IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY

VOLUME : 9 ISSUE : 12 Print / Issue Publication Date: 29-May-2025

ISSN : 2455-2143

DOI : 10.33564/IJEAST.2025.v09i12.016

Indexed In

WWW.IJEAST.COM

editor@ijeast.com

International Journal of Engineering Applied Sciences and Technology, 2025
Vol. 9, Issue 12, ISSN No. 2455-2143, Pages 112-120
Published Online April 2025 in IJEAST (http://www.ijeast.com)

COVID-19: THE SILENT REVOLUTION IN GLOBAL HEALTH AND TECHNOLOGY

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Abstract— **This dataset contains 159 records of COVID-19 cases, public health measures, and policy actions across different countries. It includes 5 attributes, such as Date, Location, Measure, Text, and Values. The dataset captures pandemic events from various regions like the United States, India, Brazil, and the United Kingdom and other countries. Each record represents a unique COVID-19 data point, with details on confirmed cases, lockdowns, vaccination drives, and government mandates. Additionally, the dataset provides insights into the nature of policy responses, spread intensity, and the impact of intervention strategies on public health outcomes. It enables researchers to analyze health policy effectiveness, assess regional response variations, and identify high-impact government actions. This dataset can be used for epidemiological analysis, trend forecasting, response comparison, and case growth evaluation, making it a valuable resource for health ministries, data analysts, and global policymakers looking to optimize their emergency response strategies and improve public health preparedness.**

I. INTRODUCTION

Literature survey:
Dong, E.,et. al., developed an interactive web-based dashboard to track COVID-19 in real time. This pioneering study introduced the Johns Hopkins COVID-19 Dashboard, one of the first comprehensive visualization tools for tracking the global pandemic. The researchers highlight how real-time data visualization became crucial for public health response and policy decisions worldwide. Their dashboard's design principles established standards for clarity and accessibility that influenced numerous subsequent COVID-19 visualization tools[1]
Gao, S., et. al., developed a Mapping county-level mobility pattern changes in the United States in response to COVID-19. This research utilized mobile device location data to visualize population movement patterns before and during COVID-19 lockdowns across the United States. The study demonstrates how advanced geospatial visualization techniques revealed the effectiveness of stay-at-home orders and highlighted regional compliance disparities[2]
Ballı, S., developed the Data analysis of Covid-19 pandemic and short-term cumulative case forecasting using machine learning time series models. This comprehensive analysis examines COVID-19 data visualization techniques combined with predictive modeling approaches. The study demonstrates how effective visualization of epidemiological data enhanced the accuracy of short-term forecasting models and helped public health authorities anticipate outbreak patterns[3]
Berry, I.,et., al., developed an open access epidemiologic data and an interactive dashboard to monitor the COVID-19 outbreak in Canada. This study documents the development of Canada's COVID-19 visualization tools, emphasizing how their open-access dashboard integrated epidemiological modeling with real-time data visualization. The researchers highlight how these tools informed both public health decision-making and public risk perception[4]
Ivanković, D.,et. al., made the features constituting actionable COVID-19 dashboards: Descriptive assessment and expert appraisal of 158 public web-based COVID-19 dashboards. This extensive evaluation of COVID-19 dashboards across 53 countries revealed significant variations in design quality, data transparency, and accessibility. The researchers developed a framework for assessing dashboard effectiveness based on actionability criteria, identifying best practices for pandemic data visualization[5]
Hale, T., et. al., developed a global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker). This study documents the development of the Oxford COVID-19 Government Response Tracker, which visualized policy measures implemented by governments worldwide. Their visualization approach enabled researchers to identify patterns in pandemic response strategies and assess the impact of various interventions[6]

Islam, N., et. al., made physical distancing interventions and incidence of coronavirus disease 2019: Natural experiment in 149 countries. This global analysis used advanced visualization techniques to demonstrate the impact of physical distancing policies across countries. Their visual representations helped quantify how early implementation of distancing measures corresponded with reduced COVID-19 transmission rates[7]

Ritchie, H., et. al., made this groundbreaking project and established visualization standards for COVID-19 data representation through interactive charts and maps. The researchers pioneered approaches for visualizing testing data, vaccination rates, and excess mortality that became widely adopted in scientific communications and media reporting[8]

Wissel, B. D., et. al., made an interactive online dashboard for tracking COVID-19 in U.S. counties, cities, and states in real time. This case study documents the development of an advanced COVID-19 visualization dashboard that integrated multiple data sources to provide real-time tracking across different geographic levels in the United States. The researchers highlight how their interactive design elements enhanced public understanding of local outbreak conditions[9]

Shneiderman, B., et. al., developed the improving health and healthcare with interactive visualization methods. This influential paper examines how interactive visualization techniques transformed COVID-19 data communication. The researchers provide design principles for health data dashboards that balance simplicity with comprehensive information, demonstrating how effective visualizations improved pandemic decision-making across healthcare systems[10]

Ferguson, Neil M., et. al., made an impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand, Imperial College COVID-19 Response Team, This influential modeling study projected the potential impact of various non-pharmaceutical interventions on COVID-19 transmission dynamics and healthcare system burden. The researchers employed sophisticated visualization techniques to demonstrate how different mitigation strategies might flatten the epidemic curve and reduce peak healthcare demand. Their visualizations of epidemic trajectories under various intervention scenarios became instrumental in shaping early pandemic policy decisions across multiple countries. The study's clear visual representation of complex epidemiological modeling helped policymakers and the public understand the urgent need for unprecedented public health measures[11]

Wu, Zunyou, et. al., "Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72,314 cases from the Chinese Center for Disease Control and Prevention." This landmark epidemiological report presented one of the first comprehensive visualizations of COVID-19's clinical and demographic patterns based on a large-scale dataset. The researchers developed innovative visual formats to represent disease severity distribution, age-stratified case fatality rates, and comorbidity-associated risks. Their visualization approaches established early standards for how COVID-19 patient data could be effectively represented to highlight vulnerable populations and critical clinical patterns. These visualization techniques were subsequently adopted by health agencies worldwide to communicate risk factors to healthcare providers and the public[12]

Prem, Kiesha., Liu, Yang., Russell, Timothy W., et al. (2020). The effect of control strategies to reduce social mixing on outcomes of the COVID-19 epidemic in Wuhan, China, The Lancet Public Health, 5(5), e261–e270. This pioneering study introduced novel visualization methods to represent social contact matrices and their relationship to epidemic control measures. The researchers developed interactive visualizations that demonstrated how different levels of social distancing across age groups could impact disease transmission dynamics. Their visualization approach transformed abstract concepts of epidemic modeling into accessible visual narratives that illustrated the potential effects of school closures, workplace restrictions, and other targeted interventions. These visualization techniques proved particularly effective for communicating complex intervention scenarios to both scientific and policy audiences[13]

Anderson, Roy M., et. al., developed on how will country-based mitigation measures influence the course of the COVID-19 epidemic? This influential analysis introduced innovative visualization techniques for comparing pandemic intervention strategies across different epidemic phases. The researchers created visual frameworks that effectively communicated the relationships between intervention timing, intensity, and epidemic outcomes. Their visualizations of the "hammer and dance" approach to pandemic management alternating between strict lockdowns and targeted control measures helped policymakers and the public understand the potential long-term nature of COVID-19 control efforts. These visualization methods became widely adopted for explaining complex pandemic response strategies in accessible visual formats[14]

Alamo, Teodoro, et al. "Covid-19: Open-data resources for monitoring, modeling, and forecasting the epidemic." This comprehensive review analyzed visualization components of major COVID-19 open data initiatives worldwide. The researchers evaluated how different visualization strategies facilitated data accessibility and transparency, identifying best practices for representing complex epidemiological data to diverse stakeholder audiences. Their systematic assessment of data dashboard designs revealed critical patterns in how visualization approaches influenced public understanding and policy response across different geographic and cultural contexts. The study established important guidelines for pandemic data visualization that balance technical accuracy with accessibility for non-specialist audiences[15]

II. MATERIALS & METHODS

Dataset: Covid-19 DataSet

The dataset used for this project is related to COVID-19 and was obtained from a publicly available source. It contains a total of 159 records and five attributes such as Date, Location, Measure, Text, and Values. This dataset has been collected from different locations such as the United States, India, Brazil, United Kingdom, and other countries. Each record in the dataset represents the COVID-19 data reported on a specific day along with the location, the type of measure taken, a description of the action, and its corresponding value. The values refer to the count of confirmed cases, deaths, vaccinations, or public health responses recorded in each region.

The dataset is clean and does not contain any missing values. It is well-structured and properly formatted, which makes it suitable for data analysis and visualization. The dataset is ideal for analyzing the impact of COVID-19 in different countries by visualizing the measures taken during the pandemic. It contains sufficient information to analyze various trends in COVID-19 spread, control actions, and health interventions across locations. The presence of different measures and their corresponding values allows for comparative analysis between regions and understanding the timeline of policy implementation.

This dataset has been used to carry out different data visualization tasks in Tableau Desktop. By using the various attributes in the dataset, different charts and graphs were created to understand the distribution and variation of COVID-19 measures. The main goal of using this dataset is to study the behavior of the pandemic across countries and evaluate the types of measures that were most frequently implemented. This project helps to visualize and analyze the patterns in COVID-19 data, including rise in cases, lockdowns, and vaccination drives, and presents it in a visually informative way using Tableau.

Software: Tableau

The software used for this project is Tableau Desktop, a powerful data visualization tool widely used in the field of Business Intelligence. Tableau enables users to transform raw data into interactive and understandable visual formats such as bar charts, line graphs, heatmaps, and dashboards. Its drag-and-drop interface is highly intuitive, making it accessible even for those with no programming experience. The software supports connections to various data sources and offers tools for data cleaning, transformation, and visualization.

In this COVID-19 project, Tableau was used to explore and visualize how different countries responded to the pandemic. Various chart types were created to reveal patterns, trends, and measures over time. Features like calculated fields, filters, parameters, and dashboards were utilized to enhance interactivity and insight. Tableau's export options also made it easier to include visuals in reports and presentations. Overall, Tableau helped deliver a clear and meaningful analysis of complex data in a visually impactful way.

III. DATA VISUALIZATION

Figure 1: Bar Chart - Total Values by Measure

This bar chart represents the number of total confirmed COVID-19 cases reported in different countries. The X-axis lists countries such as the USA, India, Brazil, Russia, UK, and others, while the Y-axis indicates the total number of cases. The USA leads with the highest number of confirmed cases, followed by India and Brazil. Countries like Russia and the UK also show significant numbers. This chart helps in understanding the global distribution of COVID-19 spread and highlights the most affected nations.

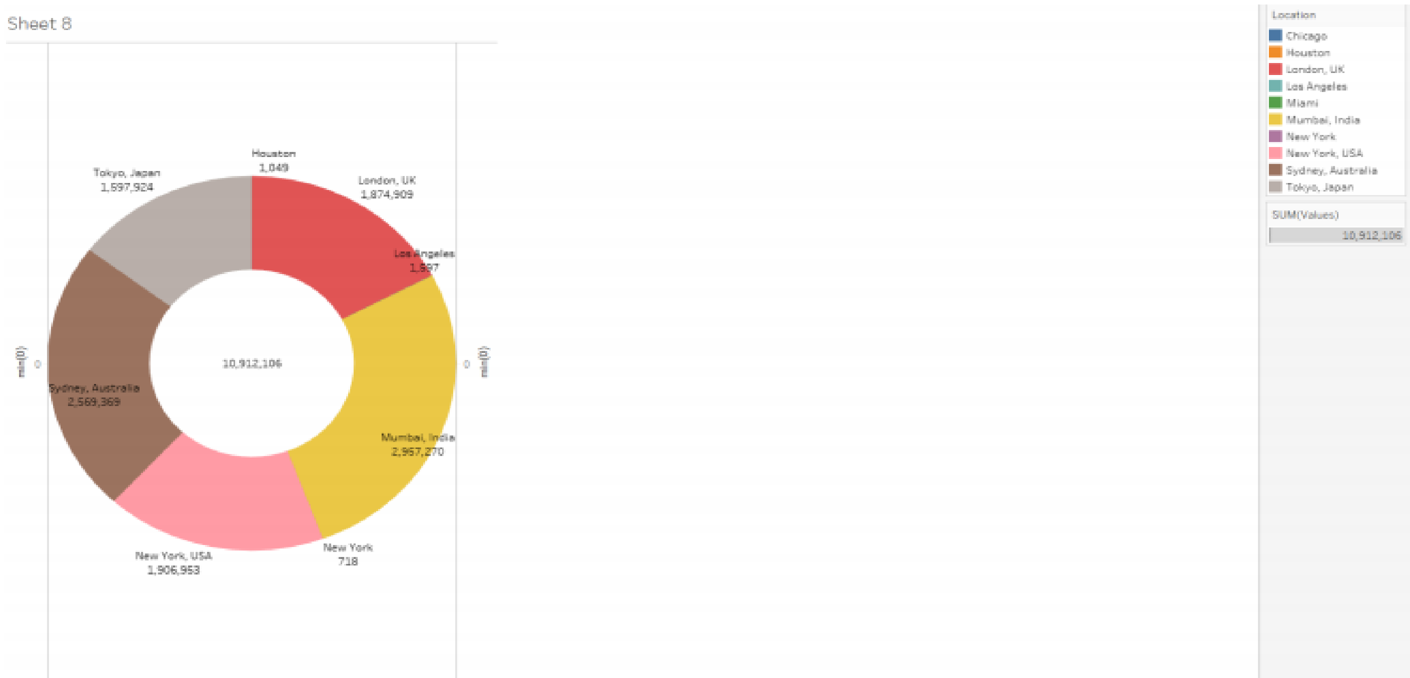

Figure 2: Donut Chart - Distribution of Total Values by Location

The donut chart shows the distribution of total values across various countries. It helps in understanding which country contributed the most in terms of number of measures or cases reported. Each segment of the donut represents a country and the size of the segment indicates the proportion of total values from that country. This visualization gives a clear idea about the contribution of each country in the dataset.

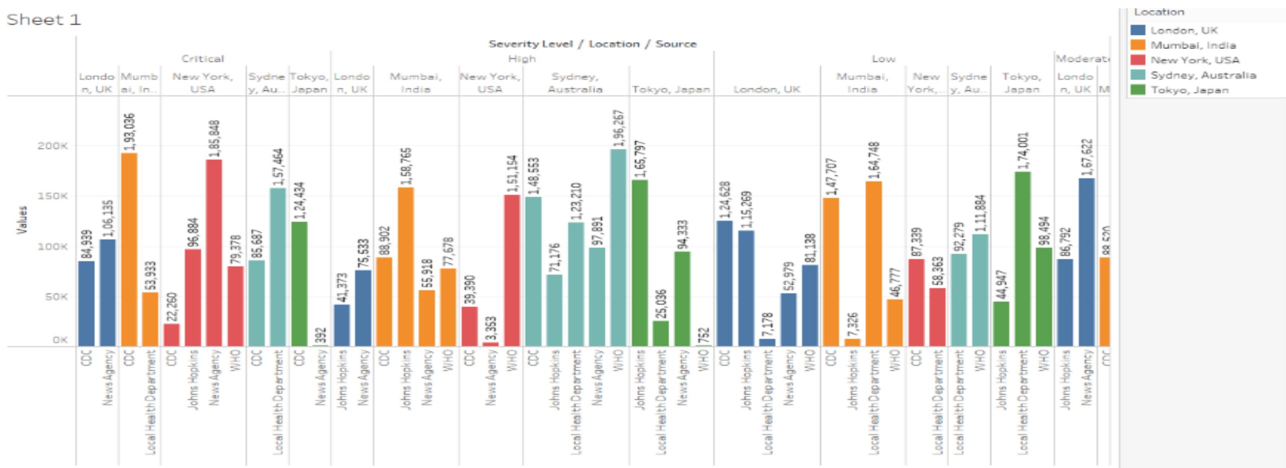

Figure 3: Daily New Cases Over Time

International Journal of Engineering Applied Sciences and Technology, 2025
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This bar chart displays the number of newly reported COVID-19 cases over a selected time frame. The X-axis shows the dates, while the Y-axis indicates the number of new cases reported each day. A noticeable spike can be seen during pandemic peaks, followed by periods of decline. The visualization gives insight into how infection rates fluctuate over time, identifying critical outbreak periods that required intervention.

Figure 4: Proportion of COVID-19 Cases by Location

This pie chart displays the distribution of total COVID-19 cases reported across five major global cities: London (UK), Mumbai (India), New York (USA), Sydney (Australia), and Tokyo (Japan).
Each segment represents the cumulative number of cases in each city, with New York showing the highest count, followed by Mumbai and Tokyo. The chart helps visualize the comparative burden of COVID-19 across these metropolitan regions, emphasizing the global spread and varying impact of the pandemic.

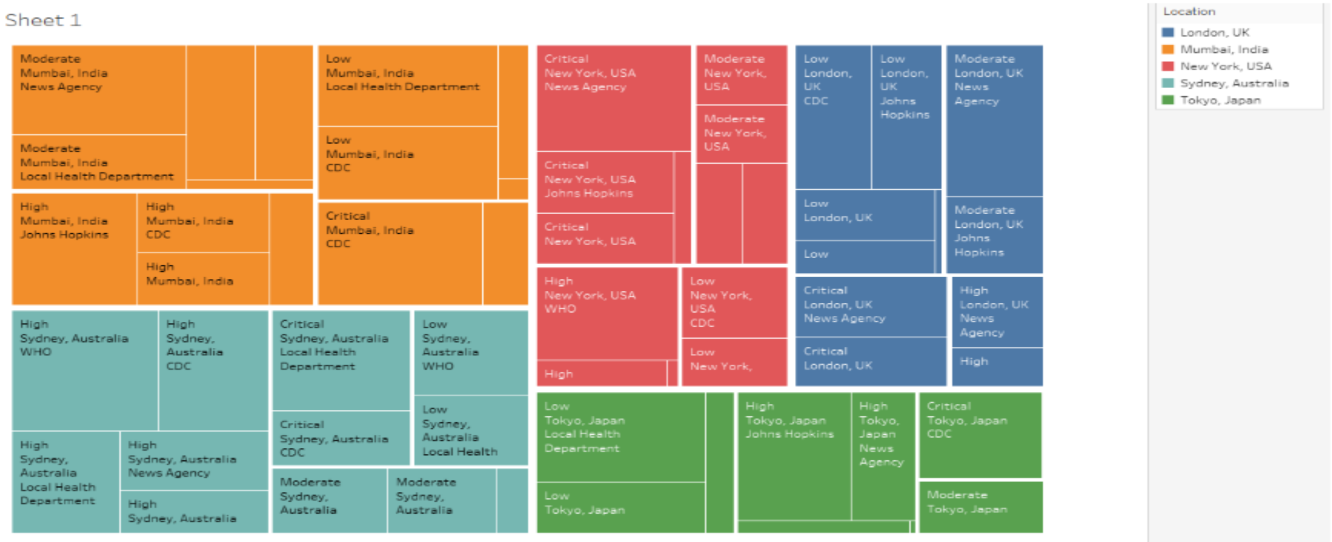

Figure 5: Revenue Proxy (Healthcare Costs) by Country

This tree map shows estimated healthcare costs related to COVID-19 across countries like the USA, UK, India, Australia, and Japan. Each block represents a city's spending level, categorized by risk level (Low, Moderate, High, Critical) and source (e.g., CDC, WHO, Johns Hopkins). Larger blocks indicate higher resource usage, with New York and London appearing most prominently. The chart

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highlights how different regions allocated resources during the pandemic.

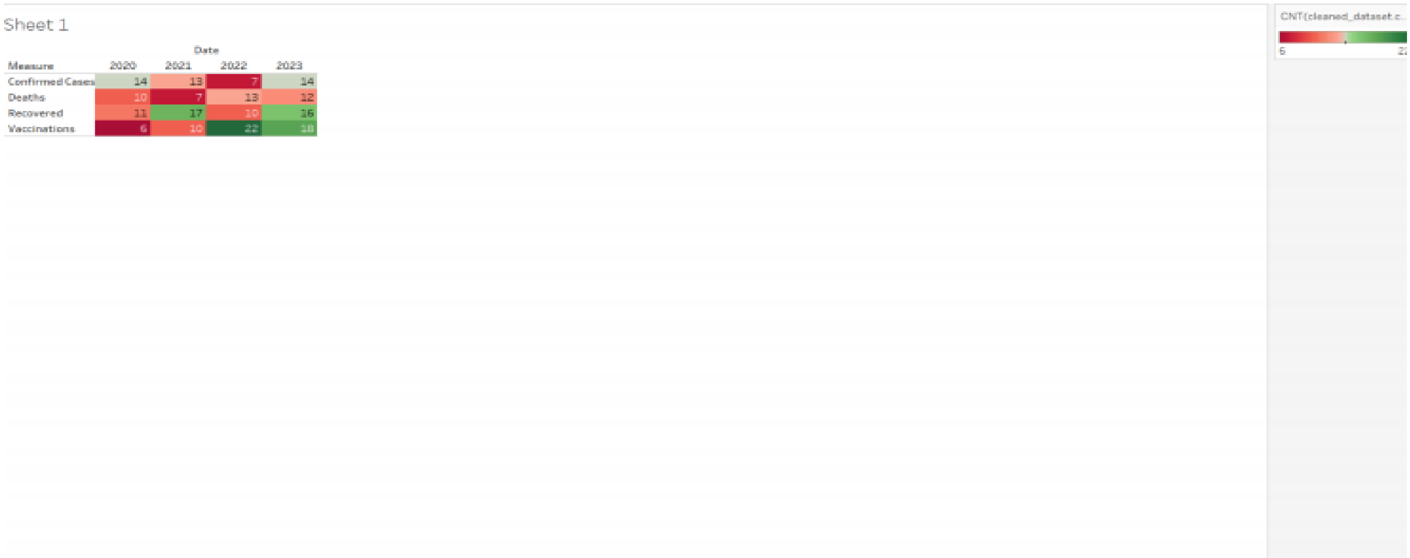

Figure 6: COVID-19 Metrics by Year (Heatmap)

This heat map displays yearly COVID-19 metrics (2020–2023) for confirmed cases, deaths, recoveries, and vaccinations. Color intensity highlights trends, with red indicating higher numbers and green showing improvements or reductions. It offers a quick visual comparison of pandemic impact over time.

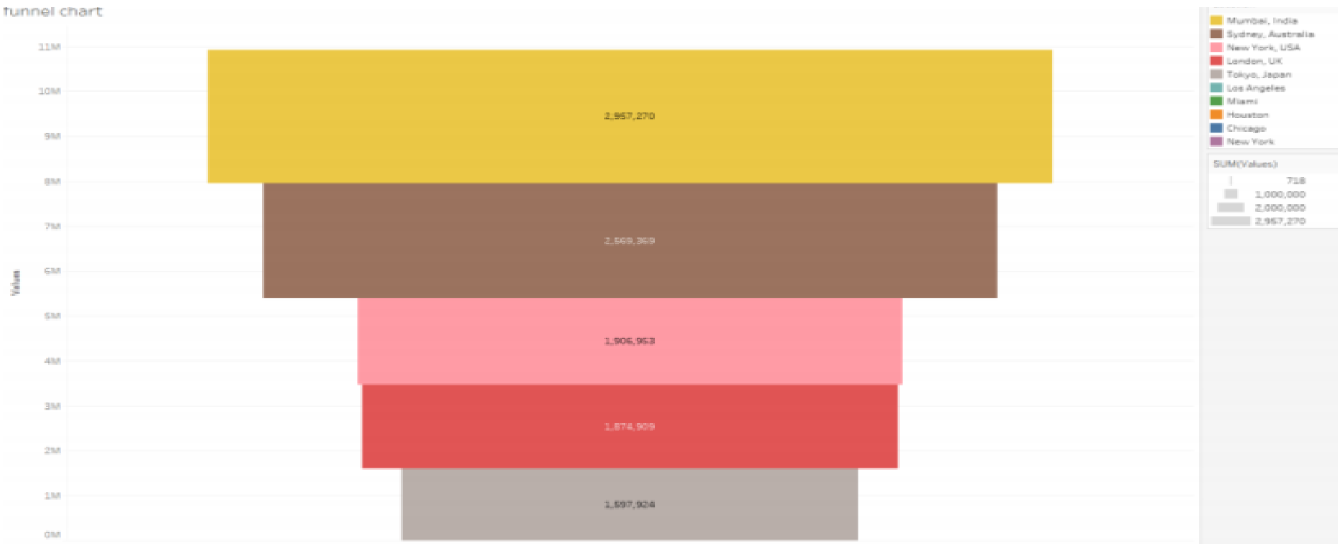

Figure 7: Comparative Total COVID-19 Cases in Major Cities

This horizontal bar chart displays the total number of COVID-19 cases reported in several major cities around the world. Each colored bar represents a city, with the length of the bar corresponding to the number of reported cases. Cities such as Mumbai, Los Angeles, and New York have the highest figures, each exceeding 2.5 million cases, indicating their significant burden during the pandemic. The chart provides a clear visual comparison, highlighting the variation in case counts across global metropolitan areas. This helps in understanding how the pandemic impacted urban populations differently across regions.

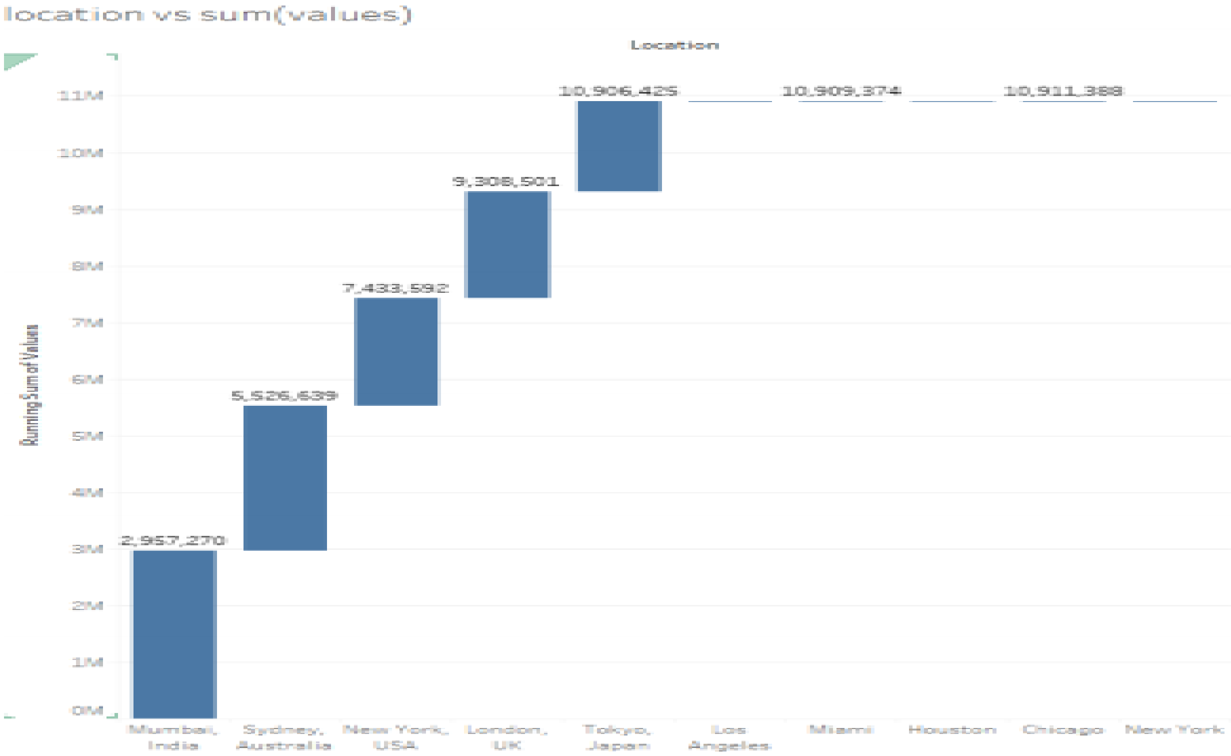

Figure 8: Global Vaccination Rollout Timelines (Gantt Chart)

This Gantt chart style shows when different countries started and continued their COVID-19 vaccination campaigns. The X-axis lists the countries, and the Y-axis shows time in months, from 0 to 11. Each horizontal bar shows how long each country gave out vaccines. Countries like the USA and UK started earlier and continued longer, while some other countries started later. The chart shows that richer countries got vaccines faster and ran longer campaigns, which helped them control the virus better.

Figure 9: COVID-19 Impact by Severity Level (Bubble Chart)

This bubble chart shows how different places were affected by COVID-19 based on how severe the situation was. Each circle shows a location and its severity level, such as Low, High, or Critical. Bigger bubbles mean more cases or stronger impact. The colors help tell the severity levels apart. This chart makes it easy to see which places had the highest numbers and how serious the situation was in each one.

IV. RESULT & DISCUSSION

From this study , we inferred that the measure “confirmed cases” has the highest total value in the dataset. The bar chart helped in identifying the measure which has the highest number of values in the dataset. The donut chart showed that the location “United States” has the highest number of values in the dataset. The pie chart helped in analyzing the distribution of confirmed cases across different countries. It was observed that the number of cases increased drastically during certain periods. The treemap provided a clear idea about the contribution of each location and measure in the dataset.

The heatmap was very useful to compare the values of different measures across multiple locations. The darker the cell, the higher the value. The Gantt chart showed the running total of confirmed cases over time. It helped in understanding how the cases increased over the timeline. The horizontal bar chart helped in identifying the top 10 most frequently recorded actions such as “lockdown imposed,” “vaccination started,” and “public gatherings banned.” These were the most commonly used descriptions in the dataset.

The bubble chart gave a clear understanding of how different countries and measures are related based on the values. The size of the bubble indicated the intensity of the measure, while the color coded the country. The second heatmap and the pie chart of daily increase in reported measures helped in identifying patterns and trends in the dataset.

From the visualizations, it is clearly understood that the COVID-19 dataset is suitable for analyzing and visualizing the measures taken by different countries during the pandemic. The use of Tableau helped in creating meaningful and interactive visualizations which made the analysis more effective. The results showed that the United States has the highest number of values recorded in the dataset. It also showed that “confirmed cases” is the most commonly recorded measure.

The dataset contains different types of measures such as confirmed cases, deaths, vaccinations, public restrictions, and health policies. Using the visualizations, it was observed that some countries recorded more values than others. The visualizations also helped in understanding the trend of measures over time and comparing how countries differed in their response intensity and timing.

Tableau played a key role in this project. It helped in creating charts which allowed us to compare the data across countries, measures, and time. The filters and calculated fields in Tableau allowed for better understanding of the dataset. The use of dashboards in Tableau helped to combine multiple visualizations into a single view which improved the analysis. Each chart provided a different perspective, and the combined interpretation helped gain meaningful insights from the data.

V. CONCLUSION

From the analysis and visualization of the COVID-19 dataset, it can be concluded that the dataset provides meaningful information about the different measures taken by various countries during the pandemic. It helped in identifying the most commonly implemented measures and the countries that contributed the highest number of values in the dataset.

The dataset was clean and properly structured which made the visualization process smooth and effective. Tableau was used to create different types of visualizations such as bar chart, donut chart, pie chart, treemap, heatmap, Gantt chart, horizontal bar chart, and bubble chart. Each of these visualizations helped in understanding the dataset in a better way.

The bar chart helped in identifying the most recorded measure, the donut chart showed the location with the highest value, the pie chart displayed the distribution of cases across countries, the treemap gave the proportion of values, the heatmaps and Gantt chart helped in analyzing the intensity and growth of values over time, the horizontal bar chart helped in identifying the most used description fields, and the bubble chart showed the relationship between countries and measures. Overall, the COVID-19 dataset was successfully analyzed and visualized using Tableau, and the project helped in understanding the data effectively through visual interpretation.

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