Appendix E: Local analysis of areas with lower dental supply

Introduction

E.1 In this appendix, we set out: (a) the methodology, and (b) the results of our local analysis of dental supply.

Key findings

We estimated the levels of dentistry supply (including private, mixed and NHS dental practices) relative to populations for local areas across the UK. Different approaches may be more appropriate to assess the supply of NHS dentistry specifically, which was not within our scope. The results show variation in each UK nation, with some areas ranking higher based on scores – indicating greater levels of supply relative to populations, while others ranked lower – indicating more scarce supply relative to populations.

We found no material differences between the scores of urban areas and rural areas. There was a mild positive correlation between the scoring of areas and the level of deprivation – indicating more deprived areas may have lower levels of dentistry availability relative to populations than less deprived areas.

Methodology

Overview of approach

E.2 In order to access dental treatment, consumers typically travel to dental practices in their local area. Therefore, to identify areas with lower provision, we are interested in understanding the supply of dental care by practices (both NHS and private provision)[1] within local areas compared to the demand from the populations those practices serve.

E.3 To estimate the balance of supply and demand in regions across the UK, we used the two-step floating catchment area (2SFCA) method, established in 2003 to examine spatial accessibility of healthcare (primary physicians).[2] Floating catchment area methods (including methodological variants) have since been used many times to assess spatial accessibility to a range of services and public

[1] Although the scope of the market study is private dentistry, we are assessing regional supply with regard to coverage gaps of any provision type, since coverage gaps for private-only practices may not be a true coverage gap if there is NHS provision available in those areas. We expect that areas of low provision identified in this analysis should be an approximate subset of areas with low NHS provision, ie areas where both NHS and private dentistry provision is insufficient.

[2] Luo, Wei, and Fahui Wang (2003), 'Spatial accessibility to primary care and physician shortage area designation: a case study in Illinois with GIS approaches' Geographic information systems and health applications, 261-279. https://doi.org/10.4018/978-1-59140-042-4.ch015

areas.[3] In this application, spatial accessibility scores (SAS) provide a measure of consumers' access to dentistry in their local area.

E.4 Floating catchment area methods model the accessibility of providers of services to their consumers by defining catchment areas centred on the providers and consumers. In our application:

(a) The locations of dental practices in the UK are the providers.[4]

(b) The locations of 'population centres' in the UK are the consumers.[5] These locations are provided by public authorities and are generated by dividing the UK into local areas of approximately 1,000-3,000 residents. The population centres are determined by finding the centre point of these local areas based on the density of the resident population.

E.5 Spatial accessibility is calculated in two steps – also shown in Figure E.1 below:

(a) In the first step, we calculate a supply-demand ratio for each dental practice in the UK within its catchment area.

(i) Supply: We use the number of dentists employed at the practice as a proxy, on the assumption that practices with more dentists can take on more patients.

(ii) Demand: We identify the population centres within the catchment area of the dental practice and sum the population sizes of those centres to estimate demand.

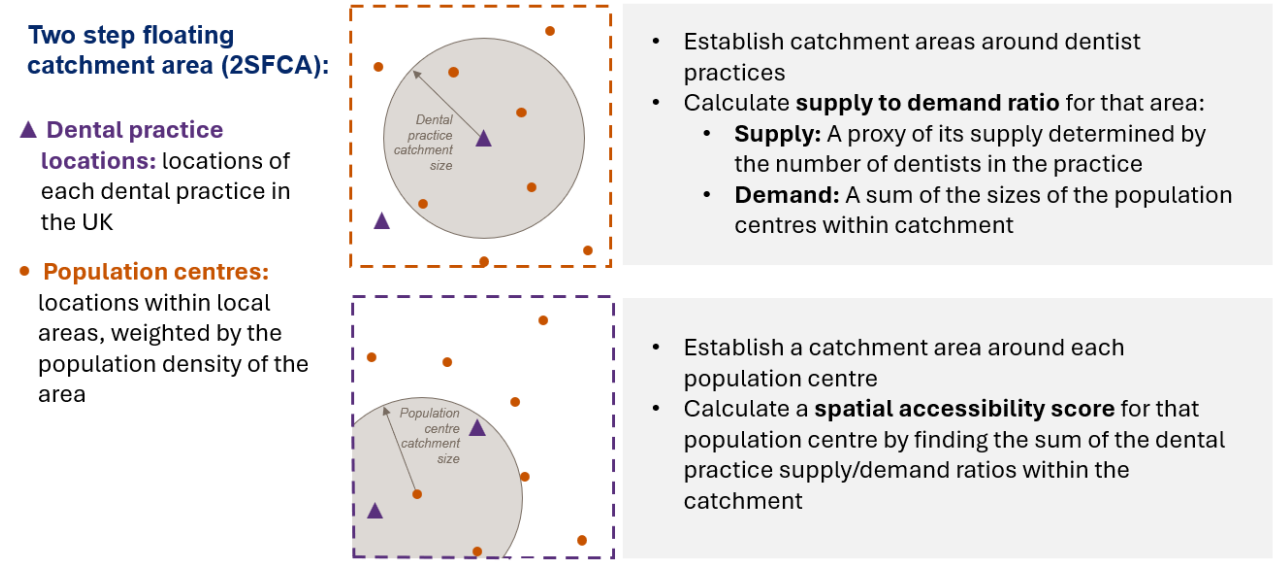
(b) In the second step, we calculate a spatial accessibility score (SAS) for each population centre. This is the sum of the supply-demand ratios of the dental practices within a catchment area of the population centre.

[3] Such as healthcare facilities and primary care physicians, care facilities for older adults, cancer care, pharmacies, parks and green spaces, and food shops. Hunyadi, J., et al. (2025). 'A comparison of floating catchment area parameters with applications to a dataset of clinics enrolled in a statewide child and adolescent psychiatric consultation program', Front. Public Health, 13:1498819. https://doi.org/10.3389/fpubh.2025.1498819

[4] We included dental practices that offer general dental services to the public, but did not include other specialist dental services such as prison dental services, emergency clinics, health clinics, cosmetic dentists and orthodontists.

[5] As explained below in the Description of data section, different types of population centre are available per UK nation. For England and Wales, we used the weighted population centroids of Lower-layer Super Output Areas (LSOAs) from the ONS. For Scotland and Northern Ireland, we used the weighted population centroids of Data Zones from the National Records of Scotland (NRS) and Northern Ireland Statistics and Research Agency (NISRA), respectively.

Figure E.1: A diagram illustrating the steps of the two step floating catchment area method



Source: CMA analysis

E.6 We established the catchment areas using geographical straight-line distances around population centres and dental practices.[6] We assume that consumers in rural areas are likely to be willing to travel a larger distance to access dentistry than residents of urban areas, due to the lower density of civilian infrastructure in rural areas. Using public data, we categorised each local area as urban or rural and used a catchment of four miles for urban areas and eight miles for rural areas. We chose catchment area sizes which are broadly in line with those used in the CMA's most recent dental merger investigations.[7]

E.7 We tested the sensitivity of catchment area radius by both reducing and increasing the size by 25% and checking the effect on the SAS.

E.8 We averaged the SAS of the local areas within local authority districts (LADs),[8] using the mean score, to facilitate interpretation of the results. The average SAS provides a relative measure to compare the provision of dentistry across LADs. We also analysed the extent to which reduced spatial access to dentistry is correlated with deprivation of local areas in England, Scotland and Wales. Due to

[6] See 'Limitations of Approach' section below for limitations related to using straight-line distances.
[7] In the three most recent dental merger investigations carried out by the CMA (See (i) CMA Portman / Dentex P1 Final Report, March 2023: Full text decision, (ii) CMA Rodericks / Dental Partners P1 Final Report, August 2022: Full text decision, & (iii) CMA Bupa / Oasis P1 Final Report, March 2017: Bupa/Oasis- Decision.) local competition was assessed on the basis of catchment areas around the merging parties' sites. In those three cases, and in line with the CMA's typical practice, the CMA identified catchment areas within which 80% of customers of the merging parties' sites were located. Customer home location data from the parties was used to calculate the size of catchment areas in miles. The size of catchment areas were calculated separately for different treatment types, eg NHS general, private general, private cosmetics – for which averages were then settled on. Within this study, we did not have access to comparable data (ie customer home location data) so have sought to rely on the catchment area sizes used as a general precedent rather than estimating new site-specific catchment area sizes.
[8] Local authority districts is a term used in England to refer to regional areas where local authorities have some responsibility for running local services. Each of the UK nations has a different term for this. In Wales they are known as principal areas; in Scotland they are known as council areas; and in Northern Ireland they are known as local government districts. We refer to all collectively in this appendix using the term local authority districts.

differences in methodologies between nations, we were unable to compare or aggregate results between nations, and due to data constraints (explained in the Description of Data below), we were not able to produce a correlation for Northern Ireland.

Description of data

Data on populations, area boundaries and rural/urban classifications

E.9 We obtained publicly available UK population data for local areas, Lower-layer Super Output Areas (LSOAs) and Data Zones, for the devolved nations in the UK. Below we provide further detail for each of the UK nations:

(a) **England & Wales**: Data was obtained from the Office for National Statistics (ONS).

(i) The ONS Census is conducted once a decade, but is regularly updated using estimates based on birth, death and migration rates. The local areas were defined in the most recent census in 2021. In particular: the boundaries,[9] population weighted centroids (population centres)[10] and rural/urban classification of LSOAs.[11]

(ii) We used population estimates for each LSOA from the mid-2024 update to the Census.[12] Due to changes in 2024 of the boundaries of LADs, the LSOA boundaries no longer map directly to LAD boundaries. We used the LAD boundaries defined in 2023 to aggregate the results to LADs.[13]

(iii) Urban and rural locations were classified into more granular categories labelled with codes by the ONS. We aggregated those into binary rural/urban classifications.[14]

(iv) Rural/urban classifications for LADs were calculated from the percentage of rural LSOAs within each LAD. A LAD was classified as rural if 50% or more of its local areas were rural, mixed if between 21%

[9] Lower layer Super Output Areas (December 2021) Boundaries EW BSC (V4) | Open Geography Portal accessed 15/06/26.
[10] Lower layer Super Output Areas (December 2021) EW Population Weighted Centroids | Open Geography Portal accessed 15/06/26.
[11] 2021 Rural Urban Classification - Office for National Statistics accessed 15/06/26.
[12] Lower layer Super Output Areas (December 2021) EW Population Weighted Centroids | Open Geography Portal accessed 15/06/26.
[13] Local Authority Districts (December 2023) Boundaries UK BFE - National Data Library accessed 15/06/26.
[14] We used codes UN1 and UF1 as 'urban' and codes RSN1, RSF1, RLN1 and RLF1 as 'rural'.

and 49% were rural, and urban if 20% or fewer were rural.[15] This approach was used for all UK nations.

(b) **Scotland**: Data was obtained from the National Records of Scotland (NRS).

(i) The local areas were defined in the NRS 2011 Census as Data Zones.[16] We used population data for each Data Zone from the small area population estimates of the mid-2022 update to the Census.[17]

(ii) We used the population weighted centroids and rural/urban classification of data zones that were updated in 2022, but map to the 2011 data zone boundaries.[18]

(iii) Urban and rural locations were divided into more granular categories labelled with codes by the NRS. We aggregated those into binary rural/urban classifications.[19]

(c) **Northern Ireland**: Data was obtained from the Northern Ireland Statistics and Research Agency (NISRA).

(i) We used the local areas defined in the NISRA 2021 Census, including boundaries, population weighted centroids and population estimates for Data Zones.[20]

(ii) Rural/urban classification values were published by NISRA in 2015 for Super Output Areas (SOAs), the previous local area definition which has since been replaced by Data Zones.[21] We mapped SOAs from 2011 to Data Zone boundaries from 2021 by matching the centroids from the Data Zones to SOA boundaries.

(iii) Urban and rural locations were divided into more granular categories, marked A to H by the NISRA. We aggregated those into binary rural/urban classifications.[22]

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[15] As per the methodology defined by the ONS: Rural-Urban Classification Methodology (2021) | Open Geography Portal. We combined the ONS categories 'intermediate rural' and 'intermediate urban' to form the mixed category.
[16] SpatialData.gov.scot accessed 15/06/26.
[17] Small area population estimates: mid-2022 - National Records of Scotland (NRS) accessed 15/06/26.
[18] SpatialData.gov.scot, Supporting documents - Scottish Government Urban Rural Classification 2022 - gov.scot accessed 15/06/26.
[19] We used codes 1 and 2 as 'urban' and codes 3-6 as 'rural'.
[20] Census 2021 person and household estimates for Data Zones in Northern Ireland | Northern Ireland Statistics and Research Agency, Census 2021 population-weighted centroids for Data Zones and Super Data Zones | Northern Ireland Statistics and Research Agency and Super Data Zone boundaries in GIS format | Northern Ireland Statistics and Research Agency accessed 15/06/26.
[21] Settlement 2015 Documentation | Northern Ireland Statistics and Research Agency accessed 15/06/26.
[22] We used categories A to D as 'urban' and E to H as 'rural'.

E.10 We recognise that populations will differ in need for dental services (eg elderly have higher need), which we are unable to reflect in our assessment of demand.

Data on UK dental practices

E.11 We obtained a commercially available dental practice data set from LaingBuisson.[23] The data covers the location of dental practices, including postcode, and the number of dentists employed at each practice.[24] The number of dentists field was missing for a very small number of practices (less than 1%). In these instances, the number of dentists was assumed to be 1, as this is the minimum required to run a practice. For up to 10 dentists, the number of dentists was exactly specified, however above 10 dentists it was listed as 10+, which was the case for approximately 5% of dental practices in the data set. In these instances, we set the value to 10.

E.12 We checked the completeness of the dataset against publicly available sources[25] and found some discrepancies,[26] including postcode differences, differences in the types of organisations included (eg health clinics, cosmetic-only dentists, orthodontists), and some de-registered/closed practices. Updates were carried out by LaingBuisson to ensure the data set was as complete as possible, whilst excluding organisations not relevant to our analysis (such as health clinics, cosmetic dentists and orthodontists).

E.13 We recognise that one third of dentists are reported to work in more than one practice, for which we are unable to adjust, and that not all dentists work full time, so we will overstate supply for practices where dentists do not work full time.

Indices of deprivation

E.14 We obtained publicly available deprivation index data for each nation of the UK. The methodology to calculate deprivation indices varies across UK nations – information about each methodology is available in the referenced sources below.

(a) **England**: The data was published by the UK Ministry of Housing, Communities and Local Government in 2025.[27] It includes the Index of Multiple Deprivation (IMD) rank for each LSOA.

[23] Dentistry Database Subscription - LaingBuisson, accessed 02/09/26.
[24] This data was gathered via data feeds and verified using individual dentist's websites and phone calls.
[25] We could not determine a publicly available data set containing the private dental practices in Scotland.
[26] Using CQC data - Care Quality Commission, Search results | Healthcare Inspectorate Wales, Recently Completed Inspection Reports | RQIA, Find a Dentist - BSO, Dental Practices and Patient Registrations - Dental Practices June 2025 - Scottish Health and Socia…
[27] English indices of deprivation 2025 - GOV.UK accessed 02/0726.

(b) **Wales**: The data published by the Welsh Government in 2025.[28] It includes the Welsh Index of Multiple Deprivation (WIMD) rank for each LSOA.

(c) **Scotland**: The data was published by the Scottish Government in 2020.[29] It includes the Scottish Index of Multiple Deprivation (SIMD) rank for each Data Zone (from 2011). We note that this data is six years old, which reduces the reliability of this analysis, especially as the boundaries of Data Zones have been updated since the 2022 Census.[30]

(d) **Northern Ireland**: It was not possible to produce a correlation for Northern Ireland because the most recent deprivation index data is outdated (produced in 2017) and was calculated for SOAs which have since been replaced by Data Zones.

Results

E.15 As set out in Chapter 3, findings from the Verian research indicate that access to private dentistry is not a wide-spread concern – the Verian research found that, for the 20% of consumers that are not registered with a practice, lack of access to an NHS dentist was the most common reason at 44%, while lack of access to a private dentist was only reported by 3%.

E.16 A low SAS in our analysis indicates that an area has lower spatial access to dentistry in general, as we included NHS, mixed and private practices in the analysis. Given the number of NHS-only practices in the UK is low, the small proportion of consumers who are unable to find a private dentist are more likely to be in areas where the SAS is low. While a high SAS indicates an area has higher spatial access to dentistry, it does not mean that consumers in those areas necessarily have sufficient choice of practice / dentist. For example, a practice may have no availability for new patients.

E.17 Access to NHS dentistry is better modelled using the distribution of NHS dental activity across the UK (for example, units of dental activity (UDAs) provide a measure of this in England). The 44% of consumers that report being unable to find an NHS dentist are more likely to be found in NHS 'dental deserts',[31] although

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[28] Welsh Index of Multiple Deprivation: 2025 | GOV.WALES accessed on 02/07/26.
[29] Scottish Index of Multiple Deprivation: data and resources - gov.scot accessed 02/07/26.
[30] Revising small area statistics geographies – data zones and intermediate zones: consultation - gov.scot
[31] Studies on NHS dental deserts include:

- Devlin H. (2026). High-need dental deserts in England: a national spatial analysis of NHS access and deprivation. *British dental journal*, *241*(3), 191–194.
- 2022 and 2025 reports from the Association of Dental Groups assessing dental deserts in England and the UK respectively. Association of Dental Groups (2022), England's Dental Deserts: The urgent need to "level up" access to dentistry. Association of Dental Groups (2025), Creating Dental Oases: The solution for dental deserts.
- A 2024 report by the National Audit Office assessing the value for money of the NHS dental recovery plan in England. National Audit Office (2024), Investigation into the NHS dental recovery plan, pp12-27.
- A 2024 academic paper that maps NHS dental deserts in England. University of Leeds. (2024). Mapping NHS-funded dentistry to protect against 'dental deserts'. Faculty of Environment.

some may be in areas with low spatial accessibility scores where lack of NHS and private provision overlap.

Spatial Accessibility Scores

E.18 Table E.1 shows overall SAS for each of Wales, Northern Ireland, Scotland and the nine regions of England. These overall SAS are calculated by taking the median of SAS for all the LSOAs in each region/nation.

Table E.1: Spatial accessibility scores for Wales, Northern Ireland, Scotland and the nine regions of England, August 2026

UK region/nation	*Spatial accessibility score*
London	8.6
Northern Ireland	6.2
South East	6.2
East of England	5.4
Scotland	5.4
South West	5.3
North West	5.1
Yorkshire and Humber	5.1
East Midlands	4.9
West Midlands	4.9
North East	4.7
Wales	4.4

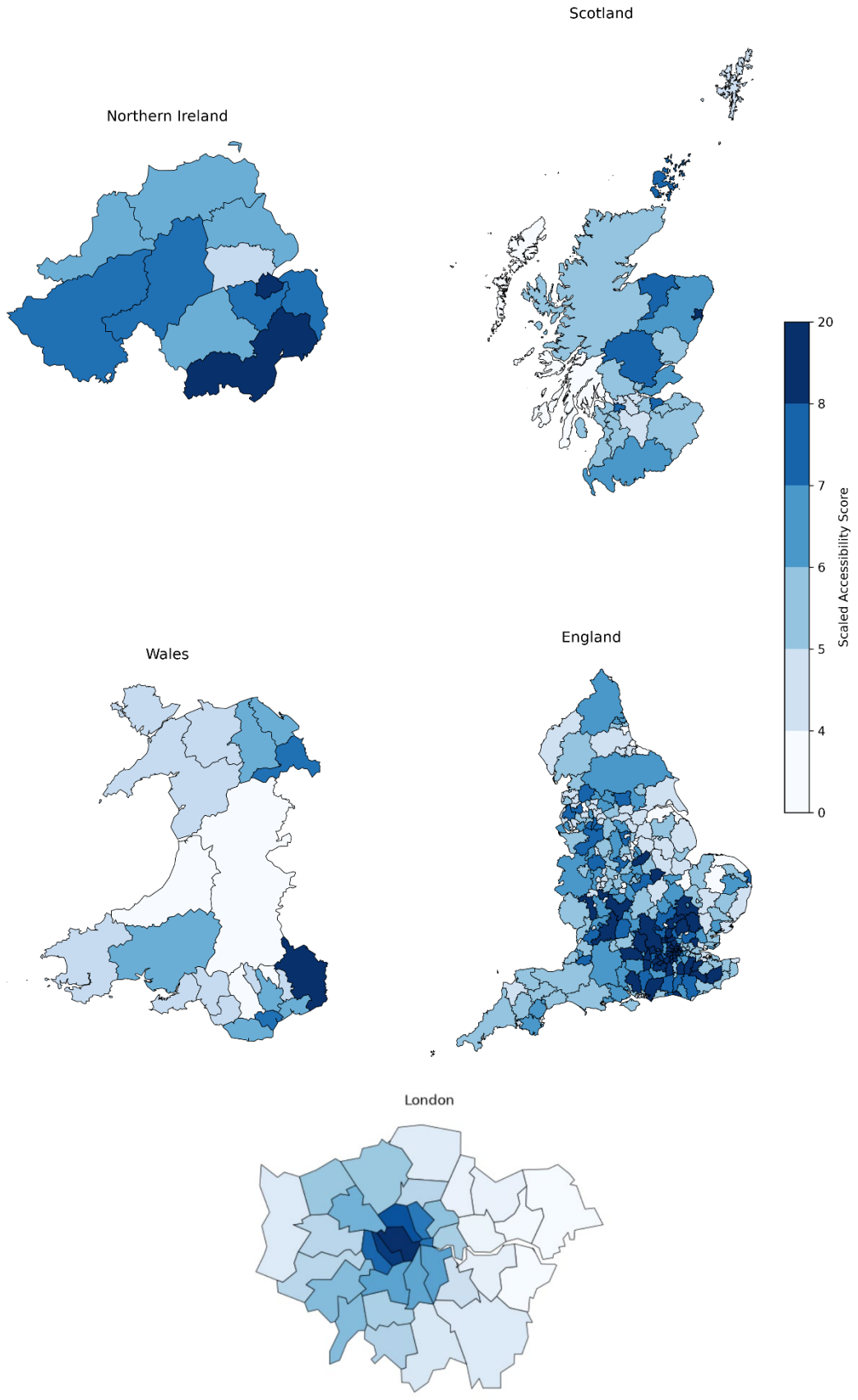
Source: CMA analysis of data from LaingBuisson.

E.19 As can be seen, the scores vary substantially between the 12 regions/nations, indicating different levels of dental supply relative to local populations across the UK. London has the highest score, while Wales has the lowest – nearly half as high as London.

E.20 Figure E.2 shows the SAS for each LAD (calculated using the mean score of its constituent local areas). Darker shading represents areas with a high SAS, indicating better access to dental care.

- A 2025 study by the Local Government Association assessing dental deserts in England and Wales. Local Government Association (2025), Dental deserts: Analysis of active dental practices offering NHS services across local authorities in England and Wales.

Figure E.2: Spatial accessibility scores per UK local authority district



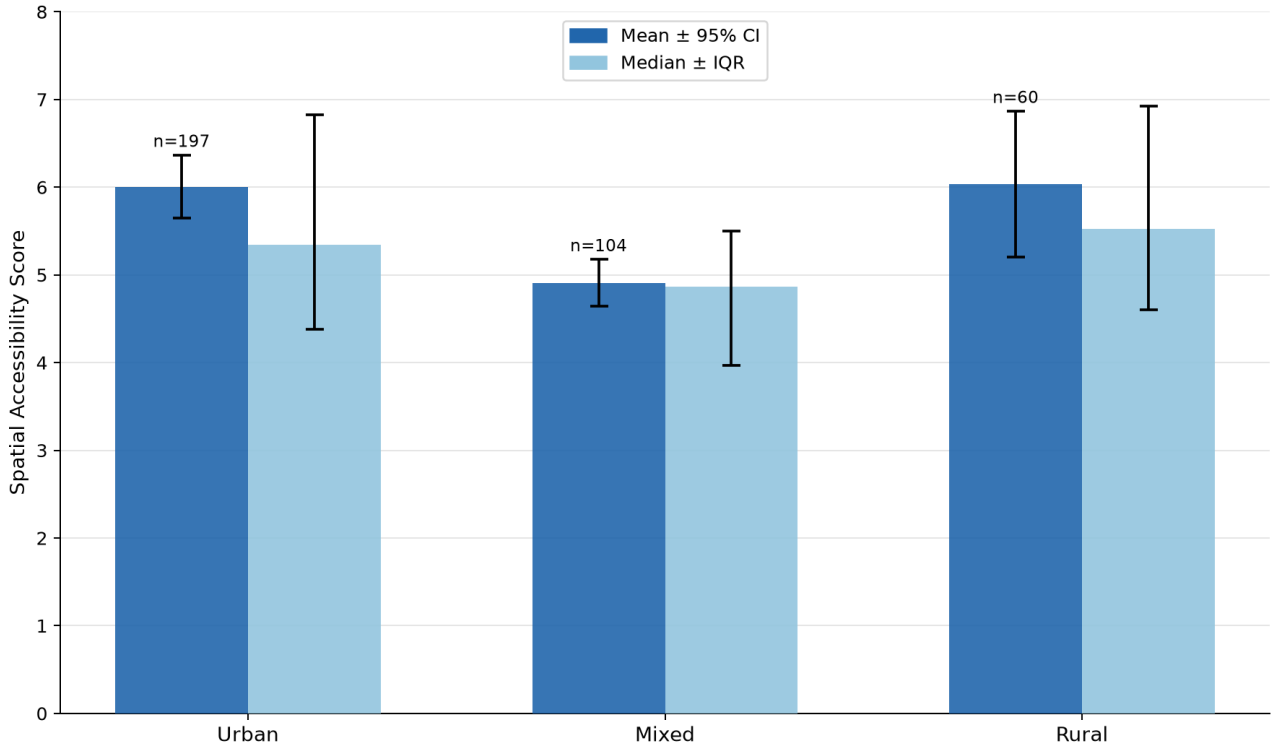
Source: CMA analysis.

E.21 As can be seen, there are varied shades in each UK nation, indicating different levels of dental supply relative to local populations. For example, in Wales, Powys and Ceredigion in the centre and Rhondda Cynon Taf and Blaenau Gwent in the south have the lightest shading. In addition, regions in the west-coast of Scotland, such as Na h-Eileanan Siar and Argyll and Bute, and regions in the East of England, such as Fenland, Breckland and North Norfolk, also have the lightest shading.

Comparing scores between rural and urban areas

E.22 We compared the SAS between rural, mixed and urban local authority districts. Figure E.3 shows that differences between the median and mean spatial accessibility index of rural, mixed and urban local authorities are not significantly different, and that the variation could be attributed to error. We are therefore not able to conclude that residing in a rural or urban area increases or decreases spatial access to dentistry.

Figure E.3: The mean and median accessibility scores of urban, mixed and rural local authority districts. The error bars are a 95% confidence interval (CI) for the mean and the interquartile range (IQR) for the median.



Source: CMA analysis

Correlation between scores and deprivation

E.23 We used Spearman's rank correlation to compare SAS with deprivation indices. The coefficient ranges from 1 (more deprived areas have lower spatial

accessibility) to -1 (more deprived areas have higher spatial accessibility). A coefficient of 0 would indicate a random relationship between the two parameters.

E.24 For each nation (omitting Northern Ireland)[32] the Spearman rank correlation coefficient of SAS and deprivation are close to zero, indicating a weak positive association:

(a) England: 0.11

(b) Wales: 0.18

(c) Scotland: 0.12

E.25 Correlations between access and deprivation are therefore weak in all three nations, but with a very high degree of statistical significance: p-values < 0.001.

E.26 Similar analysis done by Clark 2024 showed a negative trend between spatial accessibility to dental care and deprivation in England, although we note that the statistical significance of this trend was not assessed.[33] There were also two significant differences between analysis methods:[34]

(a) Clark 2024 only included NHS dentists whereas we have also included private-only practices. This effect could explain an increase in accessibility in less deprived areas.

(b) When calculating the accessibility index, Clark 2024 used UDAs – a metric of NHS funded treatments – as the supply of given practices. We have used number of dentists for the supply of practices, as there is not an equivalent metric to UDAs for both NHS and private treatments.

E.27 The weak correlation indicates that more deprived areas tend to have less access to dentistry overall, but this association is not strong. However, those more deprived areas might also be better served by NHS dentistry.

Sensitivity analysis

E.28 To verify the reliability of the results, we tested the sensitivity of catchment area radius by both reducing and increasing the size by 25% and checking the effect on the SAS.

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[32] As set out in the earlier section on Indices of deprivation, we were unable to compute the correlation for Northern Ireland due to data constraints.
[33] Stephen D Clark, Spatial disparities in access to NHS dentistry: a neighbourhood-level analysis in England, *European Journal of Public Health*, Volume 34, Issue 5, October 2024, Pages 854–859, https://doi.org/10.1093/eurpub/ckae099
[34] There are other differences in the methodology. Clark 2024 used Modified Huff Variable Three Step Floating Catchment Area, which includes the probability of interaction between a provider and a population centre and a distance decay function to model the dental accessibility of LSOAs. The study also used travel time instead of straight-line distance for defining catchment areas. The study did not include a calculation of Spearman's coefficient.

E.29 We used Spearman's rank correlation coefficient to measure the change in the order of spatial accessibility score for population centres when changing the catchment area radius. The correlation coefficient ranges from 1 (correlated positively) to -1 (inversely correlated). A coefficient of 0 would indicate no relationship between the two parameters.

E.30 The correlation between the scores using the central and smaller radius was 0.90 and between the scores using the central and larger radius was 0.92. This is a strong positive correlation indicating that the results are similar.

E.31 Across the full set of 361 LADs, the median shift in rank of the scores of the local authority districts was 21 places for the smaller radius and 19 places for the larger radius. For the lowest scoring 10%, the median rank shift of the LAD's was 7 places for the central vs small radius and 5 for the central vs larger radius. This indicates that whilst the SAS rank of the LADs was affected by changing the radius size, the lowest scoring areas were less sensitive to this effect.

E.32 For rural and urban areas, the sensitivity analysis showed that urban areas are more stable in their mean SAS, whilst rural area scores tend to be lower for the smaller radius and higher with the larger radius, indicating that areas where dental practices are sparse are more sensitive to radius. A small change in the catchment radius can include an additional practice in the catchment area of a rural population centre or include an additional population centre in the catchment area of a rural dental practice because population and dental practices are not spread evenly but are instead in small nodes across the area. Urban areas are far more robust to changes in radius as both dental supply and populations are dense.

E.33 Overall, we consider our choice of catchment size to be sufficiently robust given that our testing shows that 25% variation in size does not alter our conclusions, although our results may need to be taken with more caution in rural areas due to greater sensitivity to catchment area radius.

Limitations of approach

E.34 Two limitations of the 2SFCA method are that:

(a) all population centres within the catchment are assumed to have equal access to dental practices despite the distance to travel within the catchment to the practice (ie some practices might be closer to the population centre than others), and;

(b) catchment areas have hard boundaries, meaning all population centres that fall outside of the catchment of a dental practice are modelled as receiving no access to that practice at all despite the likelihood that at least some residents would be willing to travel further than the catchment size.

E.35 To address these limitations, some methodological variants of floating catchment area approaches include additional steps such as incorporating distance decay functions. In this instance, we opted instead to not use a distance decay function to ensure that the spatial accessibility is easy to understand and interpret. We note that any model of consumers' access to dentistry would have limitations, for example due to variations at a local level in factors such as local geographies and availability of public transport. We consider the 2SFCA method a sufficient model for our purposes.

E.36 Similarly, on the balance of resource/proportionality, we utilised physical distances to determine catchment areas. Travel-time catchment areas may provide a more realistic model of consumer behaviour.

E.37 As set out above, we used the number of dentists per dental practice as a proxy of the dental practice supply capacity. As dentists can work at multiple practices, may work part-time or may work over-time hours, if the data had been available, average dentist FTE or the total capacity for registered patients would have been a superior proxy. Similarly, the data does not differentiate between types of dentists (eg it does not specify general vs specialists).

E.38 Similarly, we have used population data as a measure of potential demand, however, different populations may have varying clinical needs that affect actual demand which we are not able to account for.

E.39 We have used a binary classification of urban and rural areas, however in reality, the characteristics of urbanicity and rurality exist on a spectrum. For example, rural areas that are closely located to urban centres may be better approximated using an urban catchment size. Whilst data providing more granular categories for rural and urban areas is available, the categories are different between nations and we consider that the benefit of adding further catchment sizes is outweighed by the drawbacks of increasing the complexity of the analysis.