NHS England

Diagnostic Imaging Dataset: Standardised CCG rates 2021/22

Version 1, 19th January 2023

Contents

1 Introduction

Imaging activity from the Diagnostic Imaging Dataset (DID) is presented by Clinical Commissioning Group (CCG) in Tables 7 and 8 of the annual 2021/22 report[1]. This Annex to the report expresses CCG activity as a rate per population, for each modality and for early diagnosis of cancer (EDOC) tests[2], standardised by age, sex and deprivation. It additionally shows the impact of age, sex and deprivation on the rates using Rates Ratios.

2 CCG Standardised Rates

2.1 Method

In 2021/22, the CCG of patients in the DID was derived from either their GP Practice code or, where this was missing, the Lower Super Output Area (LSOA) of their postcode. Rates per 10,000 population were calculated by dividing 2021/22 DID activity by CCG by October 2021 GP Practice-registered CCG populations. Both sources were available by age and sex, with Index of Multiple Deprivation (IMD) quintile information added based on Lower Super Output Area (LSOA[3]).

Counts of imaging activity by CCG, sex, 5-year age band, imputed IMD quintile and modality or EDOC were extracted from DID. Cases that did not have full completeness for all these fields were removed: approximately 792,000 (1.8%) cases in 2021/22, compared with 392,000 (1.1%) cases in 2020/21.

Rates were indirectly standardised by applying the national rate by modality or EDOC for each IMD/Sex/Age breakdown to the local CCG population, to obtain an expected rate for each CCG based on their demography. The extent to which the observed rate differed from the expected rate indicated the extent to which the CCG differed from the standard, national rate. A standardised rate for each CCG by modality or EDOC was calculated as:

$$\text{Standardised Rate}_{\text{CCG}} = \left(\frac{\text{Observed Rate}_{\text{CCG}}}{\text{Expected Rate}_{\text{CCG}}}\right) \times \text{National Rate}$$

Indirect standardisation allows each rate to be compared with the national average, but does not allow direct comparison between CCGs. Nevertheless, it can demonstrate regional patterns and indicate the extent of variation.

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[1] Diagnostic Imaging Dataset Annual Statistical Release 2021/22, NHS England and NHS Improvement, 15th December 2022. Available (with tables by CCG) from https://www.england.nhs.uk/statistics/statistical-work-areas/diagnostic-imaging-dataset/diagnostic-imaging-dataset-2021-22-data/

[2] See above publication for definitions of each modality and further details on the collection.

[3] The 2021/22 DID has 2011 LSOA derived from patient postcode, which was matched to 2015 IMD quintiles.

2.2 Results

The national rates[4] of diagnostic imaging tests in 2021/22 per 10,000 people are shown in Tables 1 & 2 below.

Table 1. National Imaging Rates per 10,000 by modality, 2021/22

	X-ray	Ultrasound	CT Scan	MRI	Fluoro-scopy	Nuclear Medicine	PET Scan	SPECT Scan	Medical Photography
Rate per 10,000 people	3,498	1,616	1,079	620	146	53	39	7	9

Table 2. National Imaging Rates per 10,000 by Early Diagnosis of Cancer[5], 2021/22

	Brain MRI	Chest X-ray	Chest CT	Kidney or Bladder Ultrasound	Abdomen or Pelvis Ultrasound
Rate per 10,000 people	135	1,267	110	33	190

All these rates are higher than in 2020/21 due to recovery of imaging activity following the impact of the COVID-19 pandemic.

The rates for some CCGs were impacted by missing data, as outlined in Section 4.1. Rates for some CCGs, especially at the lowest end of the distribution across all modalities, may therefore have shortfalls.

For most CCGs the standardised rate was within 10% of the crude rate, but there are bigger differences particularly in areas with predominantly younger or older populations. The impact of age, sex and deprivation on imaging rates is explored in Section 3.

Standardised 2021/22 rates by CCG are available in Annex B (separate Excel file). The following sections summarise the distribution of rates for each modality or EDOC and illustrate these on a map.

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[4] These national rates exclude activity with missing age, sex, deprivation or CCG (1.8% of overall imaging tests).
[5] Brain MRI may be used to diagnose brain cancer; Chest X-ray and Chest CT to diagnose lung cancer, Kidney or Bladder ultrasound to diagnose kidney or bladder cancer and Abdomen and/or pelvis ultrasound to diagnose ovarian cancer (but this test, and the rates given here, are not restricted to females). Although these tests may be used to diagnose cancer, many have wider clinical uses and it is not possible to distinguish between the different uses of these tests.

2.2.1 X-ray

There was some regional variation in X-ray rates, see Map 1 and Graph 1, with rates generally higher than average in CCGs in the North East and Yorkshire, North West and Midlands regions. The national rate was 3,498 X-rays per 10,000 registered population and 72% CCGs were within one standard deviation of the mean, that is between 3,072 and 4,082 tests per 10,000 population.

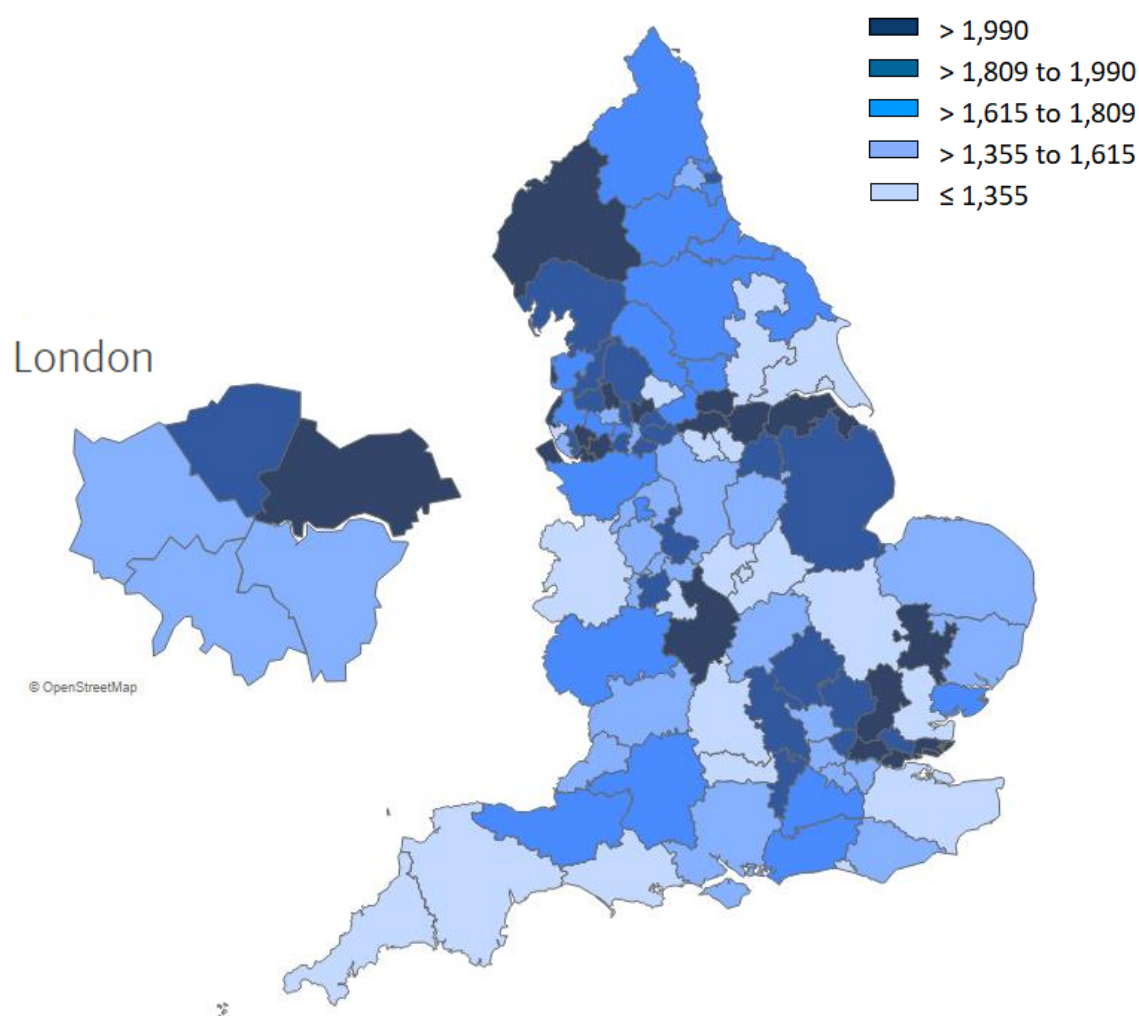**Map 1. Standardised X-ray rates by CCG, 2021/22**
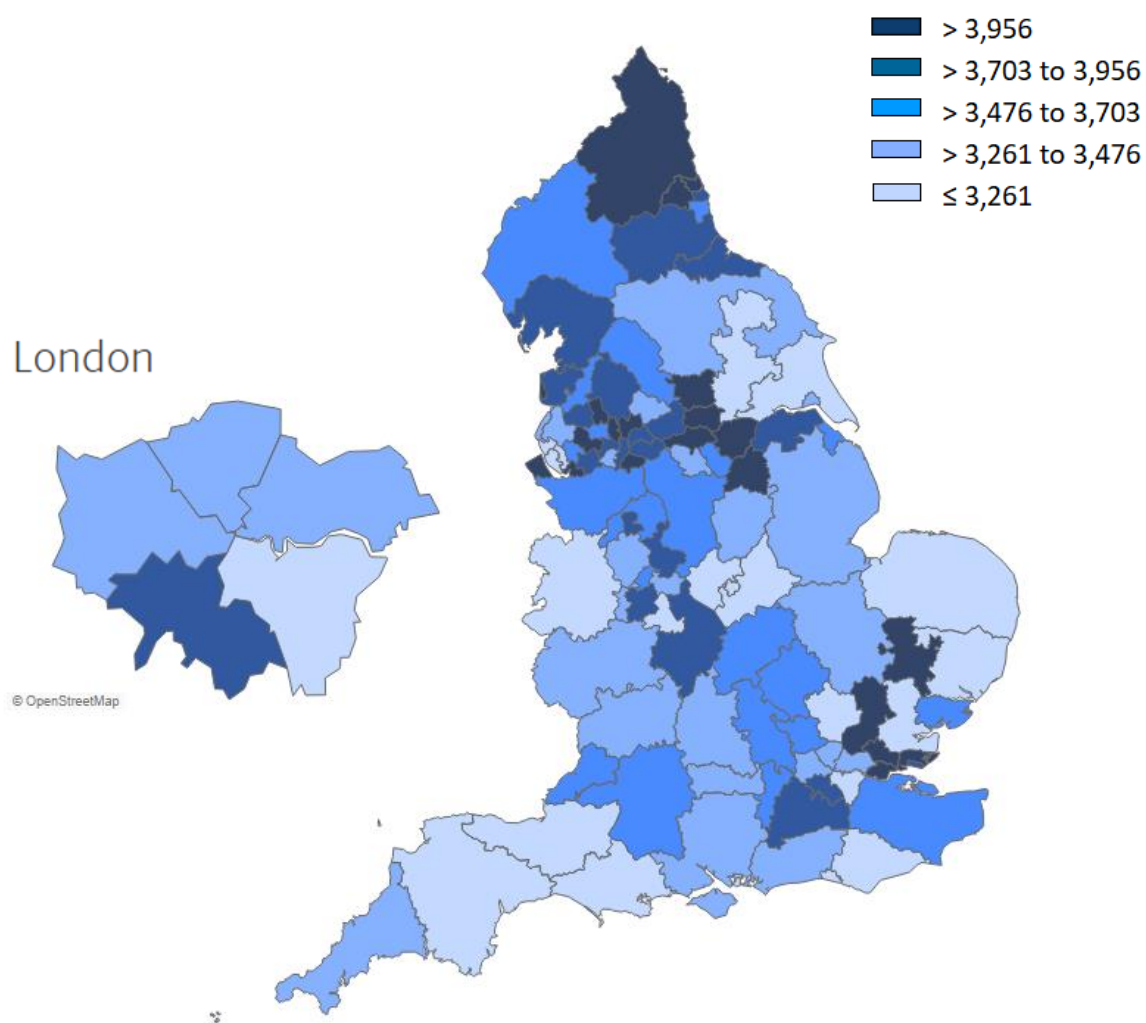
**Graph 1. Standardised X-ray rates by CCG, 2021/22**
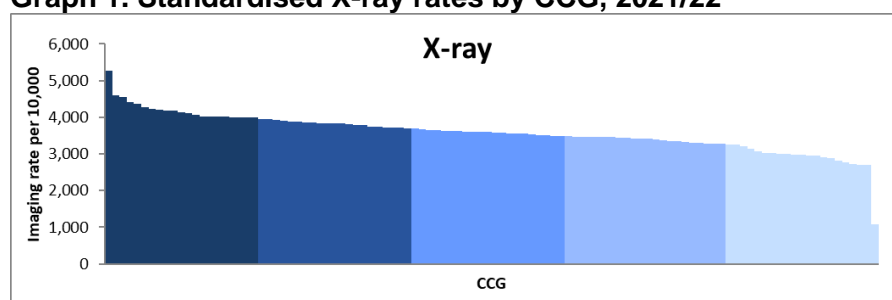
2.2.2 Ultrasound

As with X-ray, Ultrasound showed a concentration of higher rates in CCGs in the North West region (Map 2). Ultrasound does not rise as steeply with age as the other modalities (see Section 3), so most CCGs have similar standardised rates and crude rates per 10,000 population. Nevertheless, the CCG rates varied more than the other major modalities, probably because of differences in the extent to which all ultrasound activity (especially obstetric) is recorded in hospitals' radiological information systems. The national rate was 1,616 ultrasounds per 10,000 population.

**Map 2. Standardised Ultrasound rates by CCG, 2021/22**

**Graph 2. Standardised Ultrasound rates by CCG, 2021/22**
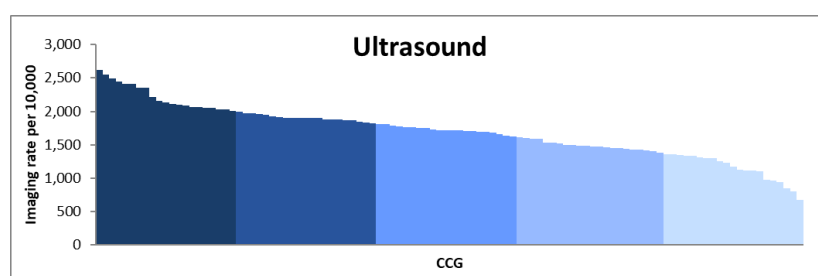
2.2.3 CT Scans

The rate of CT scanning tended to be low in the South West region, but there were areas of both high and lower rates across England (Map 3). Demographics had a large effect on CT scan rates, with only 57% of CCGs having a standardised rate within 10% of their crude rate. The national rate was 1,079 CT scans per 10,000 registered population and 88% CCGs were within one standard deviation of the mean, that is between around 860 and 1,321 tests per 10,000 population.

Map 3. Standardised CT rates by CCG, 2021/22
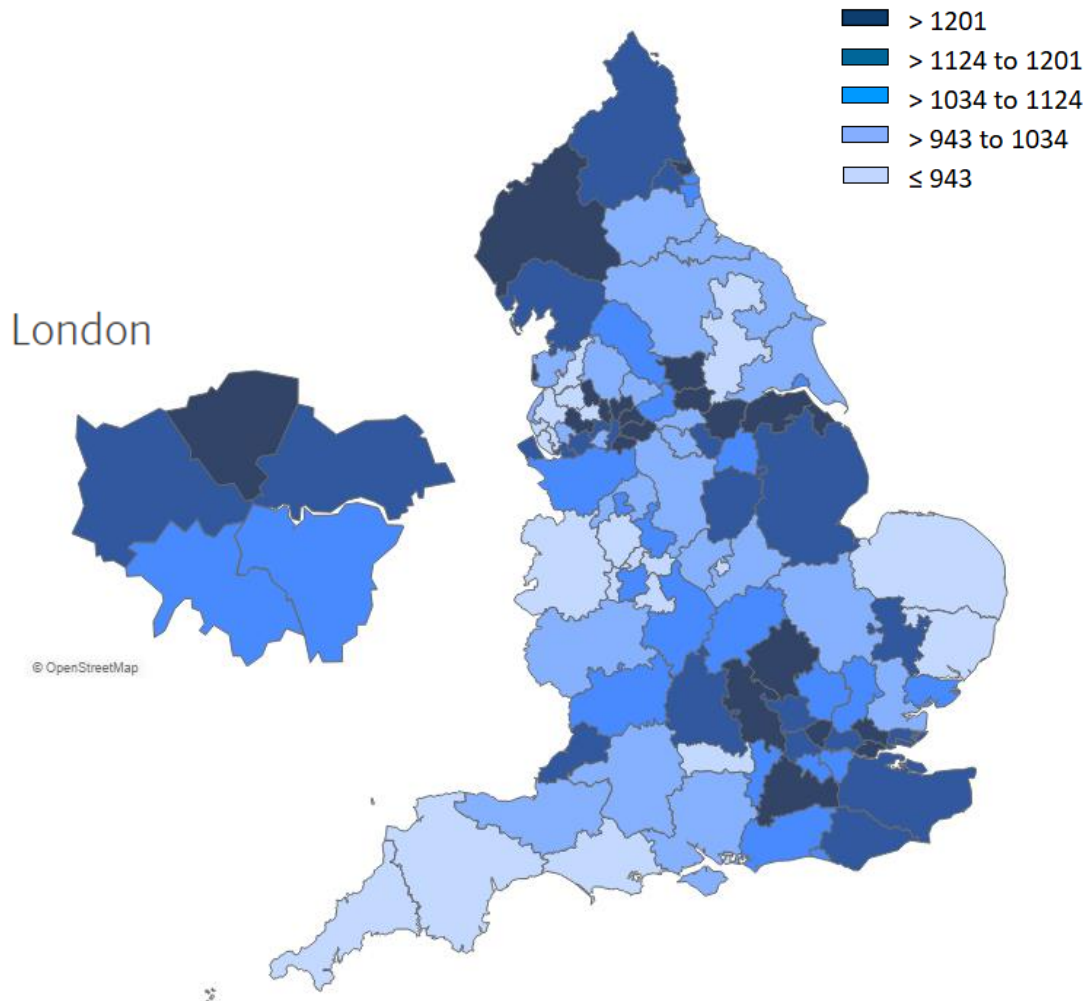
Graph 3. Standardised CT rates by CCG, 2021/22
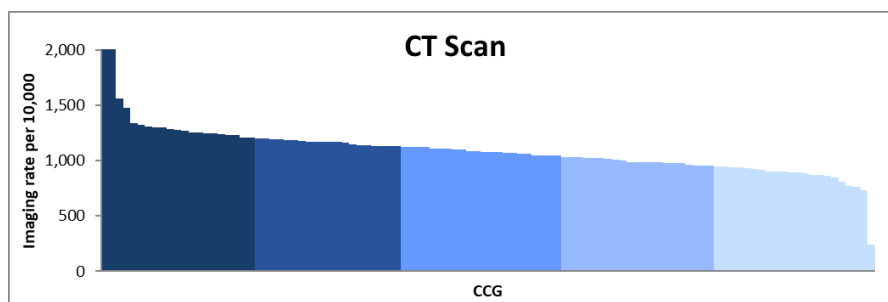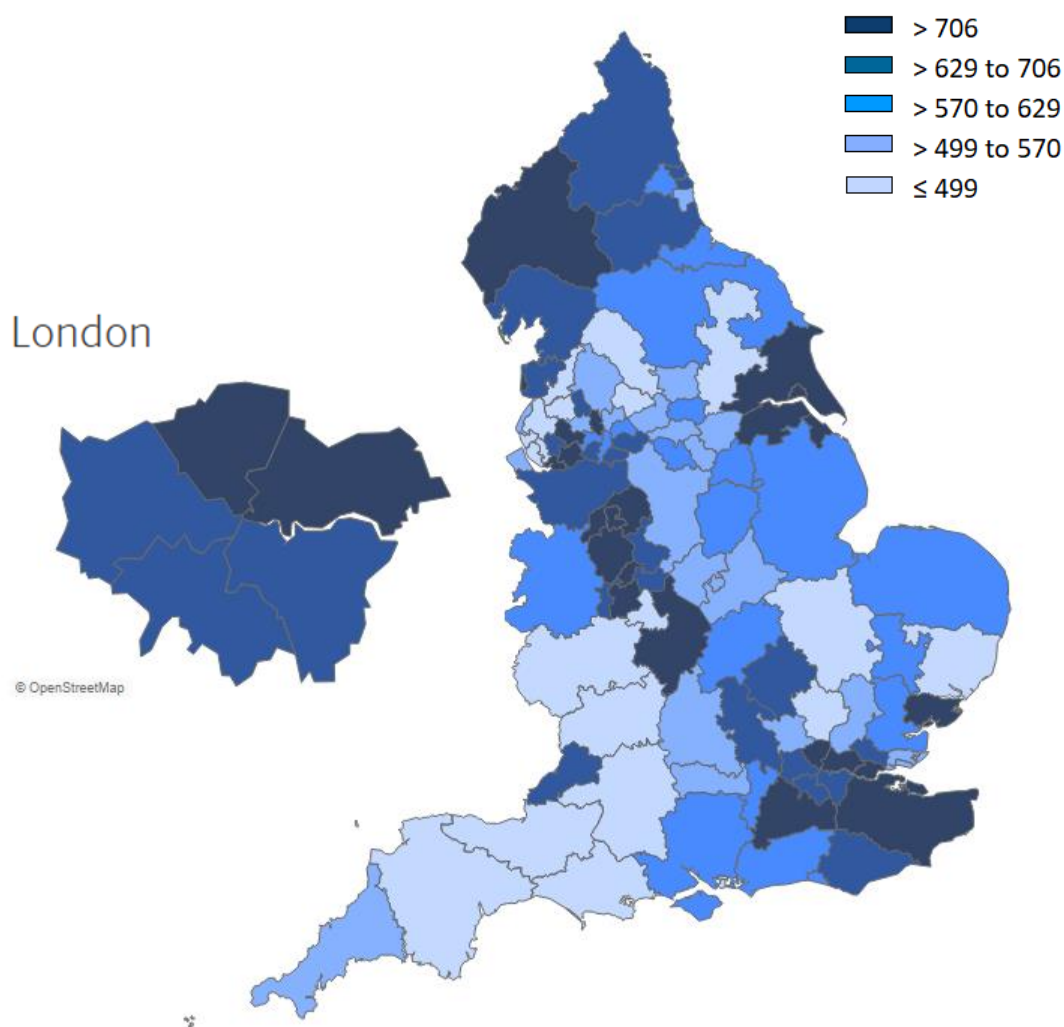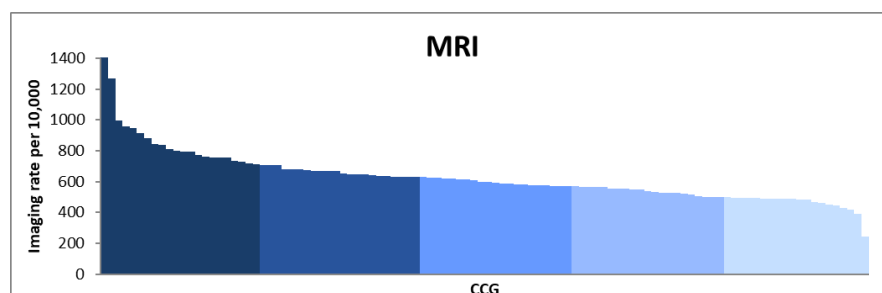
2.2.4   MRI Scans

MRI showed relatively little regional pattern but with a slight concentration of high rates in parts of North East and Yorkshire, the Midlands and Kent and Medway (Map 4). The national rate was 620 MRI scans per 10,000 registered population.

Map 4. Standardised MRI rates by CCG, 2021/22

Graph 4. Standardised MRI rates by CCG, 2021/22

2.2.5 Fluoroscopy

Rates of Fluoroscopy tended to be lower in London (Map 5) but were nonetheless quite variable across England. The national rate was 146 Fluoroscopy scans per 10,000 registered population.

Map 5. Standardised Fluoroscopy rates by CCG, 2021/22
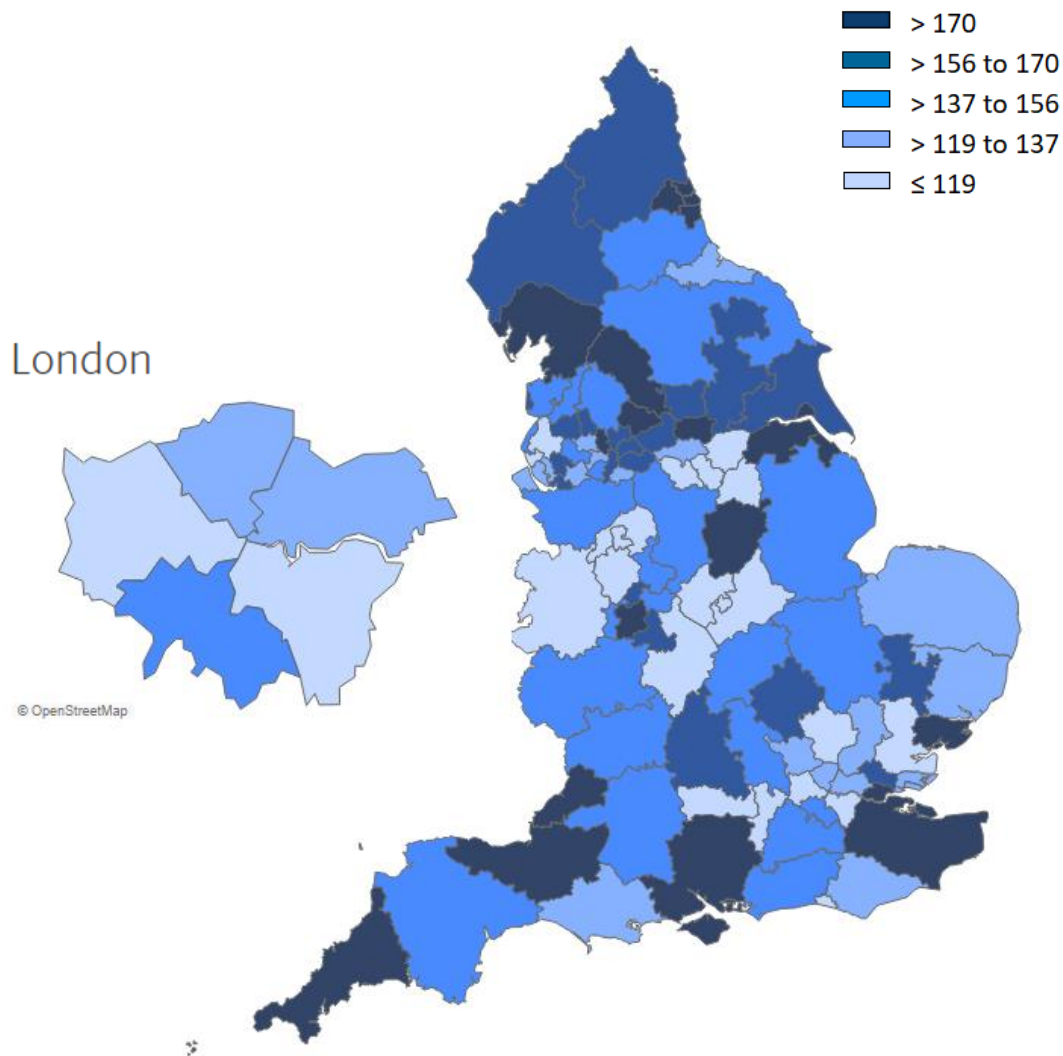
Graph 5. Standardised Fluoroscopy rates by CCG, 2021/22
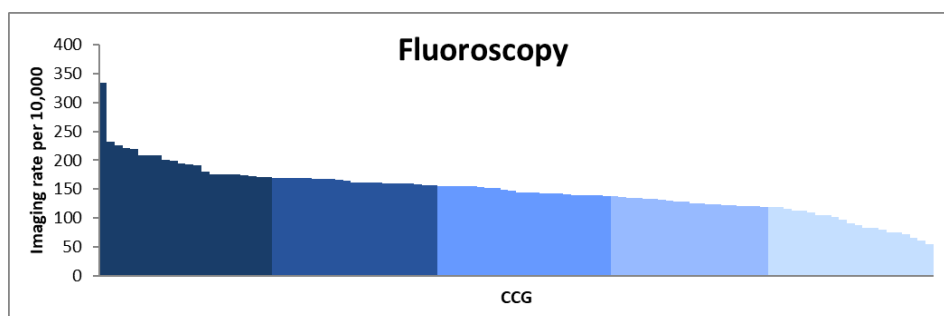
2.2.6 Nuclear Medicine

Nuclear Medicine showed some regional variation, with high rates around the South East and lower rates in parts of the South West and Midlands (Map 6). The national rate was 53 Nuclear Medicine exams per 10,000 registered population.

Map 6. Standardised Nuclear Medicine rates by CCG, 2021/22
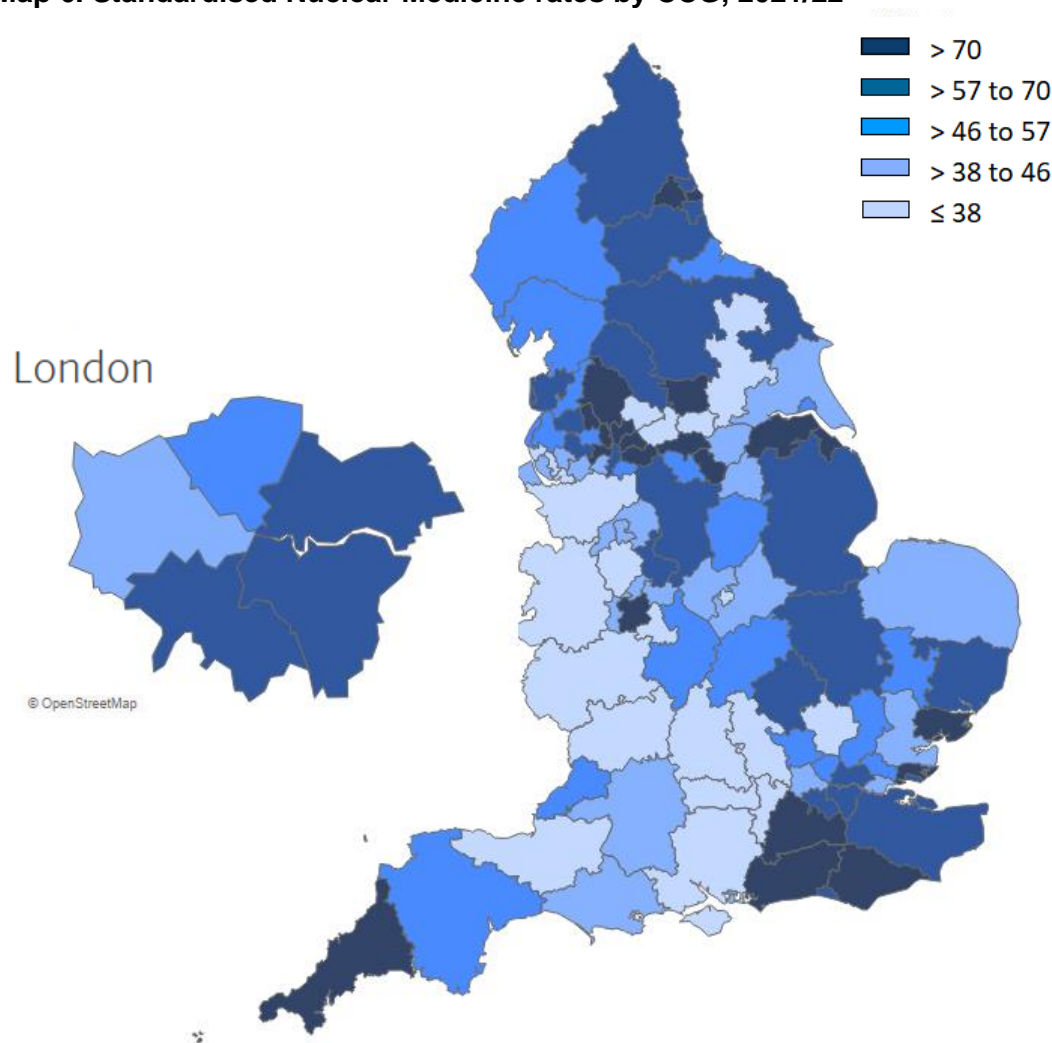
Graph 6. Standardised Nuclear Medicine rates by CCG, 2021/22
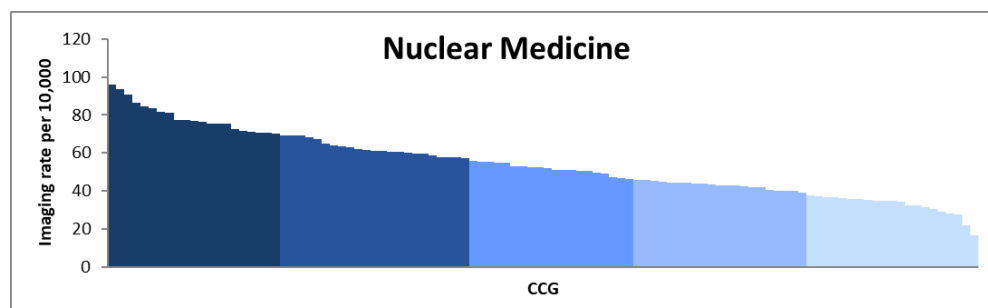
2.2.7 PET Scan

PET scan showed some regional variation, with several clusters of higher rates (Map 7). Some of the variability arose from the relatively small numbers: the national rate was 39 PET scans per 10,000 registered population and 73% CCGs were within one standard deviation of the mean between 21 and 50 tests per 10,000 population.

Map 7. Standardised PET Scan rates by CCG, 2021/22
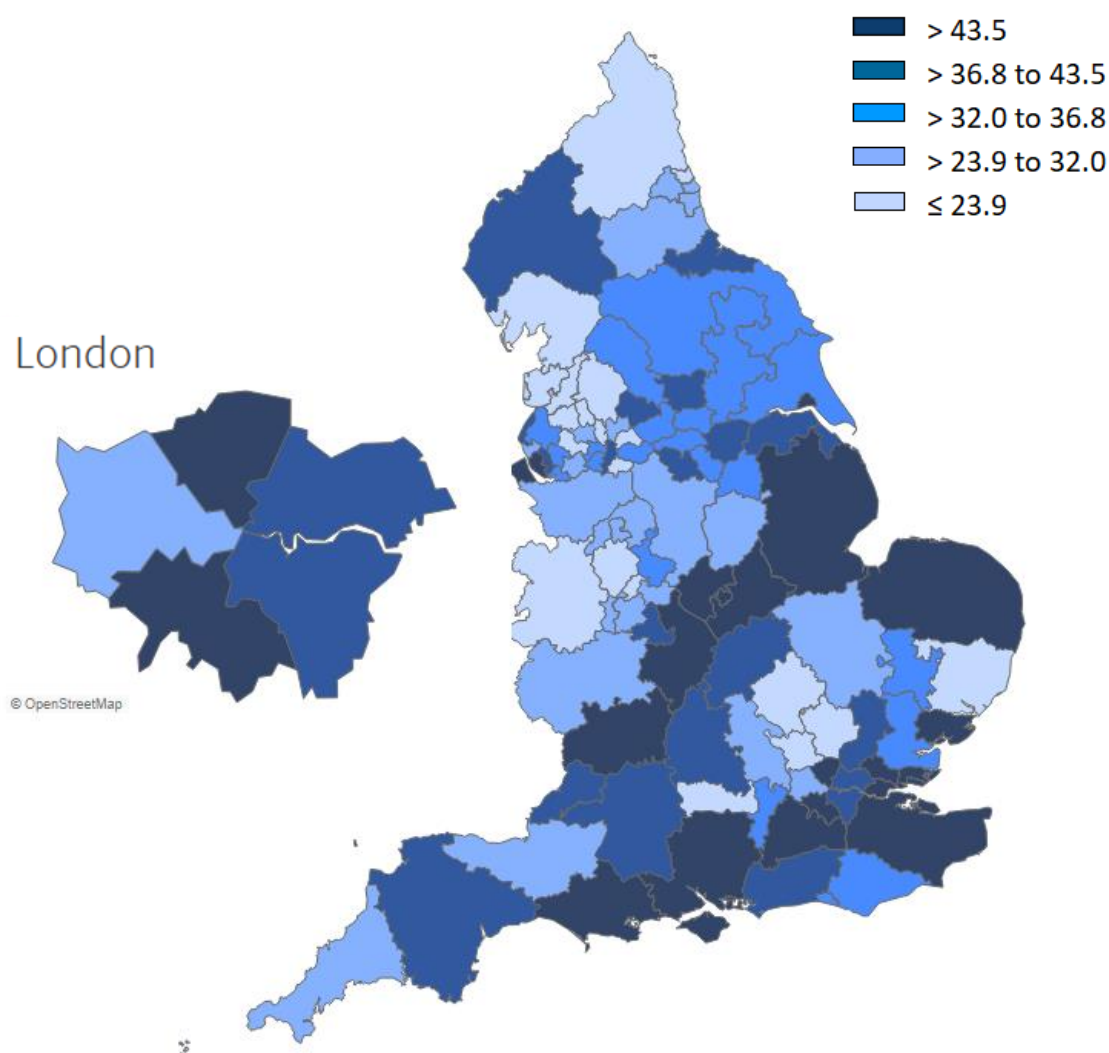
Graph 7. Standardised PET Scan rates by CCG, 2021/22
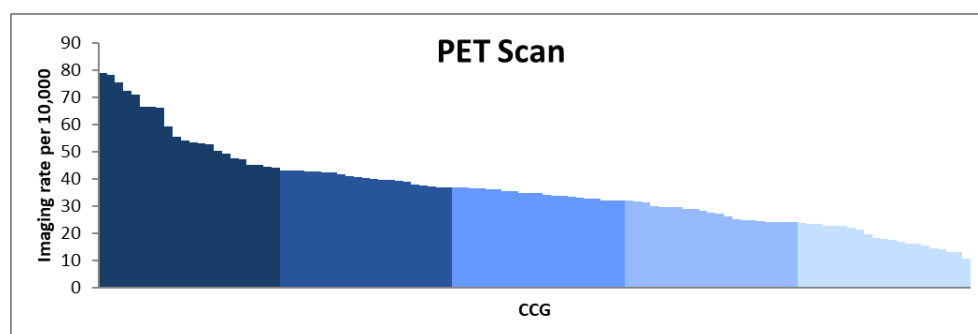
2.2.8 SPECT Scan

SPECT scan showed clusters of high rates, including London, amongst generally low rates (Map 8). The biggest volume providers of SPECT were in Blackburn with Darwen and East Lancashire CCGs, all with rates over four times the national rate. The national rate was 7 SPECT scans per 10,000 registered population but the variance was wide and one standard deviation of the mean extended from 1 to 12 tests per 10,000 population (with 88% CCGs within this range).

Map 8. Standardised SPECT Scan rates by CCG, 2021/22
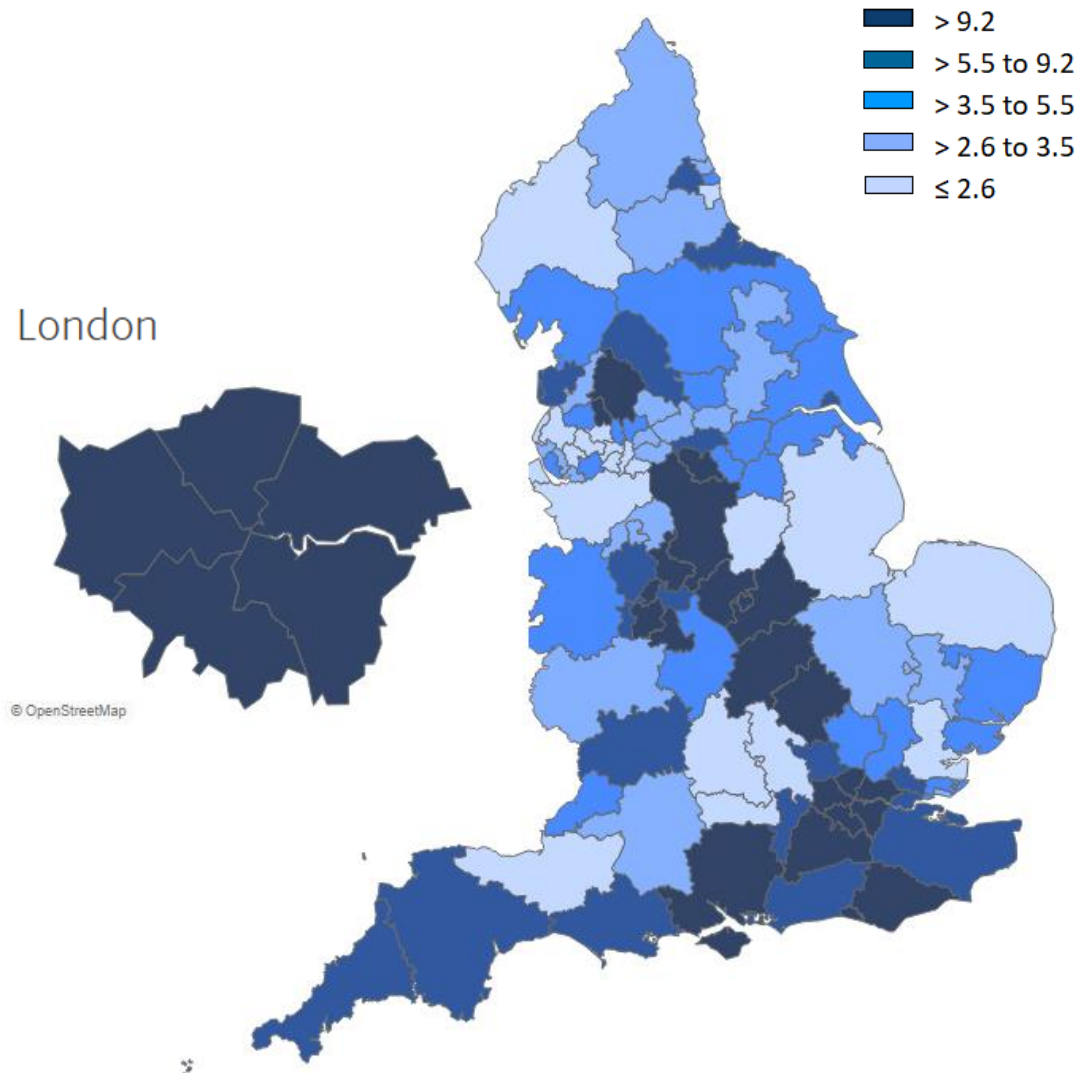
Graph 8. Standardised SPECT Scan rates by CCG, 2021/22
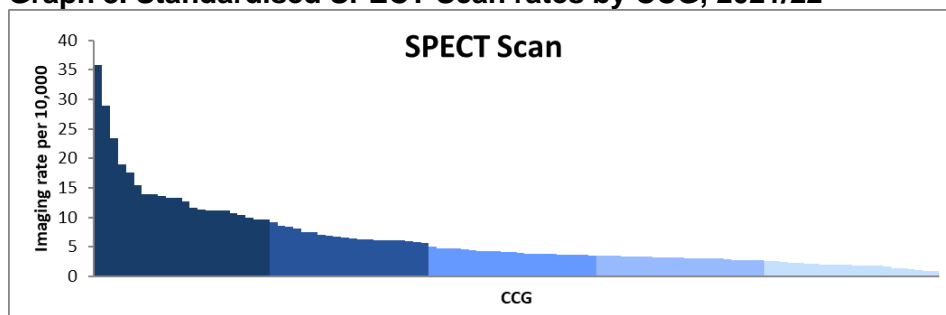
2.2.9 Medical Photography

Medical Photography showed a very marked cluster of high rates in the North West of England and around Surrey, Hampshire and Wiltshire and Norfolk (Map 9). However, only 15 providers nationally reported a rate of more than a few Medical Photography images in the DID, the biggest being James Paget University Hospitals NHS Foundation Trust, Northern Care Alliance NHS Foundation Trust, Royal Surrey County Hospital NHS Foundation Trust and Calderdale and Huddersfield NHS Foundation Trust. Most CCGs had very little reported Medical Photography (Map 9).

Map 9. Standardised Medical Photography rates by CCG, 2021/22
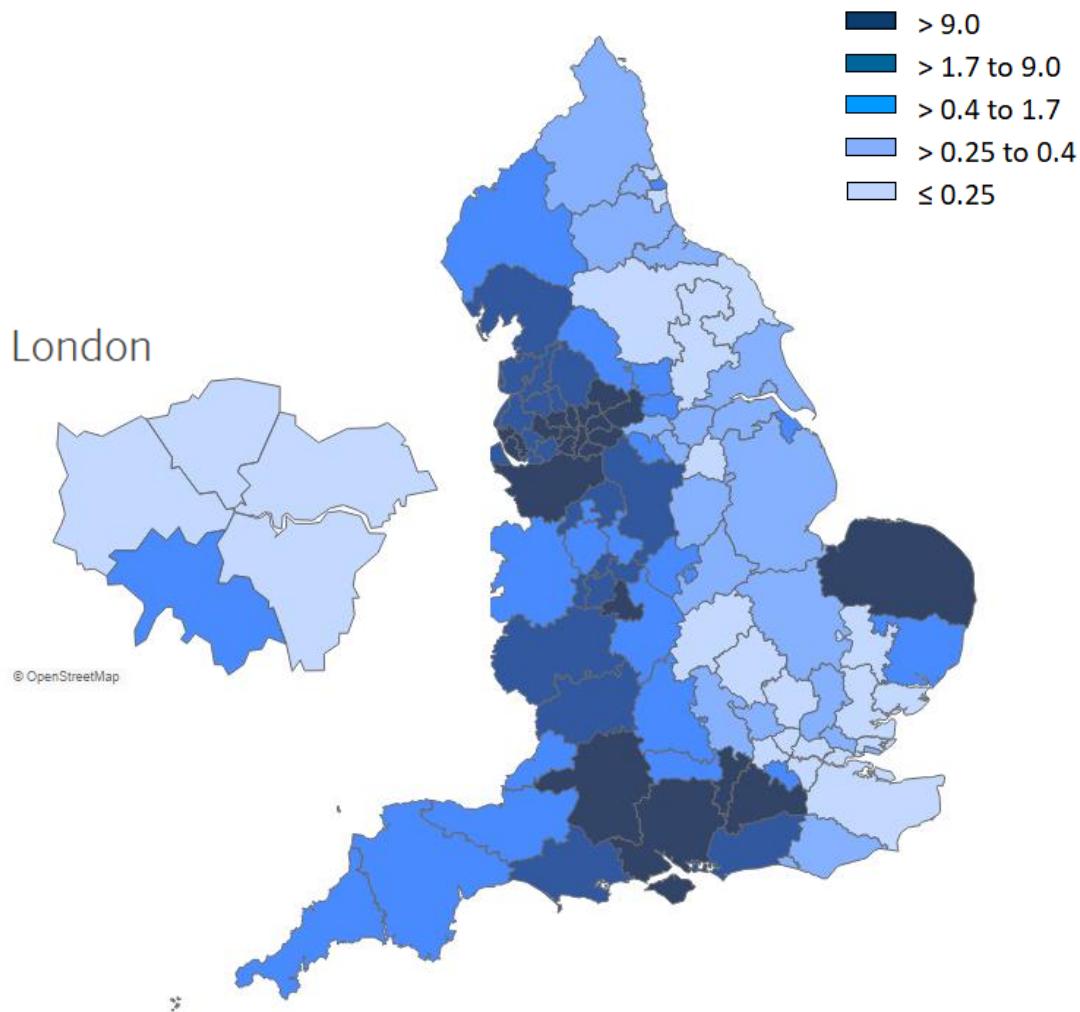
Graph 9. Standardised Medical Photography rates by CCG, 2021/22
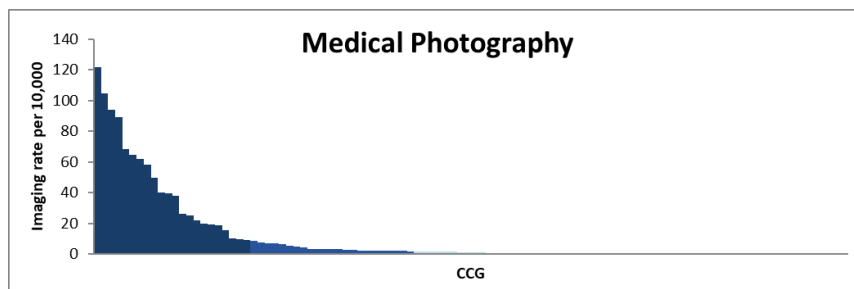
2.2.10 Brain MRI

Brain MRI showed relatively little regional pattern (Map 10), but with high rates in Kent and some areas of the Midlands, as for all MRI (see section 2.2.4). High rates tended to cluster around neighbouring CCGs and many of these areas had at least one high-volume provider, although there were a wide variety of providers of different levels of activity. The national rate was 135 Brain MRIs per 10,000 registered population.

Map 10. Standardised Brain MRI rates by CCG, 2021/22
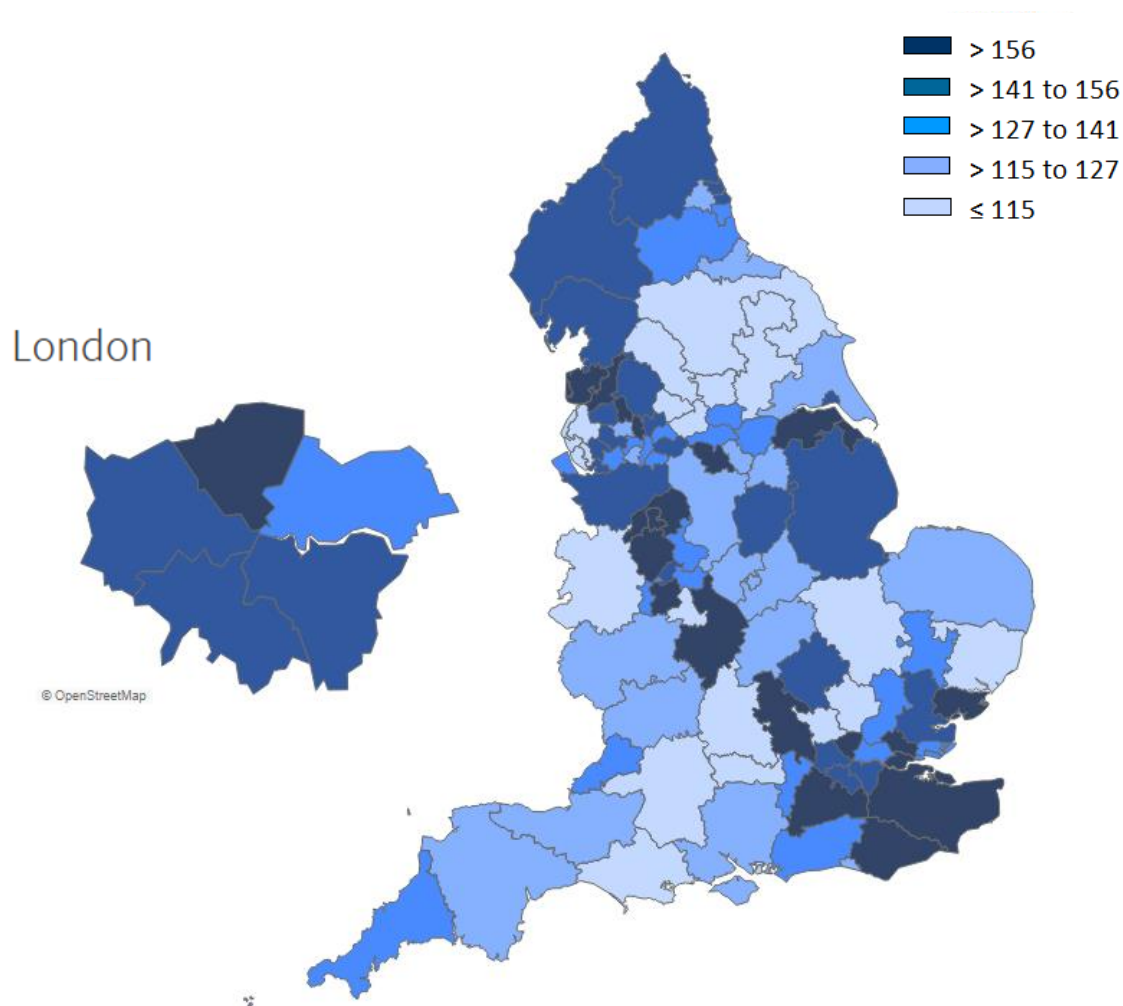
Graph 10. Standardised Brain MRI rates by CCG, 2021/22
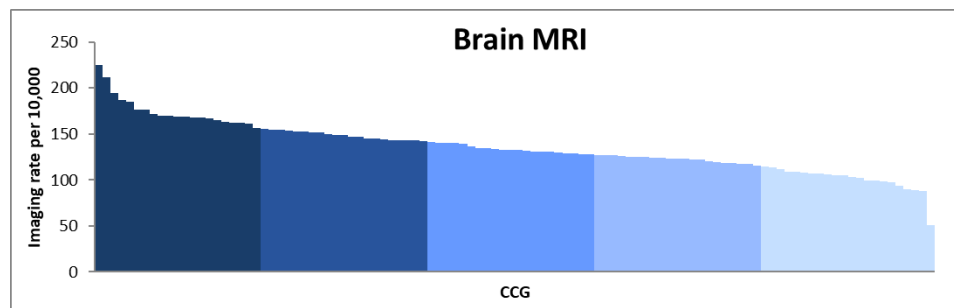
2.2.11 Chest X-ray

Chest X-ray showed less variation across CCGs than the other tests for potential early diagnosis of cancer, with much bigger numbers of tests (Map 11). The national rate was 1,267 Chest X-rays per 10,000 registered population.

Map 11. Standardised Chest X-ray rates by CCG, 2021/22
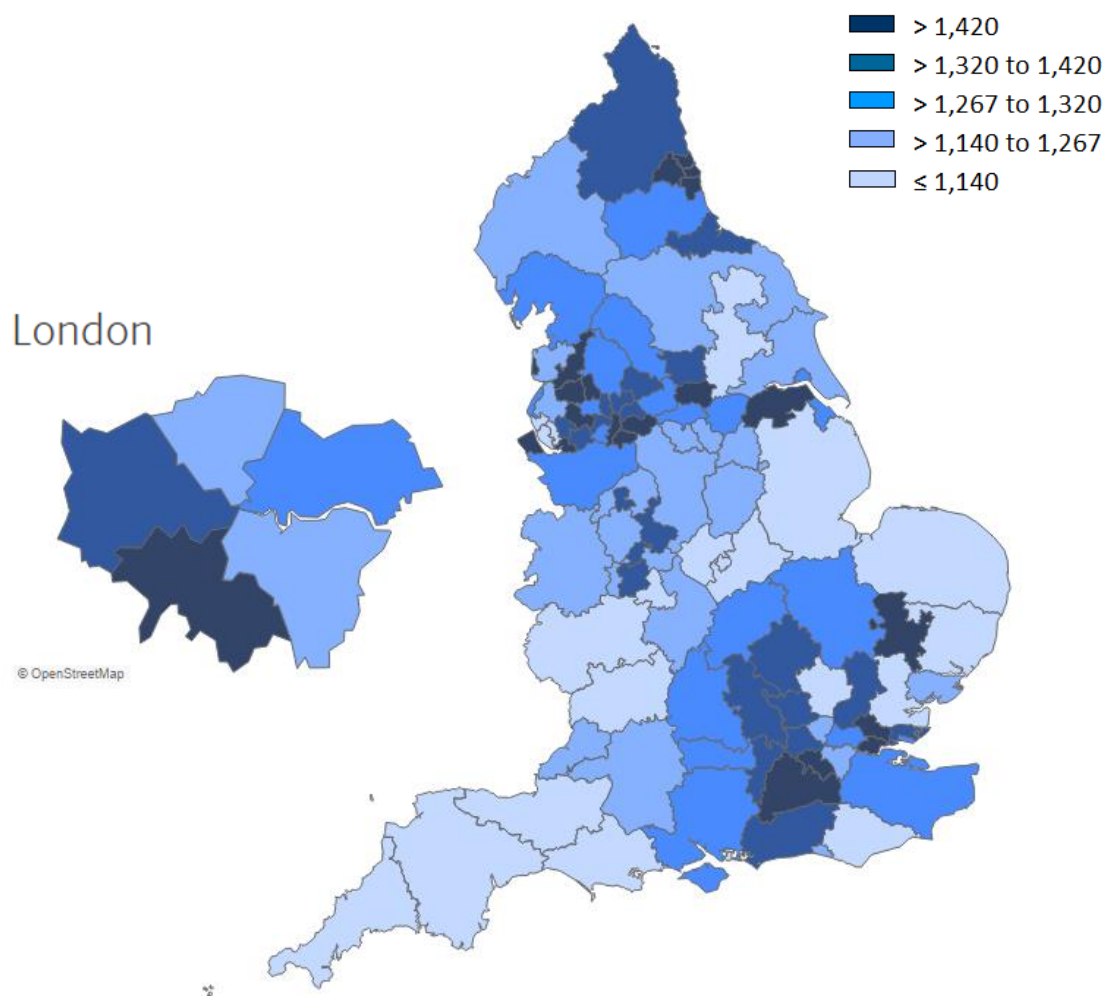
Graph 11. Standardised Chest X-ray rates by CCG, 2021/22
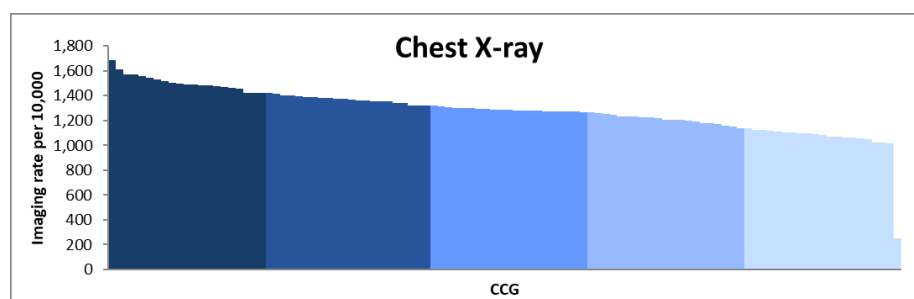
2.2.12 Chest CT

Chest CT showed some regional variation with the highest rates clustered around West and South Yorkshire (Map 12). The national rate was 110 Chest CTs per 10,000 registered population and 86% CCGs were within one standard deviation of the mean, between 63 and 170 tests per 10,000 population. However, five CCGs had more than twice the national rate: NHS North East Lincolnshire, North Lincolnshire, Wakefield, Thurrock and Leeds CCGs.

Map 12. Standardised Chest CT rates by CCG, 2021/22
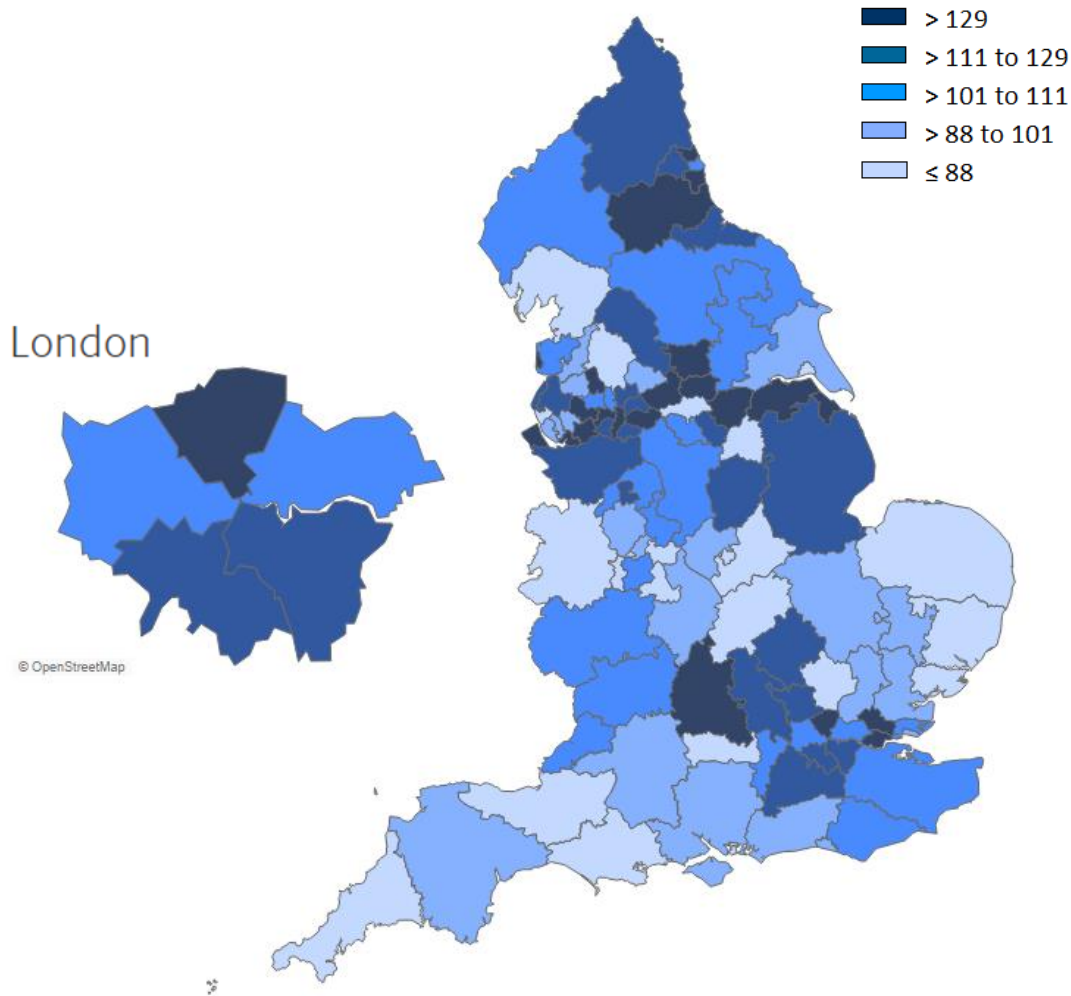
Graph 12. Standardised Chest CT rates by CCG, 2021/22
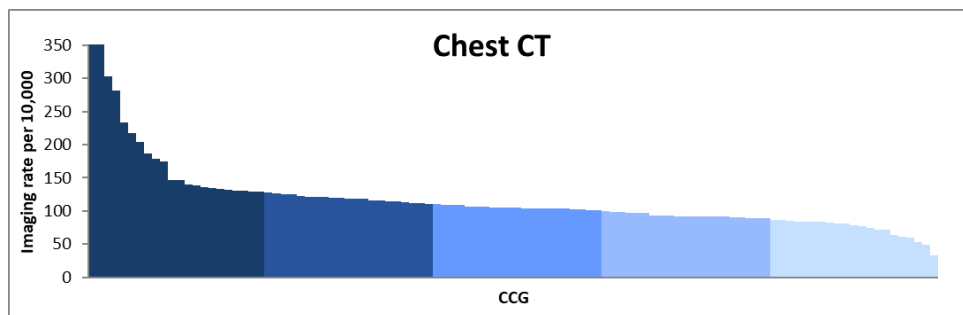
2.2.13 Kidney & Bladder Ultrasound

There was a wider range of rates of Kidney & Bladder Ultrasound than other Early Diagnosis of Cancer (EDOC) tests, with both the lowest and highest rates grouped together in clusters of CCGs (Map 13). The national rate was 33 Kidney & Bladder ultrasounds per 10,000 registered population. One CCG reported rates significantly higher than the national average: NHS Wakefield CCG.

Map 13. Standardised Kidney & Bladder Ultrasound rates by CCG, 2021/22
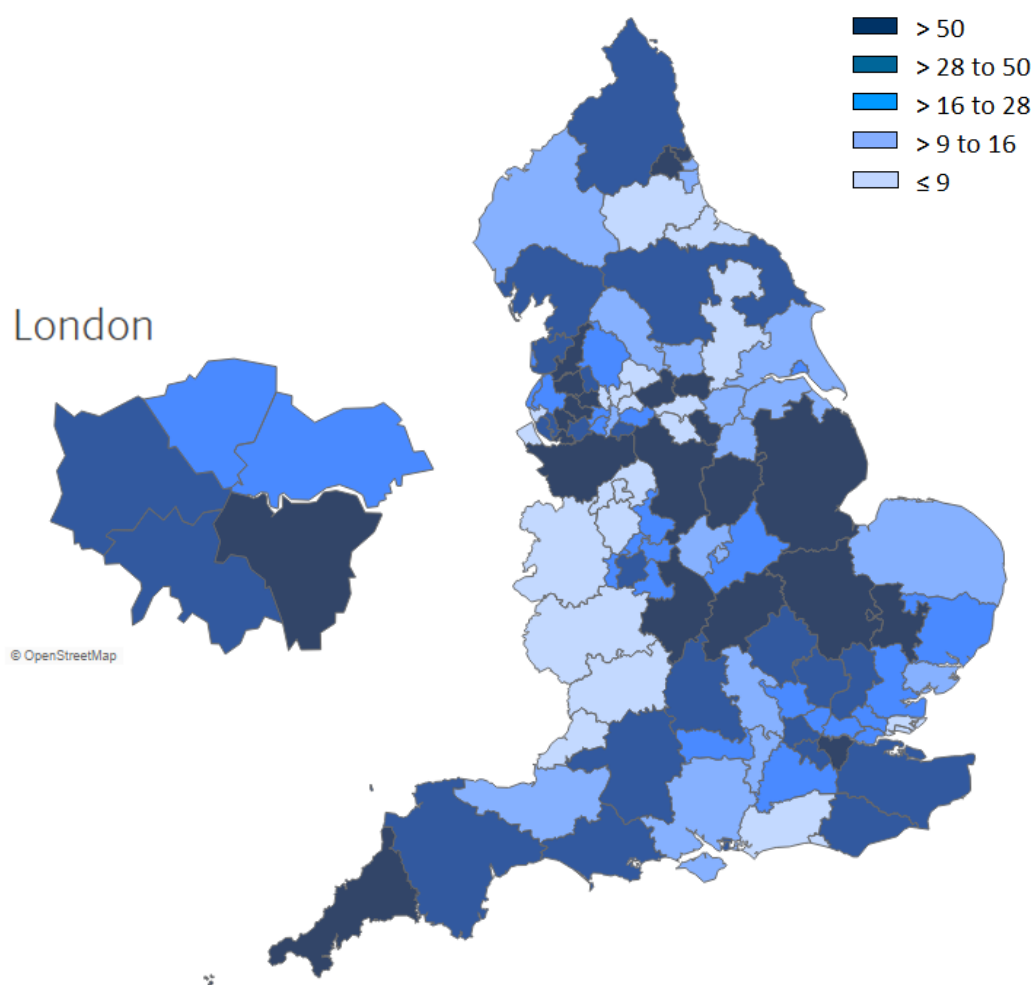
Graph 13. Standardised Kidney & Bladder Ultrasound rates by CCG, 2021/22
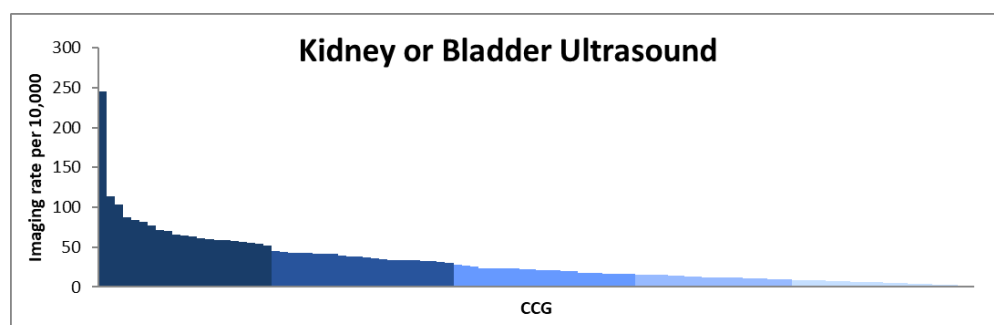
2.2.14 Abdomen & Pelvis Ultrasound

The highest rates of Abdomen & Pelvis Ultrasound were in the North East, especially NHS Sunderland CCG, with relatively few high rates in the South and East (Map 14). The national rate was 190 Abdomen & Pelvis ultrasounds per 10,000 registered population.

Map 14. Standardised Abdomen & Pelvis Ultrasound rates by CCG, 2021/22
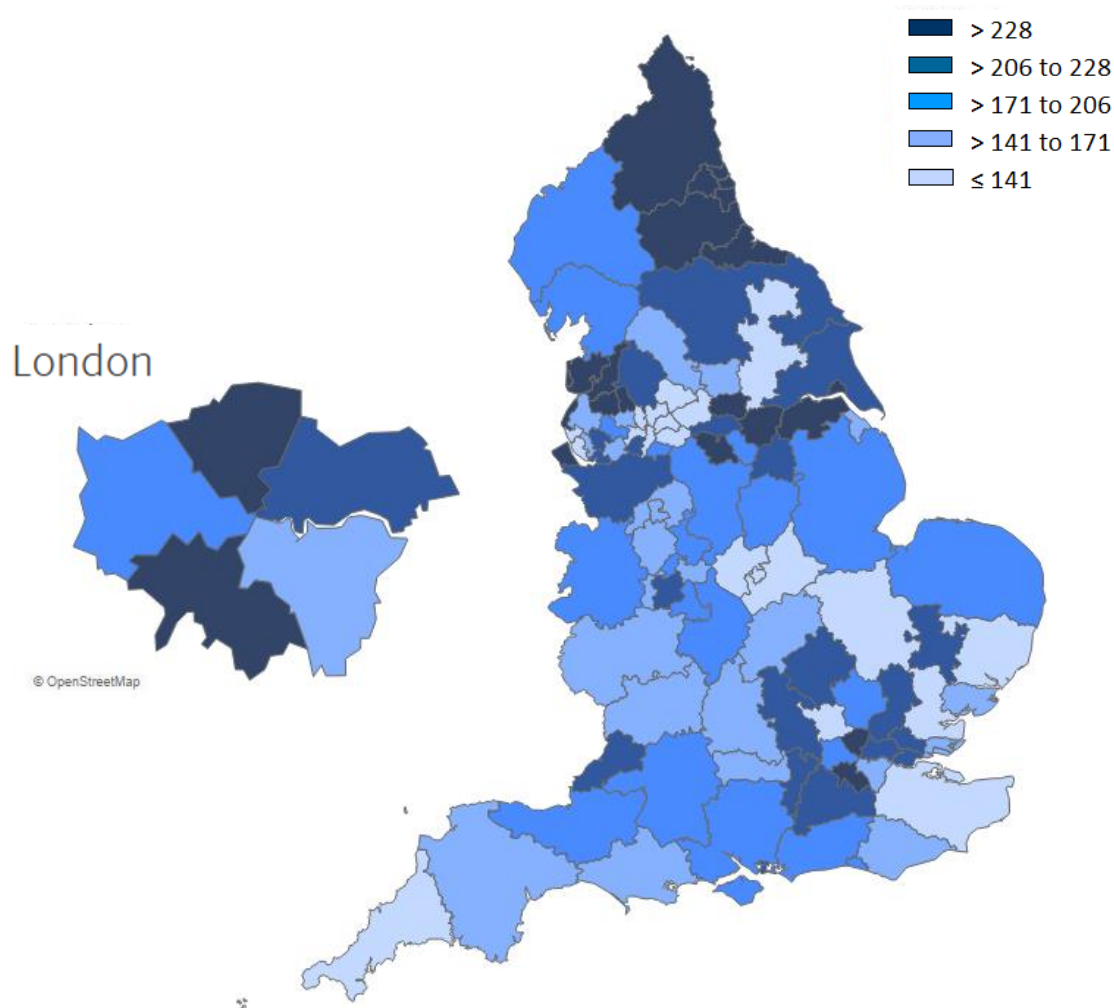
Graph 14. Standardised Abdomen & Pelvis Ultrasound rates by CCG, 2021/22
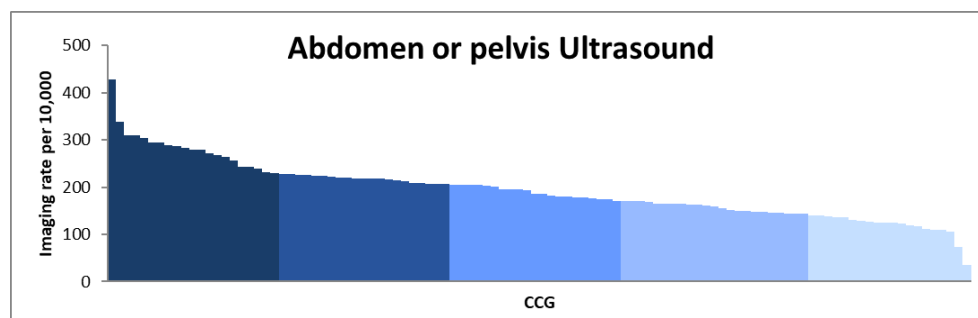
3 Rates Ratios

3.1 Method

Three factors were considered that could have an impact on the rate of diagnostic testing: age (five-year age bands[6]), sex (male and female) and deprivation (quintiles of the Index of Multiple Deprivation). Differences in the distribution of these factors across CCGs might be partially responsible for the differences in crude observed rates between CCGs. Rates ratios were used to demonstrate the impact of each factor on the rate of diagnostic testing, whilst controlling for the others. Significant differences between the rates ratios for each factor suggest that it was worth standardising for these.

National rates of diagnostic testing activity were calculated by two of the three factors at a time, in order to estimate expected values for the third factor (IMD, Sex or Age). For example, if rates ratios were being calculated for IMD, rates were standardised by Sex and Age. This resulted in three sets of standardised rates per 10,000 population. Rates ratios were calculated using the following formula:

$$\text{Ratio} = \frac{r2}{r1}$$

Where
r_1 = standardised rate for the base category (e.g. female)
r_2 = standardised rate for the comparison category (e.g. male)
expressed per unit of population.

So for example the rates ratio for male X-rays was calculated by:

	Standardised rate per 10,000	Rates Ratio
Female	3,808	1.00
Male	3,082	0.81

Note: The base level will always be set to 1 with other levels given as a ratio of this.

In this example, the rate of X-rays was 19% lower in males than females, even after standardising for the effect of age and IMD.

Further statistical analysis of the rates ratios was conducted using Pearson's Chi Square test of significance.

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[6] Although five-year age bands were used for analysis and standardisation, Rates ratios are given for broader age bands.

3.2 Results

3.2.1 Sex

There was variation in the rates of imaging tests by gender, see Tables 1 and 2. As would be expected, the rate of ultrasound tests in men was around a third of that in women (rates ratio = 0.34), however men had a higher rate of Chest X-ray procedures (1.08). Of these rates ratios, X-ray, Ultrasound, MRI, Chest X-ray and Abdomen or Pelvis Ultrasound were found to be significant.

Table 1. Sex rates ratios by modality, 2021/22

	X-ray	Ultrasound	CT Scan	MRI	Fluoro-scopy	Nuclear Medicine	PET Scan	SPECT Scan	Medical Photography
Female	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Male	0.81***	0.34***	0.98	0.81***	1.11	0.84	1.12	0.82	0.98

Table 2. Sex rates ratios by Early Diagnosis of Cancer, 2021/22

	Brain MRI	Chest X-ray	Chest CT	Kidney or Bladder Ultrasound	Abdomen or Pelvis Ultrasound
Female	1.00	1.00	1.00	1.00	1.00
Male	0.79	1.08*	1.17	0.94	0.68***

3.2.2 Deprivation

There appears to be a consistent tendency for areas of highest deprivation to have most imaging tests, see Tables 3 and 4. Deprivation had a significant impact at all levels for X-ray, Ultrasound, CT and Chest X-ray, whilst the three least deprived quintiles were significantly different from the most deprived for Chest CT and Abdomen or Pelvis Ultrasound, and the least deprived quintile was significantly different for Fluoroscopy.

Table 3. Deprivation rates ratios by modality, 2021/22

	X-ray	Ultrasound	CT Scan	MRI	Fluoro-scopy	Nuclear Medicine	PET Scan	SPECT Scan	Medical Photography
1 Most deprived	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2 More deprived	0.91***	0.92*	0.87***	0.97	0.90	0.96	0.94	0.94	0.63
3 Mid quintile	0.84***	0.88***	0.79***	0.93	0.85	0.92	0.92	0.82	0.62
4 Less deprived	0.80***	0.87***	0.74***	0.92	0.81	0.92	0.91	0.85	0.49
5 Least deprived	0.76***	0.84***	0.68***	0.90	0.76*	0.91	0.88	0.88	0.49

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* significant at p < 0.05
** significant at p < 0.01
*** significant at p < 0.001

Table 4. Deprivation rates ratios by Early Diagnosis of Cancer, 2021/22

	Brain MRI	Chest X-ray	Chest CT	Kidney or Bladder Ultrasound	Abdomen or Pelvis Ultrasound
1 Most deprived	1.00	1.00	1.00	1.00	1.00
2 More deprived	0.96	0.85***	0.82	0.96	0.90
3 Mid quintile	0.92	0.73***	0.70**	0.83	0.79*
4 Less deprived	0.90	0.67***	0.66**	0.83	0.74**
5 Least deprived	0.87	0.61***	0.59***	0.74	0.69***

3.2.3 Age

Age has the largest impact on the rates of imaging tests, with the age band of 75 or older showing much higher rates ratios across all modalities and early diagnosis of cancer tests compared with age under 45. All modalities and EDOCs have a significant result for the 65+ age bands and most other age bands were also significantly higher than the 0 to 45 group except for Ultrasound and the modalities with small numbers (SPECT Scan and Medical Photography). Full breakdowns are given in Tables 5 and 6.

Table 5. Age band rates ratios by modality, 2021/22

	X-ray	Ultrasound	CT Scan	MRI	Fluoro-scopy	Nuclear Medicine	PET Scan	SPECT Scan	Medical Photography
0 - <45	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45 - <55	1.67***	0.97	2.90***	2.17***	2.47***	2.70***	5.02***	2.13	1.50
55 - <65	2.23***	0.96	4.43***	2.60***	3.94***	4.43***	10.35***	3.75*	2.27
65 - <75	3.07***	1.09*	7.33***	3.07***	5.89***	7.40***	18.92***	6.89***	4.31**
75+	4.67***	1.22***	12.51***	2.67***	7.34***	8.06***	17.62***	8.27***	10.23***

Table 6. Age band rates ratios by Early Diagnosis of Cancer, 2021/22

	Brain MRI	Chest X-ray	Chest CT	Kidney or Bladder Ultrasound	Abdomen or Pelvis Ultrasound
0 - <45	1.00	1.00	1.00	1.00	1.00
45 - <55	1.87***	2.19***	4.79***	1.37	1.82***
55 - <65	2.27***	3.09***	9.50***	1.69	2.11***
65 - <75	2.93***	4.76***	17.29***	2.60***	2.36***
75+	3.28***	8.46***	20.74***	3.99***	2.42***

4   Annex

4.1   Annex A - Data quality and the impact of missing data

In 2021/22, the CCG of patients in the DID was derived from either their GP Practice code or, where this was missing, the Lower Super Output Area (LSOA) of their postcode. Although resident (LSOA based) CCG may not be the same as responsible (GP Practice based) CCG, with nationally around 7% patients living in a different CCG from their GP Practice, this method improves the coverage of CCG activity.

For the standard modalities, 96.5% imaging tests (42.6 million) had an English CCG based on GP Practice in 2021/22, compared with 96.0% in 2020/21. A further 0.5% (202,000) had a non-English or other valid GP Practice (e.g. prisons and Ministry of Defence practices), 2.8% (1.3 million) had an English CCG derived from LSOA and 0.2% (81,000) were unknown or unidentified.

Providers with more than 10% and 10,000 imaging tests (standard modalities) with no GP Practice are listed at the top of Table A.1. Most of these were allocated to a CCG using LSOA. However, providers with more than 10,000 imaging tests with no GP Practice *or* LSOA from which to allocate CCG are listed at the bottom of Table A.1. Frimley Health NHS Foundation Trust (RDU) exceeds 5% and 30,000 imaging tests with no basis for deriving CCG, contributing to an estimated shortfall of 29,000 (5.3%) in NHS Frimley CCG (D4U1Y). Liverpool University Hospitals NHS Foundation Trust (REM) had 13,000 (2.6%) imaging tests with no basis for deriving CCG, contributing to estimated shortfalls of 11,000 (2.7%) and 4,000 (2.9%) imaging tests respectively in NHS Liverpool CCG (99A) and NHS South Sefton CCG (01T). Nationally, 81,000 (0.2%) imaging tests were omitted from the CCG tables because no valid CCG could be identified.

Table A.1.   Providers with more than 10% and 10,000 imaging tests with no GP Practice in the Diagnostic Imaging Dataset, 2021/22

Provider code and name	Activity with no GP Practice		Of which, activity with no LSOA	
	No. tests	% tests	No. tests	% tests
RWF Maidstone and Tunbridge Wells NHS Trust	368,000	100%	2,400	0.6%
RVV East Kent Hospitals University NHS Foundation Trust	144,400	27%	700	0.1%
RXK Sandwell and West Birmingham Hospitals NHS Trust	86,600	25%	600	0.2%
RFR The Rotherham NHS Foundation Trust	58,100	36%	-	0.0%
RTD The Newcastle Upon Tyne Hospitals NHS Foundation Trust	45,100	10%	500	0.1%
NT9 Alliance Medical	27,700	12%	100	0.0%
RDU Frimley Health NHS Foundation Trust	33,900	6%	33,900	5.7%
REM Liverpool University Hospitals NHS Foundation Trust	17,900	3%	13,300	2.6%

Providers with more than 5% and 5,000 imaging tests (standard modalities) with no age or sex or LSOA (to impute deprivation score) are listed in Table A.2. Nationally, 333,000 (0.8%) imaging tests with a valid CCG were omitted from standardised rates because no deprivation score could be imputed from LSOA, a further 194,000 (0.4%)

had gender missing and a further 2,000 (0.0%) had no date of birth submitted (to impute age band).

Table A.2. Providers with more than 5% and 5,000 imaging tests with no Age or Sex or LSOA in the Diagnostic Imaging Dataset, 2021/22

Provider code and name		Total no. tests	Of which, age, sex or LSOA missing	% missing	Most common missing
REM	Liverpool University Hospitals NHS Foundation Trust	513,100	238,300	46.4%	LSOA
RQ3	Birmingham Women's and Children's NHS Foundation Trust	153,300	62,600	40.9%	Sex
R0A	Manchester University NHS Foundation Trust	816,200	60,800	7.5%	Sex
RAX	Kingston Hospital NHS Foundation Trust	242,300	41,200	17.0%	Sex
RDU	Frimley Health NHS Foundation Trust	598,600	35,900	6.0%	LSOA,Age
RA2	Royal Surrey County Hospital NHS Foundation Trust	226,500	19,500	8.6%	Sex
NTP	Practice Plus Group	112,100	9,800	8.7%	LSOA
NFO	Kleyn Healthcare	6,300	6,300	100.0%	LSOA
RBS	Alder Hey Children's NHS Foundation Trust	64,100	6,000	9.3%	Sex

The CCGs most affected by the omission of LSOA (to impute deprivation score), sex or age are listed in Table A.3. The biggest shortfall is for NHS South Sefton CCG which has standardised rates around 61% lower than expected.

Table A.3. CCGs with more than 5% and 5,000 imaging tests with no Age or Sex or LSOA in the Diagnostic Imaging Dataset, 2021/22

CCG code and name		Total no. tests	Of which, age, sex or LSOA missing	% missing	Most common missing
99A	NHS Liverpool CCG	415,000	93,000	22%	LSOA
01T	NHS South Sefton CCG	127,000	78,000	61%	LSOA
15E	NHS Birmingham and Solihull CCG	824,000	45,000	6%	Sex
01J	NHS Knowsley CCG	143,000	30,000	21%	LSOA
14L	NHS Manchester CCG	468,000	27,000	6%	Sex
02A	NHS Trafford CCG	189,000	15,000	8%	Sex
01V	NHS Southport and Formby CCG	108,000	8,000	8%	LSOA
02G	NHS West Lancashire CCG	91,000	5,000	6%	LSOA

In addition to the list above, some CCGs have reduced rates because of shortfalls in the data submissions of their providers. Details of known data coverage issues by provider are listed in Section 6.1 of the DID Annual Statistical Release 2021-22. The most impactful of these is the missing site activity in October to November 2021 for University Hospitals Dorset NHS Foundation Trust (R0D), which particularly affects rates in NHS Dorset CCG (11J).

The impact of missing data outlined above is larger than in 2020/21, with more CCGs affected, especially at the lower end of the distribution across all modalities. Outliers at the higher end of the distribution may be impacted by providers that tend to report multiple scans individually rather than as a group, but this is not common.

4.2 Annex B - CCG Standardised Imaging Rates per 10,000, 2021/22

See separate excel file (Annex 4a – DID Standardised CCG Rates 2021-22).

4.3 Contact Us

4.3.1 Feedback

We welcome feedback on this publication. Please contact us at england.did@nhs.net

4.3.2 Websites

Further information about the DID dataset can be found on NHS Digital DID website.

The DID Tables and Reports can be found on the NHS England DID website (http://www.england.nhs.uk/statistics/diagnostic-imaging-dataset/).

4.3.3 Additional Information

For press enquiries contact the NHS England Media team on 0113 825 0958 or 0113 825 0959. Email enquiries should be directed to nhsengland.media@nhs.net

The Government Statistical Service (GSS) statistician responsible for producing these data is:

Sheila Dixon
Performance Analysis Team
NHS England
Room 5E24, Quarry House, Quarry Hill, Leeds LS2 7UE
Email: england.did@nhs.net