Republics of China and Korea recorded the most Impressive response reduction in rates of the infection and fatality during the same period. Fatality of COVID-19 did not depend on frequency of the infection transmission rather it varies with the management strategies and policies of the affected countries. Massive screening of domestic mammals and pets was advocated to forestall re-emergence of the infection even after the successful control of the pandemic

Key words: COVID-19, Transmission dynamics, Distribution, Fatality
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Authors' contributions

This work was carried out and approved in collaboration between all the authors, who take responsibility for its accuracy and integrity. The study was conceptualized by AAA. Primary data were collated from the websites of the World Health Organization and Center for Disease Control by AAA, WOA and AIA while AI and AIA organized and analyzed the data. AAA and WOA supervised the data analysis. AIA, WOA, AI and AAA jointly prepared the initial draft of the article while the final manuscript was prepared by AAA and WOA and approved by all the authors after a thorough review.

Received: April 30, 2020; **Accepted**: June 10, 2020; **Published**: June 30, 2020

Citation: Abubakar AA, Adebimpe OW, Abdulazeez IA, Ibrahim A. Geographical distribution, transmission dynamics and fatality of an emerging novel coronavirus disease. **J Med Lab Sci, 2020; 30 (2): 70-81.**

INTRODUCTION

Before the ongoing COVID-19 pandemic, several other global outbreaks had occurred in the past including the Spanish flu that left 20-50 million people dead while about 500 Million people were infected globally (1), the Asian flu pandemic of 1957-1958 that emerged in East Asia and killed about two millions of people mostly children worldwide; and the swine flu identified in Mexico in March 2009 with an estimated deaths of 250,700 (2,3). World has also experienced seven cholera pandemics in 1817,1825,1829, 1863, 1881, 1889 and 1961. The cholera pandemic of 1961 persists till now most especially in Asia, Africa, Europe and the United State of America (4). The HIV pandemic of 1981 believed to have been originated from West Africa had so far killed not less than 34 million of people while still ravaging several countries of the world to date (5). As at 75th day of the novel COVID-19 infection outbreak, 1,133,758 people have been infected and 62,784 deaths have been documented so far while the novel virus continues with the ravaging of the globe.

The emergence of the new coronavirus was identified in December 2019 from metropole Wuhan, China and was now named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) by the Coronavirus Study Group (6). Since then, it has remained a global public health challenge (7) as several studies have identified the virus as the causative agent of the Corona Virus Disease 2019 (8-11). The first reported case based on clinical presentations was on the 29th December 2019 followed by several other cases between December 29th, 2019 and January 20th, 2020. By 21st January 2020, the first set of laboratory-confirmed cases were reported and deposited on the website of the Center for Disease Control. The disease condition was subsequently renamed by World Health Organization as COVID-19 on Feb 11, 2020 (12)

The COVID-19 infection is caused by SARS-COV2 which is an RNA and enveloped virus that can cause serious respiratory, neurologic and hepatic disorders (13,14). The outbreak of the novel viral infection started in the city where the wet animal market was located for sales of live animals. Molecular and bioinformatics studies on the mode of transmission revealed that bat is a likely carrier of the virus that infect humans (15,16). The virus is widely distributed among birds and mammals including humans; however, the possibility of human-to-human transmission have been reported involving persons in close contact with infected people especially among local and travelers (17-19). Other reports gave pieces of evidence that birds and mammals including humans are the known reservoirs of the virus (20,21). Meanwhile, WHO has provided a guideline for the screening of respiratory diseases including coronavirus based on different situations especially those that are returning from international tour (22-27)

The aim of this study is to analyze the geographical distribution, transmission dynamics and fatality of the pandemic in the affected areas within the first 75 days of the COVID-19 outbreak. This could serve as a useful guide for other countries with ongoing sporadic cases or those without any case in their control efforts.

MATERIALS AND METHODS

The study design is a descriptive epidemiological method. The primary data on COVID-19 infection in the last 75 days of the global outbreak was accessed online from the websites of the World Health Organization and Center for Disease Control:

(https://www.cdc.gov/coronavirus/2019-ncov) and (https://www.who.int/docs/default-source/coronaviruse/situationreports) The data obtained were collated, input into the Microsoft Excel of a personal computer and analyzed to assess the epidemiological distributions, transmission dynamics, and fatality of the pandemic. The data were presented in bar and pie charts, graphical, and tabular forms. International best practices were applied when collating the data to avoid the risk of data loss, repetition and wrong entries. In most cases, data were cross-checked from the CDC website of every region and the affected countries

All data were interpreted with caution as the outbreak is evolving rapidly and no available information on different testing policies of all the countries of the world.

RESULTS AND DISCUSSION

Transmission dynamics of COVID-19 pandemic

Transmission dynamics describes the pattern and trajectory of local and community transmissions of an outbreak from index to full-blown cases. World Health Organization guideline has earlier identified four levels of COVID-19 transmission among the affected countries. They are countries with no case, countries with sporadic cases, countries with clusters of cases and countries with community transmission.

Based on the high intensity of the infection and its geographical spread among the affected countries and territories of the world, some epi-centers were identified as follows: USA, Spain, Italy, Germany, France, Iran and China, United Kingdom, Turkey, Switzerland, Belgium, Netherlands, Canada, Austria, Portugal and Korea. The infection in these countries have progressed significantly to community transmission considering the exponential proportion of reported daily confirmed cases. Table 1 depicts the distribution of COVID-19 infection in the sixteen most affected countries in the world. It is worthy of note that these hotspot countries alone constitute over 70% of the entire global transmission.

Daily distribution of COVID-19 infection among the epi-centers is as shown in **Figure 1**. According to our analysis, despite attaining community transmission status, infection in China is progressively declining with a consistent dropping in confirmed cases from the peak at three thousand eight hundred and ninety-three (3893) cases on day-16 of the outbreak to 73 cases on day-75 while the highest number of deaths in a day decreased from two hundred and fifty-four (254) on day-24 to four (4) on day-75. This impressive finding probably explains why the total lockdown policy by the government of China was relaxed in Wuhan on day-76 (April 6, 2020) implying effective management of the infection by the government of China. China was therefore considered a gold standard in this study because despite the fact that the outbreak started from the country, yet the infection is almost brought under control as at the time of this report.

Similarly, a promising reduction was also noted in the Republic of Korea where the highest confirmed cases (813) were recorded on day-40 which gradually reduced to 94 on the last day of this analysis. Other severely affected countries did not show any appreciable reduction in the number of confirmed cases daily

In contrast, the frequency of COVID-19 cases in the USA, Spain, Italy, and Germany were on the increase up to day-75 recording 273,808, 124,736, 124,632 and 91,714 confirmed cases respectively (**Figure 1**). This alarming increase is of grave concern to the entire world because of the possibility of extension to other countries and territories especially the neighboring ones.

Although the index case was reported in Spain and Italy 14 days after the outbreak in Wuhan-China, some unprecedented high level of confirmed COVID-19 cases were reported in both countries recording 124736 and 124632 cases and placing them in second and third positions respectively after the USA with the highest cases of 273,808 since the global alert. Overall, the average number of confirmed cases per day in each of the worse hit areas at the time of this analysis was 3700, 2012 and 2010 per day for the USA, Spain, and Italy respectively (**Table 1**).

Table 1: Variations in average daily COVID-19 infection and fatality among the sixteen hotspot countries in the 75 days of the outbreak

Region	**Affected area**	**Date of the index cases**	**Confirmed COVID-19 cases at April 5, 2020**	**Average COVID-19 cases per day**	**Number of deaths**
Western Pacific	China Korea	Jan 21, 2020 Jan 21, 2020	82, 930 10, 237	1,106 137	3, 338 183
European	Spain Italy Germany France UK Turkey Switzerland Belgium Netherlands Austria Portugal	Feb 3, 2020 Feb 3, 2020 Feb 2, 2020 Jan 25, 2020 Feb 3, 2020 Mar 13, 2020 Feb 26, 2020 Feb 5, 2020 Feb 29, 2020 Feb 28, 2020 Mar 3, 2020	124,736 124,632 91, 714 67, 757 41,907 23, 934 20489 18, 431 16,627 11, 766 10, 524	2012 2010 1456 954 676 1088 526 307 462 318 319	11,744 15, 362 342 7,546 4,313 501 666 1283 1651 186 266
Eastern Mediterranean	Iran	Feb 20, 2020	55, 743	995	3452
Americans	USA Canada	Jan 22, 2020 Jan 22, 2020	273, 808 12, 938	3700 188	7020 214

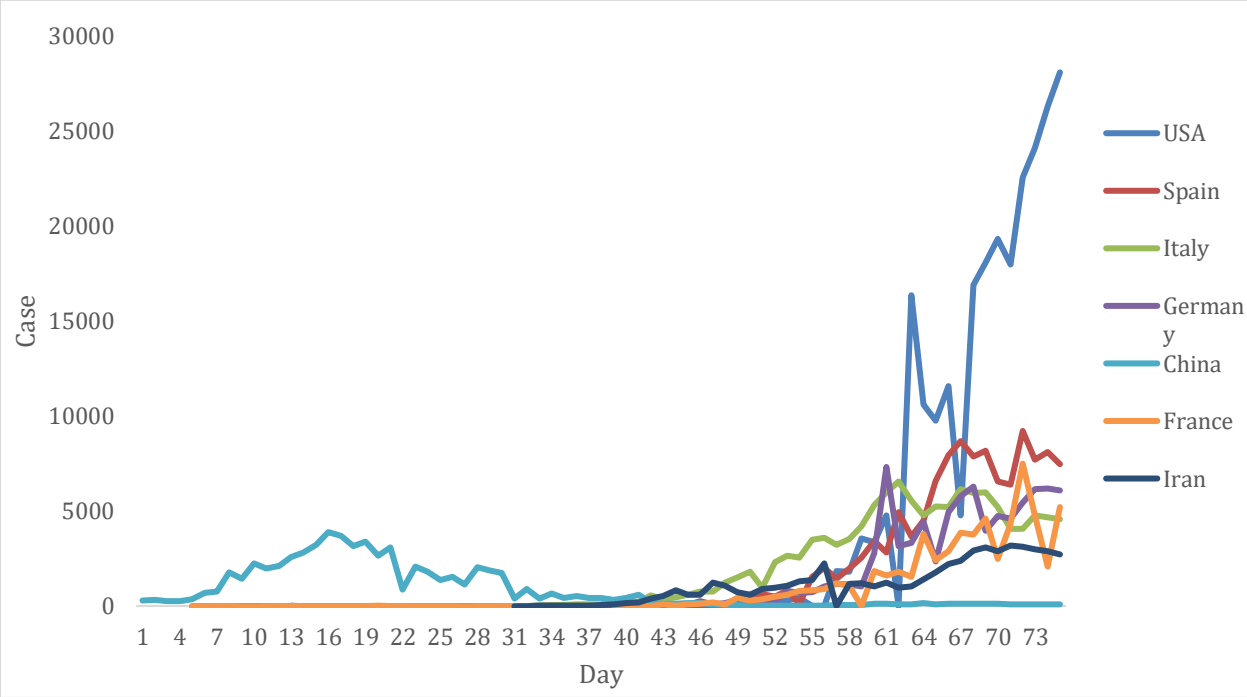

Figure 1: Daily Progression of COVID transmission in epi-centers in the first 75 days of the outbreak

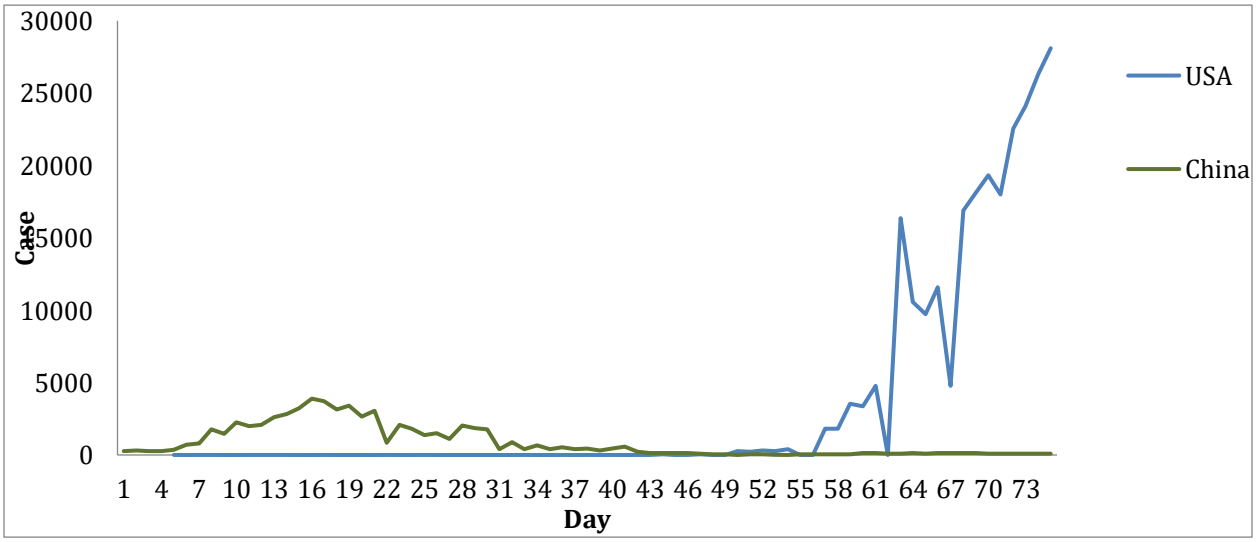

Figure 2: Daily COVID-19 infection in the United States of America using China as a reference country in 75 days of the outbreak

Global distribution of COVID-19 infection as at day-75 of the outbreak

The steady increase in confirmed cases in USA got to the peak on day-75 (**Figure 2**) and there is a possibility of progression in the

transmission rate of the disease if drastic measures are not put in place to contain and curtail it.

Assessing the average daily infection with COVID-19 among the hotspot countries and territories, 75 days since the outbreak (Table 1), the lowest average COVID-19 infection per day (137) was recorded in the Republic of Korea while the highest (3700) of was documented in the United State of America. Efforts of the government of the Republic of Korea at containing and curtailing the pandemic is commendable compared to the fifteen other countries and territories severely affected.

The trajectory of transmission in Turkey is noteworthy. In just 22 days of the infection, the country recorded a very high daily average of 1088 confirmed case which is far higher than what obtained in many countries that got their index cases even much earlier (**Table 1**). The findings may probably be attributed to poor and inadequate disease management policies of the country. The introduction of more stringent public health control measures and the total lockdown of the country is advocated to avert any exponential community transmission.

The increasing spate of confirmed cases and geographical spread of COVID-19 pandemic across different regions of the globe is worrisome and further explosion of the emerging infection is of grave concern. The distribution of COVID-19 infection by regions in the last 75 days of the outbreak is as indicated in Table 2. In our analysis, the European region recorded the highest cases of 621,407 followed by the region of America and Western Pacific regions with 315714 and 111396 cases respectively. The lowest confirmed cases of the infection were documented in the African region although the number of suspected people tested in Africa was not as significant compared to other regions at the time of this analysis.

Table 2: Global fatality rate as at 75 days of the pandemics

Region	**Confirmed cases**	**Number of deaths**	**% Fatality**
Western Pacific	111,396	3,838	3.45
European Region	621, 407	46,416	7.45
southeast Asia	7, 816	302	3.86
Eastern Mediterranean	70, 293	3. 794	5.40
Region of Americans	315,714	8,187	2.59
African region	6, 420	236	3.68
Total	**1,133, 758**	**62, 784**	**5.54**

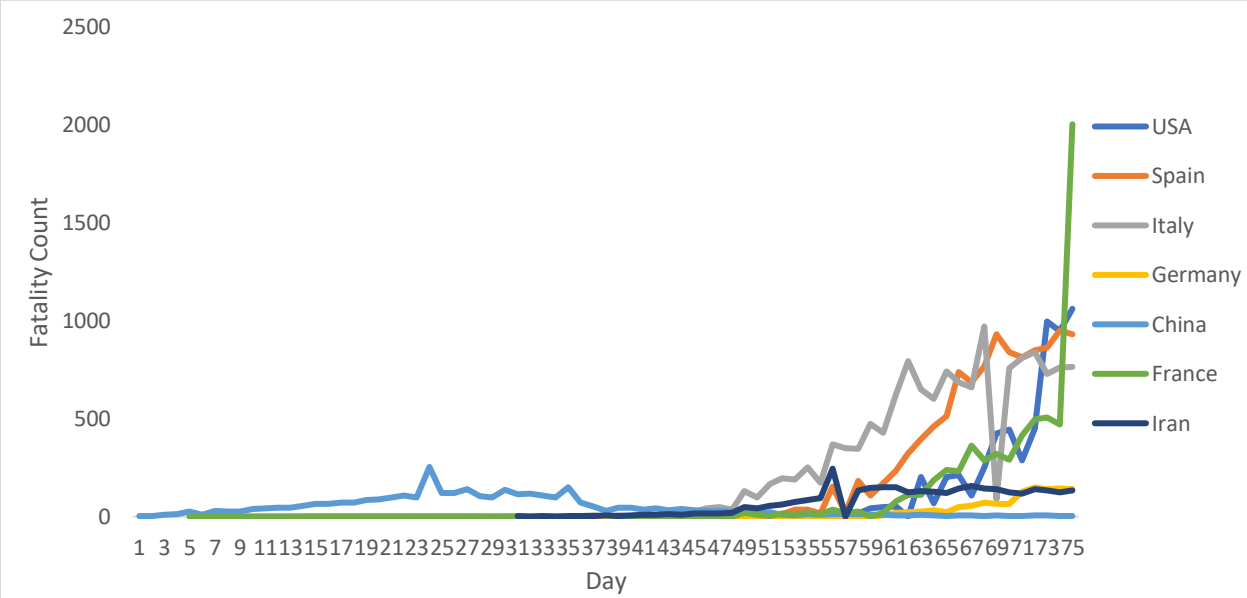

Figure 3: COVID-19 fatality in epi-centers (countries) in the first 75 days of the outbreak

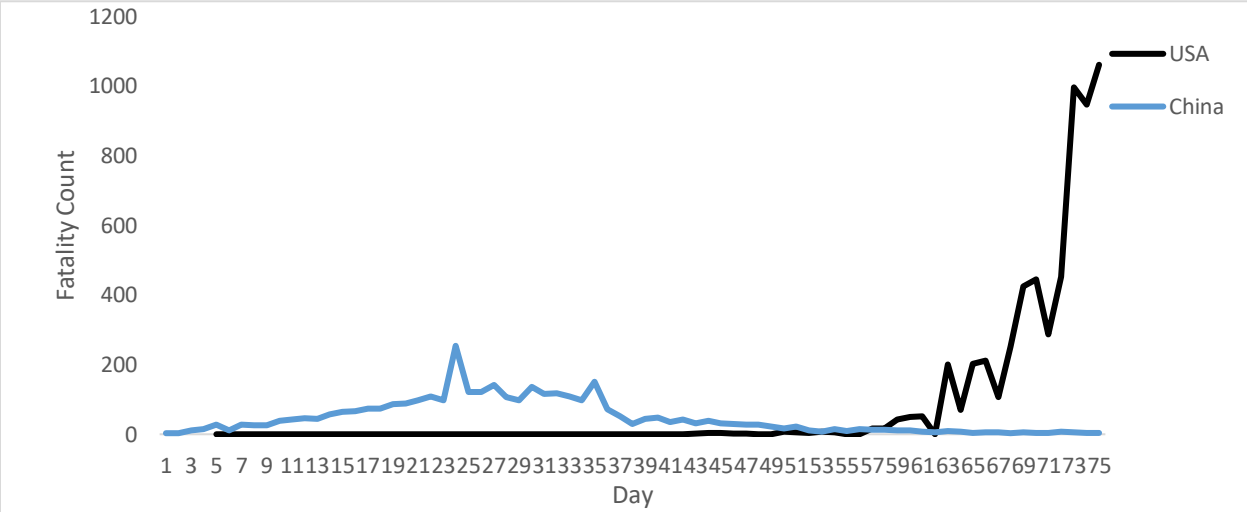

Figure 4: Daily COVID-19 fatality in United States of America using China as a reference country in 75 days of the outbreak

The fatality of COVID-19 infection as at day-75 of the outbreak

Assessment of COVID-19 fatality by country as at April 5, 2020 revealed that Italy

recorded the highest number of deaths (15,362) while Austria reported the least (186). Figures 3 depicts the daily distribution of fatality in hotspot countries. Comparing the fatality of COVID-19 in the countries to the situation in China, the Republic of Korea appears to compete favorably with the reference country considering the declining fatalities in both countries. However, fatalities in other hotspot countries showed no appreciable reduction as at day-75 of the pandemic.

The fatality rate by region also did not follow a regular trend. With the high number of confirmed cases and deaths in the European region, highest fatality rate of 7.45% was analysis.

documented in the region (Table 2). This implies that the case fatality ratio in the region at the time of this report was high. However, the region of America in spite of the high cases of infection (315,714), still recorded the lowest fatality rate of 2.59% due to lower case fatality ratio.

Overall analysis of fatality with respect to the confirmed cases of the infection also depicts no regular pattern. However, the European region recorded the highest fatality of 46,416 deaths followed by the region of America and western Pacific region with 8,187 and 3,838 respectively while the least number of deaths (236) was recorded in the African region as at the time of this

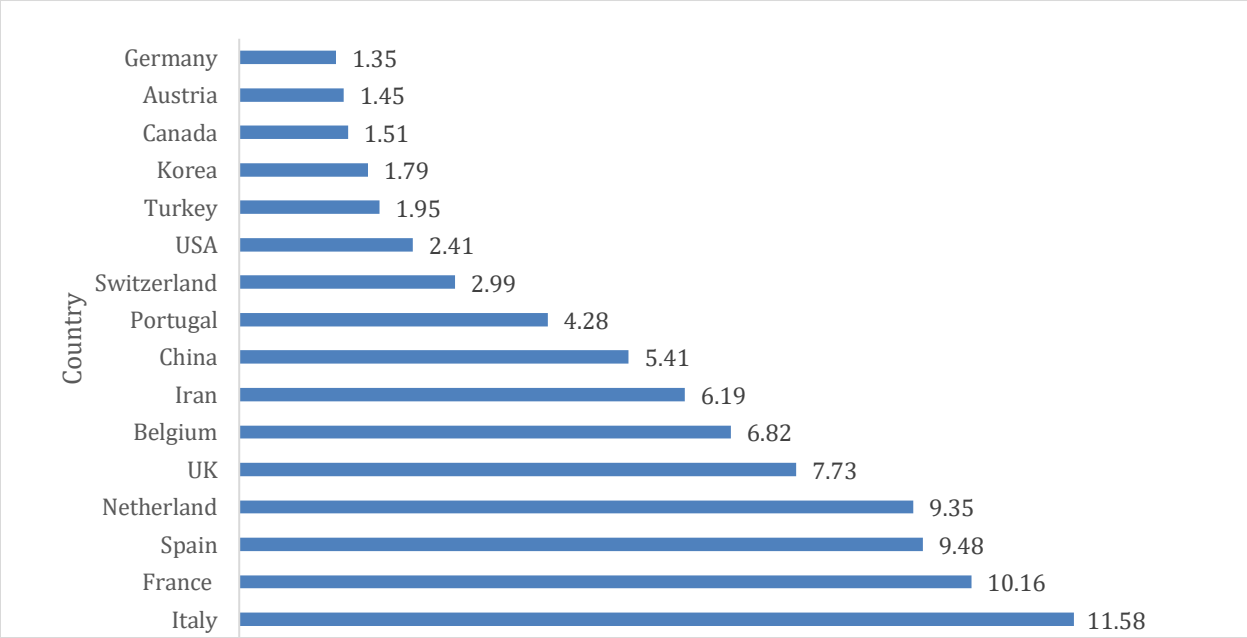

Figure 5: Fatality rate of COVID-19 in epi-centers (countries) in the first 75 days of the outbreak

Figure 5 shows the fatality rate in the epi-centers of the world. The highest rate (11.58%) was reported in Italy while the least (1.35%) was documented in Germany due to low case fatality ratio at the time of this analysis (April 5, 2020). Judging the fatality rate by country, a minimal fatality rate of 2.41% was recorded in the USA even with as

high as 273,808 cases of COVID-19 infection whereas Netherlands with confirmed cases of 16,627 recorded a high rate of 9.35% while Belgium recorded a fatality rate of 6.82% from 18,431 confirmed cases. Considering these non-proportional distributions, we observed that the fatality rate was not necessarily dependent of the number(s) of infected persons but rather on the public health disease management strategies and policies of the affected countries.

Conclusion

In the first 75 days of COVID-19 outbreak, 1,133,758 people were infected while 62,784 lives were lost to the virus from two hundred and ten (210) countries worldwide with the highest fatality of 46,416 documented in the European region.

An impressive reduction in confirmed cases and fatality of COVID-19 in China and Korea is worthy of note. The governments of both countries deserved commendation for their efforts at combating the pandemic. On the other hand, the findings from the United States of America, Italy, France, the United Kingdom, and Spain are worrisome, therefore frantic efforts should be put in place to check the rate of community transmissions in these countries. Exponential distributions of the infection should be avoided in many countries currently with the sporadic transmissions. All countries with daily confirmed cases greater than 45 per day should be lockdown while the epi-centers in such countries should be identified for necessary interventions. In addition, countries with sporadic cases should avoid nonchalant and lackadaisical attitudes towards handling the incubation and contagion periods of the infection.

We advocate that WHO, CDC and its subsidiaries in all countries of the world especially the affected nations double their efforts to ensure that the spate of community transmission is effectively checked to prevent further fatality that occurred in the past global epidemics.

Lastly, we want to suggest that all affected countries throughout the world as a time of this analysis should embark on population based testing and massive screening of domestic animals for the virus. This is based on the fact that other mammals apart from humans have been reported to be reservoirs of the virus, therefore the screening will guide against re-emergence of the infection even after successful control of the pandemic.

Conflict of interest and funding

There was no conflict of interest of any kind among all authors and the article has not been sent to any journal for consideration. The study has not attracted any grant from funding organization in the public, commercial or not-for-profit sector.

Acknowledgement

We are grateful to World Health Organization and Center for Disease Control for availing us a free access to their websites.

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