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Analysis of COVID-19 Impact using Data Visualization

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Abstract: *The world has suffered from many crises and pandemics in the past but it's the creativity and inventiveness of its people and their rigorous efforts with the capacity to think out of the box which has made them combat and overcome those situations. The world is facing a similar situation with the inception of COVID-19. The deadly new coronavirus first detected in Wuhan; the capital of China's Hubei province has sat its foot across the globe by infecting millions of people worldwide. Nevertheless, tough times ask for draconian measures and smart solutions, so the objective of our research work is to analyse the data with the help of visualization using Python to delineate and bring out a result by comparing the COVID-19 outbreak in different continents and countries like the USA, China, India, Italy, and Taiwan. For differentiation, we have used the total number of confirmed cases, the total number of casualties, and the total number of recovered cases of the COVID-19. Additionally, we have also compared the total number of tests conducted by the countries mentioned above. Our research will also concentrate on what makes COVID-19 pandemic different from other epidemics like SARS (2003), MERS (2012), Ebola (2014) by comparing their mortality rate, contagiousness, and symptoms. For all the comparison we have used data visualization. This research provides a comprehensive understanding of COVID-19 and compares its impact on different regions of the world with the help of Data Visualization and it will also help to derive a better solution for future emergencies.*

Keywords: *COVID-19, coronavirus, Ebola, MERS, SARS, Mortality rate, Data Visualization, Python.*

I. INTRODUCTION

The COVID-19 outburst has caused an event of distress across the globe. The advent of the novel coronavirus was first spotted in Wuhan, the capital of China's Hubei province, and was reported to the WHO (World health organization) on 31 December 2019. WHO has claimed that the novel coronavirus has an incubation period of 2-14 days [4]. Nevertheless, the period can vary exceptionally among patients. The outbreak was confirmed as a global pandemic on 11 March 2020 by WHO. The spread of the virus is unprecedented with more than 1 million active cases till 15 April 2020 [2] and with the mortality rate of 3.4% estimated by WHO as of March 3, 2020 [3]. An infected individual with the COVID-19 virus can be asymptomatic which means showing no symptoms or can develop symptoms which mainly include symptoms of flu, shortness of breath, loss of smell, etc [4]. Furthermore, elderly people and individuals with a pre-medical condition appear to be more vulnerable to the COVID-19. The conception of COVID-19 and factors related to it like lockdown, medical facilities, etc has led to disturbances and disorders in the health conditions of various countries.

This paper provides a better understanding of the effects of the COVID-19 on various countries bolstered by plots and charts that have been constructed using matplotlib for visualization. In this paper, we will recognize the related works that have been done before in this field to placate the pestilence. Further, there will be a detailed study of the methodology employed, and questions like why we have used those methods and technology, etc. will be answered. Next, we have discussed the result and conclusion we have drawn from the analysis of data, this will be going to help researchers to understand the pandemic in a better way. Next is future enhancements, it contains some potential enhancements that can be done in this field to counter this pandemic in a smarter way. The last section of this paper contains citations and references used.

The COVID-19 pandemic has become an insurmountable problem for the world people so, this prompts us to find out the different impacts of COVID-19 in different regions due to the factors stated above. We will be differentiating the total number of cases, casualties, recoveries, lockdown dates, and tests conducted in different continents and countries to gain better insight into the effects of the COVID-19 across the globe. Additionally, we will also compare the COVID-19 virus with other epidemic diseases like Severe Acute Respiratory Syndrome (SARS 2003), Middle East Respiratory Syndrome (MERS 2012) and Ebola (2014). Particularly comparing how is severity, mortality rate, and contagiousness of the COVID-19 is different from other epidemic maladies.

II. RELATED WORK

Difficult situations like a global pandemic can be endured with the help of courage and resilience by the people. This research informs us that with world emergencies arrives the awareness among people to thwart it. Nonetheless, the world has faced many pandemics but the spread of the COVID-19 is unprecedented in history so what makes it different from other pandemics. Currently, COVID-19 estimation and analysis is a topic that has been explored in much detail in the research industry. There are several who estimated the damages and conditions in the selected time frame through different approaches. Anis Kourba [5], Md. Rezaul Karim [7] have presented papers that have done comparisons between various features related to the COVID-19. [5] also compared COVID-19 with other epidemic outbreaks like Ebola 2014, MERS 2012, and SARS 2003. He concluded that cumulative confirmed case, death case, recovered case rates are much higher in March as compared to that in January and February. [7] used Internet search data to scrutinize the responses after the announcement of the first COVID-19 case and concluded that announcements had the biggest effect on searches for coronavirus, its symptoms, and hand sanitizer. However, the announcements did not induce searches for coronavirus treatment, testing, quarantine, isolation, and coronavirus hoax.

Besides this, People have come up with many explanations and solutions to conquer this pandemic with the help of technology to anticipate future outcomes. Harshad Khadilkar[6], Villalobos Arias [8], and Md. Rezaul Karim [9] have used the control measures and technology like Artificial intelligence and machine learning to mitigate the effects of the COVID-19. [6] have shown the evolution of infection rates under lockdown as well as in the absence of lockdown with the help of reinforcement learning and [7] has used machine learning model and curve fitting to anticipate an increase in people infected with COVID-19 in particular areas while [9] studied about predicting the COVID-19 patients for the screening in the hospital with the help of CXR(Chest X-ray) images and propose an AI-assisted application which incorporates Deep Neural Network(DNN) based on automatic detection of COVID-19 symptoms followed by highlighting class-discriminating regions using gradient guiding method.

III. METHODOLOGY

This analysis is based on the information under balanced periodic panel from the advent of the COVID-19 virus aka coronavirus to April 15, 2020, this study has incorporated the official information disclosed by government websites of different factors like lockdown period, mortality rate, contagiousness, due to which there is the different impact of this virus on different regions of the world. Two key aspects are the data source and representation of data.

A. Datasets

Data gathered is from the government-approved organization's websites in 2 different excel format ODF (Open Document Format) and XLSX [2], [10], [11], [12] Different sources are taken into consideration to take as much deviated information into the evaluation to get more realistic, as well as conclusive information and it is commonly used, as a considerable number of datasets are available. The dataset for comparing the impact of COVID-19 on different regions of the world includes several outlines: The total number of cases, the total number of recoveries, the total number of sufferers died, the total number of tests taken, and the lockdown dates. Additionally, we have taken a dataset to compare various epidemics which include features like contagiousness, the total number of cases, and the mortality rate.

B. Data Visualization

In this paper, we've created a descriptive model by analyzing the collected data and applying statistical analysis to it, which encompasses the collection, analysis, interpretation, presentation, and modeling of data. This model classifies the COVID-19 pandemic in 2 different categories i.e. at a country level and at the continent level. Both of these categories have some common features and some unique features and we have drawn different conclusions from the collected data using inferential analysis which is the part of statistical analysis. Besides, this model also provides a comparison between various other epidemic outbursts: SARS (2003), MERS (2014), and EBOLA (2014). For all the graphical representations, we have used matplotlib and NumPy modules of python3.

IV. RESULT

The descriptive model designed in this paper provides us different types of statistical charts, including bar charts and pie charts to represent different features of the COVID-19 outbreak. Firstly, we have compared the impact of COVID-19 at the continent level. We have instigated every continent individually. The gravity of a pandemic can be estimated on the basis of the total number of cases (as shown in Fig. 1), recoveries (Fig. 2) and casualties (Fig. 3) it has caused across the globe, which can be seen with the help of figures illustrated below (till 15th April 2020). It gives us the basic coverage of the virus across the globe. It can be inferred

that Europe is the most affected continent so far with the utmost total number of cases, recoveries, and deaths.

We have also taken many countries like China, India, Italy, The USA, Iran, and Taiwan in the account for comparing effects of COVID-19 on them due to various factors like lockdown dates and total tests conducted. Likewise, we have shown the total number of active cases, recoveries, and deaths in these countries. This will help us in comparing the effects of the new coronavirus on different countries and will also help to discover and answer questions like what factors have led some countries to be severely affected by the pandemic.

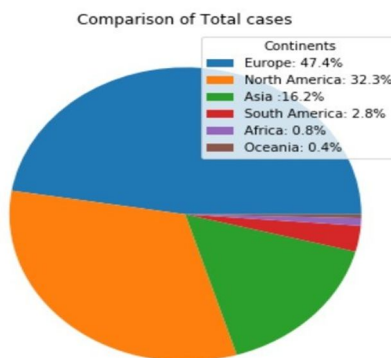


Figure 1. This chart shows the comparison of Total COVID-19 cases in different continents around the globe.
(Europe: 923280, North America :629095, Asia: 315341, South America: 55255, Africa: 16306, Oceania: 7857)

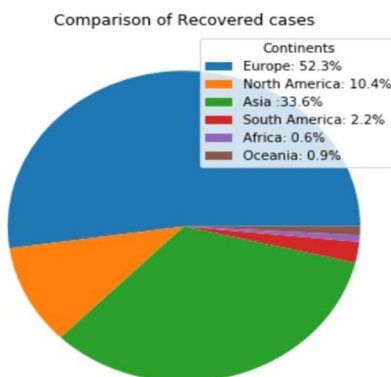


Figure 2. Chart for the total number of Comparison of Recovered cases in different continents.
(Europe: 240179, Asia: 154325, North America: 47808, South America:9915, Africa: 3,136, Oceania: 4,227)

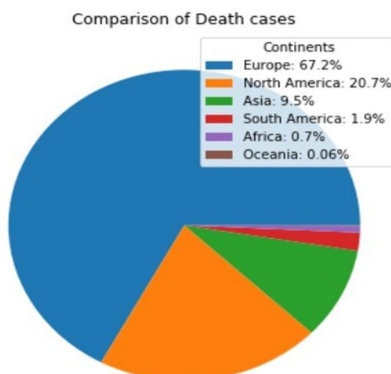


Figure 3. Chart for the total number of Comparison of Deaths in different continents around the globe.
(Europe: 81787, North America: 25,226, Asia: 11570, South America: 2,286, Africa: 840, Oceania: 70)

From Figure 4, Figure 5 and Figure 6 we can visualize that The USA has the highest number of cases and casualties of the COVID-19. Whereas Figure 7 outlines that the total number of recuperations is maximum in China. As the number of tests conducted has played an important role in estimating the effect of the COVID-19, it can be seen from the bar graphs that country with a maximum number of tests conducted has the greatest number of total cases so the total number total cases can be directly commensurate to the tests conducted.

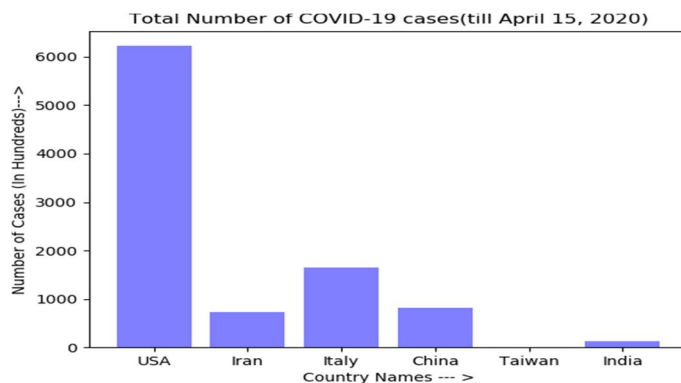


Figure 4. Bar graph representing the total number of cases in different countries.
(The USA: 622412, Iran: 76389, Italy: 165155, China: 82160, Taiwan: 12320, India: 12320)

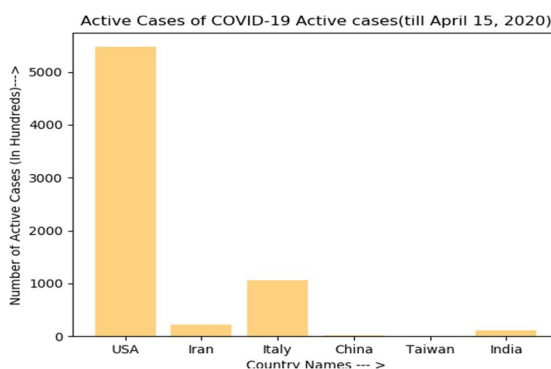


Figure 5. Bar graph representing the total number of active cases in different countries.
(The USA: 547116, Iran: 21679, Italy: 105418, China: 1137, Taiwan: 252, India: 10483)

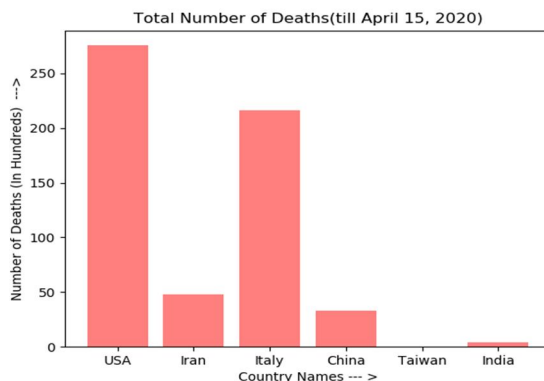


Figure 6. Bar graph representing the total number of death cases in different countries.
(USA: 26549, Iran: 4777, Italy: 21645, China: 3341, Taiwan: 6, India: 405)

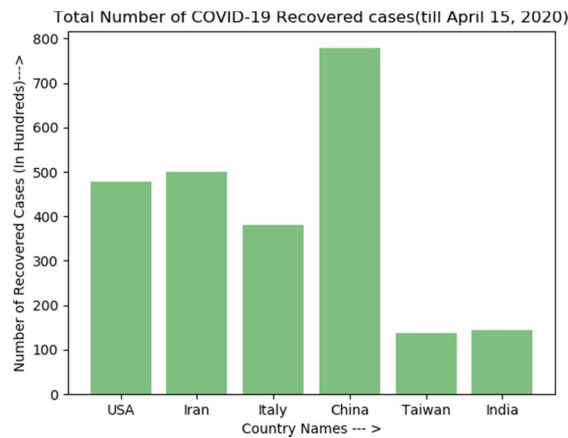


Figure 7. Bar graph representing the total number of recovered cases in different countries. (China: 77816, the USA: 47707, Iran: 49933, Italy: 38092, India: 1432, Taiwan:137)

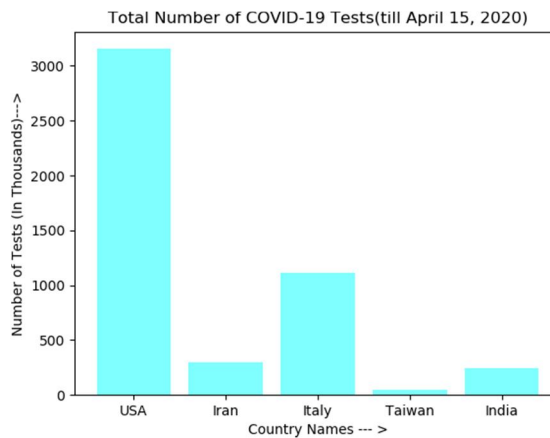


Figure 8. Bar graph representing the total number of tests conducted for COVID-19 in different countries. (USA: 3154384, Iran: 299204, Italy: 1117404, Taiwan: 49748, India: 244893)

Taiwan has implemented some severe travel restrictions and followed self-isolation which helped them to combat COVID-19 infection. China implemented a draconian lockdown of 2 months at an early which helped them to conquer the COVID-19 pandemic. On the contrary countries like Italy and Iran implemented lockdown after having cases in thousands and therefore paid the price, likewise, the USA implemented a partial lockdown which caused a drastic effect in combating with COVID-19 making it a country with a maximum number of positive cases. Some countries like India learned the lesson and implemented lockdown at an early stage hence accounted for fewer cases despite having the largest population per kilometer. Some nations came up with draconian measures by setting high bars and some paid the high price (figure 9)

Country	Lockdown Date	Total Cases
China	23-01-2020	830
Italy	09-03-2020	9172
Iran	13-03-2020	11364
India	25-03-2020	657
USA	Partial Lockdown	-

Figure 9. Table for Lockdown date and Total number of cases at the time of inception of Lockdown in different countries

So, the factors that have led some countries to suffer more severely than the others are lockdown and travel restrictions which have played an important role in containing COVID-19.

Moreover, we have compared the COVID-19 with various other epidemic diseases like Severe Acute Respiratory Syndrome (SARS 2003), Middle East Respiratory Syndrome (MERS 2012) and Ebola (2014) based on their mortality rate, consciousness, contagiousness, and severity. This has given us the visualization of the impact of various epidemics on human society and will prepare us to face the worst in the future. Figure 10 and Figure 11 describes that the spread of the COVID-19 is unprecedented as compared to the other epidemics accounting for the highest number of cases and sufferers who died. Next, we collected the mortality rate of various epidemics and after comparing their mortality rates, it can be seen from the graph (Figure 12) that Ebola has the highest mortality rate.

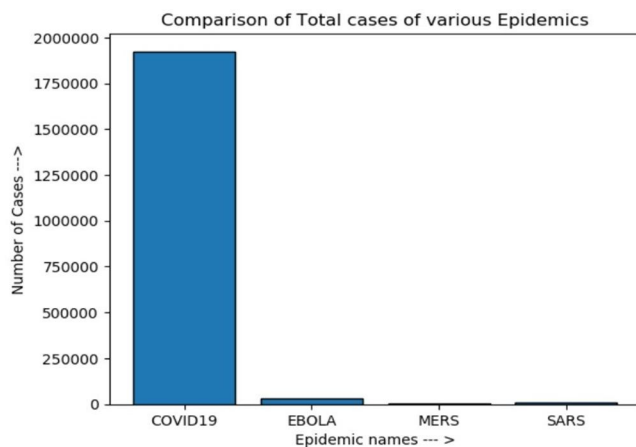


Figure 10. This Bar graph shows the comparison of Total cases of various Epidemic outbreaks (COVID-19: 1923848, EBOLA: 28646 SARS: 8096, MERS: 2494)

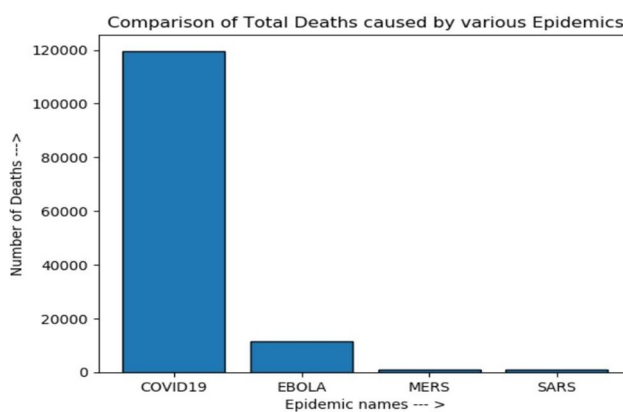


Figure 11. This Bar graph shows the comparison of Total deaths caused by Epidemic outbreaks (COVID-19: 119618, EBOLA: 11323, SARS: 858, MERS: 774)

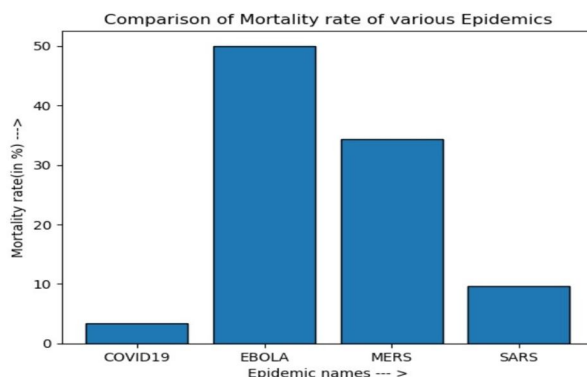


Figure 12. This Bar graph shows the comparison of Mortality rate of various Epidemic outbreaks (COVID-19: 3.4%, EBOLA: 50% (approx.) SARS: 9.6% MERS: 34.3%)

V. CONCLUSION

In this paper, firstly we demonstrated the total number of cases of the COVID-19 along with the total recovered and casualties across the continents with the help of plots and charts. The information presented and cases evaluated above has directed us to the inference that among various continents, Europe has been severely affected by COVID-19 pandemic with the highest number of cases, and recoveries (till April 15th, 2020). Talking about countries, The USA has been severely affected by the COVID-19 as compared to the other countries.

Different factors have led some countries to suffer more severely than others. After studying we have come to the conclusion that lockdown and travel restrictions have played an important role in containing COVID-19.

We have also concluded that COVID-19 has the highest number of cases that means it has the highest contagiousness as compared to other epidemics and has the lowest mortality rate.

VI. FUTURE ENHANCEMENT

The future application of the information presented is promising with many possible ideas in the eradication of the COVID-19 and control the situation. In future, we can use many different kinds of technology to change the idea of dealing with these problems and situations like we can achieve the classification of the disease, scanning the symptoms of patients, rectify the manufacturing ramifications, achieve the complexity of chemical mixing easily and accurately through artificial intelligence, machine learning, etc. All of the ideas are just the beginning, the applications of technology go to the boundaries of imagination which practically limitless.

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