NHS Dental Statistics 2018/19 - A Critical Study

February 1, 2022

Introduction

Given data about NHS Dental Statistics for England for the 12 months to 31/3/19 , at the level of Clinical Commissioning Groups (CCGs), we will analyse certain criteria about this data-set and communicate our findings. We discuss patterns found in the number of patients treated in specific age groups, the effects of deprivation on dental treatment and projected dentists shortages for respective CCGs. Patient, workforce and deprivation datasets were used, with the corresponding files being found via NHS Digital Statistics and English Indicies of Deprivation websites with respective links:

- NHS Dental Statistics for England - 2018-19: Annex 3 (Adult and Child Patients Seen by Age)
- NHS Dental Statistics for England 2018-19 Annex3 (Workforce)
- NHS Dental Statistics for England - 2018/19: Annex 4 (Guide to Dental Publications)
- English Indicies of Deprivation 2019

Data Characterisation

Cardinalities

The constructed data-table that will be used for analysis has a file size of 850KBs, consisting of 14516 rows and 10 columns whereby each row is a specific combination of English CCG, patient age band and dentist age group. The file has .XLSX encoding - a zip-compressed XML spreadsheet file used to analyze and organize data that is more efficient at storing large datasets than for example its .CSV counterpart. A table describing and characterising each field of the data-set is as follows.

Variable name	Variable Description	Valid/example values
CCG_NAME	NHS England Clinical Commissioning Group (CCG) Name	NHS Crawley CCG
CCG_CODE	NHS England Clinical Commissioning Group (CCG) Code	00C
CCG_ONS_CODE	NHS England Clinical Commissioning Group (CCG) ONS Code	E38000001
AGE_BAND	Age group of patient	$\{0, 1, 2, ..., 16, 17, 18+\}$
PATIENT_TYPE	Classification of patient: adult or child	Adult/Child
PATIENTS_SEEN	The number of patients seen in the period	Number
POPULATION	The population estimate in the period	Number
AGE_GROUP	Age group of performer	Under $35, 35-44, 45-54, 55+$
DENTIST_COUNT	Count of performers	Number
IMD	Indices of Deprivation population weighted average of the combined scores	Number

Table 1: Contains definitions of each of the data items found in the constructed data-table

The 0-17 patient age bands seen in table 1 cover child patients of 0-17 years of age who have begun a course of treatment and have received NHS dental care in the past 12 months. The 18+ patient age band covers adult patients of 18+ years of age who have begun a course of treatment and have received NHS dental care in the past 24 months. Patients are counted once in the data, independent of the number of courses of treatment over the 12 or 24 month period. A unique patient is identified via surname, first initial, gender and date of birth. However, if there are two unique people who have these same personal details, they will be counted as one patient, leading to patients in some cases being undercounted, although rarely.

Population numbers are obtained from the Office for National Statistics (ONS) mid-year population estimates. Patients being treated in a CCG may not live within that CCG, for example if they live close to a CCG boundary, so an individual may count towards a CCG's patients seen and not population, or vice versa. Dental practices are not contracted to CCGs. The source dental data has been mapped to CCGs using dental practice postcodes and the NHS Postcode Directory. Some practice postcodes are not covered by a CCG, and have been reported as "unallocated". These practices were removed from the data-set.

Distribution

All variables in table 1 with valid/examples values containing characters are stored as string (including "AGE_BAND" & "AGE_GROUP"), the remaining are stored as integers. We may numerically characterize relevant integer variables.

Variables	Minimum	1st Quartile	Median	Mean	3rd Quartile	Maximum
PATIENTS_SEEN	5	1141	1174	7974	2662	496029
POPULATION	747	2109	3001	15326	4366	962934
DENTIST_COUNT	13	31	44	50.55	61	196

Table 2: Numerical summary of NHS Dental patient data 2019

NHS Devon clinical commissioning group sees the most patients out of all English CCGs. However, this CCG does indeed have the highest population too - 962934 residents as evident in Table 2. NHS Wakefield's workforce contains the average number of dentists across English CCGs yet only 6578 patients go to this CCG, less than the average across the country by over 1000 patients. This large deviation may be due to inaccuracies produced in the adult patient data as will be discussed further into the report. Furthermore, since the age bracket of adults is far greater than other age groups of patients, we ignore adult data in certain cases such as finding patterns in the number of patients treated in specific age groups.

Variables w/o Adults	Minimum	1st Quartile	Median	Mean	3rd Quartile	Maximum
PATIENTS_SEEN	5	1092	1708	2030	2467	10819
POPULATION	747	2065	2892	3452	3977	17492
DENTIST_COUNT	13	31	44	50.55	61	196

Table 3: Numerical summary of NHS Dental patient data 2019 with adults removed

Patterns

The patients seen and population of the English CCGs have now reduced deviations with values of 1515, 2193 and 31 respectively. Dentist count is unaffected by removing adult data as expected. To understand these fields, we graphically summarise the variables as follows.

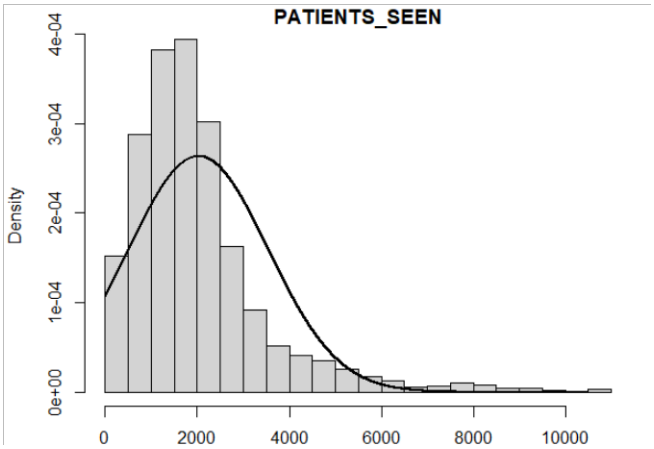

Figure 1: Histogram showing the density of patients seen 2018 – 19

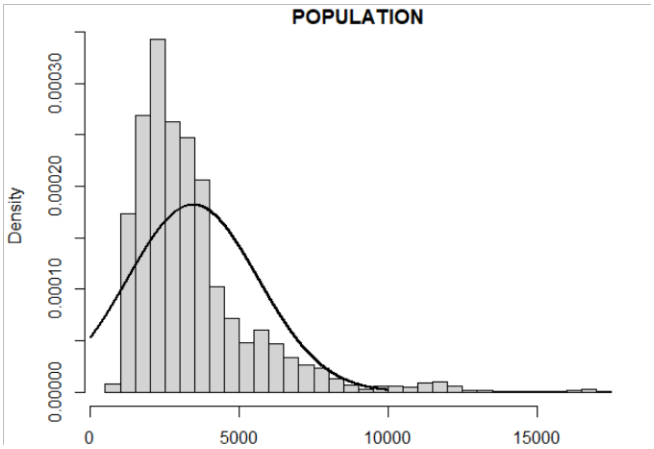

Figure 2: Histogram showing the density of English CCG populations

From the histograms of the variables in question seen in figures (1) and (2), we see that the patients seen and population of the English CCGs form 'bell-shapes'. We apply the method of moments curve fitting technique to these variables and produce normally distributed densities that aim to model the true distribution of the data - this can be seen via the solid lines on the histograms. The data is skewed towards lower values. This is evident from the coefficients of skewness values of the two variables which are 2.07 and 2.35 respectively. You can see that our distribution is positively skewed and most of the outliers are present on the right side of the distribution. This is due to the fact that there are large clusters of small clinical commissioning groups situated across England such as NHS Corby, Surrey Heath and Wyre Forest with populations/patients seen fewer than average, and a small number of CCGs with large populations such as NHS Devon.

Data Quality

When assessing data quality, the completeness and correctness of the source data should be analysed. The completeness refers to how comprehensive and detailed the data-set is. The correctness refers to how well the data reflects the real world object, in this scenario a patients and dentist population.

Completeness

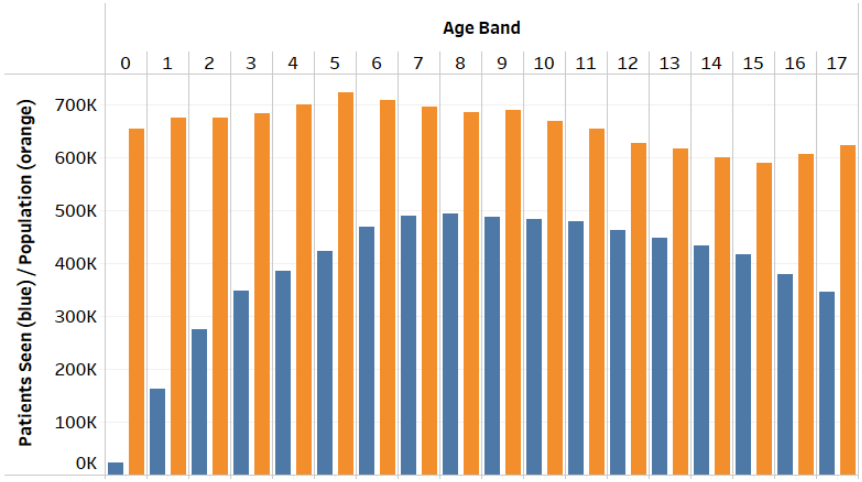

Figure 3: Age Bands 0-17 vs. Patients Seen (blue) & Population (orange)

Two plots have been created which display the dentist-population relationships. Figure (3) graphs the patients seen and population by age band. The 18+ age band was not included in this visualisation due to its massive relative size. Figure (4) graphs dentist count and patients seen by CCG. Figure (3) shows a pattern of patients seen that we would typically expect, and the population has no anomalies.

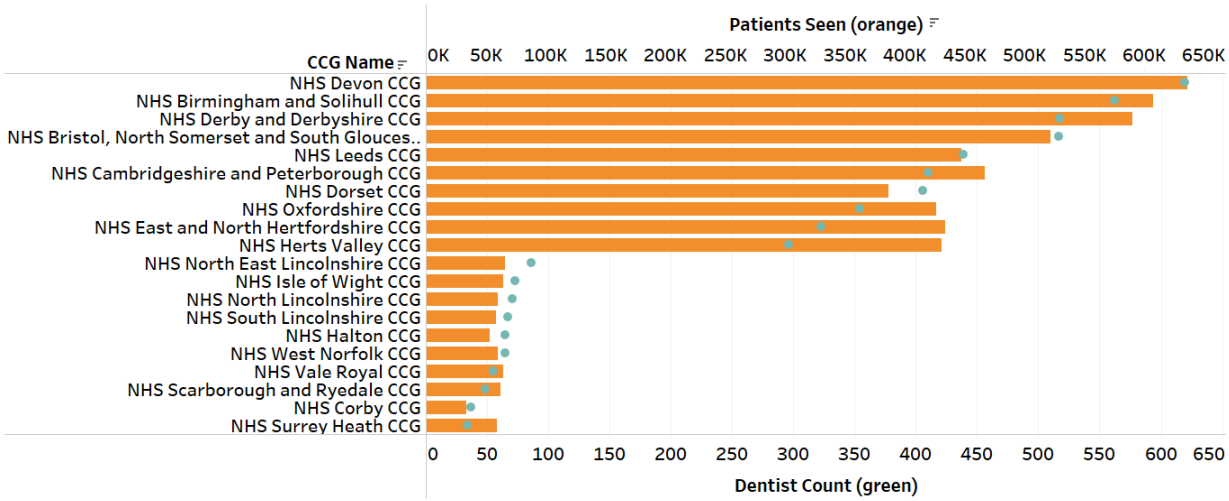

Figure 4: Top & Bottom 10 Dentist Count CCGs vs. Dentist Count (orange) and Patients Seen (green)

The patients seen and dentist counts appear to follow a trend: the greater the number of patients seen, the higher the dentist count, which we would expect. However, CCGs with fewer patients seen appear to have a greater dentist count to patients seen ratio than CCGs with more patients seen.

A lack of completeness in the data will, in-turn, reduce the accuracy of some of the counts. Patients will be duplicated in cases of name change, name misspelling, having multiple courses of treatment, or if the patient visits two different practices for treatment. This provides inaccuracy in the Patient Count number, with NHS Digital claiming that duplications and omissions can alter Patient counts by up to 2%. In addition, The Office for National Statistics (ONS) mid-year

population estimates do not account for short-term migrants (people who come to or leave the country for a period of less than 12 months). This will affect the 0-17 age bracket only as this refers to any individual who receives NHS dental care in the last 12 months. Population figures in this category are likely to be less than the true figure as a result.

Correctness

The adult patients seen age band 18+ covers the 24 months leading to 31/03/2019 and we are only interested in the 12 month period leading to 31/03/2019. We must treat these as special values. Halving the adult patients seen figures as an approximation to the patients seen over the last 12 months assumes that patients counted only underwent one course of treatment, while the real average number of courses of treatment per patient will be above one, as all patients underwent at least one. This age band is also incomparable to the others due to its sheer size. Hence, we will not change these values, as it will not hinder the investigation.

Plotting the ratio of patients seen to population by CCG and ordering from the highest to the lowest, it is apparent that NHS South Tyneside CCG, NHS Bradford City CCG and NHS Norwich CCG have abnormally high ratios compared to the rest of the data.

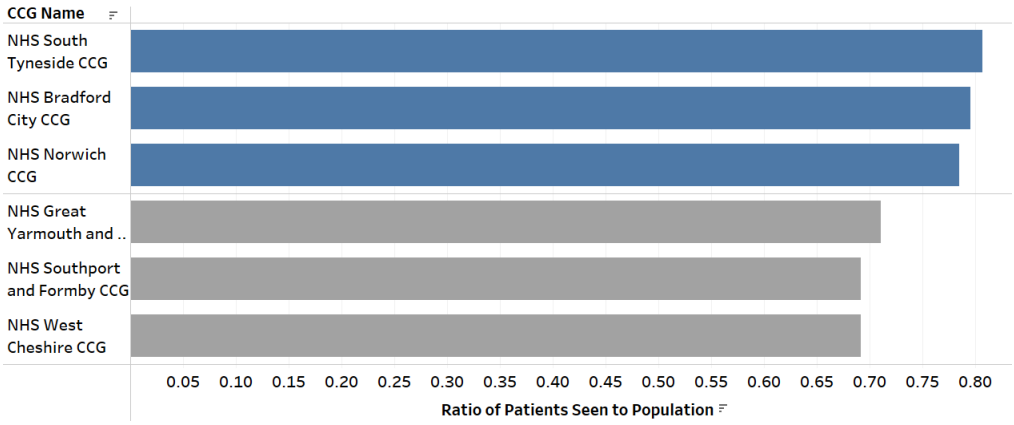

Figure 5: Greatest 6 Ratios of Patients Seen to Population by CCG

Upon further investigation, the following CCG and age band combinations have patients seen to population ratios over 1:

- NHS Bradford City CCG: age bands 7-14
- NHS Norwich CCG: age bands 7 & 10-15
- NHS South Tyneside CCG: age band 7
- NHS Bath and North East Somerset: age bands 11-12.

Patients should only be counted once in the data, so we would expect to see ratios under 1 - a ratio over 1 is only likely if a lot of patients of a CCG are from neighbouring areas covered by other CCGs, if duplicates have not been recorded. Although NHS Bath and North East Somerset has an age band patients seen to population ratio over 1, it has a relatively low ratio across all age bands (0.56).

Detailed Analysis

Patients

There are numerous patterns in the number/age of patients treated. As seen in figure (3) with data quality, children in the age band 0 have the least patients seen with a rapid increase until 3-4 years old. Babies are not born with teeth and therefore there is a small number of babies under a year old seen - the only reason may be because of things such as an infection. The rapid increase on the graph of patients seen may be due to problems when children/toddlers first start to teethe as teething happens to the majority of toddlers within this age range.

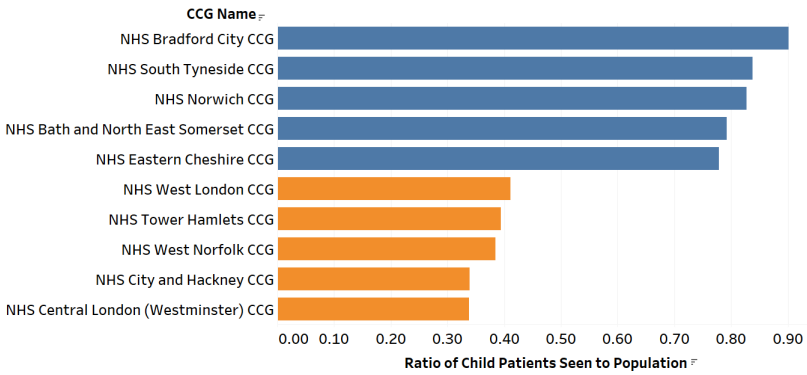

Figure 6: Top and Bottom 5 Ratio of Child Patients Seen to Population by CCG

From around 4-5 until around 12 children's milk teeth will fall out and be replaced by adult teeth. Therefore in between this time is the most important time for a child to see the dentist, which corresponds to the graph as for the majority of these ages the patients seen on the graph are closest to the total population. After the age of around 12 the patients seen starts to fall considerably - this could be a result of children having a full set of healthy adult teeth and do not need to see a dentist as regularly.

NHS Bradford City, South Tyneside and Norwich CCGs respectively have the highest ratios of child patients seen to population, while NHS South Tyneside, Norwich and Bradford City CCGs respectively have the highest ratios of adult patients seen to population. There is a correlation with the respected areas' IMD ranking with the areas with the highest ratio being from areas with a lower IMD ranking. For example, Bradford appears in both the adult and child top 3 and has the lowest IMD rank out of all 191 CCGs. All 7 of the CCGs that rank in the top 5 child and adult ratios have a ranking below 100 (out of 191). On the contrary, all of the lowest ratio practices have an IMD ranking of above 100 with Richmond and Surrey Heath being in the top 10.

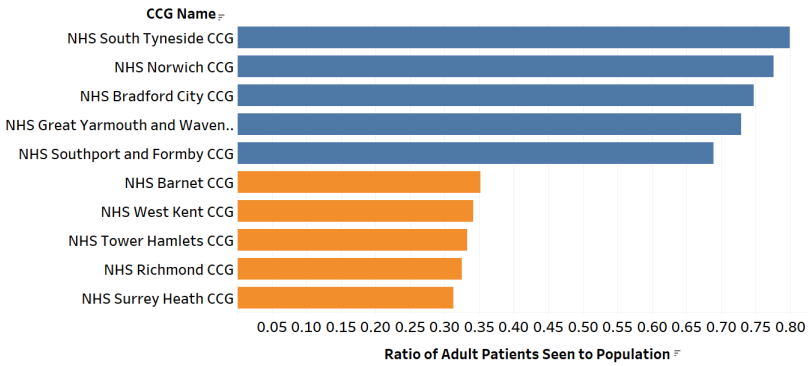

Figure 7: Top and Bottom 5 Ratio of Child Adult Seen to Population by CCG

Deprivation

Indices of multiple deprivation (IMD) are widely-used datasets within the UK to classify the relative deprivation of small areas. Multiple components of deprivation are weighted with different strengths and compiled into a single score of deprivation. The components include income, employment, education and health. The lower the index value the more deprived the area. There are numerous effects of deprivation on the NHS Dental system. Adults tend to receive treatment at a greater rate in these lower income areas.

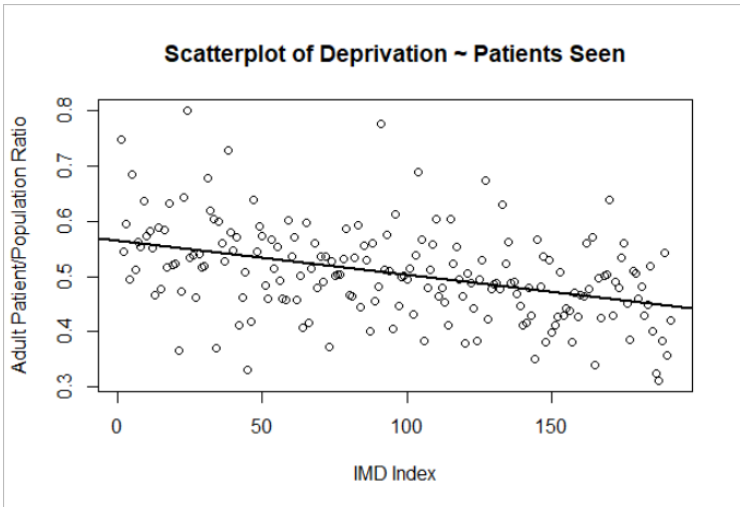

Figure 8: Scatterplot showing the relation between the deprivation rank of each English CCG and their corresponding patient/population ratio for adult patients.

Figure (8) tells us that the correlation coefficient between these two variables is -0.416. This is a relatively strong negative correlation and suggests that living in a deprived area increases the probability of requiring dental treatment in adulthood. This may be due to the increased rates of smoking, fast-food, sugary drinks etc. linked to these lower income areas.

CCG Shortage

NHS Corby CCG has the highest percentage of dentists in the 55+ age group at over 30%, making it the most at-risk CCG to face a shortage of dentists in 2031. This is dramatically more than the next CCG, NHS Lincolnshire CCG, at 26% -- 4% more than the highest CCG. NHS West Suffolk CCG and South Kent CCG have the 3rd and 4th highest percentages respectively at 25%, with another dramatic decrease to the 5th highest, NHS West Suffolk CCG, at 22% -- a 3% gap.

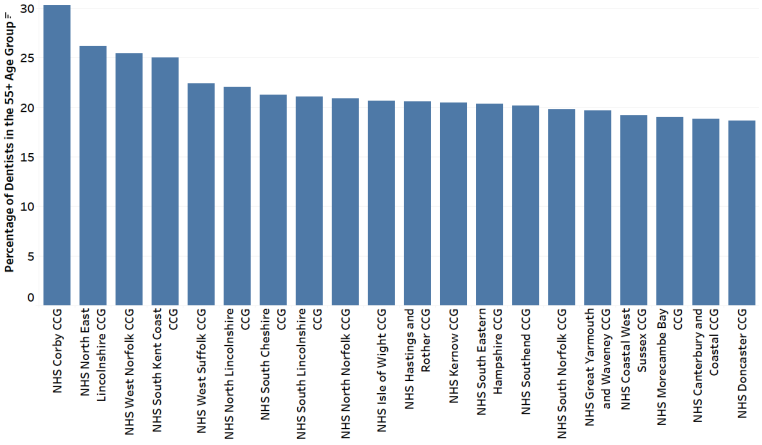

Figure 9: Bar-chart showing English CCGs with the highest proportion of elderly workforce (Age 55+)

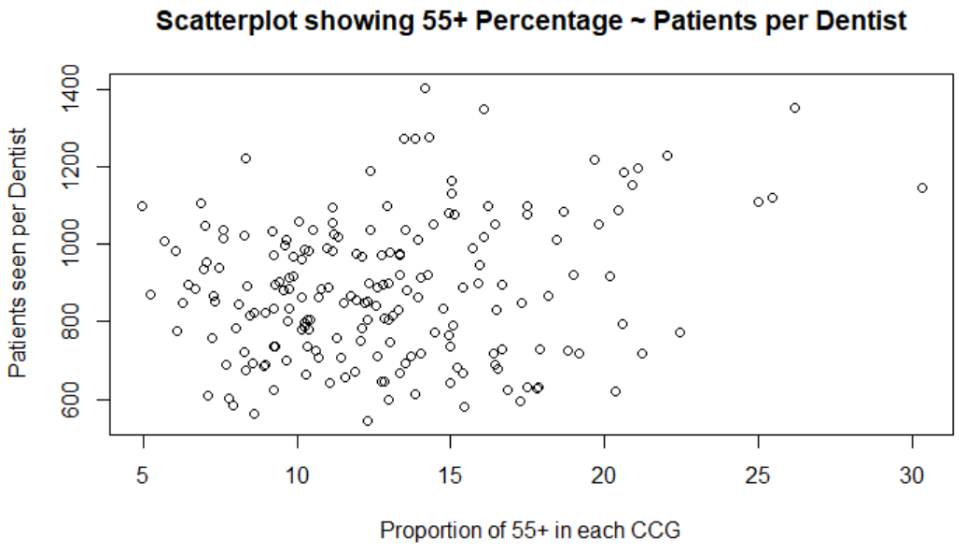

Figure 10: Scatterplot showing outlying English CCGs with aging workforce and high proportion of patients seen per dentist

The types of CCGs that will face the greatest shortage in 2031 are the CCGs with the highest percentage of over 55 year old dentists. Figure (10) shows that there are 4 CCGs with more than 25% of their workforce of the age 55 or older. These CCGs are North East Lincolnshire, West Norfolk, Corby and South Kent Coast. There will be a greater impact on the CCGs where the number of patients seen per dentist is higher -- these are the CCGs in the upper right of Figure (10).

Conclusions

By analysing data about NHS Dental Statistics for England for the 12 months to 31/3/19, at the level of Clinical Commissioning Groups , we have found patterns in the number of patients treated in specific age groups, the effects of deprivation on dental treatment and projected dentists shortages for certain CCGs.

Young children 0-7 do not receive dental treatment as often as children in there early teens 7-13. This band has the most patients seen with children in their later teens tending to reduce their frequency of treatment. Adults living in deprived areas are more likely to require dental treatment in comparison to adults situated in affluent CCGs. Clinical Commissioning Groups with a workforce that has a high proportion of elderly dentists 55+ and also have a workforce that is over-stretched with high patients seen per dentists will most likely face the greatest shortage of dentists in 2031.