

## Introduction to the 2<sup>nd</sup> Atlas of Variation in NHS Diagnostic Services in England

In September 2012 a visioning event brought together leaders in diagnostic services from across the NHS to explore what diagnostic services could look like in 2020 and beyond, and how the health system needs to plan and transform to meet the emergent vision.<sup>1</sup> Three principles were identified:

- improving availability and access to information, including access for patients to their own medical records
- acceleration of widespread innovation and adoption which may need ‘technology adoption specialists’ to support spread
- redesign of pathways to support patients to manage their conditions and improve access to services: test new pathways across systems so patients can access diagnostic services in the most appropriate settings for the complexity of their needs from a flexible workforce working across seven days of provision
- recommend for some specific suspected cancer-related symptoms that GPs should consider referral directly to diagnostic testing (to be performed within two weeks), which depending on the symptoms/suspected cancer site could be for X-ray, ultrasound, CT-scan, MRI scan or upper gastrointestinal endoscopy
- new evidence for the effectiveness of early interventions which can improve outcomes
- advances in diagnostic technologies and techniques and adoption and dissemination of new diagnostic services
- recognition, following the 2013 diagnostic services Atlas, that there were shortfalls in provision and/or quality of diagnostic services and responsive increases in provision, quality or change in mode of delivery

The first NHS Atlas of Variation in Diagnostic Services<sup>2</sup>, published in November 2013 was a landmark in bringing together information on geographical variation in diagnostic testing in the disciplines of imaging, endoscopy, physiological diagnostics, pathology and genetics across England. The Atlas showed marked geographical variation in levels of service provision and access.

Since this publication, the demand for diagnostic testing services has continued to rise as a result of:

- increased need for diagnosis due to increased life-expectancy as most diseases increase in incidence and prevalence with age
- people living longer with long-term diseases that require regular monitoring
- an increase in evidence-based guidelines for example the NICE Suspected cancer: recognition and referral guidelines (2015)<sup>3</sup> which in addition to describing the indications for GPs to refer to specialists,

In this 2<sup>nd</sup> Atlas of Variation in NHS Diagnostic Services in England we have updated the indicators in the imaging, endoscopy and physiological diagnostics sections, and added a new section for screening indicators. It was unfortunately not possible, on this occasion, to update the indicators for pathology and genetics services as the data could not be accessed. The indicators in this Atlas are presented to show geographical variation in diagnostic services as before, but the presentation of the maps has changed to show whether the local values are statistically significantly different from the England value. The accompanying column chart shows the range of local values compared with the England value as a whole, together with the statistical significance of each local value.

Static (single-period) thematic maps and column charts are interesting but we recognise that it is important to know whether there is improvement, or deterioration in diagnostic services provision and quality.

<sup>1</sup> Department of Health - Diagnostic Services in 2020 and beyond: Visioning for the future v1.9 (December 2012).

<sup>2</sup> The NHS Atlas of Variation in Diagnostic Services (November 2013). [www.fingertips.phe.gov.uk/profile/atlas-of-variation](http://www.fingertips.phe.gov.uk/profile/atlas-of-variation)

<sup>3</sup> NICE. Suspected cancer: recognition and referral NICE guideline [NG12] (June 2015) [www.nice.org.uk/guidance/ng12](http://www.nice.org.uk/guidance/ng12)

Therefore we have introduced a new form of presentation for this Atlas series: time series box and whisker plots which demonstrate not only whether the level is improving, but also whether the degree of variation between local areas is narrowing. Both are tested statistically. Of course a simple narrowing of variation, even if statistically significant, may not be desirable if, for example, the best worsen, even if the worst get better. It is important to look at the shape of the distribution, in other words the variation around the median, and this too is important for the interpretation. In the time series of box and whisker plots, the change in shape of the distribution of variation can clearly be seen over time, for example in time to brain imaging for stroke patients (Map 4a).

This Atlas is part of a series of NHS Atlases of Variation in Healthcare – the first being published in 2010 as a compendium of indicators and updated in September 2015. There is also a number of specialist atlases of variation in NHS healthcare services for example the NHS Atlas of Variation in Liver Disease<sup>4</sup> which also contains data on diagnostic services.

## Why are we interested in geographical variation in diagnostic services?

In the National Health Service, we are interested to know whether people in different parts of the country have equal access to the same quality of evidence-based NHS services according to their need. We are also interested in the value which NHS services provide so it is important to identify ineffective practice as well, as this can lead to wasted resources and potential patient harm. Ideally we would like to know whether the level of provision of diagnostic services is appropriate and other aspects of the quality of the services. Examples of level of provision and quality indicators are included in this Atlas. For example, maps 4a through to 6b show geographical variation in the quality of a diagnostic service; time taken to imaging (CT scan) for patients admitted with signs and symptoms of stroke compared with the recommended standard which should be one hour from arrival at hospital. Indeed, the time series accompanying maps 4a through to 6b

show marked improvements. Others, for example maps 7 and 8, are indicative showing average time to imaging following admission to hospital with acute trauma to the head or pelvis.

The majority of the indicators in this Atlas are shown at Clinical Commissioning Group (CCG) level. Geographical variation by CCG is important because it is the CCGs who commission health services for their local populations and it is easier to compare the indicators from an equity point of view. It is also important because it reinforces the importance of considering the provision of diagnostic services from a population perspective rather than on the basis simply of their clinical indications. Some of the indicators are shown at provider Trust level and also at upper-tier local authority level.

## Is there a 'right' rate of diagnostic testing?

The assessment of variation in the rates of diagnostic testing is more complicated than the assessment of variation in the rates for a treatment intervention. There are several reasons for this:

- there is often not a clear evidence base
- many diagnostic tests or interventions have a range of disease/condition indications for their use. When there are multiple uses of a test, there may be a clear evidence base for one particular indication for which a level of service could be estimated but there is no evidence base for the total use
- where diagnostic tests are used for conditions which vary in their incidence or prevalence with the demography of the population this needs to be taken into account when determining the appropriate level of testing
- benchmarking can be used against a specific standard, the England value, against the highest in England or against European comparisons, as are given for CT and MRI scanning in the text accompanying maps 1 and 2. However, differences in population demographics make this complex as does the availability of other alternative diagnostic tests for the same conditions

<sup>4</sup> The NHS Atlas of Variation in Liver Disease (March 2013), [www.fingertips.phe.gov.uk/profile/atlas-of-variation](http://www.fingertips.phe.gov.uk/profile/atlas-of-variation)

- several diagnostic tests for example CT scanning or lower GI endoscopy have a range of indications for use not just in diagnosis but also for follow-up monitoring or, in the case of lower GI endoscopy also in population screening for colorectal cancer and surveillance of patients with genetic risk of colorectal cancer
- the introduction of a new method of testing for a specific condition, particularly if the new method is more sensitive, may require a reappraisal of the optimal level of testing

In contrast, to the generality of diagnostic testing there is a particularly strong evidence base underpinning the use of screening tests including evidence on effectiveness, need and level of service provision, risks and costs as well as quality standards<sup>5</sup>. For the screening tests shown in maps 30-38 the aim is to achieve high levels of uptake or adherence with quality standards.

As with everything, it is not always the case that more is better. This is because as in most medical practice, interventions, in this case diagnostic testing, carry risks of harm as well as benefit. For example, there has been concern about the private health sector offering asymptomatic people whole body CT scanning with the rationale to find cancer or other serious problems early. The Committee on Medical Radiation in the Environment (COMARE) highlighted the potential dangers of causing cancer through exposure to radiation and the over diagnosis of conditions which may cause no harm to the patient's health and made strong recommendations against this practice.<sup>6,7</sup>

Avedis Donabedian was the first to highlight the challenges in establishing optimal levels for intervention and demonstrated how at certain levels the benefits of yet more intervention or diagnostic testing plateau and risks increase (Figure 1). This impinges on the value attached

to the intervention. As resources are increased, the value derived from them increases quickly at first, but then the rate of increase slows down (known as the Law of Diminishing Returns). This is because when a new test is introduced to diagnose a problem which previously could not readily be detected there is a large pool of undiagnosed cases. As time goes on the undetected pool reduces in prevalence until only the incident (new) cases are being detected. In other words the benefits plateau. Overuse of tests will not only lead to little additional detection of disease for which treatment is indicated but may be associated with overdiagnosis, increased risk of complications, increased cost, and reduced value. Unlike the curve for benefit which initially rises rapidly and then plateaus, harm is directly proportional to the resources invested. For each unit increase of resources invested<sup>8</sup> each increment of benefit, after the initial impact, decreases whereas each increment of harm remains constant. When the increase in both benefit and harm is plotted on the same graph it reveals the point of optimality at which there is maximum benefit compared with harm.

This phenomenon is elegantly demonstrated with the introduction of new screening tests for cancer and underpins the rationale for why cancer screening tests are not performed every year<sup>9</sup>. As with all health service interventions, diagnostic tests may carry a risk of harm as well as benefit and these will need to be weighed up at an individual level by clinicians and at a population level too. Examples of diagnostic tests where harm has been quantified include mammography<sup>10</sup>, X-rays<sup>11</sup> and CT scanning<sup>6,7</sup> where the risk is from radiation exposure, and colonoscopy, where the risk is of perforation<sup>12</sup>. All screening programmes are introduced after an evidence-based assessment of the relationship between benefit and harm.<sup>9</sup>

<sup>5</sup> National Screening Committee [www.gov.uk/government/groups/uk-national-screening-committee-uk-nsc](http://www.gov.uk/government/groups/uk-national-screening-committee-uk-nsc)

<sup>6</sup> Committee on Medical Aspects of Radiation in the Environment (COMARE). Sixteenth Report. Patient radiation dose issues resulting from the use of CT in the UK. Public Health England: 2014.

[www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/343836/COMARE\\_16th\\_Report.pdf](http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/343836/COMARE_16th_Report.pdf)

<sup>7</sup> Committee on Medical Aspects of Radiation in the Environment (COMARE). Twelfth Report. The impact of personally initiated X-ray computed tomography scanning for the health assessment of asymptomatic individuals. Health Protection Agency: 2007.

[www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/304607/COMARE12thReport.pdf](http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/304607/COMARE12thReport.pdf)

<sup>8</sup> Donabedian A. An Introduction to Quality Assurance In Healthcare. Oxford University Press. 2002.

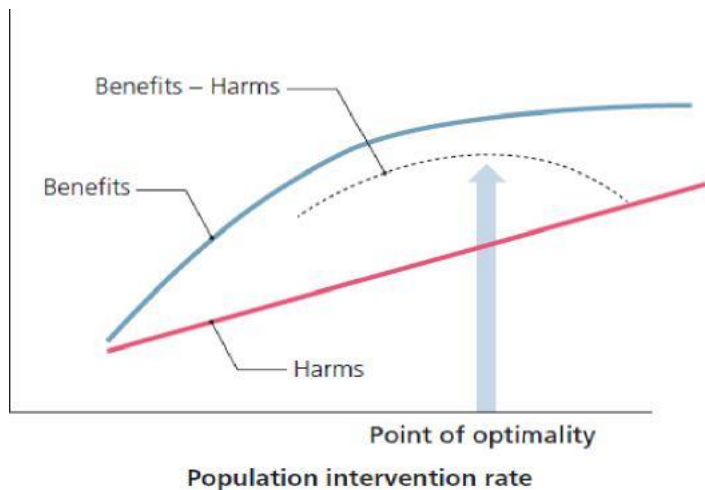
<sup>9</sup> Current UK NSC recommendations: <http://legacy.screening.nhs.uk/screening-recommendations.php>

<sup>10</sup> Løberg et al. Benefits and harms of mammography screening. Breast Cancer Research (2015).

<sup>11</sup> Linet MS, Slovis TL, Miller DL et al. Cancer Risks Associated With External Radiation From Diagnostic Imaging Procedures. A Cancer Journal for Clinicians 2012;62:75–100.

<sup>12</sup> Gavin D, Valori R, Anderson JT, et al. The National Colonoscopy Audit: a nationwide assessment of the quality and safety of colonoscopy in the UK. Gut 2013;62:242–9.

**Figure 1: Donabedian's point of optimality, the point of maximum benefit compared to harm of an intervention for a population**



The overuse of testing or increased sensitivity of tests can also lead to the detection of conditions of uncertain or little pathological significance. This causes anxiety for the patients, an increase in the number of people who become patients and may lead to unnecessary medical intervention. There has been much interest particularly in the US<sup>13</sup>, in the overuse of diagnostic testing. Overdiagnosis was first described in the literature on cancer, and was defined as:

*“a condition is diagnosed that would otherwise not go on to cause symptoms or death”.*<sup>14</sup>

There are several reasons for overdiagnosis, leading to, and in the likelihood of ‘overtreatment’, including:

- the provision of a screening service in the absence of strong evidence of a favourable balance of benefit to harm
- the introduction of new tests and technologies with an increased sensitivity to identify lesions and other functional abnormalities that will not develop into harmful disease within the patient’s lifespan
- the practice of ordering a battery of tests ‘just in case’, sometimes referred to as ‘defensive medicine’

In addition to radiation exposure, over diagnosis was identified as one of the problems of whole

body CT scanning in asymptomatic patients by COMARE<sup>7</sup>. This is also an issue arising from high rates of Prostate Specific Antigen (PSA) testing for prostate cancer<sup>15</sup> which leads to increased rates of detection of early prostate cancer for which the optimal treatment, if any, is uncertain and this is the reason why ‘watchful waiting’ is one of the options for management. An example of the challenges associated with changing the sensitivity of testing associated with the introduction of new diagnostic technology is provided by a study of time trends in pulmonary embolism. It was found that, since the introduction of Computed Tomography Pulmonary Angiography (CTPA), a highly sensitive imaging technology which had been assumed would improve outcomes for people with this disease, there have been changes consistent with overdiagnosis and overtreatment of pulmonary embolism<sup>16</sup>. The introduction of digital mammography as part of the NHS Breast Cancer Screening Programme is another example of the challenges associated with introducing a new diagnostic test with increased sensitivity. This led not only to better detection of early breast cancer but also greater numbers of women with ductal carcinoma in situ (DCIS), a common type of non-invasive breast cancer. It is not clear what the best management should be for women with low or intermediate DCIS and so it is recommended that these women be entered into clinical trials<sup>17</sup>.

Despite the challenges in establishing the optimal level of diagnostic testing at a population level, it is clear from the extent of variation that the reasons for the variation need to be elucidated.

### Warranted variation in diagnostic services

It is important to emphasise that some degree of geographical variation is warranted because different populations have different levels of need. The level of need is largely driven by population demographics, need is often higher in older populations and those which are more socioeconomically deprived and is also dependent on current and historical lifestyle choices. The maps in figures 3, 4 and 5,

<sup>13</sup> Welch HG, Schwartz LM, Woloshin S. Overdiagnosed: Making People Sick in the Pursuit of Health. 2011: Beacon Press

<sup>14</sup> Elmore JG, Fletcher SW. Overdiagnosis in Breast Cancer Screening: Time to Tackle an Underappreciated Harm. *Ann Intern Med* 2012; 156: 536.

<sup>15</sup> Draisma G, Boer R, Otto SJ, et al. Lead times and overdiagnosis due to prostate-specific antigen screening: estimates from the European Randomized Study of Screening for Prostate Cancer. *J Natl Cancer Inst*. 2003; 95 ( 12 ):868 – 878.

<sup>16</sup> Wiener RS, Schwartz LM, Woloshin S. Time Trends in Pulmonary Embolism in the United States: Evidence of Overdiagnosis. *Arch Intern Med* 2011; 171; 831-837.

<sup>17</sup> [www.cancerresearchuk.org/about-cancer/type/breast-cancer/about/types/dcis-ductal-carcinoma-in-situ](http://www.cancerresearchuk.org/about-cancer/type/breast-cancer/about/types/dcis-ductal-carcinoma-in-situ)

which can be found at the end of this section, show how age and socioeconomic deprivation and ethnicity vary geographically.

These demographic factors not only affect need for diagnostic testing but importantly access to testing. Older people, those from areas of higher socioeconomic deprivation and from Black and Minority Ethnic (BME) groups often have poorer access to NHS services.

If diagnostic services accurately reflected need, then a simple map of level of provision would show variation and this, if it mirrored the map for need, would be classified as warranted variation. In an attempt to identify residual variation which is not simply reflecting need but indicates unwarranted variation due to, for example, under- or over- provision, some of the maps in this Atlas have been standardised for age, gender, socioeconomic deprivation and a composite measure of 'need' to attempt to create a more level playing field for comparison (this can be ascertained from the map's title). Standardisation has been undertaken where the prime condition being tested for increases with age and socioeconomic deprivation.

### Unwarranted variation in diagnostic services – does it matter?

In this Atlas we are especially interested in unwarranted variation in NHS diagnostic services. John Wennberg, the pioneer of research into clinical variation and founder of the "Dartmouth Atlas of Health Care", concluded that in the US:

*".. much of the variation .. is accounted for by the willingness and ability of doctors to offer treatment rather than differences in illness or patient preference."*<sup>18</sup>

Wennberg differentiates between warranted variation and unwarranted variation. He defines unwarranted variation in healthcare as variation that cannot be explained on the basis of illness, medical evidence, or patient preference.<sup>19</sup>

In the 2011 King's Fund report "Variations in Health Care – the Good, the Bad and the Inexplicable"<sup>20</sup>, the authors concluded that:

*"the existence of persistent unwarranted variations in health care directly impacts on equity of access to services, the health outcomes of populations and efficient use of resources"*.

### The impact of underuse of diagnostic tests

Underuse of diagnostic tests may result from under provision, failure of clinicians to refer patients appropriately or problems in patient access. Diagnostic tests are used to help confirm or refute the diagnosis of a condition in patients presenting to their doctors with signs or symptoms. They are also used in asymptomatic patients either as screening tests or for surveillance to monitor for progression of disease. Underuse of diagnostic services can prevent the early recognition and diagnosis of disease or the identification of changes in its severity. In the worst case for a patient this can lead to late-stage diagnosis and premature death; even in the best case it can lead to a longer and more costly stay in hospital or frequent visits to a general practitioner. In a study of patients presenting with acute abdominal symptoms, surgical outcomes were improved by earlier access to and increased use of CT scanning.<sup>21</sup>

As described above, sometimes there are patient factors which act as obstacles to accessing services, these may include: language barriers, poor health literacy, economic factors or travelling times. These differences in access are unwarranted as they may result in inequalities in health outcomes, despite provision of diagnostic testing being adequate. These patient factors which are barriers to access may be masked by the standardisation used to adjust for variation in need, as both need, and patient-related access issues, can both depend on the same demographic characteristics.

Some of the maps in this Atlas clearly illustrate that there are significant geographical access issues especially where services are delivered by specialist centres. Maps 1, 10, 12, 13, 14, 15, 22, 23, 25 and 26 show evidence of problems with access to specialist diagnostic services.

<sup>18</sup> Wennberg J. Tracking Medicine: A Researcher's Quest to Understand Health Care. Oxford University Press. 2010

<sup>19</sup> Right Care. NHS Atlas of Variation in Healthcare, November 2010. [www.rightcare.nhs.uk/atlas/](http://www.rightcare.nhs.uk/atlas/)

<sup>20</sup> Appleby J, Raleigh V. Variations in Health Care – the Good, the Bad and the Inexplicable. The King's Fund. 2011. [www.kingsfund.org.uk/publications/healthcare\\_variation.html](http://www.kingsfund.org.uk/publications/healthcare_variation.html)

<sup>21</sup> Symons NR, Moorthy K, Almoudaris AM et al. Mortality in high-risk emergency general surgical admissions. British Journal of Surgery 2013; 100; 1318-1325. doi: 10.1002/bjs.9208. Epub 2013 Jul 17. [www.ncbi.nlm.nih.gov/pubmed/23864490](http://www.ncbi.nlm.nih.gov/pubmed/23864490)

## The impact of overuse or inappropriate use of diagnostic tests

As described above, it is important to also bear in mind that sometimes variation may also represent over- or inappropriate provision of a diagnostic test or increased sensitivity of a diagnostic process.

Map 18 is the most notable example of inappropriate use in this Atlas, showing those CCGs where barium enema is still being used for the diagnosis of lower gastrointestinal problems even though this should be replaced by lower gastrointestinal endoscopy. Interestingly, Figure 2 shows that there is almost no association between the rate of lower GI endoscopy (colonoscopy plus flexible sigmoidoscopy) and the rate of barium enema.

Over- or inappropriate use always wastes resources and sometimes causes harm.

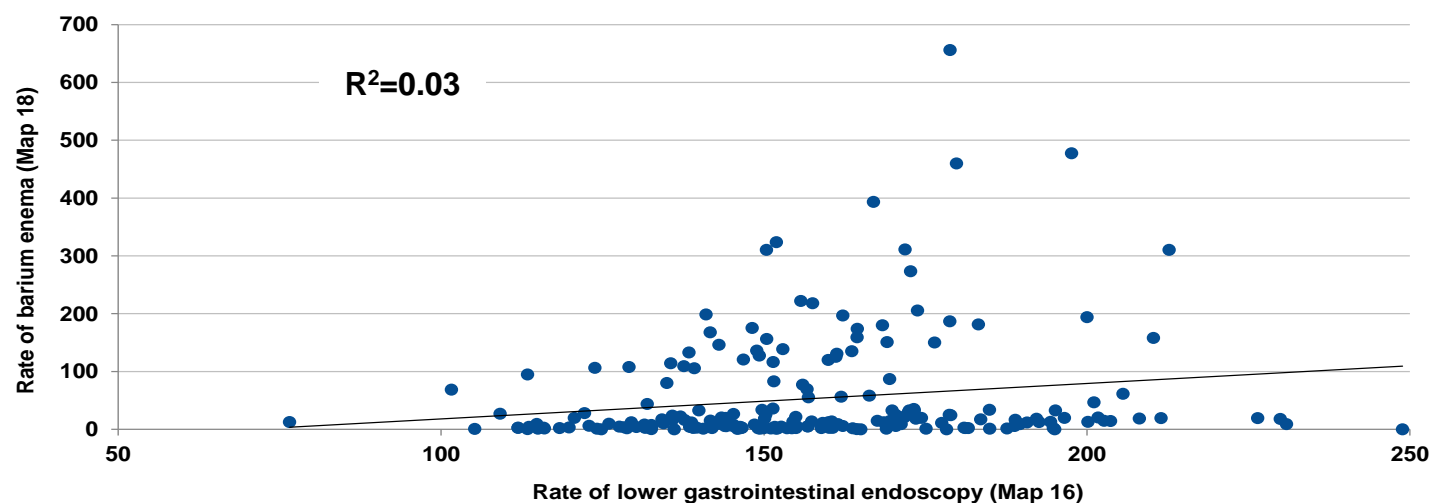
While there are systems of checks and controls in the NHS, including evidence-based referral guidelines to limit the inappropriate use of testing, the NHS often has to deal with the consequences of over-testing in the private sector in the follow-up and reassurance of the

people who have been screened in the private sector.

Despite the continuing policy drive to reduce unwarranted variation, there is evidence it persists as a result of the combination of many factors, thereby preventing the NHS from achieving the full potential of improved outcomes and increased value. This is unacceptable, as highlighted in five major recent publications, all of which underline the need to reduce unwarranted variation:

- “NHS Five Year Forward View”<sup>22</sup>
- “Delivering the Forward View: NHS planning guidance 2016/17-2020/2021”<sup>23</sup>
- “From evidence into action: opportunities to protect and improve the nation’s health”<sup>24</sup>
- “Protecting resources, promoting value: a doctor’s guide to cutting waste in clinical practice”<sup>25</sup>
- Lord Carter of Coles’ independent review “Operational productivity and performance in English NHS acute hospitals: Unwarranted variations”<sup>26</sup>
- “Leading Change, Adding Value. A framework for nursing, midwifery and care staff”<sup>27</sup>

**Figure 2: Scatterplot of the 2014/15 rate of colonoscopy procedures and flexible sigmoidoscopy procedures per 10,000 population (Map 16) vs the 2015/16 rate of barium enema procedures per 100,000 weighted population (Map 18) by CCG**



<sup>22</sup> NHS England, Care Quality Commission, Health Education England, Monitor, Public Health England, Trust Development Agency. Five Year Forward View. October 2014. [www.england.nhs.uk/wp-content/uploads/2014/10/5yfv-web.pdf](http://www.england.nhs.uk/wp-content/uploads/2014/10/5yfv-web.pdf)

<sup>23</sup> NHS England, NHS Improvement, Care Quality Commission, Health Education England, NICE, Public Health England. Delivering the Forward View: NHS planning guidance 2016/17-2020/21. 22 December 2015. [www.england.nhs.uk/wp-content/uploads/2015/12/planning-guid-16-17-20-21.pdf](http://www.england.nhs.uk/wp-content/uploads/2015/12/planning-guid-16-17-20-21.pdf)

<sup>24</sup> Public Health England. From evidence into action: opportunities to protect and improve the nation’s health. October 2014. [www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/366852/PHE\\_Priorities.pdf](http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/366852/PHE_Priorities.pdf)

<sup>25</sup> Academy of Medical Royal Colleges. Protecting resources, promoting value: a doctor’s guide to cutting waste in clinical practice. November 2014. [www.aomrc.org.uk/wp-content/uploads/2016/05/Protecting\\_Resources\\_Promoting\\_Value\\_1114.pdf](http://www.aomrc.org.uk/wp-content/uploads/2016/05/Protecting_Resources_Promoting_Value_1114.pdf)

<sup>26</sup> Lord Carter of Coles. Operational productivity and performance in English NHS acute hospitals: Unwarranted variations. An independent report for the Department of Health by Lord Carter of Coles. February 2016.

[www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/499229/Operational\\_productivity\\_A.pdf](http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/499229/Operational_productivity_A.pdf)

<sup>27</sup> NHS England. Leading Change, Adding Value. A framework for nursing, midwifery and care staff. May 2016. <https://www.england.nhs.uk/wp-content/uploads/2016/05/nursing-framework.pdf>

## Does unwarranted variation in diagnostic testing matter to patients?

People in the local population, especially those who are patients or their carers, need to be assured that service providers are addressing their needs. Therefore, they are likely to be concerned about the existence of unwarranted variation and its consequences. If people experience a several-fold difference in their chance of being diagnosed promptly, of receiving the right care to control symptoms or prevent deterioration, of being admitted to hospital as an emergency or of dying prematurely, and if this variation is largely dependent on where they live or on which general practice they are registered with, they have a right to ask why and to demand better.

The key to meeting these challenges is:

- understanding the concept of variation and its causes
- identifying variation, and ascertaining whether it is warranted or unwarranted and if unwarranted, what the causes are
- reducing unwarranted variation in quality, safety and outcome, and in activity and cost
- in reducing unwarranted variation, the aim is to maximise the value – the relationship between overall outcomes and all costs, including opportunity costs – of healthcare resources both for individual patients and for populations

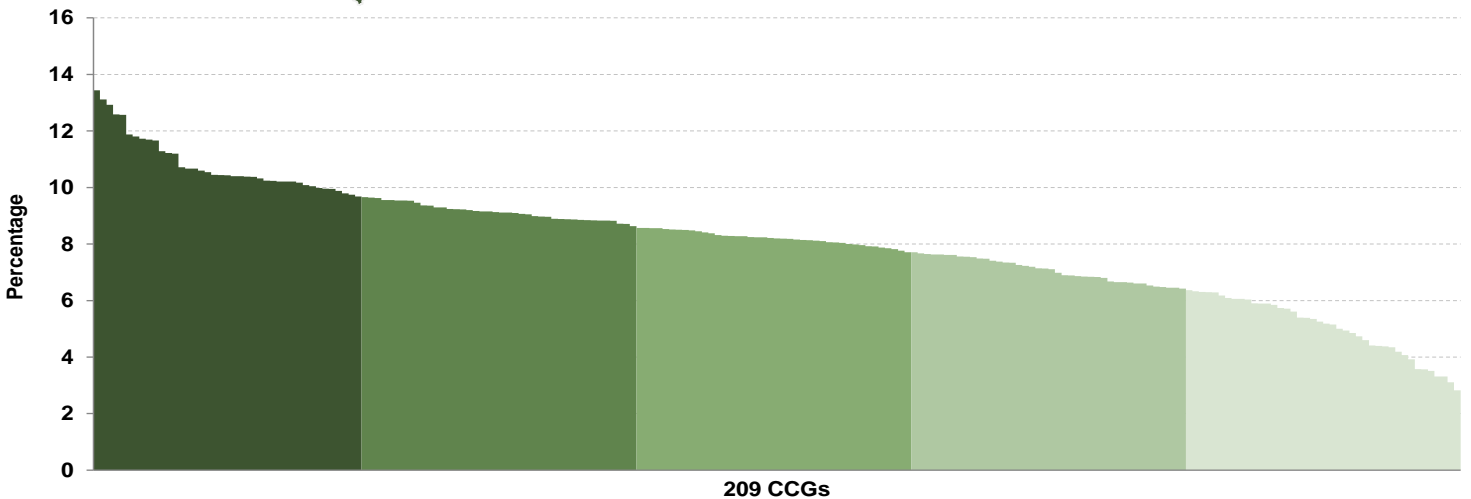
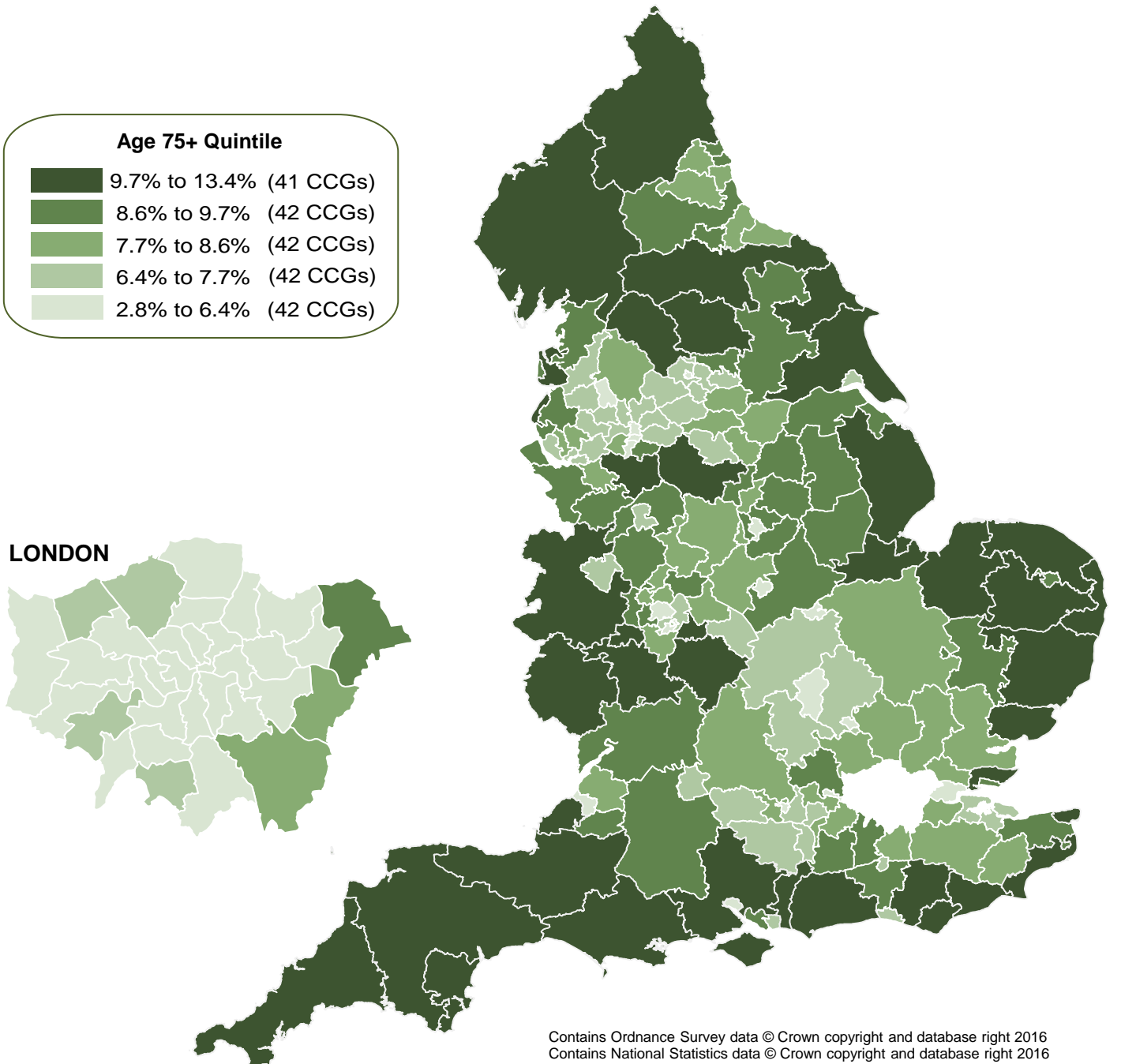
As it is expected that the demand for diagnostic tests will continue to increase, the resources needed to fund such developments will have to be shifted from lower value activities. To facilitate this resource shift it is essential that diagnostic services are viewed as population based services. This is already true of screening programmes.

## Planning for the future

The visioning event for leaders in diagnostic services in NHS held in September 2012 created the vision for 2020 and beyond.<sup>1</sup> Overall, the vision for diagnostic services for 2020 was that of an innovative, technologically enabled, integrated service providing the highest quality, convenience and timeliness for patients from a range of locations, in order to accelerate accurate diagnosis, appropriate treatment

intervention, and recovery. This Atlas shows, not only the current level of statistically significant variation in quality or provision, but importantly also trend data. The trend data also uses statistical significance testing to assess trend in the England overall value and the spread of variation. Policy makers and local decision makers can use this Atlas to assess progress towards the 2020 and beyond vision. In 2016, we are half way through this anticipated period of change, and while this Atlas shows improvements since 2013, there are still wide variations in levels of service provision and quality which need to be addressed. Commissioners perhaps less frequently monitor the costs of diagnostic services compared with treatment costs, but this will need to change if they are to make business cases to change service provision. The future of diagnostic services is one where the service user will be at the heart of service design, delivery and evaluation.

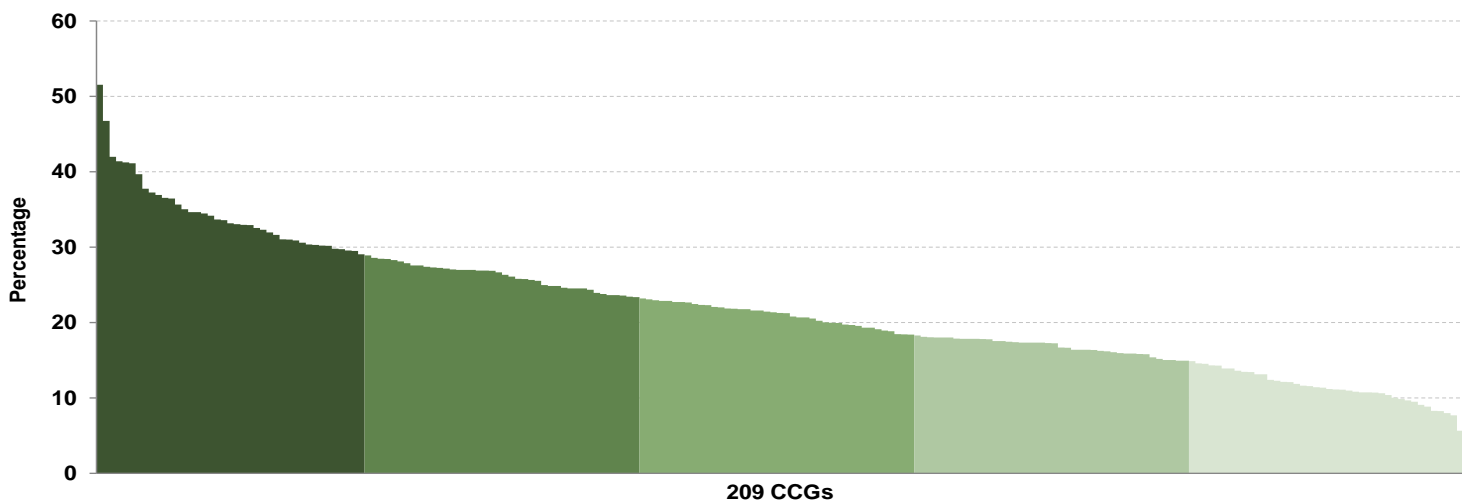
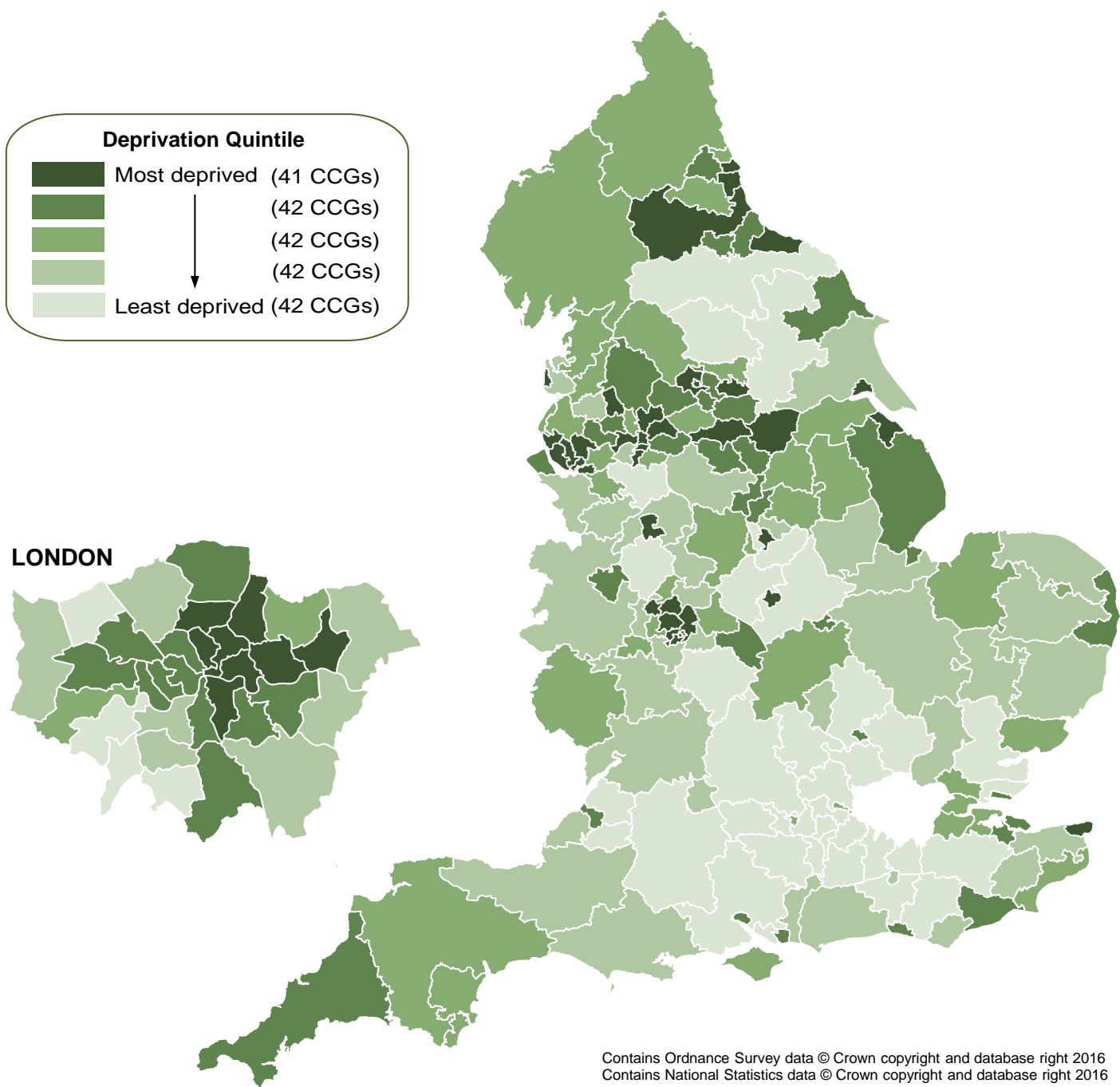
**Figure 3: Percentage of the population aged 75 years and over CCG quintiles<sup>28</sup>**



<sup>28</sup> Office for National Statistics 2014 mid-year population estimates (2011 Census based)

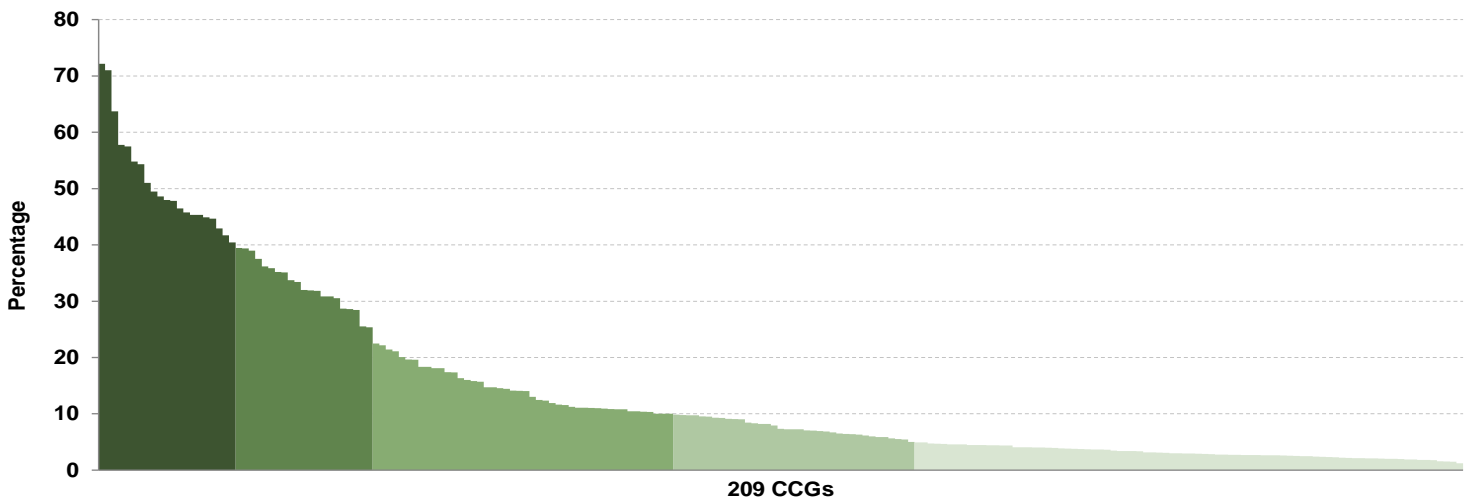
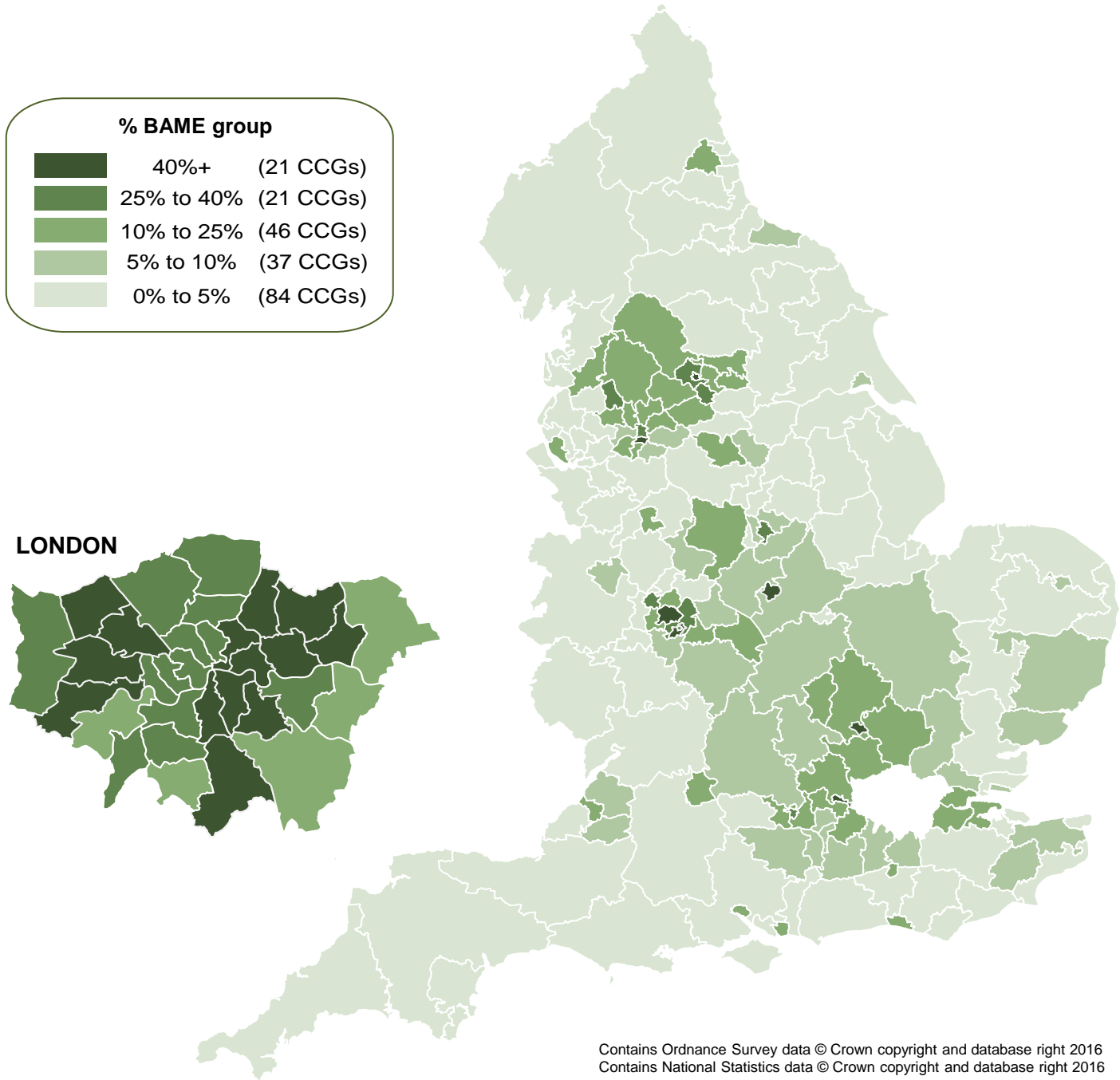


**Figure 4: Index of Multiple Deprivation 2015 average LSOA score CCG quintiles<sup>29</sup>**



<sup>29</sup> Department for Communities and Local Government, Indices of Deprivation 2015

**Figure 5: Percentage of the population with Black, Asian and Minority Ethnic group by CCG<sup>30</sup>**



<sup>30</sup> The Office for National Statistics, 2011 Census, table KS201EW