Context:

The National Health Service (NHS) in the UK provides a wide range of public healthcare services. With rising demand, the NHS is under pressure to optimize capacity, improve appointment attendance, and plan for future resource needs. One of its strategic priorities is to shift more care into the community by strengthening primary services and integrating health and care delivery[1].. This project analyzes NHS appointment data to uncover utilization trends, assess non-attendance patterns, and forecast future demand. The goal is to provide insights that support operational decision-making and guide strategic investments in workforce planning and service delivery.

Analytical approach:

This project supports the NHS in making informed decisions about whether to increase service capacity by analyzing historical appointment data and forecasting future trends. The analysis focused on identifying high-demand services, appointment trends, and indicators for future planning and resource allocation.

To conduct the analysis and extract actionable insights, Python libraries were used, such as **Pandas**, **NumPy**, **Seaborn**, **Prophet**, and **Matplotlib**. Firstly, the datasets were imported into Python using the Pandas function. read_csv(), followed by exploring each dataset's structure and descriptive statistics using the .info() and .describe() functions. These helped assess data types, central tendencies (mean and median), and the overall distribution of the data. To evaluate data quality, the isnull() function was used to check for missing values and confirmed that the datasets were complete, allowing for a smooth analysis process.

To prepare the data for analysis and visualization, the datasets were aggregated and cleaned using various Pandas functions. For example, pandas.merge() is used to combine relevant columns from the actual_duration and appointments_regional datasets, enabling the calculation of average attendance and comparison across categories.

Date fields, such as appointment_date, were converted to datetime format to facilitate time-based analysis and forecasting. Additionally, new features were engineered to support key insights. For instance, the region column was added in the actual_duration dataset by mapping region_ons_code values to their respective region names using the apply() function. This allowed for the analysis of geographic variations in appointment volume to be done more effectively.

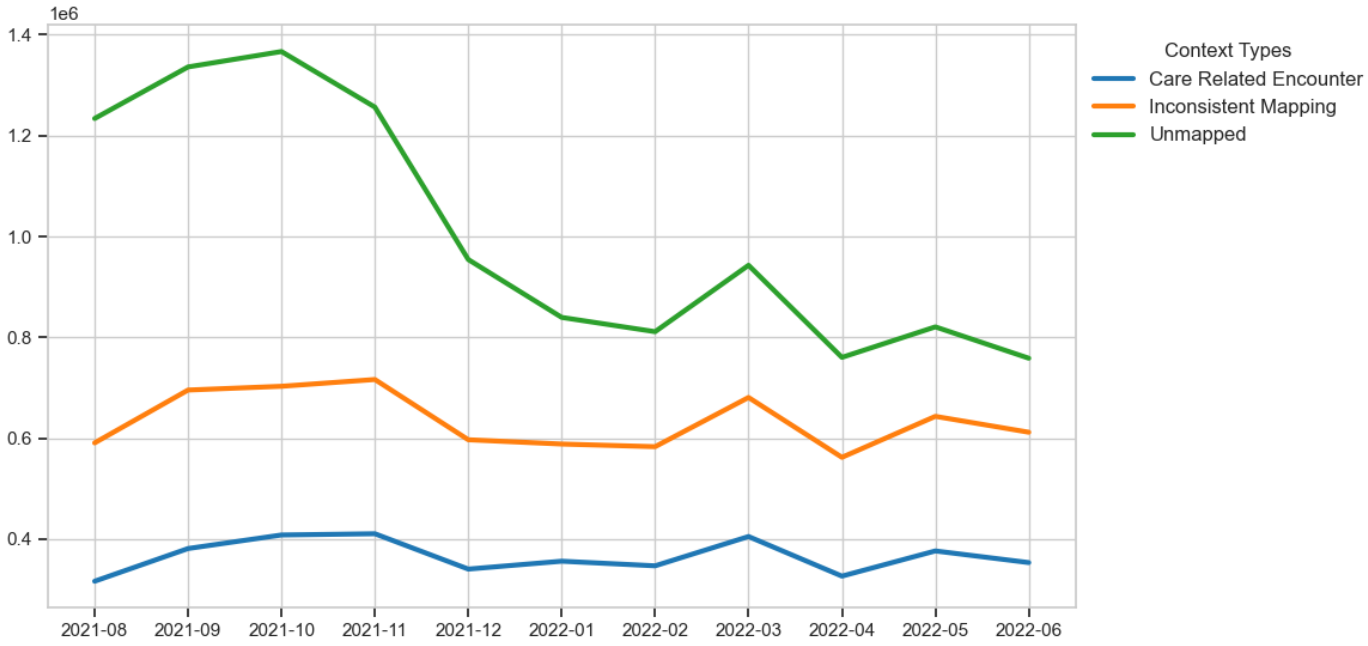
[1] Source: Lancashire and South Cumbria ICB – Our Vision and Priorities

Visualizations and Insights:

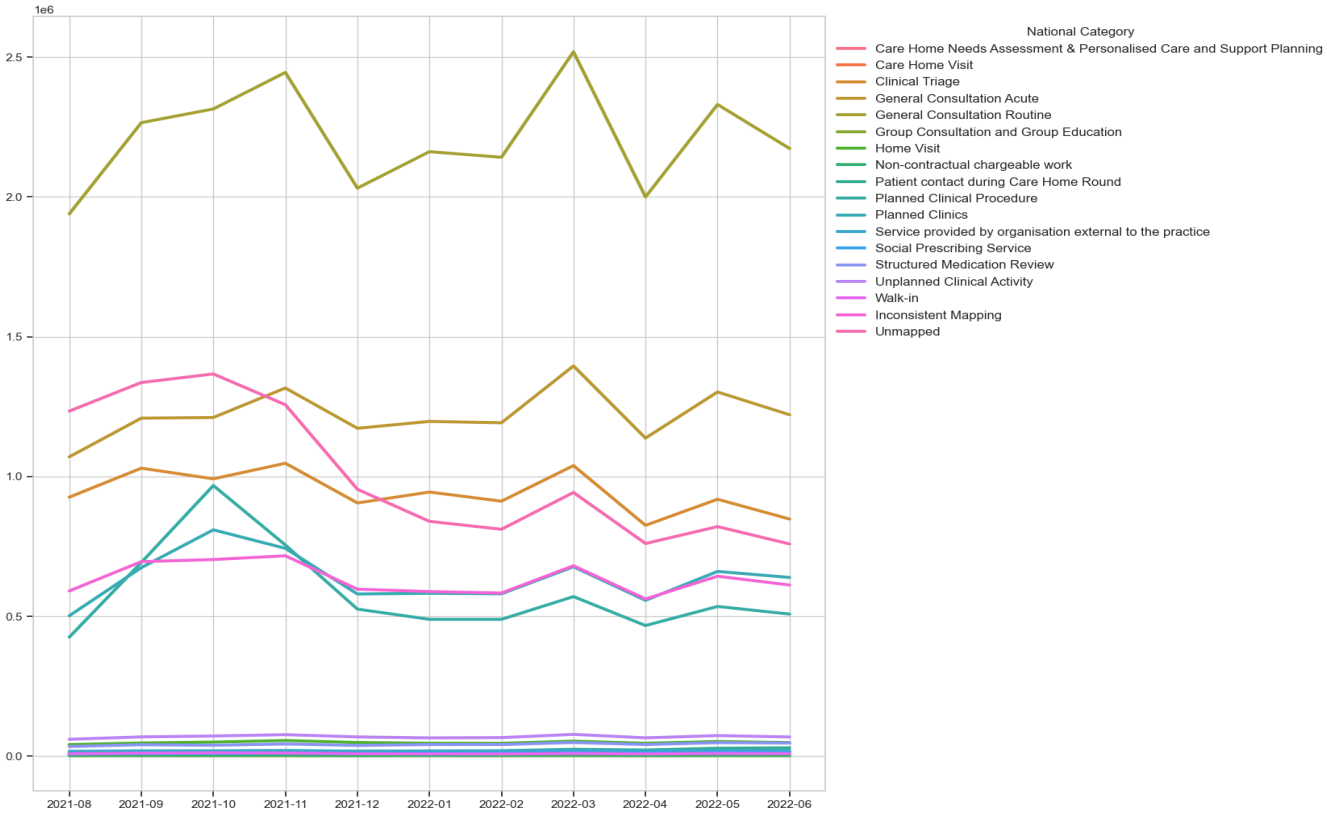
The Seaborn and Matplotlib libraries were used throughout the project to create clear and informative visualizations. These charts were essential for identifying trends, uncovering patterns, and supporting data-driven decisions aligned with NHS planning objectives.
Visual analysis focused on monthly and seasonal appointment volumes, attendance behavior, healthcare professional utilization, and regional differences. These insights help inform service delivery strategies, capacity planning, and efforts to shift more care toward community-based services, one of the NHS's strategic priorities.

- *Monthly Appointment Trends by Context Type, National Category, and Service Setting*

  NHS appointment data shows 'Inconsistent Mapping' and 'Unmapped' as the dominant context types. This highlights an issue with data quality. In contrast, 'Care Related Encounter' remains stable across the reporting period.



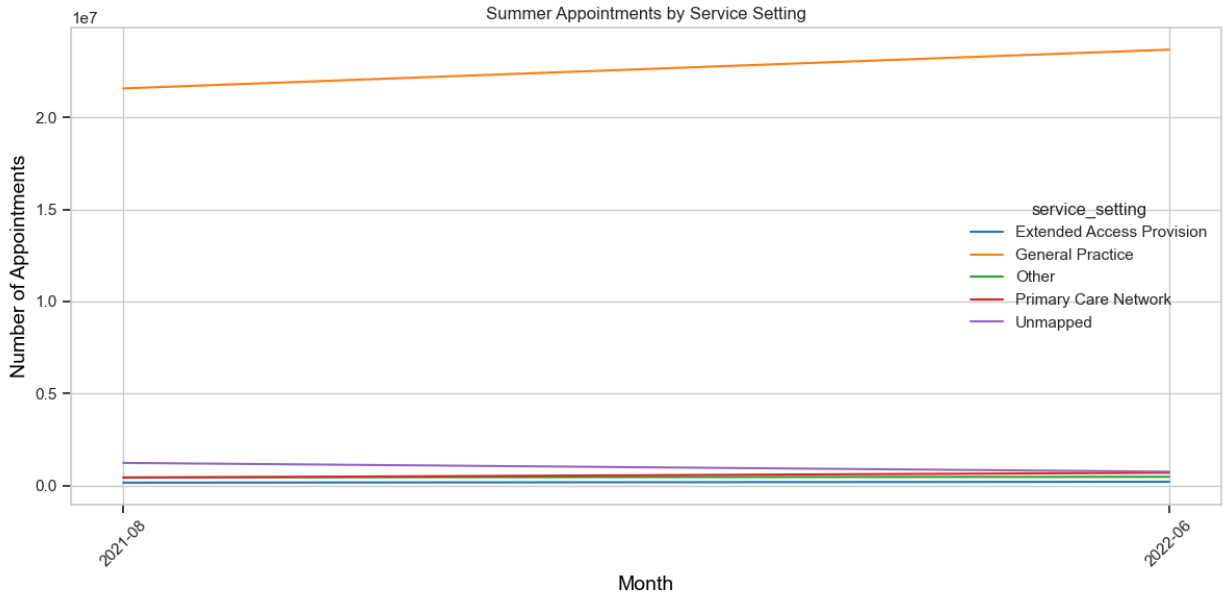
- In terms of **national categories**, *"General Consultation Routine"* consistently records the highest volume of appointments, indicating a strong and ongoing demand for routine care.

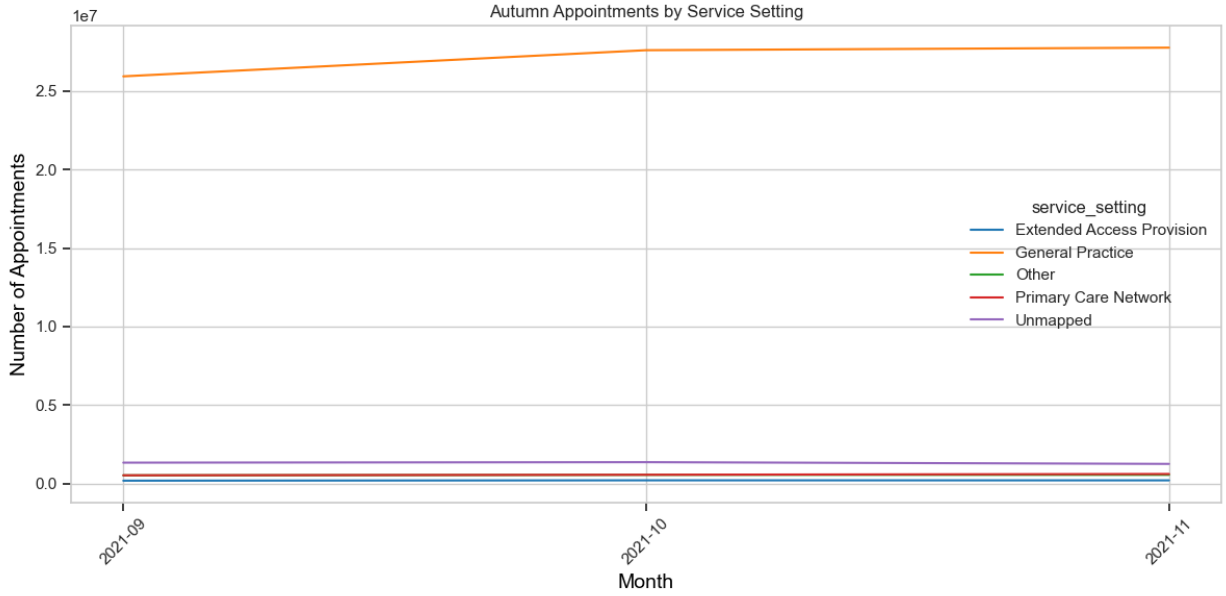


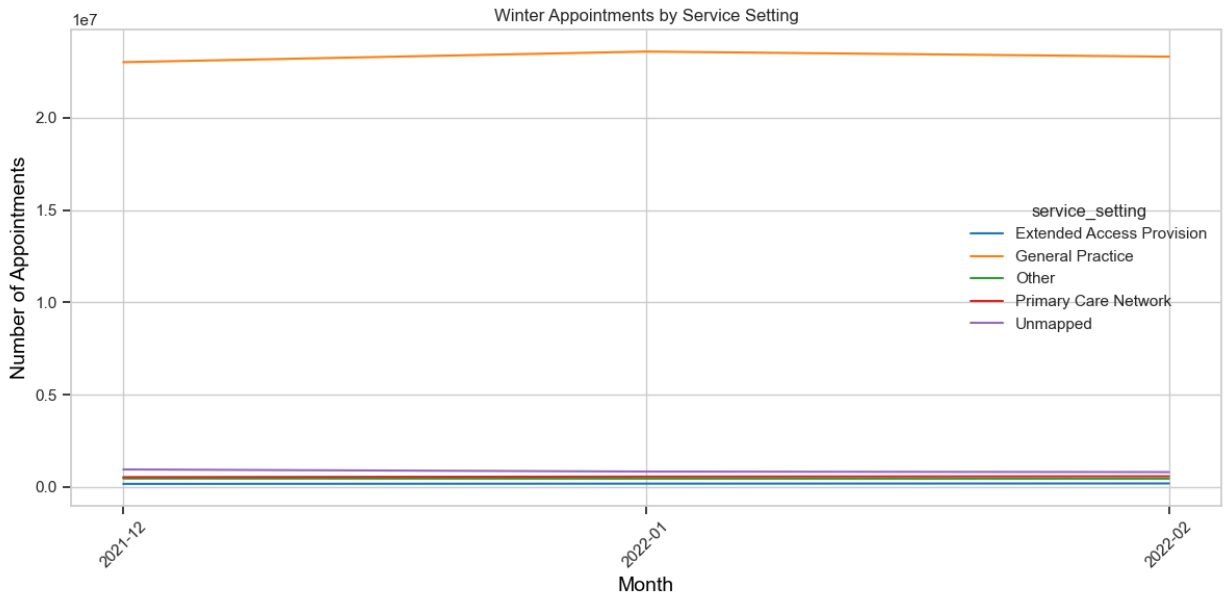
- For **service settings**, *"General Practice"* clearly stands out with the highest appointment volume across all months, reinforcing its role as the primary access point within the NHS healthcare delivery model.

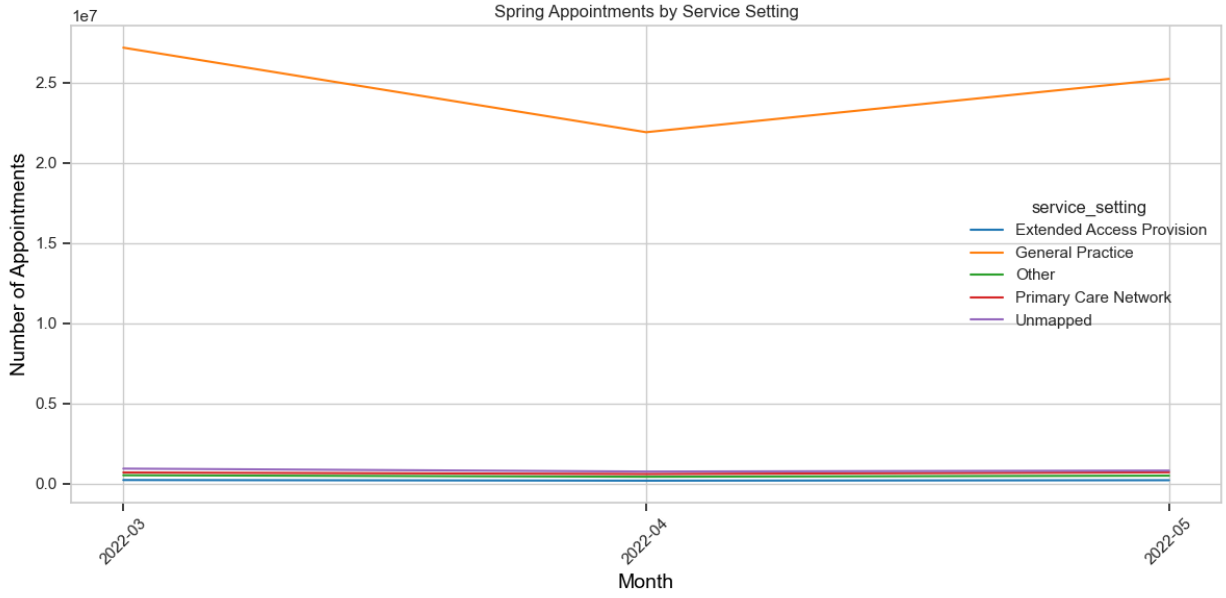
- *Seasonal Appointment Trends*

Across all seasons, **General Practice** consistently has the highest appointment volume. Peaks are observed in **autumn** and **spring**, indicating increased demand during these periods. Other settings remain stable, while **Unmapped** services highlight areas for improving data qualitåy.



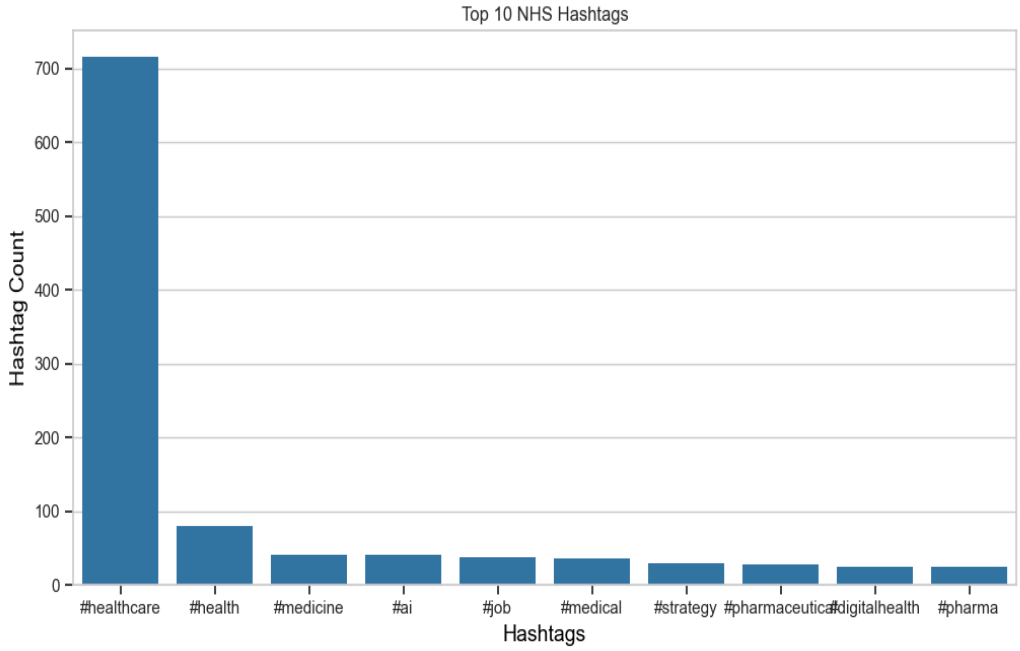



Winter Appointments by Service Setting
1e7
2.0
1.5
1.0
0.5
0.0
Number of Appointments
service_setting
Extended Access Provision
General Practice
Other
Primary Care Network
Unmapped
2021-12
2022-01
2022-02
Month


Spring Appointments by Service Setting
1e7
2.5
2.0
1.5
1.0
0.5
0.0
Number of Appointments
service_setting
Extended Access Provision
General Practice
Other
Primary Care Network
Unmapped
2022-03
2022-04
2022-05
Month

Twitter Insights: Hashtag Usage and Engagement

Analysis of NHS-related tweets shows that **#healthcare**, **#health**, and **#medicine** are the most frequently used hashtags. Meanwhile, **#tipsfornewdocs**, **#medical**, and **#medtwitter** generate the highest engagement through retweets. Hashtags like **#healthtech**, **#datascience**, and **#bigdata** appear across both categories, highlighting growing interest in digital transformation.



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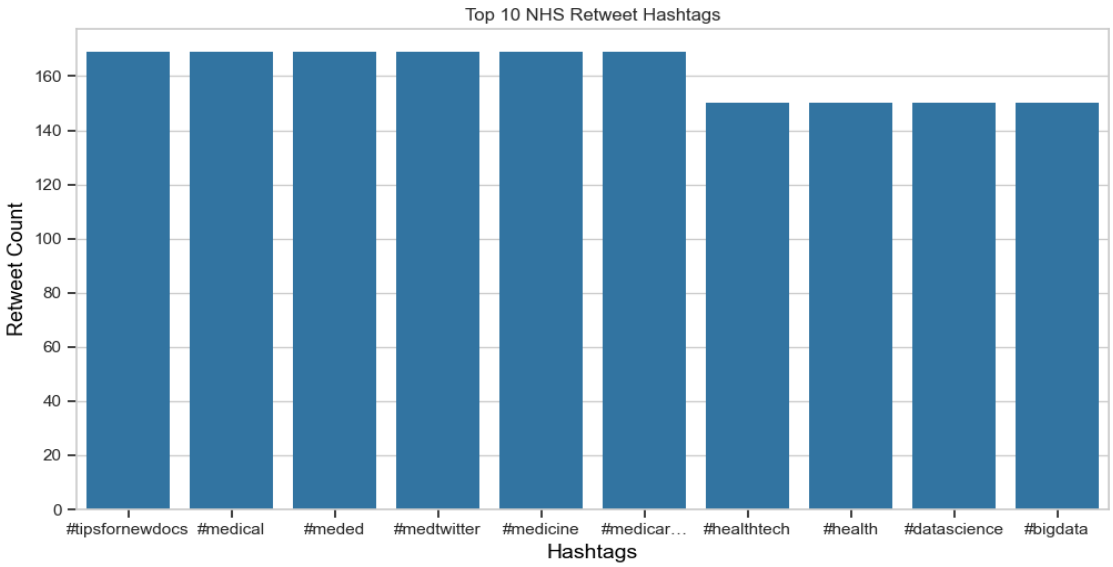
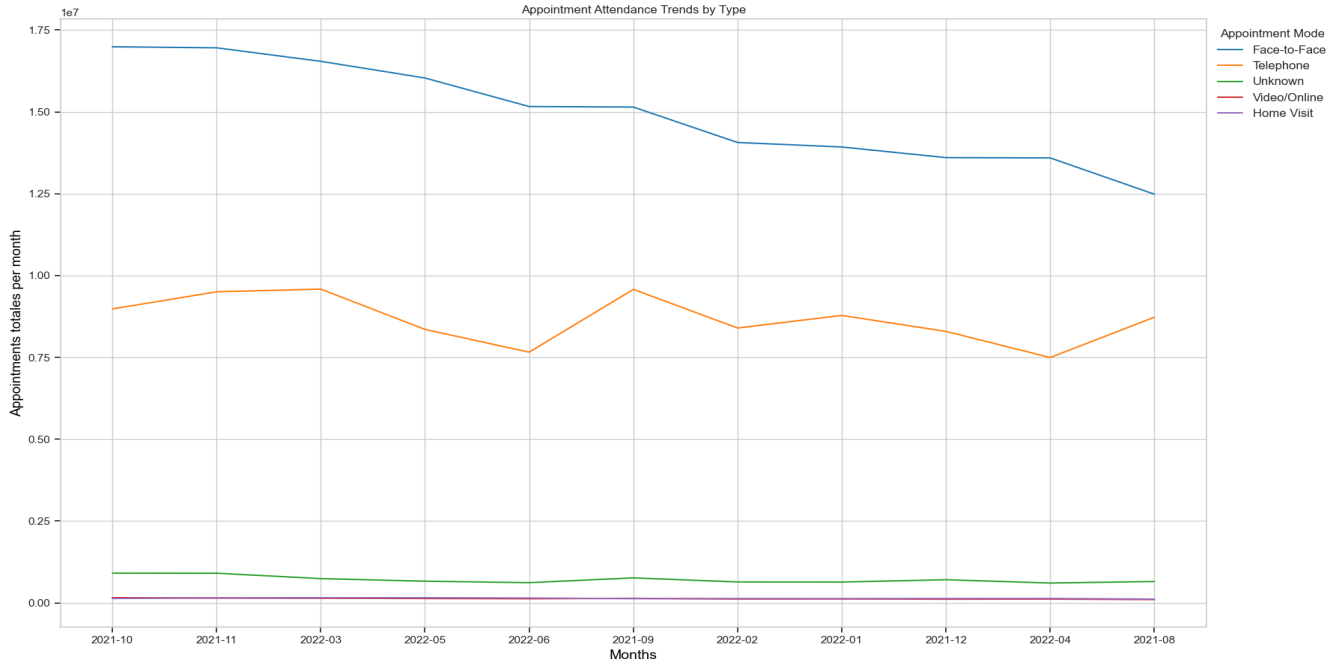

Top 10 NHS Retweet Hashtags
Retweet Count
0
20
40
60
80
100
120
140
160
#tipsfornewdocs
#medical
#meded
#medtwitter
#medicine
#medicar…
#healthtech
#health
#datascience
#bigdata
Hashtags

Patterns and Predictions

Shifting Trends in Appointment Modes

The chart indicates that face-to-face appointments remain the most common, but they are gradually declining. Telephone consultations rank second and fluctuate in response to demand. This trend supports the NHS's shift toward remote care, indicating growing public acceptance and readiness for digital service delivery, which is valuable for future planning.

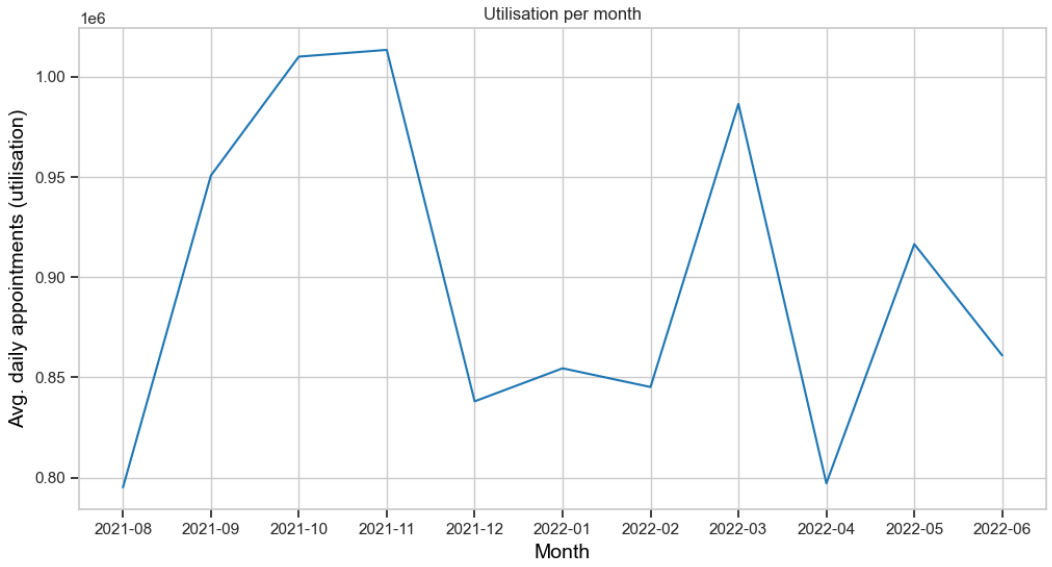


Timeliness of Care: Monthly Trends in Appointment Waiting Times

NHS appointment data shows most patients are seen on the same day. However, a significant number of experiences have delays of 2–14 days or over 28 days, which may affect access and outcomes. Targeted interventions are needed to reduce these wait times.

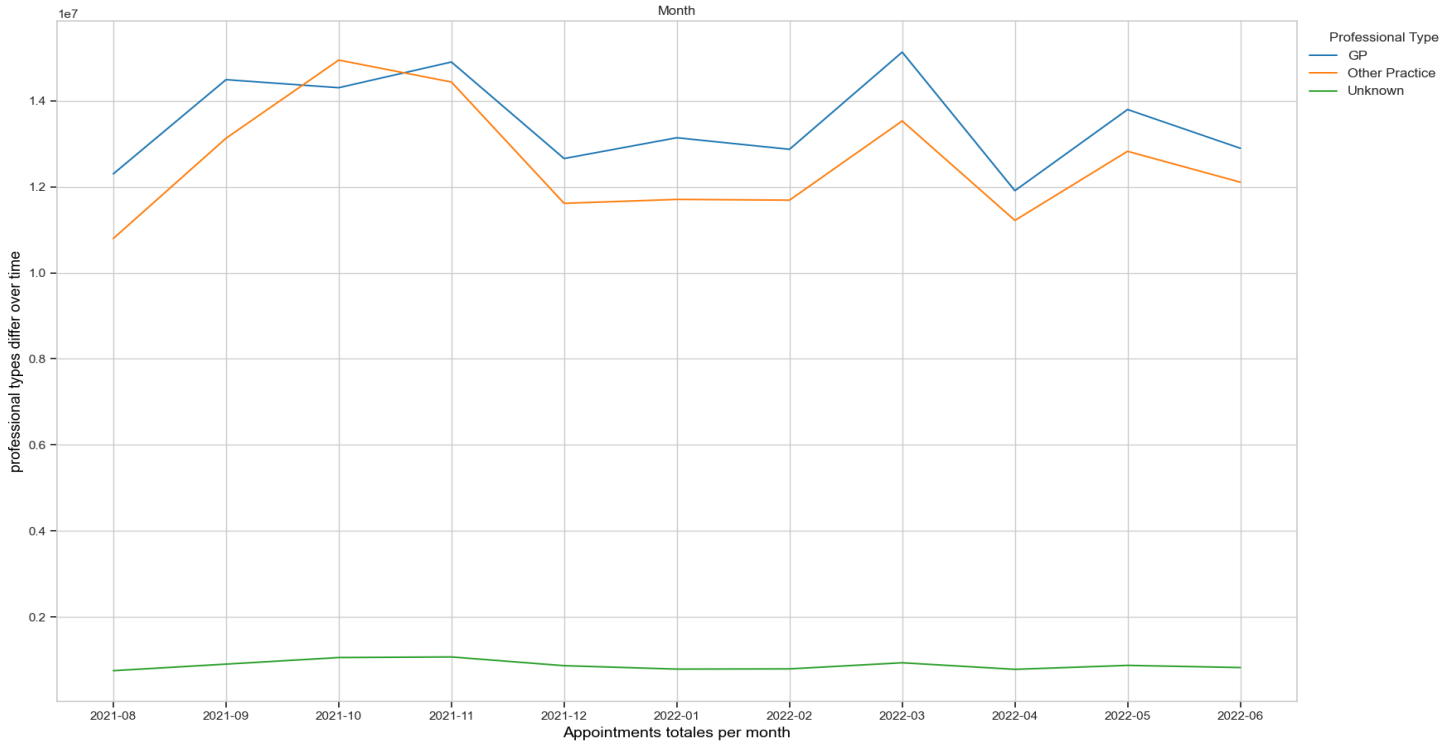
Monthly Utilization Trends in NHS Appointments

The chart shows average daily appointments peak in October and March, with a sharp drop in April 2022—likely due to seasonal factors, capacity limits, or data gaps. These fluctuations are essential for forecasting and effective resource planning.



Professional Types Over Time

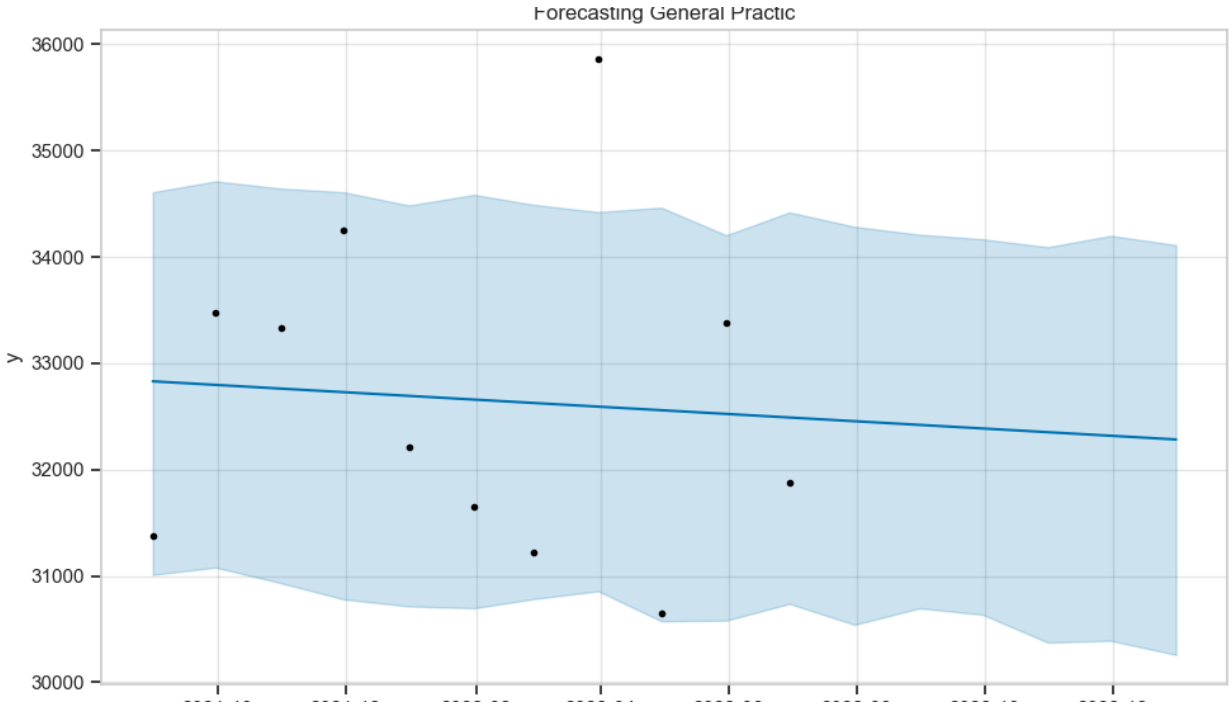
This chart shows that GPs consistently handle the most appointments, highlighting their central role in NHS service delivery.



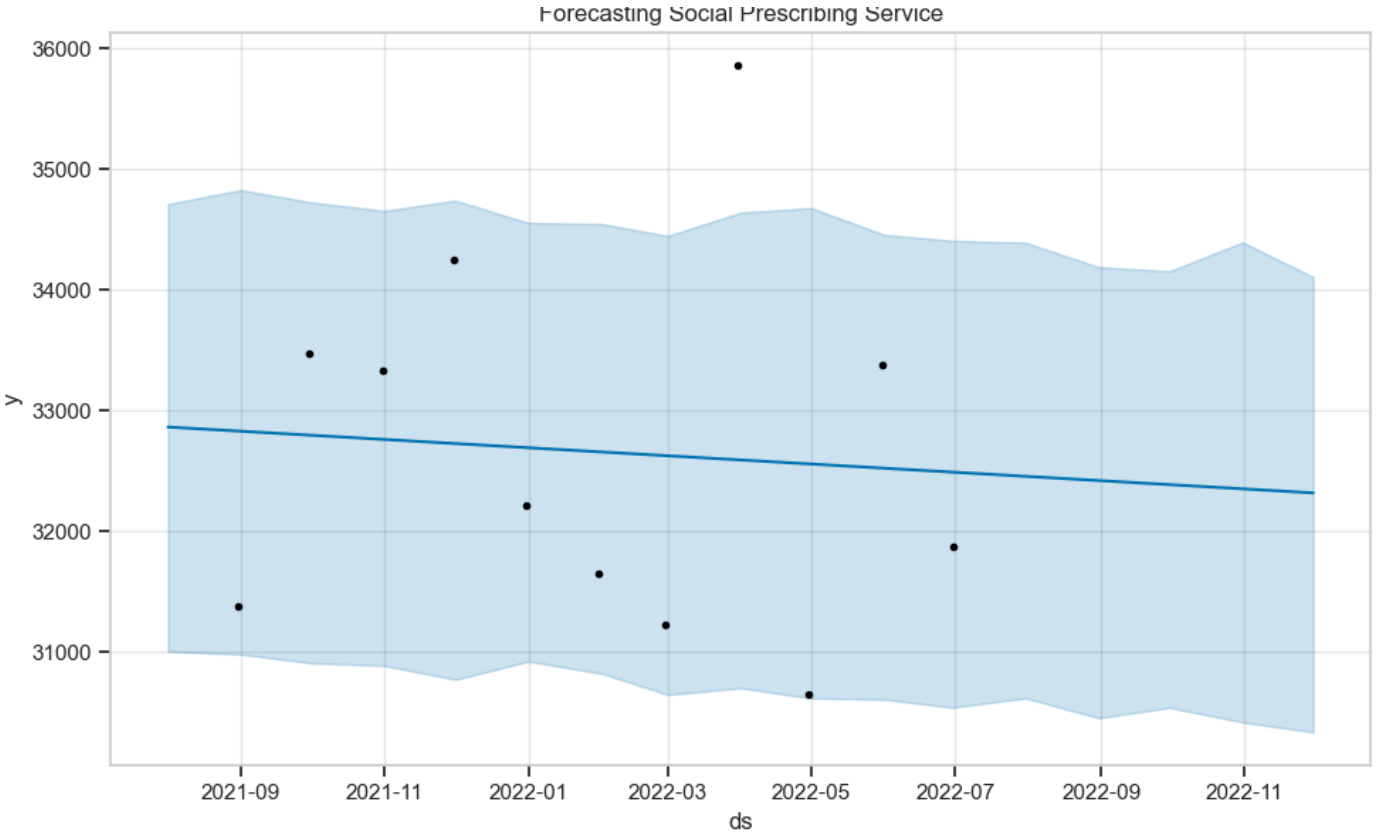
Forecasting GP Appointments: Anticipating Future Demand

To support NHS workforce planning and community care objectives, Prophet forecasting was applied to General Practice (GP) and Social Prescribing Services. GP was selected due to consistently high appointment volumes; Social Prescribing aligns with NHS goals of preventative, non-clinical care. The GP forecast shows a slight decline, indicating the need for proactive capacity planning. Social Prescribing shows a modest decrease, with wide uncertainty, suggesting limited uptake despite policy ambitions.

General Practice Forecasting



Social Prescribing Services



Conclusion

This analysis of NHS appointment data confirms the dominance of General Practice, seasonal demand peaks, and a shift toward remote care. While same-day appointments are common, delays exceeding two weeks persist for many patients. Attendance remains low at 38%, with non-attendance reaching 11% in some areas. Forecasts show a slight decline in GP demand and limited uptake of Social Prescribing, despite NHS goals to expand community-based care. These trends highlight key pressure points and changing patterns in service use.