NHS Staffing and Resource Utilization Analysis for Network Operations

Background/context of the business scenario:

Our team is conducting research to identify trends that can help reduce avoidable costs of missed general practitioner appointments in the England National Health Services (NHS).

To ensure data-driven solutions, we are analyzing historical data about all appointments at general practitioner (GP) surgeries across the country, gathered from the integrated care board (ICB), a statutory NHS organization responsible for healthcare and budget management in specific regions of England. Currently, we are focusing on two key questions posed by the NHS: whether there is enough staff and capacity in the networks, and what the actual utilization of resources looks like.

Analytical approach

➢ Import and explore the data

Using Python and Pandas, we analyzed three datasets with valuable information about medical practices, appointment dates, and appointment counts. The datasets were checked for missing values and successfully imported.

The ‘actual_duration’ dataset groups appointments by duration range, while the ‘appointment_regional’ dataset provides additional appointment details such as mode, healthcare professional type, and attendance status.

However, the ‘national_category’ dataset is the most comprehensive, containing the largest range of dates from August 2021 to June 2022 with the most records. Therefore, we will focus on analyzing this dataset in more depth.

Across all sites, there are 106 locations, with Figure 1.1 highlighting the top five sites with the highest number of appointments.

Top 5 locations for the number of appointments:

Location name	Total count of appointments
NHS North West London ICB - W2U3Z	12142390
NHS North East London ICB - A3A8R	9588891
NHS Kent and Medway ICB - 91Q	9286167
NHS Hampshire and Isle Of Wight ICB - D9Y0V	8288102
NHS South East London ICB - 72Q	7850170

Figure 1.1

In order to identify patterns within the dataset, we will delve into the location with the highest number of records, during the most recent period from January to June 2022. Our analysis of the service setting column reveals that General Practice holds the maximum number of appointments, accounting for 86.47% of the total appointments (refer to fig. 1.2).

Most popular service setting for NHS North West London from 1 January to 1 June 2022

Service setting	Total count of appointments
General Practice	4804239
Unmapped	391106
Other	152897
Primary Care Network	109840
Extended Access Provision	98159

Figure 1.2

Analyzing the busiest month of the year can offer valuable insights into the utilization of NHS resources. Upon delving deeper into the data, it was revealed that November, October, and March have the highest number of appointments (as shown in Fig. 1.3).

Number of appointments per month

Month	Count of appointments
November	30405070
October	30303834
March	29595038
September	28522501
May	27495508
June	25828078
January	25635474
February	25355260
December	25140776
April	23913060
August	23852171

Figure 1.3

Visualisation and insights

During this phase, we are utilizing the Seaborn and Matplotlib libraries to create visualizations and plots that assist in analyzing the trends discovered in the exploratory phase. Our analysis indicates that General Practice had the most appointments, but interpreting it accurately is difficult due to the significant difference in the number of appointments from the other service settings (as shown in Fig. 2.1). To gain a clearer understanding, we excluded 'Unmapped' and isolated other services (as seen in Fig. 2.2). The data reveals that General Practice experienced a spike in appointments during October, November, and March, without any growth over time. On the other hand, Extended Access Provision and Primary Care Networks display a rising trend, with noticeable peaks in November, March, and May.

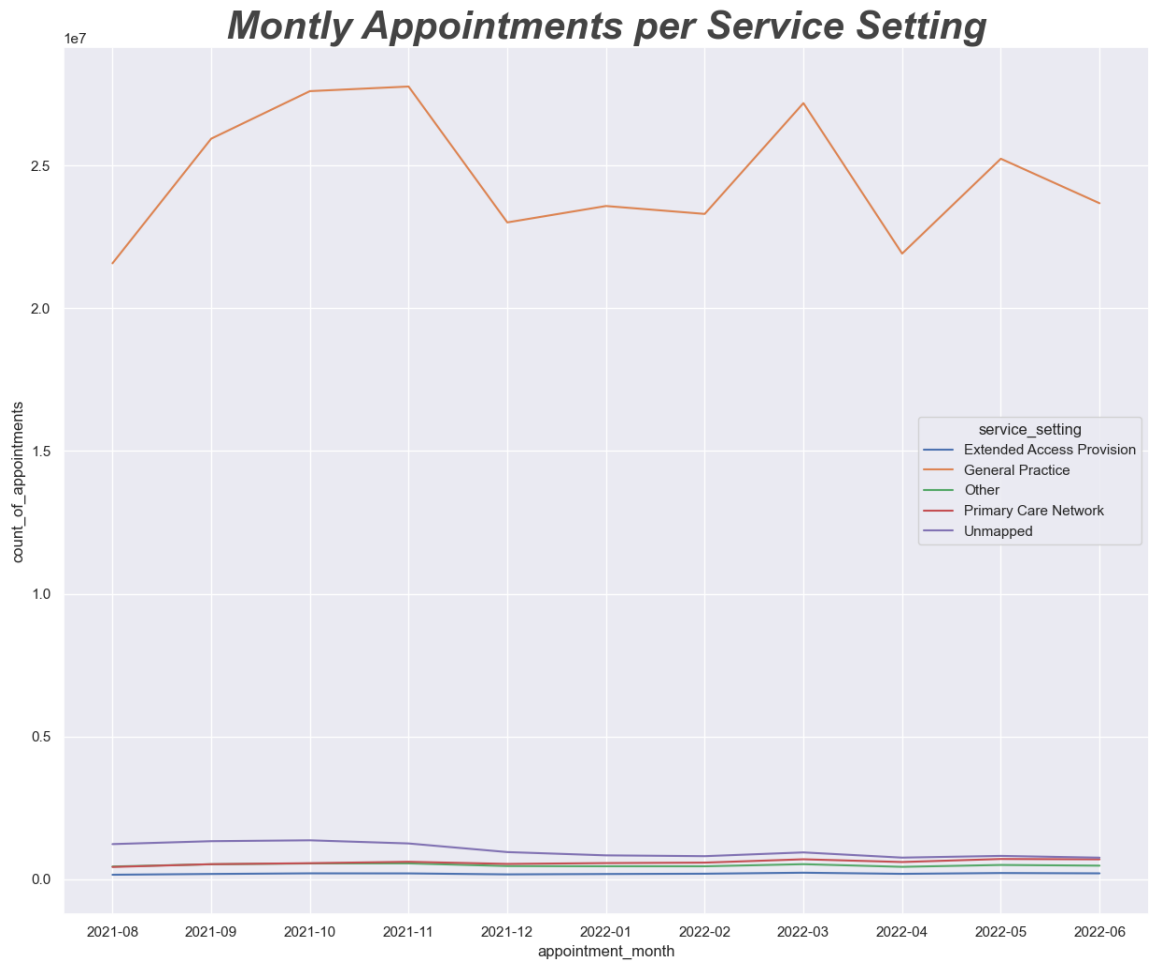
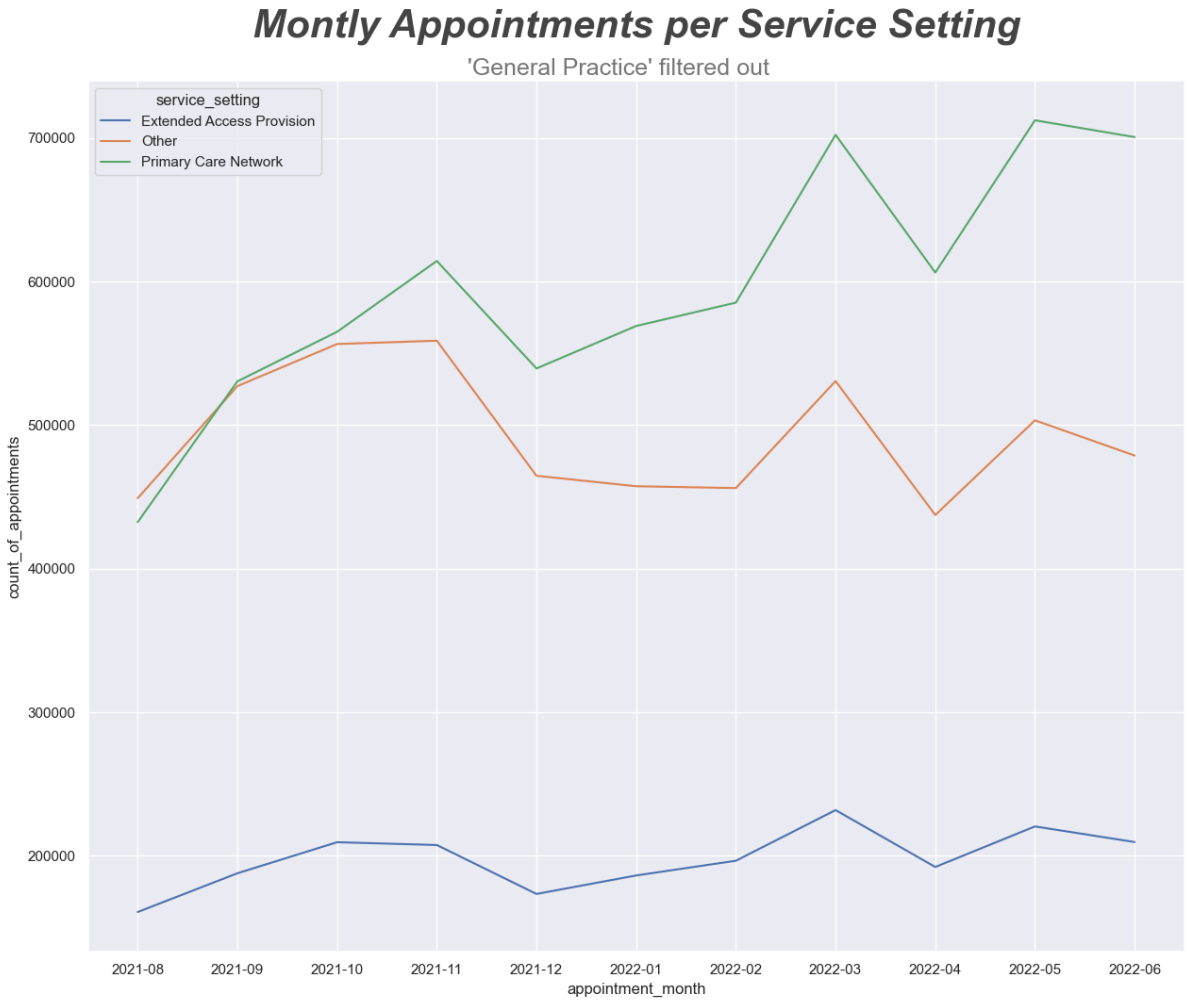


Figure 2.1



Our investigation has shifted towards exploring national appointment categories. Due to the abundance of categories, we have chosen to focus on the one with over 200,000 appointments. In Figure 2.3, we can observe that general consultation routines are the most sought-after, followed by general consultation acute and clinical triage. The category with the most prominent surge in October is planned clinical procedures, while all categories experience a peak in November, March and May.

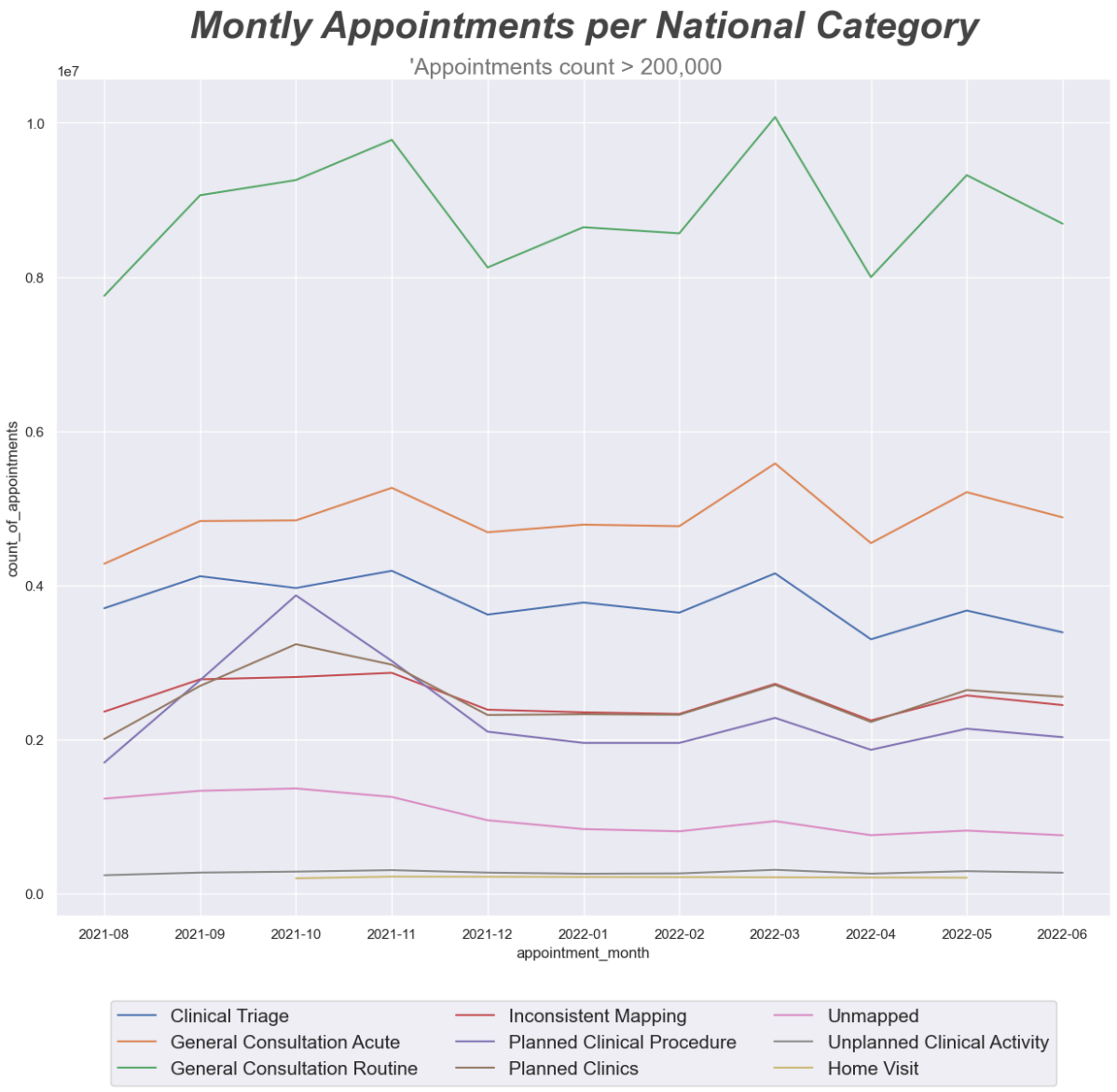

Montly Appointments per National Category
'Appointments count > 200,000
1e7
1.0
0.8
0.6
0.4
0.2
0.0
count_of_appointments
2021-08
2021-09
2021-10
2021-11
2021-12
2022-01
2022-02
2022-03
2022-04
2022-05
2022-06
appointment_month
Clinical Triage
General Consultation Acute
General Consultation Routine
Inconsistent Mapping
Planned Clinical Procedure
Planned Clinics
Unmapped
Unplanned Clinical Activity
Home Visit

Figure 2.3

➢ Analyse the Twitter data

Within the last csv file, there are tweets from anonymous users discussing National Health Care. The objective is to identify hashtags within the raw data and determine the most popular ones. Additional external data can provide valuable context and insights for analysis. By incorporating Twitter data, NHS can gain a more comprehensive understanding of their patients.

To extract all words with hashtags from the raw tweet text, a for loop was utilized in Python. The words were then stored in a pandas series and sorted by their count, revealing the most frequently tweeted hashtags regarding the NHS on social media. Not surprisingly, #healthcare was at the top of the list. The social media managers at NHS can look at the list in Figure 3 of the most frequently used hashtags and incorporate them into their posts to increase visibility.

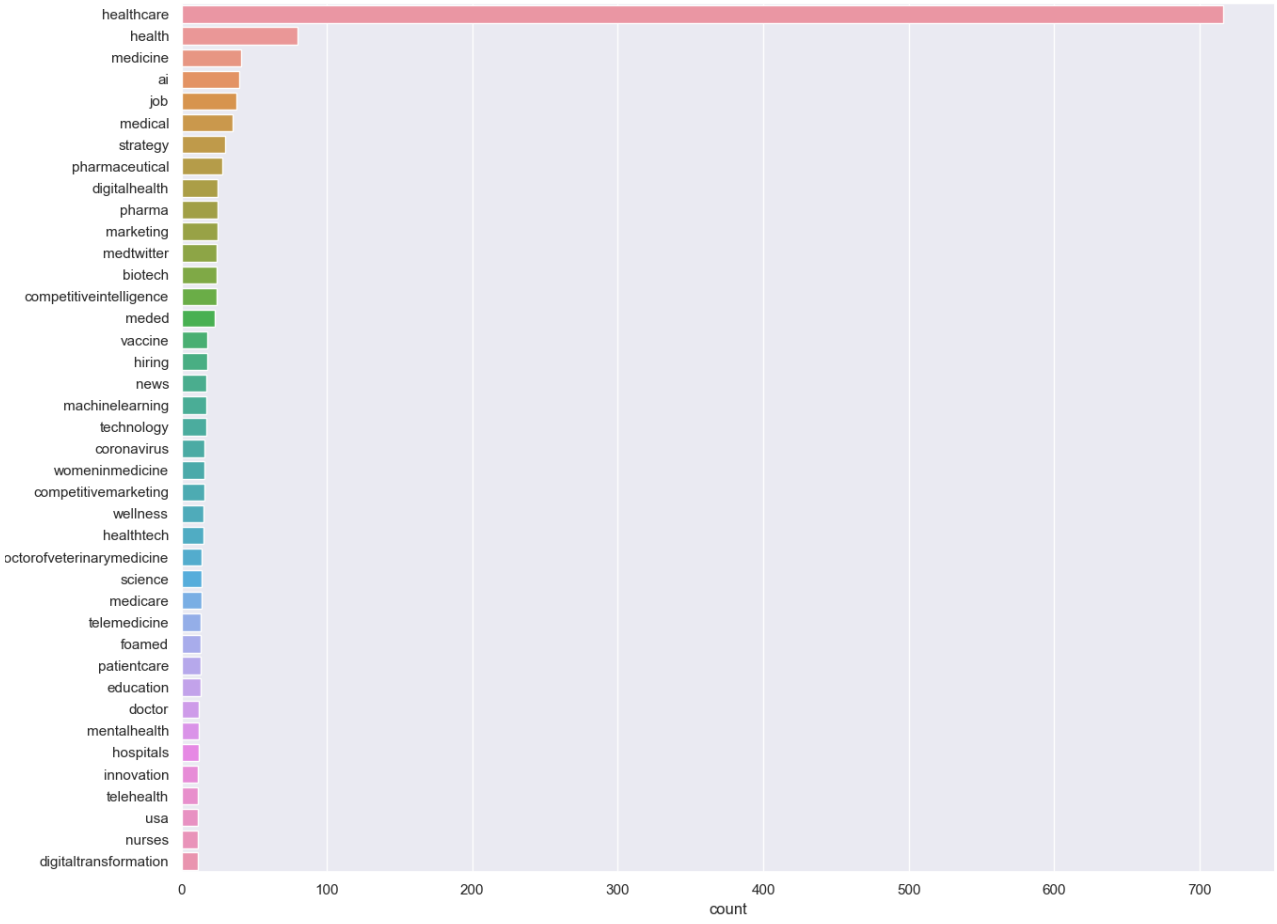


Figure 3

Make recommendations

Let's start by addressing whether the networks had enough staff and resources. The NHS can handle up to 1,200,000 appointments daily. However, upon analyzing Figure 4.1, it's evident that this limit is exceeded every day of the week, except weekends, during the busiest month, November. Even in the least busy month, August, as shown in Figure 4.2, the limit is surpassed every Monday. Thus, it's clear that the maximum capacity needs improvement. Encouraging the distribution of appointments throughout the week can be accomplished through incentivizing policies.

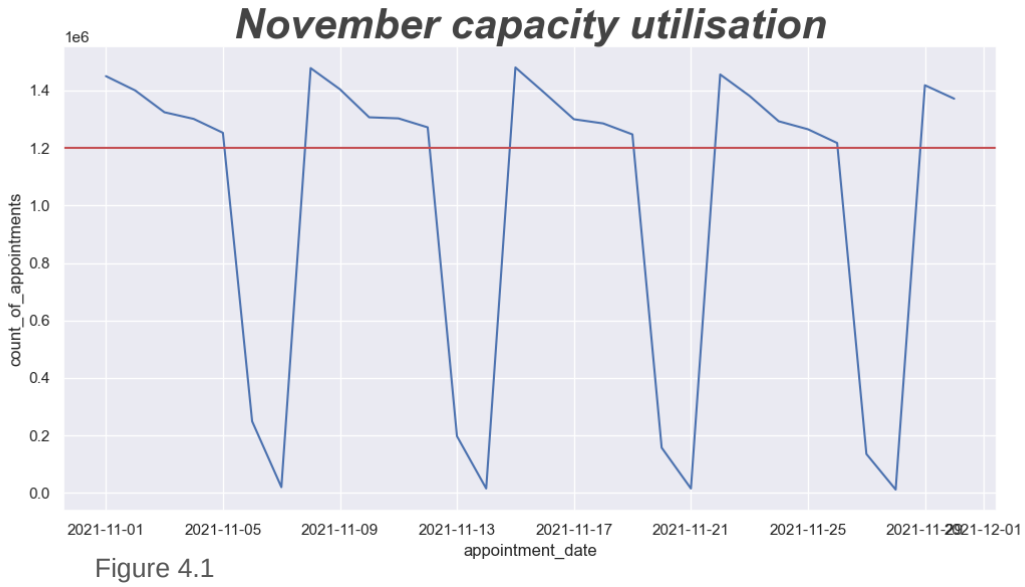


Figure 4.1

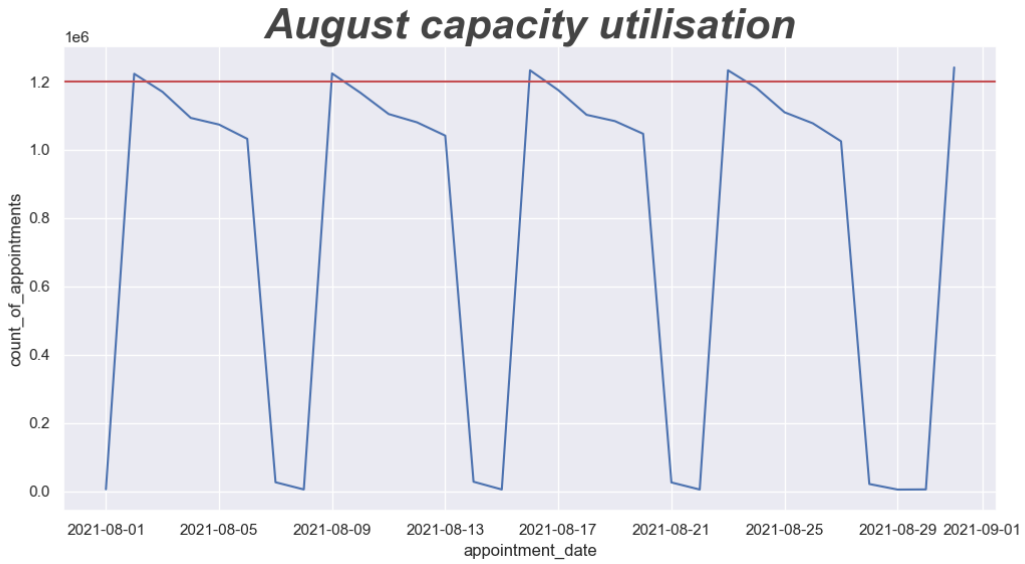


Figure 4.2

By analyzing the data on healthcare professional types, we can assess the utilization of resources. Our findings reveal that general practitioners have more total appointments than all other staff practitioners combined. A shift in appointment volume occurs in October, as depicted in Figure 4.3. In Figure 4.4, we make an intriguing observation regarding appointment attendance. Notably, when the healthcare professional is not a general practitioner, the rate of missed appointments is considerably higher at 6.88%, compared to the 2.64% rate for GPs. Further investigation can be done to decrease the rate of missed appointments.

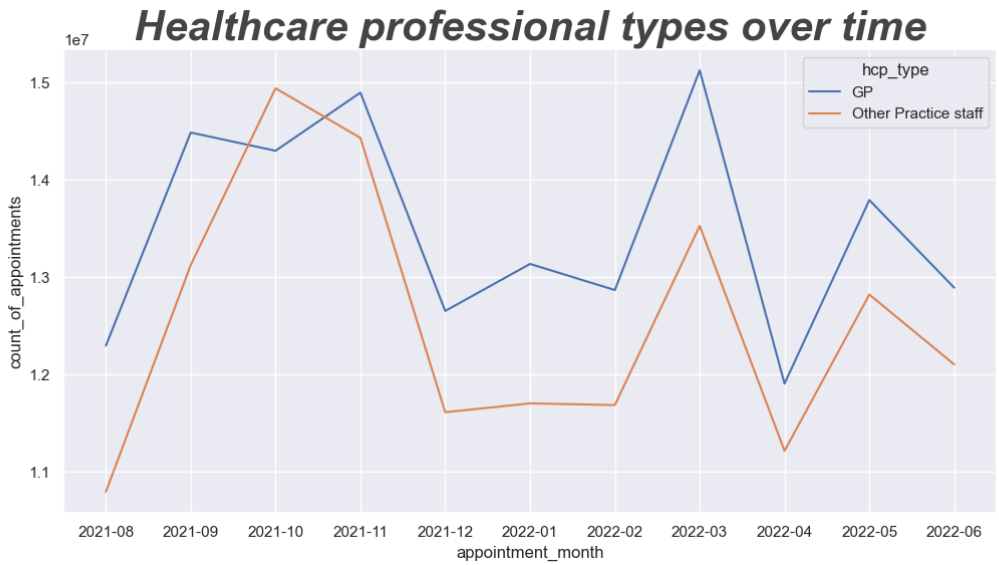


Figure 4.3

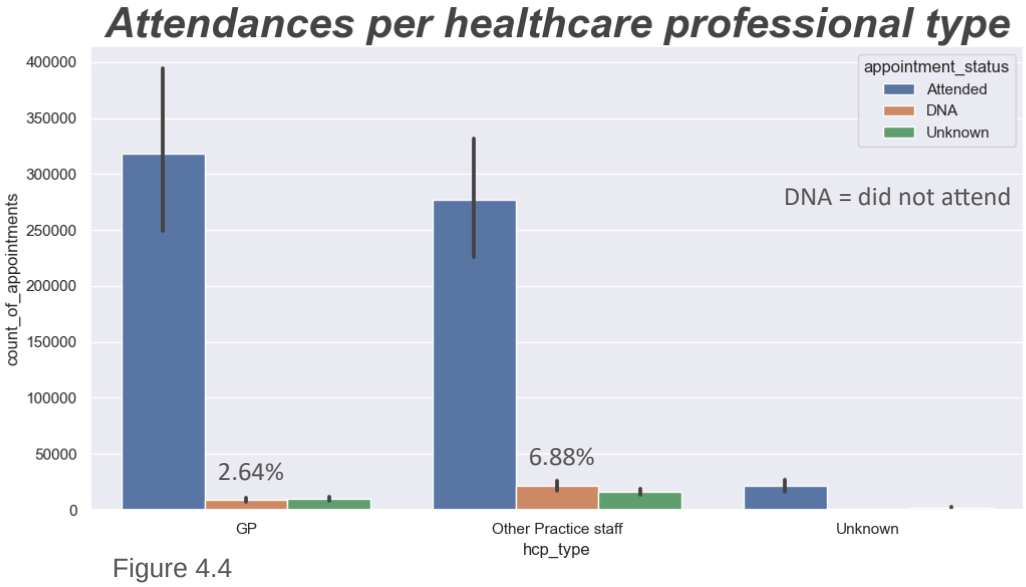


Figure 4.4

Figure 4.5 reveals an intriguing pattern: face-to-face appointments fluctuate depending on the busiest month, whereas telephone appointments remain constant all year round, indicating their reliability as a valuable tool that can be enhanced.

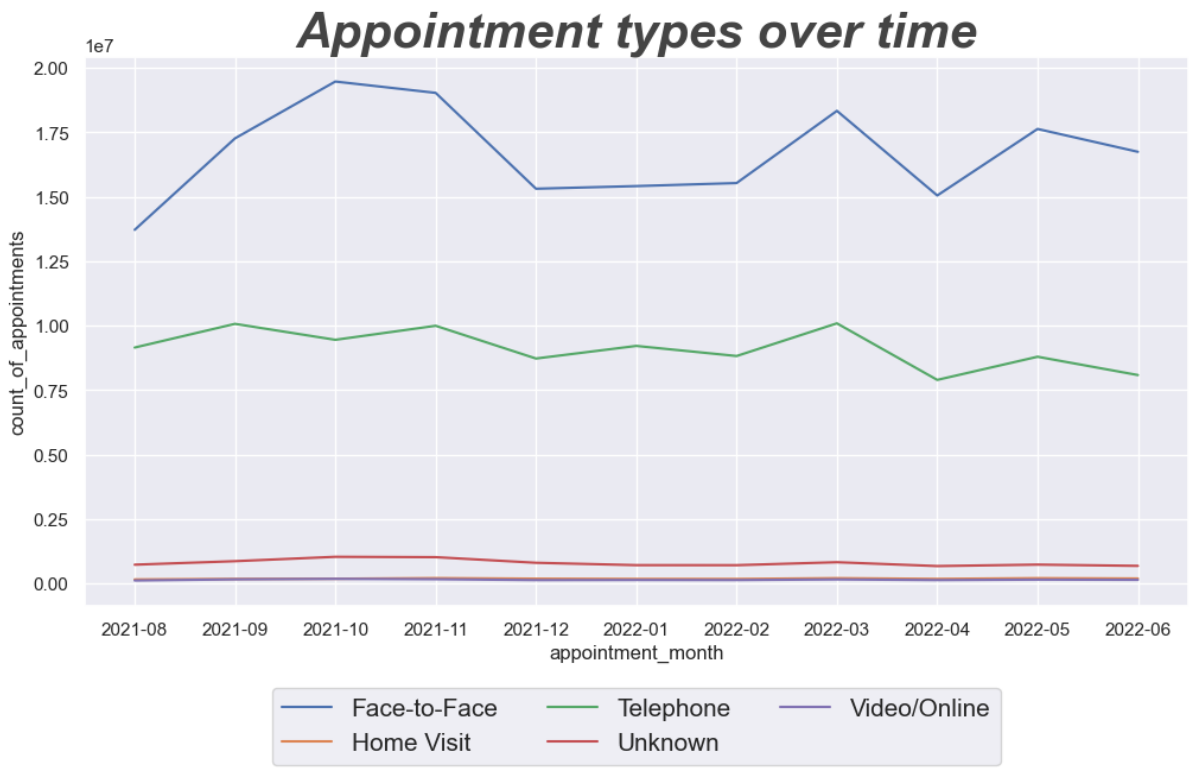


Figure 4.5

According to Figure 4.6, most appointments are booked for the same day, implying that the system is efficient and there are no significant waits from booking to visit.

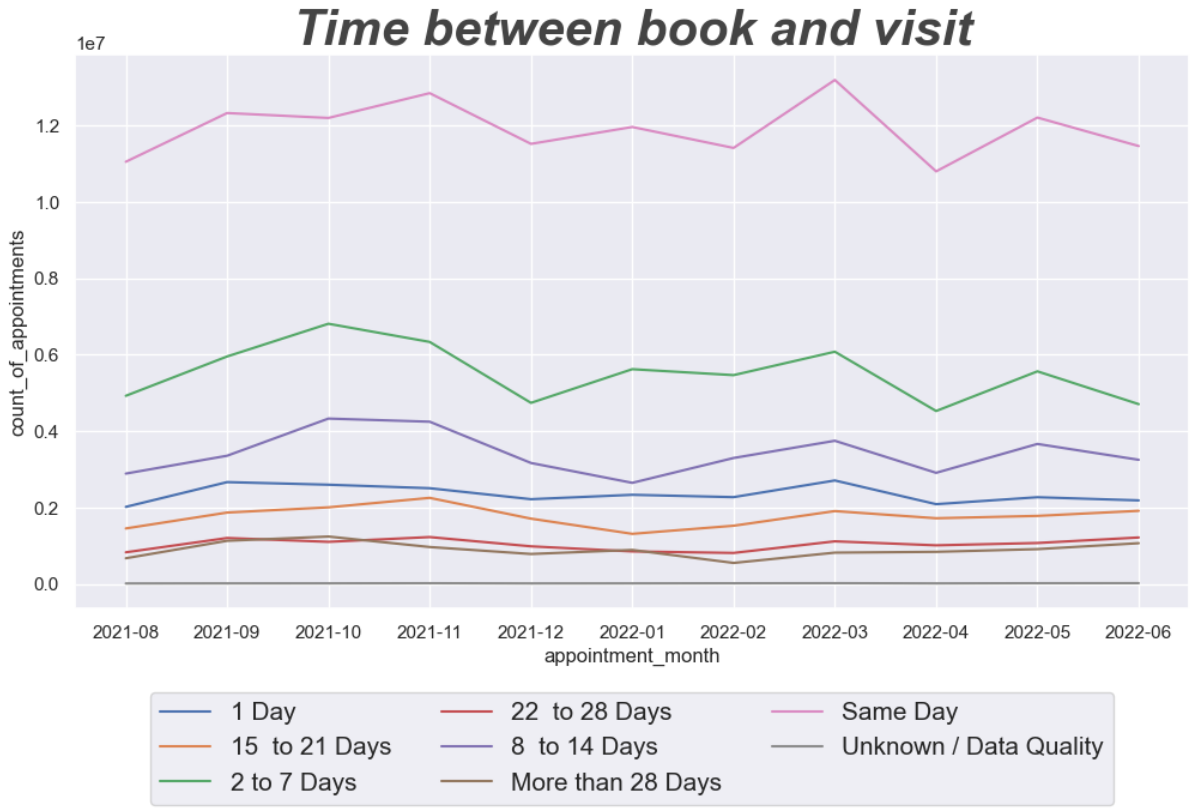


Figure 4.6

In addition, according to Plot 4.7, there is a consistent number of appointments booked on the same day during busy months in winter. This helps to prevent any disruptions during the busy period.

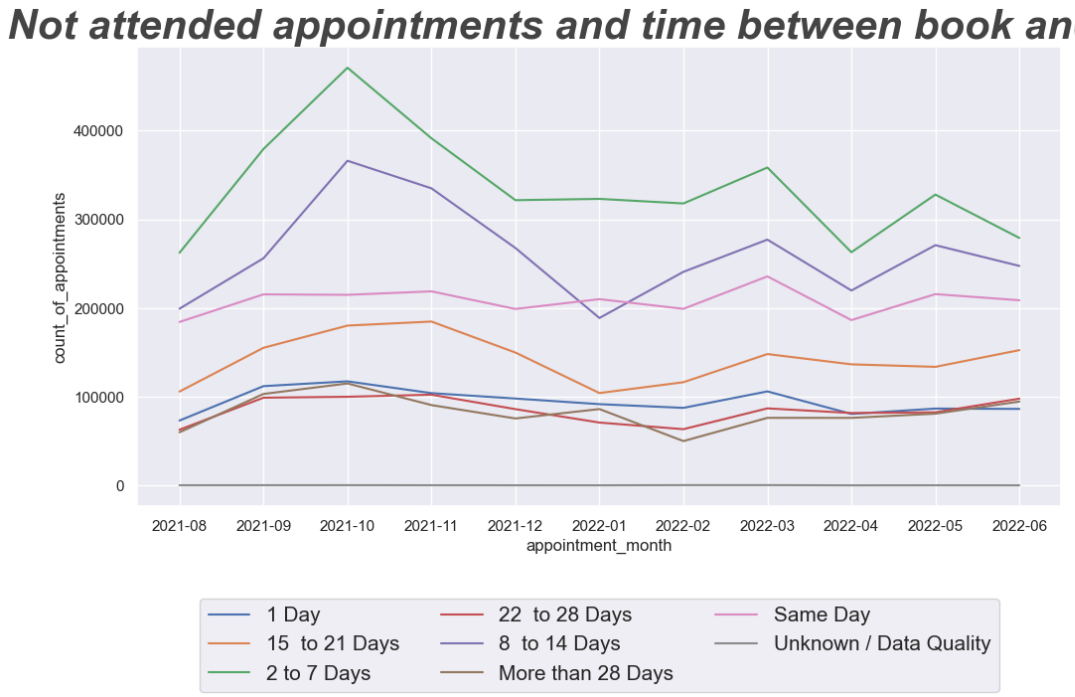


Figure 4.7

Based on our observations, General Practice appears to be the busiest service setting. To improve the overall network and provide better service, it would be helpful to find ways to lessen their workload (as shown in Fig 4.8). One possible solution could be avoiding scheduling planned clinic procedures during the peak month of October (as indicated in Fig 2.3).

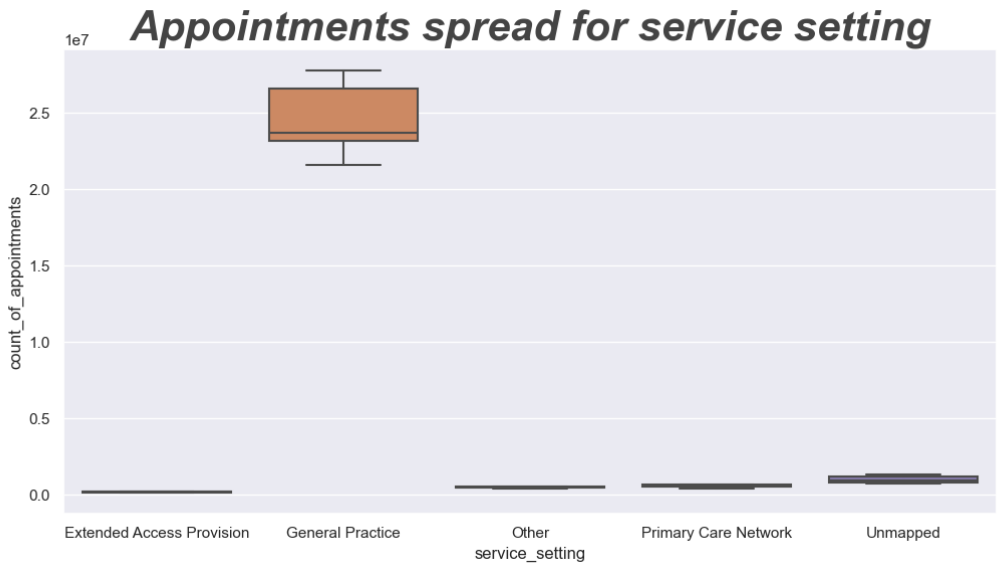


Figure 4.8

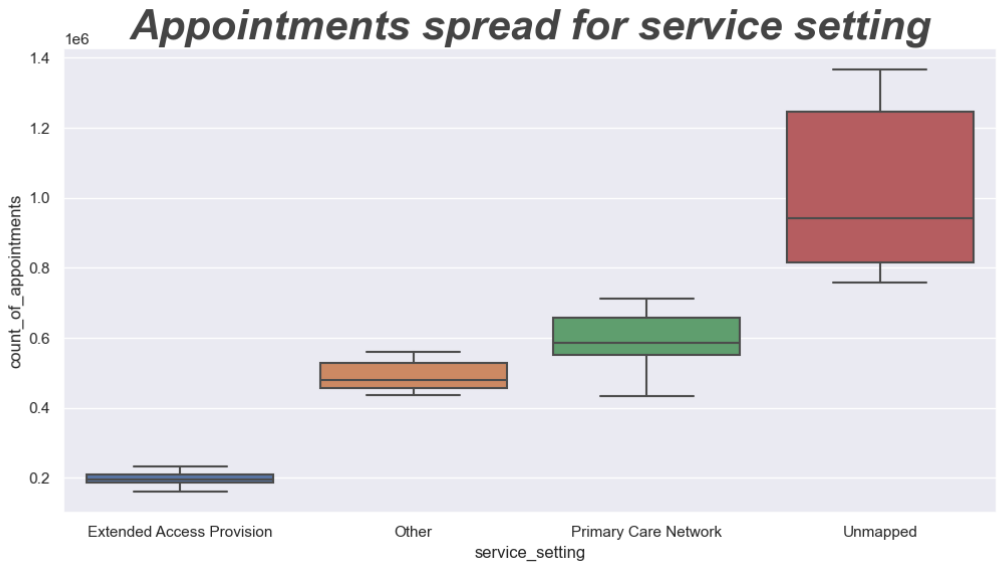


Figure 4.9