Introduction

In this report, we will be evaluating the two dashboards. First dashboard will be focussing on the information that is of more significance to general audience. This dashboard will be focussing on top NHS to take treatment in, mean age(in years), mean length of stay(in days), mean time that the patients has to wait etc. This information is of more significance to general public. Second dashboard shows the total number of outpatients, inpatients, hospitals in different counties in UK, number of day and bed day cases in UK categorised by specialties, NHS etc.

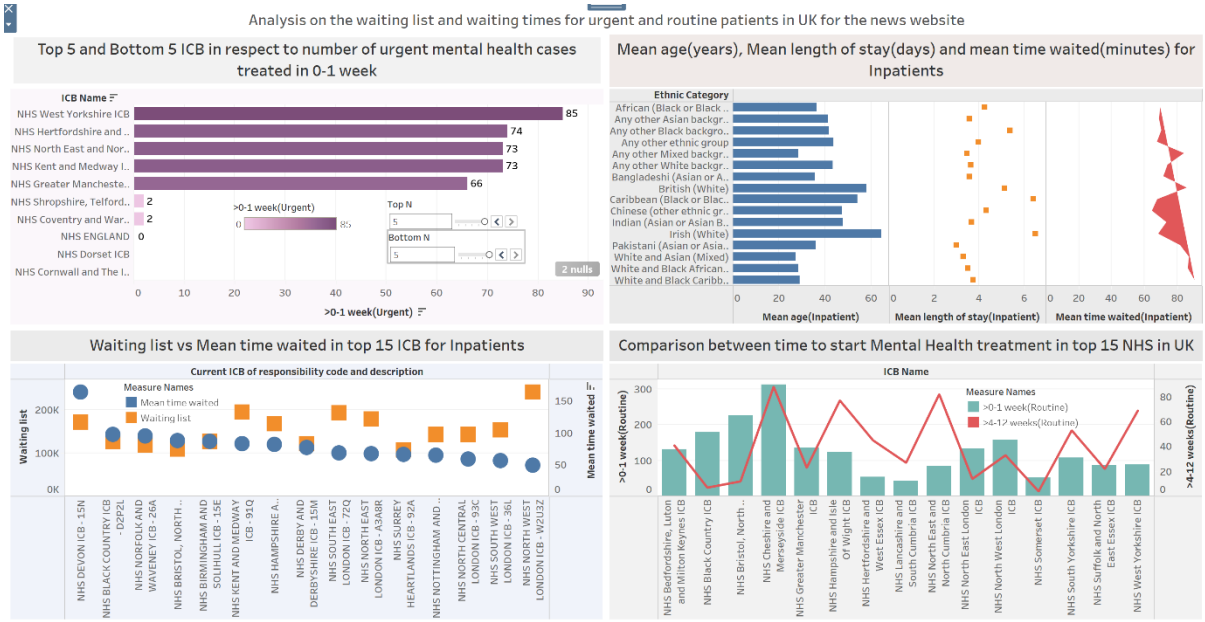
Evaluation process discussed in this report throws light on how the data was cleaned, processed and re-processed in excel and tableau. Visualisation designs and techniques are been discussed in this report along with thought process behind using particular formatting styles and designs.

Evaluation of Dashboards

Link of Dashboard 1 and Dashboard 2(Scroll through the sheets and the dashboards)

https://public.tableau.com/app/profile/sukhman.singh1298/viz/CapstoneDataVisualisation_17188433554620/Dashboard1_1?publish=yes

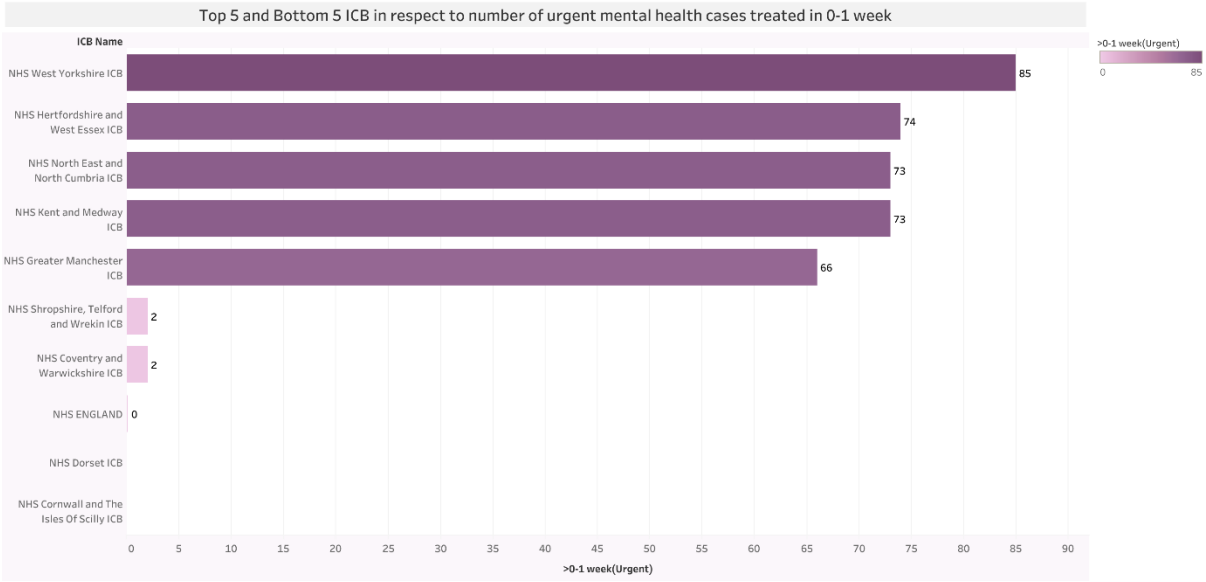
1. Analysis on the waiting list and waiting times for urgent and routine patients in UK for the news website (Year 2022-2023)



This dashboard depicts waiting times, waiting list, mean age, mean length of stay of inpatients, time waited etc. of patients across different NHS in UK. This information will help the patients to decide the NHS they want to get treatment in, as per their urgency and need. **(Website, 2023)**

Analysis of each sheet in Dashboard 1

- **Top 5 and Bottom 5 ICBs with Respect to Number of Urgent Mental Health Cases Treated in 0-1 Week**



This graph shows the top 5 and bottom 5 ICB's in terms of dealing urgent cases in (0-1) week. Sets and parameters were created to make and showcase this graph.

Chart Type and reason: Bar chart as the bars here effectively displays the data. Color grading helps us distinguish the top N and bottom N effectively. Setting parameters gives us flexibility to see top and bottom 1,2,3,4 or 5 NHS you like. **(Milligan, 2019)**

Interpretation:

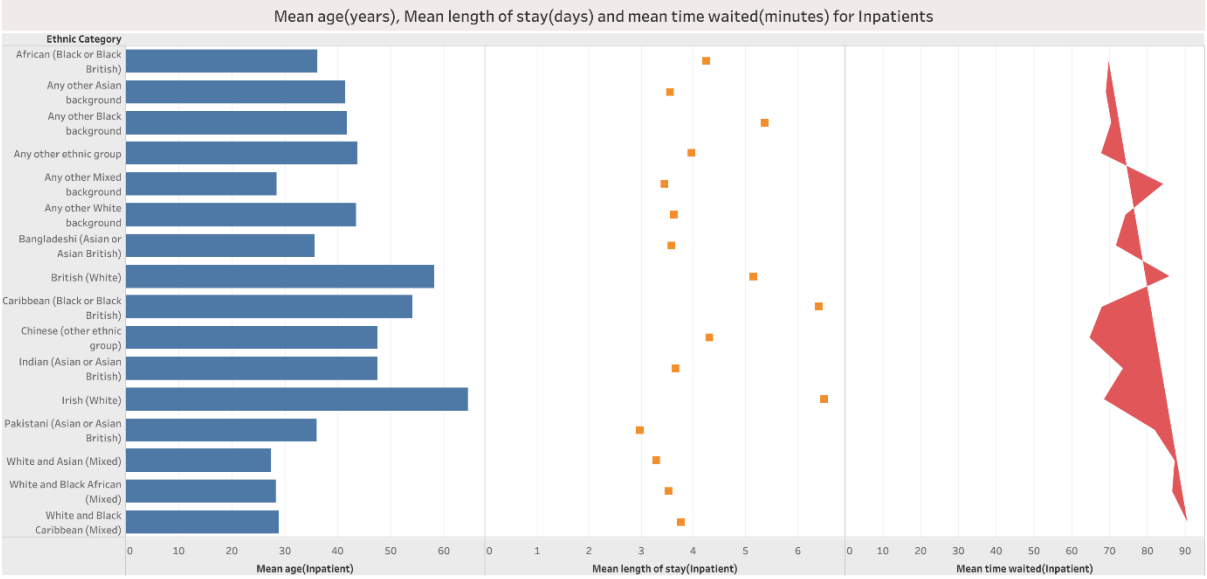
• From the chart it can be see, there is a huge variation in the number of urgent mental health cases treated within 0-1 week among these different ICBs.

• NHS West Yorkshire ICB had the highest number of urgent cases, which is 85, so maybe it has better capacity or is more efficient in treating urgent mental health cases.

• On the other end NHS Shropshire, NHS Coventry and Warwickshire ICB have only 2 urgent cases treated within 1st week followed by NHS England, NHS Dorset and NHS Cornwell with 0 cases that shows signs of concerns for these NHS.

Therefore, important measures are required to allocate resources in these NHS to be able to treat patients. These resources can be Doctors, medical equipments, nursing staff etc.

- **Mean Age(Years), Mean Length of Stay(Days), and Mean Time Waited(Minutes) for Inpatients by Ethnic Category**



This graph shows mean age(in years), the length of days stayed in hospital and mean time waited by inpatients to be treated in minutes.

Chart Type and reason: This graph includes 3 kind of chart types namely bar, square and area chart. Bar and Square chart effectively displays the varying levels between different ethinic categories. The area chart in the last displays the variance in between different ethinic groups. More the area, more the variance.

Analysis:

Y-axis: Ethnic Category

X-axis: Mean age in years represented by blue bars.

X-axis: Mean length of stay in days represented by square boxes

X-axis: Mean time waited minutes represented by red area

What the graph shows:

- We can notice at a glance, there is a huge variation in the mean age, mean length of stay, and mean time waited amongst the various ethnic groups.

- British (White) and British(Irish) are the most aged, stayed for most amout of time in hospitals, and were among the ones who waited the most for their treatment among all ethinic groups.

- Some ethnic groups from the graph portray a long mean length of stay or waiting time, which might show irregularities in access to good and timely treatment from the

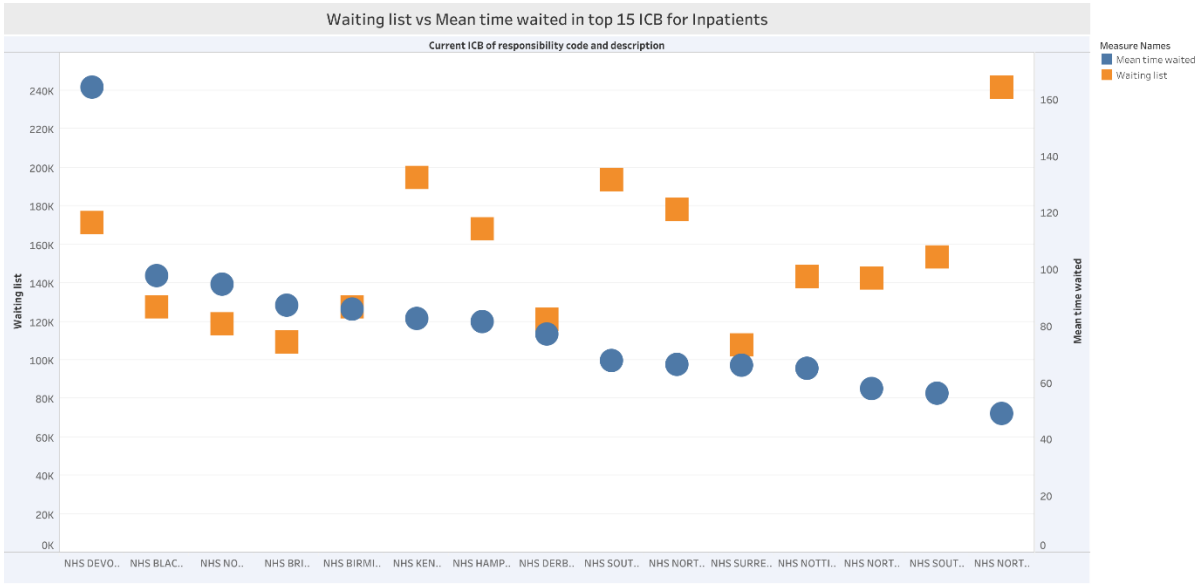
hospitals. This may also reflect different procedures that people from different ethinic groups has to follow in order to get treatment.

- The mean distribution of age indicates the average age of in-patients for each ethnic group, which can reflect different health needs and demographic profiles.

- This graph gives fair idea to public about the mean time they would have to wait if they go for the treatment and for how much time they can expect to be in hospital during the treatment.

The following visualisations give the overview of healthcare performance metrics across different ICBs and patient demographics, with a view to the areas of efficiency and possible improvement.

➢ **Waiting List vs Mean Time Waited in Top 15 ICBs for Inpatients**



This graph shows the waiting list of inpatients and mean time waited by inpatients in all different NHS in UK.

Chart type and reason: Square and Circle as these kind of charts efficiently shows different data points that makes it easy to compare.

Analysis:

Y-axis (Left): Waiting List (Patients)

Y-axis (Right): Mean time waited (days)

X-axis: ICB

Blue Circles: Mean time waited

Orange Squares: Waiting list

Interpretation:

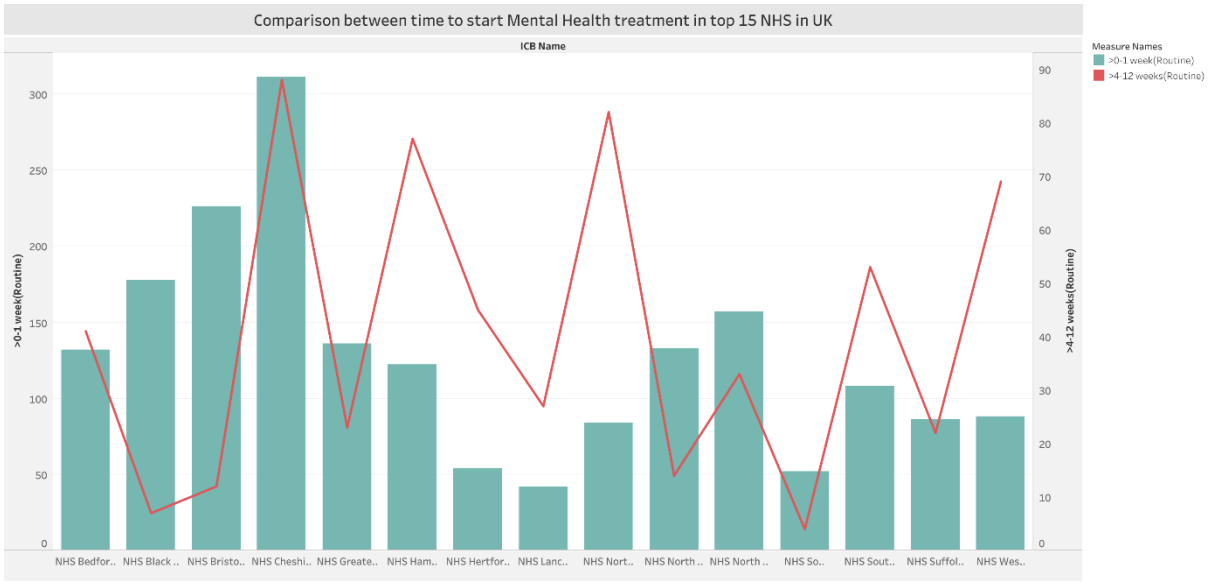
• The top 15 ICBs have a diversified distribution of the waiting lists and mean waiting times.

• Some ICBs with higher waiting lists are not necessarily those waiting longest, thus indicating varied efficiencies and capacities to manage in-patent care.

In NHS Devon and NHS Kent, there were lavish waiting lists, but in NHS North East London and NHS South East London, these waiting Lists are altogether lower with a mean waiting time.

For critical criticism, when I tried to show the values of data points on the chart area, they were overlapping each other and none of them were visible properly. Tableau has room for improvement in this.

- **Comparison between time to start Mental Health treatment in top 15 NHS in UK**



Through this chart, my aim is to analyze how quickly the routine cases are treated in top 15 NHS in UK by measuring the number of cases solved in (>0-1) week and (>4-12) week.

Chart type and reason: Bar and Line Chart Combination as it perfectly separates the data points of week (0-1) and (4-12).

Representation of Data

Y-axis (Left): No. of routine patients starting >0-1 week.

Y-axis (Right): No. of routine patients starting >4-12 weeks.

X-axis: ICBs in the UK

Bars: Teal—No. of routine patients starting treatment in >0-1 week.

Red Line: No. of Routine Patients Starting Treatment in >4-12 weeks.

Comparability Across ICBs:

- **Highest Immediate Treatment (>0-1 week):** NHS Greater Manchester represents the largest amount of routine patients starting treatment within >0-1 week, with figures above 300.
- **Lowest immediate treatment (>0-1 week):** NHS Lancashire and South Cumbria report the lowest figures for immediate treatment, below 50.

Interpretation

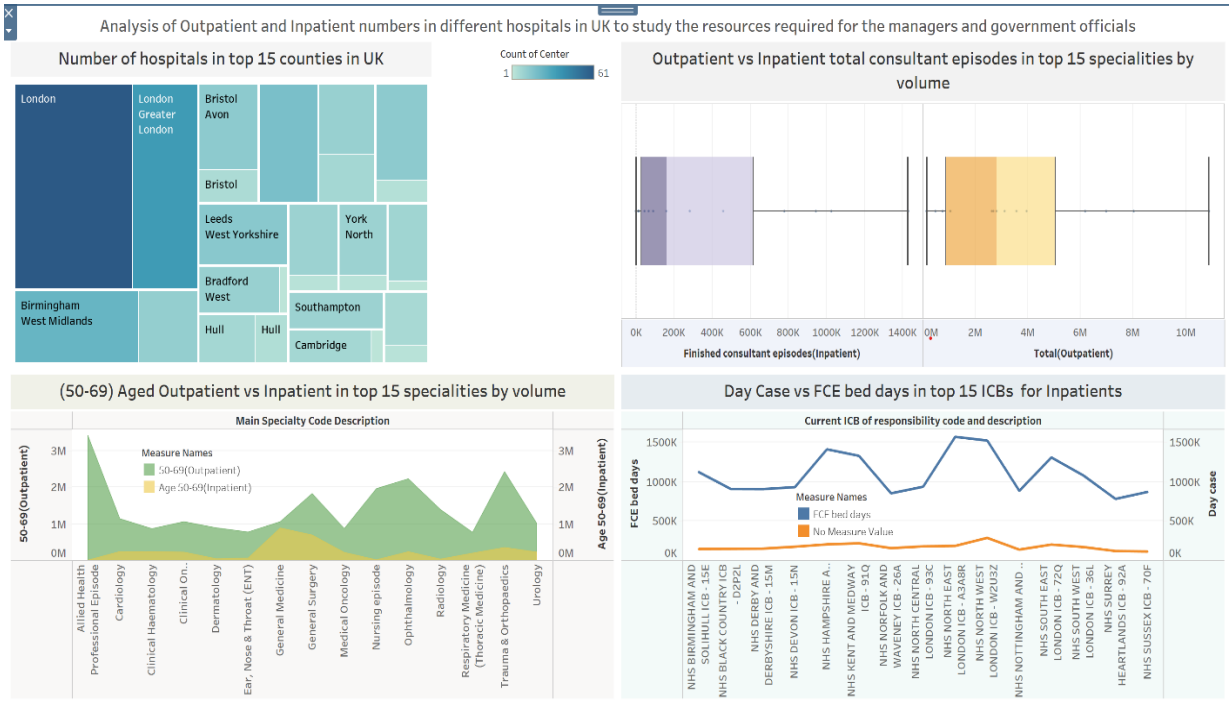
- The chart showcases the huge variation in time across various independent Clinical Commissioning Groups in the UK.

- Now, high numbers of immediate treatments for some ICBs would indicate either better efficiency or resource allocation, while on the other hand, high numbers of delayed treatment would show those areas where service delivery might be lagging.

- Immediate versus delayed waiting times reflect inequity of access to mental health services and may indicate variations in resources, management efficiency, or patients handled.

- The chart could, therefore, be beneficial in identifying which ICBs might require more support or resources to reduce waiting times and improve the delivery of mental health services.

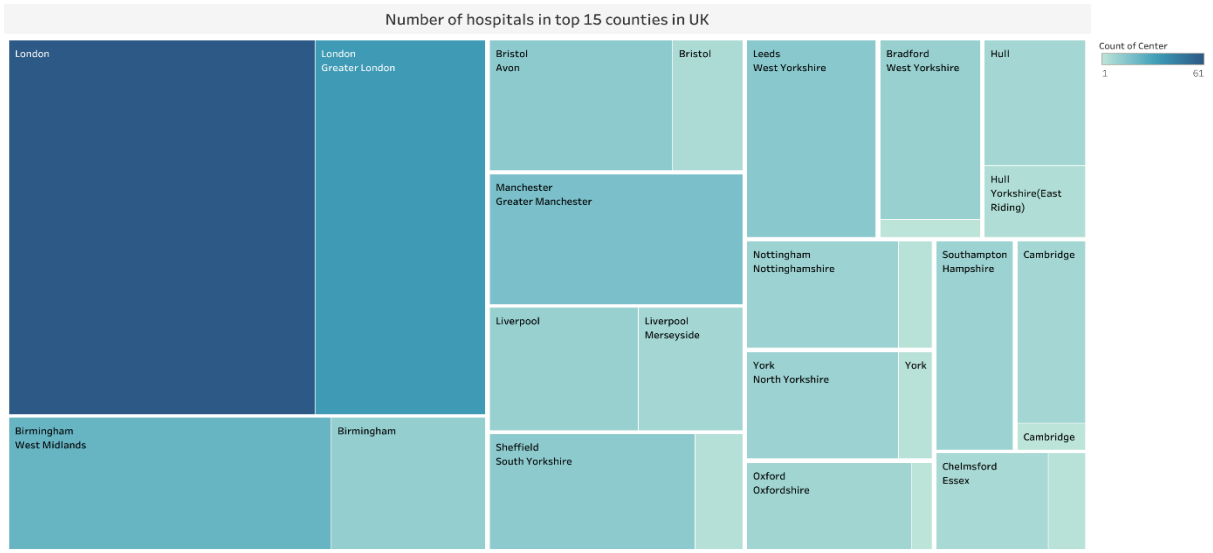
2. Analysis of Outpatient and Inpatient Numbers in Different Hospitals in the UK for managers



This dashboard depicts the total number of inpatients and outpatients in hospitals in UK for the year 2022-2023. This dashboard will assist managers and government officials to allocate various resources that may include number of doctors required in hospitals, medical equipments, nursing staff etc.

Analysis of each sheet in Dashboard 2

➢ Number of Hospitals in top 15 counties in the UK



This treemap shows the total number of hospitals distributed across different cities and counties in UK.

Chart type and reason: It's a Treemap and the reason to show this chart is that the color grading and size of the boxes gives us an instant information on which county has the most number of hospitals. **(Wijk, 2013)**

Insights in the data:

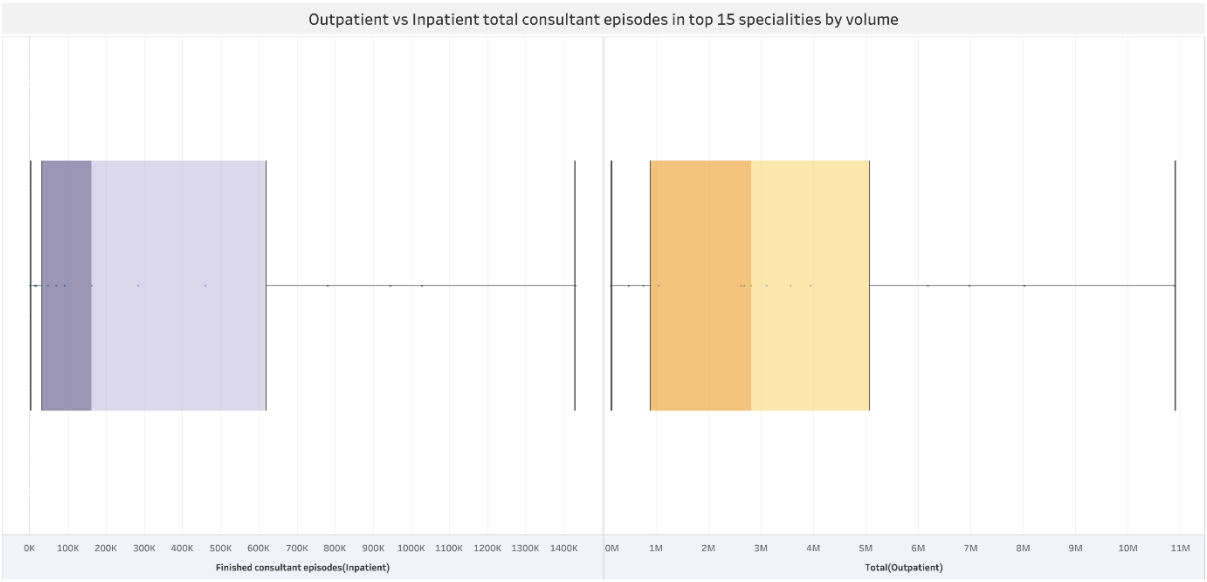
• London has a maximum number of hospitals, followed by Greater London. It is clear by the color grading of the treemap where dark blue and bigger size of the boxes indicate more number of hospitals in the particular area.

• Bristol Avon, Bristol, Birmingham West Midlands, Manchester Greater Manchester are other major counties in hospital counts.

• While London and Greater London top the count, it has a higher density for the health facilities compared to other places.

Hospital Distribution: London and Greater London are the primary hubs of Hospitals in the UK. More number of hospitals directly indicates the number of outpatients and inpatients that the hospitals in differnet areas can indicate. This gives fair idea to managers and government officials to efficiently allocate their resources to right places.

- **Outpatient vs Inpatient Total Consultant Episodes in Top 15 Specialities by Volume**



This graph shows the total number, mean and median of total number of outpatients and inpatients in top 15 specialties in UK.

Chart type and reason: This is Box and Whisker Plot and it displays the whole range of data values with the information on data distribution, median and outliers. **(Majaw, 2023)**

Analysis:

X-axis (Left): Finished consultant episodes (Inpatient) represented in purple Box and Whisker plot.

X-axis (Right): Finished consultant episodes (Outpatient) represented in orange Box and Whisker plot.

Y-axis: Top 15 specialities by volume

Interpretation:

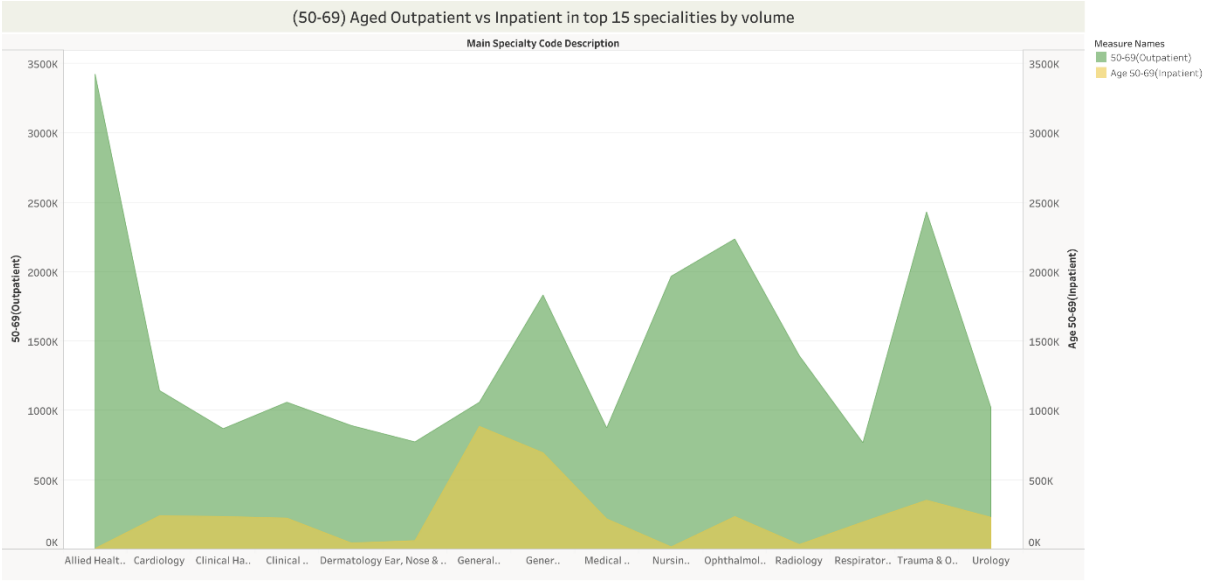
- Outpatient episodes significantly outnumber inpatient episodes across the top 15 specialities, indicating a higher volume of outpatient consultations.

- The spread in the box plots for both inpatients and outpatients suggests variability in consultant episodes within each speciality.

- Specialities with higher outpatient volumes may focus more on preventive and follow-up care compared to those with higher inpatient volumes.

For constructive criticism, data points along the range in this chart can be more visible plus guidance could have been provided on what different sections of the chart means as many people find it difficult to understand Box and Whisker chart.

- **(50-69) Aged Outpatient vs Inpatient in Top 15 Specialities by Volume**



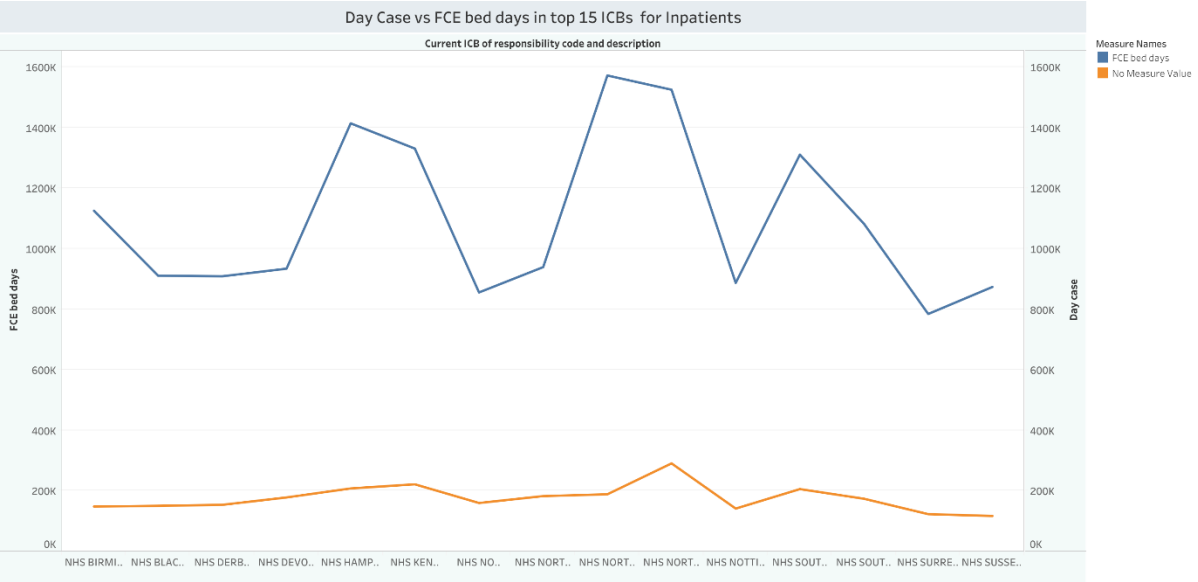
This graph shows the comparison between Outpatients and Inpatients in the age group (50-60) in top 15 specialities in UK.

- **Chart type and reason :** This chart type is stacked area chart and specific reason of using area chart was that the amount of area efficiently compares the number of outpatients and inpatients.

Data Insights:

- Specialties are metnioned on the x-axis and y-axis indicates the total number of outpatients and inpatients.
- Allied Health Professional Episode had the highest volume of the outpatient episodes for the age group 50-69.
- General Surgery and Trauma & Orthopaedics have high volumes of inpatient episodes.
- This differentiation between outpatient and inpatient episodes, which the graph makes clear, demonstrates that generally for most specialties, volumes are relatively higher for outpatients than inpatients like in the cases of Cardiology, Dermatology, and Medical Oncology, where there are also high volumes of outpatient episodes.
- This graph tells us about the type of problems people face as their age progresses and whether they need to stay overnight in the hospital for that or not.

- **Day Case vs FCE Bed Days in Top 15 ICBs for Inpatients**



The graph shows day case(no night) and FCE bed days in top 15 ICBs by volume of Inpatients.

Chart type and the reason: This is line chart and it clearly differentiates between FCE bed days and Day cases and shows explicit difference between the two. **(Ryan, 2014)**

To clear this chart, there are two kinds of inpatients,

1) **Day case:** Who stays there for a day but do not spend night
2) **FCE Bed Days:** Spend night in the hospital.

Data Insights:

- The chart compares the number of Finished Consultant Episodes (FCE) bed days (blue line) with day cases (orange line) across various Integrated Care Boards (ICBs).

- There is a significant variation in FCE bed days among the top 15 ICBs, with **NHS North East London** showing the highest FCE bed days.

- Day cases remain relatively stable across the ICBs, with slight variations, much lower in volume compared to FCE bed days.

- The peaks and troughs in the blue line indicate fluctuations in bed day usage, with notable high usage in certain ICBs such as **NHS North East London** and **NHS North West London**.

Bed Days vs. Day Cases

There is a wide disparity in FCE bed days across ICBs, highlighting regions with potentially higher inpatient care demands in certain ICB's. Day cases, although **much lower in volume, remain consistent.**

Evaluation of methodologies used to form these Visualisations

Target Audience

The target audiences for dashboard 1 will be general audience for the news website and for dashboard 2 will be healthcare managers and government officials in the UK involved in resource allocation and policy decisions in the area of healthcare. Dashboard 1 aims to depict waiting times, waiting list, mean age, mean length of stay of inpatients, time waited etc. of patients across different NHS in UK while Dashboard 2 aims to brief users on the number of outpatients and inpatients in various hospitals, special interests addressed are specialties, ethinicity and regions.

Relevancy of Data

Almost all data sets were taken from NHS website and one from Kaggle. The Kaggle dataset is also available on NHS website. Kaggle dataset showcases the total number of hospitals in UK in different counties. It was important to include because the counties with more number of hospitals will definitely have more number of inpatients and outpatients. It is important to take relevant datasets to the target audience because it contains measures of central tendency affecting healthcare decisions. It provides data on analysis both in outpatient and inpatient cases. Therefore, information can be derived regarding the demand and utilization of healthcare services in various regions and specialties. Such data would be imperative for ensuring optimization in the allocation of resources, management of waiting lists, and delivery of healthcare to patients.

Assessing Quality of Data

For quality data, various steps were taken:

Verification of Sources: Reputed databases and checked sources such as NHS official website and Kaggle were consulted to obtain the data with regard to its accuracy and reliability.
Checking for consistency: The data used here was checked in regard to its consistent reporting of figures across different datasets.
Completeness: The datasets used were complete, having no missing values, which would have skewed the analysis.

Assessing Relevance and Reliability

Contextual Relevance: Information was chosen to reflect the existing issues relevant in the healthcare sector organization on outpatient and inpatient services volume, waiting times, and efficiency in various healthcare dynamic regions.

Past information Analysis: Past information was analyzed using credible information to show trends and patterns relevant for use in making decisions in the future. Cleaning the Data using Excel and Tableau.

Cleaning the Data

Removing unnecessary rows: All datasets were cleaned in MS Excel. Excel offers range of options to clean datasets efficiently. The first few rows containg the description of NHS dataset has to be removed to effeciently process and analyse it in tableau. Null values were removed in Tableau as it is very easy to filter all nulls in Tableau with just one click.

Missing Value Handling: There were very few incomplete records that needed to be removed for maintaining integrity of the visualisation results, so that the quality of the dataset could be maintained.

Normalization: The application of data normalization techniques brought different datasets to a common scale, hence easily analyzable. Tableau Data Preparation.

Import cleaned data: Clean data from Excel was imported into Tableau for more rigorous analytics. Later I removed all the null values in Tableau.

Tableau data blending: Data blending functionality of Tableau was used to merge data from different sources to ensure completeness of vision. **(Swapna, 2017)**

Formatting of data

Categorization: Data gets categorized into relevant classes like age, specialties and regions for more granular views.

Labeling: The information is correctly and briefly labeled so audiences can easily comprehend it. **(Guerrero, 2019)**

Preparation of data

Aggregation: This involved doing it at several levels, including county and specialty, to give both aggregate pictures and granular insights.

Filtering: Almost all graphs are filtered in either ‘Top 10’ or ‘Top 15’ category using the filter option in Tableau.

Combining Supplementary Data Sets

There were whole lot of different datasets that were used to make visualisations. I manually combined the outpatient and inpatient datasets to compare their numbers with respect to ethinicity and different NHS to make a master dataset. This helped me to make some insightful visualisations camparing outpatient and inpatient data. Apart from this master dataset, I merged multiple excel files in Tableau to make more insightful visualisations.

Merging Process

Common Fields: The data sets were combined using common fields—hospital IDs, ICB codes, and specialty descriptions.

Validation: The datasets were validated for accuracy and coherence.

Principles of Good Visualisation Design

Clarity and Simplicity

Not Allowed to Clutter: The dashboards were designed in such a manner so as to not allow clutter. White space is effectively used to separate different sections.

Clear Titles and Labels: All charts and graphs have clear titles and labels that will allow the user to clearly understand the information being passed.

Effective Use of Colors

Color Coding: Colors were used consistently to differentiate different data points, like distinct specialties or age brackets.

Heat Maps: The density of hospitals in areas has been graphically represented through heat maps to make it easier to spot areas with greater availability of health service.

Interactivity

Filters, Drill-Downs, Sets and Parameters: Interactive elements, such as filters, drill-downs, sets and parameters were incorporated to let users dive deeper into the data in greater detail.

Tooltips—this would give the reader more information when hovering over a certain data point. **(Ohmann, 2015)**

Comparison and Trends

Side-by-Side Comparisons: Charts and graphs set beside each other, easily comparing metrics such as outpatient versus inpatient numbers.

Trend Lines: The time-series data was accompanied by trend lines indicating this change over time or long-term data, thereby making trends more apparent.

Accessibility

Font Sizes: These were big enough to ensure making data always readable.

Color Contrast: High contrast in color has been used, making the dashboards accessible to users with low vision.

Conclusion

The first dashboard shows, through inpatient and outpatient numbers, important insights into the dispersion of healthcare resources and volume of services provided across different regions and specialties. Seconde dashboard provide key equipment to healthcare managers and government officials in making informed decisions on resource allocation and policy-making for the UK's healthcare system. It enables stakeholders to identify areas of high demand by adopting a data-driven approach to the deployment of health professionals, equipment, and other resources. Armed with this information and the data displayed in an extremely user-friendly format, patients are better placed to decide where, depending on the urgency of their cases and specialized healthcare needs, they should be treated.

Ensuring adequate quality and reliability of the data by proper cleaning, preparation, and integration into Excel and Tableau makes it possible for the data to provide relevant and accurate insights. It applies good visualisation rules in clarity, effective colors, interactivity, and comparison, which makes it user-friendly and informative dashboards. All these act as strong pedestals in lifting the delivery of healthcare along with good care for the patients in the UK and attending to the increasingly important role of data analytics in the management of public health.

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