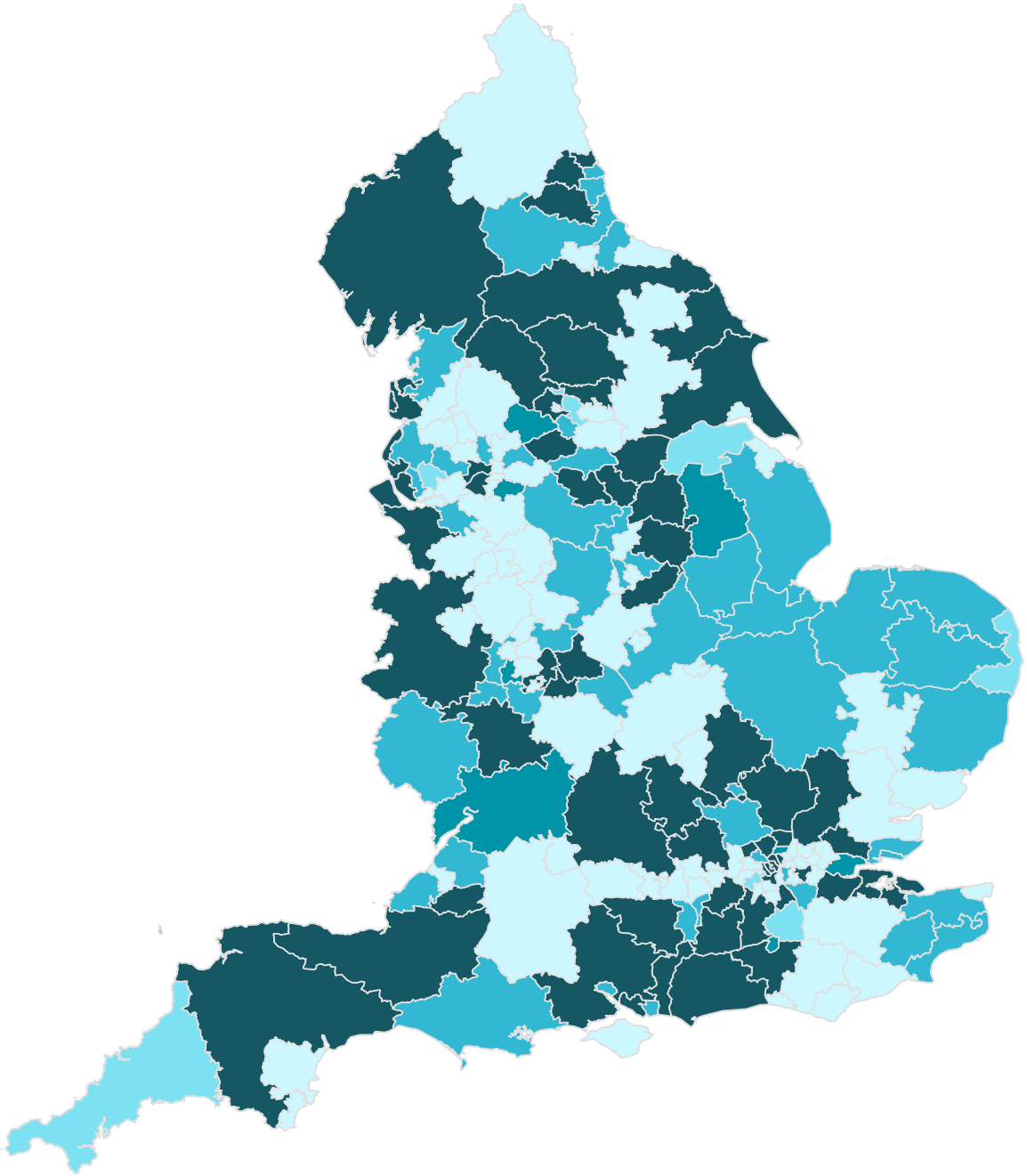
Public Health England

NHS RightCare

The 2nd Atlas of Variation in NHS Diagnostic Services in England

January 2017

Reducing unwarranted variation to improve health outcomes and value



http://fingertips.phe.org.uk/profile/atlas-of-variation

www.england.nhs.uk/rightcare/

About Public Health England

Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. We do this through world-class science, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. We are an executive agency of the Department of Health, and are a distinct delivery organisation with operational autonomy to advise and support government, local authorities and the NHS in a professionally independent manner.

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The 2nd Atlas of Variation in NHS Diagnostic Services in England

Reducing unwarranted variation to improve health outcomes and value

The 2nd Atlas of Variation in NHS Diagnostic Services in England has been prepared in partnership with a wide range of organisations:

Public Health England

Public Health England (PHE) exists to protect and improve the nation's health and wellbeing and reduce health inequalities. It does this through advocacy, partnerships, world-class science, knowledge and intelligence, and the delivery of specialist public health services. PHE is an operationally autonomous executive agency of the Department of Health.
http://www.gov.uk/phe

The **National Child and Maternal Health Intelligence Network** is part of PHE and provides information and intelligence that will help users examine and address questions which the NHS Atlas of Variation in Healthcare series may raise for your local area. Its resources can be found at the weblink below.
http://www.chimat.org.uk/

National population screening programmes are implemented in the NHS on the advice of the UK National Screening Committee (UK NSC), which makes independent, evidence-based recommendations to ministers in the four UK countries. Public Health England leads the NHS Screening Programmes and hosts the UK NSC secretariat.
https://www.gov.uk/topic/population-screening-programmes

The **NHS Abdominal Aortic Aneurysm (AAA) Screening Programme** aims to reduce AAA-related mortality among men aged 65 years and over through early identification, appropriate monitoring and treatment. A simple ultrasound test is offered to all men during the year they become 65 years whereas men over 65 years who have not previously been screened can self-refer. The scan is quick, painless and non-invasive. Results are provided immediately and there is a clear pathway to care.
https://www.gov.uk/topic/population-screening-programmes/abdominal-aortic-aneurysm

The **NHS Bowel Cancer Screening Programme** offers screening every two years to all men and women aged 60 to 74 years. It aims to detect bowel cancer at an early stage when treatment is more likely to be effective. People eligible for screening receive an invitation letter and information leaflet explaining the benefits and risks of screening. They then receive a faecal occult blood sampling kit that includes simple instructions for:

- completing sampling at home
- sending the samples to the laboratory

The sample is then processed and the results sent to the individual within two weeks.
https://www.gov.uk/topic/population-screening-programmes/bowel

The **NHS Breast Screening Programme** aims to reduce deaths by detecting breast cancer at an early stage when treatment is more likely to be effective. All women aged 50 to 70 years are invited for breast screening every three years using an X-ray test called a mammogram to check the breast for signs of cancer. Eligible women receive an invitation letter explaining:

- the programme
- the benefits and risks of breast screening

Women over 70 years can still have breast screening every three years on request.
https://www.gov.uk/topic/population-screening-programmes/breast

Public Health England

The **NHS Cervical Screening Programme** aims to prevent cancer by detecting and treating abnormalities of the cervix. Early detection and treatment can prevent 75% of cancers developing. Screening is offered to all women aged 25 to 49 years every three years and to all women aged 50 to 64 years every five years. All eligible women who are registered with a GP are automatically invited for screening.
https://www.gov.uk/topic/population-screening-programmes/cervical

The **NHS Newborn Blood Spot Screening Programme** aims to identify rare conditions that can lead to serious illness, development problems and even death. A health professional takes blood from a child's heel and sends the sample for testing. The screening tests leaflet sets out the test process and purpose. Midwives carry out heel prick tests when babies are 5 days old. Babies who are new to the country or are yet to have a heel prick test are eligible for testing up to one year old. This excludes the cystic fibrosis screening test, which is not reliable after 8 weeks of age.
https://www.gov.uk/topic/population-screening-programmes/newborn-blood-spot

The **NHS Newborn Hearing Screening Programme** aims to identify moderate, severe and profound deafness and hearing impairment in newborn babies. The programme offers all parents in England the opportunity to have their babies' hearing tested shortly after birth. Early identification of hearing impairment gives children a better chance of developing speech and language skills, and of making the most of social and emotional interaction from an early age.
https://www.gov.uk/topic/population-screening-programmes/newborn-hearing

The **NHS Sickle Cell and Thalassaemia Screening Programme** is a genetic screening programme that identifies people who are genetic carriers for sickle cell, thalassaemia and other haemoglobin disorders. If two people who are carriers have a baby together, there is an increased risk that their baby could inherit a haemoglobin disorder. It offers screening to:

- all pregnant women
- fathers-to-be, where antenatal screening shows the mother is a genetic carrier
- all newborn babies, as part of the Newborn Blood Spot Screening Programme

https://www.gov.uk/topic/population-screening-programmes/sickle-cell-thalassaemia

NHS RightCare

NHS RightCare is a national programme committed to reducing unwarranted variation to improve people's health and outcomes.

It ensures that the right person has the right care, in the right place, at the right time, making the best use of available resources to help deliver a sustainable NHS.

The RightCare approach identifies variation among similar healthcare communities and encourages health economies to focus efforts in these areas, leading to improvements in outcomes and quality, and the release of capacity and resources for future investment. NHS RightCare's Intelligence work includes Commissioning for Value and supporting knowledge management, ensuring local health economies have the data, evidence, tools and practical support to reduce unwarranted variation and deliver better value.https://www.england.nhs.uk/rightcare

NHS England

NHS England leads the NHS in England. It sets the priorities and direction of the NHS and encourages and informs the national debate to improve health and care. It wants everyone to have greater control of their health and their wellbeing, and to be supported to live longer, healthier lives by high-quality health and care services that are compassionate, inclusive and constantly improving. NHS England believes in health and high-quality care for all, now and for future generations.
http://www.england.nhs.uk/

The Chief Scientific Officer (CSO) at NHS England has a system-wide role providing authoritative, professional advice and leadership to the NHS in England. The team in the **Office of the CSO** is responsible for driving a whole health-system approach to providing high-quality, innovative, patient-centred, scientific services integrated across all delivery sectors with influential scientific leaders, aspirational service providers and informed commissioners.
http://www.england.nhs.uk/

The **NHS Improving Quality** (NHS IQ) seven-day services programme team undertook the fourth annual survey of English hospitals in 2014, in collaboration with NHS England, the National Clinical Director for Diagnostics and the British Society of Interventional Radiology, to assess the level of weekend and out-of-hours access to interventional radiology services. At the time of the survey NHS IQ was the improvement body for the NHS in England. On 1 November 2015 NHS IQ transferred to **NHS England** as the new **Sustainable Improvement Team**, and will continue to support the health system by providing improvement and change expertise.
https://www.england.nhs.uk/ourwork/qual-clin-lead/nhsiq/

NHS Digital, previously the Health and Social Care Information Centre, is the national provider of information, data and IT systems for commissioners, analysts and clinicians in health and social care. Our work includes publishing more than 260 statistical publications per year, providing a range of specialist data services, and managing informatics projects and programmes, and developing and assuring national systems against appropriate contractual, clinical safety and information standards.
http://digital.nhs.uk/home

The **Office for National Statistics** (ONS) is the UK's largest independent producer of official statistics and the recognised national statistical institute of the UK. Our main responsibilities as the Executive Office of the UK Statistics Authority include the collection, compilation, analysis and dissemination of economic, social and demographic statistics that serve the public good and meet our legal obligations (domestic and international); the provision of statistical leadership and methodological advice for the benefit of UK official statistics; representing the UK in the international arena; and the development and maintenance of definitions, methodologies, and classifications of statistics.
http://www.ons.gov.uk/ons/index.html

The **Sentinel Stroke National Audit Programme** (SSNAP) aims to improve the quality of stroke care by auditing stroke services against evidence-based standards and national and local benchmarks. Building on nearly 20 years of experience delivering the National Sentinel Stroke Audit (NSSA) and the Stroke Improvement National Audit Programme (SINAP), SSNAP is pioneering a new model of healthcare quality improvement through near real-time data collection, analysis and reporting on the quality and outcomes of stroke care.
http://www.rcplondon.ac.uk/projects/sentinel-stroke-national-audit-programme
For the latest SSNAP results: www.strokeaudit.org/results

Trauma Audit and Research Network (TARN) is a collaboration of hospitals from England, Wales, Ireland and other parts of Europe, which supports a highly skilled team on a non-profit-making basis at the University of Manchester, Salford Royal NHS Foundation Trust. The TARN database is the largest trauma database in Europe with more than 500,000 cases and over 42,000 injured children. Our foundation in research ensures that we provide accurate and relevant information to help doctors, nurses and managers improve their trauma services.
https://www.tarn.ac.uk/

British Society of Interventional Radiology

The **British Society for Interventional Radiology** (BSIR) is a charitable foundation established to promote and develop the practice of interventional radiology, and is now the largest radiological subspecialty society in the UK. The main objectives of the BSIR are: to support and develop access to high-quality information on interventional radiology for patients and all healthcare professionals; to support audit and research in interventional radiology; and to support education and training in interventional radiology. http://www.bsir.org/

BRITISH SOCIETY OF GASTROENTEROLOGY

The **British Society of Gastroenterology** is a registered charity focused on the promotion of gastroenterology and hepatology within the UK. It has over 3000 members drawn from the ranks of physicians, surgeons, pathologists, radiologists, scientists, nurses, dietitians, physiologists and others interested in the field. Founded in 1937, it has grown from a club to be a major force in British medicine and healthcare. Internationally it is represented at world and European level.
www.bsg.org.uk

JAG Joint Advisory Group on GI Endoscopy

The **Joint Advisory Group on GI Endoscopy** (JAG) ensures the quality and safety of patient care by defining and maintaining the standards by which endoscopy is practised. The JAG was established in 1994 under the auspices of the Academy of Medical Royal Colleges (AMRC), and operates within the Clinical Standards Department of the Royal College of Physicians, with a UK-wide remit. The JAG's core objectives are to agree and set acceptable standards for competence in endoscopic procedures, and to quality assure endoscopy units, endoscopy training and endoscopy services.
http://www.thejag.org.uk/

BSPGHAN working for children with digestive and liver disorders
British Society of Paediatric Gastroenterology Hepatology and Nutrition

British Society of Paediatric Gastroenterology and Hepatology and Nutrition (BSPGHAN) is a professional organisation with the specific roles of promoting research, training and standards of clinical practice for health professionals and scientists in paediatric gastroenterology, hepatology and nutrition. BSPGHAN provides professional leadership and promotes standards of care for children with nutritional, gastrointestinal and hepatological disorders. Membership includes consultants and specialist trainees in paediatric gastroenterology, hepatology and nutrition as well as specialist dietitians, nurses and nutrition pharmacists.
http://bspghan.org.uk/

British Society of Echocardiography
Affiliated to the British Cardiovascular Society

The **British Society of Echocardiography** (BSE) promotes the study and advancement of cardiac ultrasound imaging and Doppler techniques, through professional representation, education and quality benchmarking. Membership comprises cardiac physiologists, clinicians and others involved in cardiac ultrasound. The BSE represents the interests of those working in clinical echocardiography at all levels and in all areas, including adult and paediatric cardiology, cardiovascular research and teaching. With over 2600 members, it is the largest of the professional groups affiliated to the British Cardiovascular Society. It also has functional links to the European Association of Echocardiography and the European Society of Cardiology.
http://www.bsecho.org/

Sheffield Teaching Hospitals NHS
NHS Foundation Trust

Sheffield Teaching Hospitals NHS Foundation Trust is one of the UK's largest, busiest and most successful NHS foundation trusts. We provide a full range of hospital and community services for people in Sheffield, as well as specialist care for patients from further afield. We manage five of Yorkshire's best known teaching hospitals, and have a long history of providing high-quality care, clinical excellence and innovation in medical research. http://www.sth.nhs.uk/

The Newcastle upon Tyne Hospitals NHS Foundation Trust

The North East's **Hepato-Pancreato-Biliary (HPB) Centre at the Freeman Hospital**, part of the Newcastle upon Tyne Hospitals NHS Foundation Trust, is a regional centre that provides highly individual, specialist services for patients with benign (non-cancerous) and malignant (cancerous) diseases of the liver, biliary system and pancreas. The service involves patients throughout the North East, Cumbria and North Yorkshire, as well as across the UK and beyond. Rated as 'Outstanding' by the Care Quality Commission, the Newcastle Hospitals provide one of the most comprehensive specialist care and treatment portfolios in the NHS.
http://www.newcastle-hospitals.org.uk/services/surgical_services_hepato-pancreato-biliary-surgery.aspx

East Kent Hospitals University NHS Foundation Trust

East Kent University Hospitals NHS Foundation Trust is one of the largest hospital trusts in England, with five hospitals serving a local population of around 759,000 people. We also provide many health services from other NHS facilities across East Kent including renal services in Medway and Maidstone. We have a national and international reputation for delivering high-quality, specialist care, particularly in cancer, kidney disease, stroke and vascular services.
http://www.ekhuft.nhs.uk/

UCL

University College London (UCL) was founded in 1826. We were the first English university established after Oxford and Cambridge, the first to open up university education to those previously excluded from it and the first to provide systematic teaching of law, architecture and medicine. We are among the world's top universities, as reflected by performance in a range of international rankings and tables. UCL currently has over 35,000 students from 150 countries and over 11,000 staff. Our annual income is more than £1 billion.
https://www.ucl.ac.uk/

MANCHESTER 1824 The University of Manchester

The **University of Manchester**, a member of the prestigious Russell Group of British universities, is the largest and most popular university in the UK. It has 20 academic schools and hundreds of specialist research groups undertaking pioneering multidisciplinary teaching and research of worldwide significance. The University of Manchester is one of the country's major research institutions, rated fifth in the UK in terms of 'research power' in 2014, and has had no fewer than 25 Nobel laureates who either work or study there. The University had an annual income of £1 billion in 2014/15.
http://www.manchester.ac.uk/

KING'S College LONDON

King's College London is one of the top 20 universities in the world (2015/16 QS World University Rankings) and among the oldest in England. King's has more than 27,600 students (of whom nearly 10,500 are graduate students) from some 150 countries worldwide, and 6,800 staff. It has an outstanding reputation for world-class teaching and cutting-edge research, and a particularly distinguished reputation in the humanities, law, the sciences (including a wide range of health areas such as psychiatry, medicine, nursing and dentistry) and social sciences including international affairs.
http://www.kcl.ac.uk/

Contents

Foreword

I am delighted to be writing the foreword for The 2nd Atlas of Variation in NHS Diagnostic Services in England, the first of the specialist Atlases to be updated.

Diagnostic services are essential for the provision of high value healthcare in the NHS because when used correctly they support or rule out potential diagnoses, and underpin effective and efficient management of patient pathways. Many diagnostic tests and investigations are embedded within complex care pathways. This means that NHS commissioners and service providers, who are equally responsible for the stewardship of resources, face the difficult task of understanding what is required from whom, and then need to assess critically whether what is being provided will lead to high-quality outcomes and meet peoples' needs and expectations. The data included in this second Atlas of Variation in NHS Diagnostic Services will facilitate effective commissioning processes, with commissioners and service providers working together to build systems for improving patient experience.

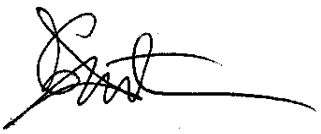
Unwarranted variation in the rates of diagnostic testing is of the utmost relevance to individual patients: the overuse of diagnostic tests as well as their underuse are potentially serious issues. For example, effective capacity planning in imaging services should improve patient access but be balanced by the need to avoid the overuse of interventions with the potential to cause harm, such as ionising radiation. It is important to appreciate that the usefulness of diagnostic test results lies in guiding the most appropriate next steps in the care pathway and ruling out inappropriate interventions thereby ensuring effective patient care and generating value for money.

Continuous quality improvement and a shift from process targets to outcome measures are central to the delivery of healthcare today. Achieving better outcomes for patients will depend on commissioning and providing the right level of effective, high-quality services: commissioners need to set priorities and stimulate improvement in the delivery of local diagnostic services.

It is also important for commissioners and service providers to be mindful of the new opportunities for diagnostic services as a consequence of advances in the field of genomics and the drive for precision medicine, which underline the pivotal role of diagnostic services in the monitoring and analysis of the progress of a disease and/or the effects of its treatment.

Although the data presented in this Atlas may be open to more than one interpretation, the power of the NHS Atlas series is not in the answers each Atlas provides but in the questions they raise. Work must continue to deepen our insights into variation in the rates of many diagnostic services, and to understand whether the variation observed is random, warranted (ie true clinical variation) or caused by other factors such as poor access to services or unmet education needs.

Work across the NHS in England needs to be focused on addressing the issues raised by and described in this 2nd Atlas of Variation in NHS Diagnostic Services in England, with the aim of ensuring that patients have timely, equitable access to the appropriate diagnostic tests and the reports generated. Subsequent decisions about patient care can then be made as quickly and as accurately as possible.



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January 2017

Preface

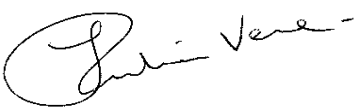
The magnitude of variation for many of the indicators in this Atlas may surprise some people. In a context of evidence-based medicine and guidelines how is it possible that the degree of variation in diagnostic testing is so great?

One answer may be that the important focus on the quality and safety of treatment and care during the last decade has diverted attention from what many people perceive as being at least as important, that is, the art and science of diagnosis. In most of the NHS Atlases of Variation series the focus of the indicators is on intervention and treatment. In the Diagnostic Services Atlas, the focus is on people with symptoms who may be in need of a diagnosis. For people who already have a diagnosis, although there are variations in treatment, there is some consistency regarding what happens to them. This is in direct contrast to people in need of a diagnosis, who face inequities in access.

Putative diagnosis is based on the history given by the patient and on the physical examination and observations carried out by the clinician. These clinical skills, however, are complemented and supplemented by diagnostic services. Over the last 60 years there have been great advances in the precision of diagnostic equipment and testing, such as the power of modern CT and MRI scanning.

There are several reasons why variation in the use of diagnostic services persists. The evidence base is much weaker for diagnosis than for treatment, which has led to the persistence of historic patterns and the development of new services in pioneering departments with non-systematic planning for and adoption of new technologies across the country. These advances take place in the context of overdiagnosis, the subject of a major series in the 'British Medical Journal' in 2013, and underdiagnosis.

There is a renewed focus on variation to maximise the value that not only the individual patient but also the population derives from the allocation and management of staff, capacity and other resources within the health system. The investment by the National Institute of Health Research in Diagnostic Evidence Co-operatives[1] and other initiatives to strengthen the evidence base is welcome. This diagnostics services Atlas has been updated to support commissioners, service providers and clinicians in identifying where variation exists and what should be done about it.



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[1]National Institute for Health Research. Diagnostic Evidence Co-operatives. 4.12 Diagnostic Evidence Co-operatives Version 2 (July 2015). http://www.nihr.ac.uk/documents/about-NIHR/Briefing-Documents/4.12-Diagnostic-Evidence-Co-operatives.pdf

Introduction to the 2nd 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.[1] 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**: t**est 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

The first NHS Atlas of Variation in Diagnostic Services[2], 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)[3] which in addition to describing the indications for GPs to refer to specialists, 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

In this 2nd 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.

[1] Department of Health - Diagnostic Services in 2020 and beyond: Visioning for the future v1.9 (December 2012).
[2] The NHS Atlas of Variation in Diagnostic Services (November 2013). www.fingertips.phe.gov.uk/profile/atlas-of-variation
[3] NICE. Suspected cancer: recognition and referral NICE guideline [NG12] (June 2015) 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[4] 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

[4] The NHS Atlas of Variation in Liver Disease (March 2013), 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[5]. For the screening tests shown in maps 30-38 the aim is to achieve high levels of uptake or adherence with quality standards.

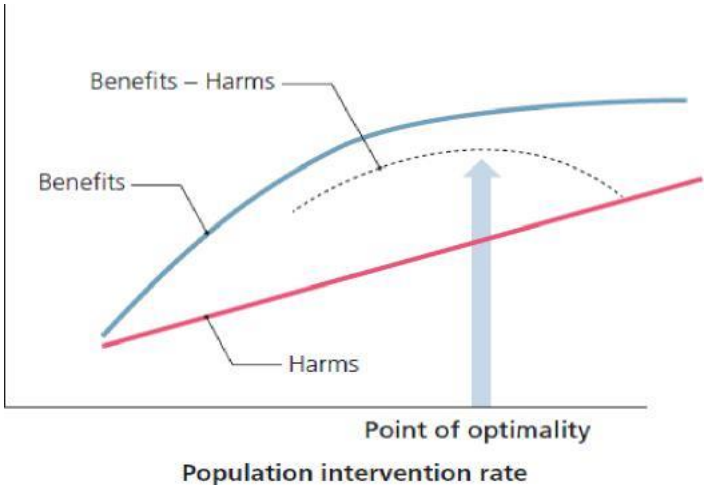
As with everything, it is not always the case that more is better. This is because as in most medical practice, interventions, in this case diagnostic testing, carry risks of harm as well as benefit. For example, there has been concern about the private health sector offering asymptomatic people whole 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.[6,7]

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[8] 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[9]. 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[10], X-rays[11] and CT scanning[6,7] where the risk is from radiation exposure, and colonoscopy, where the risk is of perforation[12]. All screening programmes are introduced after an evidence-based assessment of the relationship between benefit and harm.[9]

[5] National Screening Committee www.gov.uk/government/groups/uk-national-screening-committee-uk-nsc
[6] 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
[7] 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
[8] Donabedian A. An Introduction to Quality Assurance In Healthcare. Oxford University Press. 2002.
[9] Current UK NSC recommendations: http://legacy.screening.nhs.uk/screening-recommendations.php
[10] Løberg et al. Benefits and harms of mammography screening. Breast Cancer Research (2015).
[11] 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.
[12] 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[13], 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".*[14]

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[7]. This is also an issue arising from high rates of Prostate Specific Antigen (PSA) testing for prostate cancer[15] 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[16]. 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[17].

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,

[13] Welch HG, Schwartz LM, Woloshin S. Overdiagnosed: Making People Sick in the Pursuit of Health. 2011: Beacon Press
[14] Elmore JG, Fletcher SW. Overdiagnosis in Breast Cancer Screening: Time to Tackle an Underappreciated Harm. Ann Intern Med 2012; 156; 536.
[15] Draisma G , Boer R , Otto SJ , et al . Lead times and overdetection due to prostate-specifi c antigen screening: estimates from the European Randomized Study of Screening for Prostate Cancer . J Natl Cancer Inst . 2003 ; 95 (12):868 – 878.
[16] 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.
[17] 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."*[18]

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.[19]

In the 2011 King's Fund report "Variations in Health Care – the Good, the Bad and the Inexplicable"[20], 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.[21]

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.

[18] Wennberg J. Tracking Medicine: A Researcher's Quest to Understand Health Care. Oxford University Press. 2010
[19] Right Care. NHS Atlas of Variation in Healthcare, November 2010. www.rightcare.nhs.uk/atlas/
[20] 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
[21] 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

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.

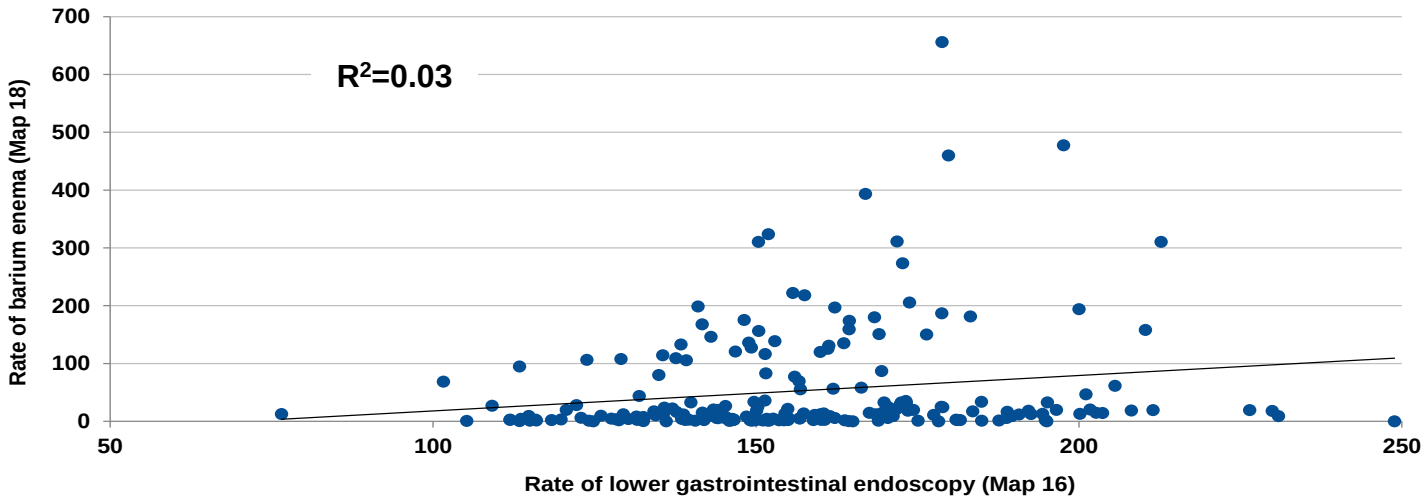
Over- or inappropriate use always wastes resources and sometimes causes harm.

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

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**



[22] 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
[23] 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
[24] 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
[25] 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
[26] 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
[27] 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:

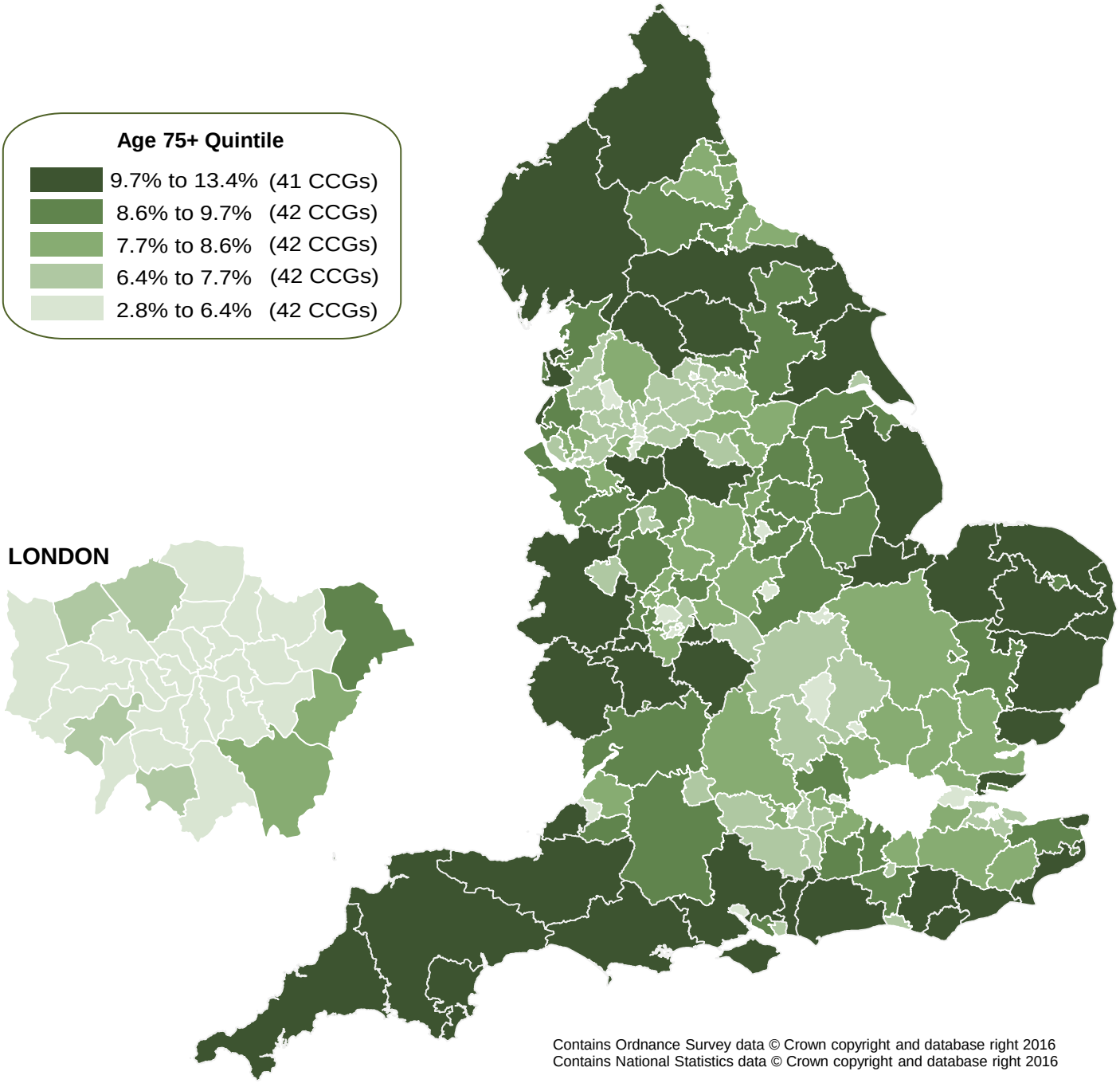
- understanding the concept of variation and its causes
- identifying variation, and ascertaining whether it is warranted or unwarranted and if unwarranted, what the causes are
- reducing unwarranted variation in quality, safety and outcome, and in activity and cost
- in reducing unwarranted variation, 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

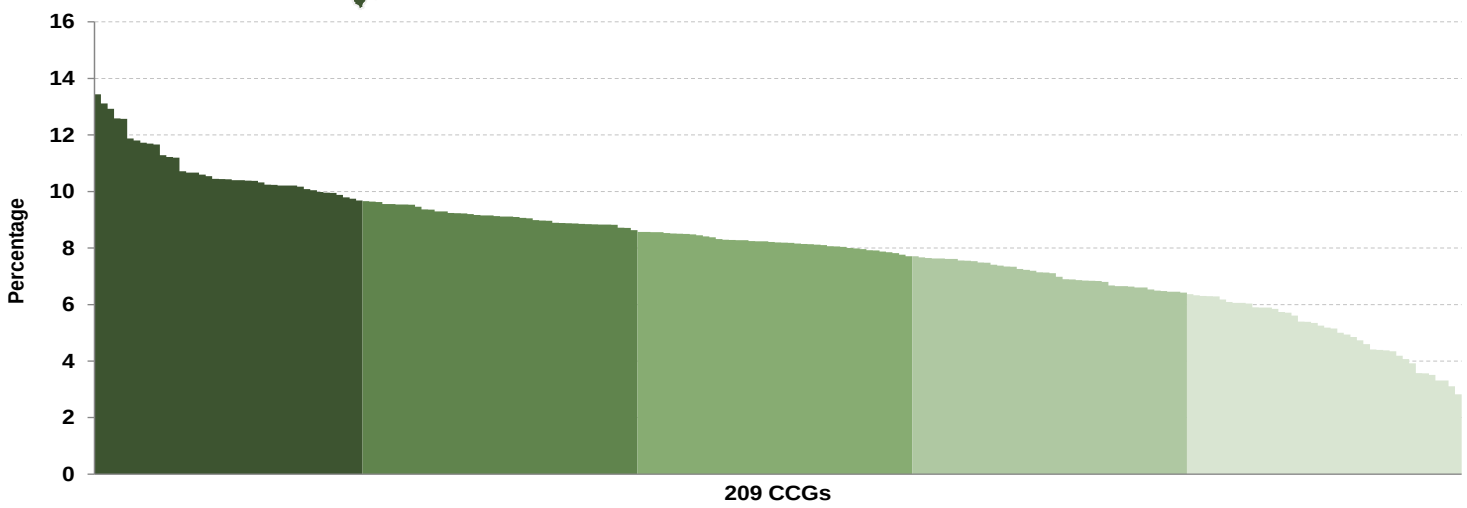
As it is expected that the demand for diagnostic tests will continue to increase, the resources needed to fund such developments will have to be shifted from lower value activities. To facilitate this resource shift it is essential that diagnostic services are viewed as population based services. This 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.[1] 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.

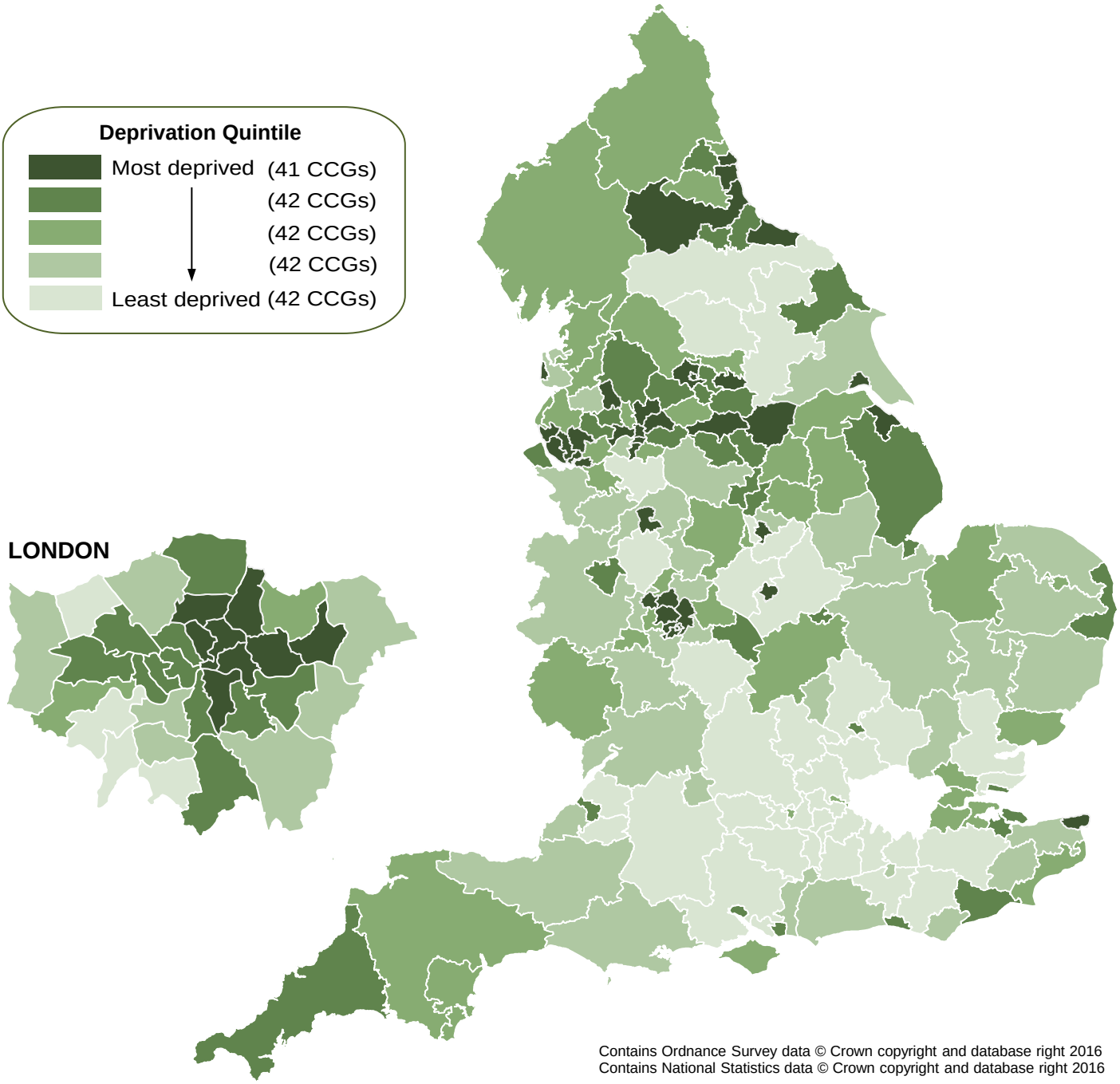
Figure 3: Percentage of the population aged 75 years and over CCG quintiles[28]

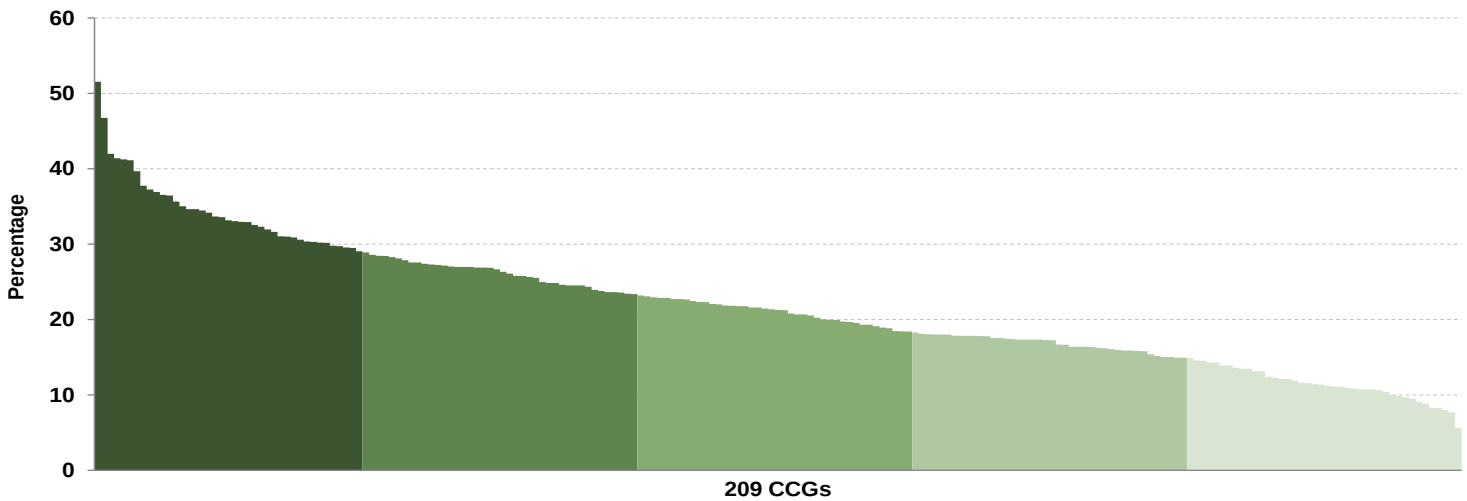




[28] Office for National Statistics 2014 mid-year population estimates (2011 Census based)

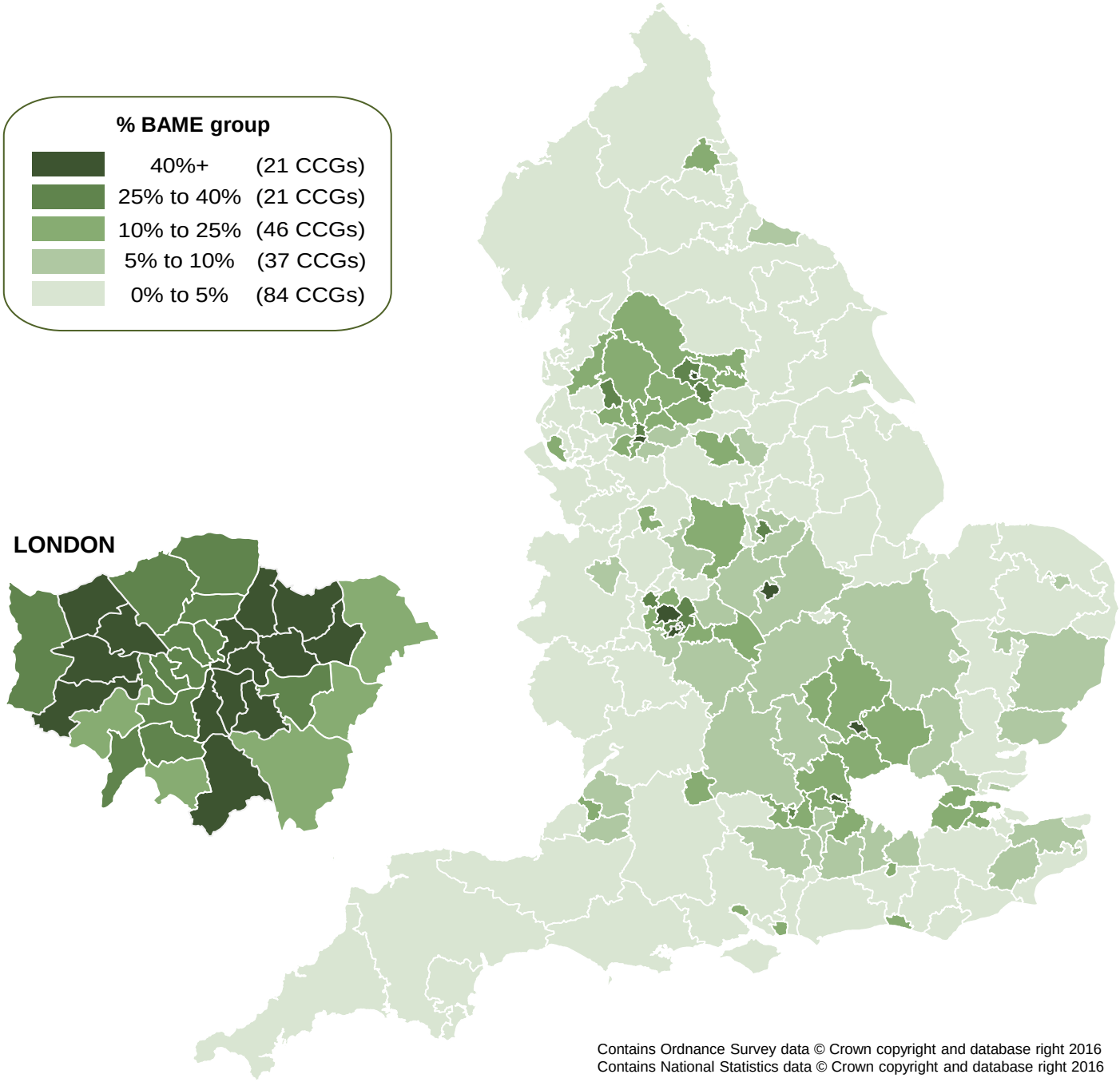
Figure 4: Index of Multiple Deprivation 2015 average LSOA score CCG quintiles[29]

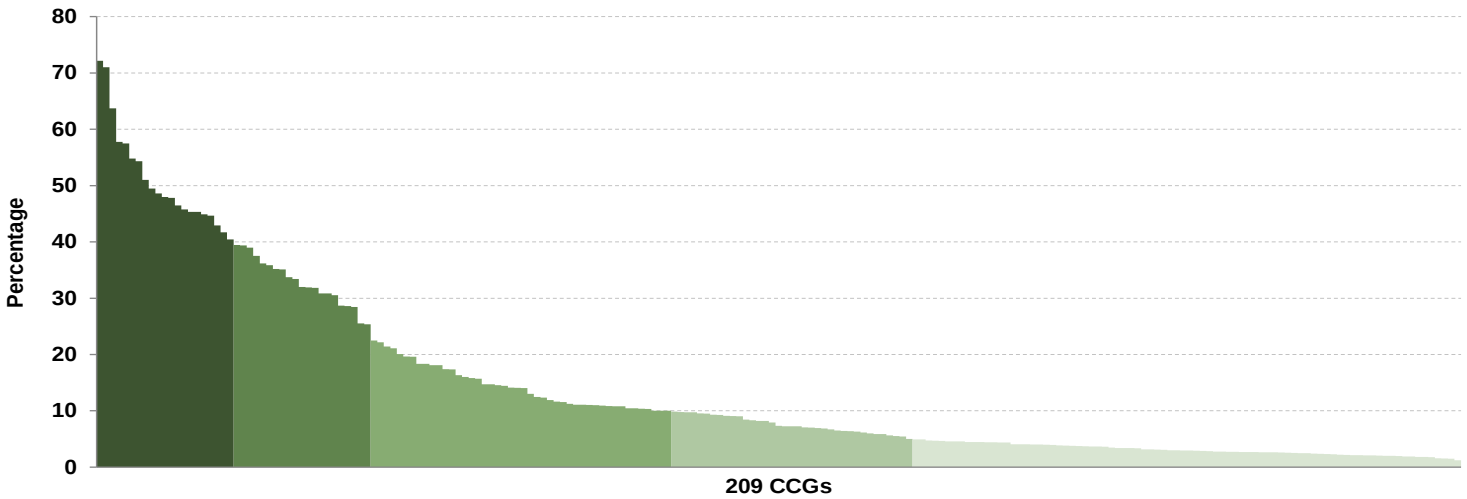




[29] Department for Communities and Local Government, Indices of Deprivation 2015

Figure 5: Percentage of the population with Black, Asian and Minority Ethnic group by CCG[30]





[30] The Office for National Statistics, 2011 Census, table KS201EW

Introduction to the data

Selection of indicators

In devising the 2nd Atlas of Variation in NHS Diagnostic Services we have worked closely with the National Clinical Director (NCD) for Diagnostics and Imaging and the Chief Scientific Officer (CSO) to present indicators within three of the five specialties of diagnostic services:

- imaging
- endoscopy
- physiological diagnostics

We have also worked with other NCDs and clinical leads that have responsibility for certain groups of patients undergoing some of the diagnostic tests, for example, the lead for screening, and NCDs for trauma, musculoskeletal services, respiratory services and heart disease.

Indicators have been calculated using a variety of population denominators including resident and registered CCG populations, and upper-tier local authority populations. For Maps 4a to 6b the data is presented by both the CCG of patient residence and by hospital site of treatment.

Order of appearance

Indicators are grouped under headings of three of the specialties of diagnostic services (see above) plus screening.

Data sources

Data for most of the indicators in the 2nd Atlas of Variation in NHS Diagnostic Services have been provided by the Department of Health (DH), The Office for National Statistics (ONS), Royal College of Physicians, Public Health England (PHE), the Trauma Audit and Research Network (TARN), NHS Digital, NHS England (NHSE) and NHS Improving Quality (NHSIQ) from a variety of sources including:

- Hospital episode statistics (HES)
- ONS mid-year population estimates
- TARN database, University of Manchester
- Sentinel Stroke National Audit Programme (SSNAP), Royal College of Physicians
- NHSE Monthly Diagnostics Waiting times and Activity return (DM01)
- NHSE diagnostic imaging dataset (DID)
- NHS Digital quality and outcomes framework (QOF)
- NHS abdominal aortic aneurysm (AAA) screening programme
- NHS bowel cancer screening programme
- NHS breast cancer screening programme
- NHS cervical cancer screening programme
- NHS newborn blood spot screening programme
- NHS newborn hearing screening programme
- NHS sickle cell and thalassaemia screening programme

A metadata document with methodology, data extraction coding schemes and data sources for each indicator is available at: www.fingertips.phe.gov.uk/profile/atlas-of-variation

The data analysis, column charts and boxplots were produced using Microsoft Excel 2010. The maps were created using MapInfo Professional version 12.5.

Innovations in statistical methods and presentation in this Atlas

In this Atlas two innovations in analysis and presentation have been introduced:

- the presentation of the maps and column charts has changed: shading is now based on statistical significance (difference from the England value)
- the introduction of time series analyses in the form of repeated box and whisker plots, revealing trends in the level and spread of local area indicator values across England

In the map and column charts, the England value is used as the statistical benchmark against which organisations are compared. It is important to note that this does not imply that the England rate is the optimal or aspirational level for that indicator, as this value is often not established, but gives a sense of the performance of organisations compared with the national value.

Maps and column charts

For each indicator, data is presented visually in the form of a thematic map and a column chart, which show the most recent data. London is shown as an enlarged page inset on all maps to keep detail that might otherwise be lost.

The range of local area indicator values and the England value are presented in the column chart accompanying each map. The same statistical methodology is used to determine the shading in the map and column chart. This is based on statistical significance of difference from the England value.

It is important to note that due to the change in statistical presentation, maps and column charts from the first iteration of the Diagnostics Atlas cannot be compared with those presented in this Atlas.

Box and whisker plots

For each indicator, data is presented visually in a time series of box and whisker plots that shows the median and spread of local area values across England at consecutive timepoints. Importantly, the tables accompanying the box and whisker plots show whether there has been any statistically significant change in the median, or in the degree of variation over time. It should be noted that the England value is not represented in the box and whisker plots.

Interpretation of the maps

For each indicator, the data presented in the map is that for the most recent time period shown in the corresponding box and whisker plot time series (excepting Map 18). For each indicator, individual CCGs (or other geographies) are allocated to one of five groups (see Table 1) based on how statistically significantly different their value is from the England value (the horizontal dark blue line across the column charts). The column charts and maps are identically colour classified into thematic displays according to that significance banding. Where data is unavailable for an area/organisation, the corresponding map area/symbol is shaded grey. All data values including the significance banding can be downloaded at www.fingertips.phe.gov.uk/profile/atlas-of-variation

The intensity of shading of each area indicates the degree of statistical significance of each indicator value in terms of its difference from the England value. The key to the map shows the significance level for each of the five shades compared with the England value for that indicator. The two darkest shaded bars indicate that an indicator value is significantly higher than the England value at the 99.8% and 95% significance levels. The two lightest shades indicate that an indicator value is significantly lower than the England value at the 99.8% and 95% significance levels. Mid-shaded areas are those with an indicator value that is not significantly different to the England value.

Table 1 shows the degree of statistical significance associated with each of the five shades used in the maps and column charts.

Table 1: Five shade significance bands used in the maps and column charts

Shade	Significance band
	Significantly higher than England at the 99.8% level
	Significantly higher than England at the 95% level
	Not significantly different from England
	Significantly lower than England at the 95% level
	Significantly lower than England at the 99.8% level

Interpretation of the column charts

For each indicator, the data presented in the column charts is that for the most recent time period shown in the corresponding box and whisker plot time series (excepting maps 1, 2,3 and 18 where annualised rates are presented). The column chart visualisations give the reader two sets of information about the data:

- the height of each bar in the chart shows the indicator value for each geography (such as a clinical commissioning group (CCG) or local authority (LA)) – the columns are ordered from the highest value on the left to the lowest value on the right.

- the shading of each column indicates the degree of statistical significance of each indicator value in terms of its difference from the England value (the blue horizontal line across the chart). The colour shading used in the column charts is the same as that used in the corresponding map. The two darkest shades indicate that an indicator value is significantly higher than the England value at the 99.8% or 95% significance level and are towards the left-hand side. Bars with the two lightest shades indicate that an indicator value is significantly lower than the England value at the 99.8% or 95% level and are towards the right-hand side (see Figure 6). Mid-shade bars are those areas with an indicator value that is not significantly different from the England value

Conventional column charts might display the confidence interval for each column to enable the reader to determine whether or not the local area value is significantly higher or lower than the national value represented by a horizontal line. However, column charts in this Atlas have so many columns and utilise two sets of local area confidence intervals (95% and 99.8%) that it would be very difficult for the reader to assimilate this information. The five blue shades replace the use of displayed confidence intervals on column charts in this Atlas. Consequently the column charts in this Atlas differ from those in previous atlases in terms of methodology and interpretation.

The significance band does not indicate whether a high or low value represents good or bad performance, merely whether or not the indicator value is significantly higher or lower than the England value, and the degree of statistical confidence that the difference is not due to random variation.

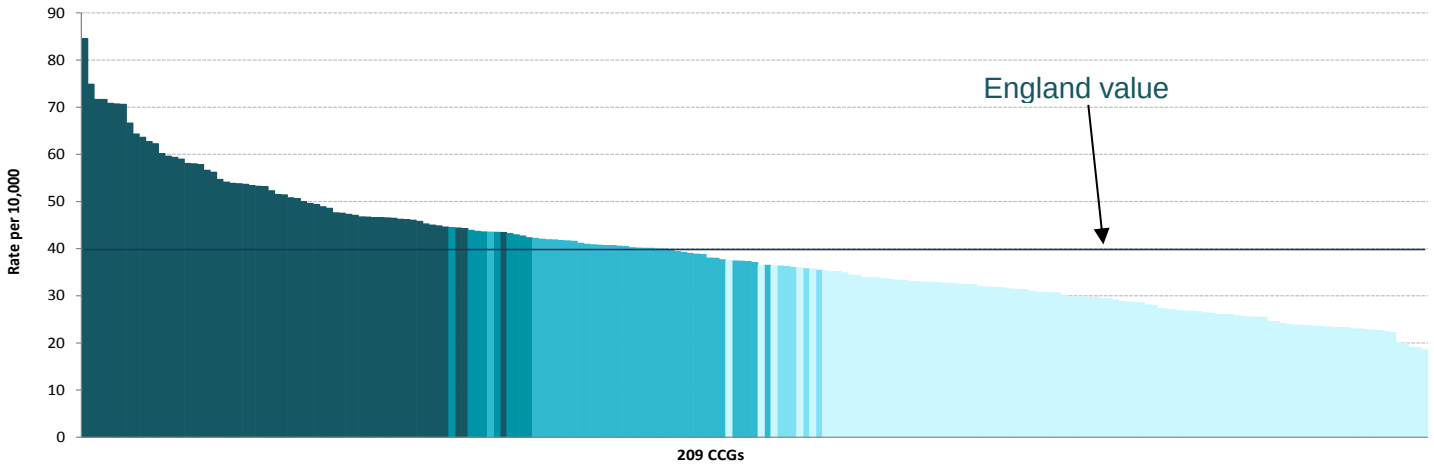
- Indicator values that are not significantly different from the England value (mid-shade) are said to display ‘random’ variation alone
- Indicator values that are higher or lower than the England value at the 95% significance level are deemed statistically significantly different. However, as so many indicator values (209 in the case of CCGs) are being simultaneously tested against the England value, the likelihood of finding indicator values that are significantly different from the England value is raised by chance alone. For this reason a more stringent 99.8% significance level is also applied
- There is much greater certainty that indicator values found to be different from the England value at the 99.8% significance level (the lightest and the darkest shades) are due to a systematic non-random variation that requires investigation. In these localities it is likely that the process or system of generating these values is markedly different from that in other CCGs.

If there is a large number of indicator values significantly different from the national value at the 99.8% level this may be due to what is known as overdispersion, characterised by many localities having indicator values at the extremities of the distribution, and fewer indicator values around the central value of the distribution.

Overdispersion typically occurs when there are factors influencing the values that have not been accounted (or adjusted) for in the method of calculating the statistic, such as demographic risk factors, casemix or localised service configuration, which is particularly relevant to specialised services. These factors may account for the larger than expected volume of areas with values greatly different from the England value. Wherever possible statistics presented in this Atlas have been adjusted for known influences, such as locality based variations in age structure, using techniques such as standardisation (see below). It is important to consider whether all known warranted factors have been adjusted for when assessing whether the observed variation is unwarranted.

Figure 6 is an example of the column charts presented in this Atlas. It shows that differently shaded columns are mixed at both ends of the chart, rather than same-shaded columns appearing in adjacent blocks. This is because being statistically significantly different from the England value depends not only on the magnitude of the indicator value, but also on statistical confidence. This may be influenced by the size of the population for which the indicator value is shown, as smaller populations tend to have wider confidence intervals.

Figure 6: Example column chart showing statistical difference from the England value



Interpretation of the box and whisker plots

For the first time in the NHS Atlas series, time series data is presented in the form of box and whisker plots (referred to as boxplots in following sections). The purpose of the box and whisker plot is to give an impression of the level and spread, or distribution, of the data points. The box and whisker plots presented in this Atlas are a customised version of conventional box and whisker plot used elsewhere (see Figure 7).

The box and whisker plots use a methodology which is unrelated to the method determining the map and column chart shading. The box and whisker plots do not represent statistical significance. They represent the data value at key rank positions when the geographical areas are rank-ordered according to data value size. This graphic shows how variable the indicator is across all of the geographical areas. A single box and whisker plot is displayed for each time period so that comparisons can be made through time of the level and spread of values.

The 'box' and its 'whiskers' represent the data values of the following rank positions in the data:

- maximum (or the greatest and therefore highest ranked data point)
- 95th percentile (the data value that lies in the 95% highest rank position)
- 75th percentile (the data value that lies in the 75% highest rank position, also known as the 'upper quartile' or Q3)
- median (or middle ranked data point also known as Q2)
- 25th percentile (the data value that lies in the 25% highest rank position, also known as the 'lower quartile' or Q1)
- 5th percentile (the data value that lies in the 5% highest rank position)
- minimum (or smallest and therefore lowest ranked data point)

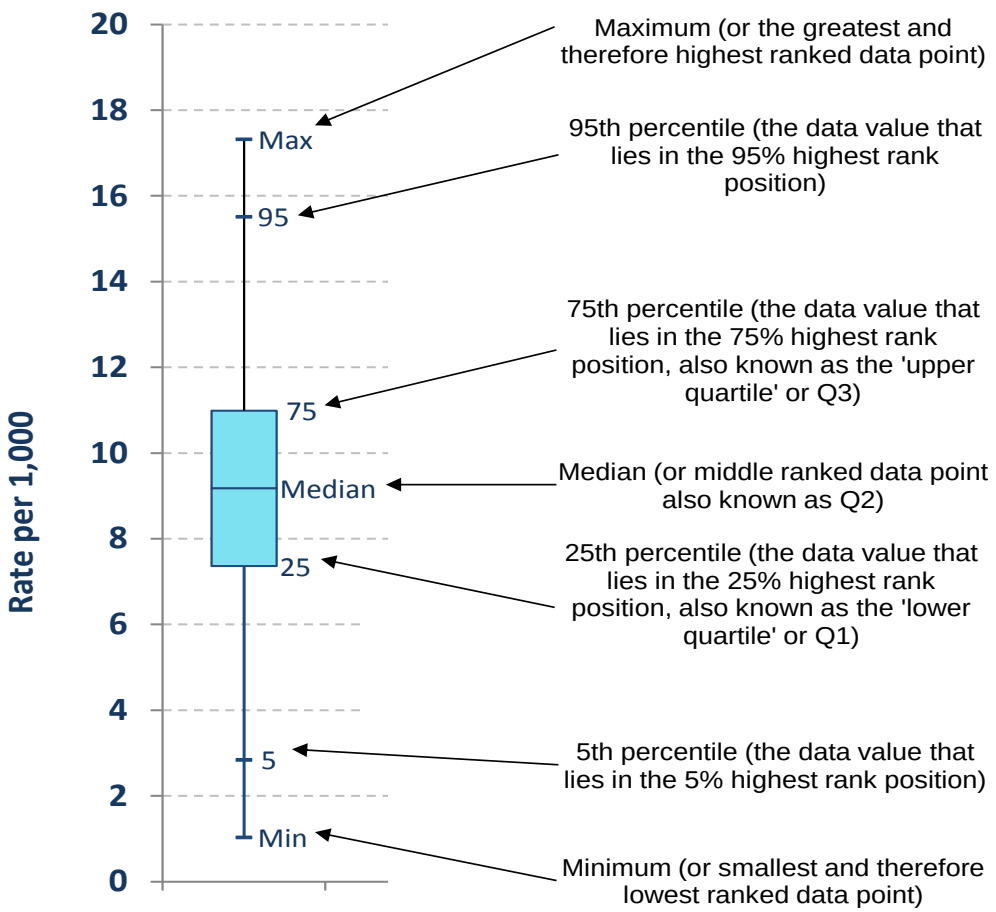
The 'box' runs from the upper quartile (Q3 or 75th percentile) to the lower quartile (Q1 or 25th percentile) and represents the middle 50% of data points. The height of the box between Q1 and Q3 is known as the interquartile range (IQR) and is calculated as Q3 minus Q1.

Inside the box is a horizontal line, which shows where the median (or Q2) lies. The median is the middle point of the dataset. Half of the data points are above the median and half of the data points are below it.

The ‘whiskers’ extend out from either end of the box and show the highest and lowest values contained within the dataset, in other words they show the entire range of values contained within the dataset.

Box and whisker plots split the data presented into four equal parts in terms of the number of data points represented. Twenty-five per cent of data points lie between the maximum and the upper quartile, 25% of data points lie between the upper quartile and the median, 25% of data points lie between the median and the lower quartile, and 25% of data points lie between the lower quartile and the minimum. An unconventional aspect of the box and whisker plots presented in this Atlas, is that the 95th percentile and the 5th percentile are also represented by tick marks on the 'whiskers'.

Figure 7: How to read the box and whisker plots



A box and whisker plot enables the user to obtain information about the shape or spread of the data points and in particular, whether or not the data points have a symmetric or skewed distribution. A dataset with a normal distribution is symmetric (non-skewed) around the mean (average), the mean and the median are equal to each other, and each half of the distribution is a mirror-image of the other half. In a distribution that is skewed there is a lack of symmetry between the upper and lower halves of the dataset. The median and the 'box' is not centrally located between the maximum and minimum.

Box plot summary statistics table

Presented below the boxplot time series is a table of statistics summarising the trend in the absolute degree of variation and the median:

- **max–min (Range)**: This is the absolute difference between the maximum value and the minimum value of the dataset, ie the full range of the data. However, extreme outliers can heavily influence this statistic and consequently mislead about the extent of variability across the majority of the dataset. It may therefore be more helpful to use the 95th to 5th percentile (see below)
- **95th–5th percentile**: This shows the range of the data between the 95th percentile and the 5th percentile of the dataset; if there are extreme outliers this statistic may give a better impression of variation across the majority of data values because the highest 5% of values and lowest 5% of values have been discounted
- **75th–25th percentile**: These percentiles are the upper and lower limits of the middle 50% of data values. This statistic indicates the dispersion or spread of the data for the middle 50% of values. The absolute difference between these percentile is also known as the interquartile range (IQR). It is related to the median (see below): if the IQR is small it indicates that the central 50% of data values are close to the median; if the IQR is large it indicates that the data is spread out from the median and there is more dispersion in the middle 50% of values in the dataset

- **median**: The median is the middle value in a dataset, identified by arranging each of the values in ascending order from the smallest value to the highest value. If there is an even number of values the median will be the average of the two central data points. It is not the mean or average

The final column of the table is a summary of whether each of these four statistics is narrowing or widening (or median increasing/decreasing) and whether the trend is statistically significant at the 95% level. The statistical significance was determined using a two-tailed t-test on the slope of a linear regression line fitted to the values in the table over time, where the null hypothesis is that the slope equals zero. The significance test is only performed for indicators with data at three or more time periods. This regression line and the detailed results of the t-test are not presented in this Atlas.

Data frequency

The data frequency, ie the length of the time period for which data is presented, directly affects the number of observations represented in the visualisations. Statistical power, ie the ability to detect true differences, tends to increase with an increasing number of observations. The following 'data frequency' selected for each Atlas indicator is intended to yield a sufficiently large enough number of observations to reveal patterns and trends that are statistically robust.

- maps 1-3†, 4a-6b, 15, 18†, 24, 25, 27-29, 34, 35, 37 and 38 present quarterly rates
- maps 7, 8, 11-14, 16, 17, 19-22, 26, 30-33 and 36 present annual rates
- maps 9, 10 and 23 present three-year pooled rates

Standardisation

Differences in the number of events, for example incidence of disease, which the diagnostic tests are being used to detect, can be strongly related to the age structure of that population. If the level of diagnostic testing reflected need, for example driven by older age, then we would expect to see geographic variation in the diagnostic testing rate that was strongly correlated with older age as shown in Figure 3 (percentage of the population aged 75 years and over).

In an attempt to identify variation that is beyond that related to different patterns of need, a technique called standardisation is used. This enables the level of testing to be compared between populations with different demographic structures producing a more level playing field.

For instance if we compare two population groups, A and B, and population A has a higher rate of deaths when compared with population B we could conclude that population A has worse mortality outcomes in comparison with population B. However, if population A has a much higher proportion of older people in it we would expect population A to have a higher mortality rate when compared with population B because mortality rates are linked to increasing age. Therefore, it would be misleading to infer that people in population A are dying at a faster rate than people in population B.

There are two main methods of calculating standardised rates:

- direct standardisation
- indirect standardisation

Directly standardised rates may adjust for the differences in age and sex distribution in a population and are usually expressed, for example, as a number of infections per 100,000 population. To calculate a directly standardised rate the observed number of cases from the study population (eg CCG) in each age-band (usually five-year age-bands) is divided by the number of the local population for that age-band and the multiplied by the standard population (in this case the European Standard Population) in the same age-band. These calculations are then summed across the relevant age-bands to obtain the weighted rate per 100,000 population. This method of direct standardisation has been used for Map 9 and Map 23.

Indirectly standardised rates may adjust for differences in age distribution, and possibly other demographic factors such as sex and deprivation, by applying the observed rates for each age-group in a standard population (in this case England) to the population of the same age-groups in the study areas (eg CCG).

† Box plots for maps 1-3 and 18 present quarterly rates, their corresponding thematic maps and column charts present the latest annual rate

Indirect standardisation using age, sex and deprivation decile has been used for the indicators in maps 16, 19, 21 and 22.

The rates derived from the NHS England Diagnostics Imaging Dataset (maps 1-3, 15, 17 to 18, 24 to 25, 27 to 29 use NHS England 'need' weighted CCG populations[1] as the denominator. These populations are weighted for age, sex and 'need' variables, and therefore adjust the rates of activity for these factors.

Confidence intervals

Confidence intervals are used to represent the level of uncertainty of an estimate value (the calculation). Statistical uncertainties usually arise because the indicators are based on a random sample or subset from the population of interest or over a defined time period, both of which may not be representative of the whole population. A smaller confidence interval indicates that the estimate is more reliable, and a larger confidence interval indicates that the estimate is less reliable. Although none of the charts in the 2nd Atlas of Variation in NHS Diagnostics Services are displayed with confidence intervals, confidence intervals were used to determine the shading in the column charts and the thematic maps. The two main methods of calculating confidence intervals in this Atlas are:

- the Wilson score method for maps[2]
- the Byar's method for maps[3]

Exception-reporting

The indicator in Map 26 is from the Quality and Outcomes Framework 2014/15[4]: COPD0045[5]. Under the QOF scheme GPs are rewarded for achieving an agreed level of population coverage for each indicator. The level of achievement recorded depends on the GP practice treating the patients with the relevant problem. However, not all patients are treatable or willing to be treated, for example, when patients do not attend for review despite repeated invitations or if a medication cannot be prescribed due to a contraindication or side effect. In order for the practices not to be penalised due to circumstances beyond their control they can exclude those patients from counting towards their achievement through exception-reporting. Exception-reporting is allowed for a range of reasons. The QOF achievement reported annually is the exception-adjusted population coverage. Map 26 shows the actual population coverage for each CCG in which excepted patients have been included in the denominator.

Use of categorical data

Four of the indicators (maps 11 to 14) are a categorical statistic ('24 hour access' or 'Not 24 hour access'). Since 2011 there has been an annual survey by NHS Improving Quality (NHSIQ) of all hospitals in England to assess the level of provision of weekend and out-of-hours interventional radiology (IR) services. For this series of indicators the 2013 data have been used, although the results of later surveys are available. The 2013 data were selected because it is possible to show not only which NHS Trusts had formal out-of-hours IR provision but also the degree of variation in service provision across England using the strategic health authority (SHA) as a level of geography. Although the SHA is no longer part of the NHS structure it is a useful proxy measure for larger populations; moreover, the larger geography is relevant to the need to develop an optimal system for out of hours IR services via a network of providers across a geographical area.

The survey was sent to all IR services in England, and there are three categories of response for each NHS Trust:

- there is core service provision with a formal rota and formal network pathways to an agreed recipient
- there are some core services available on a formal rota, and there is limited formal network provision
- there is no core service provision and no network pathway

[1] NHS England. Technical Guide to Clinical Commissioning Group and Area Team allocations 2014-15 and 2015-16. https://www.england.nhs.uk/2014/03/allocations-tech-guide/
[2] Wilson EB. Probable inference, the law of succession, and statistical inference. J AM Stat Assoc 1927; 22: 209-212.
[3] Breslow NE, Day NE. Statistical methods in cancer research, volume II: The design and analysis of cohort studies. Lyon: International Agency for Research on Cancer, World Health Organization; 1987: 69.
[4] BMA, NHS England and NHS Employers. 2014/15 General Medical Services (GNS) Contract Quality and Outcomes Framework (QOF). Guidance for GMS Contract 2014/15. March 2014. www.nhsemployers.org/~/media/Employers/Documents/Primary%20care%20contracts/QOF/2014-15/2014-15%20QOF%20guidance%20documents.pdf
[5] In "2013/14 general medical services (GMS) contract quality and outcomes framework (QOF). Guidance for GMS contract 2013/14" http://www.nhsemployers.org/Aboutus/Publications/Documents/qof-2013-14.pdf the indicator number was changed from 'COPD10' to 'COPD

Domains in the NHS Outcomes Framework

Underneath the title for each indicator the domain or domains in the NHS Outcomes Framework 2016/17[6] relevant to the indicator have been listed. The five domains are as follows:

- domain 1: Preventing people from dying prematurely
- domain 2: Enhancing quality of life for people with long-term conditions
- domain 3: Helping people to recover from episodes of ill health or following injury
- domain 4: Ensuring that people have a positive experience of care
- domain 5: Treating and caring for people in a safe environment and protecting them from avoidable harm

[6] Department of Health. The NHS Outcomes Framework 2016-17. www.gov.uk/government/publications/nhs-outcomes-framework-2016-to-2017

Tips for using the Atlas of Variation in NHS Diagnostic Services to deliver healthcare improvement and financial sustainability: the RightCare Approach

The data shown in this Atlas can be used by a range of bodies including Local CCG Commissioners, NHS England, Specialised Commissioning, Public Health England, National Policy Makers, Health Education England and the Royal Colleges to identify the need for action and to assess whether improvements have been made.

The first step is to use the maps and underpinning data to indicate if the geographical area of interest has any cause for concern eg being statistically higher/lower than the England value and whether this has been consistent over the time period presented. The data presented in this Atlas can be downloaded in the form of an Excel spreadsheet[1].

In all maps statistical comparisons are made between the local value for the diagnostic test and the England value. The column charts show the actual range of values with shading reflecting their statistical significance. From the data spreadsheet, local teams can view their own organisational values for all time periods displayed in the boxplots. Alongside this, for each indicator and all time periods, the statistical significance banding is provided (previously unpublished). Local areas will be able to compare their data with England values and identify indicators where they have shown persistence in being significantly different to the England value.

A number of maps show data which can be compared against quality standards, these are maps 4a, 4b, 5a, 5b, 6a, 6b, 7, 8, 11 to 14, 18, 20, 26, 30-38. The other maps show data on the level of diagnostic testing per head of population. For these maps the ideal level of services is not known, thus it is important to bear in mind that if a diagnostic service for a local area is statistically significantly different from the England value this warrants further investigation. Maps 2, 9,10, 23, 25 show data on services which are usually provided in specialised centres. These show evidence of potential problems of access for patients. This may be due to lack of capacity at the centre to deliver to a wider network, travelling distances for patients, lack of awareness of local clinicians or lack of clinical protocols/pathways in areas which do not have local provision or due to commissioning decisions. However, it is clear that every map in this Atlas shows problems with access.

The questions that need to be addressed in order to reduce unwarranted variation in diagnostic services and thereby facilitate a shift in resource use to higher value activities are:

- is there underuse of any tests in the local population?
- if there is underuse is this indicative of ineffective healthcare and/or inequity of access for particular subgroups of the population?
- problems with healthcare provision may include inadequate diagnostic equipment, inadequate levels of trained staff or issues related to the hours of operation of the services or access to theatre time.
- are people from deprived populations, older people or BME groups unfairly disadvantaged, or is it a question of distance between where people live and where services are provided that reduces access?
- is there overuse of any tests in the local population?
- if there is overuse does it represent only waste or is overuse causing harm through over diagnosis or iatrogenic effects?

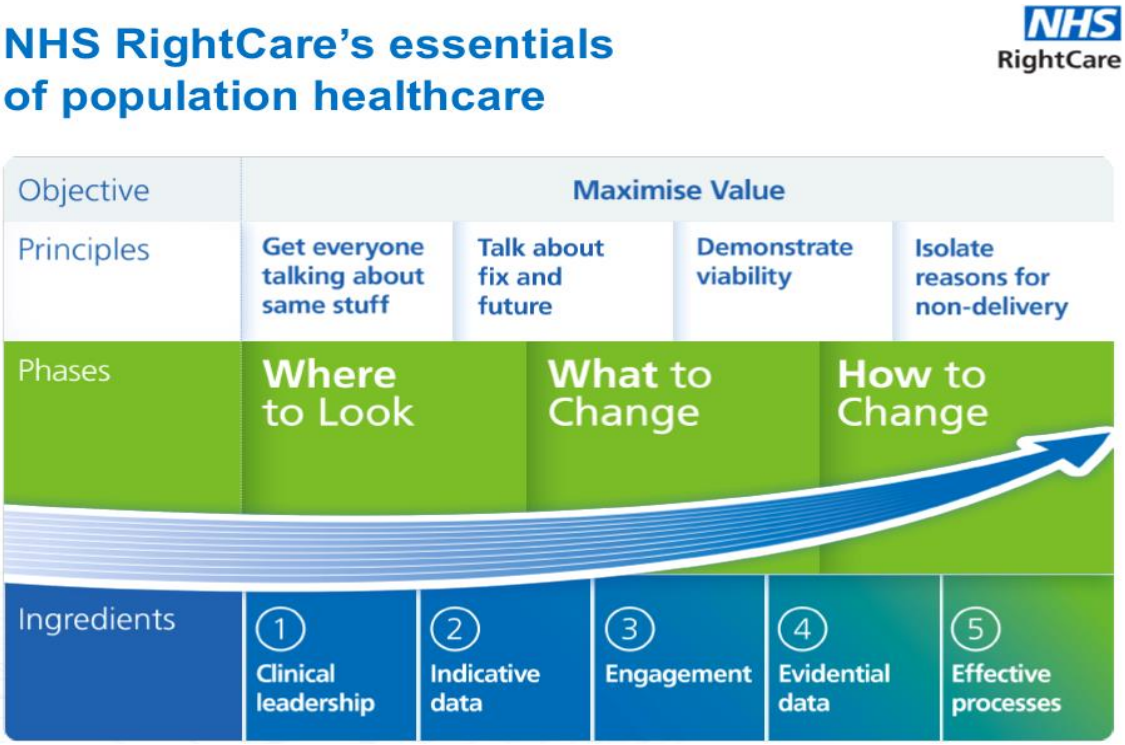
Having identified a potential need for action the NHS RightCare Approach to improving outcomes and value in the NHS provides a helpful framework and set of tools for identifying what needs to change and how to change.

The NHS RightCare Approach

By December 2016 all local health economies will be using the RightCare approach to reduce unwarranted variation and deliver better value population healthcare. The RightCare Approach has three phases and five key ingredients that build on strong evidence as a starting point.

[1] Public Health England. Public Health Profiles. www.fingertips.phe.gov.uk/profile/atlas-of-variation

Figure 8: The RightCare Approach



"*Where to Look*"

Phase 1 of the RightCare Approach begins with a review of indicative data. This highlights the top priorities and best opportunities for transformation and improvement by comparison with a CCGs most similar peers. NHS Rightcare indicative data is supplemented by local data and intelligence to get a comprehensive picture of the greatest opportunity.

The maps in this Atlas provide indicative data for local health economies on their variation relative to England values. This is shown in terms of statistical significance; higher, lower or not significantly different from the England value. To understand the impact of the level of variation on health outcomes it is important to investigate the value for the diagnostic test by undertaking a deep dive of other relevant data, for example the demography of the local population (age, socioeconomic and ethnicity distribution) as shown in figures 3, 4 and 5 and how this may impact on the need for diagnostic testing or access to testing. Other factors which should be considered are location of provision of service and how this may impact on patient access especially where tests or procedures are only provided in specialist centres. The incidence or prevalence of the condition(s) for which the test is used should be ascertained for the local health economy and how these and outcome indicators such as survival (cancers) or mortality compare with others.

Outcome data will indicate how successful the local health economy is at preventing adverse outcomes and enable a focus on the role diagnostic testing is playing in early diagnosis or monitoring of the condition.

The first set of questions relates to whether this difference is real or artefactual due to recording or coding issues and if so what could be the explanation(s), some of these questions are shown in Box 1 and Box 2.

A review of these questions will enable local health economies to determine whether there is a need for action by identifying whether variation is warranted or unwarranted.

Box 1:
What type of indicator is this?

- Does this indicator describe the quality of a diagnostic service, for example time to diagnostic scan for suspected stroke?
- Does this indicator represent level of provision locally, for example colonoscopy and flexible sigmoidoscopy services per 1,000 population?
- Does this indicator reflect levels of access to procedures only provided by specialist units, for example EVAR?

Box 2:
What could be the explanation for the variation seen?

- Could there be a recording or coding issue leading to apparent variation?
- How does the population 'need' for this diagnostic test vary? Has this indicator been standardised to take 'need' into account? Do different indicator values represent variation in provision when accounting for 'need'?
- Is there a problem of underprovision or overprovision?
- Is there evidence of poorer health outcomes related to underprovision of this diagnostic test?
- How do facilities and manpower compare with elsewhere?
- What are the organisational designs for diagnostic services? Are structural differences reflected in both the provision and availability of the full range of services for local populations, and the profile of the workforce?
- How do the diagnostic services perform across a range of indicators which cluster together because they use the same or overlapping facilities and workforce, eg endoscopy services? Are some aspects better than the England average, and others worse?
- Is there variation in the clinical application of testing – revealing the extent of variation in both the referral and the appropriateness of test requests and, therefore, the potential clinical impact of under-testing versus the lack of utility and avoidable cost of over-testing?
- How does productivity of the workforce (tests per whole time equivalent) compare?
- Are there variations in cost (and price) per test – a function of the factors above, plus differences in economies of scale, and the indirect and overhead costs?

The information contained within this Atlas can be used with a variety of other tools which describe data about health and health services to support improvement at the level of local populations. These tools, which support the NHS RightCare Approach include:

- Commissioning for Value Where to Look Packs[2]
- Commissioning for Value Focus Packs[3]
- Spend and Outcome Tools[4]
- Local disease and risk factor specific profiles contained in Fingertips[5]
- National End of Life Care Intelligence Network[6]
- National Cardiovascular Intelligence Network[7]
- Child and Maternal Health Intelligence Network[8]
- Mental Health, Dementia and Neurology Intelligence Network[9]
- National Cancer Registry and Analysis Service (NCRAS)[10]

In NHS diagnostic services there are particular challenges as the optimal number of tests per head of population is not always known. It is important to note that the England value cannot be assumed to be the optimal value and it is important for local health economies to understand more about their variation and to consider the questions in Box 2 to understand what action to take. To investigate indicators which may yield potential opportunities, local analysts should download all of the data used within this Atlas[1] for local interpretation.

[2] NHS England. Commissioning for Value. Commissioning for Value - first stage to identify opportunities to improve outcomes and increase value for local populationswww.england.nhs.uk/rightcare/intel/cfv/data-packs/
[3] NHS England, Commissioning for Value. Commissioning for Value - focus packs provide more detail on seven different topic areas including cancer, MSK & trauma and CVD family of conditions www.england.nhs.uk/rightcare/intel/cfv/data-packs
[4] Public Health England. Spend and Outcome Tool (SPOT). Understand health outcomes and expenditure across all programmes. http://www.yhpho.org.uk/default.aspx?RID=49488
[5] Public Health England. Public Health Profiles https://fingertips.phe.org.uk/
[6] Public Health England. National End of Life Care Intelligence Network. http://www.endoflifecare-intelligence.org.uk/
[7] Public Health England. National Cardiovascular Intelligence Network. www.yhpho.org.uk/default.aspx?RID=182342
[8] Public Health England. Child and Maternal Health Intelligence Network. www.chimat.org.uk
[9] Public Health England. Mental Health, Dementia and Neurology Intelligence Network. https://fingertips.phe.org.uk/profile-group/mental-health
[10] Public Health England. National Cancer Registration and Analysis Service. http://www.ncin.org.uk/home

However, for some of the indicators, for example access to imaging for patients presenting with signs of symptoms of stroke or following major trauma to the head or pelvis, there are clear standards for quality of services. Where there are clear targets, for example uptake of screening tests, or quality markers, such as patients with signs and symptoms of stroke be scanned within an hour of presentation to hospital, the local health economy should also assess how far they are from these targets. For other diagnostic testing, the challenge in deciding on an optimal level of provision for diagnostic services is that the evidence base for this is often lacking.

Provision of diagnostic services should reflect population need and this in turn will be driven by the demographics of the population. Thus, older populations and those with greater socioeconomic deprivation usually have higher levels of incidence and/or prevalence of conditions which require diagnosis and monitoring. If diagnostic services accurately reflected need then areas of higher need would have higher levels of services. Where the condition(s) being tested for vary with age and/or socioeconomic deprivation the data presented has been standardised (data availability permitting) for these factors. In theory, the residual variation presented reflects true differences in provision after removing variation due to population 'need'.

The boxplots attached to each map show the direction of progress at a national level and the Atlas data Excel spreadsheet[1] provides the time series values at a local level.

"What to Change"

Phase 2 of the RightCare approach involved a more detailed review of specific areas, care pathways and optimal design to identify the options for improvement and testing viability. Clinically led service reviews are carried out as necessary and a review of best practice and evidence will inform "what to change".

Having established that there may be a problem, it will be necessary to examine potential reasons. If there appears to be underuse of diagnostic testing it will be important to explore whether there are problems with the level of provision compared to need, for example:

- equipment or staffing
- are there protocols for referral?
- are there barriers to access for the population such as travelling times?
- poor health literacy
- discrimination
- is patient choice important?

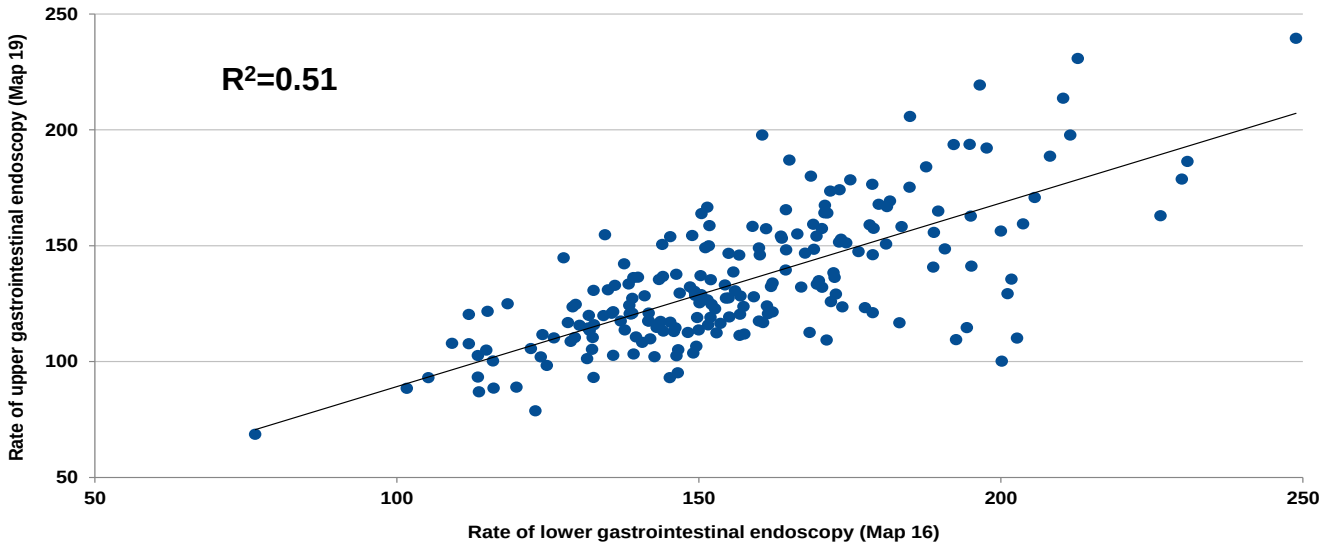
The maps in this Atlas show particular problems of access to new diagnostic services and those which are limited to specialised centres.

If there appears to be overprovision it will be important to explore whether protocols for referral are inadequate or not being adhered to or in the case of barium enema whether the pace of phasing this out with replacement by lower GI endoscopy (flexible sigmoidoscopy, colonoscopy and CT colonoscopy) is too slow.

Many of the indicators of level of diagnostic testing provision, use or quality cannot be considered in isolation. When looking at the level of diagnostic service use it is often important to consider the relationship between different forms of diagnostic testing. For example between the use of MRI scanning and CT scanning where diagnostic pathways may depend on the level of provision of, or access to, MRI scanning locally. Sometimes a composite measure combining tests which are used for a similar purpose is useful. It is for this reason that flexible sigmoidoscopy and colonoscopy (Map 16) have been combined. Other examples are EVAR (Map 9) and open surgery for treatment of abdominal aortic aneurysm (Map 10).

It may be important to consider whether there is any clustering of problems with diagnostic testing, for example endoscopy services where the same gastroenterologists may be performing upper and lower GI endoscopy and a shortage of trained staff therefore impacts on both services. A comparison of maps 16-19 appears to show a similar geographical pattern of provision of lower and upper GI endoscopy services. Figure 9 shows that there is a strong correlation (R^2=0.51) between levels of provision of lower and upper GI endoscopy services (Map 16 vs Map 19) confirming this hypothesis, although a comparison of the thematic maps shows a few notable differences.

Figure 9: **Scatterplot of the 2014/15 rate of colonoscopy procedures and flexible sigmoidoscopy procedures per 10,000 population (Map 16) vs the 2014/15 rate of gastroscopy procedures per 10,000 population (Map 19) by CCG**



Finally, it is important to consider the role of diagnostics within the entire patient pathway[5] taking into account what is known locally about the incidence and prevalence of the conditions for which the testing is being undertaken and more subtle issues such as, for colorectal cancer, the stage at which patients present with cancer or whether they present as an emergency.

The production of pathways, such as colorectal cancer, in the Where to Look packs[2], and the development of optimal value pathways, for example cardiovascular disease prevention[11], by RightCare will support this.

Case study: Colorectal cancer

One of the prime uses of colonoscopy and flexible sigmoidoscopy is in the diagnosis or exclusion of colorectal cancer in symptomatic patients and following a positive screening test for colorectal cancer. It is also used to diagnose or exclude other non-malignant pathologies of the large bowel. Colonoscopy and to a lesser extent flexible sigmoidoscopy are also used in surveillance for recurrence of colorectal malignancy, surveillance of inflammatory bowel disease and in patients with high genetic risk for colorectal cancer. A new technology CT colonoscopy has been introduced in some Trusts. The relative merits of these tests are described in the text for maps 16, 17, 18. Barium enema should no longer be used for the diagnosis of colorectal cancer and its use should have been phased out.

"Where to Look"

Phase 3 of the Rightcare approach involves taking forward opportunities and making them happen. This is achieved through outlining the case for change and making sure impact assessments and assumptions are explicit. This phase involves ensuring that there is clinical leadership of the change and that programmes of work are planned, delivered and monitored, using established improvement processes.

Using the Atlas data Excel spreadsheet[1] it is possible to see whether the local rate of colonoscopy and flexible sigmoidoscopy (Map 16) is significantly lower than the England value. It is also possible to examine the role that CT colonoscopy plays (Map 17), and it is important to check whether significant numbers of barium enema are still being performed (Map 18). Map 31 shows the percentage of eligible people aged 60-74 years with a screening test result recorded in the previous 2.5 years from the NHS bowel cancer screening programme (NHS BCSP) by upper-tier local authority. There is also useful information in the NHS Atlas of Variation in Healthcare 3.0[1]: Map 9B shows the ratio of colonoscopy procedures to flexible sigmoidoscopy procedures by CCG (2012/13) and Map 13 shows the percentage of new cases of colorectal cancer that were diagnosed at stage 1 or stage 2 by CCG (2013).

[11] NHS England. Commissioning for Value. Commissioning for Value – cardiovascular disease prevention optimal value pathway. https://www.england.nhs.uk/rightcare/intel/cfv/cvd-pathway/

Having established that the levels of diagnostic services are significantly different from the national value and/or demonstrably different from the best performers it is important to undertake a deep-dive using other data sources to assess the potential explanations and consequence of underprovision or overprovision.

For example, whether demographic characteristics or other reasons for warranted variation explain the degree of variation observed, for instance, if all demographic peers show similar degrees of variation.

The PHE National Registration and Analysis Service (NCRAS) analyses and publishes a wealth of data on cancer on its website. For colorectal cancer, data on incidence and mortality[12], stage at presentation[13] and route to diagnosis[14] can be obtained at local level. Colorectal cancer survival at CCG level is produced by ONS.[15,16] Mortality and survival are important outcome measures which reflect the success of the diagnostic and treatment elements of the pathway for colorectal cancer.

"What to Change"

Poor levels of provision of lower GI diagnostic testing could result in late stage of diagnosis of colorectal cancer, higher rates of emergency presentation both of which lead to poor survival and higher mortality rates.

Figures 10 and 11 (at the end of this section) are examples of data available from NCRAS. These show the incidence of colorectal cancer by CCG for males and females respectively. Colorectal cancer incidence increases with age but compared with other cancers it does not have a steep socioeconomic gradient.

At a local level it will be important to establish the stage distribution at presentation. This is shown in Map 13 of the NHS Atlas of Variation in Healthcare Services 3.0[1]. Good access to endoscopy services will help to improve stage at diagnosis although caution should be exercised in interpretation and it should first be verified whether poor stage 1 and 2 could also be due to poor historical rates of cancer registration by stage.

Routes to diagnosis data[14] shows in particular the proportion of patients presenting as an emergency by local health economy, as well as proportions referred through the two-week wait or other routes. A high emergency presentation rate may suggest poor access to lower GI endoscopy services and proportion of patients referred under the two-week wait.

There is a wealth of guidance available on lower GI imaging and colorectal cancer referral pathways, diagnosis and follow-up surveillance from the National Institute of Clinical Excellence (NICE), guidance on screening for colorectal cancer from the National Screening Committee and on diagnosis and surveillance of other conditions.

Implementation of change will require dialogue between commissioners and providers and in particular, clinical leadership and engagement and a business planning processes.

"How to Change"

For most of the indicators in this Atlas there is clear information on what can be done to improve practice. National organisations, such as NICE and the Royal Colleges have defined best practice. Each map in this Atlas contains sections entitled "Context", "Options for action" and "Resources". These provide the background to the use of the diagnostic testing, wider issues for consideration related to patient pathways to which the diagnostic test contributes and in the "Resources" section references to guidelines and policy statements and economic evaluations. This information together with the information of local performance can be used to highlight and improve services.

[12] Public Health England. National Cancer Registration and Analysis Service. https://www.cancerdata.nhs.uk/
[13] Public Health England. National Cancer Registration and Analysis Service. http://www.ncin.org.uk/cancer_type_and_topic_specific_work/topic_specific_work/cancer_outcome_metrics
[14] Public Health England. National Cancer Registration and Analysis Service. http://www.ncin.org.uk/publications/routes_to_diagnosis
[15] The Office for National Statistics. Table 10 to 16: 1-year cancer survival by clinical commissioning group in England, with 95% confidence intervals. https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/datasets/table10to161yearcancersurvivalbyclinicalcommissioninggroupinenglandwith95confidenceintervals
[16] The Office for National Statistics. Geographic patterns of cancer survival in England for cancer of the colon. https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/datasets/geographicpatternsofcancersurvivalinenglandforcancerofthecolon

Having assembled the evidence it will be important to discuss with local clinicians to understand how these data relate to each other and to examine local use of referral protocols, for example the two-week wait referral process. It will also be important to consider the balance between new referrals and follow-up testing. Other issues such as facilities and manpower, especially the number of endoscopists need to be considered.

As described in the text accompanying maps 16-18, the Joint Advisory Group on Gastrointestinal Endoscopy (JAG) runs accreditation schemes and surveys of numbers of endoscopists.[17]

Further information can also be determined relatively easily, such as whether the improvement:

- is supported by the clinical community
- is easy and quick to implement, for example, increased adherence to protocols
- will take time because capital investment or recruitment or training of staff is required
- has a fast or slow rate of return on investment

Taking a specialty approach

The case for improving or disinvesting in a diagnostic test can usually not be made in isolation. As described above, the level of provision of one diagnostic test may not be independent of other tests. There are several reasons for this; radiological tests and interventional radiology are provided by the same department and while personnel may be specialised often the staffing level in the department affects the delivery of several modalities of testing. This is true also for endoscopy services. Some examples are given below.

Radiology

In radiology, including interventional radiology it is clear that services are likely to have interdependencies including shared staff, equipment and room/theatre time. If a CCG or NHS Trust notes that there is a problem with one or a number of radiology services it will be useful for commissioners and providers to consider if, and how, the level of provision of diagnostic tests has interdependencies. Are some diagnostic tests or certain disease groups of patients given priority access? Is emergency use equally good across different indications eg acute stroke diagnosis, acute head injury, acute pelvic injury (maps 4a-8). Are there links and dependencies between diagnostic tests and interventional radiology or, for example, for interventional radiology (maps 11 to 14) are there clashes in the need for theatre time and personnel or do the procedures take place in different rooms with different staff?

Although each modality of diagnostic testing has specific indications some diagnostic tests may overlap in their indications for use. This use of alternative modalities, even if less good may become more apparent when there is insufficient capacity. For this reason CT scanning (Map 1), MRI (Map 2) and non-obstetric ultrasound scanning (Map 3) activity rates may need to be considered together and with the use of CT scanning in emergency scenarios (maps 4a-8) and for CT colonoscopy (Map 17).

Management of Abdominal Aortic Aneurysms

In this Atlas there are three maps relevant to the management of Abdominal Aortic Aneurysm (AAA) which should be considered together. Map 30 shows variation in the percentage coverage for initial screening tests for men aged 65 years and over in the NHS AAA screening programme. Map 9 shows the rate of endovascular aneurysm repair (EVAR) for AAA and Map 10 shows the percentage of elective procedures for AAA which were EVAR.

Endoscopy and barium enema

The maps on adult endoscopy and barium enema (maps 16-22) should be considered together as staff and theatres are often used for both upper and lower GI endoscopy. Barium enema should be almost phased out but this requires a lower GI endoscopy service to replace it. Within the endoscopy services issues like the ratio of first diagnostic examinations to follow up examinations should be considered as well as the balance between upper and lower GI endoscopy. Consideration should be given to whether all endoscopy diagnostic tests have high or low rates or whether some procedures, patient groups or referral pathways have priority.

[17] JAG Accreditation System incorporating the Endoscopy Global Rating Scale. https://www.jagaccreditation.org/

Paediatric endoscopy (Map 23) is usually performed by paediatric gastroenterologists and is a specialist services for which there appear to be important access issues.

The way forward: increasing value

The need to address under provision of diagnostic services combined with an ever increasing need for diagnostic testing will have resource consequences. At the time of writing the NHS needs to find over £22 billion in efficiency savings and it is unlikely that there will be any increase in funding for either commissioners or service providers in the next five years. Therefore commissioners and service providers need to work together more closely to identify the resources necessary to meet the increased need for diagnostic testing. Reducing the inappropriate use of diagnostic testing will help to free some resources to fund other priorities.

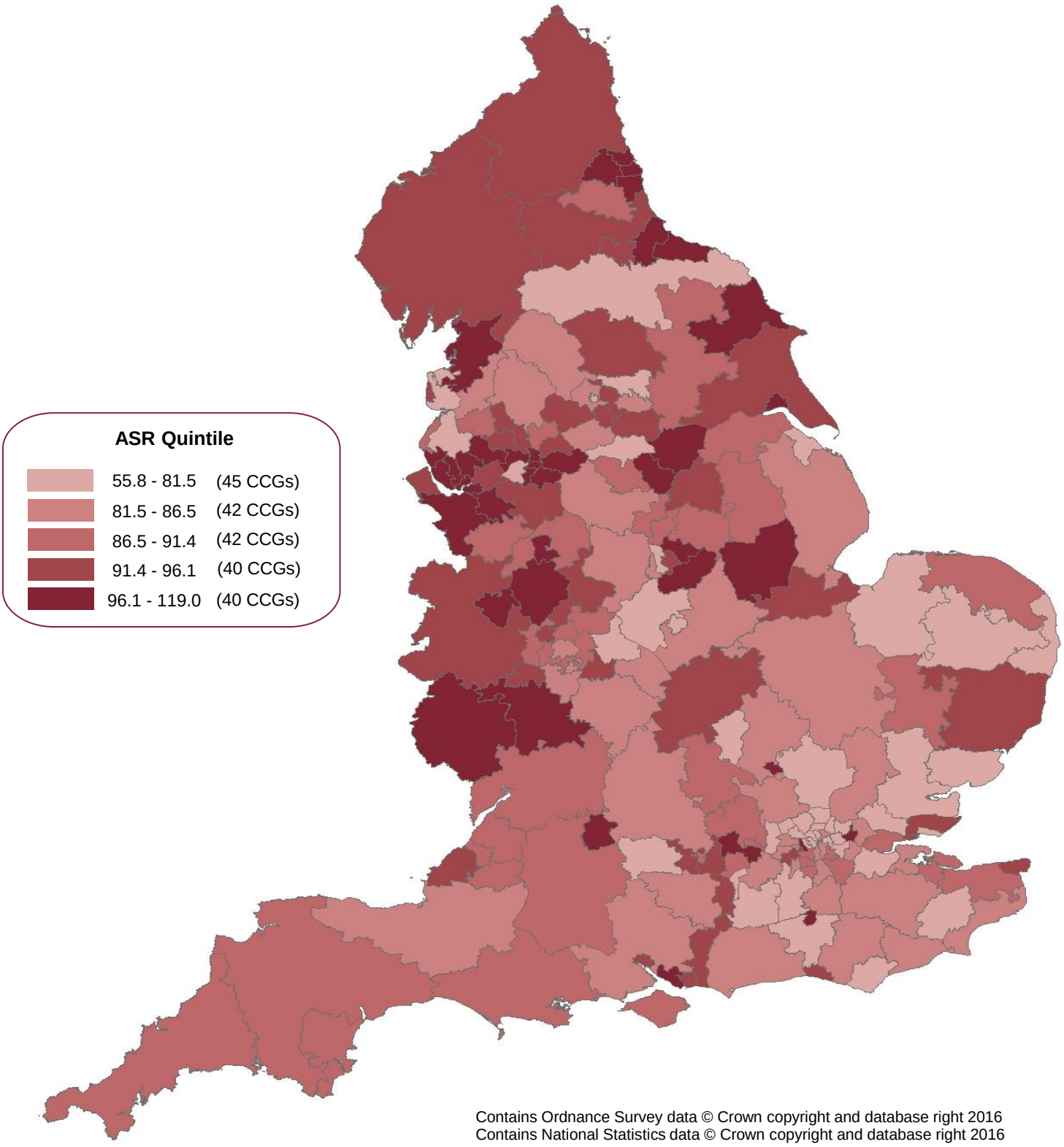
One option available for resourcing high value tests, which has not featured on the commissioners' agenda until now is to shift resources. Shifting resources has particular implications for healthcare scientists and pathologists. For the last 20 years the principal focus of their work has been on quality. Indeed healthcare scientists and pathologists are two professional groups who have achieved high standards in quality assurance and quality improvement, but as value in healthcare becomes the central concern it is not sufficient to focus on quality alone. The challenges are great as money is often ring fenced within Trust directorates so that it can be difficult to shift money between surgery and imaging for example.

Ideally, it would be possible to look at the patient pathway(s) and move some funding to the diagnostic phase of the pathway with the intention of saving costs in treatment further down the line. Many of the maps show examples of diagnostic tests where better provision would lead to better management and fewer complications including hospital admissions. A clear example of the case for investing in diagnostics to save on treatment costs is illustrated in maps 4a to 6b which show variation in time to brain imaging for patients with suspected stroke. There is now good evidence for the effectiveness of treating evolving strokes to prevent death and severe disability supported by NICE accredited guidelines for imaging. Another example would be Map 26 which shows variation in FEV1 testing for patients with COPD in the previous 12 months. Regular review of lung function is important to adjust medication and prevent unnecessary hospital admissions.

The need to shift resources to increase value in both diagnostic services and healthcare overall requires a shift in culture and practice. In addition to focusing on the quality and results of the tests conducted and the experience of patients undergoing those tests, the providers of diagnostic services need to consider the use of diagnostic testing at a population level.

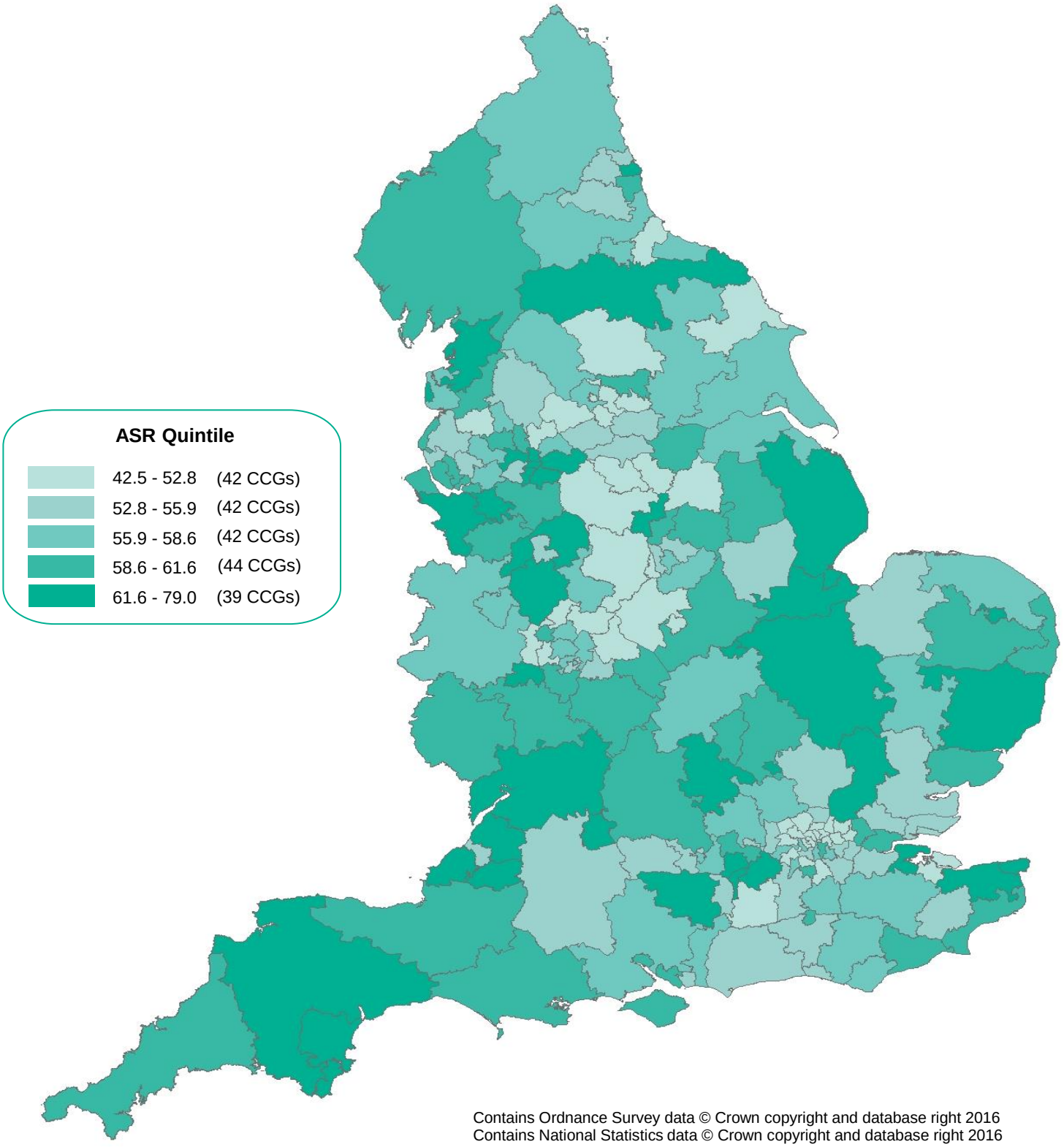
In the three years since the publication of the first NHS Atlas of Variation in Diagnostic Services in 2013 it is apparent from this update that there is still unwarranted variation in diagnostic testing. The elucidation of underuse and overuse are essential to identifying the interventions necessary to reduce it. This must be a priority for diagnostic services in the next five years.

Figure 10: Incidence of colorectal cancer in men by CCG, 2012-2014 age-standardised rate per 100,000[12]



Source: National Cancer Registration and Analysis Service, Public Health England

Figure 11: Incidence of colorectal cancer in women by CCG. 2012-2014 age-standardised rate per 100,000[12]



Source: National Cancer Registration and Analysis Service, Public Health England

Reducing unwarranted variation in individual diagnostic disciplines

In the following sections for each of the individual disciplines in the second Diagnostics Atlas, there is an overview of the discipline and a description of the services provided for patients. The reasons for variation in service provision in each discipline are outlined, some of which are common to all disciplines across diagnostic services, such as patterns of disease prevalence, the availability of a trained workforce and local custom and practices, whereas others are different, arising from the differences in the nature of the specific interventions and tests.

Discussions are currently taking place with the relevant professional groups about ways in which they can contribute to reducing unwarranted variation and increasing value. This role of value improvement can build on the leadership role these professional groups already hold in quality assurance.

Imaging services

Diagnostic imaging is a rapidly evolving field driven by technological developments. Historically in the UK imaging has been used to confirm a diagnosis and to indicate appropriate management of a particular condition. There has been a perception that imaging was inappropriate if it did not lead to a change in the management of a condition. The high costs of new technologies tended to perpetuate this belief, but the use of imaging is now being driven by different factors including changes in patient expectation and the increased speed, safety and capability of new technology.

Effective and good quality imaging is important for further medical decision making and can reduce unnecessary procedures. In some countries it might have been possible to avoid a significant proportion of all abdominal surgical interventions (exploratory laparotomy) if simple diagnostic imaging services such as ultrasound had been available.[1] Most patients now expect a definite diagnosis to be sought irrespective of whether, in the opinion of their clinician, a change of management is likely to ensue. This is likely to give the patient a greater feeling of certainty even if the test(s) is negative. In addition newly trained clinicians have tended to place greater reliance on imaging and other diagnostic tests than their predecessors, which acts as another driver for reliance upon medical imaging technologies.[2] This trend may be further exacerbated by the shortening period of time for medical training, which could mean that imaging diagnosis will become a fundamental guide to the management of most conditions.

Current government policy is to develop primary and community based assessment and treatment services in the NHS, shifting the provision of care closer to patients' homes, and reducing the burden and dependence on secondary and acute care services. A more productive use of resources at an earlier point in the care pathway offers patients a better service.

This re-sequencing has been associated with significant increases in imaging in other countries.[3] A 'significant' increase in imaging in the NHS may not necessarily lead to an overall increase in cost if diagnosis is performed earlier in the care pathway and the number of secondary care outpatient appointments is reduced, thereby improving patient experience; however, this is an aspect of diagnostic services where more research is needed. It is also important to balance access for the community with the need to avoid destabilising all services in the acute setting. Commissioners need to create a population, system wide approach to ensure that the application of local protocols is factored into any planning.

The Picture Archiving and Communications Systems (PACS) enable radiological and other images to be stored electronically and viewed on screens, so that both the image and relevant information, including the report, can be accessed and compared with previous images at the touch of a button.

[1] World Health Organization. Diagnostic imaging. Imaging modalities. 2013. http://www.who.int/diagnostic_imaging/en/
[2] Bosanquet DC, Cho JS, Williams N et al. Requesting radiological investigations – do junior doctors know their patients? A cross-sectional survey. JRSM Short Rep 2013 January 14. doi: 10.1258/shorts.2012.012043 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3572658/
[3] Organisation for Economic Co-operation and Development (OECD). Health at a Glance. OECD indicators 2005. http://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-2005_9789264012639-en

With the development of the PACS it is possible to separate the local acquisition of some images from remote reporting. In this way a local service can be provided to patients without the necessity for the reporting clinician to be on the same site. Although there are obvious advantages to such a system, it is important to take into account several considerations including credentialing of reporting clinicians, patient consent and patient confidentiality. Ultrasound and all interventional imaging should be reported by the health professional undertaking the investigation.

It is incumbent on providers of imaging services to demonstrate, among other things, improved patient experience through effective image waiting times and reporting turnaround times for all modalities [see Box 3 for details about the Imaging Services Accreditation Scheme (ISAS)]. This information should be measured and shared with commissioners, users of the service and patients to support monitoring and the achievement of continual improvement in the service. This will also ensure that key policy drivers for healthcare services are being met, including those for cancer, stroke and emergency care.

Box 3: The Imaging Services Accreditation Scheme (ISAS)[4]

- ISAS is a patient-focused accreditation scheme available to UK imaging services
- Accreditation is independent attestation of an organisation's competence to provide diagnostic imaging services such that the users have confidence in the outcomes
- The United Kingdom Accreditation Service (UKAS) was selected by The Royal College of Radiologists and The College of Radiographers to deliver and manage ISAS
- UKAS assesses imaging services against the ISAS standard and ensures, through regular monitoring, that required standards are maintained
- The scheme includes an enhanced package of support and an optional staged pathway to help imaging services preparing for and going through initial assessment for ISAS

The Diagnostic Imaging Dataset (DID) is the central collection of detailed information about diagnostic imaging tests carried out on NHS patients, extracted and submitted monthly (see Box 4 for the type of information captured in the DID). The dataset is collected at patient level and includes patient identifiers to enable linkage to other datasets, most notably cancer registration data. Combined, these data items give powerful information about access of NHS patients to diagnostic imaging tests across the country, and will help to address unwarranted variation.

Box 4: Information captured by the Diagnostic Imaging Dataset (DID)[5]

- Referral source and patient type
- Details of the test (type of test and body site)
- Demographic information such as GP registered practice, patient postcode, ethnicity, gender and date of birth
- Waiting times for each diagnostic imaging event, from time of test request through to time of reporting

In addition, the use of the most up-to-date evidence through the application of referral guidelines, such as iRefer (see Box 5), and those produced by NICE and professional bodies such as the Royal College of Radiologists (RCR) will help to reduce unwarranted variation.

Box 5: iRefer – The Royal College of Radiologists' Radiology Referral Guidelines[6]

- iRefer, the 7th edition of the adult and paediatric imaging referral guidelines from RCR, is now available via the N3 platform free of charge to all NHS organisations in England
- The iRefer guidelines are evidence-based, and designed to help clinicians, healthcare professionals, radiographers and radiologists determine the most appropriate imaging procedures for a range of clinical problems
- The radiology referral guidelines have an important role in improving the quality of care for patients

Although the healthcare professionals in the NHS who provide imaging services are leaders in quality improvement, the variation observed for some of the indicators in the imaging services section of this Atlas underlines the necessity for radiologists to be given responsibility not only for the quality of imaging services that patients receive but also for the value that can be realised for the population as a whole.

[4] UKAS Assessment and Accreditation for ISAS. http://isas-uk.org/default.shtml
[5] Diagnostic Imaging Dataset Statistics. http://data.gov.uk/dataset/diagnostic_imaging_dataset_statistics
[6] About iRefer. https://www.rcr.ac.uk/clinical-radiology/being-consultant/rcr-referral-guidelines/about-irefer

It is clear there is a need for certain types of high value imaging to be increased, but the resources necessary to fund this increase will have to be found by reducing activity for imaging tests of lower value. The amount of time, however, that radiologists have available is a limited resource, and they require support in ensuring that any referrals make the best use of finite resources. A workshop organised with the RCR focused on the role of imaging in 21st century healthcare, with the aim of increasing the value derived from imaging services as a complement to the quality improvements already achieved.

Endoscopy services

Endoscopy is a subspecialty housed principally within medical and surgical gastroenterology; however, endoscopic procedures are also performed by radiologists, general practitioners and nurses. Endoscopy is vital to:

- the diagnosis and ongoing surveillance of gastrointestinal (GI) cancers
- the diagnosis, treatment and surveillance of a range of conditions and diseases that are not related to cancer

In 2012 it was estimated that the demand for lower GI endoscopy (colonoscopy and flexible sigmoidoscopy) would double by the end of the financial year 2016/17[7] due to:

- the extension to the faecal occult blood (FOB) testing screening programme for people aged 70–75 years
- the introduction of the flexible sigmoidoscopy bowel screening programme aimed at people aged 55 years of age

In addition the demand for endoscopy for patients with symptoms was thought to be increasing alongside the need for surveillance of patients at increased risk, and in England demand was expected to continue to rise due to projected increases in the proportion of the population older than 65 years.

Since then Cancer Research UK commissioned a study of the endoscopy service in England[8] to understand the pressures resulting from increasing demand generated by the 62-day wait target[9], relatively recent NICE guidelines on referral for suspected cancer [NG12][10], and changes to the bowel cancer screening programme. The aims of the study are shown in Box 6.

Box 6: Aims of the Cancer Research UK study of the endoscopy service in England[7]

- Improve knowledge of current upper and lower GI endoscopy capacity in England
- Ascertain by how much demand is likely to increase
- Identify levels of resource (including staffing, equipment and facilities) necessary to meet growing demand
- Estimate shortfalls in these resources
- Understand what is causing this and how it can be addressed

Several challenges facing endoscopy services were identified, including:

- rising demand and a lack of capacity to respond to increasing demand
- an estimated increase of more than 750,000 additional endoscopy procedures a year will be undertaken by 2020, representing a 4.4% increase on current activity (see Figure 12)
- recruitment and retention of the workforce
- weekend working
- training and development
- lack of 'headspace' to respond to the need to improve productivity and efficiency
- data availability, quality and use[7]

In addition there is known to be variation in endoscopy across several factors: from referral rates and conversion to test rates, through to the identification of polyps, and cancers detected. In localities where there are low intervention rates for endoscopy services the shortage of appropriately trained health professionals is an important contributory factor.

[7] NHS Improvement. Rapid review of endoscopy services. 5 March 2012. https://www.gov.uk/government/publications/rapid-review-of-endoscopy-services
[8] Health Services Management Centre, University of Birmingham, and the Strategy Unit, NHS Midlands and Lancashire Commissioning Support Unit. Scoping the Future. An evaluation of endoscopy capacity across the NHS in England. September 2015. Commissioned by Cancer Research UK. https://www.cancerresearchuk.org/sites/default/files/scoping_the_future_-_final.pdf
[9] The 62-day wait target states that 85% of cancer patients should receive treatment within 62 days of being urgently referred for suspected cancer by their GP.
[10] NICE. Suspected cancer: recognition and referral. NICE guidelines [NG12]. June 2015. https://www.nice.org.uk/guidance/ng12

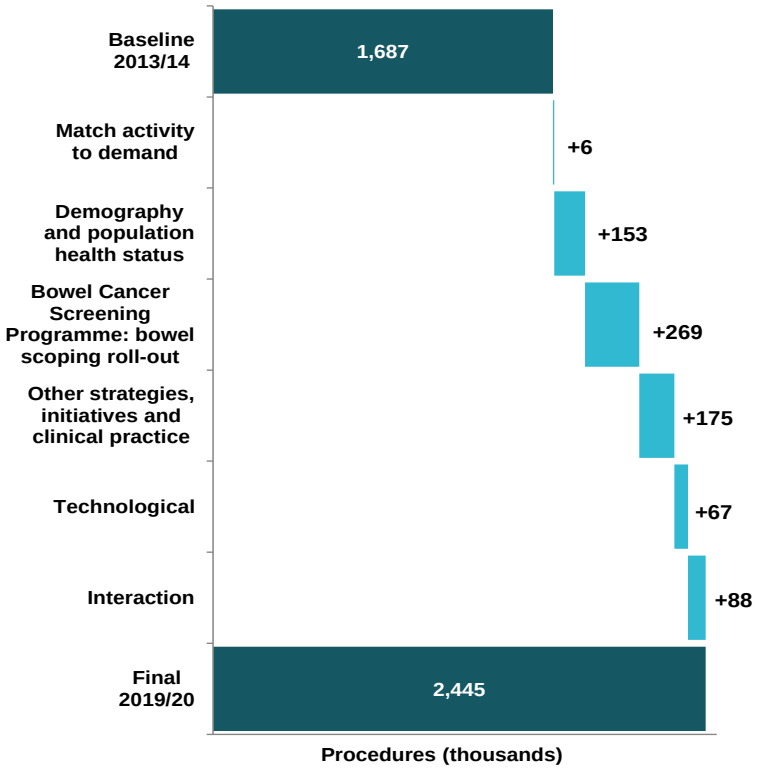


Figure 12: **Modelled changes in endoscopy activity 2013/14 to 2019/20. Reproduced with kind permission from "Scoping the Future: An evaluation of endoscopy capacity across the NHS in England" commissioned by Cancer Research UK and written by the Health Services Management Centre at the University of Birmingham and the Strategy Unit at NHS Midlands and Lancashire Commissioning Support Unit.**[8]

As for other diagnostic disciplines the emergence of new technology will also influence the number, use and costs of endoscopic techniques, and contribute to the degree of variation. Examples of emerging new technologies include:

- capsule endoscopy (Map 21), which allows direct visualisation of the entire small bowel, inaccessible to an endoscope, in a non-invasive manner – it is the gold standard in evaluating obscure GI bleeds unidentified by traditional endoscopic techniques[11] and it facilitates diagnosis of small-bowel Crohn's disease and the assessment of coeliac disease
- the introduction of the faecal immunochemical test (FIT) to replace the FOBT as the primary test in the NHS bowel cancer screening programme

In the same way as for other medical and diagnostic disciplines, identifying and understanding variation in any system can be helpful in monitoring, managing and improving a clinical service, and in identifying innovative and exemplar practice. Potential factors on which to focus in order to reduce variation in endoscopy services include:

- the quality and appropriateness of GP referrals, and the links between primary and secondary care
- the quality of consultant to consultant referrals
- the development and evaluation of alternative pathways and processes, such as 'Straight to Test' access to endoscopy
- the development of training programmes for non-medical endoscopists
- the degree to which training lists are protected and staff are adequately trained
- the use of appropriate productivity tools
- the achievement and maintenance of accreditation by the Joint Advisory Group on Gastrointestinal Endoscopy (JAG)

The JAG operates within the Clinical Standards Department of the Royal College of Physicians (RCP). The JAG has a UK-wide remit to agree and set acceptable standards for competence in endoscopic procedures and to provide quality assurance for endoscopy units, training and services. The JAG also runs an accreditation process (see Box 7), which is recognised internationally as improving quality and productivity within endoscopy services[7].

Box 7: The Joint Advisory Group on Gastrointestinal Endoscopy (JAG) Accreditation Scheme [12]

- JAG is a patient-centred and workforce-focused accreditation scheme
- Accreditation is independent against recognised standards
- JAG has been developed for all endoscopy services and providers across the UK in both the NHS and the independent sector
- It gives local commissioners assurance that an endoscopy service has the competence to deliver against the measures in the endoscopy Global Rating Scale (GRS) Standards

[11] Appleyard M, Glukhovsky A, Swain P. Wireless-capsule diagnostic endoscopy for recurrent small-bowel bleeding. N Engl J Med 2001; 344; 232–3.
[12] JAG Accreditation System incorporating the Endoscopy Global Rating Scale. https://www.jagaccreditation.org/

Implementing interventions to reduce unwarranted variation in endoscopy services will help to improve patient outcomes and increase value for local populations.

Physiological services

There are eight physiological science specialisms involved in providing diagnostic investigations:

- audiology
- cardiac physiology
- GI physiology
- ophthalmic and vision science
- respiratory and sleep physiology
- urodynamics
- neurophysiology
- vascular science

Each specialism provides diagnostic investigations that asses the function of major organ systems. For example, neurophysiology diagnostic services are used to investigate the function of the central and peripheral nervous systems. Investigations will provide information to identify pathology, and to underpin diagnosis, and treatment and care regimes. In some cases physiological services may also restore and monitor function through the provision of a range of therapeutic intervention strategies.

The demand for physiological investigations is increasing as a result of:

- the introduction of scientific and technological advances, for example, telemedicine and remote monitoring
- the increased prevalence of long-term conditions, coupled with an ageing population
- an increase in the demand for long-term follow-up of patients with complex conditions, and of patients receiving extended drug therapy
- delivering services seven days a week, and supporting both emergency and elective care
- reducing inequalities in the provision of and access to treatment and care
- supporting the implementation of NICE and other evidence-based guidance

Physiological services investigations are a key component in most clinical pathways, underpinning clinical decision making and contributing across the entire pathway of care. In England around 300 specialist physiological services investigations are available, with over 15 million procedures undertaken each year (excluding routine electrocardiograms (ECGs)).[13] These investigations are key to improving outcomes for patients through:

- the earlier identification and diagnosis of disease
- more rapid treatment of conditions
- responsive and effective monitoring

Although some physiological services have been brought together within a physiological services hub, it is more usual for services to be co-located with or adjacent to the relevant clinical specialty, even when they have a broader range of input and provide investigations across several specialties. For example, only 60% of the activity of both cardiac and respiratory physiological services is delivered to the associated clinical specialties of cardiology and respiratory medicine.

Scientific and technological developments in the delivery of physiological services have conferred considerable benefit on patients.

- The miniaturisation and portability of equipment allows investigations to be taken to the location of the patient, and enables the results to be delivered rapidly in support of clinical decision-making, thereby improving patients' experiences of healthcare
- Innovation in physiological services means that many investigations can be delivered in the community closer to where patients reside
- Innovation is also driving the delivery of non-invasive investigations that protect patient dignity: for instance, the use of carotid duplex investigations delivered by vascular scientists can streamline pathways for transient ischaemic attack (TIA) and stroke, and reduce the need for invasive treatment procedures

[13] Department of Health. What is Physiological Measurement? A guide to the tests and procedures conducted by Physiological Measurement diagnostic services. 2007. http://www.ahcs.ac.uk/wordpress/wp-content/uploads/2013/09/WhatisPhysiologicalMeasurement-dh274038.pdf

To improve patient outcomes commissioners need to work with local service providers to ensure that the adoption of innovation is timely, appropriate and effective. The systematic and consistent adoption of innovation is pivotal in reducing unwarranted variation in provision.

The existence of variation in access to physiological services is well documented; a shortage of appropriately trained healthcare scientists is a contributory factor to unwarranted variation in the provision of services. The implementation of the Any Qualified Provider policy, which introduced a choice of provider services, has improved access to adult hearing services by reducing inequalities in access, and has improved the quality of hearing services offered to all adult patients. To support the primary assessment of presenting symptoms this policy of extended choice has also instituted the delivery of some diagnostic tests closer to where patients reside. Certain cardiac and respiratory investigations are also provided in this way.

The introduction and uptake of the Improving Quality In Physiological Services (IQIPS) accreditation programme establishes a drive for quality and improved outcomes at the heart of physiological services, encourages the sharing of best practice and provides a mark of quality across all service providers (see Box 8). In addition accreditation through IQIPS plays a central role in delivering service improvement, and driving quality and innovation to meet the challenges of healthcare provision in the future.

The physiological services that are commissioned must meet local need, reflect proven innovations and good practice, realise improved health outcomes for patients, and be delivered by a healthcare science workforce that is fit for purpose and affordable.

To increase value for the populations served it is essential that the role of physiological services is not seen solely as supplying high-quality services as rapidly as possible in response to referrals. Instead those responsible for managing these services need to be given the authority and skills to ensure that resources are used to investigate and monitor individuals in the population who would derive the most value from testing.

Box 8: The Improving Quality In Physiological Services (IQIPS) programme[14]

- IQIPS accreditation gives patients assurance of the quality of physiological services investigations
- It gives commissioners assurance of the quality delivery of the physiological diagnostics services they commission from providers
- IQIPS is hosted by the RCP, and accreditation is independently delivered by the UKAS against the recognised IQIPS standard
- It demonstrates commitment to quality by promoting a responsive and learning culture
- It is a professionally owned and led programme to improve service quality, privileging patient experience, improved outcomes and safe practice

Screening services

Screening is a process of identifying apparently healthy people who may be at increased risk of a disease or condition. They can then be offered information, further tests and appropriate treatment to reduce their risk and/or any complications arising from the disease or condition.

Screening in the UK is guided by an expert scientific committee called the UK National Screening Committee (UK NSC)[15]. The UK NSC makes recommendations on all aspects of population screening. It advises ministers and the NHS in the four UK countries about screening policy, and supports the implementation of screening programmes.

The UK NSC makes recommendations whether to screen for a condition based on internationally recognised criteria and a rigorous evidence review and consultation process. It maintains an active horizon-scanning function and encourages and supports research and innovation.

The UK NSC's database of recommendations sets out more than 100 conditions, including recommendations to screen for more than 30 of them. It meets three times a year to make new recommendations or update existing ones, based on reviews of the best-quality evidence available at the time.

[14] Improving Quality In Physiological Services (IQIPS). https://www.iqips.org.uk/
[15] National Screening Committe. www.gov.uk/government/groups/uk-national-screening-committee-uk-nsc

The process of evidence review includes details of how to propose a new topic for consideration, how to request an early update of a topic where there is new evidence or how to suggest a change to an existing screening programme.

A national screening programme is established only if certain conditions are met. These include the existence of an accurate and acceptable screening test, the ability to provide treatment and advice for people who are found to have a particular condition and the ability to ensure the programme does more good than harm to the people who are screened.

There are eleven population screening programmes in England, seven of which are covered in this Atlas, as follows:

- NHS Abdominal Aortic Aneurysm Screening Programme
- NHS Bowel Cancer Screening Programme
- NHS Breast Screening Programme
- NHS Cervical Screening Programme
- NHS Newborn Blood Spot Screening Programme
- NHS Newborn Hearing Screening Programme
- NHS Sickle Cell and Thalassaemia Screening Programme

The Public Health England Screening Division leads the NHS screening programmes nationally. A range of NHS and private providers deliver screening locally in line with national service specifications, standards and care pathways.

Screening is a balance of potential benefits and harms. The decision whether to accept the offer of screening is a choice for the eligible people invited. The NHS screening programmes aim to ensure individuals have the consistent and factually accurate information they need to make an informed decision about the offer of screening.

The uptake and coverage of screening can vary between geographical areas due to different population groups being more or less likely to accept the offer of screening. This can be due to a range of factors such as the prevalence of a condition, levels of deprivation and ethnic and cultural issues.

In geographical areas with large transient populations it can be difficult to track the people eligible for screening which can lead to individuals being ‘lost’ to screening.
A range of factors, including the age and gender profile of the population, can also lead to variations in the proportion of individuals who test positive for a condition.

The NHS screening programmes set national standards to help ensure local screening services provide a consistent, high-quality service to all those people eligible for screening wherever they live in the country. Screening providers have a statutory duty to ensure all eligible people have equitable access to screening services and information about screening.

The national Screening Quality Assurance Service (SQAS) monitors the performance and assesses the quality of local services using self-assessments and independent external experts.

Consistent data collection, including the publication of key performance indicators, enables fair and transparent comparisons to be made across the country. This helps to identify outliers, and allows examples of good practice to be shared. This in turn helps to improve the quality and to increase the consistency of screening services.

The national programmes set service specifications that must be followed when:

- commissioning any local screening services
- providing any local screening services

Failsafe processes help to reduce variation by minimising the risk of avoidable errors within local screening pathways.

The NHS screening programmes aim to offer more benefit than harm at a reasonable cost to the NHS, an important part of which is to reduce variation in the way screening is delivered locally, to improve quality and to increase safety.

Good-quality, meaningful and standardised data about screening is essential:

- to manage services
- to improve quality
- to identify unwarranted variation

Table 2: Magnitude of variation summary

Map	Title	Range	Fold difference*	Number of areas significantly higher than England (99.8% level)	Number of areas significantly lower than England (99.8% level)	Optimum value
1	Rate of computed axial tomography (CT) activity per 1,000 weighted population by CCG, Adjusted for age, sex and 'need', 2015/16	35.9-163.4	4.6	80	110	Requires local interpretation
2	Rate of magnetic resonance imaging (MRI) activity per 1,000 weighted population by CCG, Adjusted for age, sex and 'need', 2015/16	22.9-145.9	6.4	91	95	Requires local interpretation
3	Rate of non-obstetric ultrasound activity per 1,000 weighted population by CCG, Adjusted for age, sex and 'need', 2015/16	48.2-200.8	4.2	95	93	Requires local interpretation
4a	Median time (minutes) from arrival at hospital to brain imaging for stroke patients by CCG, October–December 2015	15.0-168.0	11.2	21	23	Low
4b	Median time (minutes) from arrival at hospital to brain imaging for stroke patients by stroke team, October–December 2015	16.0-180.0	11.3	27	27	Low
5a	Percentage of stroke patients undergoing brain imaging within one hour of arrival at hospital by CCG, October–December 2015	14.3-91.3	6.4	23	22	High
5b	Percentage of stroke patients undergoing brain imaging within one hour of arrival at hospital by stroke team, October–December 2015	9.8-86.6	8.9	28	33	High
6a	Percentage of stroke patients undergoing brain imaging within 12 hours of arrival at hospital by CCG, October–December 2015	74.5-100.0	1.3	0	10	High
6b	Percentage of stroke patients undergoing brain imaging within 12 hours of arrival at hospital by stroke team, October–December 2015	70.7-100.0	1.4	5	15	High
7	Median time (minutes) to head computed axial tomography (CT) for patients admitted directly to hospital meeting NICE head injury guidelines by NHS Trust, 2014/15	8.0-101.0	12.6	10	10	Low
8	Median time (minutes) to pelvic computed axial tomography (CT) for patients admitted directly to hospital with pelvic injury by NHS Trust, 2014/15	11.0-252.5	23.0	7	9	Low
9	Rate of endovascular aneurysm repair (EVAR) procedures for abdominal aortic aneurysm (AAA) per 100,000 population by CCG, Directly standardised for age, 2012/13–2014/15	4.3-24.1	5.6	22	17	Requires local interpretation
10	Percentage of elective procedures for abdominal aortic aneurysm (AAA) that were EVAR by CCG, 2012/13–2014/15	33.3-98.0	2.9	22	15	Requires local interpretation
11	Percentage of NHS hospital Trusts that had formal arrangements for 24-hour access to nephrostomy by strategic health authority, 2013	40.0-78.6	2.0	-	-	High

* The fold-difference value may differ from the ratio of the maximum and minimum values presented in the 'Range' column due to rounding.

Map	Title	Range	Fold difference*	Number of areas significantly higher than England (99.8% level)	Number of areas significantly lower than England (99.8% level)	Optimum value
12	Percentage of NHS hospital Trusts that had formal arrangements for 24-hour access to endovascular intervention by strategic health authority, 2013	37.5-78.6	2.1	-	-	High
13	Percentage of NHS hospital Trusts that had formal arrangements for 24-hour access to embolisation for haemorrhage by strategic health authority, 2013	25.0-78.6	3.1	-	-	High
14	Percentage of NHS hospital Trusts that had formal arrangements for 24-hour access to embolisation for post-partum haemorrhage by strategic health authority, 2013	25.0-75.0	3.0	-	-	High
15	Rate of dual-energy X-ray absorptiometry (DEXA) activity per 1,000 weighted population by CCG, Adjusted for age, sex and 'need', January–March 2016	0.1-5.7	59.7	65	79	Requires local interpretation
16	Rate of colonoscopy procedures and flexible sigmoidoscopy procedures per 10,000 population by CCG, Indirectly standardised for age, sex and deprivation, 2014/15	76.5-248.8	3.3	77	79	Requires local interpretation
17	Rate of computed tomography (CT) colonography procedures per 10,000 weighted population by CCG, Adjusted for age, sex and 'need', 2014/15	0.2-58.2	248.2	68	104	Requires local interpretation
18	Rate of barium enema procedures per 100,000 weighted population by CCG, Adjusted for age, sex and 'need', 2015/16	0.0-655.8	-	49	154	Low
19	Rate of gastroscopy (upper gastrointestinal endoscopy) procedures per 10,000 population by CCG, Indirectly standardised for age, sex and deprivation, 2014/15	43.5-239.5	5.5	72	97	Requires local interpretation
20	Percentage of patients undergoing gastroscopy (upper gastrointestinal endoscopy) procedures aged under 55 years by CCG, 2014/15	23.7-55.2	2.3	60	64	Low
21	Rate of capsule endoscopy procedures per 10,000 population by CCG , Indirectly standardised for age, sex and deprivation, 2014/15	0.2-8.5	45.2	38	44	Requires local interpretation
22	Rate of endoscopic ultrasound procedures per 10,000 population by CCG , Indirectly standardised for age, sex and deprivation, 2014/15	18.6-84.6	4.6	60	99	Requires local interpretation
23	Admission rate for children for upper and/or lower gastro-intestinal endoscopy per 100,000 population aged 0-17 years by CCG, Directly standardised for age, 2012/13–2014/15	63.4-328.3	5.2	26	40	Requires local interpretation
24	Rate of audiology assessments undertaken per 1,000 weighted population by CCG, Adjusted for age, sex and 'need', January–March 2016	0.1-15.6	123.3	88	92	Requires local interpretation

* The fold-difference value may differ from the ratio of the maximum and minimum values presented in the 'Range' column due to rounding.

Map	Title	Range	Fold difference*	Number of areas significantly higher than England (99.8% level)	Number of areas significantly lower than England (99.8% level)	Optimum value
25	Rate of diagnostic sleep studies undertaken per 1,000 weighted population by CCG, Adjusted for age, sex and 'need', January–March 2016	0.0-3.6	447.0	43	116	Requires local interpretation
26	Percentage of patients with COPD with a record of FEV1 in the preceeding 12 months by CCG , 2014/15	62.7-86.3	1.4	77	57	High
27	Rate of urodynamic (pressures and flows) tests undertaken per 1,000 weighted population by CCG, Adjusted for age, sex and 'need', January–March 2016	0.0-1.7	380.3	39	86	Requires local interpretation
28	Rate of echocardiography activity undertaken per 1,000 weighted population by CCG, Adjusted for age, sex and 'need', January–March 2016	0.4-16.2	39.5	80	76	Requires local interpretation
29	Rate of peripheral neurophysiology tests undertaken per 1,000 weighted population by CCG, Adjusted for age, sex and 'need', January–March 2016	0.0-2.7	144.6	61	86	Requires local interpretation
30	Percentage coverage for initial screening tests for men aged 65 years in the NHS abdominal aortic aneurysm (AAA) screening programme by CCG, 2014/15	59.0-87.2	1.5	46	53	High
31	Percentage of eligible people aged 60-74 years with a screening test result recorded in the previous 2.5 years from the NHS bowel cancer screening programme (NHS BCSP) by upper-tier local authority, At 31 March 2015	37.3-67.0	1.8	59	77	High
32	Percentage of eligible women aged 53-70 years screened adequately within the previous three years in the NHS breast screening programme (NHS BSP) by upper-tier local authority, At 31 March 2015	56.3-86.4	1.5	63	73	High
33	Percentage of eligible women aged 25-64 years screened adequately in the NHS cervical screening programme (NHS CSP) by upper-tier local authority, At 31 March 2015	56.5-84.0	1.5	78	59	High
34	Percentage of babies eligible for testing in the NHS newborn blood spot (NBS) screening programme who had a conclusive result recorded on the Child Health Information System (CHIS) within an effective timeframe by CCG, July–September 2015	62.4-100.0	1.6	64	42	High
35	Percentage of babies who required a repeat test due to an avoidable failure in the sampling process during the NHS newborn blood spot (NBS) screening programme by maternity service, July–September 2015	1.0-9.6	9.9	24	23	Low
36	Percentage of referred babies who had an audiological assessment within four weeks of the decision to refer or by 44 weeks' gestational age by CCG, 2014/15	40.4-100.0	2.5	8	19	High

* The fold-difference value may differ from the ratio of the maximum and minimum values presented in the 'Range' column due to rounding.

Map	Title	Range	Fold difference*	Number of areas significantly higher than England (99.8% level)	Number of areas significantly lower than England (99.8% level)	Optimum value
37	Percentage of women tested in the NHS antenatal sickle cell and thalassaemia screening programme with a conclusive result by 10 weeks' gestation by maternity service, July–September 2015	7.3-94.0	12.9	71	40	High
38	Percentage of samples in the NHS antenatal sickle cell and thalassaemia screening programme submitted to the laboratory with a completed family origin questionnaire (FOQ) by maternity service, July–September 2015	80.2-100.0	1.2	60	21	High

* The fold-difference value may differ from the ratio of the maximum and minimum values presented in the 'Range' column due to rounding.

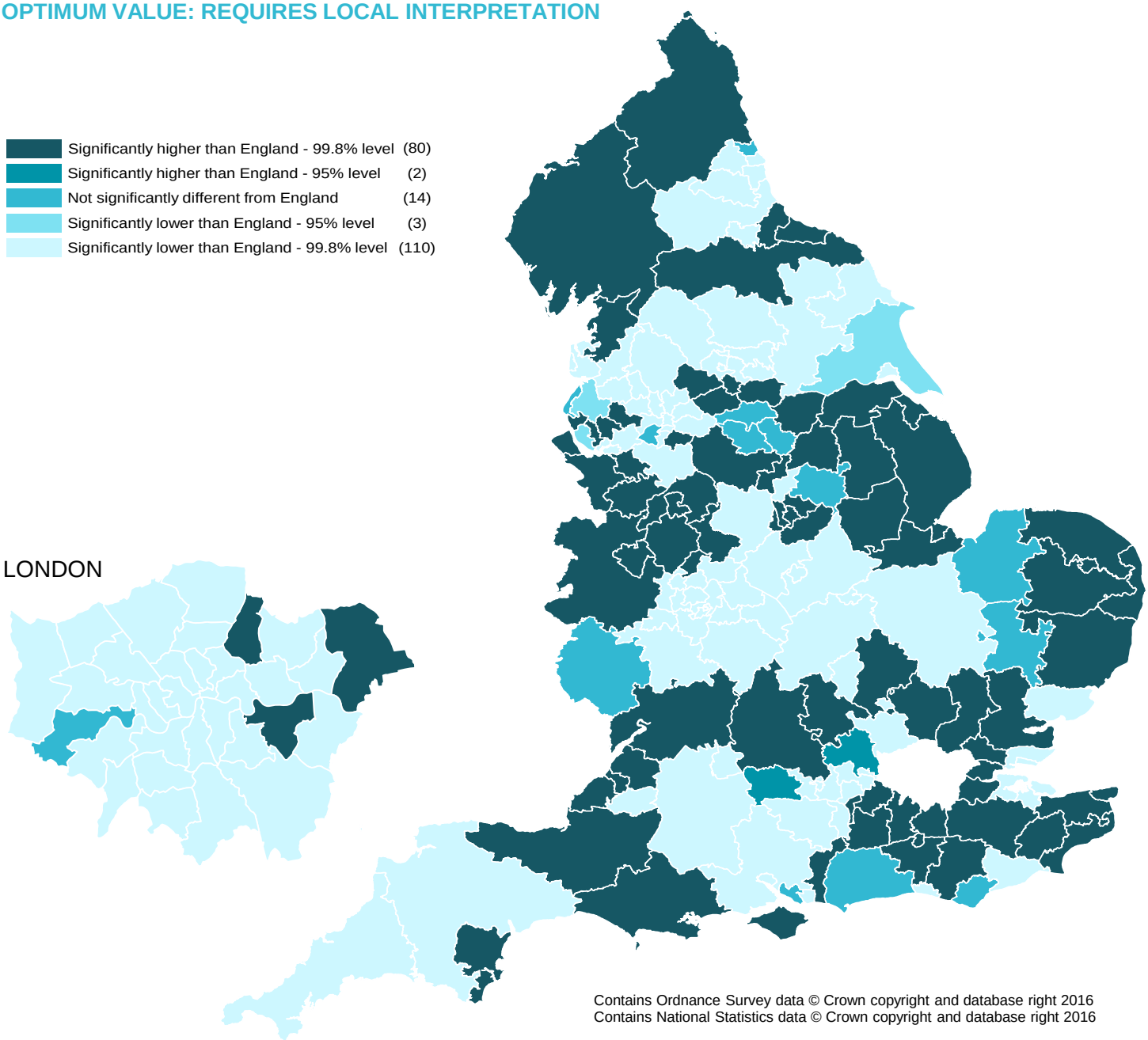
IMAGING SERVICES

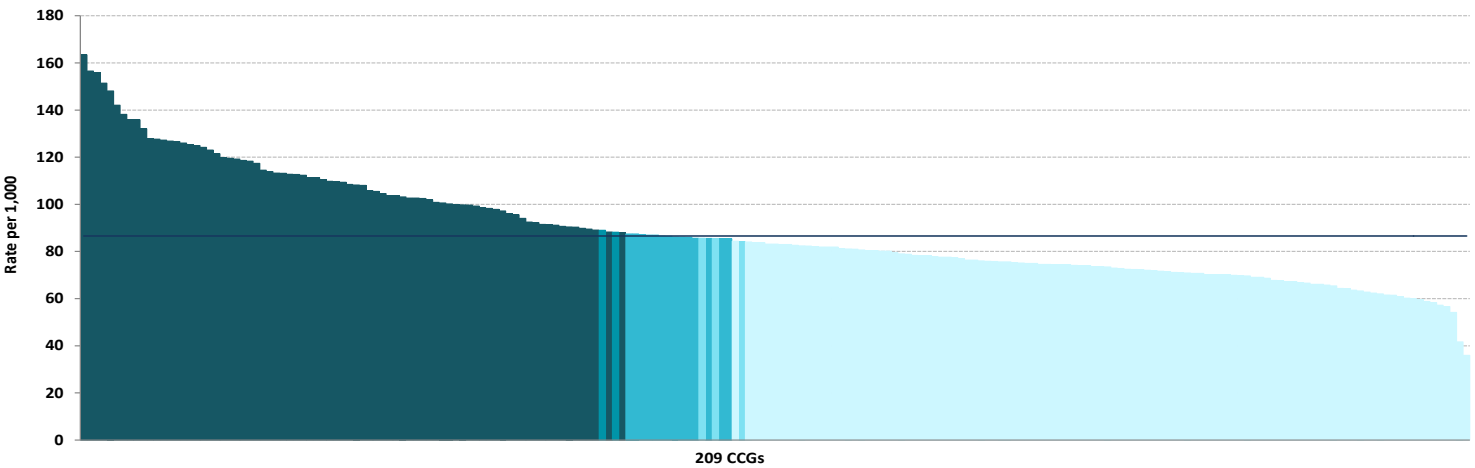
MAP 1: Rate of computed axial tomography (CT) activity per weighted population by CCG

Adjusted for age, sex and 'need', 2015/16

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





Context

Computed axial tomography (a CT scan) is an X-ray technique using a scanner that takes a series of pictures across the body allowing a radiologist to view the images in a two- or three-dimensional form.[1]

Computed axial tomography is used:

- to diagnose disease, trauma or abnormality
- to plan and guide therapeutic interventions
- to monitor response to treatment

Computed axial tomography is often the conclusive diagnostic test.

Apart from being used as an imaging modality in its own right, CT can also be used to complement and supplement information obtained from magnetic resonance imaging (MRI) and other imaging modalities such as ultrasound.

Magnitude of variation

The map and column chart display the most recent annual period (2015/16), during which CCG values ranged from 33.9 to 163.4 per 1,000 weighted population, which is a 4.6-fold difference between CCGs. The England value for 2015/16 was 86.6 per 1,000 weighted population. Although not strictly comparable, the Organisation for Economic Co-Operation and Development (OECD)[2] data shows that in 2013 CT activity ranged from 31.7 per 1,000 inhabitants in Finland to 494.6 per 1,000 inhabitants in Estonia.

The boxplot shows the distribution of CCG values for the period 2013/14 to 2015/16 by quarter.

In contrast to the maximum to minimum range narrowing significantly, both the 95th to 5th percentile gap and of the 75th to 25th percentile gap widened significantly. So whilst there was a contraction of the most extreme values, values in the central part of the distribution moved away from the median.

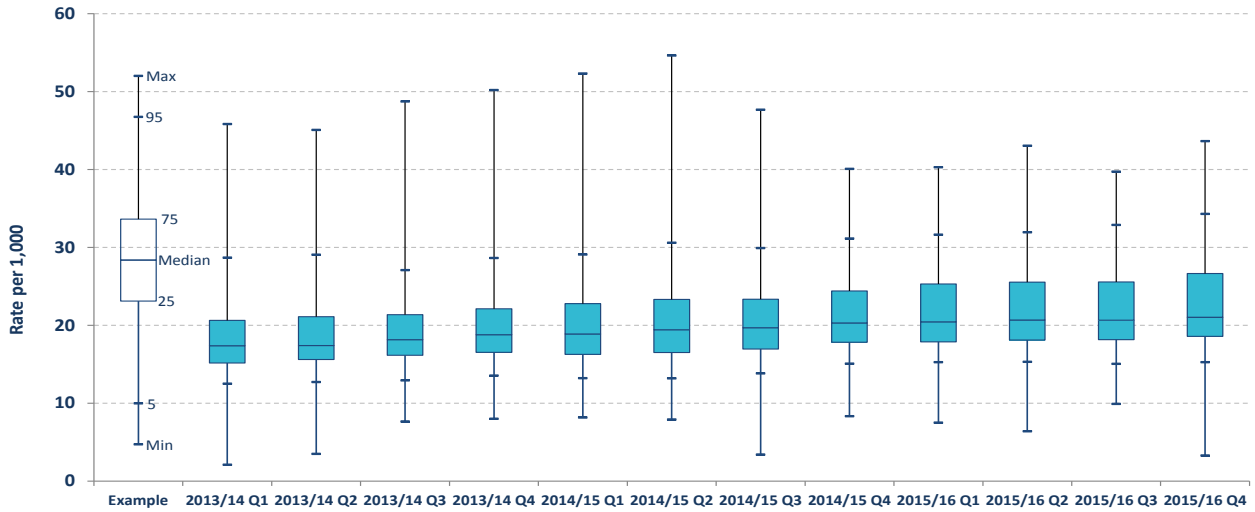
The median increased significantly.

CT scanning is one of the key diagnostic tests that can contribute to the early diagnosis of cancer, however it does have wider clinical uses than the diagnosis of cancer.

Although some of the England variation can be attributed to the availability of both equipment and workforce, much of the variation could be due to local clinical practices that have evolved over time, which may need re-assessing.

It is not clear what the optimum level of CT activity for a population should be. From an individual patient's perspective, it is important to consider the benefits and the risks of CT scanning because unlike MRI, CT scanning is associated with a heavy radiation dose to the patient. Thus, the use of CT needs to be justified because of the potential harm it could cause.

Map 1: Boxplot of CT activity by CCG



Max-Min (Range)		43.7	41.6	41.1	42.2	44.1	46.7	44.3	31.7	32.8	36.6	29.8	40.4	NARROWING Significant
95th-5th percentile		16.2	16.3	14.2	15.1	15.9	17.4	16.1	16.1	16.4	16.6	17.8	19.0	WIDENING Significant
75th-25th percentile		5.5	5.5	5.2	5.6	6.5	6.8	6.4	6.6	7.4	7.4	7.4	8.1	WIDENING Significant
Median		17.4	17.4	18.2	18.8	18.9	19.4	19.7	20.3	20.4	20.7	20.7	21.0	INCREASING Significant

[1] The Royal College of Radiologists. FAQs in radiology. http://www.rcr.ac.uk/content.aspx?PageID=504
[2] https://data.oecd.org/healthcare/magnetic-resonance-imaging-mri-exams.htm

In the UK and the US there is concern about the potential for overuse of CT and the potential risk of harm, as highlighted in the published literature:

> *"our findings that in some patients worrisome radiation doses from imaging procedures can accumulate over time underscores the need to improve their use"*[3]

> *"we have to adopt a public health mind set … and talk explicitly about the elements of danger in exposing our patients to radiation"*[4]

Although overuse may be less of an issue in England, whole-body screening by CT is being promoted by some private providers in this country. Such screening is of questionable benefit to the individuals concerned while increasing the level of radiation to which they are exposed, and often generating referrals to the NHS.

In the conclusions of the 16th COMARE Report (paragraph 8.3, page 64)[5], it states:

> *"In recent years there has been an emerging use of CT to scan asymptomatic individuals. This issue was covered in the 12th COMARE report (COMARE, 2007[6]), which determined that the benefits to the individual would not be the same as those for a symptomatic patient and that the practice of whole-body scanning on asymptomatic individuals could not be supported."*

Options for action

Commissioners and service providers need to collaborate to review rates of CT activity in the locality to identify whether there is any unwarranted variation. Commissioners may wish to investigate the source of referrals as part of this review.

To address unwarranted variation, commissioners, clinicians and service providers need to work together to apply evidence-based practice at a local level, including:

- using evidence based patient pathways for diagnostics
- promoting research to understand the benefits and harms resulting from different rates of CT investigation
- promoting audit to identify both underuse and overuse of the technology
- developing referral guidelines to include the need to assess whether a CT scan is the most appropriate modality or whether an alternative diagnostic procedure would be more effective[5]
- optimising scanning protocols to reduce dosage[5]
- appointing 'radiation protection champions' locally, including a radiologist, radiographer and medical physicist[5]

RESOURCES

- iRefer, Royal College of Radiologists imaging referral guidelines, is available to all NHS professionals in the UK. http://www.rcr.ac.uk/content.aspx?PageID=995 For iRefer – England, NHS professionals need to register to use the portal. Login to http://portal.e-lfh.org.uk/ To access guidelines, select the "Launch iRefer" link in the left-hand menu.
- NHS Radiology Improvement Team. Page 1: Computerised Tomography. Radiology Success Factors. November 2007. http://system.improvement.nhs.uk/ImprovementSystem/ViewDocument.aspx?path=Diagnostics%2fNational%2fWebsite%2fPublications%2fRadiology_Success_Factors%20-%20Nov%2007.pdf
- The Royal College of Radiologists. Sustainable future for diagnostic radiology: establishing network solutions for radiology services. BFCR(15)12. 2015. https://www.rcr.ac.uk/publication/sustainable-future-diagnostic-radiology-establishing-network-solutions-radiology

[3] Fazel R et al (2009) Exposure to low dose ionizing radiation from medical imaging procedures. *New England Journal of Medicine* 361:849-857.
[4] Lauer MS (2009) Elements of danger – the case of medical imaging. *New England Journal of Medicine* 361:841-842.
[5] 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. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/343836/COMARE_16th_Report.pdf
[6] 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. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/304607/COMARE12thReport.pdf

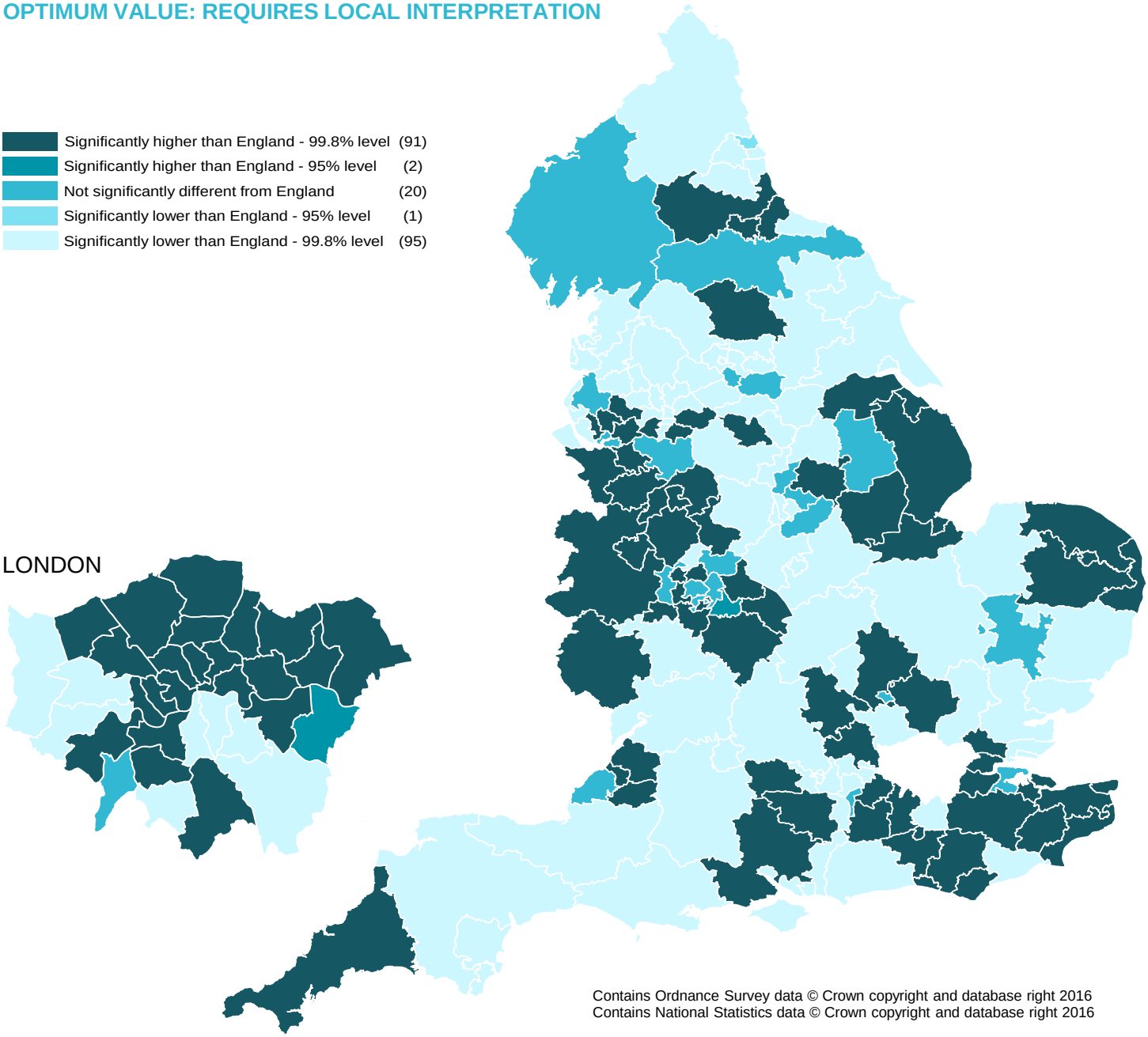
IMAGING SERVICES

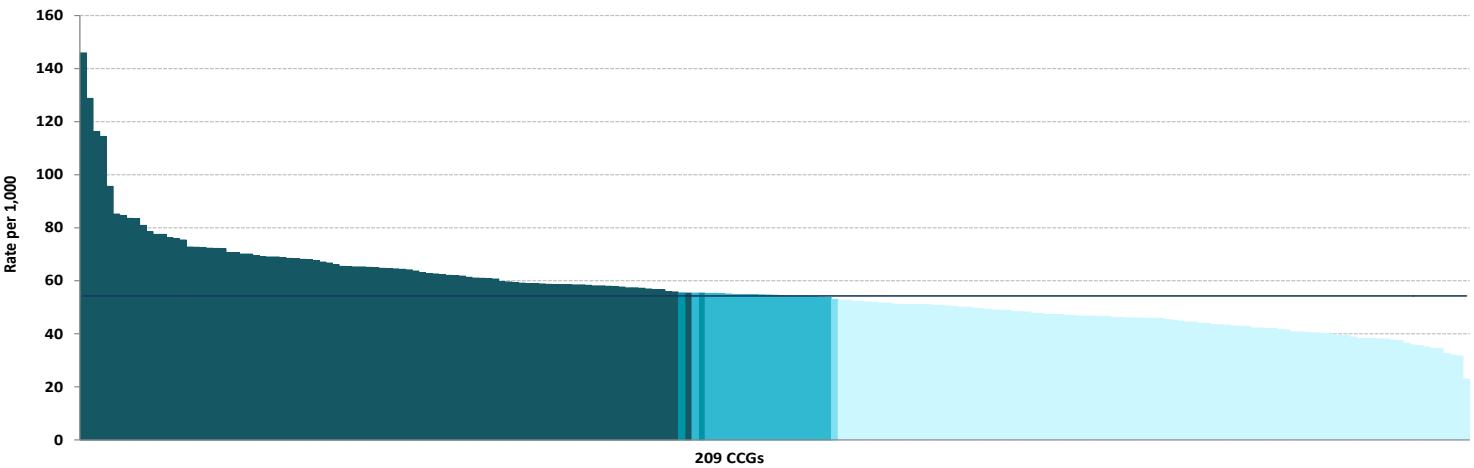
MAP 2: Rate of magnetic resonance imaging (MRI) activity per weighted population by CCG

Adjusted for age, sex and 'need', 2015/16

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





Context

Magnetic resonance imaging (MRI) uses magnetism and radio waves to build up a series of cross-sectional images of the body. It is similar to a computerised axial tomography scan, but it does not use X-rays. As MRI pictures can be very precise and provide detailed information, MRI has the potential to reduce the number of diagnostic procedures that need to be performed. The cost of MRI equipment means that it is used primarily at centres where it is kept most busy.[1]

Magnitude of variation

The map and column chart display the latest annual period (2015/16), during which CCG values ranged from 22.8 to 145.9 per 1,000 weighted population, which is a 6.4-fold difference between CCGs. The England value for 2015/16 was 54.3 scans. Although not strictly comparable, the Organisation for Economic Co-Operation and Development (OECD)[3] data shows that in Europe MRI activity ranges from 22.8 per 1,000 inhabitants in Poland to 90.9 per 1,000 inhabitants in 2013 in France.

The boxplot shows the distribution of CCG values for the period 2013/14 to 2015/16 by quarter.

The maximum to minimum range widened significantly. This is due in greater part to the maximum value increasing while the minimum value remained relatively constant.

There was a significant widening of both the 95th to 5th percentile gap, and of the 75th to 25th percentile gap. The median increased significantly.

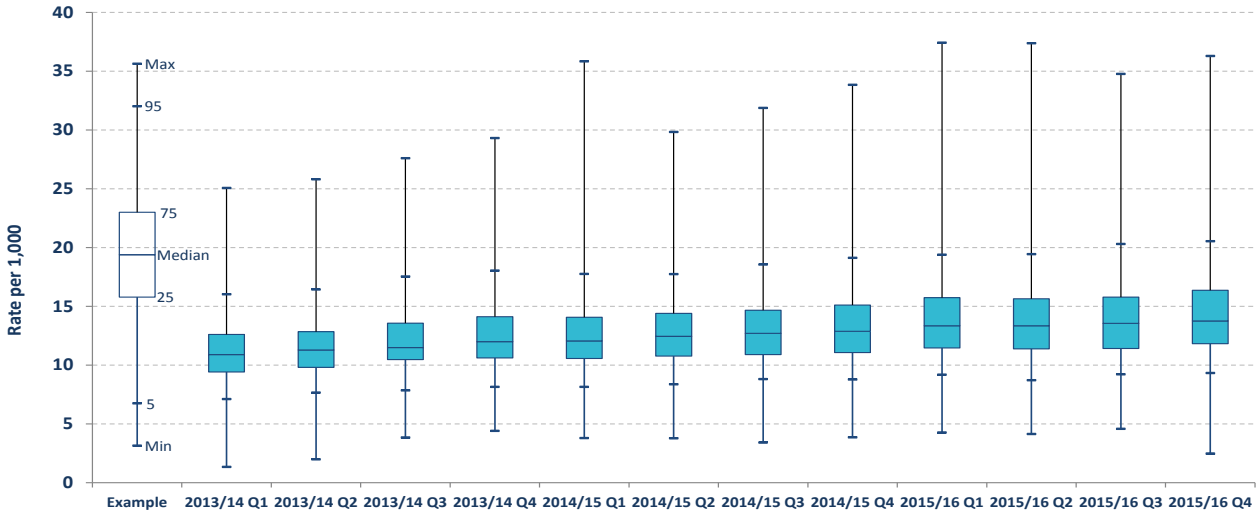
In *Improving Outcomes: a Strategy for Cancer*[2], MRI scanning is one of the key diagnostic tests that GPs should access. This is to enable more people to be checked earlier when presenting with relevant symptoms, and will contribute to the early diagnosis of cancer. It must be noted, that although this test is used to diagnose some cancers it is more commonly used in other clinical settings.

Reasons for geographical variation include availability of equipment and trained workforce as well as local clinical practice.

There may also be access issues for patients.

It is likely that underuse, rather than overuse, is the reason for the degree of variation observed.

Map 2: Boxplot of MRI activity by CCG



Max-Min (Range)		23.7	23.8	23.8	24.9	32.0	26.0	28.5	30.0	33.2	33.2	30.2	33.8	WIDENING Significant
95th-5th percentile		8.9	8.8	9.7	9.9	9.6	9.4	9.7	10.3	10.2	10.7	11.1	11.2	WIDENING Significant
75th-25th percentile		3.2	3.0	3.1	3.5	3.5	3.6	3.8	4.0	4.3	4.3	4.4	4.5	WIDENING Significant
Median		10.9	11.3	11.5	12.0	12.1	12.4	12.7	12.9	13.3	13.3	13.5	13.8	INCREASING Significant

[1] The Royal College of Radiologists. FAQs in radiology. http://www.rcr.ac.uk/content.aspx?PageID=504
[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/213785/dh_123394.pdf
[3] https://data.oecd.org/healthcare/magnetic-resonance-imaging-mri-exams.htm
[4] Morris Z, Whiteley WN, Longstreth WT Jr et al. Incidental findings on brain magnetic resonance imaging: systematic review and meta-analysis. BMJ339:doi:10.1136/bmj.b3016 (Published 17 August 2009).

There is increasing concern, however, about the increasing detection of incidental findings, that is, findings unrelated to the original reason for undertaking MRI. Incidental findings can lead to unnecessary investigation and anxiety for patients. In one systematic review and meta-analysis, the authors conclude that:

> *"Incidental findings on brain MRI are common, prevalence increases with age, and detection is more likely using high-resolution MRI sequences than standard resolution sequences. These findings deserve to be mentioned when obtaining informed consent for brain MRI in research and clinical practice."*[4]

Options for action

Commissioners and service providers need to collaborate to review rates of MRI activity in the locality to identify whether there is any unwarranted variation. Commissioners may wish to investigate the source of referrals as part of this review.

To address unwarranted variation, commissioners, clinicians and service providers need to work together to apply evidence-based practice at a local level, including:

- using evidence-based patient pathways for diagnostics
- promoting research to understand the benefits and harms resulting from different rates of MRI investigation
- promoting audit to identify both underuse and overuse of the technology

RESOURCES

- iRefer, The Royal College of Radiologists imaging referral guidelines, is available to all NHS professionals in the UK. http://www.rcr.ac.uk/content.aspx?PageID=995 For iRefer – England, NHS professionals need to register to use the portal. Login to http://portal.e-lfh.org.uk/ . To access guidelines, select the "Launch iRefer" link in the left-hand menu.
- NHS Radiology Improvement Team. Page 3: Magnetic Resonance Imaging. Radiology Success Factors. November 2007. http://system.improvement.nhs.uk/ImprovementSystem/ViewDocument.aspx?path=Diagnostics%2fNational%2fWebsite%2fPublications%2fRadiology_Success_Factors%20-%20Nov%2007.pdf
- The Royal College of Radiologists. Sustainable future for diagnostic radiology: establishing network solutions for radiology services. BFCR(15)12. 2015. https://www.rcr.ac.uk/publication/sustainable-future-diagnostic-radiology-establishing-network-solutions-radiology

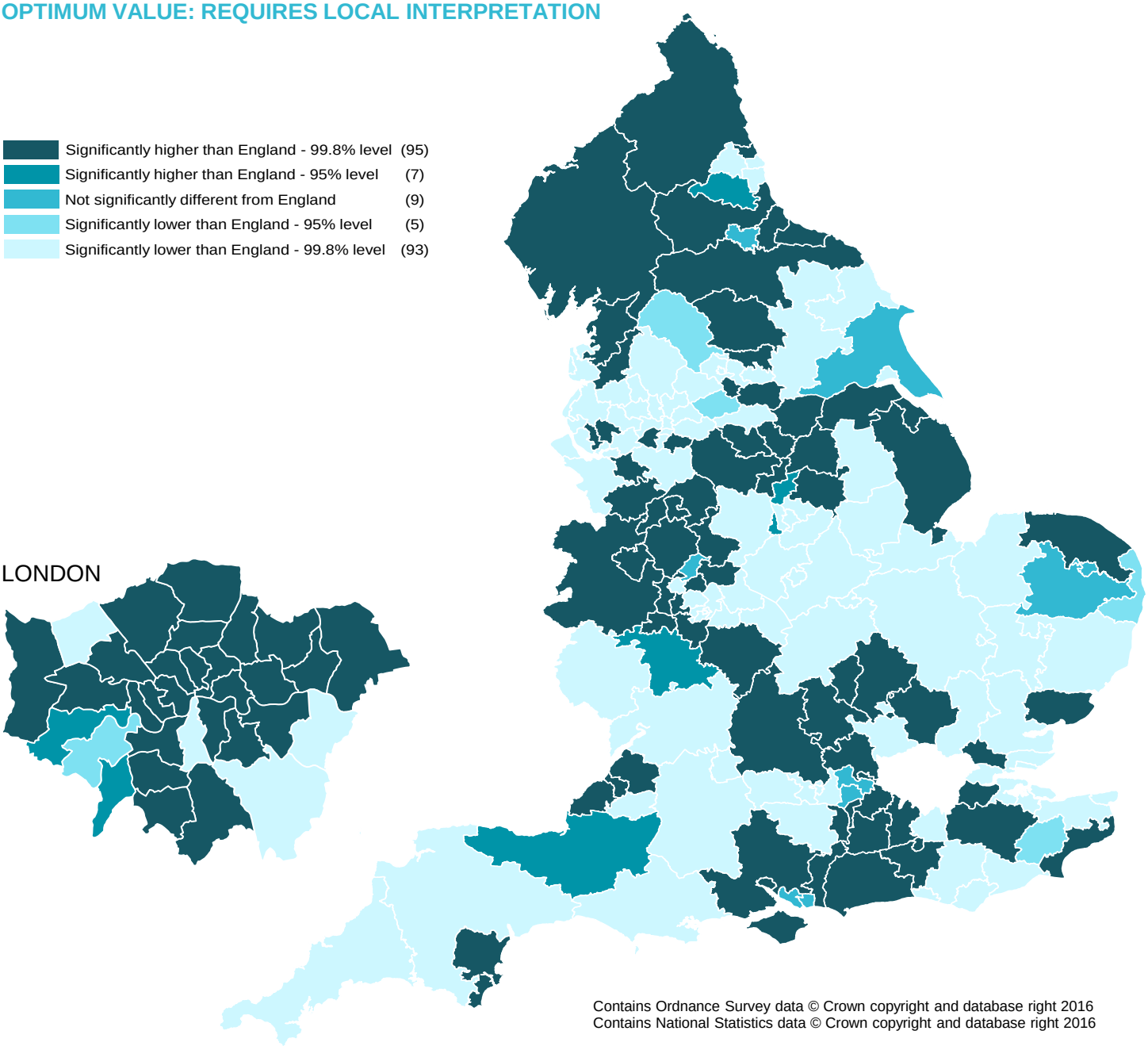
IMAGING SERVICES

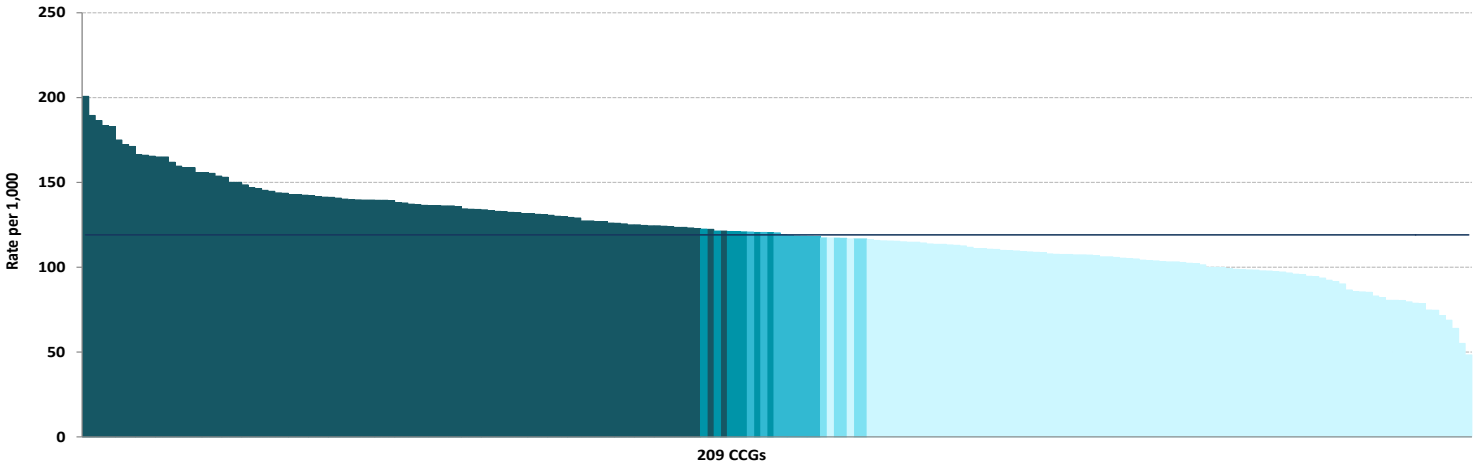
MAP 3: Rate of non-obstetric ultrasound activity per weighted population by CCG

Adjusted for age, sex and 'need', 2015/16

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





Context

During an ultrasound scan high-frequency sound waves (5-10MHz) are used to image parts of the body.

The advantage of ultrasound over other imaging modalities, such as X-rays or computerised axial tomography scans, is that it does not involve ionising radiation. Further advantages of ultrasound over other imaging modalities, such as magnetic resonance imaging, are that the equipment is cheaper and becoming smaller without compromising scan quality – some models are portable and some are hand-held.

Medical ultrasound falls into two main categories: obstetric and non-obstetric.

The uses of non-obstetric ultrasound are:

- as a diagnostic tool for problems of the soft tissues
- to detect problems with blood vessels (such as aneurysms), joints, ligaments and tendons, the skin and the eyes
- to guide an operator during certain surgical procedures such as biopsies

Although it is essential to record ultrasound images, interpretation is most often done by the operator at the time of the scan.

Magnitude of variation

The map and column chart display the latest period (2015/16), during which CCG values ranged from 48.2 to 200.8 per 1,000 weighted population, which is a 4.2-fold difference between CCGs. The England value for 2015/16 was 119.1 per 1,000 weighted population.

The boxplot shows the distribution of CCG values for the period 2013/14 to 2015/16 by quarter.

The gap between the maximum and minimum CCG values narrowed significantly. In contrast there was a significant widening of the 95th to 5th percentile gap.

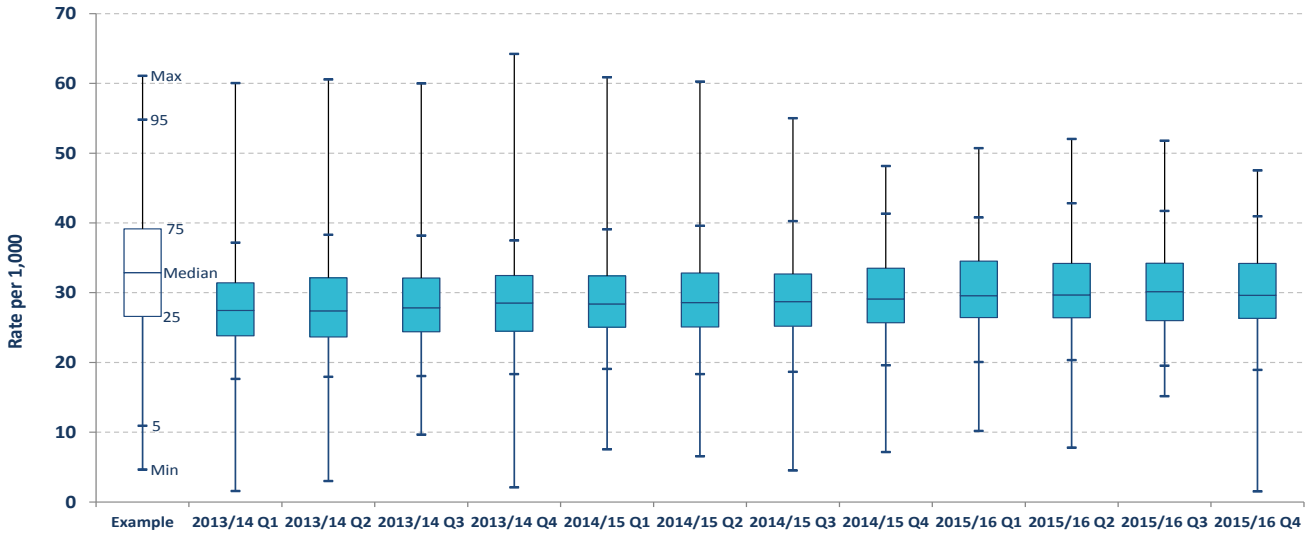
The median CCG value increased significantly.

Non-obstetric ultrasound is one of the imaging tests that could contribute to the early diagnosis of cancer, in particular relation to kidney, bladder or ovarian cancer and its use is a recommendation in *Improving Outcomes: a Strategy for Cancer*[1]. It must however be noted, that although this test is used to diagnose cancer, it does also have wider clinical uses.

Potential reasons for the degree of variation observed include differences in:

- access to non-obstetric ultrasound
- the conditions for which non-obstetric ultrasound is used as a diagnostic tool in various localities
- prevalence of the conditions for which non-obstetric ultrasound is one of the diagnostic tests

Map 3: Boxplot of non-obstetric ultrasound activity by CCG



Max-Min (Range)		58.5	57.6	50.3	62.1	53.3	53.7	50.5	41.0	40.5	44.2	36.6	46.0	NARROWING Significant
95th-5th percentile		19.5	20.4	20.1	19.1	20.0	21.3	21.6	21.7	20.7	22.5	22.2	22.0	WIDENING Significant
75th-25th percentile		7.6	8.5	7.7	8.0	7.3	7.7	7.5	7.8	8.1	7.8	8.2	7.9	No significant change
Median		27.4	27.4	27.8	28.5	28.4	28.6	28.7	29.1	29.6	29.7	30.1	29.6	INCREASING Significant

[1] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/213785/dh_123394.pdf

Options for action

When addressing unwarranted variation in non-obstetric ultrasound activity, commissioners, clinicians and service providers need to review:

- the need for non-obstetric ultrasound in the local population
- whether the rate of activity matches the need, or whether adjustments can be made
- access to non-obstetric ultrasound
- local care pathways and whether they follow the latest evidence-based guidance from the Royal College of Radiologists (iRefer, see 'Resources')

RESOURCES

- British Medical Ultrasound Society. Guidelines for the safe use of diagnostic ultrasound equipment. November 2009. https://www.bmus.org/static/uploads/resources/BMUS-Safety-Guidelines-2009-revision-FINAL-Nov-2009.pdf
- iRefer, Royal College of Radiologists imaging referral guidelines, available to all NHS professionals in the UK. http://www.rcr.ac.uk/content.aspx?PageID=995 For iRefer – England, NHS professionals need to register to use the portal. Login to http://portal.e-lfh.org.uk/ To access guidelines, select the "Launch iRefer" link in the left-hand menu.
- NHS Radiology Improvement Team. Page 5: Ultrasound. Radiology Success Factors. November 2007. http://system.improvement.nhs.uk/ImprovementSystem/ViewDocument.aspx?path=Diagnostics%2fNational%2fWebsite%2fPublications%2fRadiology_Success_Factors%20-%20Nov%2007.pdf
- The Royal College of Radiologists. Sustainable future for diagnostic radiology: establishing network solutions for radiology services. BFCR(15)12. 2015. https://www.rcr.ac.uk/publication/sustainable-future-diagnostic-radiology-establishing-network-solutions-radiology

IMAGING SERVICES

MAP 4a: Median time (minutes) from arrival at hospital to brain imaging for stroke patients by CCG

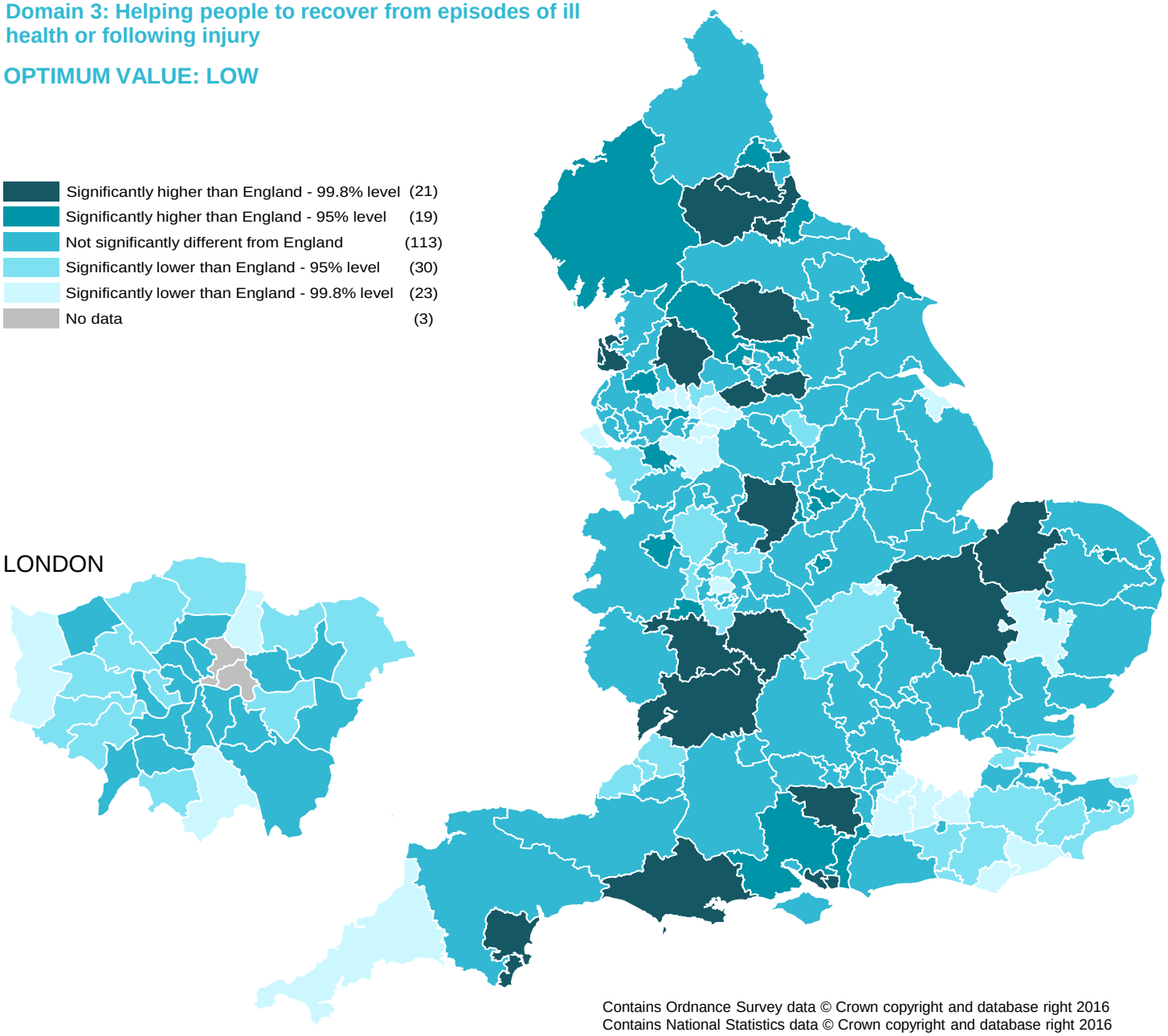
October–December 2015

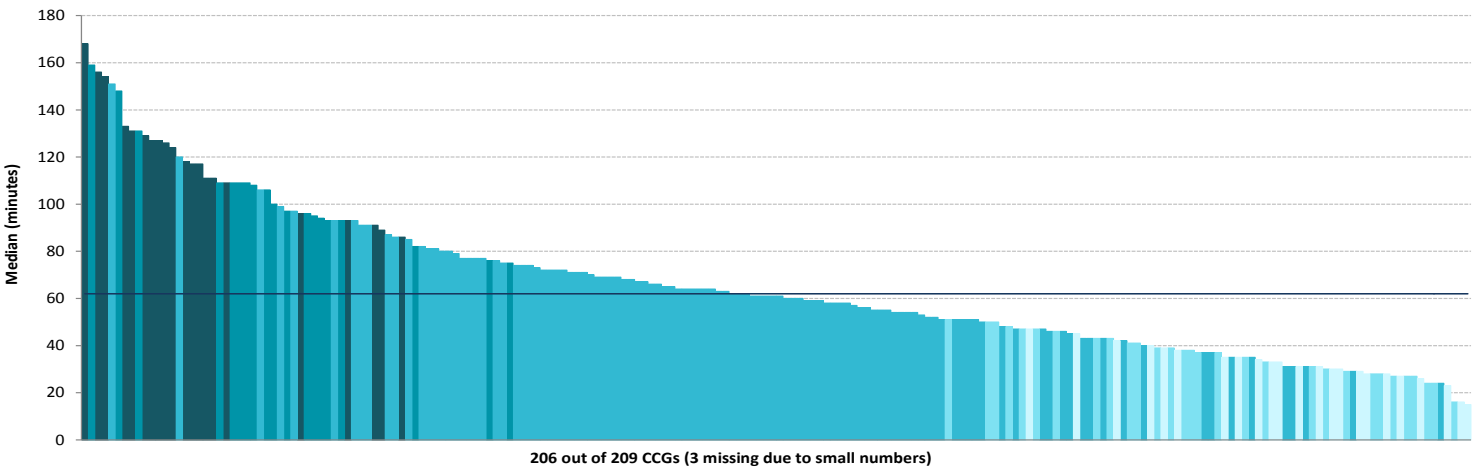
Domain 1: Preventing people from dying prematurely

Domain 2: Enhancing quality of life for people with long-term conditions

Domain 3: Helping people to recover from episodes of ill health or following injury

OPTIMUM VALUE: LOW





IMAGING SERVICES

MAP 4b: Median time (minutes) from arrival at hospital to brain imaging for stroke patients by stroke team

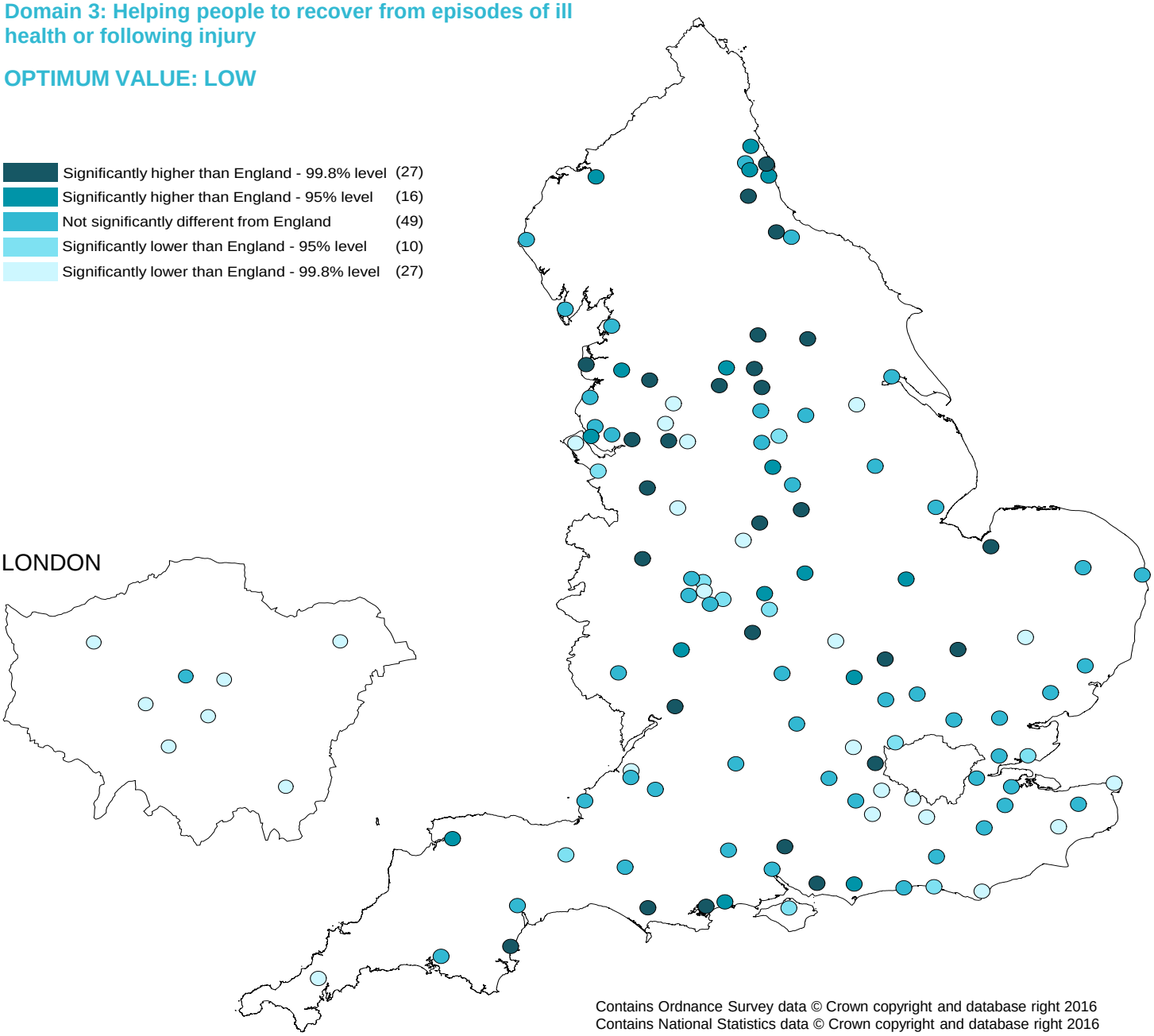
October–December 2015

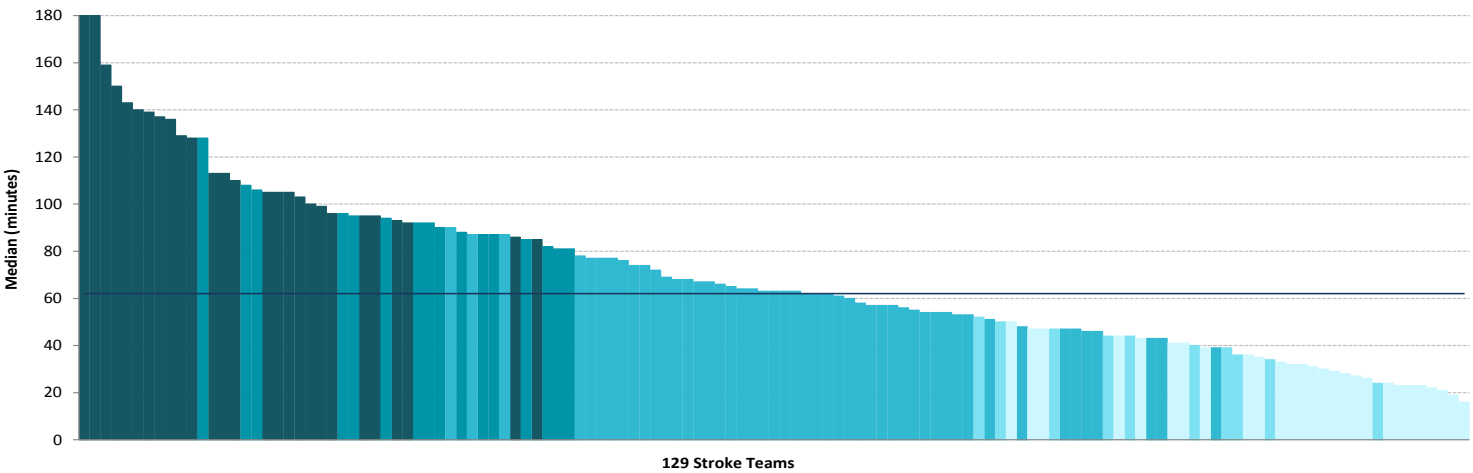
Domain 1: Preventing people from dying prematurely

Domain 2: Enhancing quality of life for people with long-term conditions

Domain 3: Helping people to recover from episodes of ill health or following injury

OPTIMUM VALUE: LOW





Context

Stroke is a preventable and treatable disease. Over the past 20 years a growing body of evidence has challenged the long-held perception that stroke is a consequence of ageing inevitably resulting in death or severe disability. There is now good evidence for:

- greater effectiveness of primary and secondary prevention strategies
- improved recognition of people at highest risk of stroke
- effective interventions soon after the onset of symptoms

The National Stroke Strategy (see 'Resources') outlines the changes necessary to improve outcomes for people with stroke.

In the NICE-accredited Royal College of Physicians (RCP) Intercollegiate Stroke Working Party guidelines (fourth edition, see 'Resources'), it is recommended that people with suspected acute stroke should receive brain imaging immediately (ideally in the next imaging slot and within one hour of admission) if the patient meets the need for urgent scanning according to specified criteria. About 50% of acute stroke admissions meet these criteria. All other stroke patients should have brain imaging performed within 12 hours of admission. A fifth edition of the RCP guideline was published in October 2016 (see 'Resources'). In the NICE guidelines (see 'Resources'), the recommendation is that brain imaging should be performed immediately in people with specific indications (for example, indications for thrombolysis), and as soon as possible in all other people with acute stroke.

The RCP audits the care of people who have had a stroke. The data for Maps 4a-6b is from the Sentinel Stroke National Audit Programme (SSNAP[1]).

Magnitude of variation

Map 4a: Median time to brain imaging by CCG

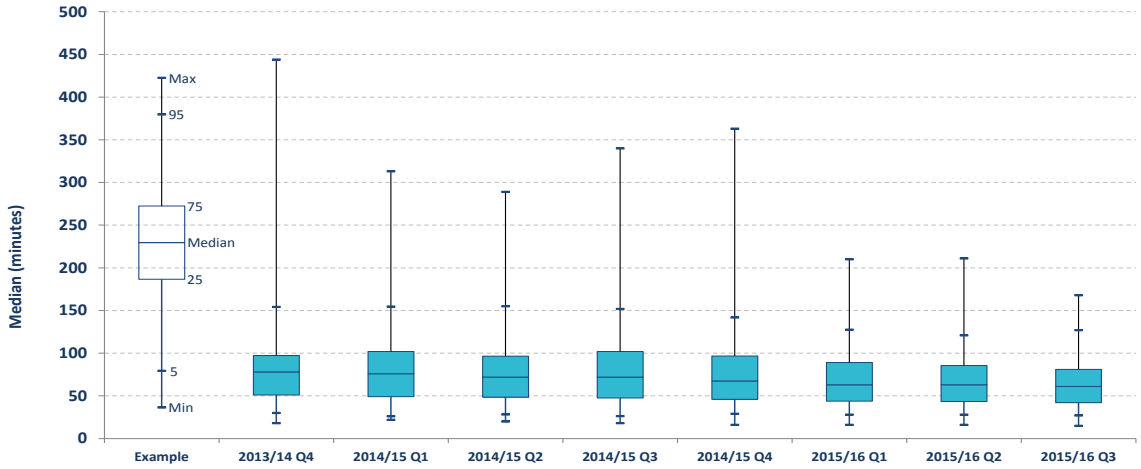
The map and column chart display the latest period (October-December 2015), during which CCG values ranged from 15 minutes to 168 minutes, which is a 11.2-fold difference between CCGs. The England value for this quarter was 62 minutes

The boxplot shows the distribution of CCG values for the period January-March 2014 to October-December 2015.

There has been a significant narrowing of the maximum to minimum range and also of the 95th to 5th percentile gap. This is mainly due to marked reductions in the maximum and 95th percentile values in the last three quarter periods displayed. There was no significant change in the 75th to 25th percentile gap.

The median of the CCG median times to brain imaging for patients has decreased significantly from 78 minutes to 61 minutes. Improvement in time to brain imaging increases the likelihood of better long-term outcomes. The median of the CCG median times is also close to meeting the RCP guidelines threshold of 60 minutes from arrival at hospital to brain imaging.

Map 4a: Boxplot of median time to brain imaging for stroke patients by CCG



Max-Min (Range)		426.0	291.0	269.0	322.0	347.0	194.0	195.0	153.0	NARROWING Significant
95th-5th percentile		124.3	128.6	126.8	125.6	112.9	99.6	92.9	100.0	NARROWING Significant
75th-25th percentile		46.3	53.0	48.0	54.5	50.8	45.3	42.0	39.0	No significant change
Median		78.0	76.0	72.0	72.0	67.5	63.0	63.0	61.0	DECREASING Significant

[1] The Sentinel Stroke National Audit Programme (SSNAP); SSNAP aims to improve the quality of stroke care by auditing stroke services against evidence-based standards. http://www.rcplondon.ac.uk/projects/sentinel-stroke-national-audit-programme

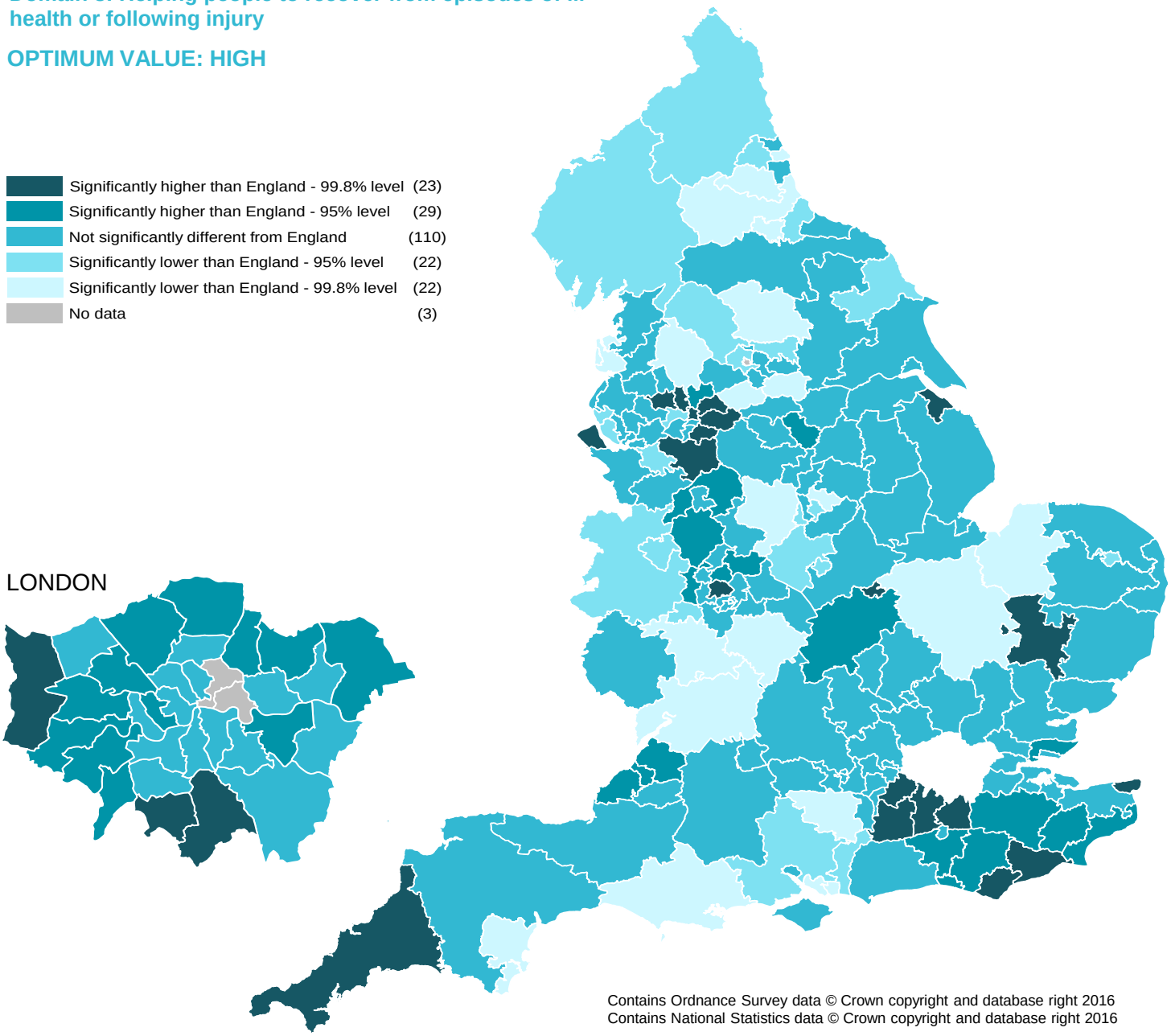
IMAGING SERVICES

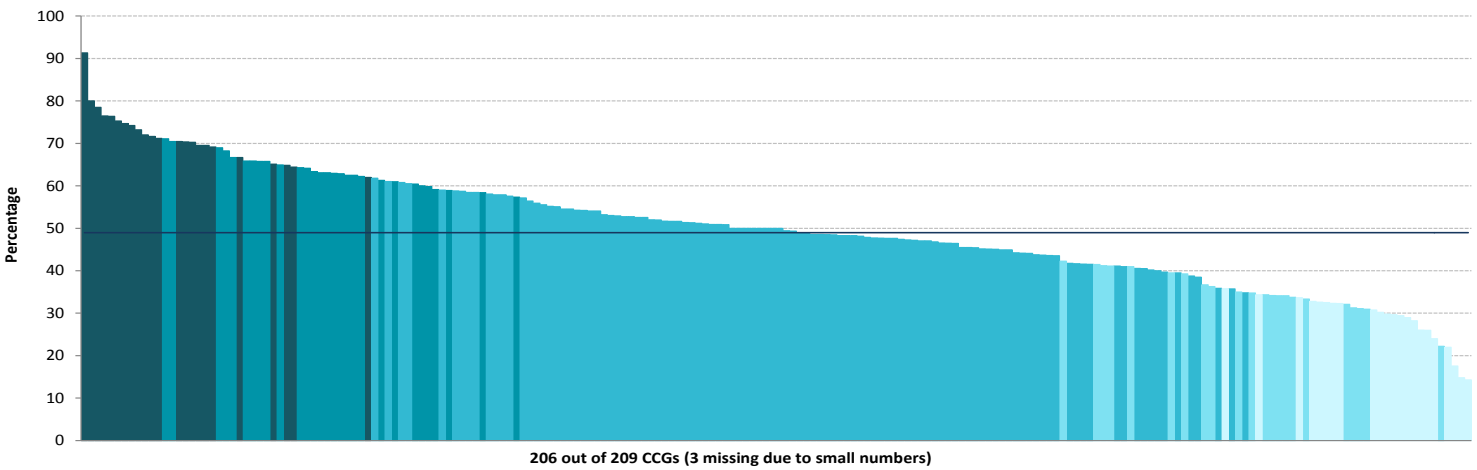
MAP 5a: Percentage of stroke patients undergoing brain imaging within one hour of arrival at hospital by CCG

October–December 2015

Domain 1: Preventing people from dying prematurely
Domain 2: Enhancing quality of life for people with long-term conditions
Domain 3: Helping people to recover from episodes of ill health or following injury

OPTIMUM VALUE: HIGH





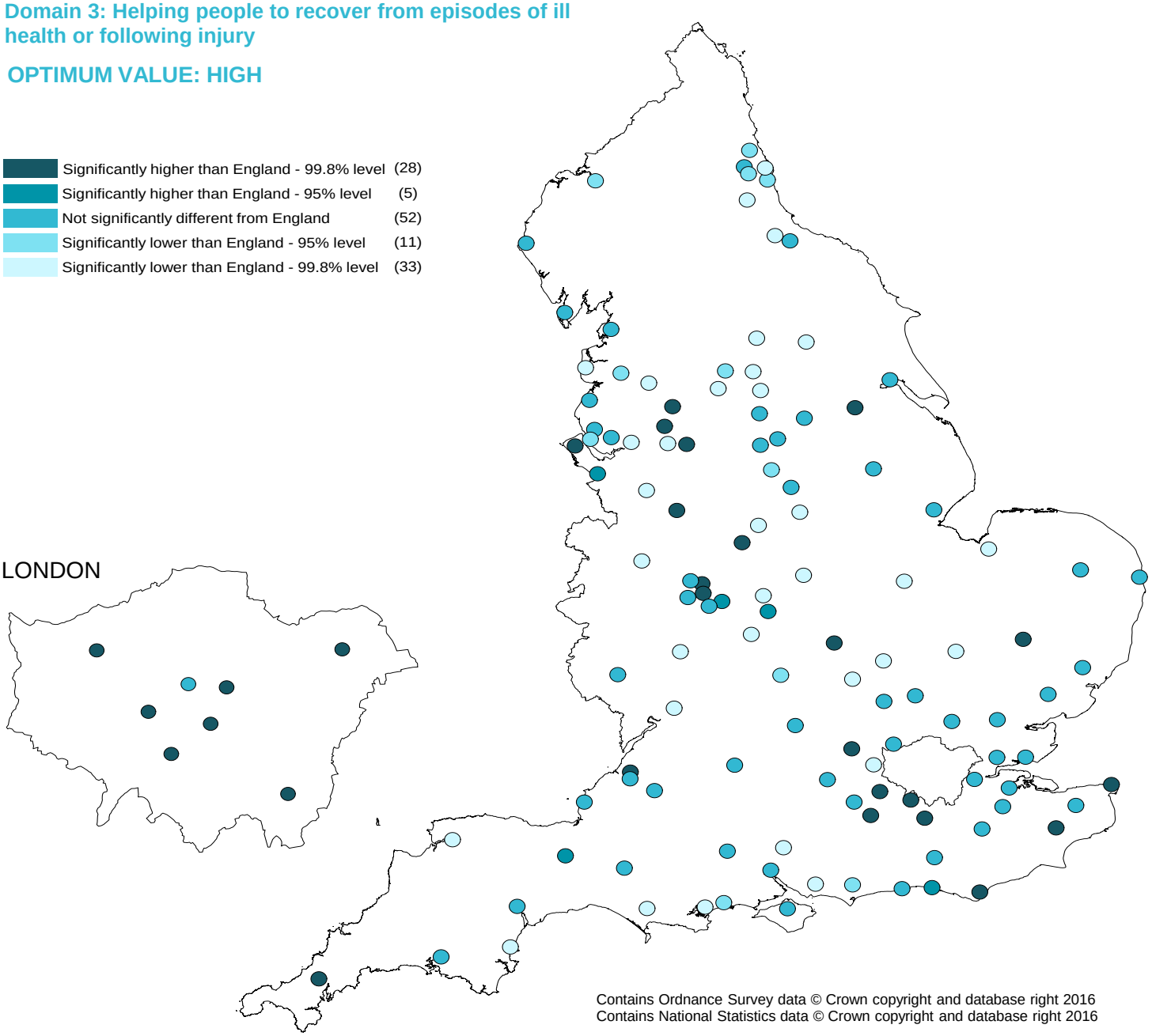
IMAGING SERVICES

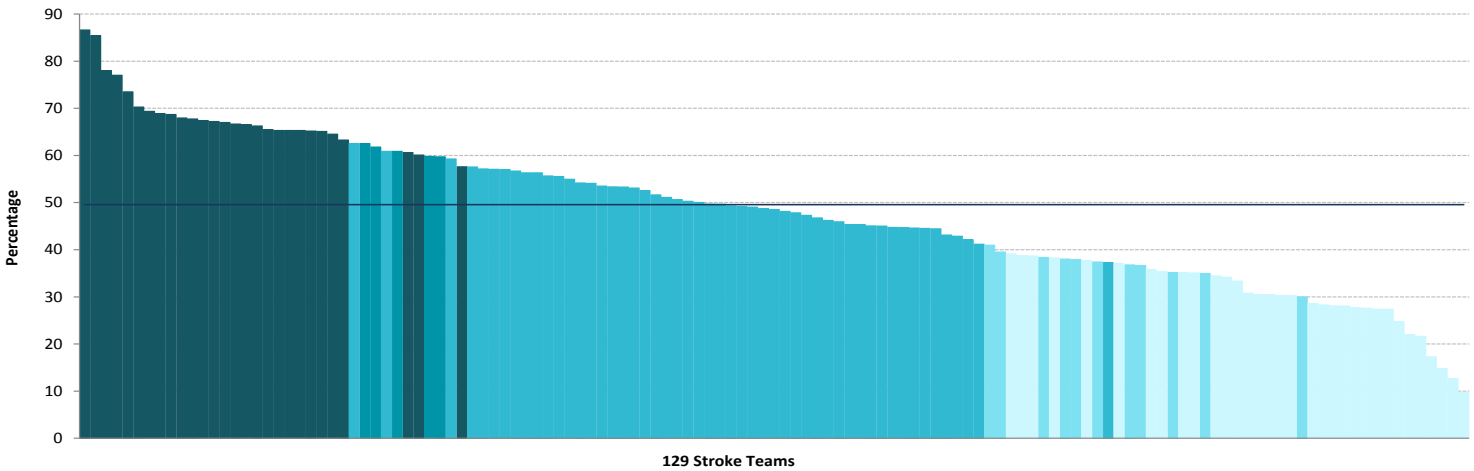
MAP 5b: Percentage of stroke patients undergoing brain imaging within one hour of arrival at hospital by stroke team

October–December 2015

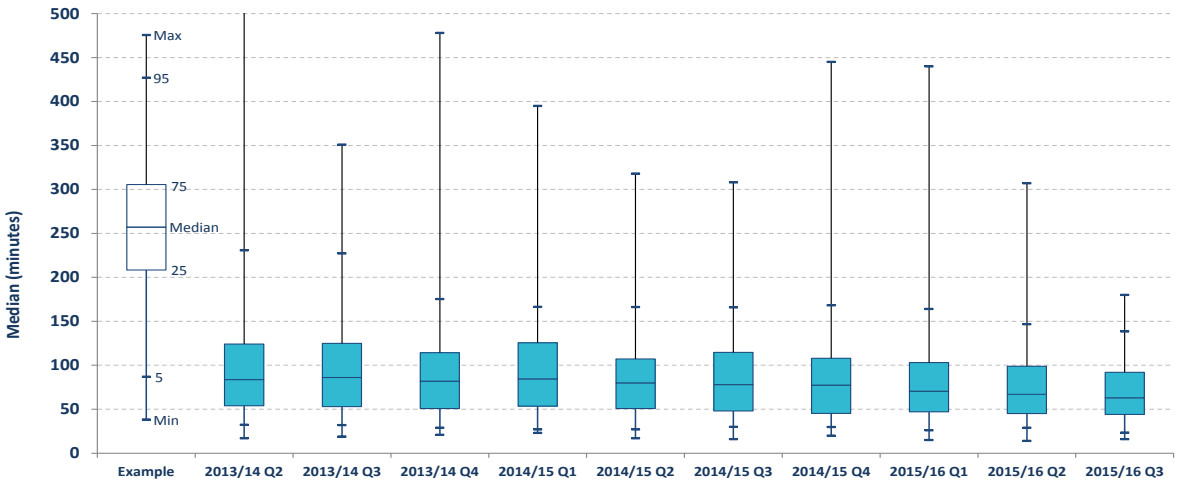
Domain 1: Preventing people from dying prematurely
Domain 2: Enhancing quality of life for people with long-term conditions
Domain 3: Helping people to recover from episodes of ill health or following injury

OPTIMUM VALUE: HIGH





Map 4b: Boxplot of median time to brain imaging for stroke patients by stroke team



Max-Min (Range)		997.0	332.0	457.0	372.0	301.0	292.0	425.0	425.0	293.0	164.0	NARROWING Significant
95th-5th percentile		198.4	195.1	146.3	139.4	139.4	135.9	138.3	138.0	117.8	115.0	NARROWING Significant
75th-25th percentile		70.4	72.0	63.5	72.0	56.5	66.8	62.8	56.0	54.0	48.0	NARROWING Significant
Median		83.8	86.0	82.0	84.5	80.0	78.0	77.5	70.5	67.0	63.0	DECREASING Significant

Map 4b: Median time to brain imaging by stroke team

The map and column chart display the latest period (October-December 2015), during which stroke team values ranged from 16 to 180 minutes, which is a 11.3-fold difference between hospital stroke teams. The England value for this quarter was 62.0 minutes. The boxplot shows the distribution of stroke team values for the period July-September 2013 to October-December 2015.

There has been significant narrowing of all three measures of variation; the maximum to minimum range, the 95th to 5th percentile gap and the 75th to 25th percentile gap. This strongly suggests that the variability across stroke teams of median times to provide brain imaging for patients has reduced both at the extremities, and at the centre of the distribution.

There was a significant decrease in the median of the stroke team median times from arrival at hospital to brain imagining from 83.8 minutes to 63 minutes, which is close to meeting the RCP threshold of 60 minutes for patients meeting the criteria for urgent scanning.

Map 5a: Brain imaging within one hour of arrival by CCG

The map and column chart display the latest period (October-December 2015), during which CCG values ranged from 14.3% to 91.3%, which is a 6.4-fold difference between CCGs. The England value for this quarter was 49%.

The boxplot shows the distribution of CCG values for the period January-March 2014 to October-December 2015. There was no significant change in any of the three variation measures over this period.

However, the CCG median value has increased significantly from 43% to 50%. Overall more patients have received brain imaging within an hour which will improve long-term patient outcomes, and the median value matches the estimate of the proportion of acute stroke admissions likely to meet the criteria for urgent scanning.

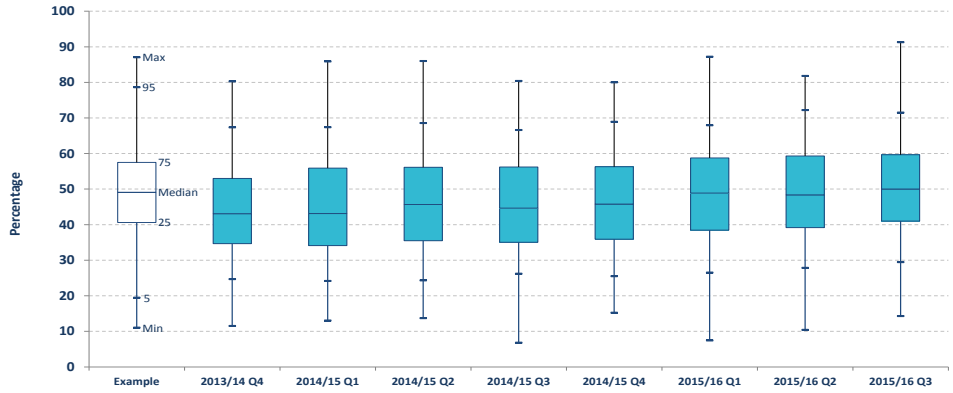
Map 5b: Brain imaging within one hour of arrival by stroke team

The map and column chart display the latest period (October-December 2015), during which stroke team values ranged from 9.8% to 86.6%, which is a 8.9-fold difference between hospital stroke teams. The England value for this quarter was 49.5%.

The boxplot shows the distribution of stroke team values for the period July-September 2013 to October-December 2015. There was no significant change in any of the three variation measures over this period.

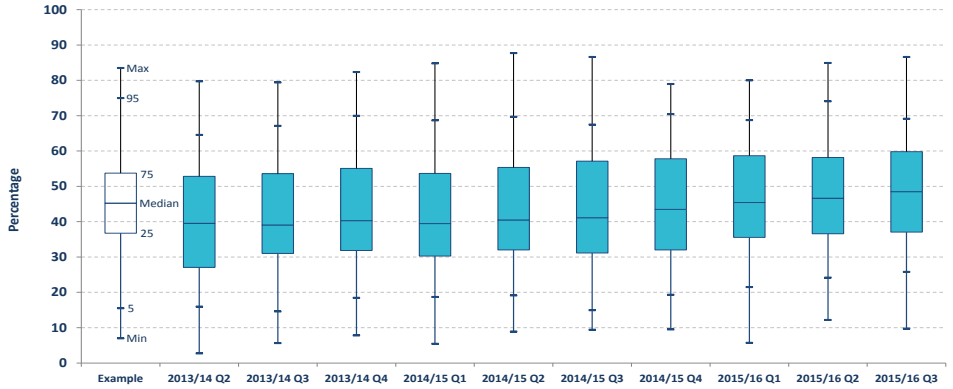
There was a significant increase in the median of stroke team values from 39.5% to 48.5% of patients being scanned within one hour of arrival at hospital; the median of stroke team values is close to the estimate of the proportion of acute stroke admissions which meet the criteria for urgent scanning.

Map 5a: Boxplot of stroke patients to brain imaging within one hour (%) by CCG



Max-Min (Range)		68.7	72.8	72.3	73.6	64.7	79.7	71.4	77.0	No significant change
95th-5th percentile		42.7	43.2	44.2	40.4	43.4	41.4	44.3	42.1	No significant change
75th-25th percentile		18.3	21.8	20.7	21.2	20.4	20.3	20.1	18.6	No significant change
Median		43.1	43.1	45.7	44.6	45.8	48.9	48.4	50.0	INCREASING Significant

Map 5b: Boxplot of stroke patients to brain imaging within one hour (%) by stroke team



Max-Min (Range)		77.0	73.8	74.5	79.3	78.8	77.2	69.4	74.3	72.7	76.8	No significant change
95th-5th percentile		48.6	52.5	51.5	49.9	50.6	52.5	51.1	47.2	49.9	43.3	No significant change
75th-25th percentile		25.7	22.6	23.2	23.4	23.3	26.0	25.8	23.1	21.6	22.7	No significant change
Median		39.5	39.1	40.3	39.5	40.5	41.1	43.5	45.4	46.6	48.5	INCREASING Significant

Map 6a: Brain imaging within 12 hours of arrival by CCG

The map and column chart display the latest period (October-December 2015), during which CCG values ranged from 74.5% to 100%, which is a 1.3-fold difference between CCGs. The England value for this quarter was 92.3%.

The boxplot shows the distribution of CCG values for the period January-March 2014 to October-December 2015.

There has been significant narrowing of all three measures of variation; the maximum to minimum range, the 95th to 5th percentile gap and the 75th to 25th percentile gap. This has been achieved despite increases in both 95th percentile and 75th percentile values and is largely due to much greater increases in the proportion of patients receiving brain imaging within 12 hours at the minimum and 5th percentile points of the CCG distribution.

The median of CCG values of the proportion of patients receiving brain imaging within 12 hours increased significantly.

Map 6b: Brain imaging within 12 hours of arrival by stroke team

The map and column chart display the latest period (October-December 2015), during which stroke team values ranged from 70.7% to 100%, which is a 1.4-fold difference between hospital stroke teams. The England value for this quarter was 92.7%.

The boxplot shows the distribution of stroke team values for the period January-March 2013 to October-December 2015.

There has been significant narrowing of all three measures of variation; the maximum to minimum range, the 95th to 5th percentile gap and the 75th to 25th percentile gap. This has been achieved despite increases in both 95th percentile and 75th percentile values and is largely due to much greater increases in the proportion of patients receiving brain imaging within 12 hours at the minimum and 5th percentile points of the stroke team distribution.

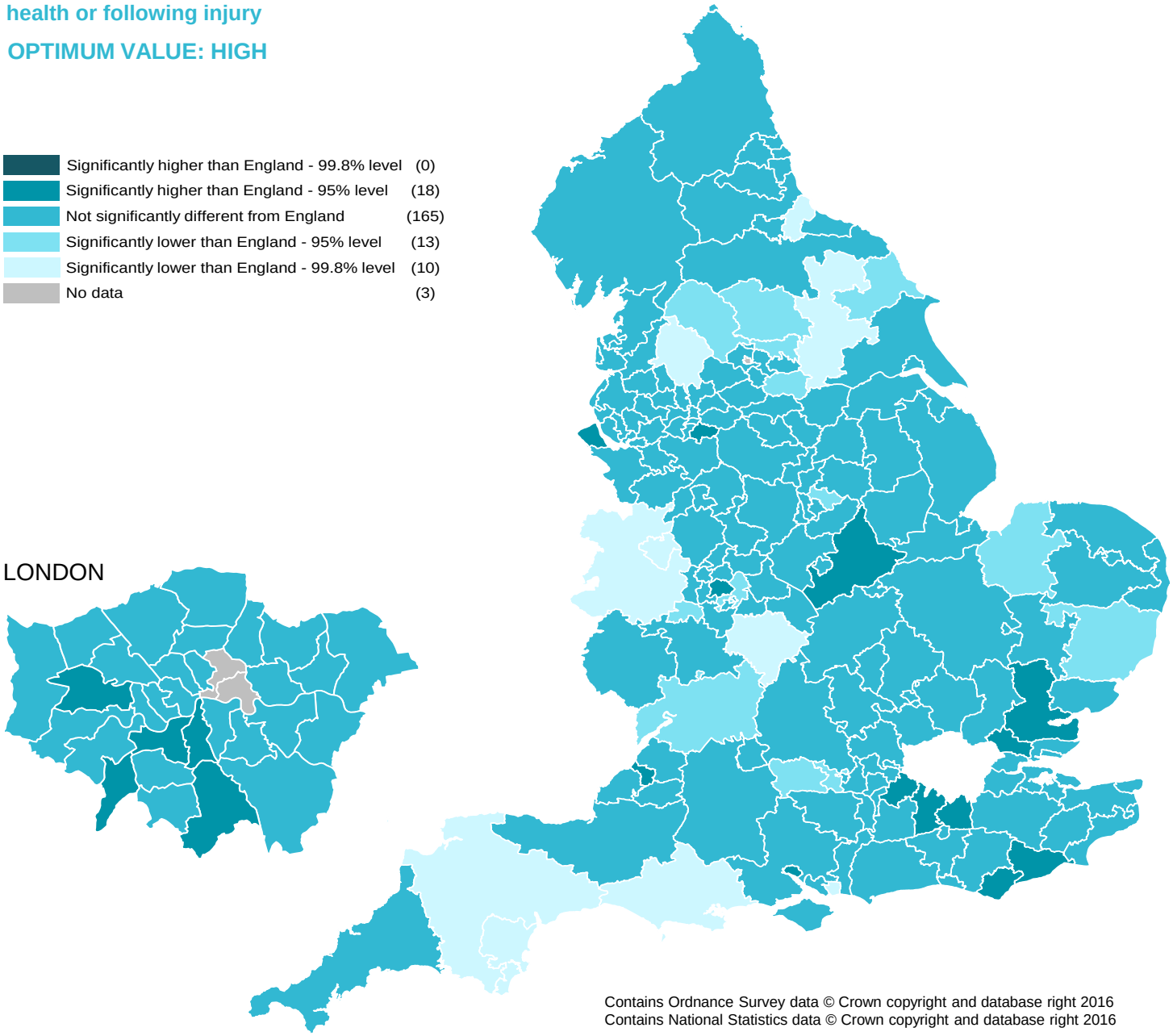
IMAGING SERVICES

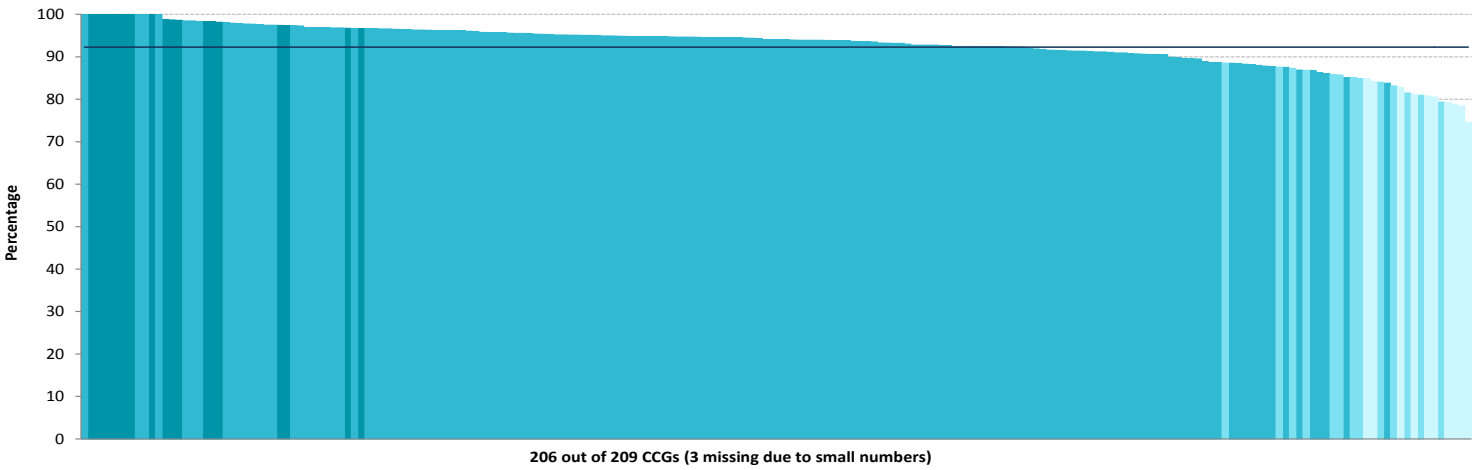
MAP 6a: Percentage of stroke patients undergoing brain imaging within 12 hours of arrival at hospital by CCG

October–December 2015

Domain 1: Preventing people from dying prematurely
Domain 2: Enhancing quality of life for people with long-term conditions
Domain 3: Helping people to recover from episodes of ill health or following injury

OPTIMUM VALUE: HIGH





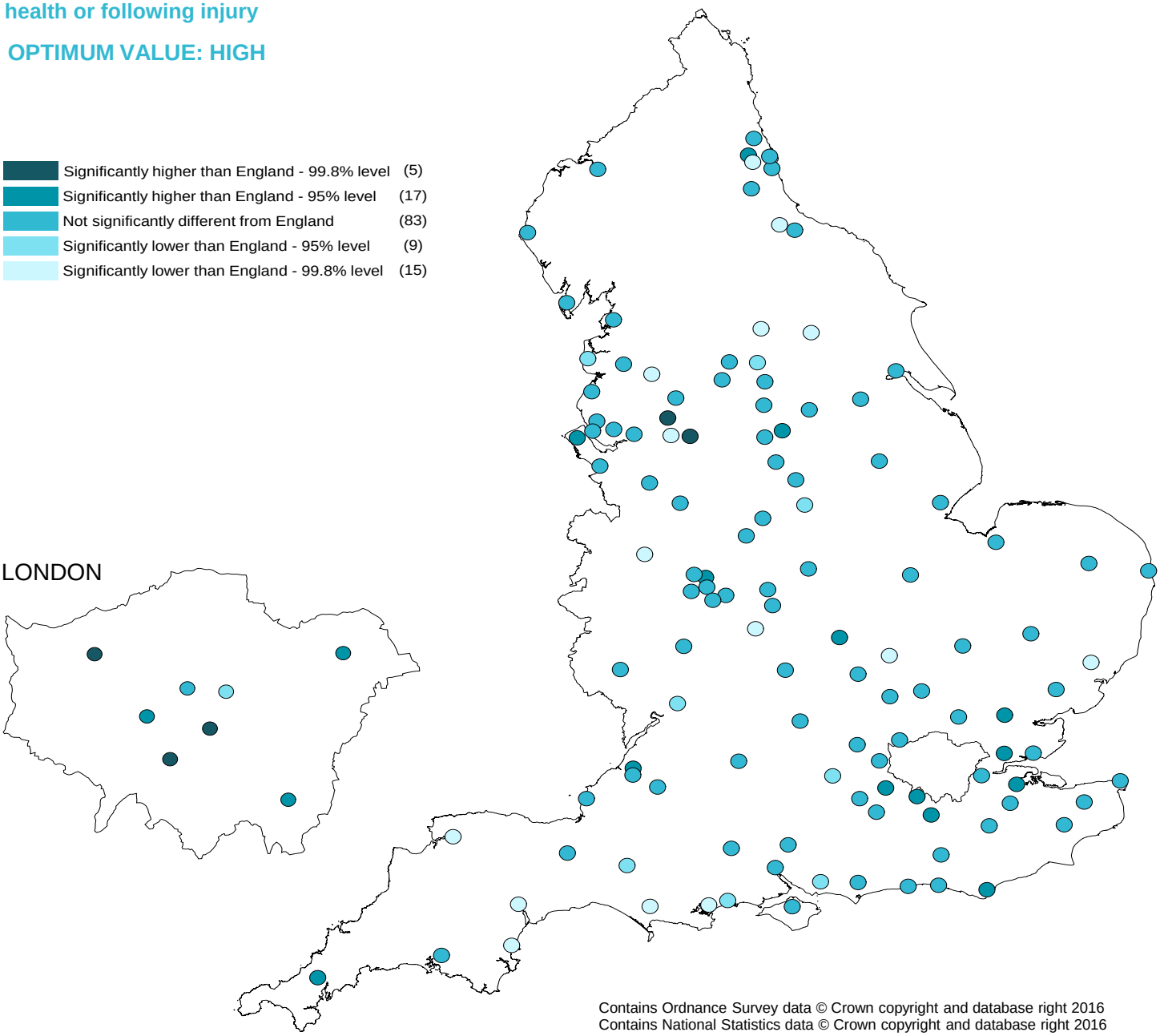
IMAGING SERVICES

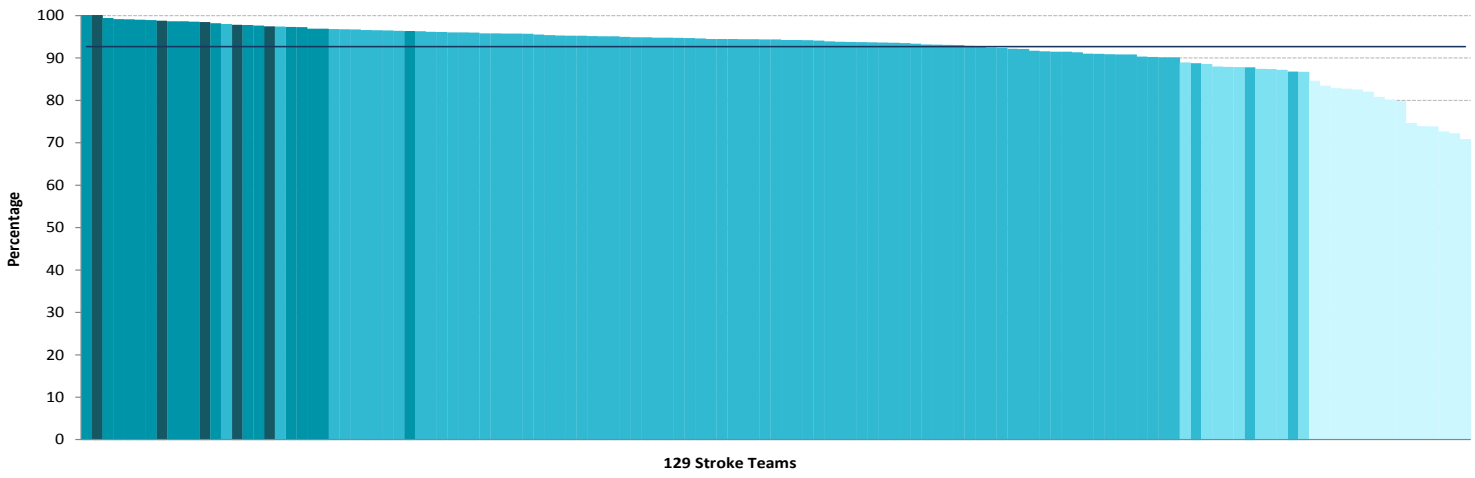
MAP 6b: Percentage of stroke patients undergoing brain imaging within 12 hours of arrival at hospital by stroke team

October–December 2015

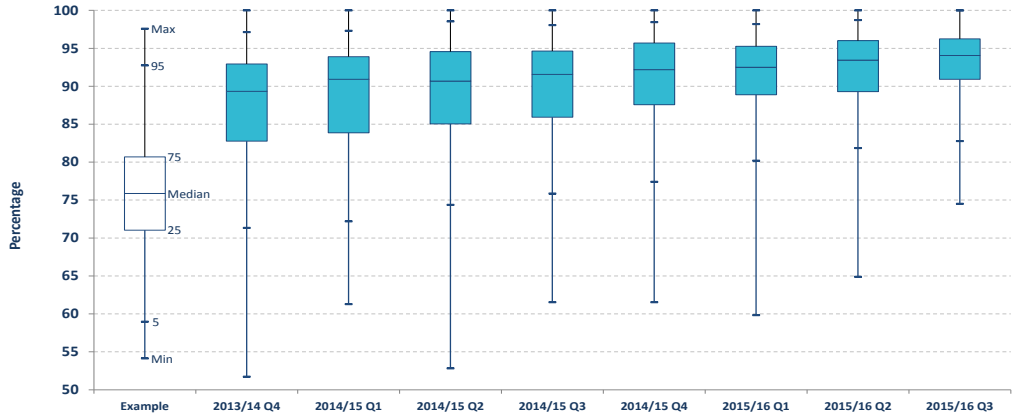
Domain 1: Preventing people from dying prematurely
Domain 2: Enhancing quality of life for people with long-term conditions
Domain 3: Helping people to recover from episodes of ill health or following injury

OPTIMUM VALUE: HIGH



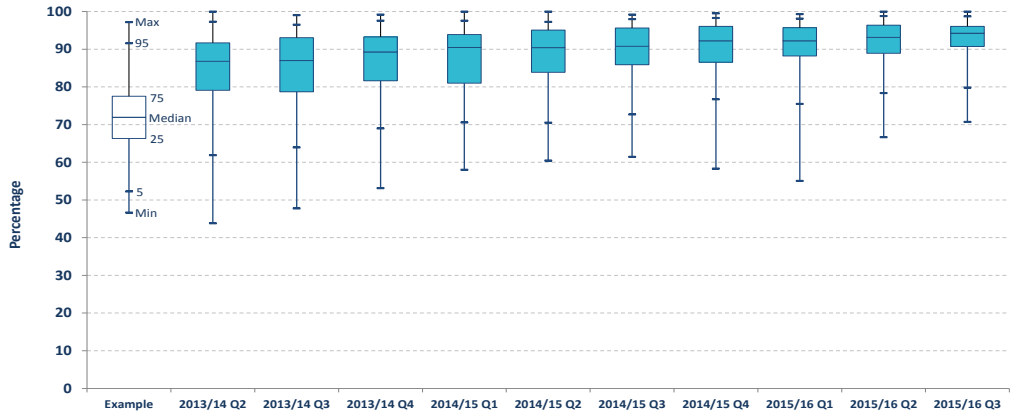


Map 6a: Boxplot of stroke patients to brain imaging within 12 hours (%) by CCG



Max-Min (Range)		48.3	38.7	47.2	38.5	38.5	40.2	35.1	25.5	NARROWING Significant
95th-5th percentile		25.8	25.1	24.2	22.2	21.0	18.0	16.9	17.2	NARROWING Significant
75th-25th percentile		10.2	10.0	9.5	8.7	8.1	6.4	6.7	5.3	NARROWING Significant
Median		89.3	90.9	90.7	91.6	92.2	92.5	93.4	94.0	INCREASING Significant

Map 6b: Boxplot of stroke patients to brain imaging within 12 hours (%) by stroke team



Max-Min (Range)		56.2	51.3	46.1	42.0	39.5	37.7	41.2	44.2	33.3	29.3	NARROWING Significant
95th-5th percentile		35.4	32.6	28.6	27.0	26.7	25.3	21.6	22.7	20.4	18.9	NARROWING Significant
75th-25th percentile		12.6	14.4	11.6	12.9	11.2	9.8	9.5	7.5	7.5	5.3	NARROWING Significant
Median		86.8	87.0	89.3	90.4	90.4	90.8	92.2	92.2	93.1	94.2	INCREASING Significant

Reasons for the degree of variation observed, particularly for median time to brain imaging (Maps 4a and 4b), and proportion of patients undergoing brain imaging within one hour (Maps 5a and 5b), include:

- lack of understanding by the admitting clinical teams of the need for early brain imaging in acute stroke and/or lack of protocols
- lack of access to imaging 24/7
- delays in patient transfer from admissions area to imaging facility

Although the percentage of people who meet the NICE criteria for immediate brain imaging in each hospital Trust is not known:

- the column chart for Map 5b shows that at 71 (out of 129) hospital Trusts less than 50% of stroke patients underwent brain imaging within one hour of arrival at hospital
- the column chart for Map 6b shows that at 27 (out of 129) hospital Trusts less than 90% of stroke patients underwent brain imaging within 12 hours of arrival at hospital

Options for action

Re-designing systems is pivotal to improving the assessment and treatment pathway for people who have a stroke (see *Case-study* section). Commissioners, clinicians and service providers need:

- to review the time to brain imaging in services providing stroke related care for the local population
- to review the patient pathway for people admitted with stroke
- to review the reporting of time to first scan for people with stroke among service providers

RESOURCES

- Department of Health. National Stroke Strategy. 5 December 2007. http://webarchive.nationalarchives.gov.uk/20130107105354/http:/www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_081062
- Public Health England (PHE) Stroke Prevalence Modelling Briefing Document, & Stroke Prevalence Estimates Dec 2011. http://www.apho.org.uk/default.aspx?RID=61214
- NICE. Stroke and transient ischaemic attack in over 16s: diagnosis and initial management. NICE guidelines [CG68]. July 2008. http://guidance.nice.org.uk/CG68
- NICE Pathways. Stroke overview. http://pathways.nice.org.uk/pathways/stroke
- Intercollegiate Stroke Working Party. National clinical guideline for stroke. Fourth edition. 3 September 2012. Royal College of Physicians.https://www.rcplondon.ac.uk/file/1299/download?token=mcyQFjEq
- Intercollegiate Stroke Working Party. National clinical guideline for stroke. Fifth edition. 3 October 2016. Royal College of Physicians. http://www.rcplondon.ac.uk/resources/stroke-guidelines

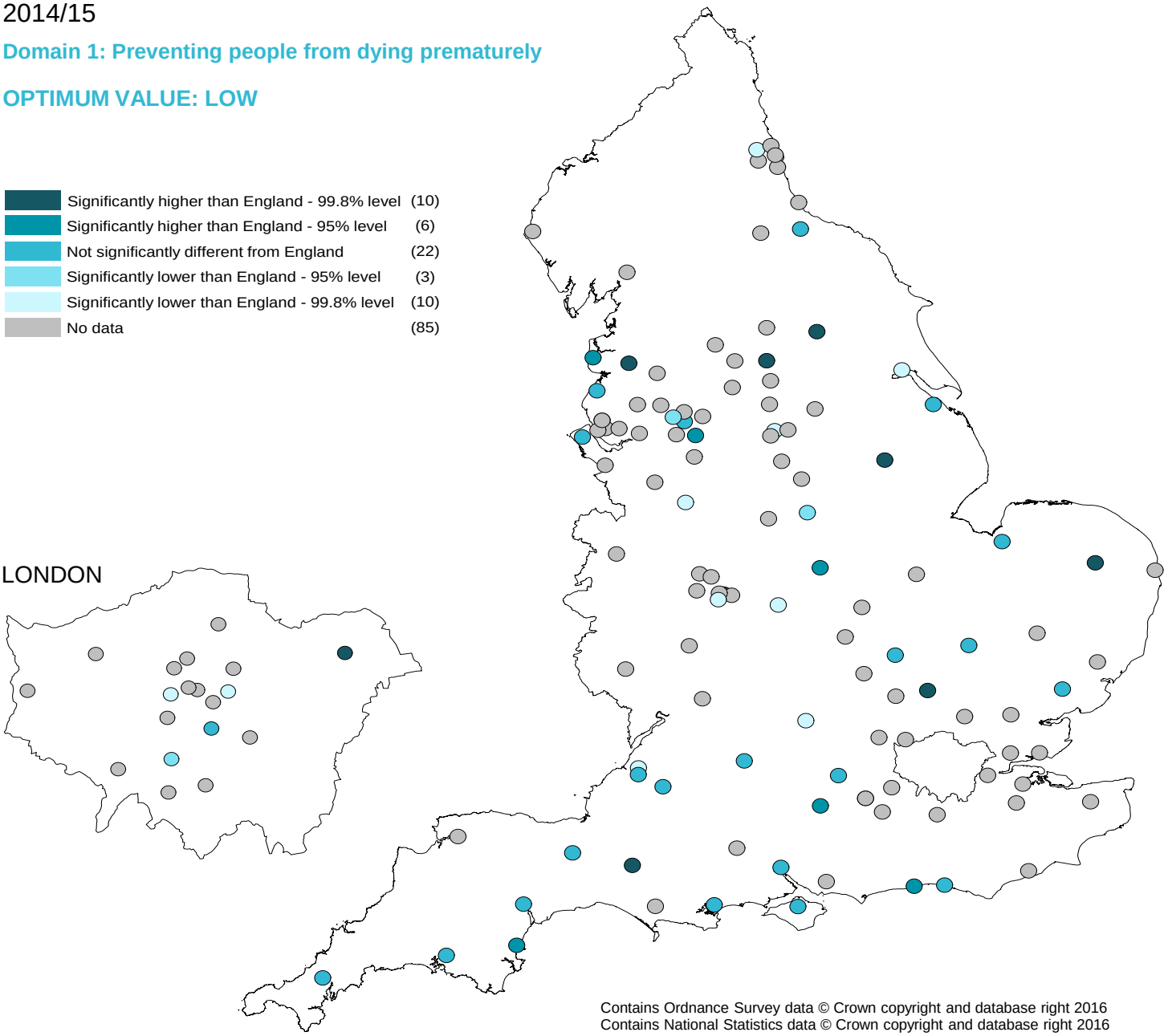
IMAGING SERVICES

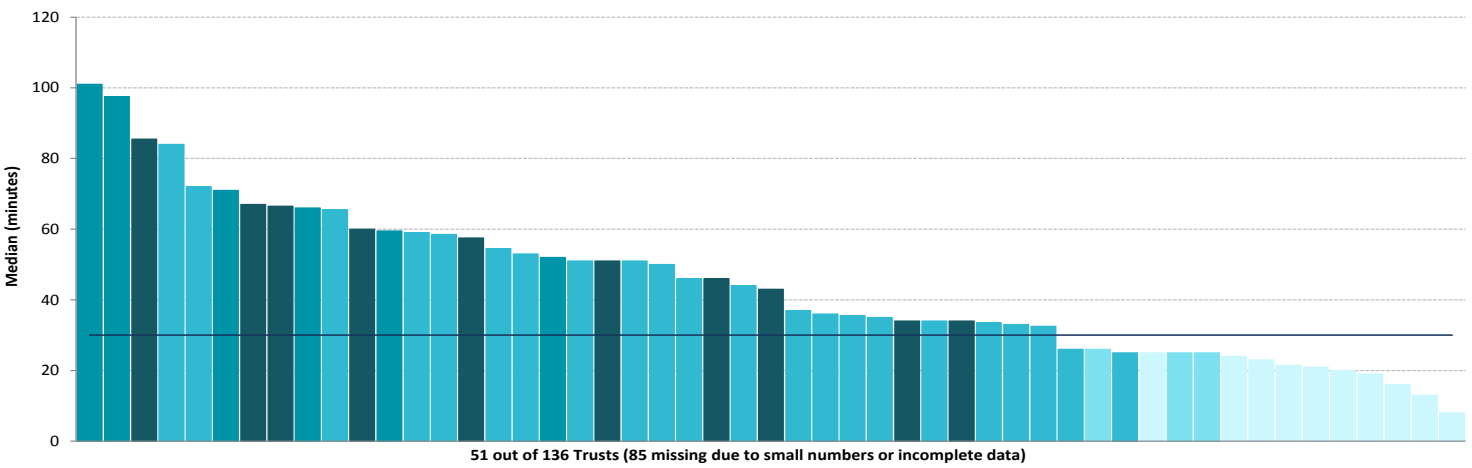
MAP 7: Median time (minutes) to head computed axial tomography (CT) for patients admitted directly to hospital[1] meeting NICE head injury guidelines[2] by NHS Trust

2014/15

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: LOW





[1] Patients directly admitted to hospital are defined as patients who are brought from the scene of the incident straight to the hospital without visiting another hospital first.
[2] NICE head injury guidelines defined as Glasgow Coma Scale (GCS) <13 and/or intubated and Abbreviated Injury Scale (AIS) 1+ head injury

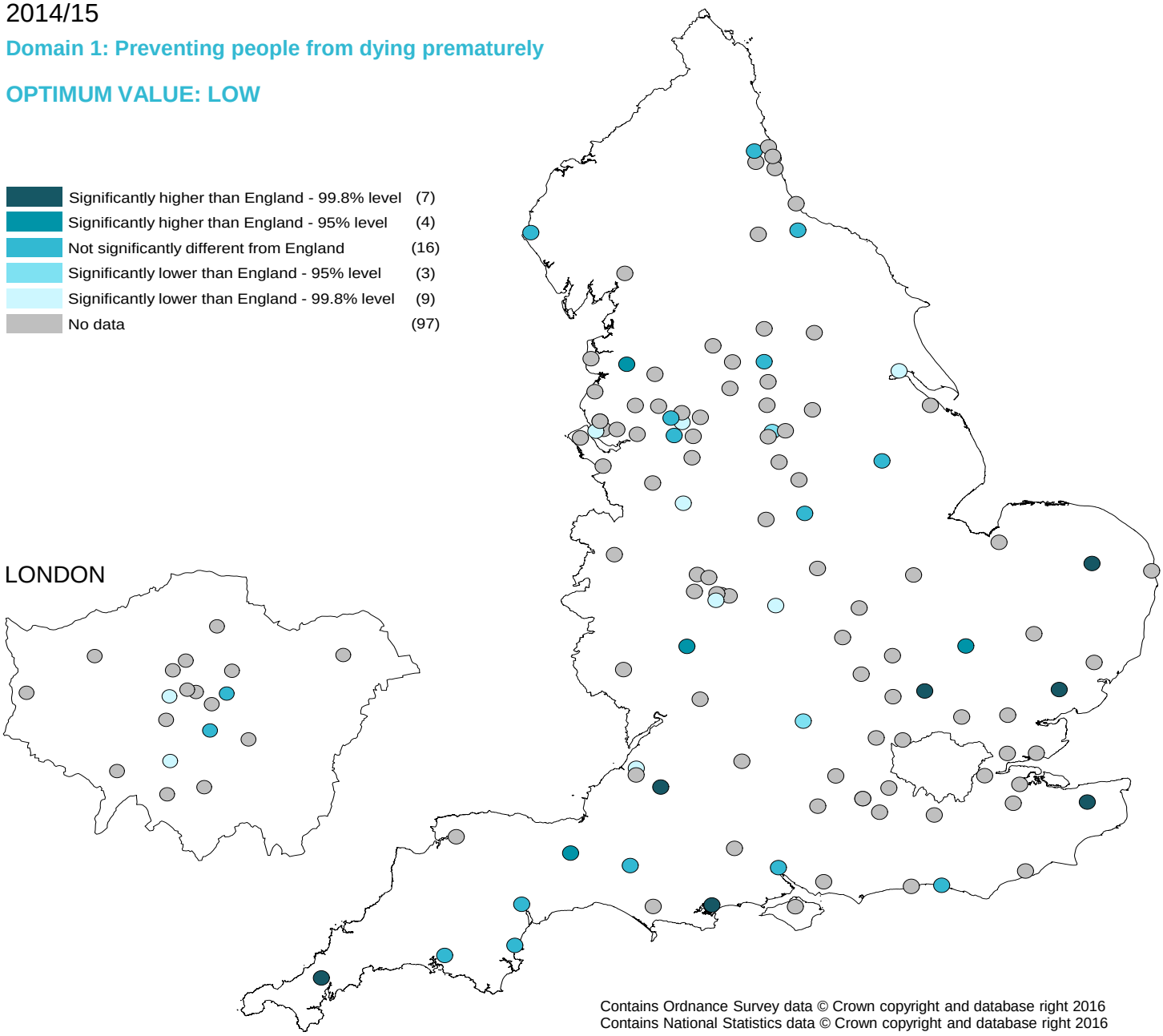
IMAGING SERVICES

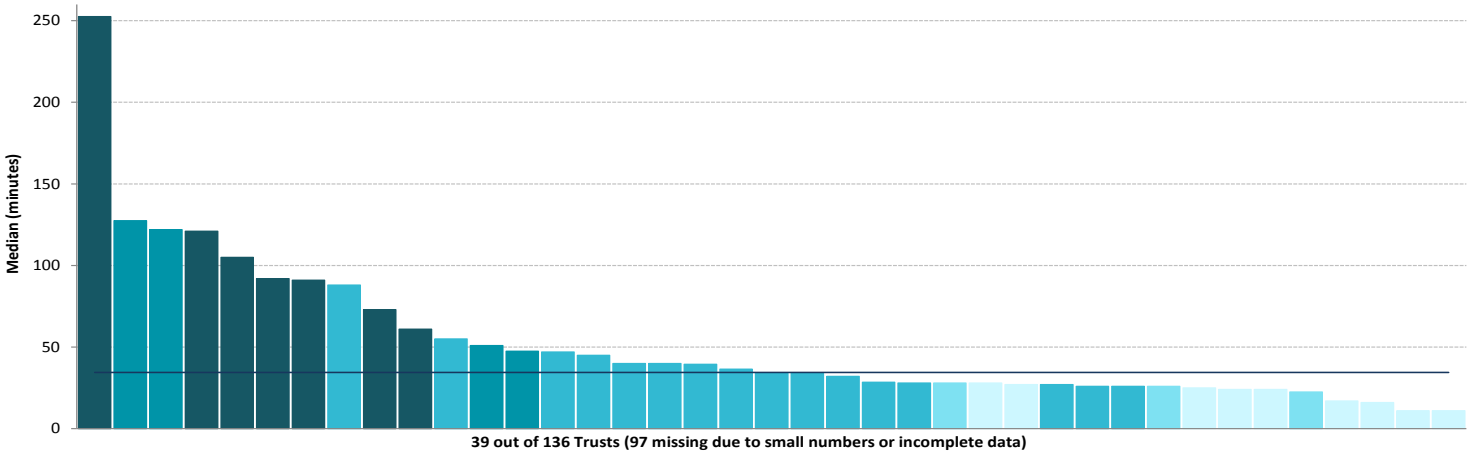
MAP 8: Median time (minutes) to pelvic computed axial tomography (CT) for patients admitted directly to hospital[1] with pelvic injury[3] by NHS Trust

2014/15

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: LOW





[3]Whole body, and abdominal CT are counted as CT to pelvis.

Context

Computed axial tomography (CT scan) is an X-ray technique using a scanner that takes a series of pictures across the body allowing a radiologist to view the images in a two- or three-dimensional form.[4]

In patients with head injuries, CT scanning of the head is used to detect:

- traumatic brain injury (TBI)
- fractures of the skull

For the assessment of head injuries, CT scanning is sufficient for detecting TBI requiring neurosurgery, whereas more detail of smaller injuries is visible on magnetic resonance imaging (MRI).

In patients with pelvic injuries, CT scanning of the pelvis is used to detect internal bleeding, broken bones and damage to internal organs.

The data for these indicators is from the Trauma Audit and Research Network (TARN)[5]. The TARN database is the largest trauma registry in Europe, with the overall aim of collecting and analysing clinical and epidemiological data to provide a statistical base:

- to support clinical audit
- to aid the development of trauma services
- to inform the research agenda

Maps 7 and 8 show provider-level data:

- the disadvantage is that they are difficult to visualise in relation to discrete geographical populations
- the advantage in relation to access to trauma services is that, unlike indicators for long-term conditions, they are less influenced by clinical bias or preferences

The online Electronic Data Collection & Reporting (EDCR) was launched to all participating Trusts in England and Wales between September 2005 and March 2006.

Magnitude of variation

Map 7: Median time to head CT

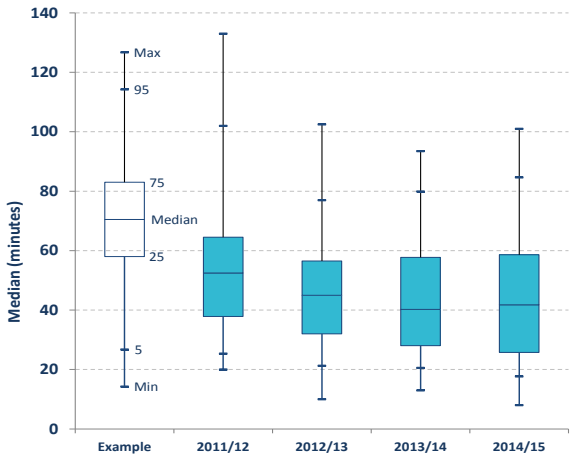
The map and column chart display the latest period (2014/15), during which NHS Trust values ranged from 8 minutes to 101 minutes, which is a 12.6-fold difference between NHS Trusts. The England value for 2014/15 was 30 minutes.

The boxplot shows the distribution of NHS Trust values for the period 2011/12 to 2014/15. There was no significant change in any of the three variation measures between 2011/12 to 2014/15.

The median time to head CT for patients decreased by 10 minutes from 52 minutes in 2011/12 to 42 minutes in 2014/15. This decrease was not statistically significant.

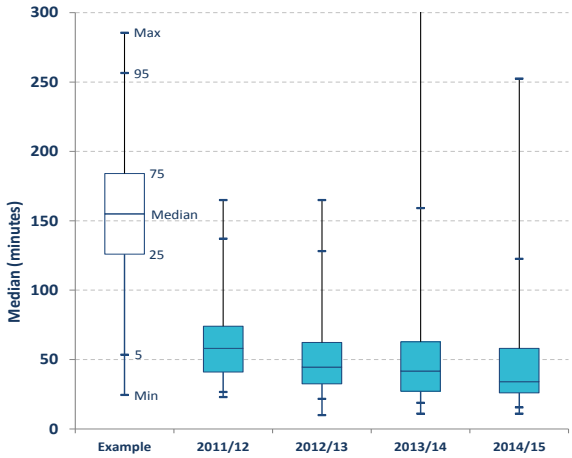
It should be noted however, that only 38% of 2014/15 Trust values were available for analysis, which was due to either small number suppression or data not being supplied.

Map 7: Boxplot of median time to head CT by NHS Trust



Max-Min (Range)		113	93	81	93	No significant change
95th-5th percentile		77	56	59	67	No significant change
75th-25th percentile		27	25	30	33	No significant change
Median		52	45	40	42	No significant change

Map 8: Boxplot of median time to pelvic CT by NHS Trust[6]



Max-Min (Range)		142	155	1064	242	No significant change
95th-5th percentile		110	106	140	107	No significant change
75th-25th percentile		33	30	36	32	No significant change
Median		58	44	42	34	DECREASING Significant

[4] The Royal College of Radiologists. FAQs in radiology. http://www.rcr.ac.uk/content.aspx?PageID=504
[5] TARN is a collaboration of hospitals from England, Wales, Ireland and other parts of Europe, established in 1989. https://www.tarn.ac.uk/
[6] Map 8 - Pelvic injuries boxplot vertical axis is truncated, 2013/14 maximum = 17.9 hours

Map 8: Median time to pelvic CT

The boxplot shows the distribution of indicator values for the period 2011/12 to 2014/15.

The map and column chart display the latest period (2014/15), during which NHS Trust values ranged from 11 minutes to 252 minutes, which is a 23-fold difference between NHS Trusts. The England value for 2014/15 was 35 minutes.

The boxplot shows the distribution of NHS Trust values for the period 2011/12 to 2014/15. There was no significant change in any of the three variation measures between 2011/12 to 2014/15.

There was a statistically significant decrease of 24 minutes in the median time to pelvic CT for patients from 58 minutes in 2011/12 to 34 minutes in 2014/15.

It should be noted however, that only 28% of 2014/15 Trust values were available for analysis, which was due to either small number suppression or data not being supplied.

The degree of variation observed for both indicators is predominantly related to case-mix. Most cases of immediately life-threatening trauma associated with reduced consciousness or shock are brought to major trauma centres which will have been alerted to arrival by ambulance services. This enables the trauma centre to activate urgent imaging before the patient arrives. In contrast, although cases of atypical major trauma are serious, such as older people falling or children who have had an accident, they may appear not to be immediately life-threatening and patients are taken to non-major trauma centres, for which there is no "pre-alert" and therefore imaging tends to be accessed at a later point in time for those patients who are subsequently identified as having head or pelvic injuries.

The lack of availability of data poses problems for commissioners, especially in localities where there is varying data coverage. In 2010 issues about data were highlighted in the National Audit Office (NAO) report, 'Major trauma care in England':

> "*There remains a lack of accurate and complete information in hospitals and ambulance trusts on the treatment of people who suffer major trauma. In addition, other than mortality rates, there is also no information on patient outcomes*."[7]

Since the implementation of the Regional Trauma Networks in 2012, data returns to TARN have improved but they are variable. At the time of writing, patient reported outcome measures (PROMs) are being evaluated in a pilot study by TARN, and this may facilitate the development of other important outcome measures in future.

Options for action

TARN undertakes routine analysis of the data for clinical commissioning groups (CCGs) and the Major Trauma Clinical Reference Group. To reduce unwarranted variation in the median time to CT scan for various injuries, hospital Trusts, using TARN data, need to benchmark performance against that of other Trusts to help identify good practice and ways to improve patient care. This will need to take account of case-mix.

The Care Quality Commission needs to use the TARN analyses to monitor the performance of trauma networks.

Following the NAO recommendations Regional Trauma Networks went live in England in April 2012. Trauma services provided by major trauma centres are commissioned directly by NHS England. The submission of data by major trauma centres was mandated, and data submission and quality by major trauma centres are excellent. By contrast, trauma services provided by trauma units are commissioned by CCGs, and a considerable amount of major trauma is managed within trauma units. The return of data from trauma units needs to be improved to enhance the quality of data on which decisions are based concerning the commissioning, planning and provision of trauma services.

RESOURCES

- The Trauma Audit & Research Network (TARN). https://www.tarn.ac.uk/
- NHS Radiology Improvement Team (2007) Page 1: Computerised Tomography. Radiology Success Factors.http://system.improvement.nhs.uk/ImprovementSystem/ViewDocument.aspx?path=Diagnostics%2fNational%2fWebsite%2fPublications%2fRadiology_Success_Factors%20-%20Nov%2007.pdf
- NICE. Head injury: assessment and early management. NICE guidelines [CG176]. January 2014. https://www.nice.org.uk/guidance/cg176
- NICE. Fractures (complex): assessment and management. NICE guidelines [NG37]. February 2016. https://www.nice.org.uk/guidance/ng37
- NICE pathways. Trauma overview. http://pathways.nice.org.uk/pathways/trauma
- National Audit Office. Major trauma care in England. 5 February 2010. http://www.nao.org.uk/report/major-trauma-care-in-england/
- Gibb I, Denton E. Guidelines for imaging the injured blast/ballistic patient in a Mass Casualty scenario. 1 June 2011. http://system.improvement.nhs.uk/ImprovementSystem/ViewDocument.aspx?path=Diagnostics%2fNational%2fWebsite%2fImaging%20Guidelines%20for%20Major%20Incidents%20June1%202011.pdf

[7] National Audit Office (2010) Major trauma care in England. http://www.nao.org.uk/publications/0910/major_trauma_care.aspx

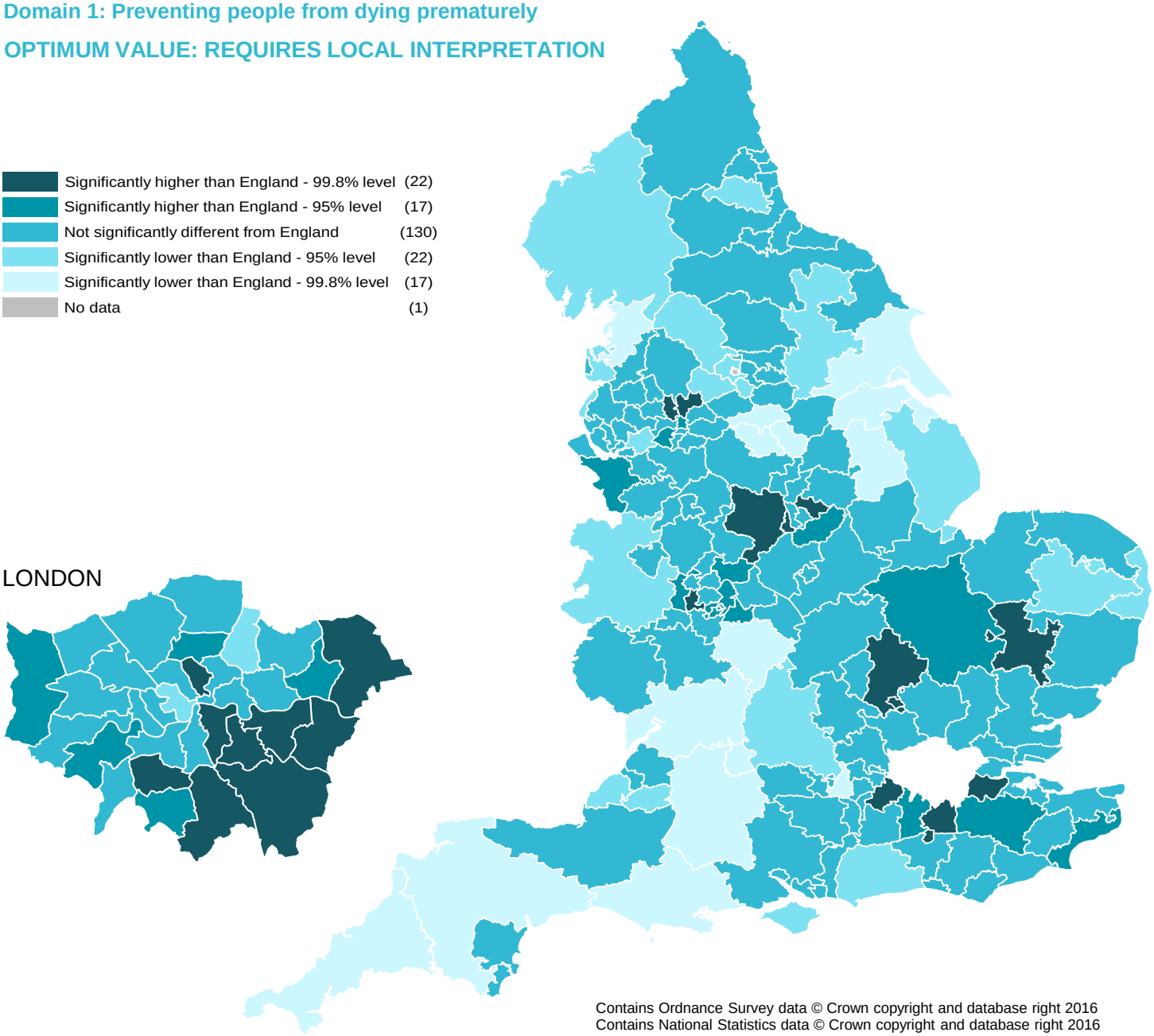
IMAGING SERVICES

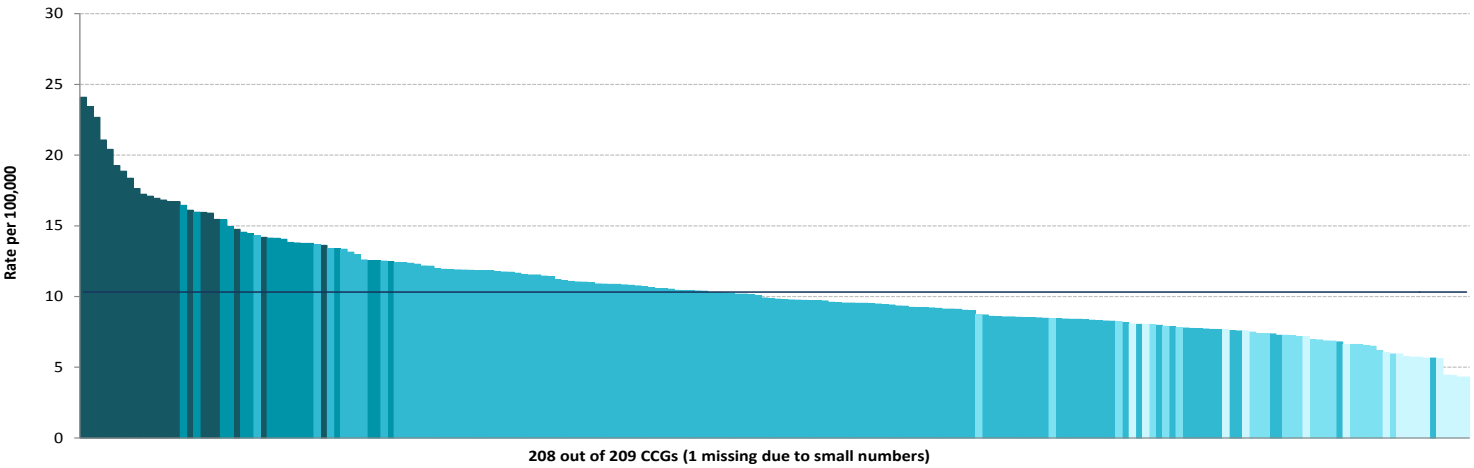
MAP 9: Rate of endovascular aneurysm repair (EVAR) procedures for abdominal aortic aneurysm (AAA) per population by CCG

Directly standardised for age, 2012/13–2014/15

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





Context

An aneurysm is the result of stretching caused by a weakness in the wall of an artery, usually as a result of degeneration due to ageing and external factors such as smoking, high levels of cholesterol and high levels of blood pressure. Although aneurysms can occur in any artery, one of the common places for aneurysm formation is the abdominal aorta. Aneurysms can be asymptomatic, but with a larger aneurysm (>5.5cm) there is a risk of rupture, which can cause severe internal bleeding. Four out of five people with a ruptured aortic aneurysm will die.[1] To reduce the risk of rupture, the diseased aorta is replaced with an artificial graft via open surgery or lined internally with a covered stent: endovascular aneurysm repair (EVAR).

Endovascular aneurysm repair is a 'keyhole' surgery technique in which an incision is made in both groins to access the femoral artery. A stent-graft is then inserted into the artery using a catheter and wire, which is guided by X-rays to the site of the aneurysm, where the stent-graft is attached to line the inside of the artery walls.

NICE does not currently recommend EVAR in people whose aortic aneurysm has already ruptured, although recent studies suggest it is a reasonable option, with some advantages in reducing hospital stay.[2]

In the UK EVAR Trial (*n*=1252 patients) the 30-day mortality rate for EVAR in elective aneurysm repair was significantly lower when compared with open surgery (1.8% vs 4.3%), although in the long term there were no differences in total mortality or aneurysm mortality.[3] De Bruin et al found similar results six years after randomisation, but in a smaller group of patients (*n*=352).[4] In a systematic review and meta-analysis of early and long-term outcomes of open and endovascular repair of AAA there was no long-term survival benefit for patients who had EVAR when compared with open surgery for AAA.[5]

For EVAR, recovery time after operation is quicker because the large abdominal incision of open surgery is avoided, and pain levels and length of stay are reduced. After intervention the risk of the stent-graft moving or kinking, such that the AAA is not sealed (known as an endoleak), is higher for EVAR than that for open surgery. Lifelong surveillance is currently recommended after EVAR, and the development of complications requiring further surgery or endovascular treatment is higher after EVAR than it is after open surgery.[2,3,4] For fragile patients aged 80 years and older, the results of a meta-analysis suggest that elective EVAR is associated with significantly lower immediate post-operative mortality and morbidity than open repair.[6]

Over the last decade there has been a remodelling of vascular services in England, and the number of providers undertaking the repair of AAA has declined by about half.[7] Until this process of centralisation has been completed there is likely to be inequity of access to services, but any variation associated with this process should decline over time. The indicator shown in Map 10 provides a proxy for monitoring the equitable provision of services.

Responses to a survey of Interventional Radiology departments in England conducted during March to May 2012 by NHS Improvement – Diagnostics showed that at that time one in five NHS Trusts were not able to provide core services for EVAR, nor did they have a network pathway to an agreed recipient.[8]

Magnitude of variation

Map 9: EVAR for AAA rate

The map and column chart display the latest period (2012/13-2014/15), during which CCG values ranged from 4.3 to 24.1 per 100,000 population, which is a 5.6-fold difference between CCGs. The England value for 2012/13-2014/15 was 10.3 per 100,000 population. There are still CCGs with significantly low levels of access to EVAR

The boxplot shows the distribution of CCG values for the period 2009/10-2011/12 to 2012/13-2014/15. There was no significant change in any of the three variation measures between 2009/10-2011/12 and 2012/13-2014/15.

The median rate of EVAR procedures increased significantly from 8.5 to 9.8 per 100,000 population, between 2009/10-2011/12 and 2012/13-2014/15.

[1] Reimerink JJ, van den Laan MJ, Koelemay MJ et al. Systematic review and meta-analysis of population-based mortality from ruptured abdominal aortic aneurysm. *British Journal of Surgery* 2013; 100: 1405-1413. doi: 10.1002/bjs.9235
[2] The IMPROVE Trial Investigators. Endovascular or open repair strategy for ruptured abdominal aortic aneurysm: 30 day outcomes from IMPROVE randomised trial. *BMJ* 2014; 348 doi: http://dx.doi.org/10.1136/bmj.f7661
[3] The United Kingdom EVAR Trial investigators. Endovascular versus Open Repair of Abdominal Aortic Aneurysm. *New England Journal of Medicine* 2010; 362: 1863-1871. http://www.nejm.org/doi/full/10.1056/NEJMoa0909305
[4] Dr Bruin JL, Baas AF, Buth J et al for the DREAM Study Group. Long-Term Outcome of Open or Endovascular Repair of Abdominal Aortic Aneurysm. New England Journal of Medicine 2010; 362: 1881-1889. http://www.nejm.org/doi/full/10.1056/NEJMoa0909499
[5] Stather P, Sidloff D, Dattani N et al. Systematic review and meta-analysis of the early and late outcomes of open and endovascular repair of abdominal aortic aneurysm. British Journal of Surgery 2013; 100: 863-872. doi: 10.1002/bjs.9101
[6] Biancari F, Catania A, D'Adrea V. Elective Endovascular vs. Open Repair for Abdominal Aortic Aneurysm in Patients Aged 80 years and Older: Systematic Review and Meta-Analysis. European Journal of Vascular & Endovascular Surgery 2011; 42: 571-576.
[7] Earnshaw JJ, Mitchell DC, Wyatt MG et al. Remodelling of vascular (surgical) services in the UK. European Journal of Vascular and Endovascular Surgery 2012; 44: 465-467.
[8] NHS Improving Quality. Interventional radiology provision in 2013 - A survey of English NHS trusts.

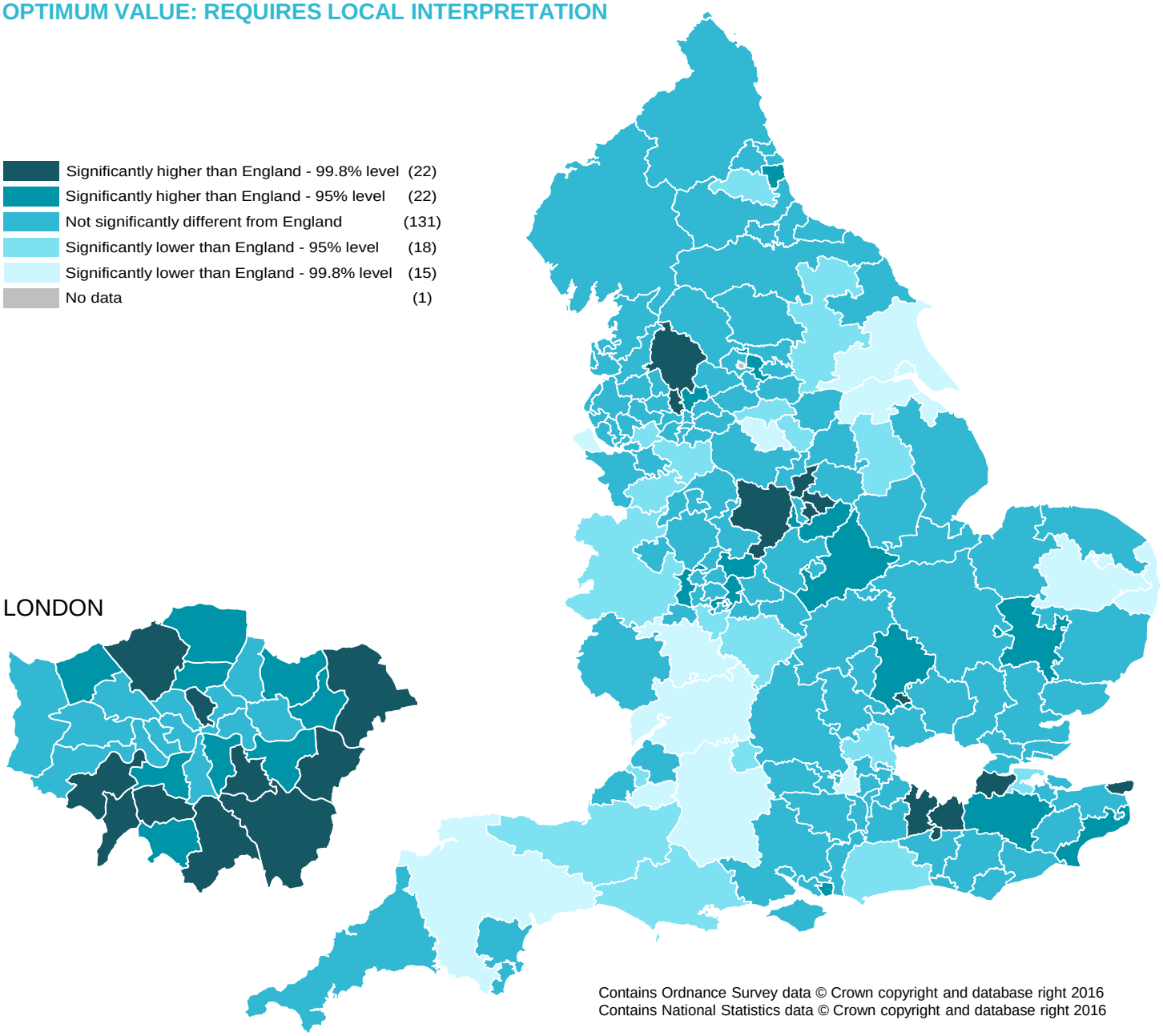
IMAGING SERVICES

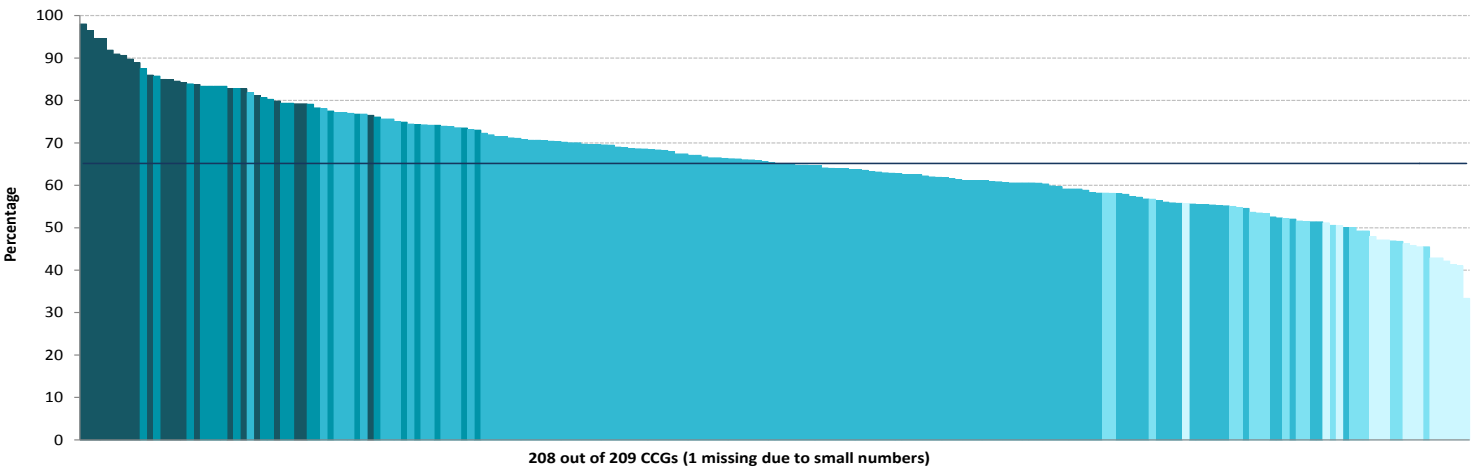
MAP 10: Percentage of elective procedures for abdominal aortic aneurysm (AAA) that were EVAR by CCG

2012/13–2014/15

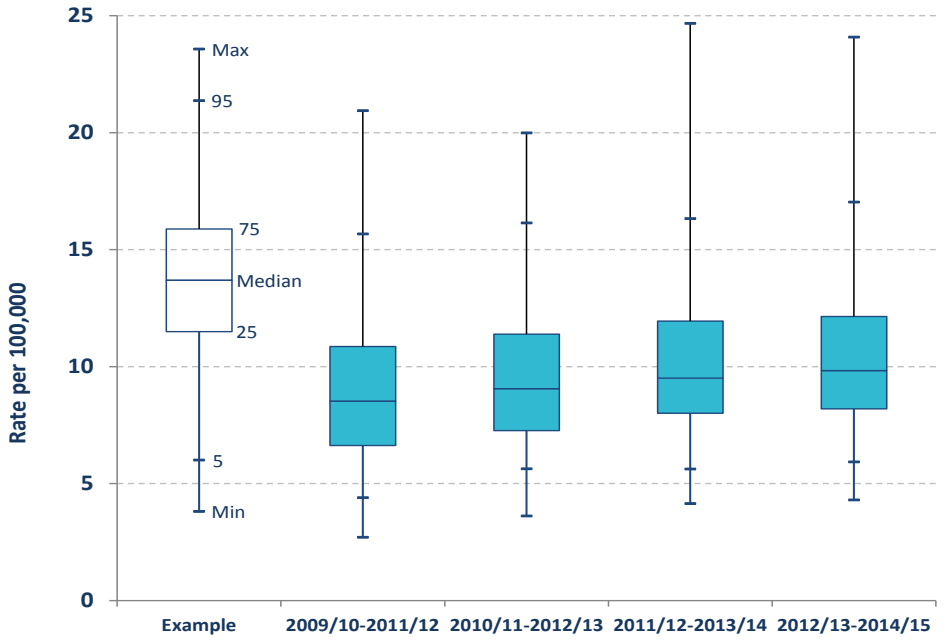
Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION



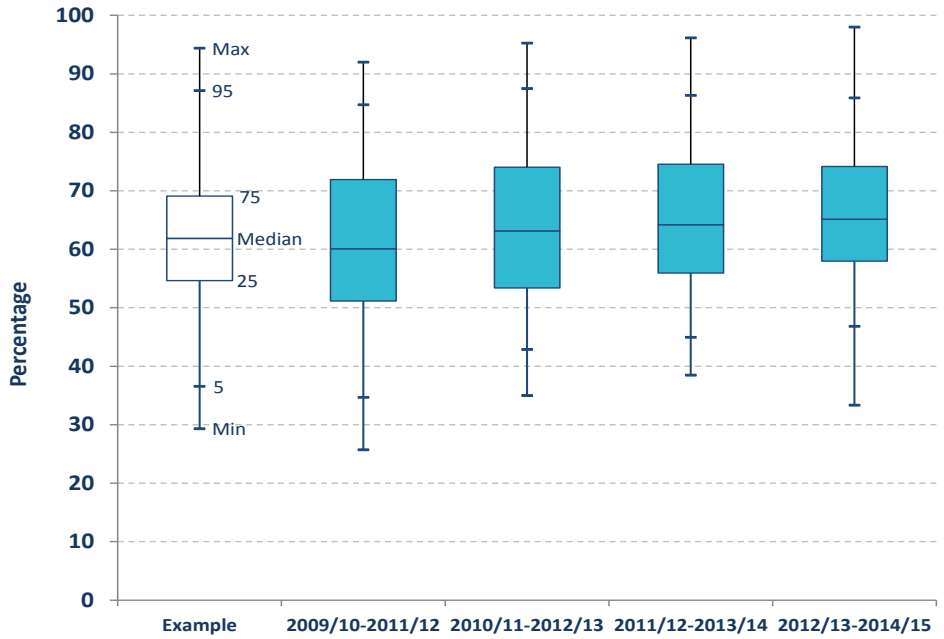


Map 9: Boxplot of EVAR for AAA rate by CCG



Max-Min (Range)		18.2	16.4	20.5	19.8	No significant change
95th-5th percentile		11.3	10.5	10.7	11.1	No significant change
75th-25th percentile		4.2	4.1	3.9	3.9	No significant change
Median		8.5	9.1	9.5	9.8	INCREASING Significant

Map 10: Boxplot of elective AAA procedures that were EVAR (%) by CCG



Max-Min (Range)		66.3	60.2	57.7	64.7	No significant change
95th-5th percentile		50.0	44.6	41.4	39.1	NARROWING Significant
75th-25th percentile		20.7	20.6	18.6	16.2	No significant change
Median		60.1	63.2	64.2	65.1	INCREASING Significant

High rates of EVAR may be appropriate due to the expertise located in vascular units that are also tertiary referral centres; however, high usage in other units could indicate that some patients are receiving this intervention inappropriately.

Map 10: Percentage of elective AAA procedures that were EVAR

The map and column chart display the latest period (2012/13-2014/15), during which CCG values ranged from 33.3% to 98%, which is a 2.9-fold difference between CCGs. The England value for this period was 65.2%.

The boxplot shows the distribution of CCG values for the period 2009/10-2011/12 to 2012/13-2014/15. There was a significant narrowing of the 95th to 5th percentile gap between 2009/10-2011/12 to 2012/13-2014/15.

The median increased significantly from 60.1 to 65.1 per 100,000 population between 2009/10-2011/12 and 2012/13-2014/15. This indicates that an increasing proportion of people are undergoing an EVAR procedure to treat AAA rather than open surgery. For some clinicians however, the use open surgery may be seen as more durable in younger patients and so the increased use of EVAR may not be warranted in all cases.

The degree of variation in the balance between EVAR and open surgery for elective repair of AAA is large. Based on an assumption that there is no difference in prevalence of aneurysms (>5.5cm), potential reasons for variation in the observed rate of EVAR include differences in:

- patient access to EVAR, either through the local provider or via a referral pathway, or problems related to long travelling distances
- local surgical custom and practice
- levels of expertise
- changes in OPCS4 codes over the time period which may not have been uniformly implemented in the Hospital Episode Statistics database for AAA repair procedures

Options for action

When addressing unwarranted variation in EVAR, commissioners, clinicians and service providers need to review:

- the need for EVAR in the local population, including screen-detected and non-screen-detected AAA
- the rate of EVAR activity in relation to need
- the balance between EVAR and open surgery locally
- levels of access to EVAR considering travelling times and access to centres providing EVAR
- local care pathways for aneurysms
- progress towards centralisation to specialist services

Commissioners need to ensure that service providers have a clear pathway for referral if open surgery for AAA and EVAR are not available at individual hospital Trusts.

RESOURCES

- NICE. Endovascular stent-grafts for the treatment of abdominal aortic aneurysms. NICE technology appraisal guidance [TA167]. February 2009. http://guidance.nice.org.uk/TA167
- Royal College of Radiologists, British Society of Interventional Radiology, The Vascular Society of Great Britain and Ireland, The Vascular Anaesthesia Society of Great Britain and Ireland, and The Medicines and Healthcare products Regulatory Agency (MHRA) Committee on the Safety of Devices (2010) Joint Working Group to produce guidance on delivering an Endovascular Aneurysm Repair (EVAR) Service. http://www.vascularsociety.org.uk/wp-content/uploads/2012/11/mhra_8pp_leaflet_amended_more_pages_web_version.pdf

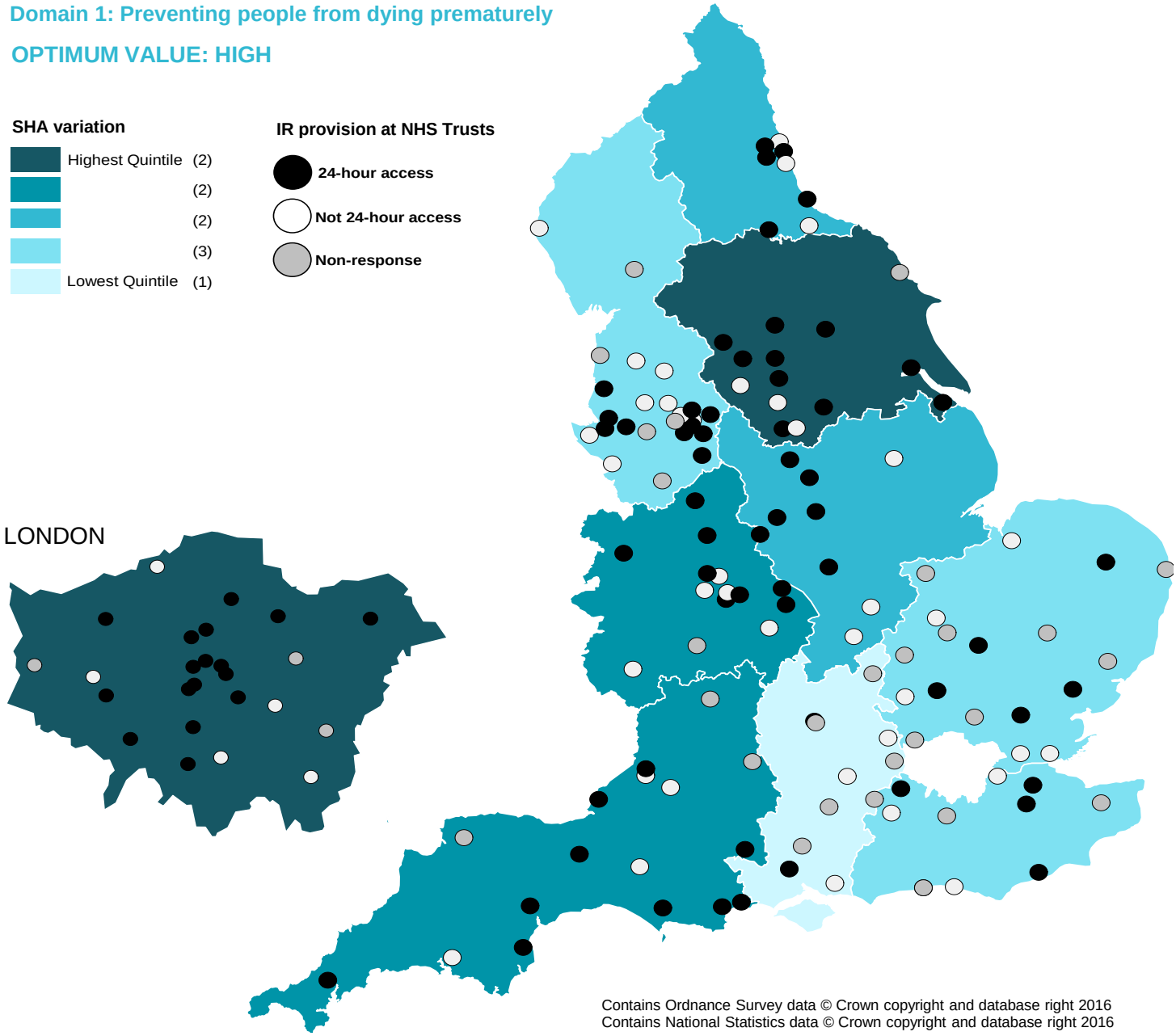
IMAGING SERVICES

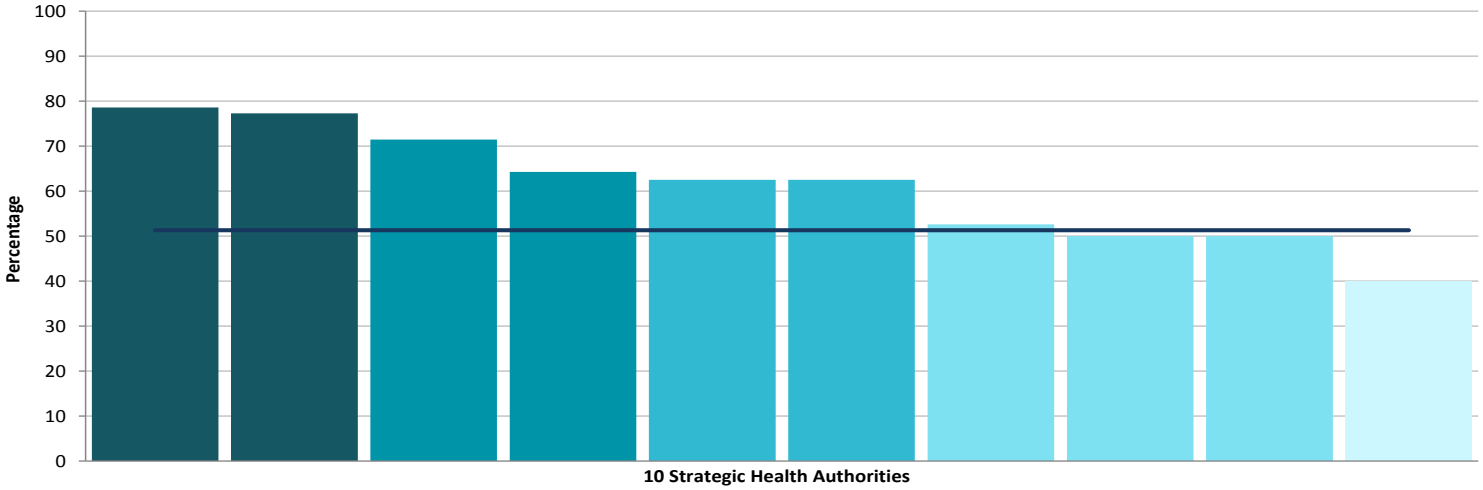
MAP 11: Percentage of NHS hospital Trusts that had formal arrangements for 24-hour access to nephrostomy by strategic health authority

2013

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: HIGH





Context

Interventional radiology (IR) refers to a range of techniques that use radiological image guidance for diagnosis and to target therapy, and interventional radiologists are trained in both radiology and interventional therapy.[1]

Most IR treatments are minimally invasive alternatives to open and laparoscopic surgery, with the advantages over the latter treatments of:

- reduced risk
- shorter hospital stays
- lower costs
- increased patient comfort
- quicker convalescence and return to work[1]

A wide range of conditions can be treated with IR, and IR services can often be life-saving, therefore, access to these services is necessary seven days a week.

Since 2011 there has been an annual survey by NHS Improving Quality (NHSIQ) of all hospitals in England to assess the level of provision of weekend and out-of-hours IR services. In 2011 and 2012 clinicians were asked to rate their IR services, but in 2013 and 2014 clinicians were asked to provide an overview of provision of four specific IR services:

- nephrostomy – in people with kidney stones, IR involves placing a tube in the kidney to allow urine to drain, and removing the stones with a variety of instruments placed through the skin into the kidney[1]
- endovascular intervention – in people with expanded arteries or aneurysms, IR treatment involves re-lining the vessel with a stent-graft[1]
- embolisation for haemorrhage – haemorrhage is the most common vascular emergency treated by IR, and bleeding often can be stopped permanently by embolisation[1]
- embolisation for post-partum haemorrhage – for women who suffer uncontrolled bleeding after childbirth and in women who have a high risk of bleeding from an abnormal placenta, IR can be used to prevent bleeding[1], and can avoid the need for hysterectomy

The delivery of IR services requires specialist expertise in the form of specifically trained radiologists, nurses and radiographers. Being able to provide such a skilled workforce is challenging for most NHS Trusts. As a result not all NHS Trusts are able to provide 24-hour access to IR services in the most effective way; some hospitals depend on informal and ad-hoc arrangements to deal with emergencies out of hours. Indeed in the IR survey ad-hoc or informal arrangements was the most common response to the question why cover for IR services was less than 24/7.

Despite an overall improvement in the formal provision of IR services over the four-year period of the survey, the questions are not directly comparable from 2011 to 2014. A more direct comparison is possible between the questions in the surveys for 2013 and 2014 (see Table 3); however, the response rate in 2013 and in 2014 was different, and some hospitals did not respond to the survey in both years. A core of 79-82 hospitals responded to the survey in both 2013 and 2014. One in five NHS Trusts did not respond to the survey.

For this series of indicators the 2013 data have been used, although the results for the 2014 survey are now available (see 'Resources'). The 2013 data was selected because it is possible to show not only which NHS Trusts had formal out-of-hours IR provision, but also the degree of variation in service provision across England using the strategic health authority (SHA) as a level of geography. Although the SHA is no longer part of the NHS structure, it is a useful proxy measure for larger populations; moreover, the larger geography is relevant to the need to develop an optimal system for out-of-hours IR services via a network of providers across a geographical area (see 'Options for action').

Table 3: Percentage of hospitals responding to the NHSIQ survey that were providing formal out-of-hours IR services in 2013 and 2014

	Formal out-of-hours provision (% hospitals)		Hospitals responding in 2013 & 2014 (n= 82, 79, 81 & 81, respectively)	
	2013	2014	% with improvement in formal out-of-hours provision	% with decline in formal out-of-hours provision
Nephrostomy	62.9% (73/116)	65.6% (61/93)	17.1%	11.0%
Endovascular intervention	60.3% (70/116)	77.8% (70/90)	19.0%	3.8%
Embolisation for haemorrhage	71.9% (82/114)	67.4% (62/92)	6.2%	14.8%
Embolisation for post-partum haemorrhage	49.1% (57/116)	59.8% (55/92)	21.0%	9.9%

[1] Kessel D. What is Interventional Radiology? British Society of Interventional Radiology website. http://www.bsir.org/patients/what-is-interventional-radiology/

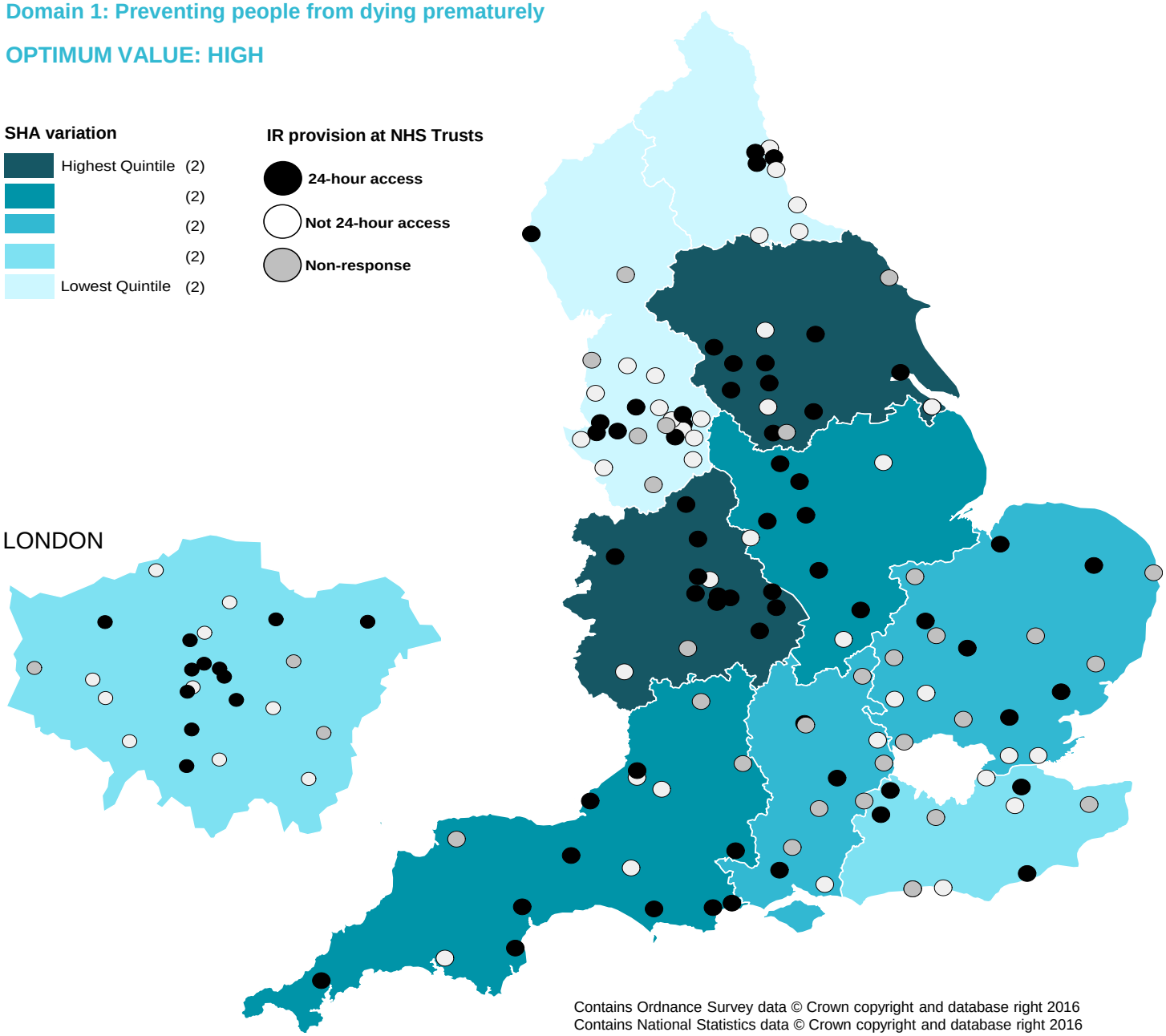
IMAGING SERVICES

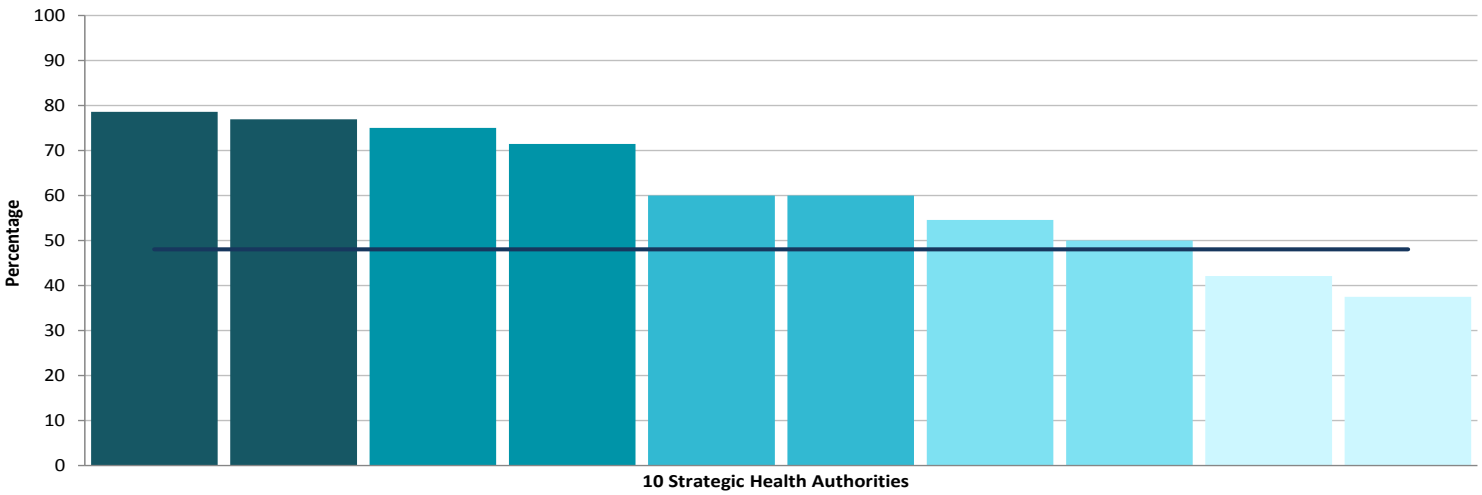
MAP 12: Percentage of NHS hospital Trusts that had formal arrangements for 24-hour access to endovascular intervention by strategic health authority

2013

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: HIGH





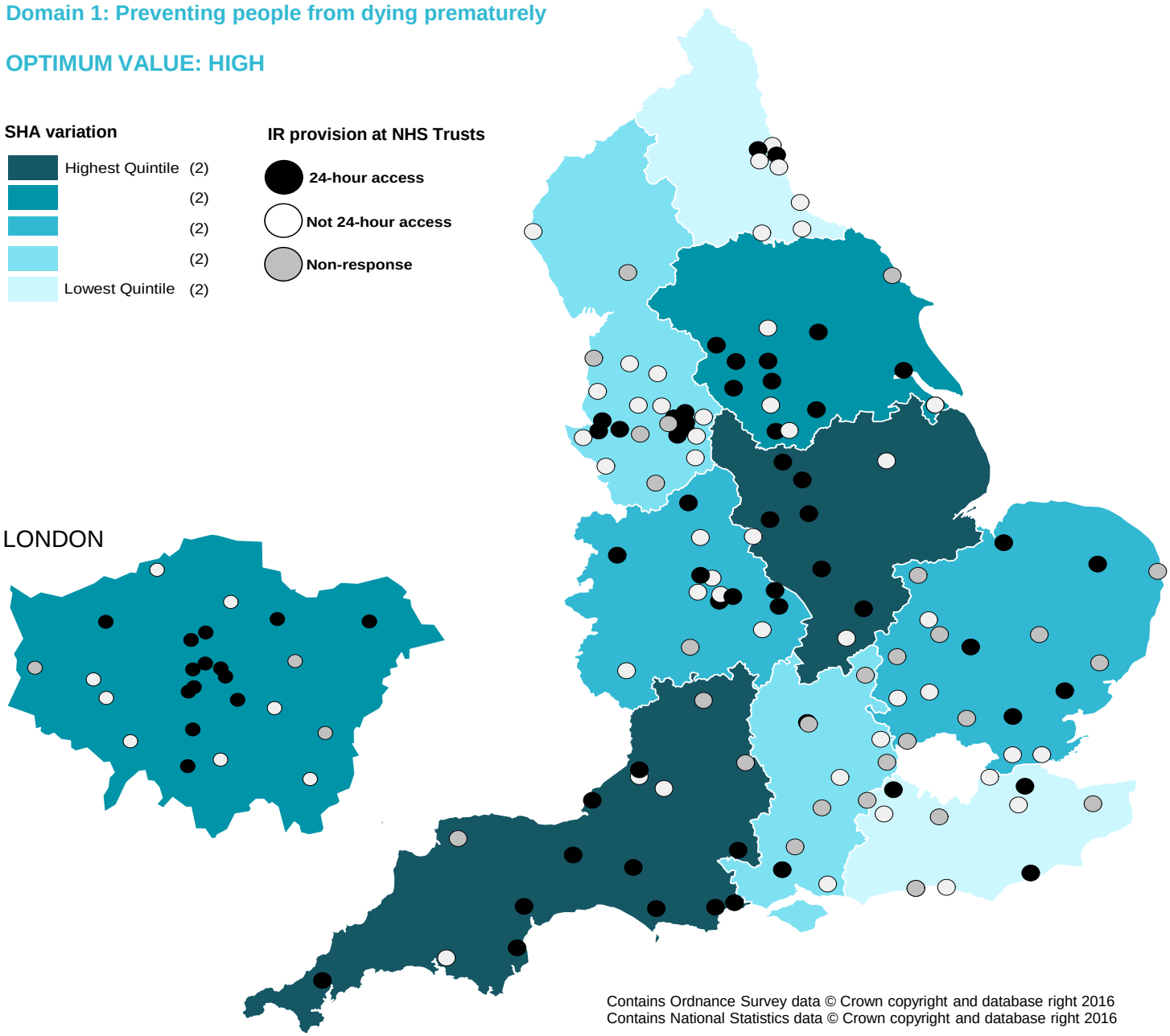
IMAGING SERVICES

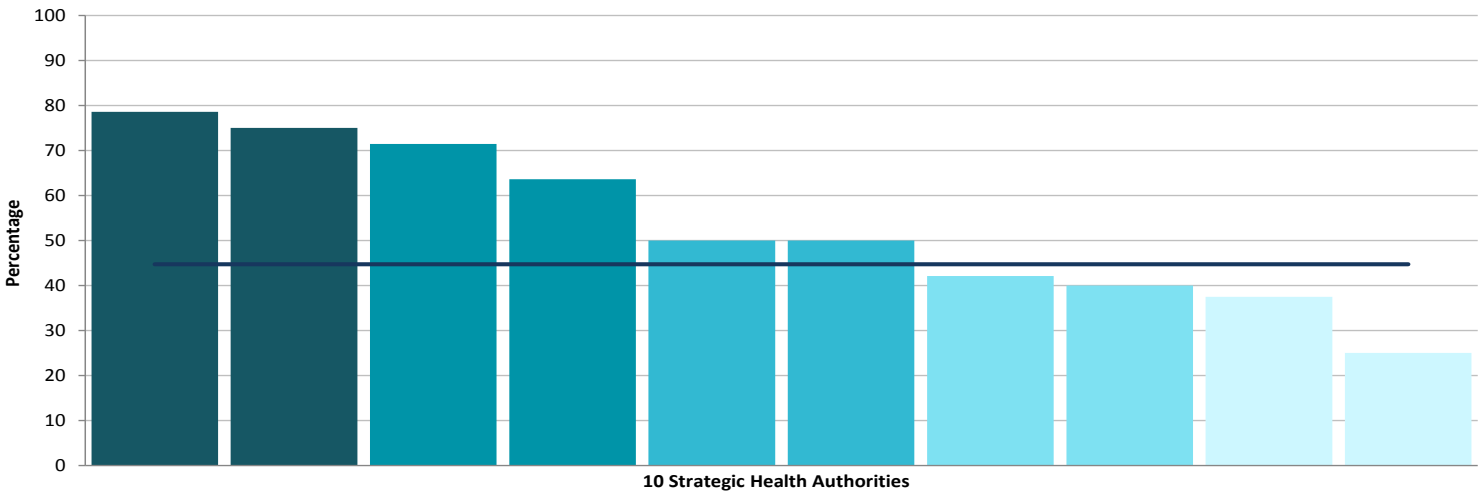
MAP 13: Percentage of NHS hospital Trusts that had formal arrangements for 24-hour access to embolisation for haemorrhage by strategic health authority

2013

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: HIGH





Magnitude of variation

Map 11: Nephrostomy

The percentage of NHS Trusts that had formal arrangements for 24 hour access to nephrostomy ranged from 40.0% to 78.6% across SHAs, a 2.0-fold difference. The value for all Trusts in England is 51%.

Map 12: Endovascular intervention

The percentage of NHS Trusts that had formal arrangements for 24-hour access to endovascular interventions ranged from 37.5% to 78.6% across SHAs, a 2.1-fold difference. The value for all Trusts in England is 48%.

Map 13: Embolisation for haemorrhage

The percentage of NHS Trusts that had formal arrangements for 24-hour access to embolisation of general haemorrhage ranged from 25.0% to 78.6% acorss SHAs, a 3.1-fold difference. The value for all Trusts in England is 45%.

Map 14: Embolisation for post-partum haemorrhage

The percentage of NHS Trusts that had formal arrangements for 24-hour access to embolisation for post-partum haemorrhage ranged from 25.0% to 75% across SHAs, a 3.0-fold difference. The value for England is 39%.

For this series of four indicators the reasons for the degree of variation observed are similar, the main one being differences in the availability of an appropriately skilled workforce, the components of which include differences in:

- interventional radiologist appointments
- interventional nurse appointments
- interventional nurse rota
- interventional radiographer rota
- network approach to service delivery
- new interventional radiology facilities

Options for action

Commissioners need to work with service providers to consider which models of IR service provision are appropriate to provide safe and effective care seven days a week for their local population including whether it is appropriate for every hospital to deliver every IR intervention seven days a week.
Commissioners need to explore whether it is possible to develop networks of service providers across a geographical area to ensure that everyone in need in the local population has access to IR.
Although it may be necessary to develop a nationally agreed system for commissioning IR services in the current situation and working within the budget available those responsible for population planning at CCG level or for sustainability and transformation planning in a geographical area and local providers of IR services need to develop and agree:

- a set of minimally acceptable standards below which no service should fall
- a complementary set of achievable standards that at least one-quarter of IR services should be able to meet

For the minimally acceptable standards, a starting point could be the existence of documentation outlining formal arrangements for out-of-hours service provision of IR. It is also important that commissioners continue to monitor arrangements for the provision of IR services for the local population.

RESOURCES

- NHS Improving Quality. Interventional Radiology Provision in 2014. A Survey of English NHS Trusts. Carried out by NHS Improving Quality in conjunction with the British Society for Interventional Radiology. http://www.nhsiq.nhs.uk/media/2647301/nhsiq_irsurvey.pdf
- The Royal College of Radiologists and with the British Society of Interventional Radiology. Provision of Interventional Radiology Services. October 2014. https://www.rcr.ac.uk/sites/default/files/publication/BFCR%2814%2912_POIR.pdf
- NHS Improving Quality. Providing access to interventional radiology services, seven days a week. May 2014. http://www.nhsiq.nhs.uk/media/2487426/interventionalradiology.pdf
- Interventional Radiology (IR): Improving Quality and Outcomes for Patients. A Report from the National Imaging Board. November 2009. http://webarchive.nationalarchives.gov.uk/20130107105354/http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_109130
- Interventional Radiology: guidance for service delivery. A Report from the National Imaging Board. Sponsored by the Department of Health. November 2010. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/215929/dh_122191.pdf
- NICE. Endovascular stent-grafts for the treatment of abdominal aortic aneurysms. NICE technology appraisal guidance [TA167]. February 2009. http://www.nice.org.uk/guidance/TA167
- Joint Working Group to produce guidance on delivering an Endovascular Aneurysm Repair (EVAR) Service. Royal College of Radiologists, British Society of Interventional Radiology, The Vascular Society of Great Britain and Ireland, The Vascular Anaesthesia Society of Great Britain and Ireland, and MHRA Committee on the Safety of Devices. Delivering an Endovascular Aneurysm Repair (EVAR) Service. December 2010. http://www.vascularsociety.org.uk/wp-content/uploads/2012/11/mhra_8pp_leaflet_amended_more_pages_web_version.pdf

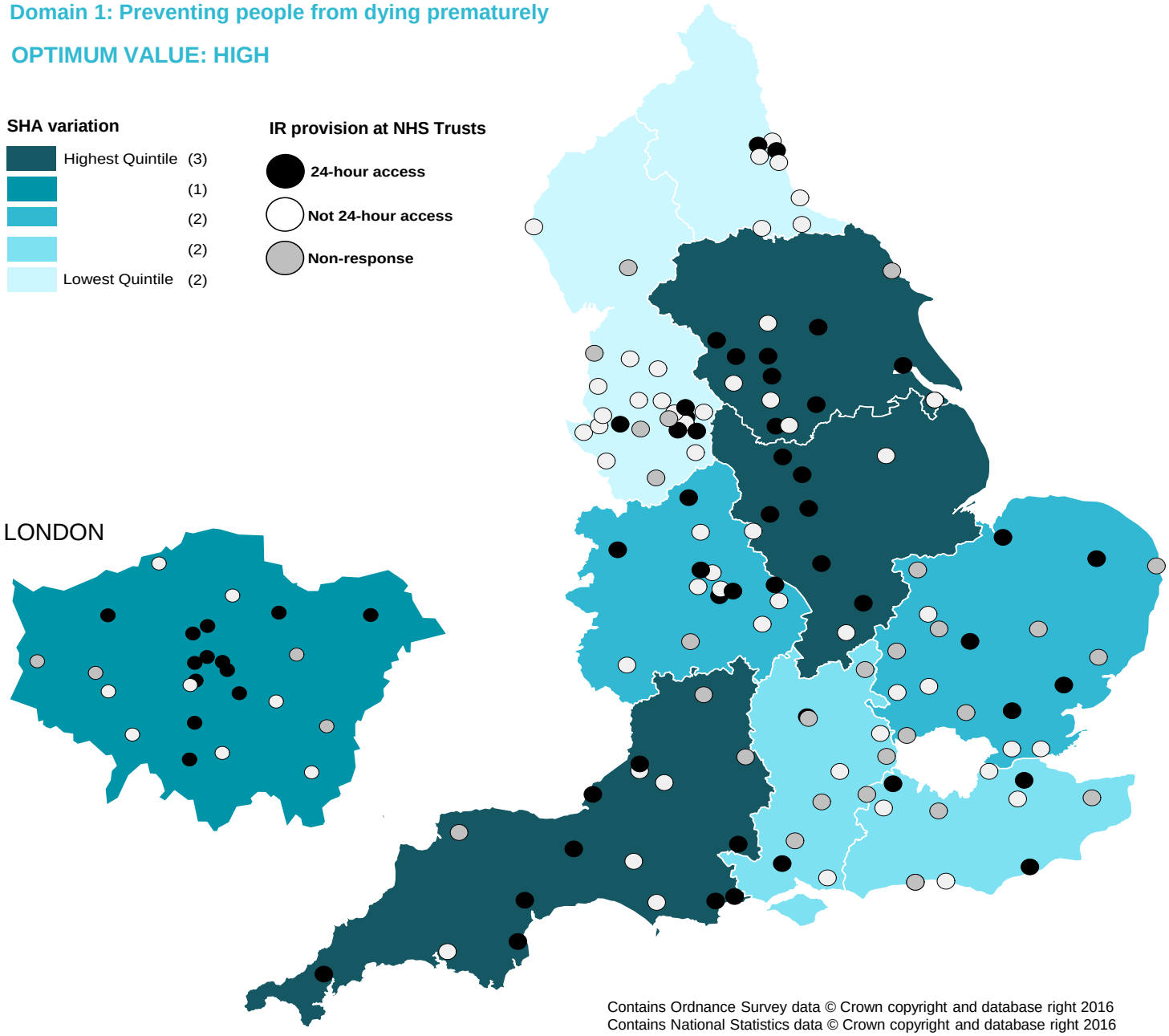
IMAGING SERVICES

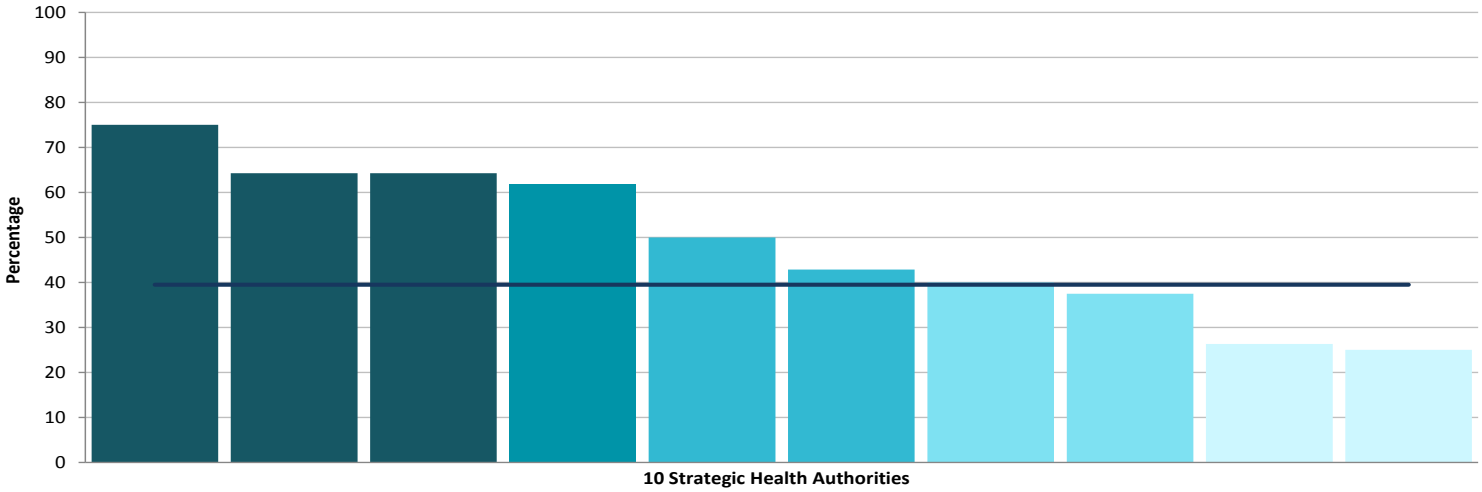
MAP 14: Percentage of NHS hospital Trusts that had formal arrangements for 24-hour access to embolisation for post-partum haemorrhage by strategic health authority

2013

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: HIGH





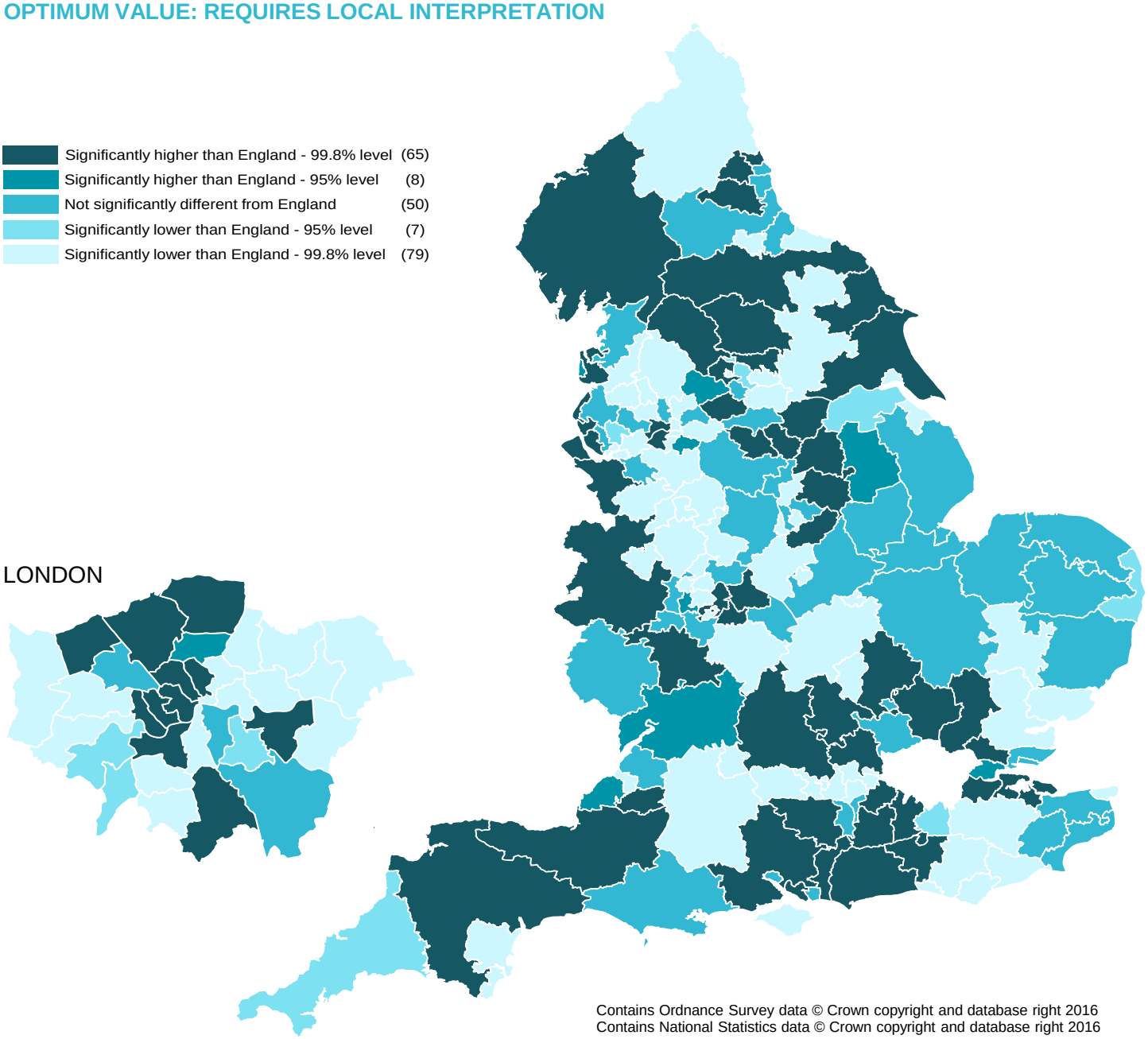
IMAGING SERVICES

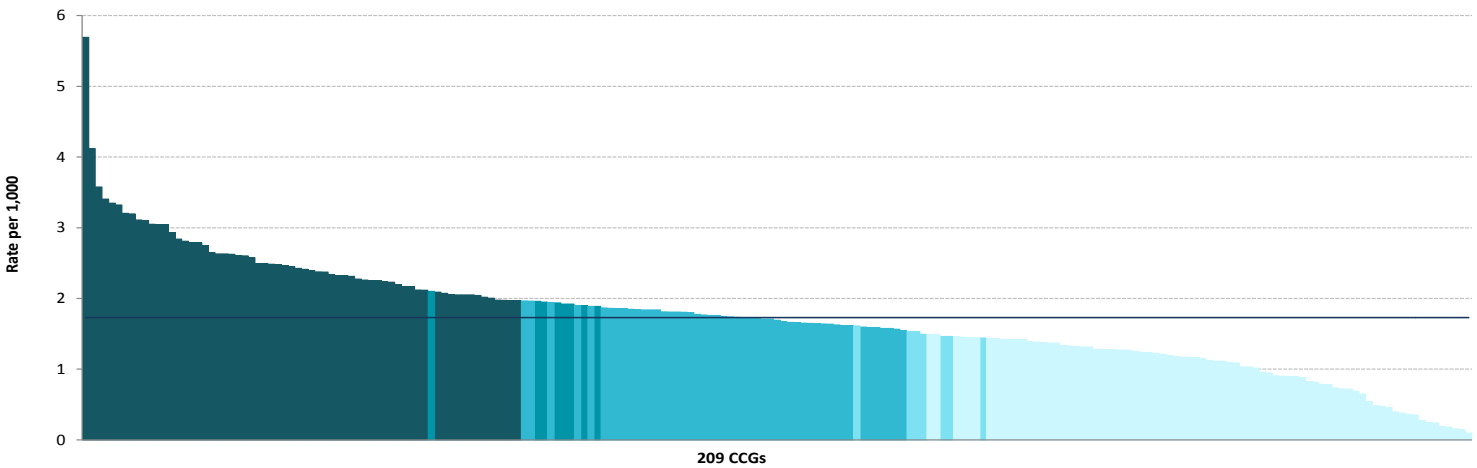
MAP 15: Rate of dual-energy X-ray absorptiometry (DEXA) activity per weighted population by CCG

Adjusted for age, sex and 'need', January–March 2016

Domain 2: Enhancing quality of life for people with long-term conditions

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





Context

Dual-energy X-ray absorptiometry (DEXA) is the best method of measuring bone density, and assessing the subsequent risk of fragility fracture.

There are two types of DEXA scan:

- axial or central, in which a scanning arm passes over the body to measure bone density in the centre of the skeleton
- peripheral (pDEXA), in which a scanning arm or portable device measures bone density in peripheral parts of the body, such as the wrist or heel

Measurements of bone density are used:

- in the diagnosis of osteoporosis or to assess the risk of osteoporosis developing
- to monitor the effectiveness of treatment for conditions such as osteoporosis
- in the diagnosis of other bone disorders, such as osteopenia, an early sign of bone loss where bone mineral density is lower than normal

Osteoporosis involves a gradual loss of calcium from the bones which results in the bones becoming thinner, more fragile and more likely to break. Osteoporosis is most commonly seen in women following the menopause, although it can affect men. The risk of a fragility fracture is affected by age, weight, prior history, family history, smoking habit and excessive consumption of alcohol. Following a suspected fragility fracture, investigation of bone density, for instance using DEXA, is advised such that osteoporosis treatment can be initiated to help prevent a subsequent fracture and the consequent considerable morbidity.

Magnitude of variation

The map and column chart display the latest period (January-March 2016), during which CCG values ranged from 0.1 to 5.7 per 1,000 weighted population, which is a 59.7-fold difference. The England value is 1.7 per 1,000 weighted population.

The boxplot shows the distribution of CCG values for the period 2013/14 to 2015/16 by quarter.

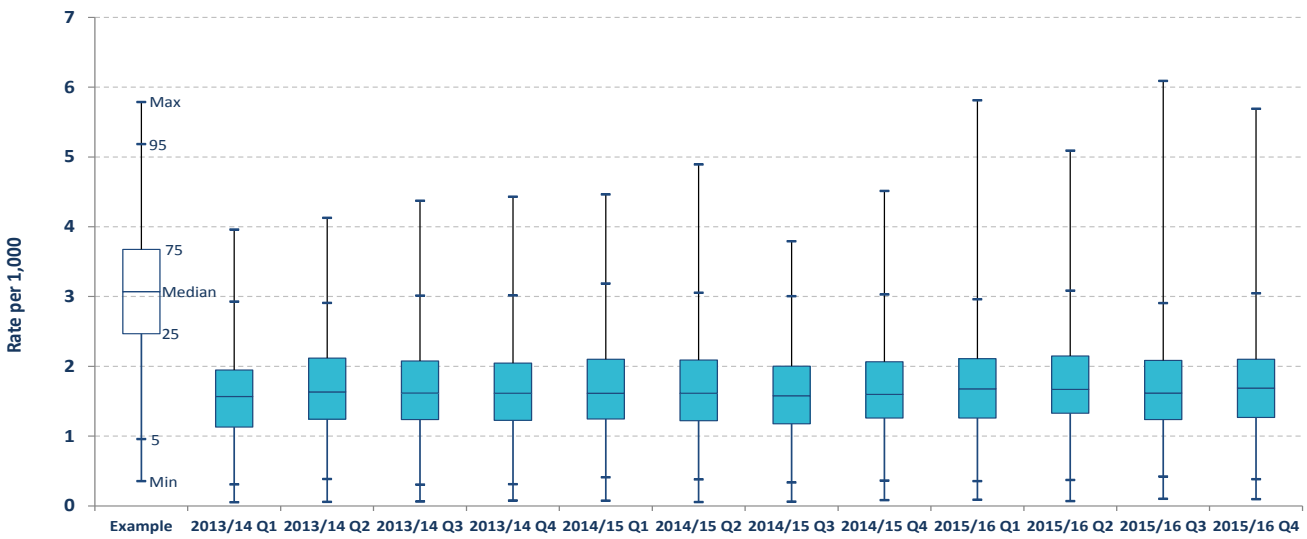
The gap between maximum and minimum CCG values widened significantly which is entirely due to the maximum CCG value increasing while the minimum CCG remained close to zero.

There was no significant change in either the 95th to 5th percentile gap or the 75th to 5th percentile gap. The median increased significantly.

One possible reason for warranted variation is differences in the use of other tests to measure bone density. It is unlikely, however, that this factor explains all of the variation observed. As this indicator has been designed to take account of the age-structure of the population, possible reasons for unwarranted variation include differences in:

- availability of imaging services
- the stage of development of integrated systems for fracture prevention

Map 15: Boxplot of DEXA activity by CCG



Max-Min (Range)		3.9	4.1	4.3	4.4	4.4	4.8	3.7	4.4	5.7	5.0	6.0	5.6	WIDENING Significant
95th-5th percentile		2.6	2.5	2.7	2.7	2.8	2.7	2.7	2.7	2.6	2.7	2.5	2.7	No significant change
75th-25th percentile		0.8	0.9	0.8	0.8	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	No significant change
Median		1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.6	1.7	INCREASING Significant

Options for action

Commissioners, clinicians and service providers need to review the prevention of falls and fractures in local populations, including:

- excessive prescribing
- primary prevention through lifestyle advice regarding diet, physical exercise and smoking
- the prevention of fragility fractures, including the use of osteoporosis investigations and treatment as part of the routine management of suspected fragility fractures
- secondary prevention through investment in fracture liaison services (see 'Resources'), which are both clinically effective and cost-effective

Commissioners need to specify to service providers that all patients who experience a fragility fracture should have access to a Fracture Liaison Service (see 'Resources'), providing falls prevention and evaluation for osteoporosis and future fracture risk.

RESOURCES

- Royal College of Radiologists imaging referral guidelines, **iRefer**. iRefer is available to all NHS professionals in the UK. http://www.rcr.ac.uk/content.aspx?PageID=995 For iRefer – England, NHS professionals need to register to use the portal. Login to http://portal.e-lfh.org.uk/ To access guidelines, select the "Launch iRefer" link in the left-hand menu.

- Prevention Package for Older People Resources. 12 March 2010. http://webarchive.nationalarchives.gov.uk/+/www.dh.gov.uk/en/Publicationsandstatistics/Publications/dh_103146

- Department of Health. Falls and fractures: effective interventions in health and social care. 22 July 2009. http://www.laterlifetraining.co.uk/wp-content/uploads/2011/12/FF_Effective-Interventions-in-health-and-social-care.pdf

- Department of Health. Fracture prevention services. An economic evaluation. 25 November 2009. http://www.cawt.com/Site/11/Documents/Publications/Population%20Health/Economics%20of%20Health%20Improvement/fractures.pdf

- NHS Radiology Improvement Team. Page 2: Dual Energy Xray Absorptiometry. Radiology Success Factors. November 2007. http://system.improvement.nhs.uk/ImprovementSystem/ViewDocument.aspx?path=Diagnostics%2fNational%2fWebsite%2fPublications%2fRadiology_Success_Factors%20-%20Nov%2007.pdf

- NICE. Osteoporosis: assessing the risk of fragility fracture. NICE guidelines [CG146]. August 2012. http://www.nice.org.uk/guidance/cg146

- NICE pathways. Osteoporosis overview. http://pathways.nice.org.uk/pathways/osteoporosis

- National Osteoporosis Society supported by The Royal College of General Practitioners. Osteoporosis Resources for Primary Care. https://www.nos.org.uk/health-professionals/osteoporosis-resources-for-primary-care

- National Osteoporosis Society. Fracture Liaison Service, including clinical standards, implementation toolkit and case-studies. https://www.nos.org.uk/health-professionals/fracture-liaison-services

- SIGN and Health Improvement Scotland. SIGN 142. Management of osteoporosis and the prevention of fragility fractures. March 2015. http://sign.ac.uk/pdf/SIGN142.pdf

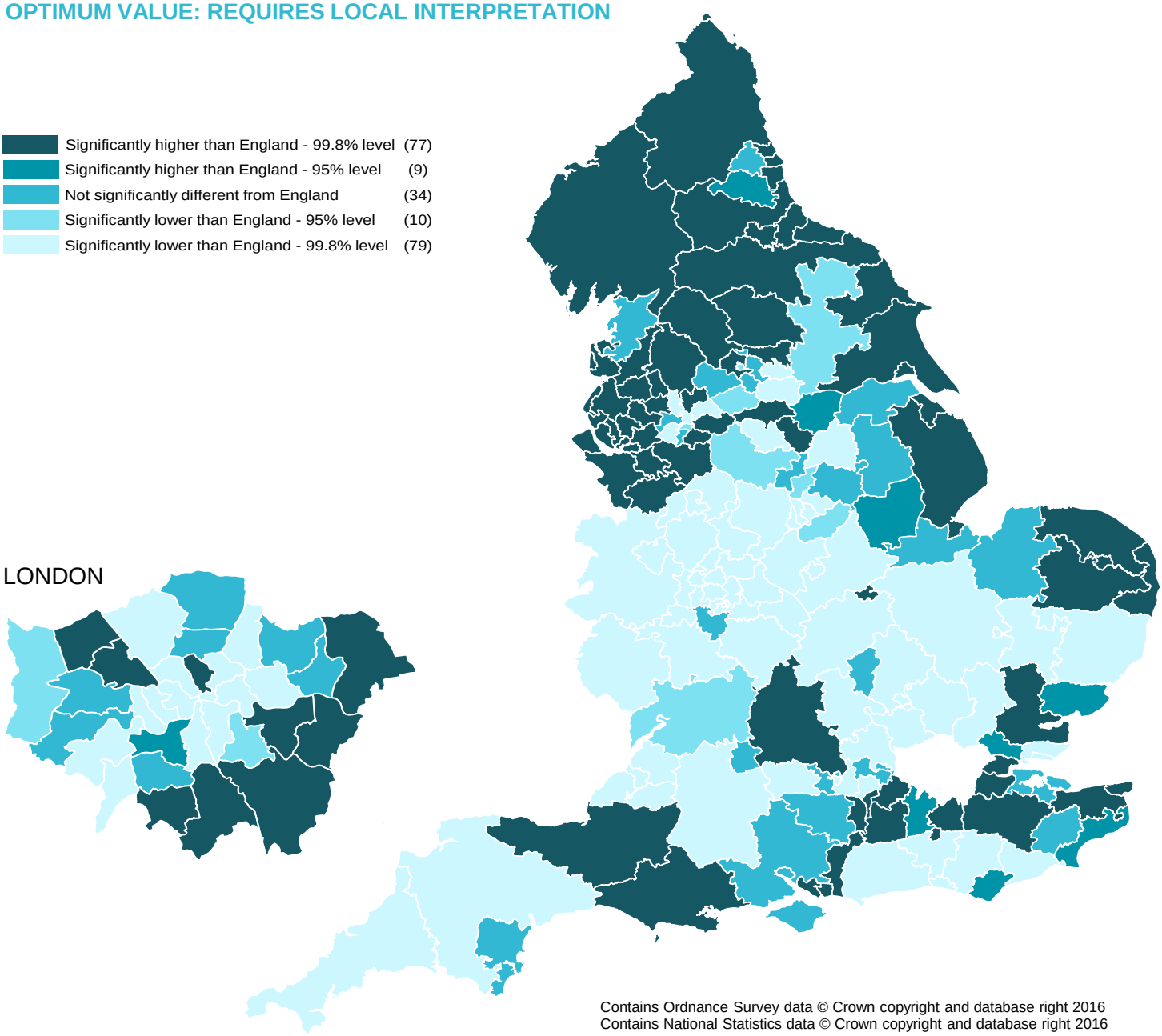
ENDOSCOPY SERVICES

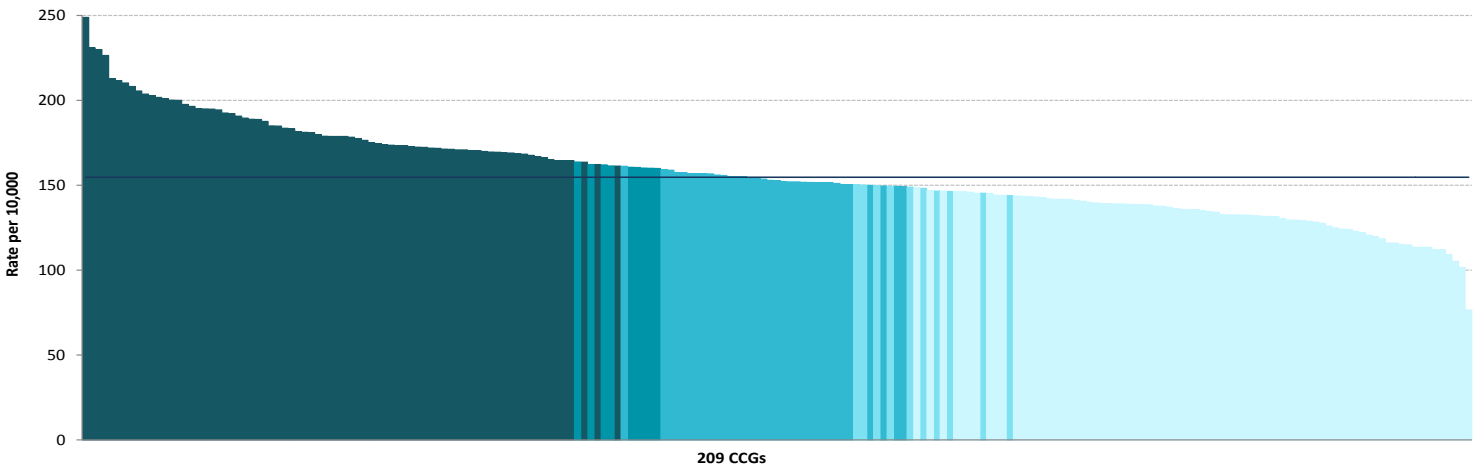
MAP 16: Rate of colonoscopy procedures and flexible sigmoidoscopy procedures per population by CCG

Indirectly standardised for age, sex and deprivation, 2014/15

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





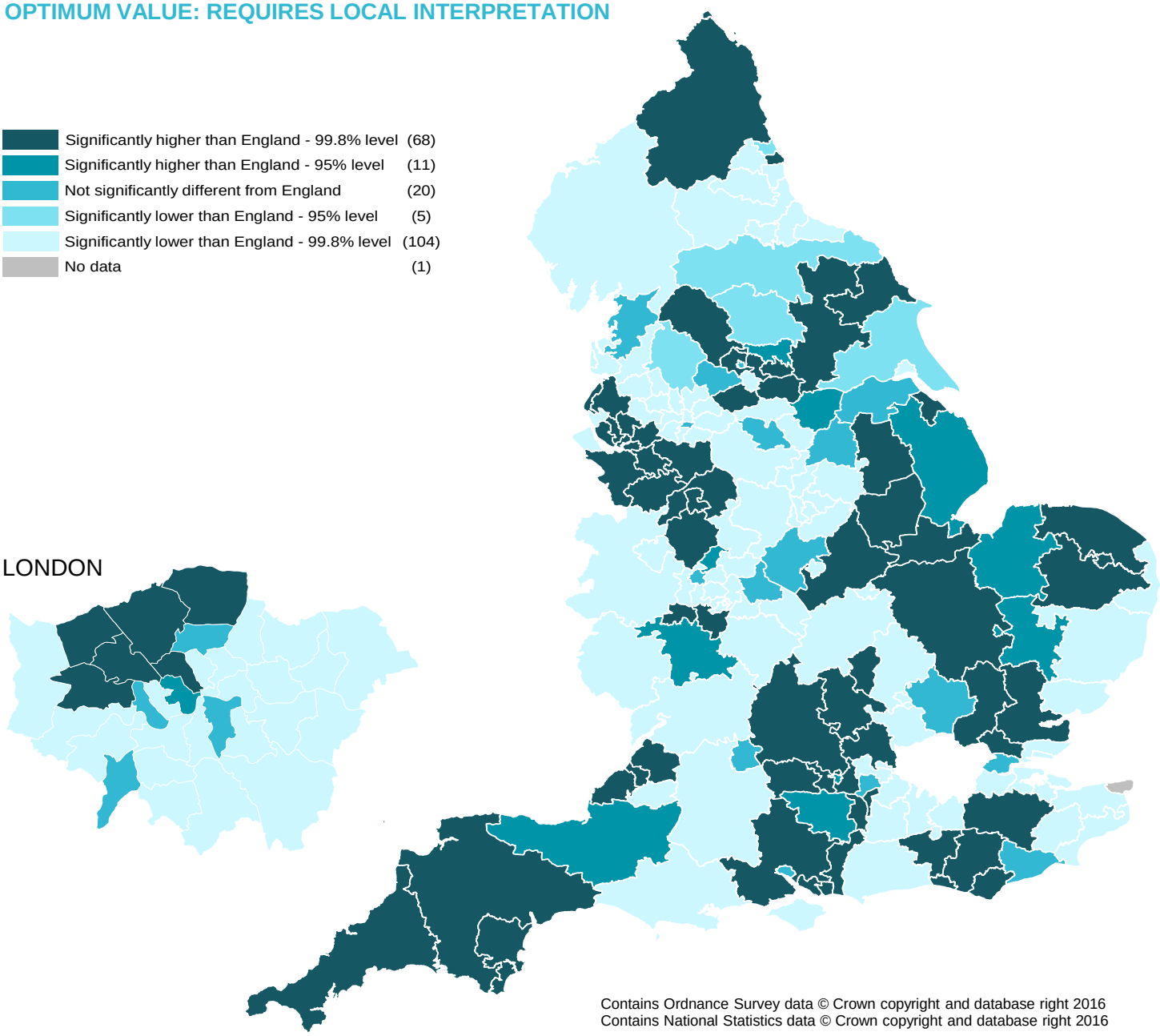
ENDOSCOPY SERVICES

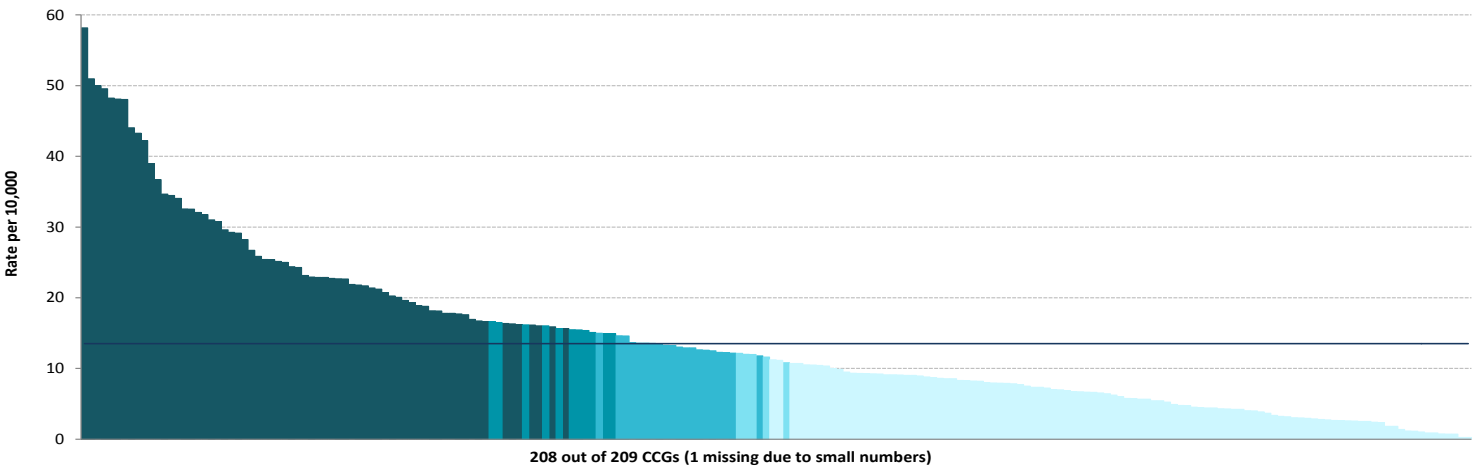
MAP 17: Rate of computed tomography (CT) colonography procedures per weighted population by CCG

Adjusted for age, sex and 'need', 2014/15

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





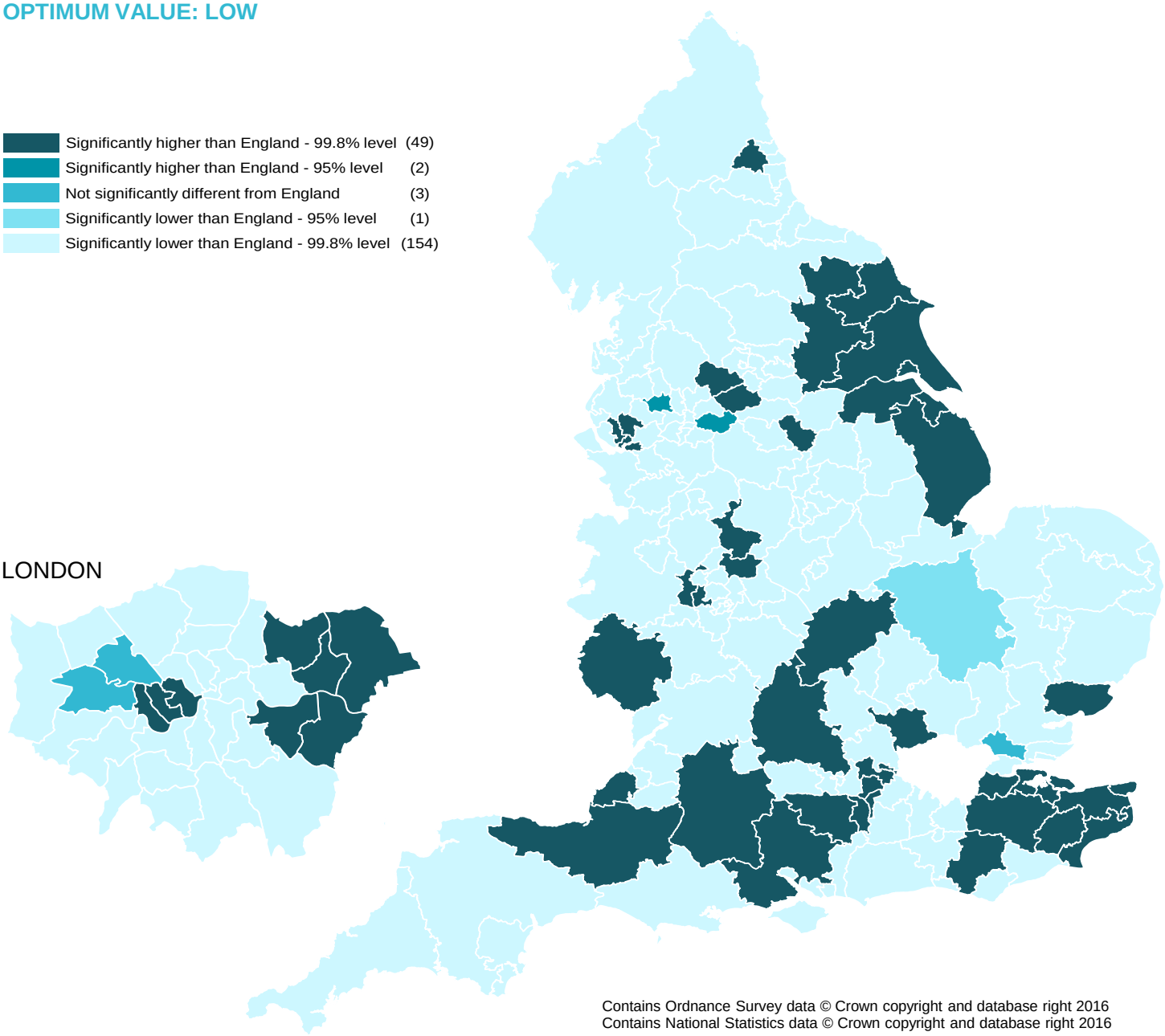
ENDOSCOPY SERVICES

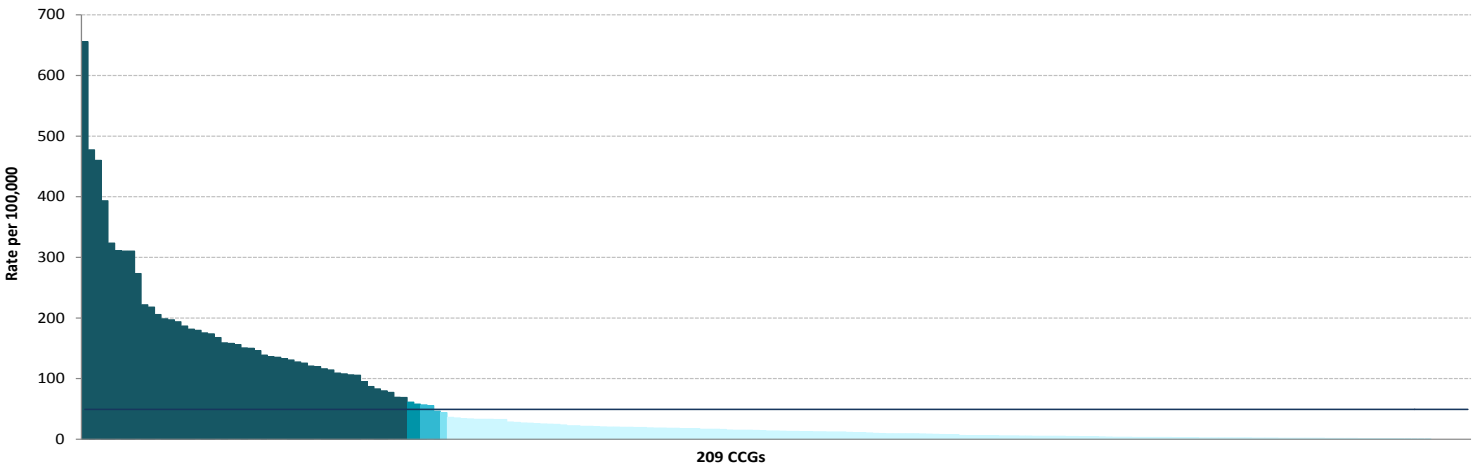
MAP 18: Rate of barium enema procedures per weighted population by CCG

Adjusted for age, sex and 'need', 2015/16

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: LOW





Context

There are several methods available for imaging the large bowel (colon), particularly in the diagnosis of cancer of the colon, including:

- colonoscopy
- flexible sigmoidoscopy
- CT colonography
- barium enema

The aim of the National Awareness and Early Diagnosis Initiative (NAEDI)[1] is to improve cancer survival outcomes in England, including that for colorectal (bowel) cancer. Although not all colonic investigations are done because of the suspicion of cancer, ruling out colorectal cancer is considered the most important reason for such an investigation, particularly because early diagnosis of colorectal cancer is vital in order to improve outcomes. It was thought that investigations could be targeted at patients with specific clinical features, but studies have shown that, in patients with lower gastrointestinal (GI) symptoms, selecting out those to investigate gives a poor correlation with cancer, and particularly early cancer. This suggests that the overall threshold for lower GI investigation should be lowered:

- to improve the overall diagnostic rate for colorectal cancer
- to increase the proportion of people diagnosed early when the cancer is curable

In colonoscopy an endoscope is used to investigate the lining of the colon (entire large bowel). In flexible sigmoidoscopy only the sigmoid colon (last part of the large bowel) and rectum is examined using a flexible endoscope.

Both procedures are used to diagnose or exclude cancer of the colon or to look for pre-cancerous polyps, small growths on the inner lining of the bowel or rectum. If polyps are found on examination, they are often removed. Flexible sigmoidoscopy and colonoscopy can also be used in the diagnosis of, and monitoring of treatment for, inflammatory bowel disease (IBD). About 60-70% of these procedures are performed for the diagnosis of cancer, 15-20% for the diagnosis of, and monitoring of treatment for, IBD, and 10% for other reasons.

Flexible sigmoidoscopy is the preferred procedure in some clinical situations because sedation is not required, and it is quicker and carries less risk than colonoscopy. Furthermore, the bowel needs to be prepared only with an enema before the procedure, whereas a colonoscopy requires strong laxatives to clear the bowel. Thus, flexible sigmoidoscopy is safer for the patient, and is particularly useful if there is rectal bleeding. Another reason for choosing flexible sigmoidoscopy in clinical situations is the higher incidence in the UK of left-sided colorectal cancer to right-sided colorectal cancer in people under the age of 70 years, when this trend reverses in women but not in men.

Other countries with developed economies have higher rates of colonoscopy than those in the UK. In the 2011 national colonoscopy audit Scotland and Northern Ireland had higher rates of colonoscopy than England.[2] Need for colonoscopy will be driven by a greater awareness of investigating symptoms that are less marked, especially in light of recent NICE guidelines for suspected cancer (NG12; see 'Resources'). It is also anticipated increased demand (about 8 procedures per 1,000 population per year), a doubling of the current rate, will be generated by the NHS Bowel Cancer Screening Programme (BCSP) bowel scope screening, currently being rolled out to all men and women aged 55 years; as of May 2016, 77% of screening centres were offering this test to 55-year-olds. In November 2015 (minutes published in January 2016[3]) the National Screening Committee recommended that the faecal immunochemical test (FIT) should replace the faecal occult blood (FOB) test, the current first test used in the NHS BCSP. It is anticipated that the FIT will:

- increase the number of cancers both detected and prevented
- reduce the number of false-positive results
- increase uptake because the test is easier to use

If the cut-off for FIT is set appropriately, it is unlikely to increase demand for screening colonoscopy, but it is likely to increase the demand for surveillance.

Computed tomography (CT) colonography (or colonoscopy) is a relatively new radiological technique designed to image the colon. It is sometimes referred to as 'virtual colonoscopy' because a CT scanner and a computer are used to generate three-dimensional images of the colon.

As such CT colonography is minimally invasive because there is no need to introduce an endoscope into the colon to obtain the images, and therefore no need for the sedation of patients, although a laxative bowel preparation is still required.

[1] Cancer Research UK. National Awareness and Early Diagnosis Initiative (NAEDI). http://www.cancerresearchuk.org/cancer-info/spotcancerearly/naedi/AboutNAEDI/
[2] Gavin DR, Valori RM, Anderson JT et al. The national colonoscopy audit: a nationwide assessment of the quality and safety of colonoscopy in the UK. Gut 2013; 62: 242-249. http://www.ncbi.nlm.nih.gov/pubmed/22661458
[3] Public Health England. UK NSC recommendations include new bowel cancer screening test. 15 January 2016. https://www.gov.uk/government/news/uk-nsc-recommendations-include-new-bowel-cancer-screening-test

CT Colonography is used to investigate patients with symptoms suggestive of colorectal cancer. The results of a meta-analysis showed that CT colonography had greater sensitivity for colorectal cancer than optical colonoscopy: 96.1% (95% CI 93.8%-97.7%; 49 studies) versus 94.7% (95% CI 90.4%-97.2%; 25 studies).[4] Thus, CT colonography is as effective in the initial diagnosis of colorectal cancer as optical colonoscopy: a negative CT colonography is a good exclusion of cancer, and a positive CT colonography is likely to require optical colonoscopy and biopsy to confirm the diagnosis.

Unlike colonoscopy and flexible sigmoidoscopy, CT colonography is less useful for the diagnosis of IBD because biopsy material is invariably required to support or refute the diagnosis, whereas a thorough cancer exclusion can follow a satisfactory CT colonography.

Barium enema is an X-ray procedure that creates images of the large intestine. During the procedure barium sulphate liquid and air are introduced into the bowel, following which X-rays are taken to obtain double-contrast images of the colon and rectum, which are then used to identify the following problems:

- cancerous or non-cancerous growths (also known as adenomas or polyps)
- colorectal cancer
- inflammation (ulcerative colitis and Crohn's disease)
- diverticular disease

Other conditions for which barium enema may be performed include:

- blockage of the large intestine
- intussusception, where one part of the intestine slides into another
- Hirschsprung's disease

In a multicentre randomised controlled trial for the diagnosis of colorectal cancer or large polyps in symptomatic patients (SIGGAR) the detection rate for barium enema was 5.6% whereas that for CT colonography was 7.3%.[5] The findings of the SIGGAR trial support considerable non-controlled evidence that barium enema is an inferior test when compared with CT colonography. Halligan et al suggest CT colonography should be the preferred radiological test for patients with symptoms suggestive of colorectal cancer.[1]

Barium enema is not appropriate for the primary diagnosis of colorectal problems.

Barium enema is also inappropriate for the diagnosis of IBD because biopsy material is invariably required to support the diagnosis.

Barium enema is a useful test in only a very small number of patients, particularly when it is necessary to visualise the particular shape of the colon, such as in megacolon.

Although in recent years it has become less common to perform a barium enema, it is still in use for patients in whom there is a contra-indication for, or in geographical areas where there is limited provision of, colonoscopy or CT colonography (Map 17). Nonetheless, all inappropriate requests for barium enema need to be stopped (see 'Options for action').

Magnitude of variation

Map 16: Colonoscopy and flexible sigmoidoscopy

The map and column chart display the latest period (2014/15), during which CCG values ranged from 76.5 per 10,000 population to 248.8 per 10,000 population, which is a 3.3-fold difference between CCGs. The England value for 2014/15 was 154.8 per 10,000 population.

The boxplot shows the distribution of CCG values for the period 2005/06 to 2014/15. There was no significant change over time in any of the three variation measures between 2005/06 and 2014/15.

However, the median increased significantly from 82.2 per 10,000 in 2005/06 to 152.7 per 10,000 in 2014/15.

Reasons for the degree of variation in the rate of colonoscopy procedures and flexible sigmoidoscopy procedures include differences in:

- local non-attendance rates for the procedure (the national non-attendance rate is 4.7%)
- the number of trained endoscopists (gastroenterologists, GI surgeons and nurse endoscopists) per head of local population and endoscopy sessions
- the amount of complex therapeutic work undertaken – in some specialist centres where the volume of complex therapeutic work is relatively high there is a concomitant reduction in diagnostic capacity

[4] Colorectal cancer: CT colonography and colonoscopy for detection — systematic review and meta-analysis. Structured abstract, DARE. Original article: Pickhardt PJ, Hassan C, Halligan S, Marmo R. Colorectal cancer: CT colonography and colonoscopy for detection — systematic review and meta-analysis. Radiology 2011; 259: 393-405. http://onlinelibrary.wiley.com/o/cochrane/cldare/articles/DARE-12011002875/frame.html

[5] Halligan S, Wooldrage K, Dadswell E et al for the SIGGAR investigators. Computed tomographic colonography versus barium enema for diagnosis of colorectal cancer or large polyps in symptomatic patients (SIGGAR): a multicentre randomised trial. The Lancet. Published online February 14, 2013. http://www.ncbi.nlm.nih.gov/pubmed/23414648

- the number of procedures conducted in the independent sector

Possible reasons for unwarranted variation include differences in:

- access to endoscopy provision
- the use of barium enema (Map 18) in some geographical areas to image the colon in people with suspected bowel cancer
- the availability of CT colonography and of local protocols for its use
- the application of guidelines for referral
- the vetting of referrals for appropriateness
- the professional practice of GPs and hospital clinicians
- local service configuration
- the volume of activity outsourced to an external provider
- the numbers of trainees at an NHS Trust and in a region in relation to the list capacity to accommodate training

Map 17: CT colonography

The map and column chart display the latest period (2014/15), during which CCG values ranged from 0.2 per 10,000 weighted population to 58.2 per 10,000 weighted population, which is a 248.2- fold difference between CCGs. The England value for 2014/15 was 13.5 per 10,000 weighted population.

The boxplot shows the distribution of CCG values for the period 2013/14 to 2014/15. The statistical significance of changes in the three variation measures or the median was not tested for those indicators with fewer than three data periods.

Reasons for the degree of variation observed in the rate of diffusion of this new technology and consequent CT colonography include differences in:

- the availability of CT scanners capable of producing CT colonography images
- the availability of radiologists skilled in interpreting CT colonography scans
- training opportunities for radiologists in CT colonography
- access to CT colonography, especially travelling distance to service provision

Map 18: Barium enema

The map and column chart display data for 2015/16, during which CCG values ranged from 0.0 to 655.8 per 100,000 weighted population. The England value for 2015/16 was 49.3 per 100,000 weighted population.

The boxplot shows the distribution of CCG values for the period 2013/14 to 2015/16 by quarter.

The range of variation between the maximum and minimum values has narrowed significantly due entirely to a decrease in the maximum CCG rate. Barium enema should not be used for the investigation of colorectal/bowel cancer and so the contraction of the upper end of the distribution suggests that its use is being modified appropriately.

The 75th to 25th percentile gap narrowed significantly. This contraction, bringing the middle 50% of CCG rates closer to the median rate is largely due a decrease in the 75th percentile of the distribution of CCG rates.

There was no significant change in the 95th to 5th percentile gap.

The median decreased significantly from 7.0 per 100,000 weighted population in April-June 2013 to 2.5 per 100,000 weighted population in January-March 2016.

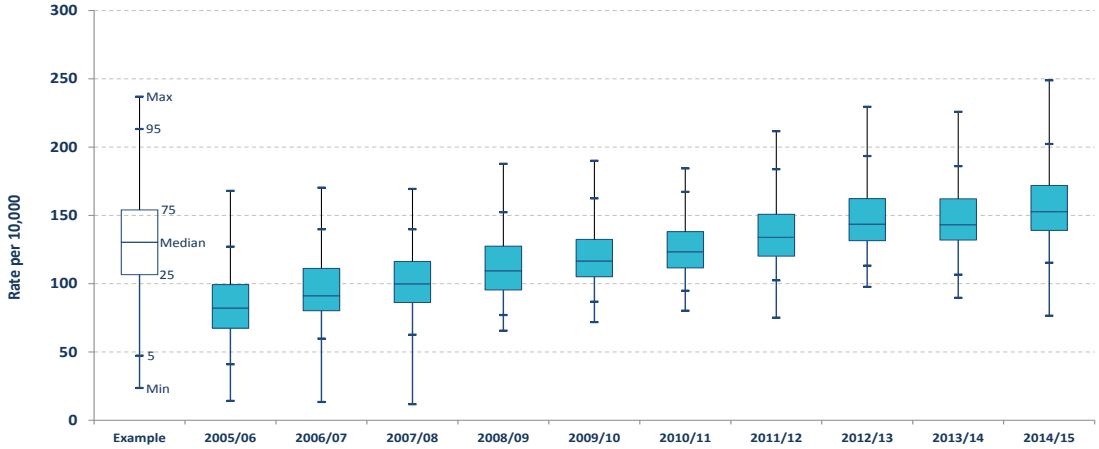
It is likely that the principal reason for the degree of variation observed in the rate of barium enema is insufficient capacity for and therefore insufficient access to colonoscopy and flexible sigmoidoscopy or CT colonography.

Options for action

For the improved diagnosis of colorectal cancer, commissioners need to specify that service providers:

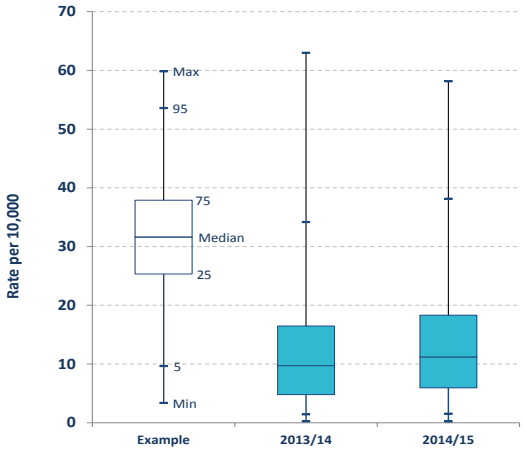
- review current levels of access to CT colonography, colonoscopy and flexible sigmoidoscopy to ensure that clinicians responsible for referrals for suspected bowel cancer no longer use barium enema to image the colon when it is best practice not to do so
- develop local referral guidelines for colonoscopy, flexible sigmoidoscopy and CT colonography, including a consideration of ‘Straight to Test’ services
- calculate, on the basis of referral guidelines, the need for colonoscopy, flexible sigmoidoscopy and CT colonography to inform planning for capacity

Map 16: Boxplot of colonoscopy and flexible sigmoidoscopy procedures by CCG



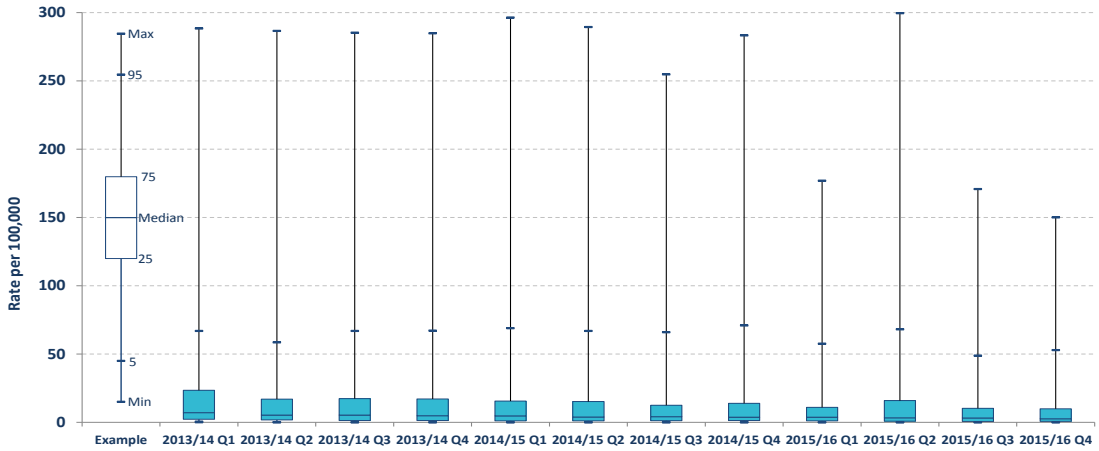
Max-Min (Range)		153.7	157.0	157.7	122.3	118.2	104.2	136.4	131.8	136.2	172.3	No significant change
95th-5th percentile		86.3	79.9	77.2	75.3	75.5	72.4	81.4	80.1	79.3	86.9	No significant change
75th-25th percentile		32.0	31.1	30.1	32.1	27.4	26.6	30.6	30.7	30.2	32.9	No significant change
Median		82.2	91.1	99.8	109.3	116.6	123.3	133.9	143.6	143.1	152.7	INCREASING Significant

Map 17: Boxplot of CT colonography procedures by CCG



Max-Min (Range)		62.8	57.9	NARROWING
95th-5th percentile		32.7	36.6	WIDENING
75th-25th percentile		11.7	12.4	WIDENING
Median		9.7	11.2	INCREASING

Map 18: Boxplot of barium enema procedures by CCG



Max-Min (Range)		288.3	286.6	285.2	284.8	296.4	289.4	254.8	283.3	176.9	299.6	170.7	150.0	NARROWING Significant
95th-5th percentile		66.5	58.5	66.8	67.1	68.8	66.9	65.9	70.9	57.6	68.0	48.8	52.9	No significant change
75th-25th percentile		21.2	15.2	16.1	15.8	14.5	14.2	11.3	12.6	9.9	15.1	9.6	9.3	NARROWING Significant
Median		7.0	5.3	5.3	4.8	4.6	3.8	4.1	3.8	3.8	3.2	3.2	2.5	DECREASING Significant

If, despite adequate provision for CT colonography and colonoscopy in relation to need in the local population, there is still demand for barium enema, commissioners need to specify that local service providers:

- investigate the reasons for this
- take action to stop inappropriate requests for barium enema – it is necessary to phase out the use of barium enema for the primary diagnosis of colorectal problems

The use of barium enema for the primary diagnosis of colorectal problems is one of the issues addressed during accreditation visits by the Joint Advisory Group (JAG) on GI endoscopy, which defines and maintains the standards by which endoscopy is practised in the UK. If the number of barium enema procedures is found to be large, key actions to stop inappropriate requests are identified.

To support the effective use of CT colonography:

- Health Education England (HEE) and the centre for Workforce Intelligence (CFWI) need to address the shortage of radiologists nationally
- local service providers need to provide training opportunities for radiologists in the interpretation of CT colonography scans, and ensure that CT equipment is of adequate capacity

With respect to the provision and management of endoscopy services overall, commissioners need to review with service providers and bowel surgeons:

- the referral rate for flexible sigmoidoscopy and colonoscopy in relation to local population needs
- local service configuration

The JAG on GI endoscopy has developed a Productivity & Planning Assessment Tool (PPAT; see 'Resources') for endoscopy services and commissioners. It provides a checklist of objectives that the most productive endoscopy services apply systematically to ensure endoscopy resource is used appropriately and efficiently. To ensure effective planning, JAG recommends that commissioners require local services to use the PPAT.

The Global Rating Scale (GRS; see 'Resources') is a tool that enables provider units to assess whether the service is patient-centred, and it includes dimensions for quality and safety, and customer care. Applying the 'Appropriateness' item reassures commissioners that referrals are vetted against best practice.

Commissioners together with service providers need to consider the totality of resources used for endoscopy procedures to achieve optimal value for individual patients and the population.

RESOURCES

- NHS Bowel Cancer Screening Programme. Guidelines for the use of imaging in the NHS Bowel Cancer Screening Programme. 2nd edition. NHSBCSP No 5. November 2012. http://www.cancerscreening.nhs.uk/bowel/publications/nhsbcsp05.pdf
- Cairns SR, Scholefield JH, Steele RJ et al developed on behalf of The British Society of Gatroenterology, and the Association of Coloproctology for Great Britain and Ireland. Guidelines for colorectal cancer screening and surveillance in moderate and high risk groups (update from 2002). Gut 2010;59:666e690. doi:10.1136/gut.2009.179804 http://www.bsg.org.uk/images/stories/docs/clinical/guidelines/endoscopy/ccs_10.pdf
- NICE. Suspected cancer: recognition and referral. NICE guidelines [NG12]. June 2015. https://www.nice.org.uk/guidance/ng12
- NICE pathways. Suspected cancer recognition and referral overview. http://pathways.nice.org.uk/pathways/suspected-cancer-recognition-and-referral
- NICE. Colonoscopic surveillance for preventing colorectal cancer in adults with ulcerative colitis, Crohn's disease or adenomas. NICE guidelines [CG118]. March 2011. http://www.nice.org.uk/guidance/CG118
- NICE pathways. Colonoscopic surveillance overview. http://pathways.nice.org.uk/pathways/colonoscopic-surveillance
- NICE. Computed tomographic colonography (virtual colonoscopy). NICE interventional procedure guidance [IPG129]. June 2005. http://guidance.nice.org.uk/IPG129
- The British Society of Gastrointestinal and Abdominal Radiology and The Royal College of Radiologists. Guidance on the use of CT colonography for suspected colorectal cancer. BFGR(14)9. 2014. https://www.rcr.ac.uk/guidance-use-ct-colonography-suspected-colorectal-cancer
- Health Services Management Centre. Scoping the future: An evaluation of endoscopy capacity across the NHS in England. September 2015. http://www.cancerresearchuk.org/sites/default/files/scoping_the_future_-_final.pdf
- Joint Advisory Group (JAG) for GI endoscopy. Website has a section on 'Commissioning'. http://www.thejag.org.uk/
- JAG for GI endoscopy. Global Rating Scale (GRS). http://www.globalratingscale.com/
- JAG for GI endoscopy. GRS Productivity & Planning Assessment Tool (PPAT) User Guidance. http://www.thejag.org.uk/downloads%5CPlanning%20&%20Productivity%5CPPAT%20User%20Guide%2022042012.pdf

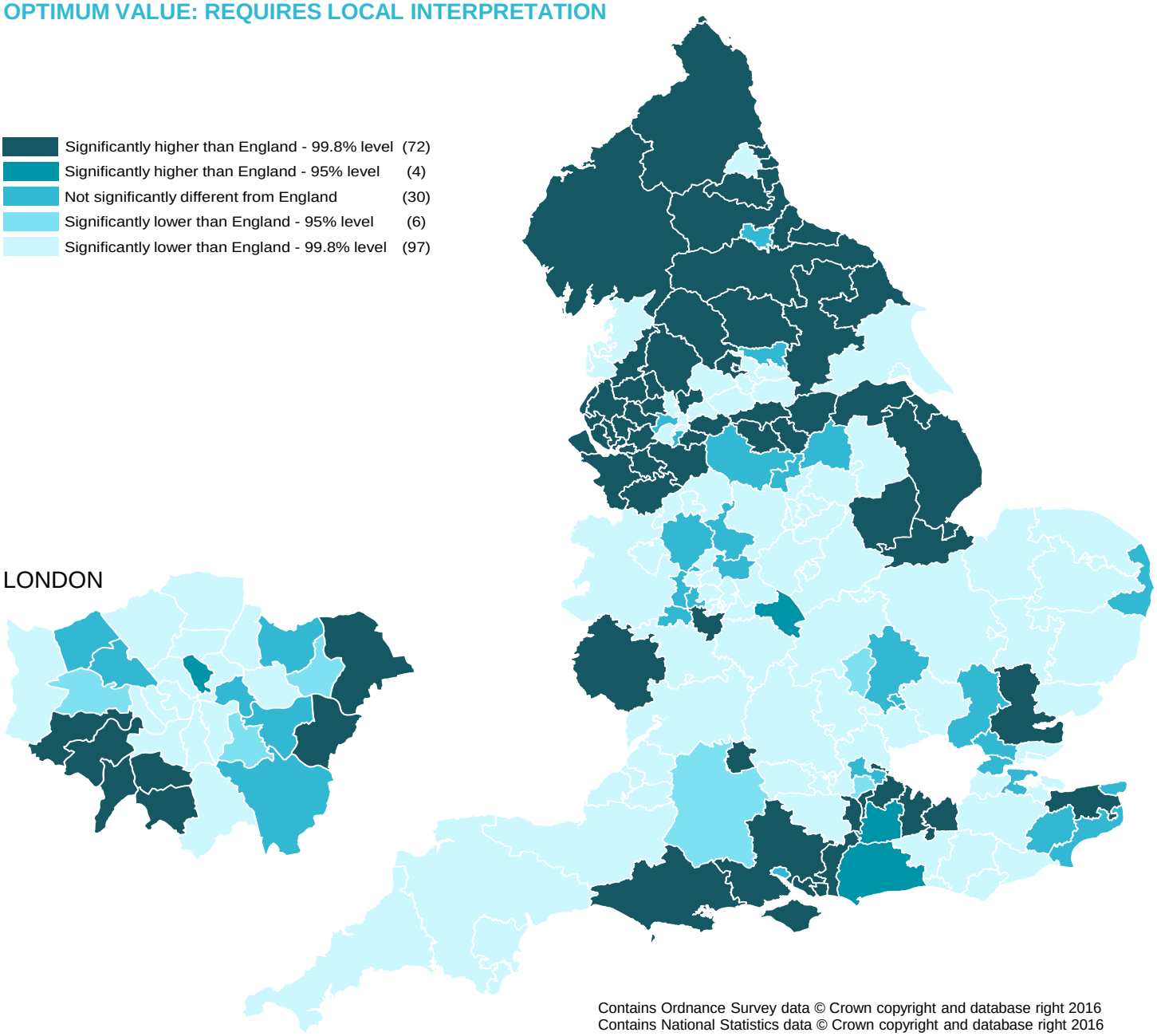
ENDOSCOPY SERVICES

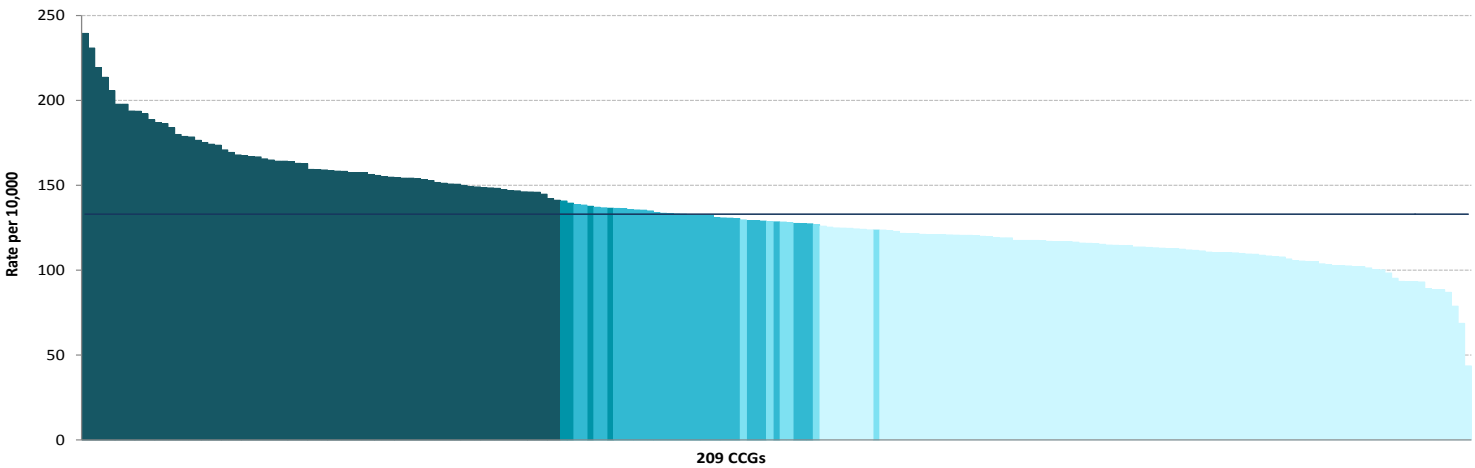
MAP 19: Rate of gastroscopy (upper gastrointestinal endoscopy) procedures per population by CCG

Indirectly standardised for age, sex and deprivation, 2014/15

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





Context

Gastroscopy is an investigation of the upper gastrointestinal (GI) tract – oesophagus, stomach and duodenum (first part of the small intestine) – using a flexible endoscope. Diagnostic gastroscopy is used in any person presenting with:

- new onset dyspepsia if they are aged 55 years or over
- new onset dyspepsia with 'alarm' symptoms, such as dysphagia, weight loss, upper GI bleeding, vomiting and/or anaemia
- 'alarm' symptoms for upper GI cancer, such as dysphagia, weight loss, anaemia, upper GI bleeding and/or persistent vomiting
- dyspepsia who has not responded to standard medical treatment

The value of the surveillance of chronic oesophageal disease to prevent cancer from a condition called Barrett's oesophagus is being evaluated in research studies, but surveillance is increasingly being accepted as an important way of preventing advanced oesophageal cancer.

Approximately three-quarters of a million gastroscopies are performed in the NHS in England every year. Much of the demand for gastroscopy comes through referrals made by primary care.

In general, the rate of gastroscopy (Map 19) needs to be at a level at which cancers can be detected in people aged over 55 years. If national guidelines for dyspepsia and reflux are being followed appropriately, the percentage of people undergoing gastroscopy procedures who are aged under 55 years (Map 20) should be relatively low: for instance, if Helicobacter is present, treating patients with dyspepsia without a gastroscopy, and, if no 'alarm' symptoms are present, treating patients with reflux symptomatically.

The percentage of people undergoing gastroscopy procedures who are aged under 55 years (Map 20) is an indicator of the appropriateness and effectiveness with which referrals for gastroscopy are managed in the context of NICE guidance on dyspepsia and on cancer referral (see 'Resources').

Magnitude of variation

Map 19: Gastroscopy rate

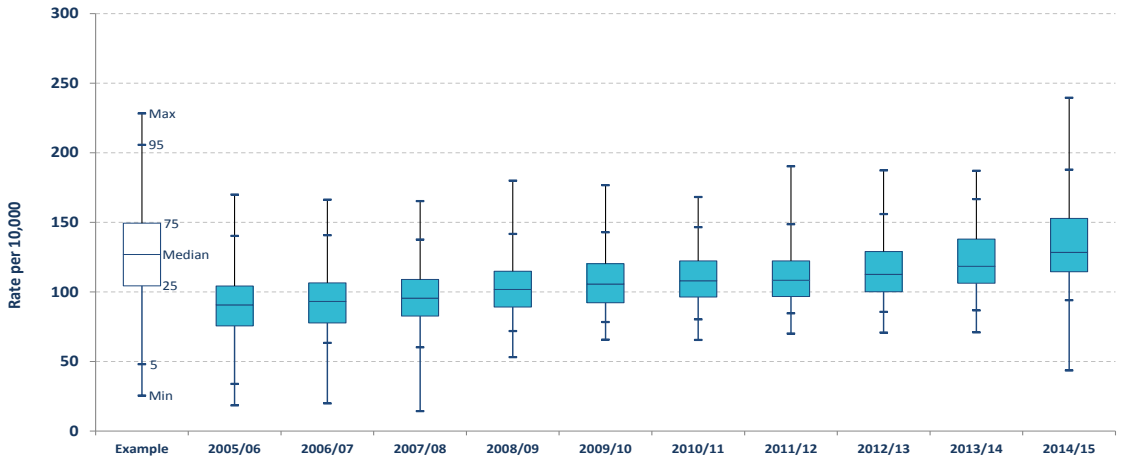
The map and column chart display the latest period (2014/15), during which CCG values ranged from 43.5 to 239.5 per 10,000 population, which is a 5.5-fold difference between CCGs. The England value for 2014/15 was 133.1 per 10,000 population.

The boxplot shows the distribution of CCG values for the period 2005/06 to 2014/15. There was no significant change in any of the three variation measures between 2005/06 and 2014/15.

The median of CCG rates of gastroscopy procedures increased significantly from 90.6 per 100,000 in 2005/06 to 128.4 per 10,000 in 2014/15 which would aid earlier detection of cancer.

One reason for variation in the rate of gastroscopy procedures is differences in regional cancer rates, which in turn are affected by smoking habit and prevalence of obesity. The degree of variation observed, however, is greater than can be explained by variations in the incidence and prevalence of disease.

Map 19: Boxplot of gastroscopy procedure rate by CCG



		2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	
Max-Min (Range)		151.6	146.5	151.0	126.8	111.0	102.7	120.1	116.6	116.2	196.0	No significant change
95th-5th percentile		106.5	77.4	77.4	69.9	64.4	66.3	64.1	70.2	80.0	93.9	No significant change
75th-25th percentile		28.6	28.8	26.3	25.7	28.1	26.0	25.6	28.8	31.7	38.3	No significant change
Median		90.6	93.2	95.5	101.7	105.7	108.0	108.4	112.6	118.4	128.4	INCREASING Significant

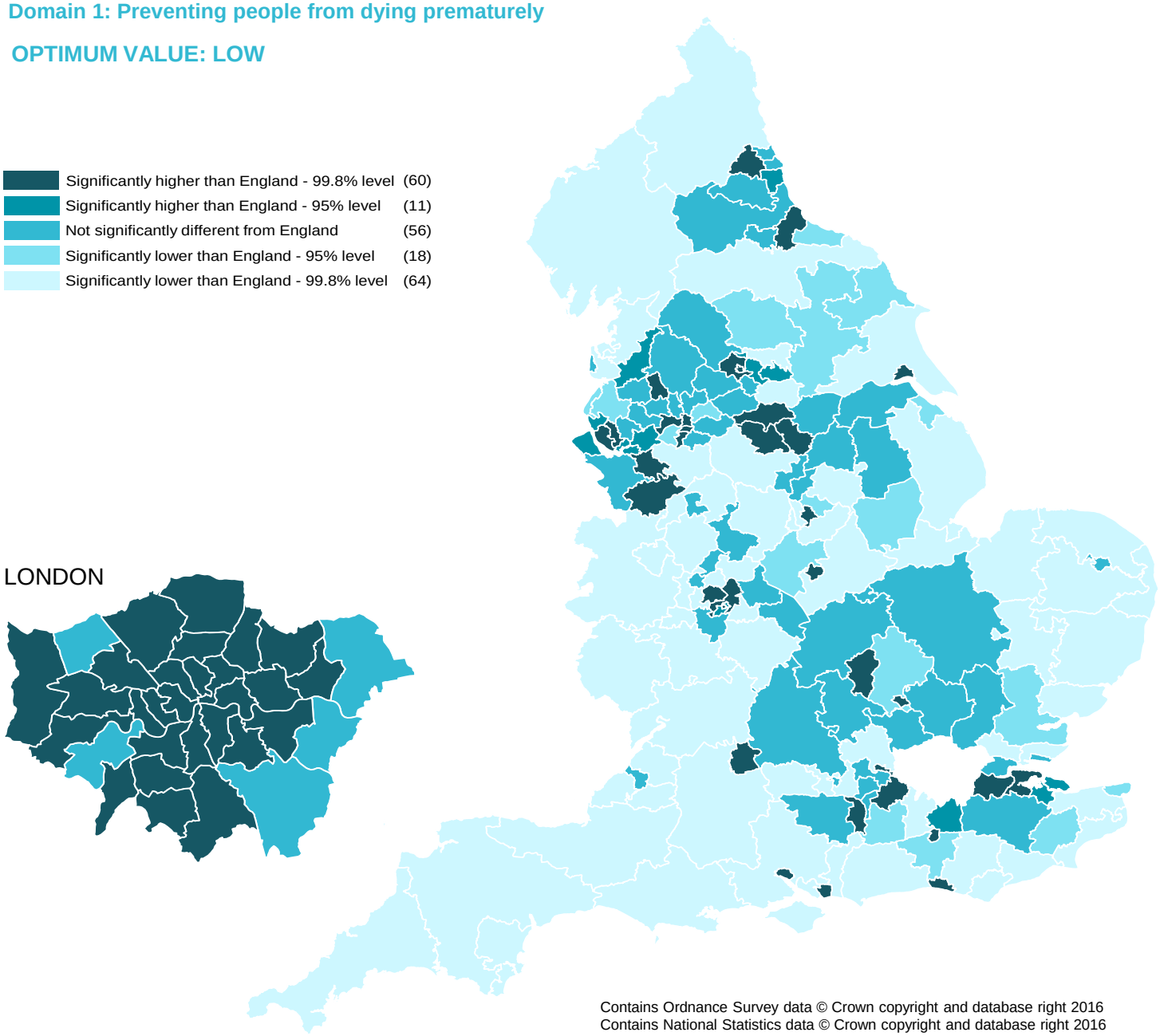
ENDOSCOPY SERVICES

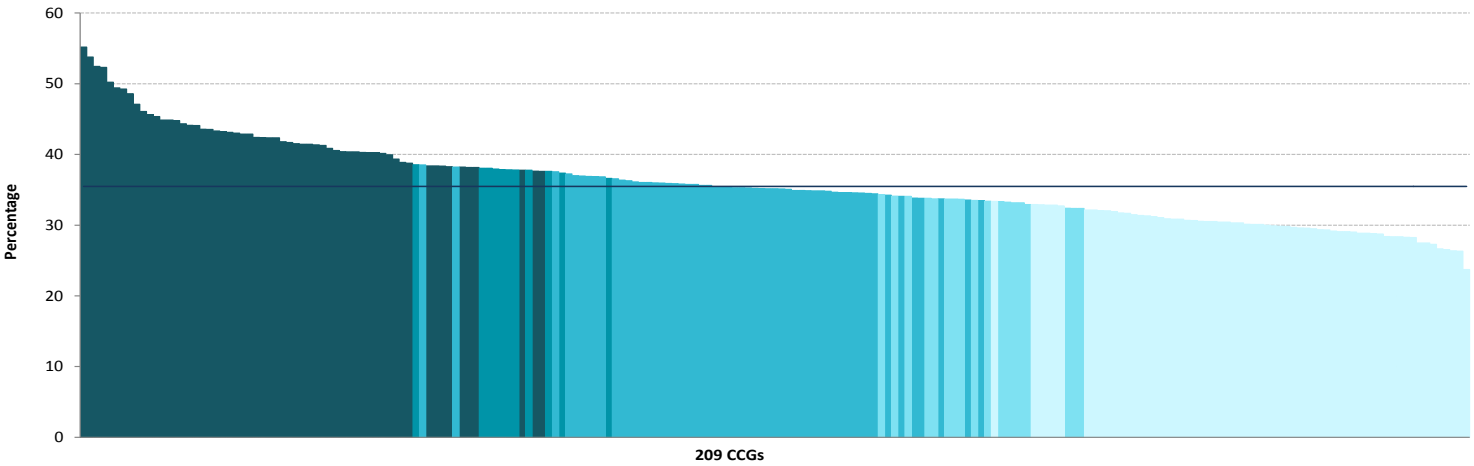
MAP 20: Percentage of patients undergoing gastroscopy (upper gastrointestinal endoscopy) procedures aged under 55 years by CCG

2014/15

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: LOW





The most plausible explanation for unwarranted variation is variation in trained endoscopists. Other possible reasons for unwarranted variation include differences in:

- thresholds for referral by GPs
- the application of guidelines for referral for gastroscopy by both GPs and hospital clinicians
- vetting the appropriateness of referrals
- the amount of resources available locally for both diagnosis and surveillance of gastroscopy cases

Map 20: Percentage undergoing gastroscopy aged under 55 years

The map and column chart display the latest period (2014/15), during which CCG values ranged from 23.7% to 55.2%, which is a 2.3-fold difference between CCGs. The England value for 2014/15 was 35.5%.

The boxplot shows the distribution of CCG values for the period 2005/06 to 2014/15. There was no significant change in any of the three variation measures nor in the median between 2005/06 and 2014/15.

The most plausible reason for warranted variation in the percentage of gastroscopy procedures is variation in the age profile of the populations.

Reasons for unwarranted variation include differences in levels of service provision and in the local management of referrals for gastroscopy in the context of NICE guidance on dyspepsia and on cancer referral.

Options for action

Commissioners need to work with all local GPs to ensure that the referral rate for gastroscopy relates to the needs of the local population, including:

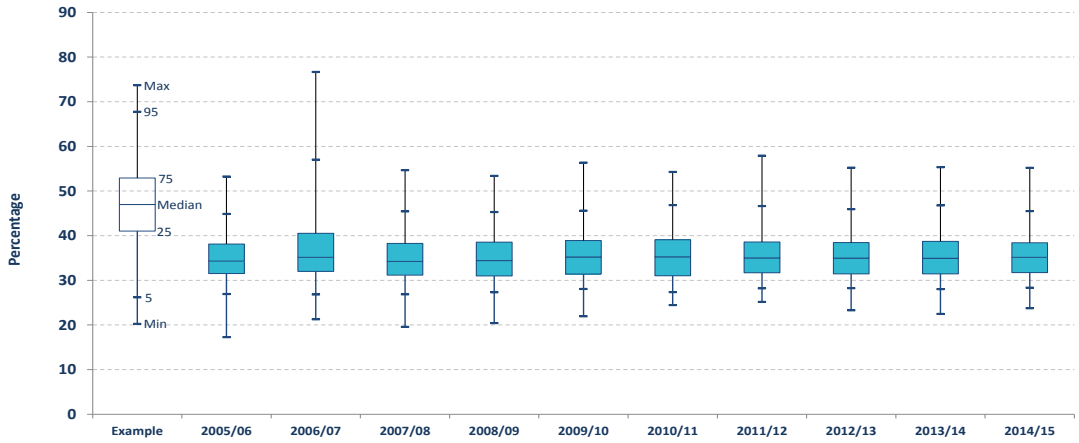
- reviewing local guidelines for dyspepsia and chronic or recurrent upper abdominal pain, especially in CCGs where there appear to be a high proportion of people aged under 55 years undergoing gastroscopy
- auditing local referral rates for gastroscopy to identify both under- and over-referral
- liaison working between endoscopy services and all local GPs to update GPs on ways to maximise value from the endoscopy service for patients

The NICE commissioning guide can help commissioners and providers develop referral criteria and determine local service levels (see 'Resources').

The Joint Advisory Group (JAG) on GI endoscopy, which defines and maintains the standards by which endoscopy is practised in the UK, has developed a Productivity & Planning Assessment Tool (PPAT; see 'Resources') for endoscopy services and commissioners. It provides a checklist of the objectives that the most productive endoscopy services apply systematically to ensure endoscopy resource is used appropriately and efficiently. For effective planning JAG recommends that commissioners require local services to use PPAT.

The Global Rating Scale (GRS; see 'Resources') enables provider units to assess the provision of patient-centred services, including dimensions for quality and safety, and customer care. Applying the 'Appropriateness' item reassures commissioners that referrals are vetted against best practice.

Map 20: Boxplot of patients undergoing gastroscopy aged under 55 years (%) by CCG



		2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	
Max-Min (Range)		36.0	55.4	35.1	33.0	34.4	29.8	32.8	32.0	32.9	31.5	No significant change
95th-5th percentile		18.0	30.2	18.6	18.0	17.5	19.5	18.4	17.7	18.8	17.2	No significant change
75th-25th percentile		6.6	8.5	7.1	7.6	7.5	8.0	6.9	7.0	7.3	6.7	No significant change
Median		34.3	35.1	34.2	34.4	35.2	35.3	35.0	35.0	34.9	35.1	No significant change

RESOURCES

- Joint Advisory Group (JAG) for GI endoscopy. Website has a section on 'Commissioning'. http://www.thejag.org.uk/
- JAG for GI endoscopy. Global Rating Scale (GRS). http://www.globalratingscale.com/
- JAG for GI endoscopy. GRS Productivity & Planning Assessment Tool (PPAT) User Guidance. http://www.thejag.org.uk/downloads%5CPlanning%20&%20Productivity%5CPPAT%20User%20Guide%2022042012.pdf
- NICE. Dyspepsia and gastro oesophageal reflux disease in adults NICE quality standard [QS96]. July 2015. https://www.nice.org.uk/guidance/qs96
- NICE. Gastro-oesophageal reflux disease and dyspepsia in adults: investigation and management. NICE clinical guidelines [CG184]. November 2014. https://www.nice.org.uk/guidance/cg184
- NICE. Suspected cancer: recognition and referral. NICE guidelines [NG12]. June 2015. https://www.nice.org.uk/guidance/ng12
- NICE pathways. Suspected cancer recognition and referral overview. http://pathways.nice.org.uk/pathways/suspected-cancer-recognition-and-referral
- NICE pathways. Acute upper gastrointestinal bleeding overview. http://pathways.nice.org.uk/pathways/acute-upper-gastrointestinal-bleeding
- NICE. Acute upper gastrointestinal bleeding in adults. NICE quality standards [QS38]. July 2013. https://www.nice.org.uk/guidance/qs38
- NICE. Acute upper gastrointestinal bleeding in over 16s: management (CG141) June 2012, updated April 15. https://www.nice.org.uk/guidance/cg141
- Health Services Management Centre (2015). Scoping the future: An evaluation of endoscopy capacity across the NHS in England. http://www.cancerresearchuk.org/sites/default/files/scoping_the_future_-_final.pdf

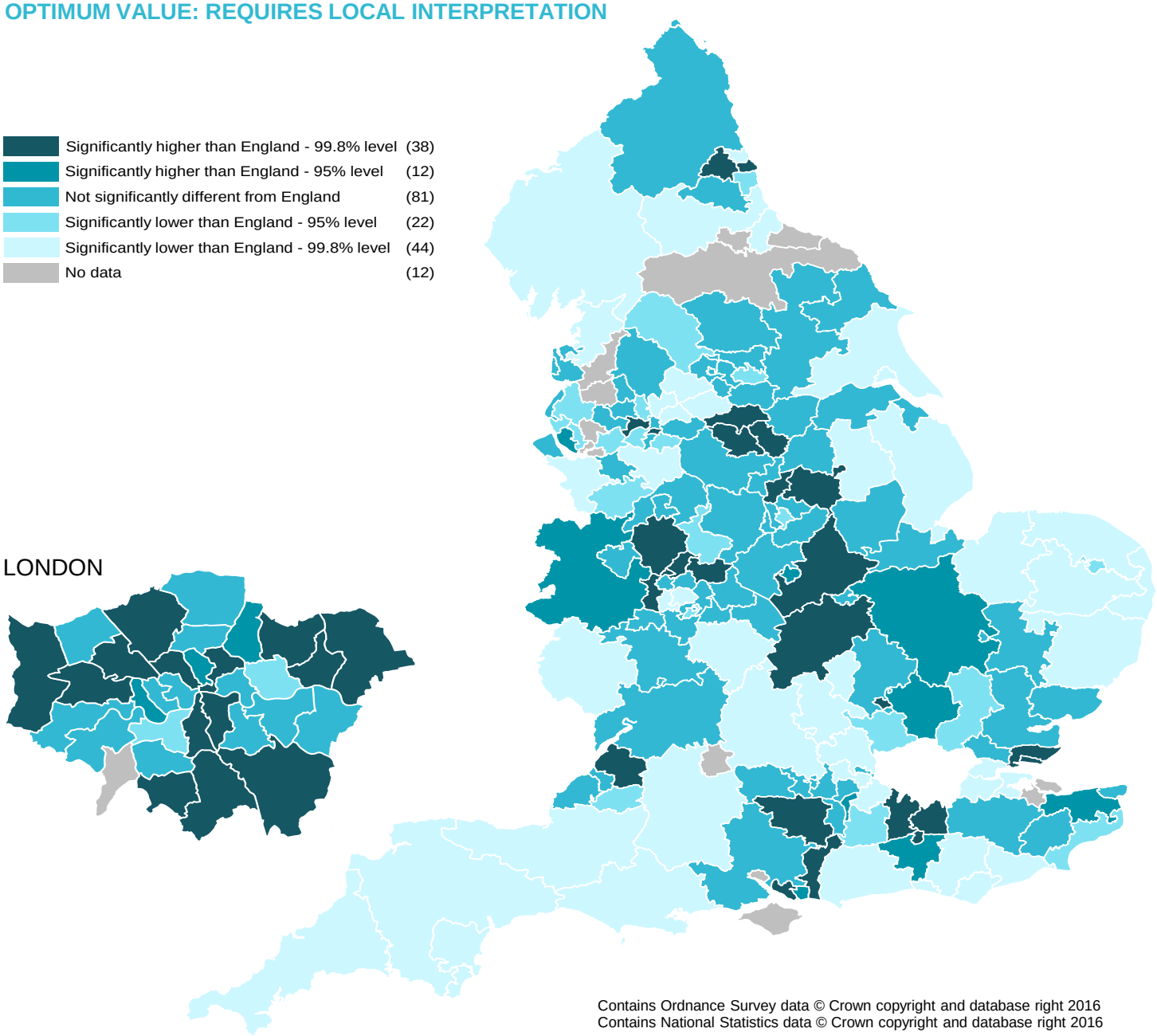
ENDOSCOPY SERVICES

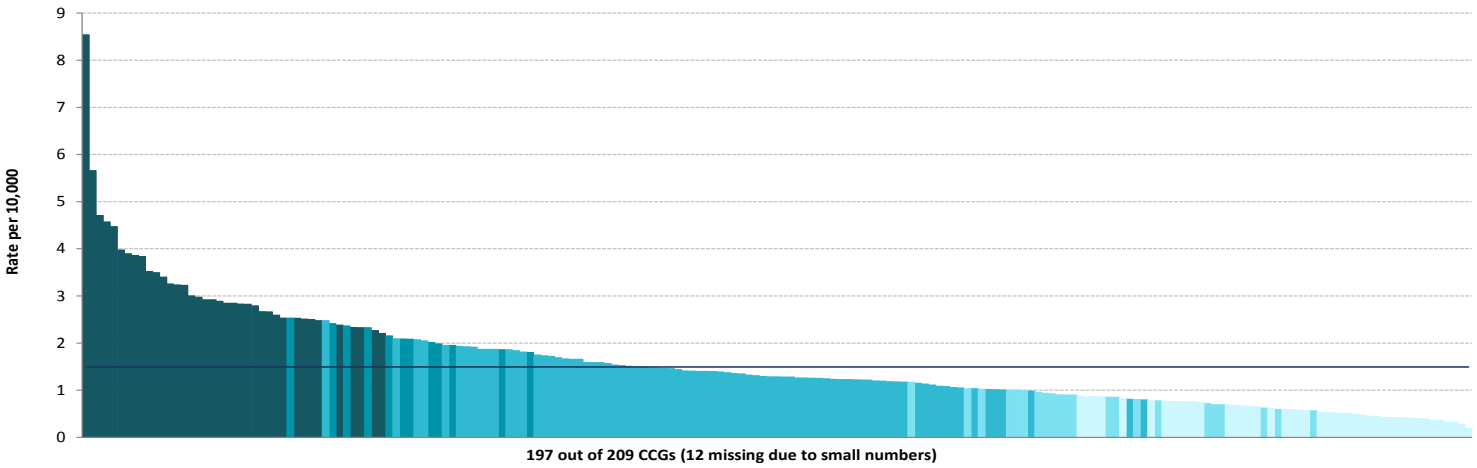
MAP 21: Rate of capsule endoscopy procedures per population by CCG

Indirectly standardised for age, sex and deprivation, 2014/15

Domain 2: Enhancing quality of life for people with long-term conditions

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





Context

Capsule endoscopy is a first-line, non-invasive small bowel imaging technique. It is more likely to identify flat vascular or inflammatory lesions than radiological methods, but the techniques are complementary when studying transmural disease (disease involving all layers of the bowel, for example, established Crohn's disease) or when mass lesions such as tumours are suspected.

Indications for capsule endoscopy are:

- obscure gastrointestinal (GI) bleeding
- small bowel Crohn's disease
- assessment of coeliac disease
- screening and surveillance for polyps in familial polyposis syndromes

The main risk associated with capsule endoscopy is capsule retention, but this can be eliminated to a large extent by testing the patient with a dissolvable 'patency' capsule before the main test in at-risk patients. Patients at higher risk of retention are people with:

- extensive small bowel Crohn's disease
- chronic usage of non-steroidal anti-inflammatory drugs
- abdominal radiation injury

Capsule endoscopy is contra indicated in patients known to have strictures or swallowing disorders.

Since the introduction of capsule endoscopy over a decade ago demand has increased. In a survey of British Society of Gastroenterology (BSG) members in 2011, 91% of respondents referred patients for capsule endoscopy.[1]

Capsule endoscopy is cost-effective[2] because it prevents unnecessary cycles of investigation in patients with obscure GI bleeding and inflammatory bowel disease.

Magnitude of variation

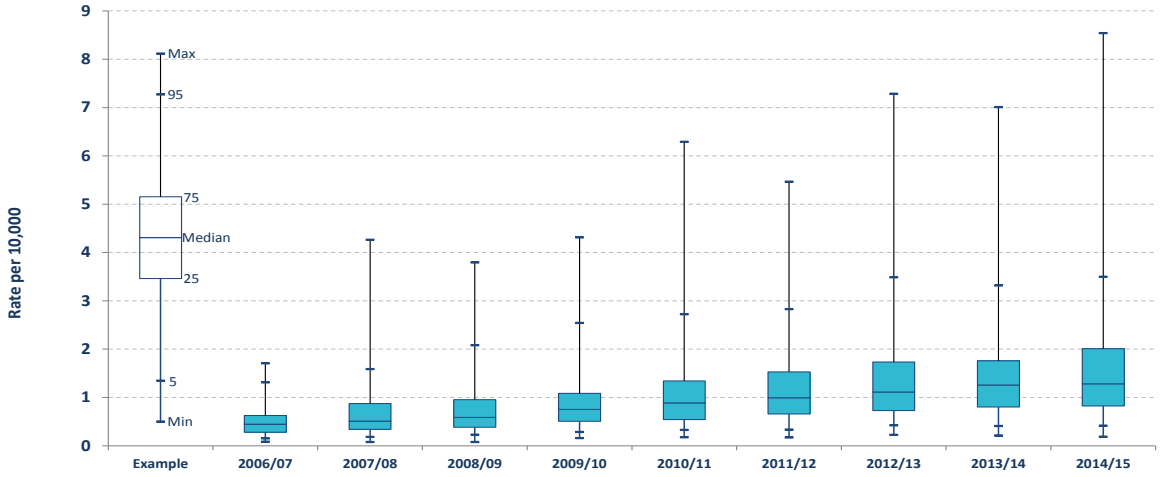
The map and column chart display the latest period (2014/15), during which CCG values range from 0.2 per 10,000 population to 8.5 per 10,000 population, which is a 45.2-fold difference between CCGs. The England value for this period was 1.5 per 10,000 population.

The boxplot shows the distribution of CCG values for the period 2006/07 to 2014/15. Throughout this period the distribution of values has been strongly positively skewed.

There has been significant widening of all three measures of variation. This is due to an upward stretching of the distribution with much greater increases in the maximum, 95th percentile and 75th percentile, than in the minimum, 5th percentile and 25th percentile.

The median increased significantly from 0.4 per 10,000 population in 2006/07 to 1.3 per 10,000 population in 2014/15.

Map 21: Boxplot of capsule endoscopy procedures by CCG



		2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	
Max-Min (Range)		1.6	4.2	3.7	4.2	6.1	5.3	7.1	6.8	8.4	WIDENING Significant
95th-5th percentile		1.2	1.4	1.9	2.3	2.4	2.5	3.1	2.9	3.1	WIDENING Significant
75th-25th percentile		0.3	0.5	0.6	0.6	0.8	0.9	1.0	1.0	1.2	WIDENING Significant
Median		0.4	0.5	0.6	0.8	0.9	1.0	1.1	1.3	1.3	INCREASING Significant

[1] McAlindon ME, Parker CE, Hendy P et al. Provision of service and training for small bowel endoscopy in the UK. Frontline Gastroenterology 2012; 3; 98-103. doi: 10.1136/flgastro-2011-100044. http://fg.bmj.com/content/3/2/98

[2] Marmo R, Rotondano G, Rondonotti E et al. Capsule enteroscopy vs. other diagnostic procedures in diagnosing obscure gastrointestinal bleeding: a cost-effectiveness study. Eur J Gastroenterol Hepatol 2007; 19: 535-542.

The degree of variation observed is unlikely to be due to differences in the prevalence of the conditions in the local population for which capsule endoscopy is indicated.

One reason for the degree of variation could be differences in the level of access to capsule endoscopy. Access to capsule endoscopy can be affected by several factors, including:

- willingness to invest in a new procedure[1]
- the perceived barriers to setting up a new service, including cost and potential workload[1]
- the availability of trained staff to interpret the results of capsule endoscopy
- thresholds for use
- lack of formal arrangements for service provision
- historical levels of the tariff for the procedure, and consequent restrictions on use[1]

Options for action

To reduce the degree of unwarranted variation in the level of activity for capsule endoscopy, commissioners, clinicians and service providers need:

- to review the level of provision in relation to need in the local population
- to deliver capsule endoscopy in line with NICE interventional procedure guidance (IPG101; see 'Resources') and the guidelines commissioned by the Clinical Services and Standards Committee of the BSG (Sidhu et al, 2008; see 'Resources')
- to audit the capsule endoscopy service at regular intervals
- to introduce formal training and accreditation programmes in the use and interpretation of capsule endoscopy

RESOURCES

- NICE. Wireless capsule endoscopy for investigation of the small bowel. NICE interventional procedure guidance [IPG101]. December 2004. http://guidance.nice.org.uk/IPG101
- Sidhu R, Sanders DS, Morris AJ, McAlindon ME. Guidelines on small bowel enteroscopy and capsule endoscopy in adults. Gut 2008; 57: 125-136. doi: 10.1136/gut.2007.129999 http://www.bsg.org.uk/pdf_word_docs/capsule.pdf
- Pennazio M, Spada C, Biakim R et al. Small-bowel capsule endoscopy and device-assisted enteroscopy for diagnosis and treatment of small-bowel disorders: European Society of Gastrointestinal Endoscopy (ESGE) Clinical Guideline. Endoscopy 2015; 47: 352-376. doi http://dx.doi.org/10.1055/s-0034-1391855 http://www.esge.com/assets/downloads/pdfs/guidelines/2015_enterosocopy_and_small_bowel.pdf

ENDOSCOPY SERVICES

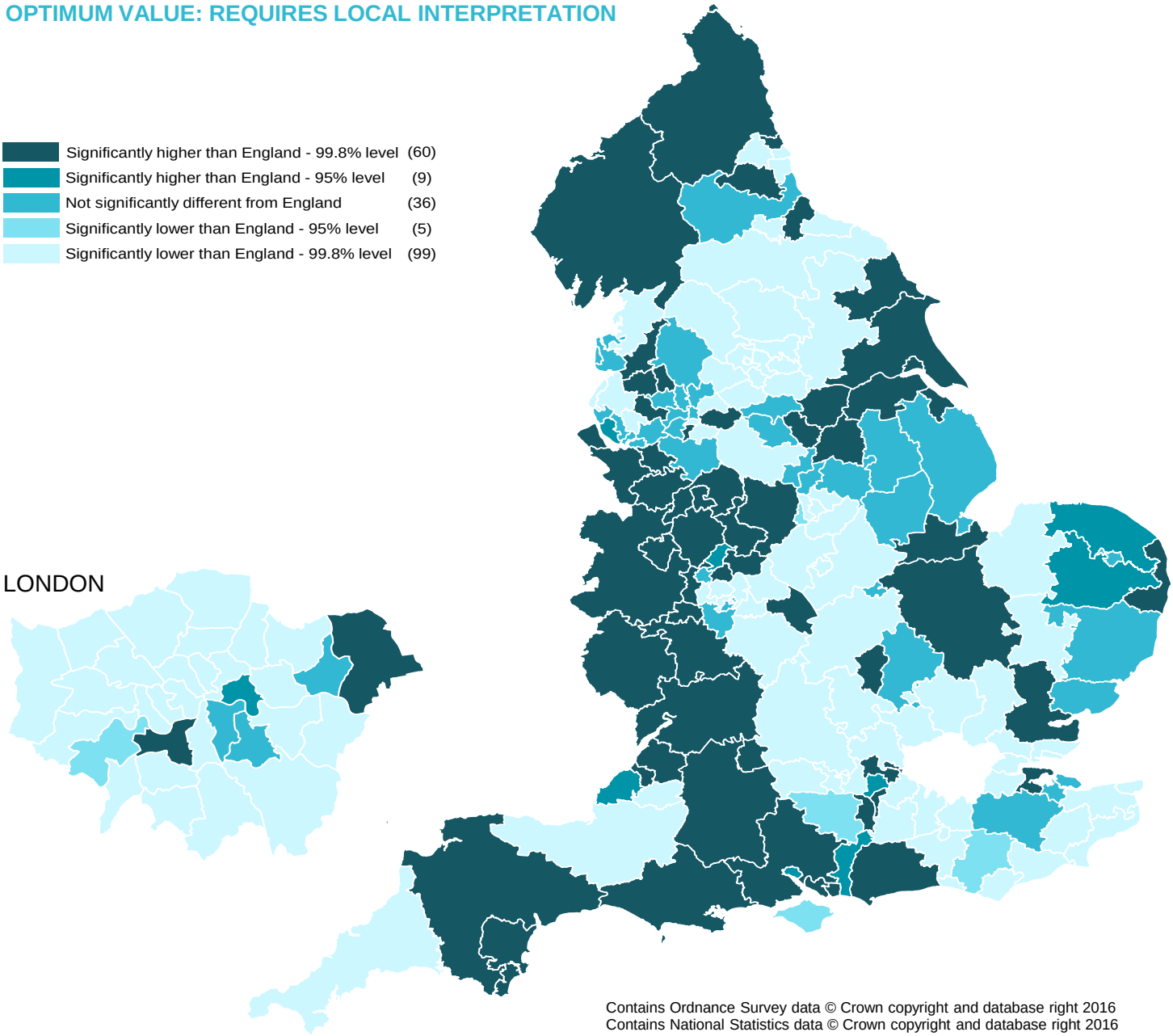
MAP 22: Rate of endoscopic ultrasound procedures per population by CCG

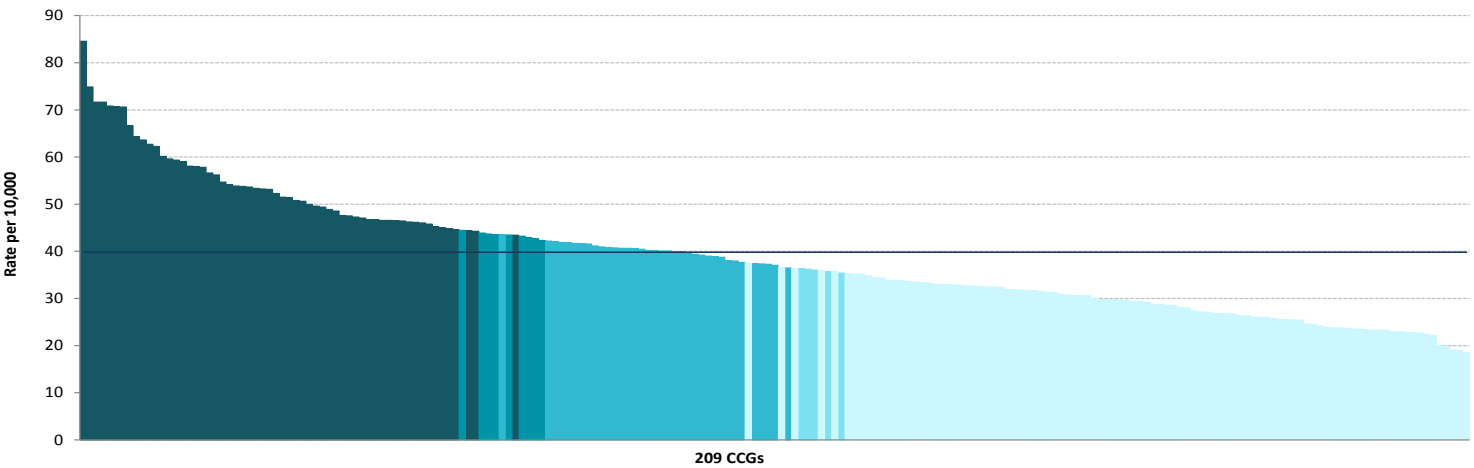
Indirectly standardised for age, sex and deprivation, 2014/15

Domain 1: Preventing people from dying prematurely

Domain 2: Enhancing quality of life for people with long-term conditions

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





Context

An endoscopic ultrasound scan combines the features of endoscopy and ultrasonography. A high-resolution ultrasound device is incorporated into the tip of an endoscope, which is introduced into the gastrointestinal (GI) tract via mouth or anus. If the ultrasound probe is immediately adjacent to the area of interest the images are much clearer, and targeted biopsy is more accurate and more likely to show a positive diagnosis.

- From entry via the oesophagus, the device can image and allow sampling from the mediastinum and chest, and from the stomach, the pancreas, adrenal glands, spleen, liver and adjacent nodes
- From entry via the rectum, the device can image and allow sampling from adjacent pelvic structures

In the UK endoscopic ultrasound is performed by gastroenterologists, surgeons and radiologists. It takes a long time for clinicians to develop the knowledge, skills and experience necessary to use the technique, and the equipment is expensive.

There are a variety of conditions in which endoscopic ultrasound can be used as a diagnostic tool, including:

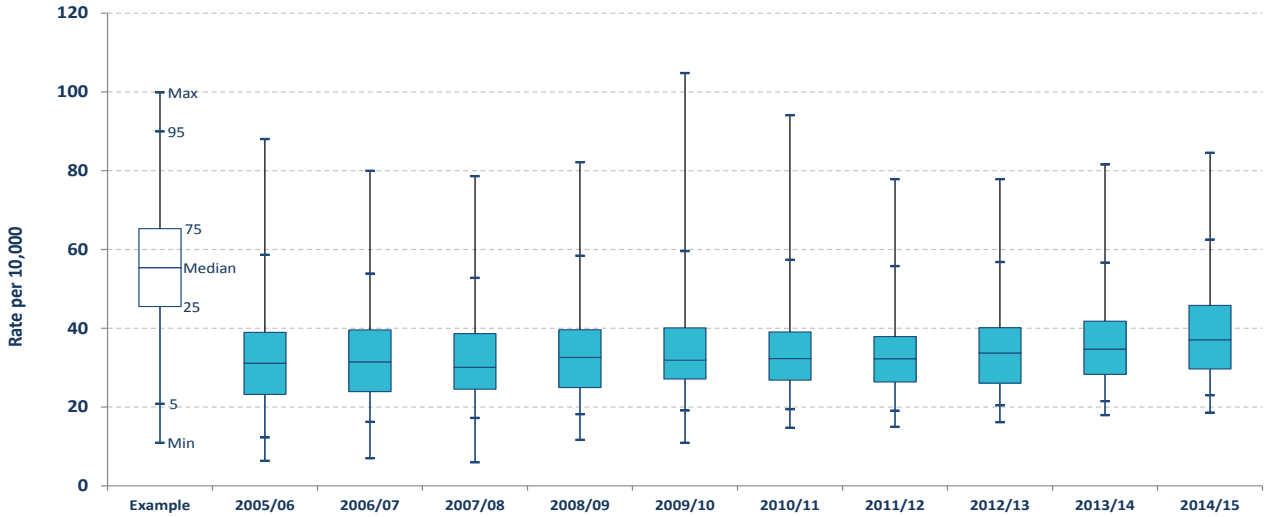
- the diagnosis of benign pancreato-biliary disease, including unsuspected gallstones
- the diagnosis of pancreatic cysts
- the diagnosis and staging of a number of GI malignancies, including those of the pancreas, stomach and oesophagus
- the diagnosis and staging of lung cancer and other chest malignancies
- the diagnosis and staging of lymphoma
- the diagnosis of masses of unknown origin

Of the well-delineated uses of endoscopic ultrasound, that for the diagnosis of suspected pancreatic malignancy is the most established and investigated. For people with suspected pancreatic malignancy, endoscopic ultrasound-guided biopsy is the standard of care when a tissue diagnosis is required.

Complications during diagnostic endoscopic ultrasound are uncommon (a rate of approximately 1%). As with any endoscopic procedure, patients should be warned of the risk of perforation. Complications specific to biopsy procedures include pain, bleeding, infection and pancreatitis; serious complications are rare.

The therapeutic use of endoscopic ultrasound occurs primarily in specialist units following discussion within a multidisciplinary team. Endoscopic ultrasound-guided drainage of pancreatic fluid collections (arising as a complication of pancreatitis) is safe and effective, and is increasingly being performed as the technique of choice for draining accessible symptomatic fluid collections. The complication rate for the drainage of pancreatic fluid collections is between 5% and 20%. Endoscopic ultrasound-guided access to the biliary tree is a new intervention providing access to and drainage of the biliary tree as an alternative to conventional means. It is not commonly performed at present, but its use is likely to increase in future.

Map 22: Boxplot of endoscopic ultrasound procedures by CCG



Max-Min (Range)		81.7	73.0	72.6	70.5	93.9	79.3	62.9	61.7	63.6	66.0	No significant change
95th-5th percentile		46.4	37.6	35.6	40.2	40.5	37.9	36.7	36.4	35.2	39.5	No significant change
75th-25th percentile		15.8	15.7	14.1	14.6	13.0	12.2	11.5	14.1	13.5	16.1	No significant change
Median		31.1	31.4	30.1	32.6	31.8	32.3	32.2	33.7	34.7	37.0	INCREASING Significant

Magnitude of variation

The map and column chart display the latest period (2014/15), during which CCG values ranged from 18.6 per 10,000 population to 84.6 per 10,000 population, which is a 4.6-fold difference between CCGs. The England value for 2014/15 was 39.8 per 10,000 population.

The boxplot shows the distribution of CCG values for the period 2005/06 to 2014/15. There was no significant change in any of the three variation measures between 2005/06 and 2014/15.

The median increased significantly from 31.1 per 10,000 population in 2005/06 to 37.0 per 10,000 population in 2014/15.

The degree of variation observed is unlikely to be due to differences among local populations of the prevalence of the conditions for which endoscopic ultrasound is indicated.

Reasons for unwarranted variation could include differences in:

- the level of access to endoscopic ultrasound
- the availability of trained operators and/or endosonographers
- clinician awareness of the diagnostic and therapeutic uses of endoscopic ultrasound

Options for action

To reduce the degree of unwarranted variation in the level of activity for endoscopic ultrasound, commissioners, clinicians and service providers need:

- to review the level of provision in relation to need in the local population
- to audit the endoscopic ultrasound service at regular intervals
- to ensure appropriate training and skills development are available for endosonographers
- to ensure the peer-review of diagnostic and staging pathways in order to demonstrate compliance with available guidance on the use of endoscopic ultrasound (see Meenan et al, ‘Resources’)

RESOURCES

- Meenan J, Harris K, Oppong K et al. Service provision and training for endoscopic ultrasound in the UK. Frontline Gastroenterology 2011; 2: 188-194. Published Online First: 8 April 2011 doi:10.1136/fg.2010.004101. http://fg.bmj.com/content/2/3/188.abstract
- Wani S, Wallace MB, Cohen J et al. Quality Indicators for EUS. Gastrointestinal Endoscopy 2015; 81: 67-80.

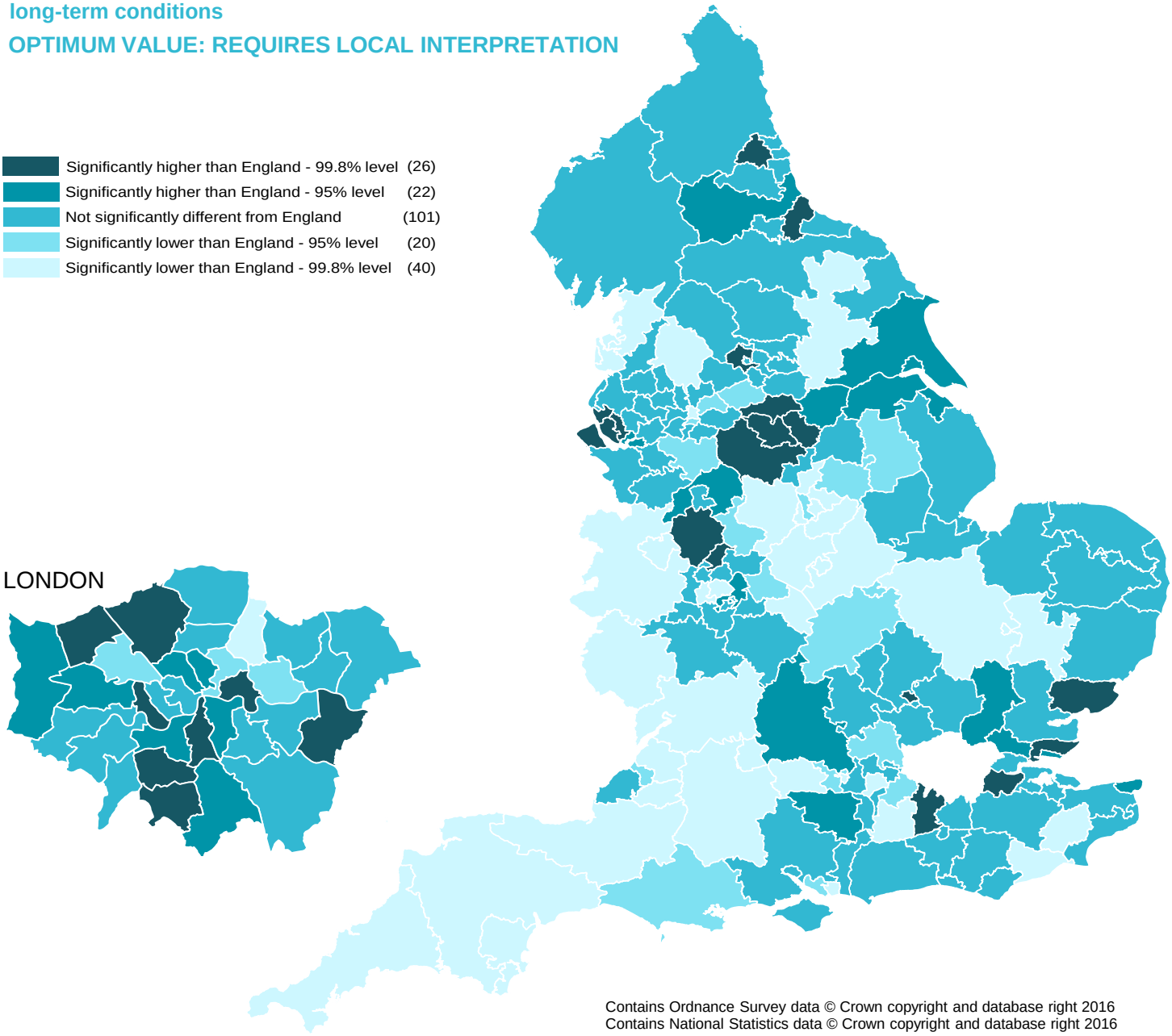
ENDOSCOPY SERVICES

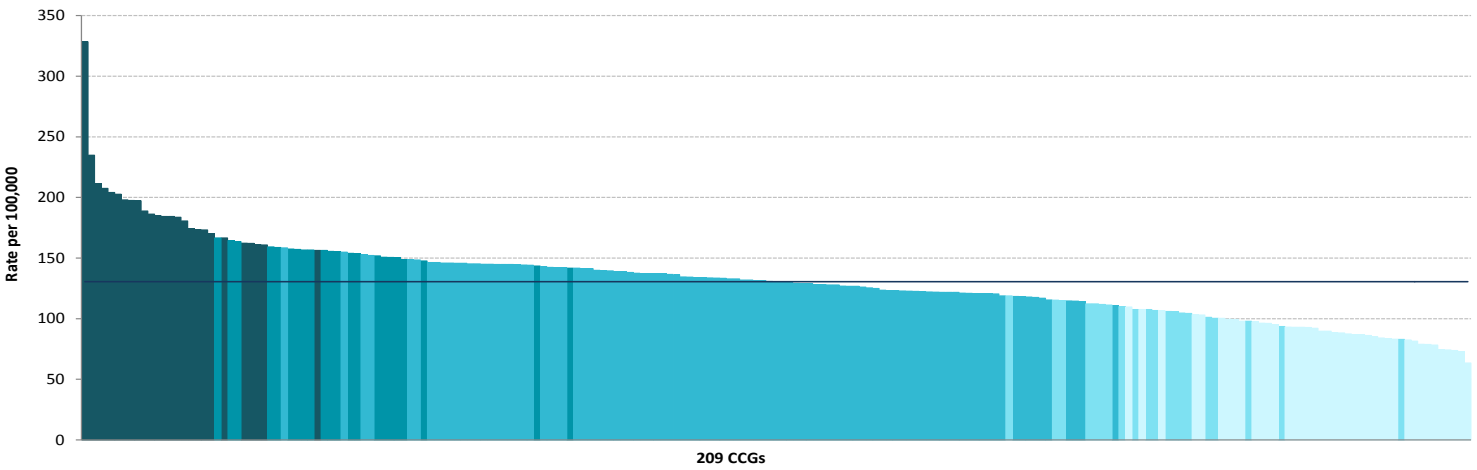
MAP 23: Admission rate for children for upper and/or lower gastro-intestinal endoscopy per population aged 0-17 years by CCG

Directly standardised for age, 2012/13–2014/15

Domain 2: Enhancing quality of life for people with long-term conditions

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





Context

Diagnostic gastrointestinal (GI) endoscopy enables the GI tract to be visualised directly, and for biopsies to be carried out to aid diagnosis. Endoscopy is usually undertaken in children with GI symptoms to diagnose or exclude serious GI disease, such as inflammatory bowel disease[1], coeliac disease, enteropathy and gastro-oesophageal reflux. Where investigations (including GI endoscopy) fail to find an organic cause for these symptoms, a diagnosis of functional GI disorder (GI symptoms without structural or physical abnormalities) is considered.

Over the past decade the rates of diagnostic GI endoscopy have greatly increased in the UK, associated with a trend for earlier and more accurate diagnosis of severe GI disease. There are, however, no data available on the 'appropriate' number of endoscopies per population to improve clinical outcomes.

Magnitude of variation

The map and column chart display the latest period (2012/13-2014/15), during which CCG values ranged from 63.4 to 328.3 per 100,000 population, which is a 5.2-fold difference between CCGs. The England value for this period was 130.6 per 100,000 population.

The boxplot shows the distribution of CCG values for the period 2005/06-2007/08 to 2012/13-2014/15. Throughout this period the distribution of values has been positively skewed.

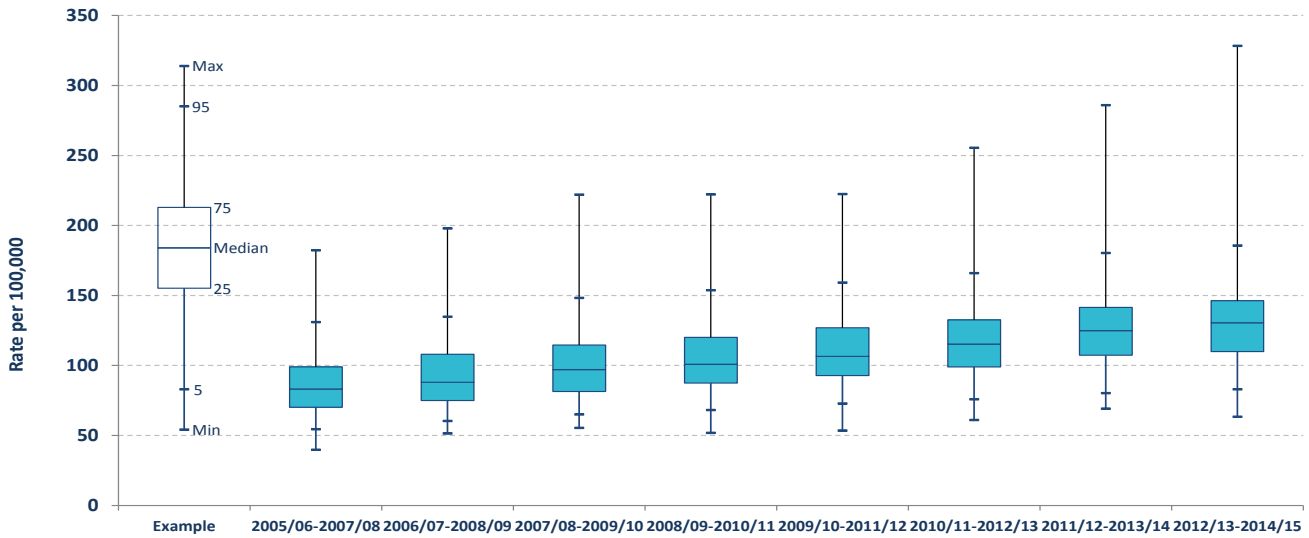
There has been significant widening of all three measures of variation. This is due to an upward stretching of the distribution with much greater increases in the maximum, 95th percentile and 75th percentile, than in the minimum, 5th percentile and 25th percentile.

There was a relatively great and statistically significant increase the median from 83.1 per 100,000 population in 2005/06-2007/08 to 130.5 per 100,000 population in 2012/13-2014/15.

The degree of variation observed is unlikely to be explained by differences in the number of children with symptoms or the incidence of serious organic GI disease. The geographical clustering of high intervention rates is also likely to reflect variation in the number of paediatric endoscopists and gastroenterologists which may may lead to different thresholds in intervention.

Low rates of GI endoscopy may reflect inadequate provision or poor access, leading to delayed or missed diagnosis in the local population of children. Variation in applying updated guidance, in which blood markers for coeliac disease should now obviate the need for endoscopy (Murch et al; see 'Resources'), may also have an effect.

Map 23: Boxplot of admissions for upper and/or lower GI endoscopy in children by CCG



Max-Min (Range)		142.6	146.5	166.6	170.4	168.9	194.4	216.9	265.0	WIDENING Significant
95th-5th percentile		76.5	74.5	83.2	85.5	86.4	90.0	100.1	102.7	WIDENING Significant
75th-25th percentile		28.8	33.1	33.2	32.6	34.2	33.6	34.2	36.4	WIDENING Significant
Median		83.1	88.0	97.1	100.9	106.5	115.3	124.9	130.5	INCREASING Significant

[1] This term is mainly used to describe two diseases – Crohn's disease and ulcerative colitis.

High rates may reflect:

- the ready availability of and lower thresholds for paediatric endoscopy at some centres
- relative lack of access to alternative diagnostic or management strategies, such as psychological support for children with functional disorders (children with GI symptoms without structural or physical abnormalities).

Options for action

Although there are diagnostic guidelines for the use of GI endoscopy to investigate specific conditions, no guidance exists for the selection of children commonly presenting with non-specific symptoms or signs most likely to benefit from diagnostic GI endoscopy. This is urgently needed to maximise yield and reduce unnecessary risk to patients. It is important to develop clinical guidance, based on best evidence rather than clinical consensus, particularly as thresholds for endoscopy are refined through advances in medical practice (such as for coeliac disease), and from the emergence of newer conditions for which endoscopy is a pre-requisite, such as eosinophilic oesophagitis.

In the absence of national guidance commissioners and clinicians need to agree local criteria for diagnostic GI endoscopies in children based on best available evidence, and the criteria need to be based on outcomes as well as process. It is important to benchmark criteria against agreements made in other localities to ensure equity of access and high-quality outcomes. A networked system of delivering paediatric endoscopy will help to rationalise the criteria for endoscopy, ensuring:

- sustainable levels of activity that relate to local population needs
- a comparison of outcomes within and among networks
- support for training and quality assurance
- equity of access through common thresholds for intervention
- rare but life-saving provision of out-of-hours interventional endoscopy in children

RESOURCES

- NICE. Coeliac disease: recognition assessment and management. NICE guidelines [NG20]. September 2015. https://www.nice.org.uk/guidance/ng20
- NICE. Inflammatory bowel disease. NICE quality standard [QS81]. February 2015. https://www.nice.org.uk/guidance/qs81
- Royal College of Physicians. Inflammatory Bowel Disease Quality Improvement Project. http://www.ibdqip.co.uk
- NHS England. 2013/14 NHS Standard Contract. Paediatric Medicine: Gastroenterology, Hepatology and Nutrition. Section B Part 1 – Service specifications. Service Specification No. E03/S/c. https://www.england.nhs.uk/wp-content/uploads/2013/06/e03-paedi-med-gastro-hepa-nut.pdf
- Murch S, Jenkins H, Auth M et al. Joint BSPGHAN and Coeliac UK guidelines for the diagnosis and management of coeliac disease in children. Arch Dis Child 2013; 98: 806-811. doi: 10.1136/archdischild-2013-303996 https://bspghan.org.uk/sites/default/files/guidelines/Coeliac%20Guidelines%202013_0.pdf
- Bretthauer M, Aabakken L, Dekker E et al on behalf of the ESGE Quality Improvement Committee. Requirements and standards facilitating quality improvement for reporting systems in gastrointestinal endoscopy: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement. *Endoscopy* 2016: 48: 1-4. http://dx.doi.org/10.1055/s-0042-100186 https://www.esge.com/assets/downloads/pdfs/guidelines/2016_s_0042_100186.pdf
- Joint Advisory Group (JAG) for GI endoscopy. JAG defines and maintains the standards by which endoscopy is practised in the UK. Website has a section on 'Commissioning'. http://www.thejag.org.uk/Commissioning.aspx
- JAG Accreditation System incorporating GRS (Global Rating Scale). Productivity & Planning Assessment Tool (PPAT) User Guide. http://www.thejag.org.uk/downloads%5CPlanning%20&%20Productivity%5CPPAT%20User%20Guide%2022042012.pdf

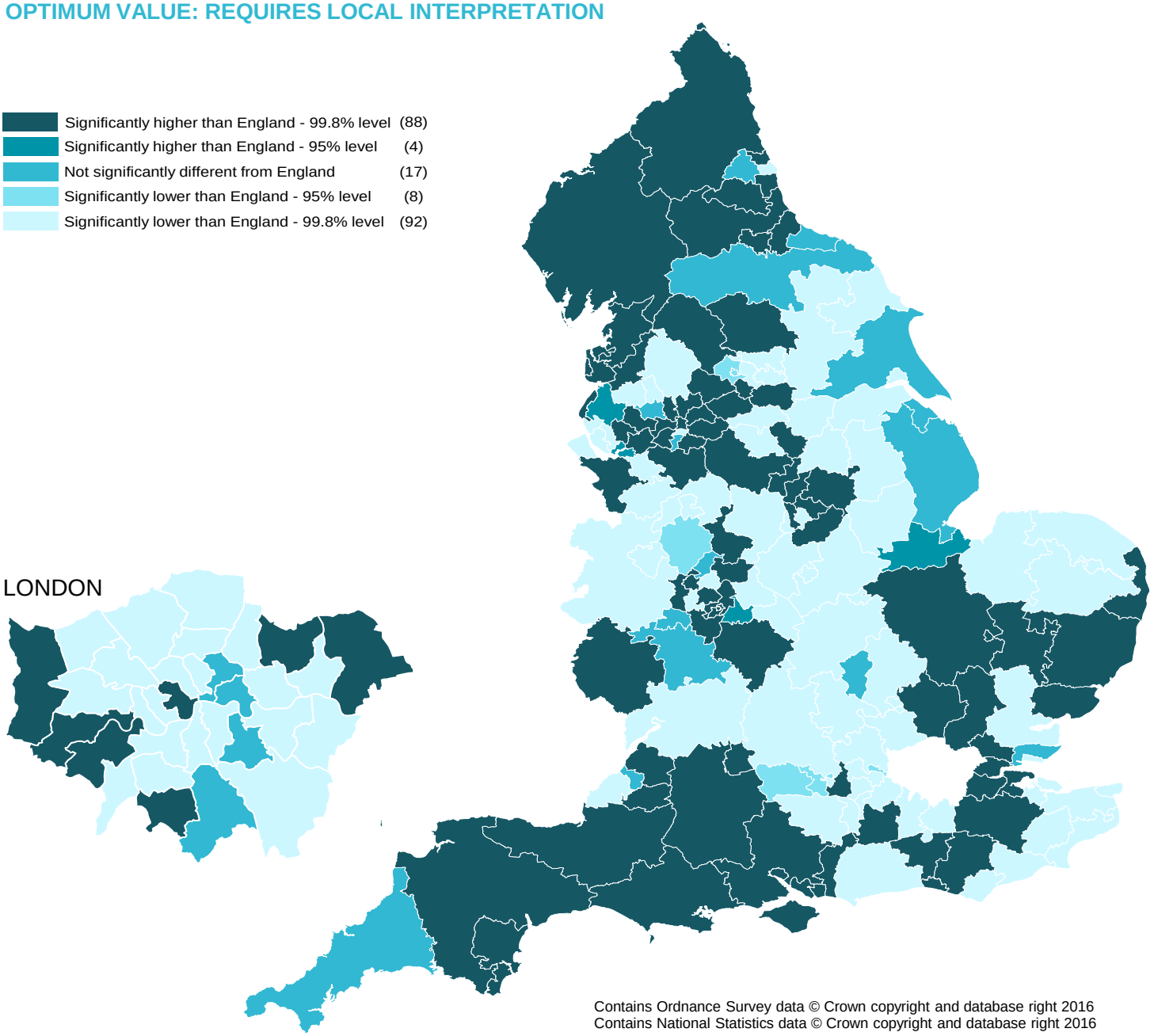
PHYSIOLOGICAL SERVICES

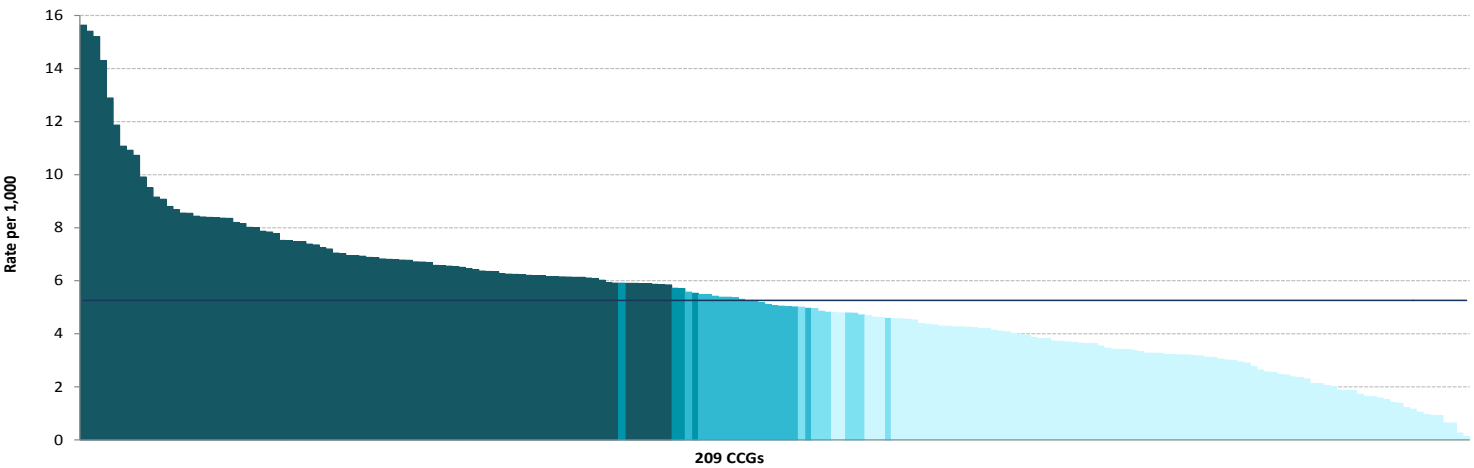
MAP 24: Rate of audiology assessments undertaken per weighted population by CCG

Adjusted for age, sex and 'need', January–March 2016

Domain 2: Enhancing quality of life for people with long-term conditions

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





Context

Over nine million in England are affected by hearing loss. Hearing problems can have an effect on the development of language in children, reduce chances of employment, restrict aspirations and life chances, increase the risk of mental health problems and interfere with peoples' ability to care for their own and their families' long-term health conditions.

In the Global Burden of Disease 2013 study it was found that for people of all ages 'age-related and other hearing loss' is the sixth most important cause of years lived with disability (YLD) in both England and UK (3.9% in both areas), up from seventh in 2010 (3.8% in both areas), and for people aged over 70 years hearing loss is the most important cause of YLDs in both England and the UK.[1]

Half of the people with a hearing loss can be managed effectively by a care package including hearing aids and other environmental aids to reduce economic, social and personal impacts across the life-course.

Audiology assessments cover a range of investigations of hearing and balance. The assessments determine functional ability, possible pathologies and impact on the individual's daily activities. Following assessment, an appropriate treatment and support pathway is selected, which can include:

- surgery for cochlear implant
- rehabilitation support including programmed digital signal processing (digital) hearing aids
- counselling
- frequency modulation (FM) systems and assistive listening devices (ALDs)

Referrals for assessment of age-related progressive hearing loss comprise the largest proportion of hearing assessments.

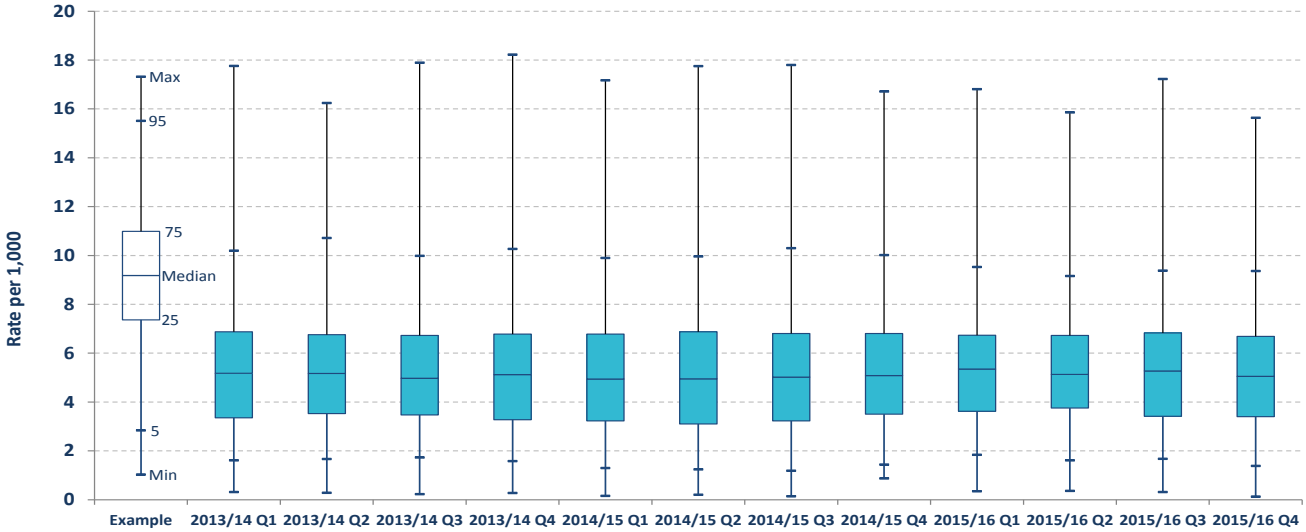
Although 35,000 children and 1.6 million adults with hearing loss are being managed and supported by public sector services, population surveys estimate eight million adults live with unreported and unmanaged loss of whom four million have hearing loss that confers great difficulty in understanding speech, even in a quiet environment.

Over the next 20 years the impact of hearing loss will increase:

- as the population ages
- with increasing exposure to social noise (from MP3 players, club music and mobile phones)

Owing to the population ageing it is estimated that by 2035 over 13 million people in England will have hearing loss.

Map 24: Boxplot of audiology assessments by CCG



Max-Min (Range)		17.4	16.0	17.7	17.9	17.0	17.5	17.7	15.8	16.5	15.5	16.9	15.5	No significant change
95th-5th percentile		8.6	9.1	8.3	8.7	8.6	8.7	9.1	8.6	7.7	7.5	7.7	8.0	NARROWING Significant
75th-25th percentile		3.5	3.2	3.3	3.5	3.6	3.8	3.6	3.3	3.1	3.0	3.4	3.3	No significant change
Median		5.2	5.2	5.0	5.1	4.9	4.9	5.0	5.1	5.4	5.1	5.3	5.1	No significant change

[1] Institute of Health Metrics and Evaluation (IHME). GBD Compare/Viz Hub. http://ihmeuw.org/3uod

Magnitude of variation

The map and column chart display the latest period (January-March 2016), during which CCG values ranged from 0.1 per 1,000 weighted population to 15.6 per 1,000 weighted population, which is a 123.3-fold difference between CCGs. The England value for this quarter was 5.3 per 1,000 weighted population.

The boxplot shows the distribution of CCG values for the period 2013/14 to 2015/16 by quarter.

The 95th to 5th percentile gap narrowed significantly. There was no significant change in the maximum to minimum range nor in the 75th to 25th percentile gap.

There was no significant change in the median.

The degree of variation should be highly related to population demography, but internal analysis conducted by NHS England showed that the degree of variation in intervention rates for people over 65 years in 2011/12 were similar to those in the general population. In 2015/16 data for England, which has been standardised for age, the annualised rate was 21.5 per 1,000 population and half of CCGs had an annualised rate of provision of less than 20 per 1,000 population, rates that cannot be explained by local demography or estimates of prevalence and incidence[2].

Options for action

Commissioners need to raise awareness of hearing loss, its implications in primary care and the cost-effectiveness of providing good-quality hearing-aid services.

Commissioners together with service providers need to review service capacity and assess long-term plans for capacity development:

- to address any gap between met and unmet need
- to meet increasing need due to factors such as an ageing population and the potential for increasing exposure to social noise

Building capacity will ensure that hearing loss in local populations is appropriately diagnosed and treated in a timely manner to minimise its broader social and physical impact. To do this commissioners and service providers need to understand:

- the current rate of audiology assessments in relation to local demography in order to estimate the gap between current provision and unmet need
- the current annual increase in audiology assessments locally and the expected rate of increase

Commissioners need to specify that service providers:

- establish triage and referral arrangements to support earlier management of hearing loss
- improve service quality, for example, by accreditation through the Improving Quality in Physiological Services programme (IQIPS; see 'Resources')

NHS England has published a framework to support the commissioning of adult hearing loss services.

RESOURCES

- NHS England and Department of Health. Action Plan on Hearing Loss. 23 March 2015. https://www.england.nhs.uk/wp-content/uploads/2015/03/act-plan-hearing-loss-upd.pdf
- NHS England, Office of the Chief Scientific Officer. Commissioning Services for People with Hearing Loss: A framework for clinical commissioning groups. 18 July 2016. https://www.england.nhs.uk/wp-content/uploads/2016/07/HLCF.pdf
- Action on Hearing Loss. Hearing Matters webpage. Scroll down to heading 'Data' for 2014 estimated prevalence of hearing loss and for 2019 projected prevalence of hearing loss for each CCG and local authority in England. https://www.actiononhearingloss.org.uk/supporting-you/policy-research-and-influencing/research/hearing-matters.aspx
- Shaping the Future: Strengthening the Evidence to Transform Audiology Services. NHS Improvement, 2010. On the following website scroll down to find weblink to paper deposited as 'DEP2012-0235'. http://www.parliament.uk/business/publications/business-papers/commons/deposited-papers/?fd=2012-01-01&td=2015-07-01&house=1&search_term=Department+of+Health&itemId=119014&page=14&max=50#toggle-235
- Pushing the Boundaries: Evidence to support the delivery of good practice in audiology. NHS Improvement 2010. https://kinwahlin.wordpress.com/2010/08/12/pushing-the-boundaries-evidence-to-support-the-development-and-implementation-of-good-practice-in-audiology-nhs-improvement-july-2010/
- NHS Improvement. The best of clinical pathway redesign. Practical examples of delivering benefits to patients. See pages 14 and 39-43 for information on Audiology including two case-studies. www.nhsiq.nhs.uk/download.ashx?mid=8223&nid=8222
- Improving Quality in Physiological Services (IQIPS). https://www.iqips.org.uk/

[2] NHS England, Office of the Chief Scientific Officer. Commissioning Services for People with Hearing Loss: A framework for clinical commissioning groups. 18 July 2016. https://www.england.nhs.uk/wp-content/uploads/2016/07/HLCF.pdf

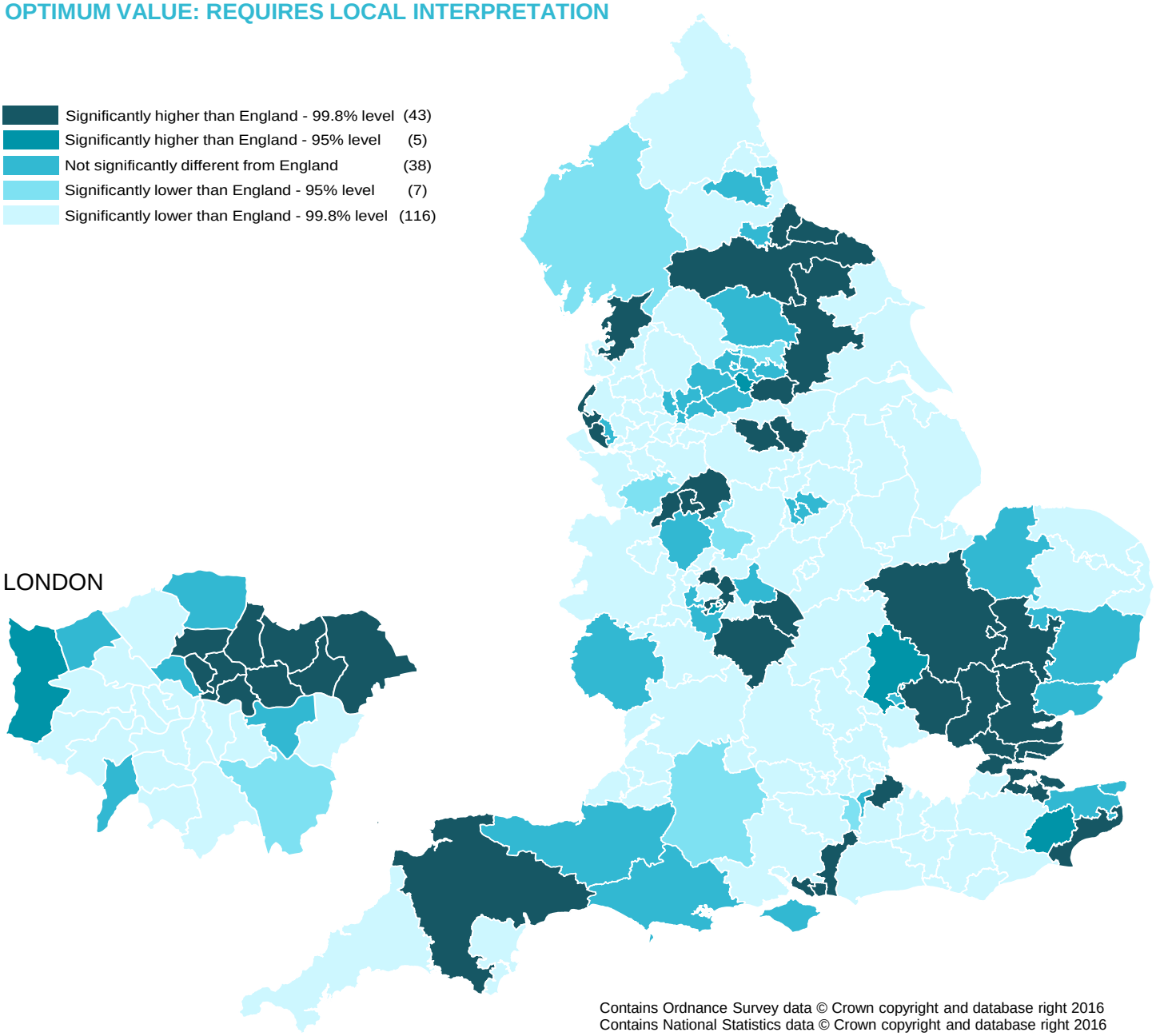
PHYSIOLOGICAL SERVICES

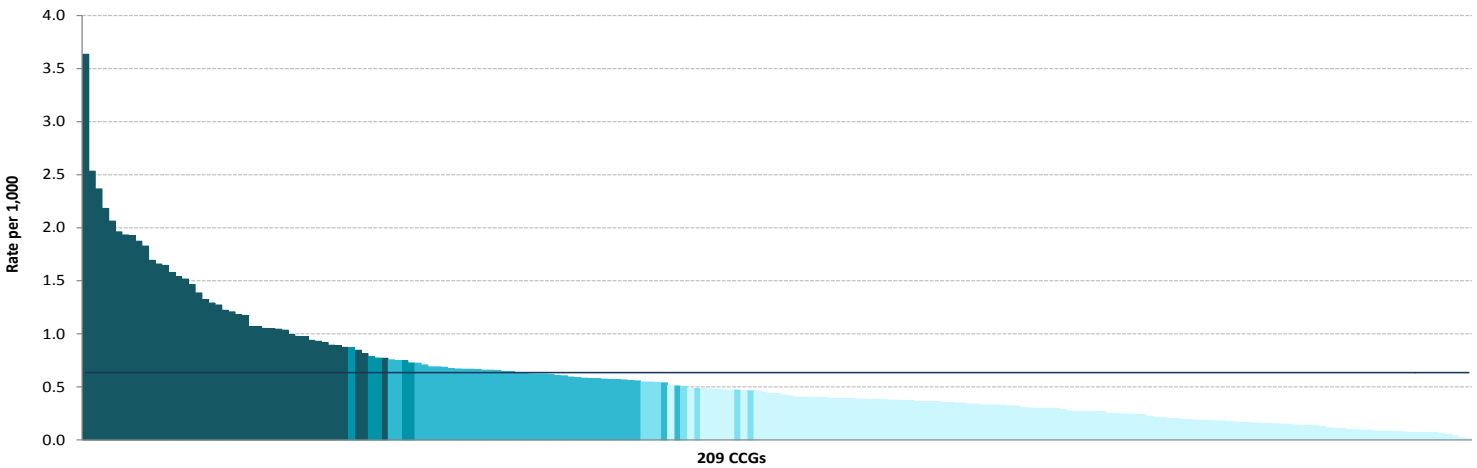
MAP 25: Rate of diagnostic sleep studies undertaken per weighted population by CCG

Adjusted for age, sex and 'need', January–March 2016

Domain 2: Enhancing quality of life for people with long-term conditions

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





Context

Sleep studies are conducted to identify abnormal sleep patterns and pathologies, and to assess and provide therapeutic intervention. There are more than 80 recognised sleep disorders, which may affect the timing, quality and quantity of sleep. Sleep disorders can vary from mild to life-threatening. Common sleep disorders are insomnia, sleep apnoea, restless leg syndrome, narcolepsy, and sleep problems associated with Parkinson's disease, autism and many other conditions.

Obstructive sleep apnoea (OSA) is the most common sleep disorder, affecting about 4% of the population. During sleep, muscles in the upper airway relax to a greater degree than normal or parts of the airway become blocked for one of several reasons, resulting in apnoeas or pauses in breathing lasting from 10 seconds to two minutes. Apnoeas can cause sleep disruption and poor-quality sleep, leading to daytime sleepiness with an increased risk of serious road traffic incidents. If left untreated, OSA can be a risk factor for stroke, cardiovascular problems or diabetes.

Obstructive sleep apnoea is more common in men than in women, and becomes increasingly more common in men with age. About 40% of people who are obese and 77% of people who are morbidly obese have OSA.[1]

There are two referral routes for sleep studies:

- respiratory
- neurological – in clinical neurophysiology departments, there is a higher mean cost but lower activity when compared with studies undertaken via the respiratory referral route

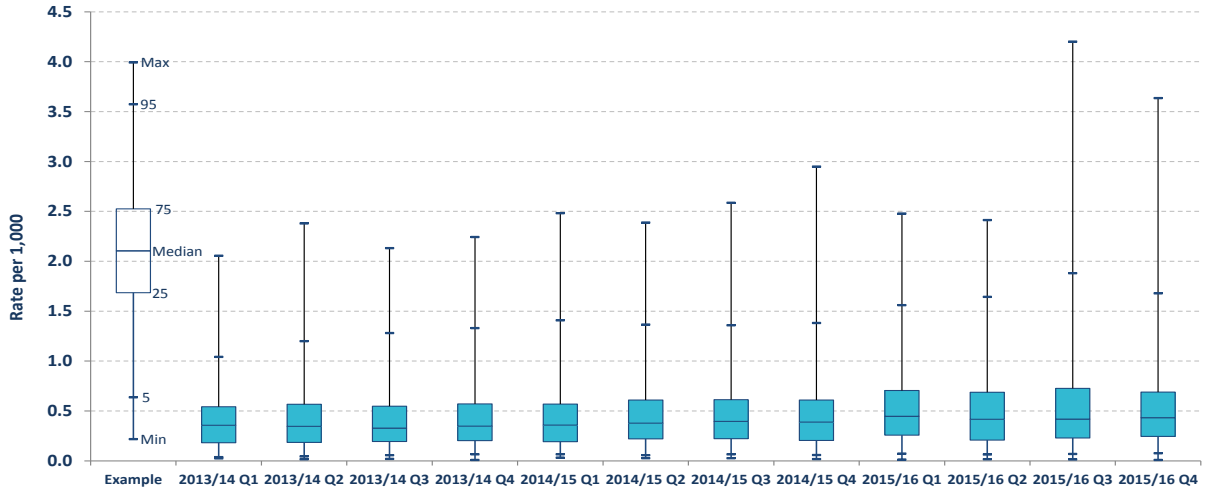
There was an increase of 69.5% in the commissioning of sleep studies from January 2007 to March 2013[2]. Reasons for this increase may be:

- the clearance of backlogs in accordance with the interim diagnostic waiting time targets and the maximum waiting time constitutional right
- other factors such as awareness-raising initiatives that may increase the demand for sleep studies and result in additional referrals

In addition there may be a demand for certain groups of patients, such as professional/commercial drivers with OSA, to be fast-tracked through the referral and management process in order to regain their driving licence and thereby retain their job and source of income.

As the real prevalence of symptomatic OSA is 4% in middle-aged men and up to 2% in middle-aged women,[3] current rates of provision of sleep studies may be too low. When the rates of polysomnography (PSG) sleep tests were compared in five countries, the UK's rate of provision was significantly lower than that in other countries.[4] In future, therefore, the number of sleep studies undertaken in England is likely to continue to increase.

Map 25: Boxplot of diagnostic sleep studies by CCG



		2013/14 Q1	2013/14 Q2	2013/14 Q3	2013/14 Q4	2014/15 Q1	2014/15 Q2	2014/15 Q3	2014/15 Q4	2015/16 Q1	2015/16 Q2	2015/16 Q3	2015/16 Q4	
Max-Min (Range)		2.0	2.4	2.1	2.2	2.4	2.4	2.6	2.9	2.5	2.4	4.2	3.6	WIDENING Significant
95th-5th percentile		1.0	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.5	1.6	1.8	1.6	WIDENING Significant
75th-25th percentile		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.4	WIDENING Significant
Median		0.4	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	INCREASING Significant

[1] O'Keefe T, Paterson E. Evidence supporting routine polysomnography before bariatric surgery. Obes Surg 2004; 14: 23-26.
[2] Public Health England and RightCare. The NHS Atlas of Variation in Healthcare September 2015: page 81 and Figure 19.1 on page 258.
[3] NHS Choices. Obstructive sleep apnoea. http://www.nhs.uk/conditions/Sleep-apnoea/Pages/Introduction.aspx
[4] Flemons WW, Douglas NJ, Kuna ST et al. Access to Diagnosis and Treatment of Patients with Suspected Sleep Apnea. American Journal of Respiratory and Critical Care Medicine 2004; 169; 668-672. doi: 10.1164/rccm200308-1124PP. http://www.atsjournals.org/doi/pdf/10.1164/rccm.200308-1124PP

Magnitude of variation

The map and column chart display the latest period (January-March 2016), during which CCG values ranged from 0.0 per 1,000 weighted population to 3.6 per 1,000 weighted population. The England value for this quarter was 0.6 per 1,000 weighted population.

The boxplot shows the distribution of CCG values for the period 2013/14 to 2015/16 by quarter. Throughout this period the distribution of values has been strongly positively skewed.

There has been significant widening of all three measures of variation. This is due to an upward stretching of the distribution with much greater increases in the maximum, 95th percentile and 75th percentile, than in the minimum, 5th percentile and 25th percentile.

The median increased very slightly from 0.36 per 1,000 weighted population to 0.43 per 1,000 weighted population, however the gradient of increase is statistically significant owing to the steady nature of the rise.

Reasons for the degree of variation observed are differences in:

- availability of the service
- prevalence of risk factors and related conditions, such as obesity
- symptom recognition and appropriate referral in primary care
- patient access including travelling distance

In localities with large sleep centres, which take many tertiary referrals, the rates of testing for sleep-related conditions tend to be higher.

Steier et al produced an overall risk map for OSA that could be used to predict relative prevalence estimates in the UK.[5] They found not only significant regional variation in predicted prevalence estimates, but also a significant mismatch between areas identified as having a high predicted prevalence estimate and the distribution of existing sleep centres.

Options for action

Commissioners together with service providers need:

- to review referral and delivery models for sleep services
- to agree clear pathways for referral, and to consider including GP screening tools
- to refine understanding of expected and observed prevalence of related conditions;
- to review funding models (for example, outcomes versus activity-based payments) to ensure the financial incentives drive improvement and increase value
- to assess the demand and available capacity for local sleep services
- to review models for initial diagnostic testing and triage approaches to referral management

Commissioners need to encourage service providers to participate in the national accreditation scheme, Improving Quality in Physiological Services (IQIPS; see 'Resources') to assess quality and productivity. Clinicians, especially those working in localities with a high prevalence of sleep disorders, can work to raise awareness of the need for sleep studies in the local population.

RESOURCES

- Transforming Respiratory And Sleep Diagnostic Services To Deliver 18 Weeks - A Good Practice Guide. Department of Health, February 2009. https://kinwahlin.wordpress.com/2009/04/08/transforming-respiratory-and-sleep-diagnostic-services-to-deliver-18-weeks-a-good-practice-guide-uk/
- NICE. Clinical Knowledge Summaries. Obstructive sleep apnoea syndrome. Last revised in April 2015. http://cks.nice.org.uk/obstructive-sleep-apnoea-syndrome
- British Lung Foundation. Obstructive sleep apnoea (OSA): Toolkit for commissioning and planning local NHS services in the UK. 2015. https://www.blf.org.uk/sites/default/files/OSA_Toolkit_2015_BLF_0.pdf
- Improving Quality in Physiological Services (IQIPS). https://www.iqips.org.uk/

[5] Steier J, Martin A, Harris J et al. Predicted relative prevalence estimates for obstructive sleep apnoea and the associated healthcare provision across the UK. Thorax doi:10.1136/thoraxjnl-2013-203887 http://thorax.bmj.com/content/early/2013/08/26/thoraxjnl-2013-203887.abstract

PHYSIOLOGICAL SERVICES

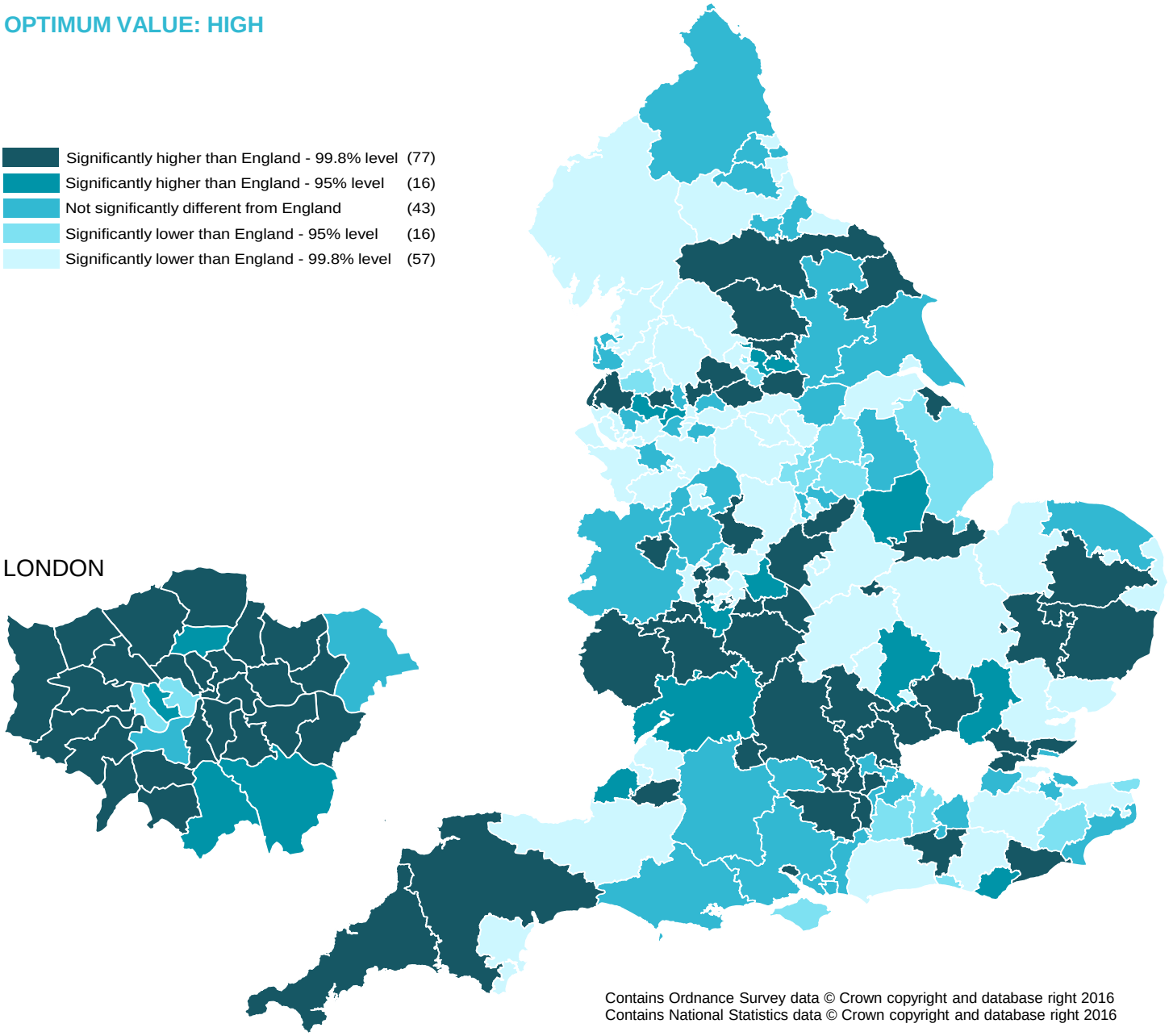
MAP 26: Percentage of patients with COPD with a record of FEV1 in the preceding 12 months[1] by CCG

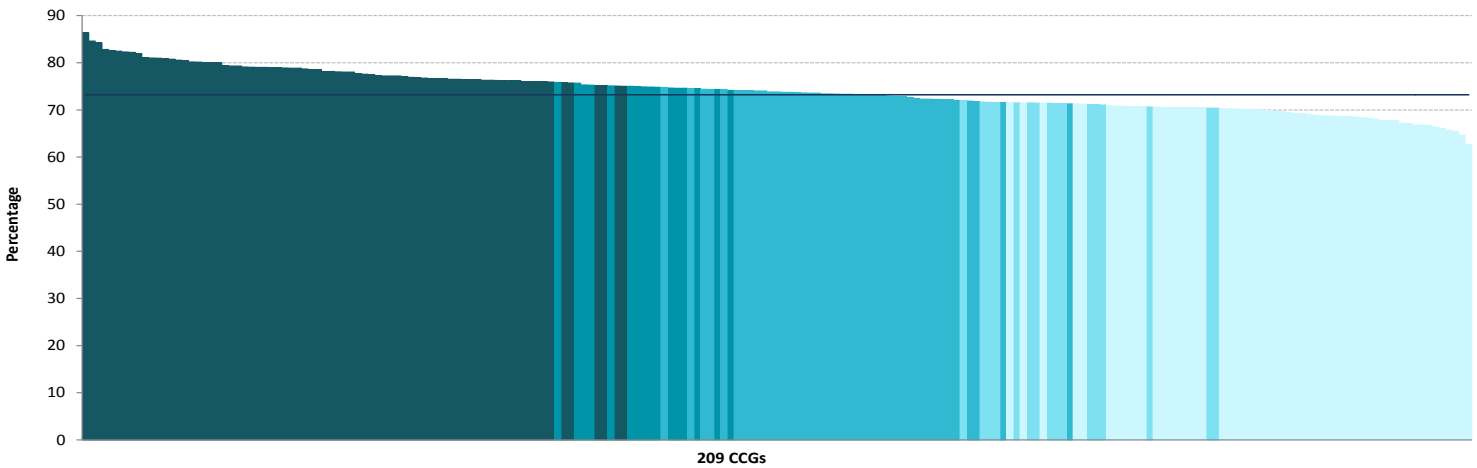
2014/15

Domain 1: Preventing people from dying prematurely

Domain 2: Enhancing quality of life for people with long-term conditions

OPTIMUM VALUE: HIGH





Context

NICE recommends spirometry as the objective test to identify abnormalities in lung volumes and air flow.[2] It is the standardised measurement of a forced expiration (FE) into a calibrated measuring device or spirometer. In conjunction with physical assessment, history-taking, blood tests and X-rays, spirometry is used to exclude or confirm particular types of lung disease including COPD.

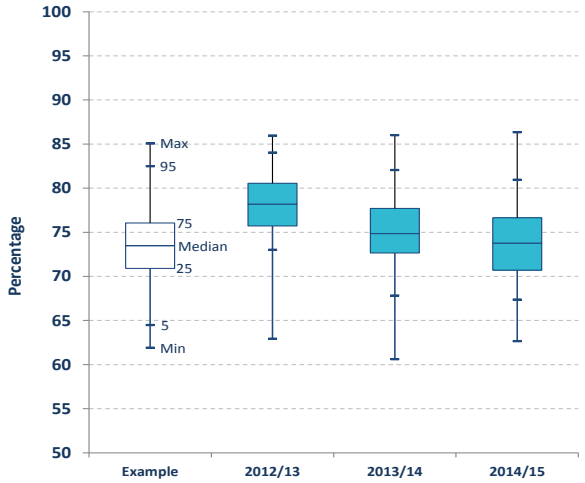
Most of the management for people with COPD is provided in the primary care sector. The long-term disease management delivered by GPs and nurses is likely to have a considerable impact on patient outcomes such as symptom control, quality of life, physical and social activity, admission to hospital and mortality.

This indicator – COPD004 in the Quality and Outcomes Framework (QOF) 2014/15[3] – reflects one aspect of the long-term disease management of COPD in primary care.[4] Under the QOF scheme GPs are rewarded for achieving an agreed level of population coverage for each indicator. In calculating coverage practices are allowed to except appropriate patients from the target population to avoid being penalised for factors beyond the GPs' control, for example, when patients do not attend for review despite repeated invitations or if a medication cannot be prescribed due to a contraindication or side-effect. Both the population coverage with exception-reported patients included and the exception-adjusted population coverage are reported annually.

For this indicator, excepted patients have been included in the denominator and therefore it shows actual population coverage.

People not seen for review, however, are at high risk of not receiving appropriate active long-term disease management and, therefore, of experiencing worse outcomes than people who do receive a review.

Map 26: Boxplot of patients with COPD with FEV1 record in previous 12 months (%) by CCG



Max-Min (Range)		23.0	25.4	23.7	No significant change
95th-5th percentile		11.0	14.2	13.6	No significant change
75th-25th percentile		4.8	5.0	5.9	No significant change
Median		78.2	74.8	73.8	No significant change

Magnitude of variation

The map and column chart display the latest period (2014/15), during which CCG values ranged from 62.7% to 86.3%, which is a 1.4-fold difference between CCGs. The England value for 2014/15 was 73.2%.

The boxplot shows the distribution of CCG values for the period 2012/13 to 2014/15. There was no significant change in any of the three variation measures between 2012/13 to 2014/15.

The median decreased from 78.2% in 2012/13 to 73.8% in 2014/15. This decrease is not statistically significant although a reduction of this magnitude is likely to be significant if it were observed over a longer time period.

One reason for unwarranted variation is differences in the accuracy of diagnosis of COPD. Spirometry is often performed inaccurately; consequently, around one-quarter of people on GP COPD registers have been incorrectly diagnosed. In the NICE COPD Quality Standard (see 'Resources') it is recommended that diagnostic spirometry should be carried out on calibrated equipment by healthcare professionals competent in its performance and interpretation. Primary care staff, however, are often inadequately trained or use poor-quality equipment. People wrongly included in or excluded from the COPD register on the basis of poor-quality spirometry may be receiving inappropriate and potentially harmful treatment. There is a considerable opportunity cost associated with this level of mis-diagnosis: the Department of Health estimated that up to £29 million is mis-spent on COPD medication for people who may not have COPD.

[1] QOF COPD004 with exception-reported patients included.
[2] NICE. Chronic obstructive pulmonary disease in over 16s: diagnosis and management. NICE guidelines [CG101]. June 2010. https://www.nice.org.uk/guidance/CG101
[3] BMA, NHS England and NHS Employers. 2014/15 General Medical Services (GMS) Contract QOF. Guidance for GMS Contract 2014/15. March 2014. http://www.nhsemployers.org/~/media/Employers/Documents/Primary%20care%20contracts/QOF/2014-15/14-15%20General%20Medical%20Services%20contract%20-%20Quality%20and%20Outcomes%20Framework.pdf
[4] This indicator was identical in the 2012/13 QQOF. Guidance for PCOs and practices. http://www.nhsemployers.org/Aboutus/Publications/Documents/QOF_2012-13.pdf but in the 2013/14 GMS contract QOF. Guidance for GMS contract 2013/14. http://www.nhsemployers.org/Aboutus/Publications/Documents/qof-2013-14.pdf the indicator number has been changed from "COPD10" to "COPD indicator 004" and the time-frame has been changed from 'in the preceding 15 months' to 'in the preceding 12 months'.

Options for action

Actual population coverage for systematic long-term disease management in people with COPD is lower than the QOF achievement suggests. It is possible that many of the people not attending for regular review or undertaking self-management programmes such as pulmonary rehabilitation are among the high-risk patients in whom control is poor[5]. Novel and creative strategies are necessary to reach people previously not reached in order to optimise their COPD control.

To increase local population coverage of long-term disease management in COPD and thereby influence patient outcomes, commissioners could consider interventions to help more local practices become effective at reaching the entire local population with COPD through regular review by:

- benchmarking and sharing local exception-reporting data
- identifying the systems to maximise patient-reach used in the best-performing practices
- supporting local practices with high exception rates to implement best-practice systems and improve patient outcomes through systematic chronic disease management

To ensure that COPD is diagnosed and treated appropriately within the local population, commissioners need:

- to commission quality-assured spirometry services with an agreed local pathway for referral from primary care, and ensure access to appropriate expertise in local lung function laboratories
- to support local spirometry services to apply for IQIPS accreditation (see 'Resources')
- to ensure that diagnostic spirometry in all local settings is performed only by professionals trained and certified as competent to Association for Respiratory Technology and Physiology (ARTP), or equivalent, standards

In addition clinicians in primary care need to review the diagnosis of people currently on the COPD register to identify individuals who may not have COPD.

RESOURCES

- Department of Health/Medical Directorate/Respiratory Team. An outcomes strategy for people with chronic obstructive pulmonary disease (COPD) and Asthma in England. July 2011. http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_127974
- Department of Health/Medical Directorate/Respiratory Team. An Outcomes Strategy for COPD and Asthma: NHS Companion Document. May 2012.
- http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_134000
- NHS Medical Directorate. COPD Commissioning Toolkit. A Resource for Commissioners. 2 August 2012. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/212876/chronic-obstructive-pulmonary-disease-COPD-commissioning-toolkit.pdf
- Primary Care Commissioning. A Guide to Performing Quality Assured Diagnostic Spirometry. 2013. http://cdn.pcc-cic.org.uk/sites/default/files/articles/attachments/spirometry_e-guide_1-5-13_0.pdf
- NICE. Chronic obstructive pulmonary disease in over 16s: diagnosis and management. NICE guidelines [CG101]. June 2010. https://www.nice.org.uk/guidance/CG101
- NICE. Chronic obstructive pulmonary disease in adults. NICE quality standard [QS10] Published: July 2011. Last updated: February 2016. https://www.nice.org.uk/guidance/qs10
- Public Health England. **I**NHALE – **IN**teractive **H**ealth **A**tlas for **L**ung conditions in **E**ngland. http://fingertips.phe.org.uk/profile/inhale
- The Primary Care Respiratory Society UK. http://www.pcrs-uk.org/
- Improving Quality in Physiological Services (IQIPS). https://www.iqips.org.uk/

[5] Andrew Keatin, Annemarie Lee and Anne E Holland. 2011. What prevents people with chronic obstructive pulmonary disease from attending pulmonary rehabilitation? A systematic review. *Chronic Respiratory Disease, 89-99.* http://crd.sagepub.com/content/8/2/89.full.pdf

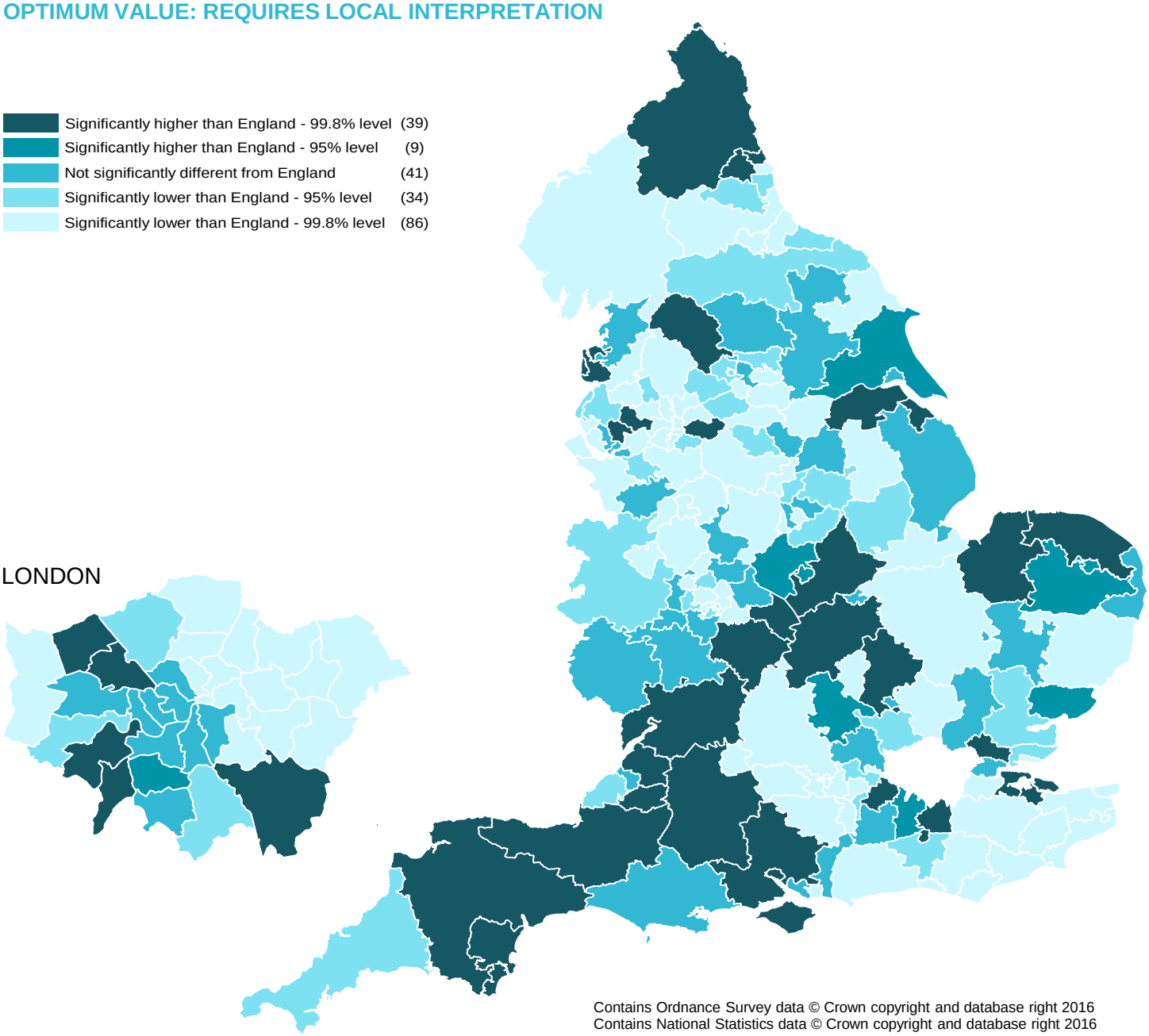
PHYSIOLOGICAL SERVICES

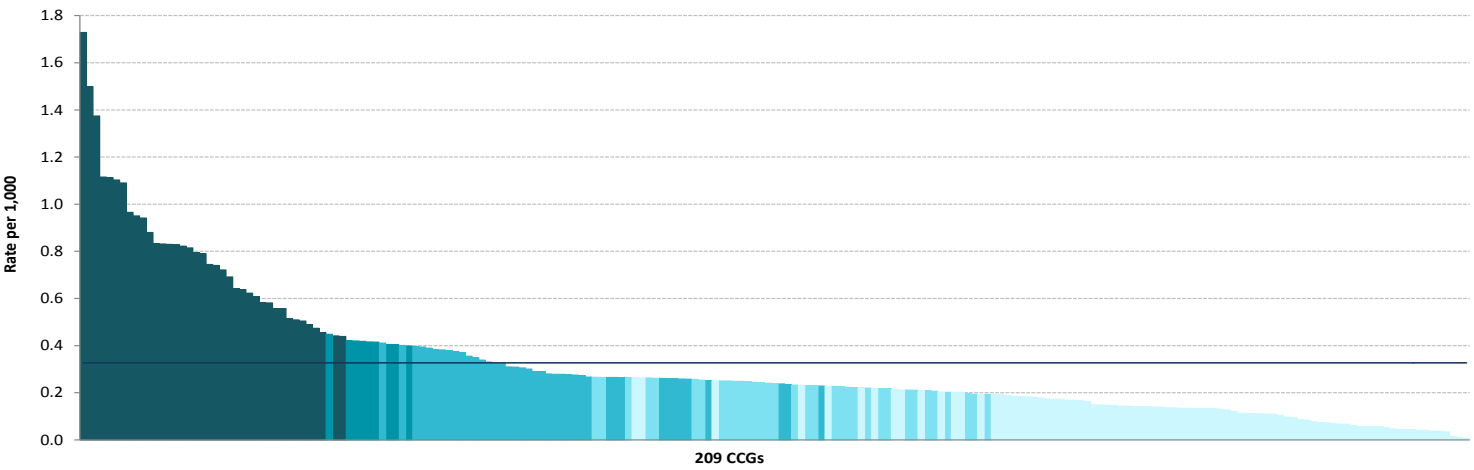
MAP 27: Rate of urodynamic (pressures and flows) tests undertaken per weighted population by CCG

Adjusted for age, sex and 'need', January–March 2016

Domain 2: Enhancing quality of life for people with long-term conditions

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





Context

Urodynamic testing is an umbrella term, which predominantly involves the measurement of pressure and flow. It enables the clinician to determine what physical factors are involved in bladder disorders. This is important, for example, in the diagnosis of different types of incontinence for which there are different indicated treatments. Urodynamic testing allows the patient to be offered the optimal therapy. The largest groups of patients undergoing urodynamic tests are:

- men with bladder outlet obstruction
- women with incontinence

The underlying conditions that require urodynamic tests are more prevalent in older people.

There was a small decrease of 0.28% per annum in the rate of urodynamic (pressures and flows) testing from January 2007 to March 2013[1]. This indicates no substantial trend in the short to medium term, with the average rate of testing of 1.75 tests per 1000 weighted population. This rate may need to increase in future to reflect an increase in the prevalence and incidence of key conditions as the population ages. Within the next ten years ONS projections predict that the number of people over 60 years of age will have increased by around 22%.[2]

Data for this indicator is taken from DM01, which collects data only on standard urodynamic tests (cystometrograms, video-cystometrograms and ambulatory urodynamics) and not on a less-specialised test known as uroflowmetry (free flow rate).

Magnitude of variation

The map and column chart display the latest period (2015/16 Q4), during which CCG values ranged from 0.0 per 1,000 weighted population to 1.73 per 1,000 weighted population. The England value for this period was 0.33 per 1,000 weighted population .

The boxplot shows the distribution of CCG values for the period 2013/14 to 2015/16 by quarter.

There was a very slight narrowing of 75th to 25th percentile gap, which was statistically significant owing to the relatively high number of periods over which the narrowing was observed.

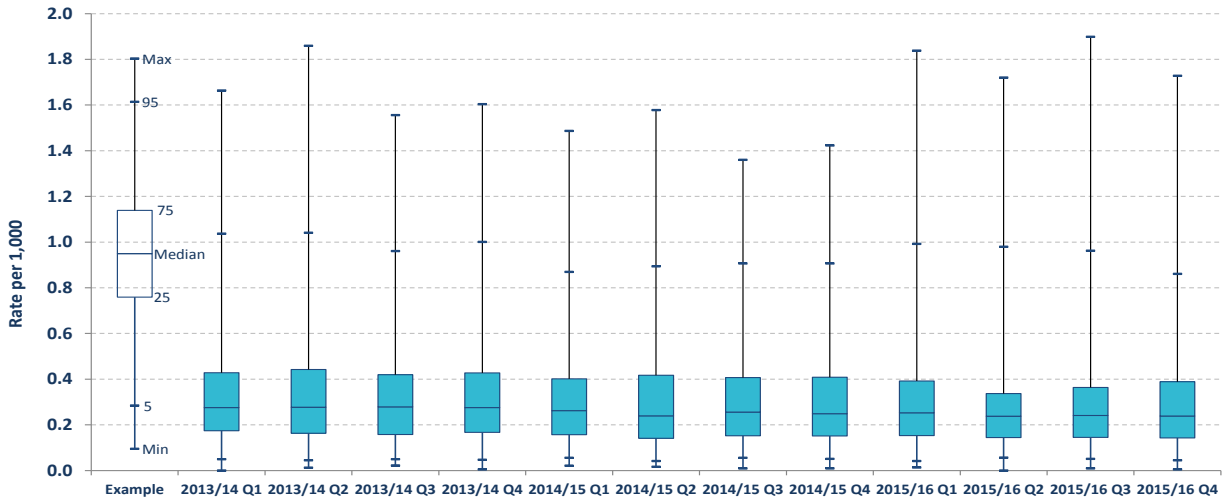
There was no significant change in the maximum to mimimum range nor in the 95th to 5th percentile gap.

There was a small decrease in the median, which was statistically significant owing to the steady nature of the fall and the relatively high number of periods over which the decrease was observed.

Possible reasons for the degree of variation observed include differences in:

- presence of a large spinal injury unit – localities with or near such units have high rates of testing
- presence of a tertiary centre for continence – localities with or near such centres have rates of testing above average

Map 27: Boxplot of rate of urodynamic tests by CCG



Max-Min (Range)		1.66	1.85	1.53	1.60	1.47	1.56	1.35	1.41	1.82	1.72	1.89	1.72	No significant change
95th-5th percentile		0.99	1.00	0.91	0.95	0.81	0.85	0.85	0.86	0.95	0.92	0.91	0.82	No significant change
75th-25th percentile		0.25	0.28	0.26	0.26	0.24	0.28	0.26	0.26	0.24	0.19	0.22	0.25	NARROWING Significant
Median		0.28	0.28	0.28	0.28	0.26	0.24	0.26	0.25	0.25	0.24	0.24	0.24	DECREASING Significant

[1] RightCare. The NHS Atlas of Variation in Diagnostic Services November 2013; page 113 and Figure 27.1 on page 191.
[2] Office of National Statistics, Subnational population projections for England: 2014-based projections

- capacity, including availability of departments, trained staff and appropriate equipment, for example, the number of tests performed each month in some services can often be explained by the presence of key members of staff
- lack of national guidelines about which diagnostic tests need to be performed in patients with bladder outlet obstruction and incontinence

Options for action

At present there are few guidelines about where and how the urodynamic (pressures and flows) tests should be used (NICE CG171 and CG148, International Continence Society and European Association of Urology; see 'Resources'). There is an urgent need to develop improved professional guidelines and/or agreements on local pathways and models of care.

The focus for commissioners is to ensure equity of access to services:

- if basic urodynamic tests can be easily and more conveniently carried out in primary care, commissioners need to investigate this option where it has the potential to increase access and reduce unwarranted variation
- by reviewing local capacity in relation to demography, especially the proportion of older people and whether that will increase in future

Commissioners and service providers need to consider developing local models and pathways for how urodynamic tests are used in key diagnostic and treatment pathways.

Service providers need to address quality and productivity in local services via participation in the national accreditation scheme, Improving Quality in Physiological Services (IQIPS; see 'Resources').

RESOURCES

- NICE. Urinary incontinence in women: management. NICE guidelines [CG171]. Published: September 2013. Last updated: November 2015. https://www.nice.org.uk/guidance/cg171
- NICE Pathways. Urinary incontinence in women overview. http://pathways.nice.org.uk/pathways/urinary-incontinence-in-women
- NICE. Urinary incontinence in neurological disease: diagnosis and management. NICE guidelines [CG148]. August 2012. https://www.nice.org.uk/guidance/cg148
- NICE Pathways. Urinary incontinence in neurological disease overview. http://pathways.nice.org.uk/pathways/urinary-incontinence-in-neurological-disease
- Rosier PFWM, Schaefer W, Lose G et al. International Continence Society Standard: Good Urodynamic Practices and Terms 2015. Urodynamics, Uroflowmetry, Cystometry and Pressure-Flow Study. www.ics.org/Documents/DocumentsDownload.aspx?DocumentID=3077
- Homma Y (Chairman) Urodynamics. International Continence Society. http://www.ics.org/publications/ici_2/chapters/chap07.pdf
- Lucas MG (Chair) Bedretdinova D, Bosch JLHR et al. Guidelines on Urinary Incontinence. European Association of Urology. April 2014. https://uroweb.org/wp-content/uploads/20-Urinary-Incontinence_LR.pdf
- Improving Quality in Physiological Services (IQIPS). https://www.iqips.org.uk/

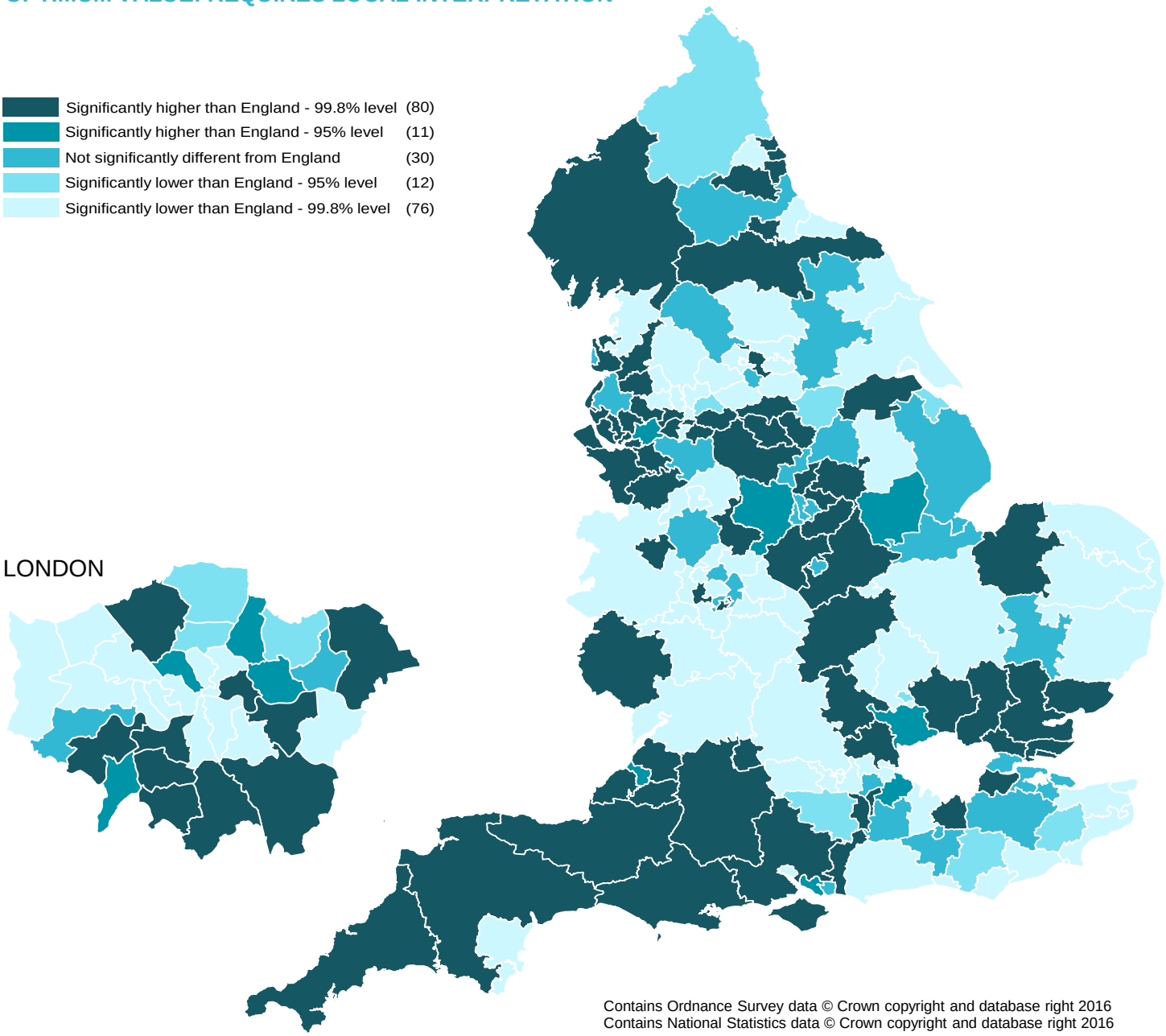
PHYSIOLOGICAL SERVICES

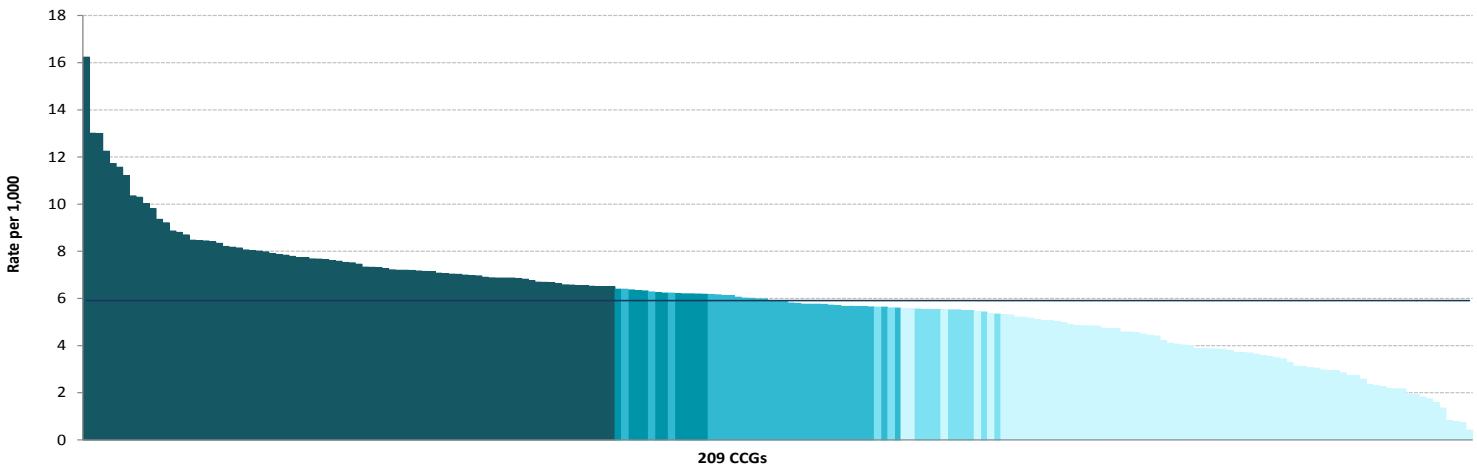
MAP 28: Rate of echocardiography activity undertaken per weighted population by CCG

Adjusted for age, sex and 'need', January–March 2016

Domain 2: Enhancing quality of life for people with long-term conditions

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





Context

Echocardiography uses ultrasound to produce images that diagnose or exclude abnormalities of the heart and major thoracic vessels. Trans-thoracic echocardiography (TTE) uses a probe placed on the chest, whereas trans-oesophageal echocardiography (TOE) uses a probe passed into the oesophagus. Both techniques measure the size, structure and function of the heart's chambers, valves and major blood vessels, and detect congenital anomalies.

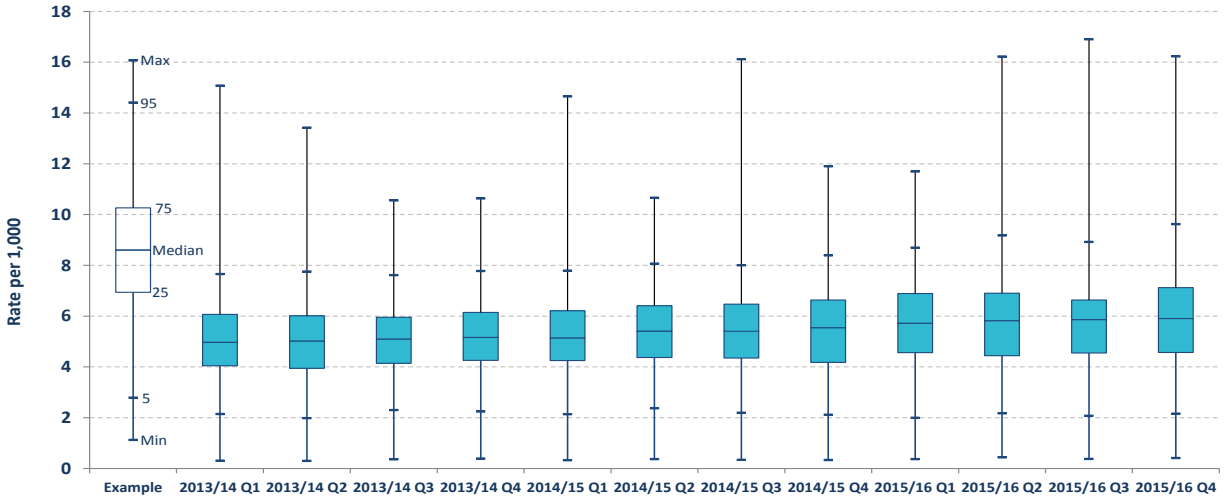
Currently, the vast majority of echocardiograms are performed in hospital, although provision in primary care is increasing.

There was an increase of 43.0% in the commissioning of echocardiography from January 2007 to March 2013[1]. Future demand is expected to rise for the following reasons:

- population ageing: (i) the incidence of heart failure increases with age, with an average age at first diagnosis of 76 years.[2] Heart failure is the leading cause of hospitalisation in people aged over 65 years[3], and an increase of 50% in the number of hospital admissions due to heart failure is projected to occur over the next 25 years.[4] Echocardiography is central both to the diagnosis of heart failure and to determining the aetiology[5]; (ii) valvular heart disease also increases with age, is underdiagnosed, and echocardiography is the principal test for detection and continued surveillance
- new indications for routine use of echocardiography: (i) monitoring cardiac side-effects of new drugs (such as Herceptin treatment for breast cancer); (ii) supplementing clinical management in acute and critical care and before surgery
- increasing life expectancy of patients with congenital heart disease
- demand for stress echocardiography in coronary heart disease[6]
- care pathways that promote the use of echocardiography in primary care (such as for heart failure)

The use of echocardiography to investigate heart failure is lower in the UK than in other European countries. In the Euro Heart Survey[7] around 35% of UK patients with acute heart failure were investigated by echocardiography compared with an average of 55% across Europe[8].

Map 28: Boxplot of echocardiographic activity by CCG



Max-Min (Range)		14.8	13.1	10.2	10.2	14.3	10.3	15.8	11.6	11.3	15.8	16.5	15.8	No significant change
95th-5th percentile		5.5	5.8	5.3	5.5	5.7	5.7	5.8	6.3	6.7	7.0	6.8	7.5	WIDENING Significant
75th-25th percentile		2.0	2.1	1.8	1.9	2.0	2.0	2.1	2.5	2.3	2.5	2.1	2.6	WIDENING Significant
Median		5.0	5.0	5.1	5.2	5.1	5.4	5.4	5.5	5.7	5.8	5.9	5.9	INCREASING Significant

[1] RightCare. The NHS Atlas of Variation in Diagnostic Services November 2013; page 115 and Figure 28.1.
[2] Cowie MR, Wood DA, Coats AJS et al. Incidence and aetiology of heart failure. A population-based study. European Heart Journal 1999; 20: 421-428. http://www.bhf.org.uk/publications/view-publication.aspx?ps=1000626
[3] NICE. Acute heart failure: diagnosis and management. NICE guidelines [CG187]. October 2014. https://www.nice.org.uk/guidance/CG187
[4] NICE. Chronic heart failure in adults: management. NICE guidelines [CG108]. August 2010. https://www.nice.org.uk/guidance/CG108
[5] McMurray JJV, Adamopoulos S, Anker SD et al. ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2012. doi: http://dx.doi.org/10.1093/eurheartj/ehs104 1787-1847 First published online: 19 May 2012. http://eurheartj.oxfordjournals.org/content/33/14/1787
[6] NICE. Chest pain of recent onset: assessment and diagnosis. NICE guidelines [CG95]. March 2010. https://www.nice.org.uk/guidance/CG95
[7] European Society of Cardiology. Euro Heart Survey. http://www.escardio.org/guidelines-surveys/ehs/Pages/welcome.aspx
[8] The Euro Heart Failure survey programme - a survey on the quality of care among patients with heart failure in Europe. Part 1: patient characteristics and diagnosis. European Heart Journal 2003; 24: 442–463. http://eurheartj.oxfordjournals.org/content/24/5/442

Furthermore use in the UK is substantially lower than that in the US, where performance of TTE is associated with lower mortality across a range of cardiovascular diseases, and yet the intervention is still considered to be underutilised.[9]

NICE guidance recommends that a brain natriuretic peptide (BNP) blood test be used to help rule out heart failure[4], but it has not reduced the demand for echocardiography for various reasons including:

- an echocardiogram has to be performed when the BNP test result is abnormal[4], and the number of BNP tests is rising
- echocardiography helps to identify the cause of heart failure, not simply its presence
- the specificity of BNP means that it is not able to replace echocardiography

Magnitude of variation

The map and column chart display the latest period (January-March 2016), during which CCG values range from 0.4 to 16.2 per 1,000 weighted population, which is a 39.5-fold difference between CCGs. The England value for this quarter was 5.9 per 1,000 weighted population.

The boxplot shows the distribution of CCG values for the period 2013/14 to 2015/16 by quarter.

There was a small but significant widening of the 95th to 5th percentile gap, and of the 75th to 25th percentile gap. This means that the dispersion of CCG echocardiography rates increased slightly both at the extremities and in the central part of the distribution.

There was no significant change in the maximum to minimum range.

There was a small but steady and statistically significant increase in the median of CCG rates from 5.0 to 5.9 per 1,000 weighted population.

The degree of variation observed may be explained, for example, by differences in:

- the size and structure of local and regional echocardiography departments
- levels of echocardiography provided in the community
- the availability of appropriately trained staff
- care pathways involving the use of echocardiography
- criteria/policies adopted for case selection
- the adequacy of training provided in echocardiography departments
- patient access

Options for action

To reduce unwarranted variation in echocardiography, commissioners need to consider:

- supporting services in centres that are actively training, and have a track record of producing qualified echocardiographers
- confirming that a centre has adequate and sustainable capacity and staffing
- supporting services in community settings (with appropriate clinical governance and quality control), which may be more convenient for patients
- requiring robust data collection to quantify local incidence and prevalence of cardiovascular disease and to monitor demand and patient outcomes over time
- using commissioning levers to improve quality, for example, by encouraging participation in the national accreditation scheme, Improving Quality in Physiological Services (IQIPS; see 'Resources')

RESOURCES

- NICE. Acute heart failure: diagnosis and management. NICE guidelines [CG187]. October 2014. https://www.nice.org.uk/guidance/CG187
- NICE Pathways. Acute heart failure overview. http://pathways.nice.org.uk/pathways/acute-heart-failure
- NICE. Chronic heart failure in adults: management. NICE guidelines [CG108]. August 2010. https://www.nice.org.uk/guidance/CG108
- NICE Pathways. Chronic heart failure overview. http://pathways.nice.org.uk/pathways/chronic-heart-failure
- McMurray JJV, Adamopoulos S, Anker SD et al. ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure 2012. doi: http://dx.doi.org/10.1093/eurheartj/ehs104 1787-1847 First published online: 19 May 2012. http://eurheartj.oxfordjournals.org/content/33/14/1787
- Improving Quality in Physiological Services (IQIPS). https://www.iqips.org.uk/

[8] Papolos A, Narula J, Bavishi C et al. U.S. Hospital Use of Echocardiography Insights From the Nationwide Inpatient Sample. Journal of the American College of Cardiology 2016; 67: 502-511. http://content.onlinejacc.org/article.aspx?articleid=2485051

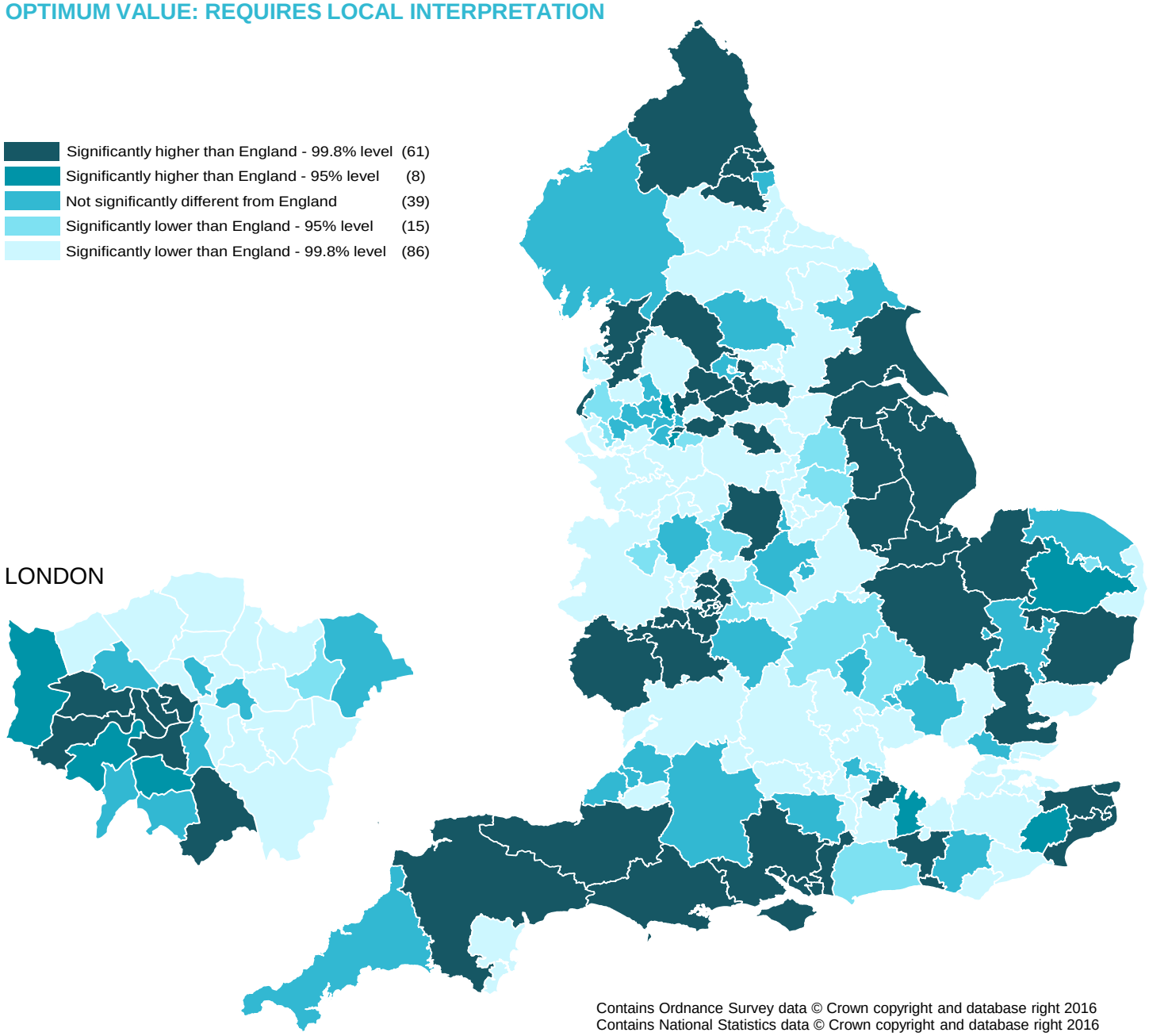
PHYSIOLOGICAL SERVICES

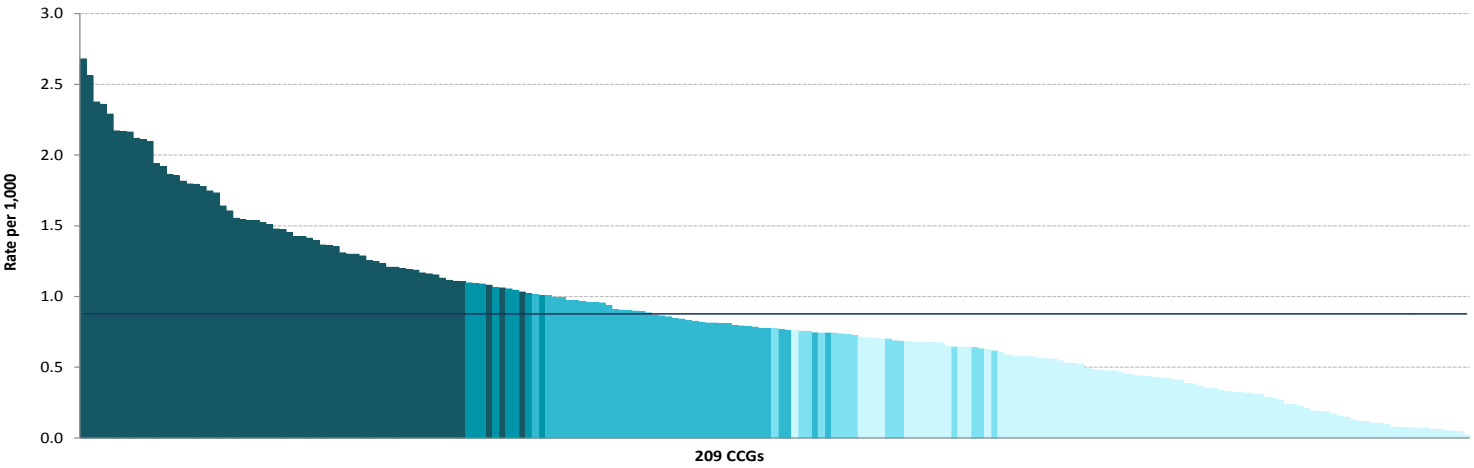
MAP 29: Rate of peripheral neurophysiology tests undertaken per weighted population by CCG

Adjusted for age, sex and 'need', January–March 2016

Domain 2: Enhancing quality of life for people with long-term conditions

OPTIMUM VALUE: REQUIRES LOCAL INTERPRETATION





Context

Peripheral neurophysiology is concerned with the peripheral neuromuscular system only. The core tests provided by clinical neurophysiology departments in peripheral neurophysiology are:

- nerve conduction studies (NCS)
- electromyography

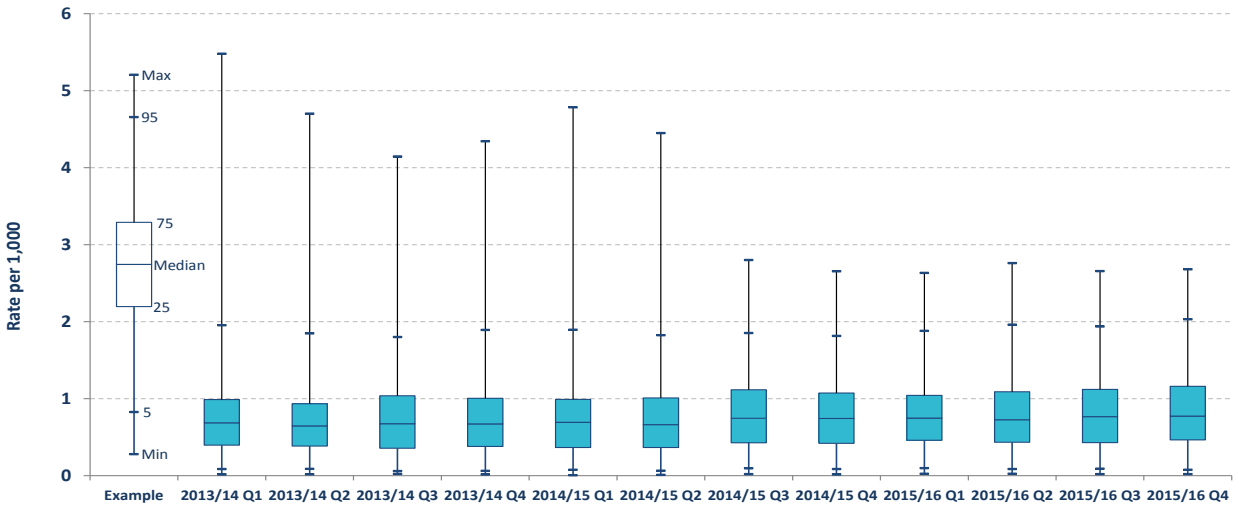
Nerve conduction studies involve electrical stimulation of peripheral nerves with recording of responses from nerves and muscles. It is used to investigate a range of peripheral nerve and muscle disorders, the most common of which is carpal tunnel syndrome (CTS), the entrapment of the median nerve as it passes through the carpal tunnel in the wrist.[1]

The annual incidence of CTS is about 1-3 presentations per 1,000 population in England. The average annual incidence of neurophysiologically confirmed CTS in East Kent from 1991 to 2001, corrected to the World Health Organization standard population, was 1.2 per 1,000 population for women and 0.6 per 1,000 population for men.[2] Carpal tunnel syndrome affects up to 3.5% of the population in England. In southern Sweden Atroshi et al found a prevalence of 3.8% for 'clinically certain' CTS and a prevalence of 2.7% for 'electrophysiolgically confirmed' CTS.[3]

Across England about 50% of NCS are related to CTS and 10% to ulnar nerve testing. In localities where there is no access to NCS through a CTS care pathway or the pathway does not involve a clinical neurophysiology service, patients with CTS are often seen by an orthopaedic surgeon who may not use NCS to inform the decision to operate. In the absence of a large prospective randomised controlled trial of the value of pre-surgical NCS, it is not possible to identify the exact contribution NCS makes to surgical success, as defined by whether patients consider their condition improved or cured. In 'ordinary' practice, surgical decompression has excellent results in only 75% of cases of CTS.[4] In a study of 6,263 patients in East Kent the surgical success rate for orthopaedic carpal tunnel decompression was 77%,[5] whereas that for 543 patients whose surgical management included NCS was 88%.[6] It is likely, however, that a correct diagnosis or classification of CTS by peripheral neurophysiology leads to better clinical outcomes.

Electromyography is a mildly invasive procedure, involving the insertion of a needle into muscle, which can help to elicit the causes of muscle weakness and other muscle symptoms such as pain and involuntary movements.

Map 29: Boxplot of rate of peripheral neurophysiology tests by CCG



Max-Min (Range)		5.5	4.7	4.1	4.3	4.8	4.4	2.8	2.6	2.6	2.7	2.6	2.7	NARROWING Significant
95th-5th percentile		1.9	1.8	1.7	1.8	1.8	1.8	1.8	1.7	1.8	1.9	1.8	2.0	No significant change
75th-25th percentile		0.6	0.6	0.7	0.6	0.6	0.6	0.7	0.7	0.6	0.7	0.7	0.7	No significant change
Median		0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	INCREASING Significant

[1] Browning P. Carpal Tunnel Syndrome Imaging. http://www.emedicine.com/radio/topic135.htm
[2] Bland JDP, Rudolfer SM. Clinical surveillance of carpal tunnel syndrome in two areas of the United Kingdom, 1991-2001. J Neurol Neurosurg Psychiatry 2003; 74: 1674-1679. http://jnnp.bmj.com/content/74/12/1674.full.pdf
[3] Atroshi I, Gummesson C, Johnsson R et al. Prevalence of carpal tunnel syndrome in a general population. JAMA 1999; 282: 153-158. http://www.ncbi.nlm.nih.gov/pubmed/10411196
[4] Bland JD. Treatment of carpal tunnel syndrome. Muscle Nerve 2007; 36: 167-171. http://www.ncbi.nlm.nih.gov/pubmed/17534984
[5] East Kent Hospitals University NHS Foundation Trust. Carpal-Tunnel.net. Surgical Prognosis. http://www.carpal-tunnel.net/treatments/sprognosis
[6] Information received from Jeremy Bland, East Kent Hospitals University NHS Foundation Trust.

There was a 2.7% increase in the commissioning of peripheral neurophysiology testing from January 2007 to March 2013[7]; in some localities where there is good availability of the service there was a much greater increase in the rate of provision.

Magnitude of variation

The map and column chart display the latest period (January-March 2016), during which CCG values ranged from 0.0 to 2.7 per 1,000 weighted population, which is a 144.6-fold difference between CCGs. The England value for this quarter was 0.9 per 1,000 weighted population.

The boxplot shows the distribution of CCG values for the period 2013/14 to 2015/16 by quarter.

The range between the maximum and minimum values narrowed significantly which was entirely due to a dramatic step down and subsequent plateauing in the maximum CCG value from the October-December 2014 quarter onwards.

There was no signifcant change in the 95th to 5th percentile gap nor in the 75th to 25th percentile gap.

There was a small but steady and statistically significant increase in the median of CCG rates from 0.7 to 0.8 per 1,000 weighted population.

Reasons for the degree of variation observed are differences in:

- availability of clinical neurophysiology services – localities with or near a large department tend to have higher rates of testing (variation in the rates of EEG testing is likely to mirror the variation in peripheral neurophysiology testing)
- service models and pathways for the use of clinical neurophysiology in key diagnostic pathways, the most important being the management of CTS – some localities always manage CTS using peripheral neurophysiology whereas other localities never use peripheral neurophysiology to manage CTS
- access to NCS through local CTS care pathways
- clinical practice – both consultant clinical neurophysiologists and clinical physiologists can perform and report investigations, which affects level of access to and cost of the service
- availability of and access to appropriate staff – at present the provision of training programmes for medical and skilled clinical physiologists is not keeping pace with a combination of factors in particular the expansion of services and the numbers of people leaving the service or retiring
- regional referral rates
- the balance between the public and private provision of services – in localities where the provision of clinical neurophysiology services appears to be low, there is likely to be a private sector or alternative service available

Options for action

Commissioners need to review referral and delivery models across neurophysiology services. To reduce unwarranted variation in neurophysiology test activity, commissioners could consider:

- developing robust data collection systems to improve understanding of the incidence and prevalence of conditions of the peripheral neuromuscular system in the local population
- reviewing funding models (for example, outcomes versus activity-based payments) to ensure there are no perverse financial incentives to appropriate service delivery
- assessing future demand and current capacity for local neurophysiology services to ensure the availability of services and equity of access
- investigating new service models that have appropriate governance and/or audit arrangements in place to ensure a high-quality of service is maintained, for example, undertaking most CTS activity through clinical physiologist-led clinics
- using commissioning levers to improve quality, for example, through schemes such as Improving Quality in Physiological Services (IQIPS; see 'Resources')

RESOURCES

- Improving Quality in Physiological Services https://www.iqips.org.uk/

[7] RightCare. The NHS Atlas of Variation in Diagnostic Services November 2013; page 121 and Figure 30.1 on page 192.

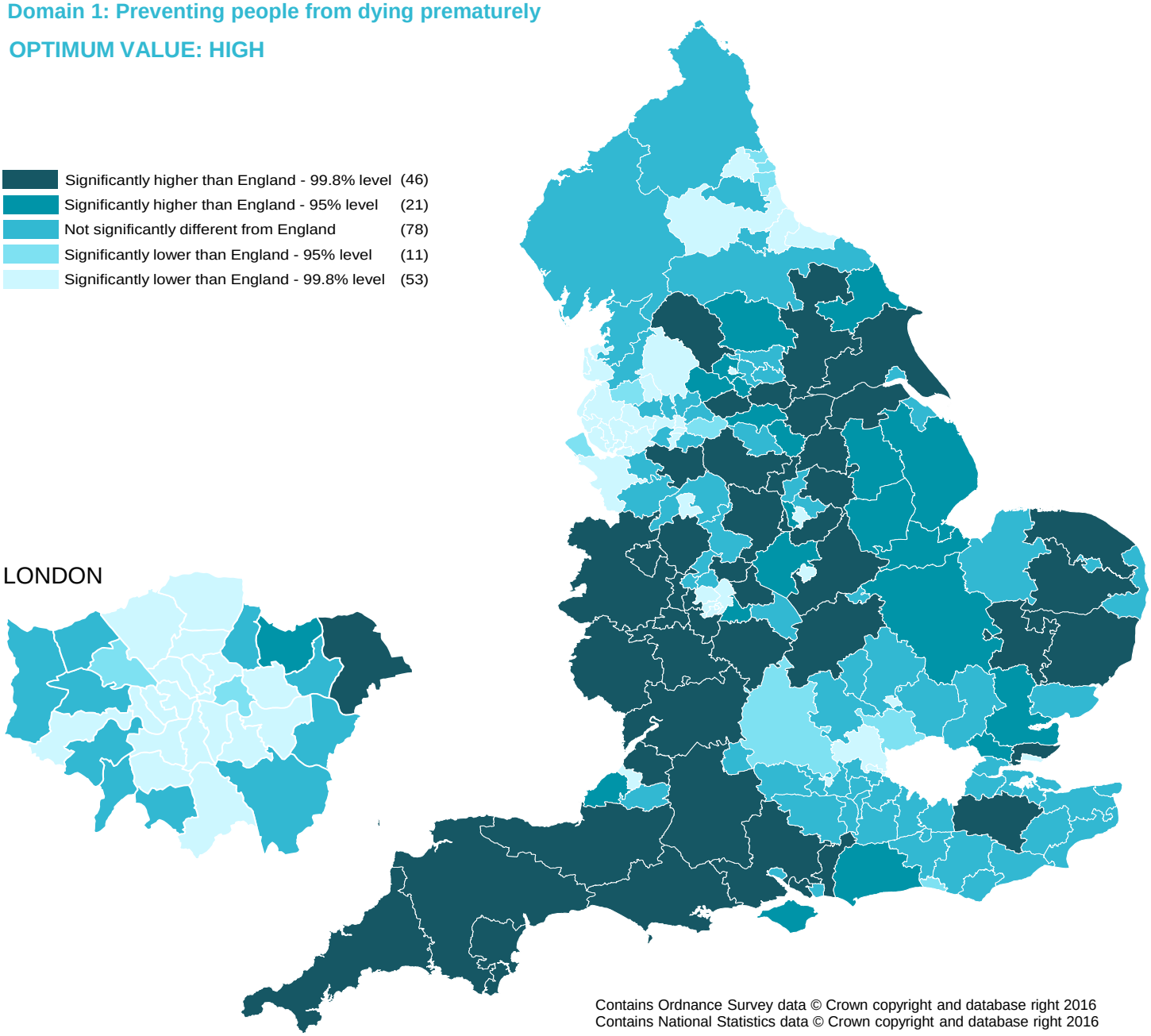
SCREENING SERVICES

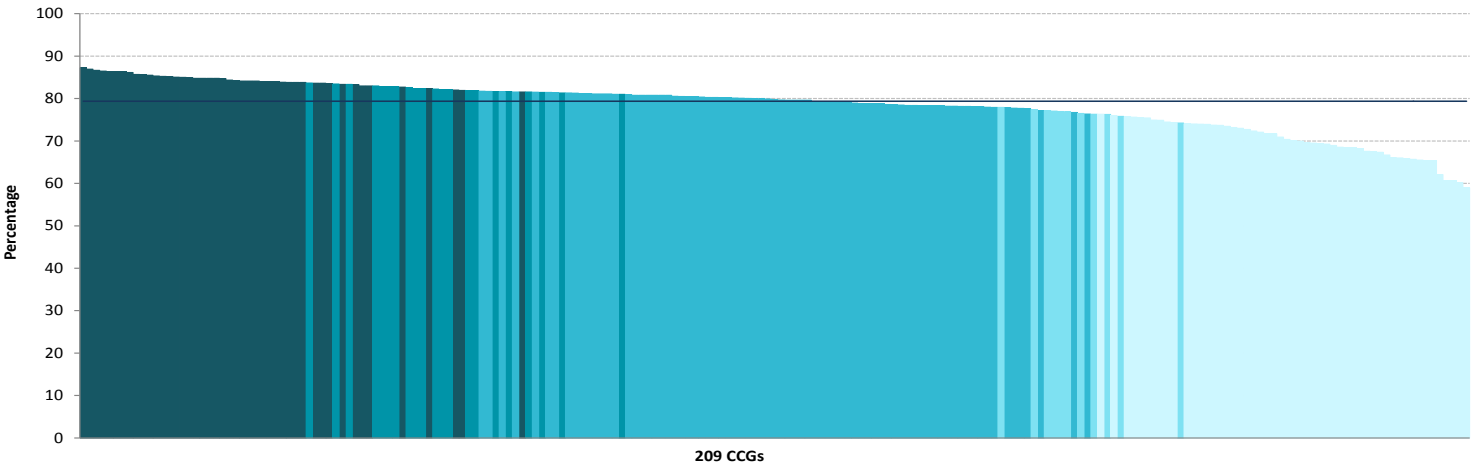
MAP 30: Percentage coverage for initial screening tests for men aged 65 years in the NHS abdominal aortic aneurysm (AAA) screening programme by CCG

2014/15

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: HIGH





Context

An aneurysm is the result of stretching caused by a weakness in the wall of an artery, usually as a result of degeneration due to ageing and external factors such as smoking, high levels of cholesterol and high levels of blood pressure. Although aneurysms can occur in any artery, one of the common places for aneurysm formation is the abdominal aorta. Aneurysms can be asymptomatic, but with a larger aneurysm (>5.5cm) there is a risk of rupture, which can cause severe internal bleeding. Four out of five people with a ruptured aortic aneurysm will die.[1]

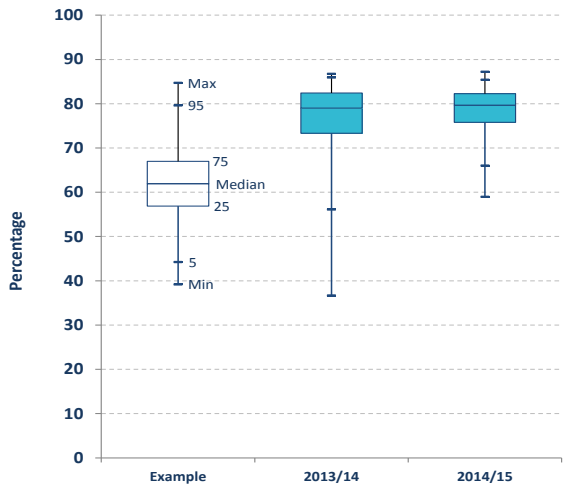
The aim of the NHS abdominal aortic aneurysm (AAA) screening programme is to reduce AAA-related mortality in men aged 65-74 years. The screening programme is open to all men over the age of 65 years, in which a non-invasive ultrasound test is performed to detect AAA. Participants are given the results immediately, and a letter containing the results is also sent to each participant's GP.

Magnitude of variation

The map and column chart display the latest period (2014/15), during which CCG values ranged from 59.0% to 87.2%, which is a 1.5-fold difference between CCGs. The England value for 2014/15 was 79.3%.

The boxplot shows the distribution of CCG values for the period 2013/14 to 2014/15. The statistical significance of changes in the three variation measures or the median was not tested for those indicators with fewer than three data periods.

Map 30: Boxplot of coverage of initial tests for men in NHS AAA screening programme (%) by CCG



Max-Min (Range)		50.1	28.3	NARROWING
95th-5th percentile		29.8	19.4	NARROWING
75th-25th percentile		9.1	6.5	NARROWING
Median		79.0	79.7	INCREASING

One reason for warranted variation in the coverage of initial screening test for AAA is the choice about whether to participate by men eligible and invited for screening.

The socioeconomic profile of local populations, however, is known to affect rates of screening acceptance.

Reasons for unwarranted variation could include differences in:

- the way local providers of AAA screening services manage the possibility of non-attendance – in some local AAA screening programmes pre-notification lists are sent to GPs with a request to be informed about any men who are unfit for screening, such as people with learning disabilities
- strategies used to reach underserved groups in the local population
- the handling and recording of call and recall information for men eligible for screening
- accessibility of screening venues

Differences in the prevalence of obesity in local populations can affect the number of conclusive scans obtained by ultrasound. Fatty tissue can obscure the image of the aorta resulting in a non-visualised scan. To obtain a clear image men with an initial non-visualised scan need to be scanned at the medical imaging unit of the local vascular service.

Options for action

Commissioners need to specify that local providers of AAA screening services adhere to:

- the service specification and the care pathway for the NHS AAA screening programme (see 'Resources')
- the standards set for the AAA screening programme by the NHS national screening programme (see 'Resources')
- the failsafe processes that support the implementation of the care pathway for AAA screening (see 'Resources')

Commissioners also need to specify that local screening services refer participants to treatment centres that adhere to the framework for improving the results of elective AAA repair developed by The Vascular Society of Great Britain & Ireland (see 'Resources').

[1] Reimerink JJ, van den Laan MJ, Koelemay MJ, Balm R, Legemate DA. Systematic review and meta-analysis of population-based mortality from ruptured abdominal aortic aneurysm. British Journal of Surgery 2013; 100; 1405-1413. doi: 10.1002/bjs.9235

Commissioners need to ensure that all local providers of AAA screening services:

- implement appropriate and effective interventions to reduce the likelihood of non-attendance and to address non-attendance following the initial invitation to participate; for instance, providers could check with relevant GPs whether there are any reasons or barriers that may hinder an individual's participation – an invitation can then be sent that is more appropriate to an individual's circumstances, such as information about the screening programme that is easy to read, in large print or in a different language
- establish robust communication processes with any prison service in the local area to ensure that men who have been detained and are eligible for screening are invited and have the opportunity to participate – this is important because GPs will not necessarily be aware of any change in residence as it is not mandatory to inform them

To ensure systematic screening for AAA – the handling and recording of call and recall information and the recording and managing of ultrasound images – commissioners need to specify that providers of local AAA screening services use the national Screening Management and Referrals Tracking (SMaRT) IT system to record the national minimum data set (NMDS)

Providers of local AAA screening services need to ensure that all healthcare professionals involved in the programme update their knowledge regularly (see 'Resources').

RESOURCES

- Public Health England. Pathway Standards for NHS Abdominal Aortic Aneurysm Screening Programme. Version 1.2/April 2016. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/512707/AAA_pathway_standards.pdf
- NHS England (prepared by Public Health England). NHS public health functions agreement 2016-17. Service specification no.23. NHS Abdominal Aortic Aneurysm Screening Programme. February 2016. https://www.england.nhs.uk/commissioning/wp-content/uploads/sites/12/2016/04/serv-spec-23-abdominal-aortic-aneurysm.pdf
- NHS Screening Programmes. Abdominal aortic aneurysm screening: care pathway. Version 1.0/08-2015. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/493976/AAAS_-_revision_1.pdf
- NHS Screening Programmes. Abdominal aortic aneurysm screening failsafe processes. Version 2.1/September 2015. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/463734/AAA_screening_2015-09-23_Failsafe_v2.1.pdf
- The Vascular Society of Great Britain & Ireland. Framework for improving the results of elective AAA repair 2011. http://www.vascularsociety.org.uk/wp-content/uploads/2012/11/VSGBI-AAA-QIF-2011-v4.pdf
- NHS Screening Programmes. Continuing Professional Development for Screening. Abdominal aortic aneurysm. http://cpd.screening.nhs.uk/aaa

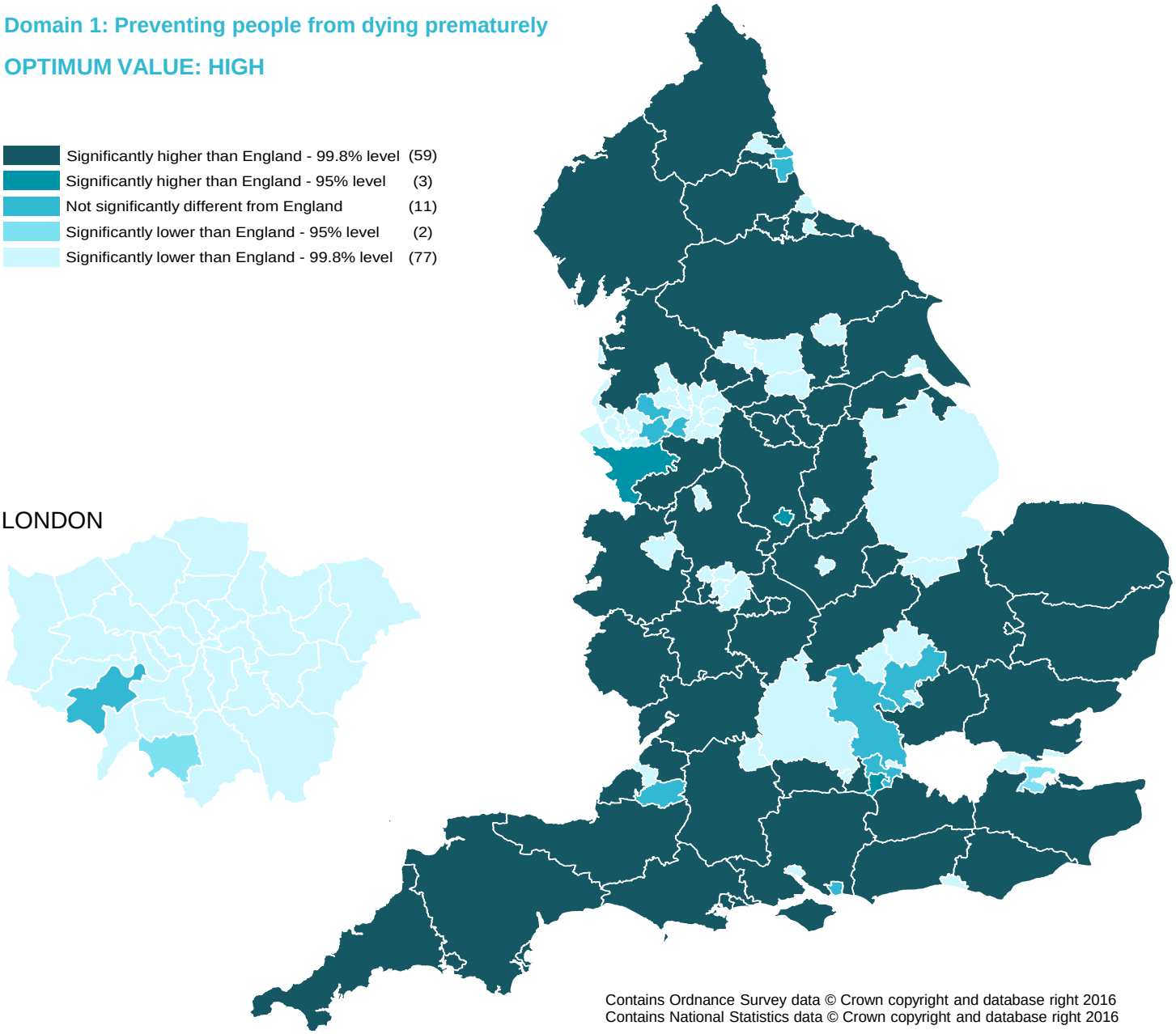
SCREENING SERVICES

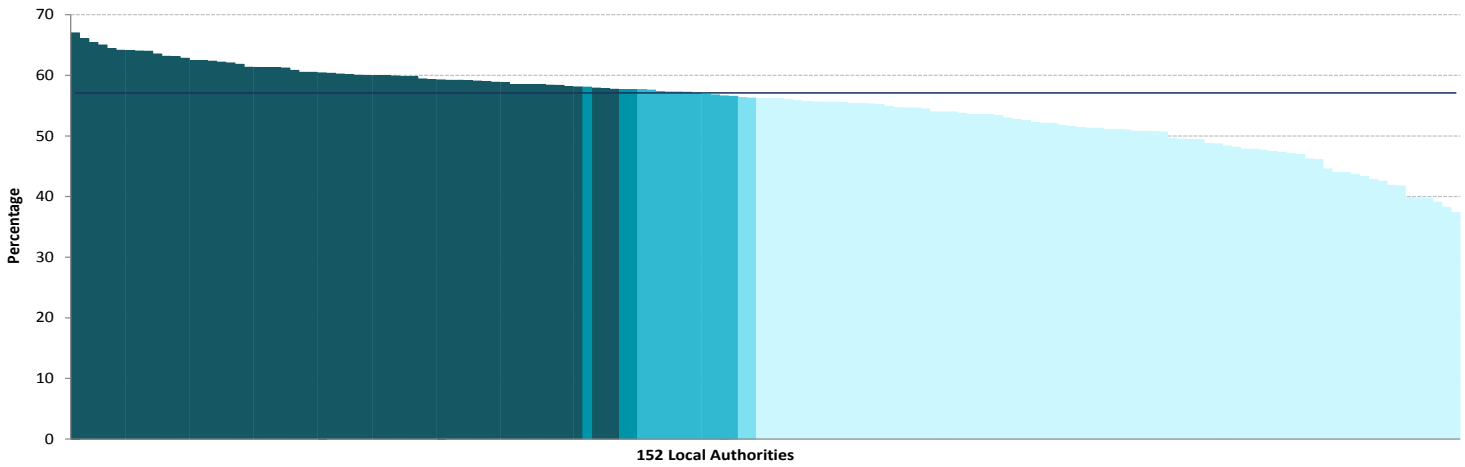
MAP 31: Percentage of eligible people aged 60-74 years with a screening test result recorded in the previous 2.5 years from the NHS bowel cancer screening programme (NHS BCSP) by upper-tier local authority

At 31 March 2015

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: HIGH





Context

Bowel cancer is the fourth most common cancer in the UK: there were 41,112 new cases in 2013.[1] In the last ten years the UK incidence rate has increased by 5%.[1] The UK incidence rate for men is the twentieth highest in Europe, and for women it is the seventeenth highest.[1]

In 2012 in the UK there were 16,187 deaths from bowel cancer; it is thought that 54% of cases are preventable.[1] In 2010/11 in England and Wales 57% of people survived for ten years or more.[1]

In England bowel cancer is more common in men living in the most-deprived areas.

The NHS Bowel Cancer Screening Programme (NHS BCSP) offers screening every two years to all men and women aged 60-74 years, using the faecal occult blood test (FOBT), with the aim of reducing deaths from bowel cancer.

When compared with patients diagnosed following an emergency presentation or GP referral, people identified through the NHS BCSP are more likely to have an early cancer which can often be treated without major surgery and has a better survival rate.

Magnitude of variation

The map and column chart display the latest time-point (31 March 2015), during which local authority values ranged from 37.3% to 67%, which is a 1.8-fold difference between local authorities. The England value at 31 March 2015 was 57.1%.

The boxplot shows the distribution of local authority values at 31 March 2015.

One in five (32 out of 152) local authorities have less than half their eligible population with a screening test result recorded in the last 2.5 years.

The main reason for warranted variation in the percentage of eligible people with a screening test result recorded is the proportion of people in the local population who choose to undertake the FOBT once received through the post. Factors that might influence whether people undertake the test are the practicalities and acceptability of using the FOBT kit.

The socioeconomic profile of the local population can also affect uptake of the screening test for bowel cancer.

One possible reason for unwarranted variation is differences in local systems for the follow-up of people who do not use the FOBT kit once received.

Options for action

To reduce variation in the percentage of eligible people with a screening test result recorded, commissioners need to follow the service specification for the NHS BCSP (see 'Resources').

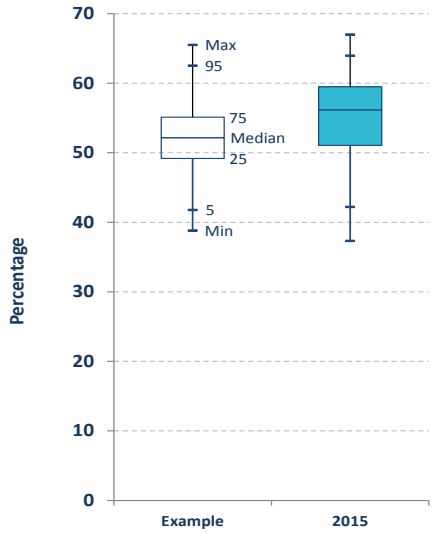
In recent years there have been several trials and initiatives designed with the aim of identifying ways to increase uptake in the NHS BCSP, and the following interventions have been found to be successful:

- a letter of endorsement from the person's GP
- an enhanced patient leaflet
- health promotion in a face-to-face consultation

Commissioners need to specify that screening service providers use these methods to increase uptake, especially when contacting groups in the population who are less likely to respond.

In addition the recent recommendation of the UK National Screening Committee (published in January 2016) to replace the FOBT with the faecal immunochemical test (FIT) could help to reduce the degree of variation observed because the FIT is much simpler and easier to perform, and produces a greater yield overall, when compared with the FOBT.

Map 31: Boxplot of people with test result in the previous 2.5 years in NHS BCSP (%) by local authority



Max-Min (Range)		29.7
95th-5th percentile		21.8
75th-25th percentile		8.4
Median		56.2

[1] Cancer Research UK. Bowel cancer statistics. http://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/bowel-cancer

RESOURCES

- Healthcare Quality Improvement Partnership. National Bowel Cancer Audit Report 2015. http://www.hscic.gov.uk/catalogue/PUB19500/nati-clin-audi-supp-prog-bowe-canc-2015.pdf
- NHS public health functions agreement 2015-16. Service specification no.26 Bowel Cancer Screening Programme. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/383200/1516_No26_NHS_Bowel_Cancer_Screening_Programme_Final.pdf
- Public Health England. Quality assurance guidelines for colonoscopy. NHS BCSP Publication No 6 February 2011. https://www.gov.uk/government/publications/bowel-cancer-screening-colonoscopy-quality-assurance
- NICE. Clinical Knowledge Summaries. Bowel Screening. Last revised October 2014. http://cks.nice.org.uk/bowel-screening
- Cairns SR, Scholefield JH, Steele RJ et al developed on behalf of The British Society of Gastroenterology, and the Association of Coloproctology for Great Britain and Northern Ireland. Guidelines for colorectal cancer screening and surveillance in moderate and high risk groups (update from 2002). Gut 2010; 59: 666-690. doi: 10.1136/gut2009.179804 http://www.bsg.org.uk/images/stories/docs/clinical/guidelines/endoscopy/ccs_10.pdf

SCREENING SERVICES

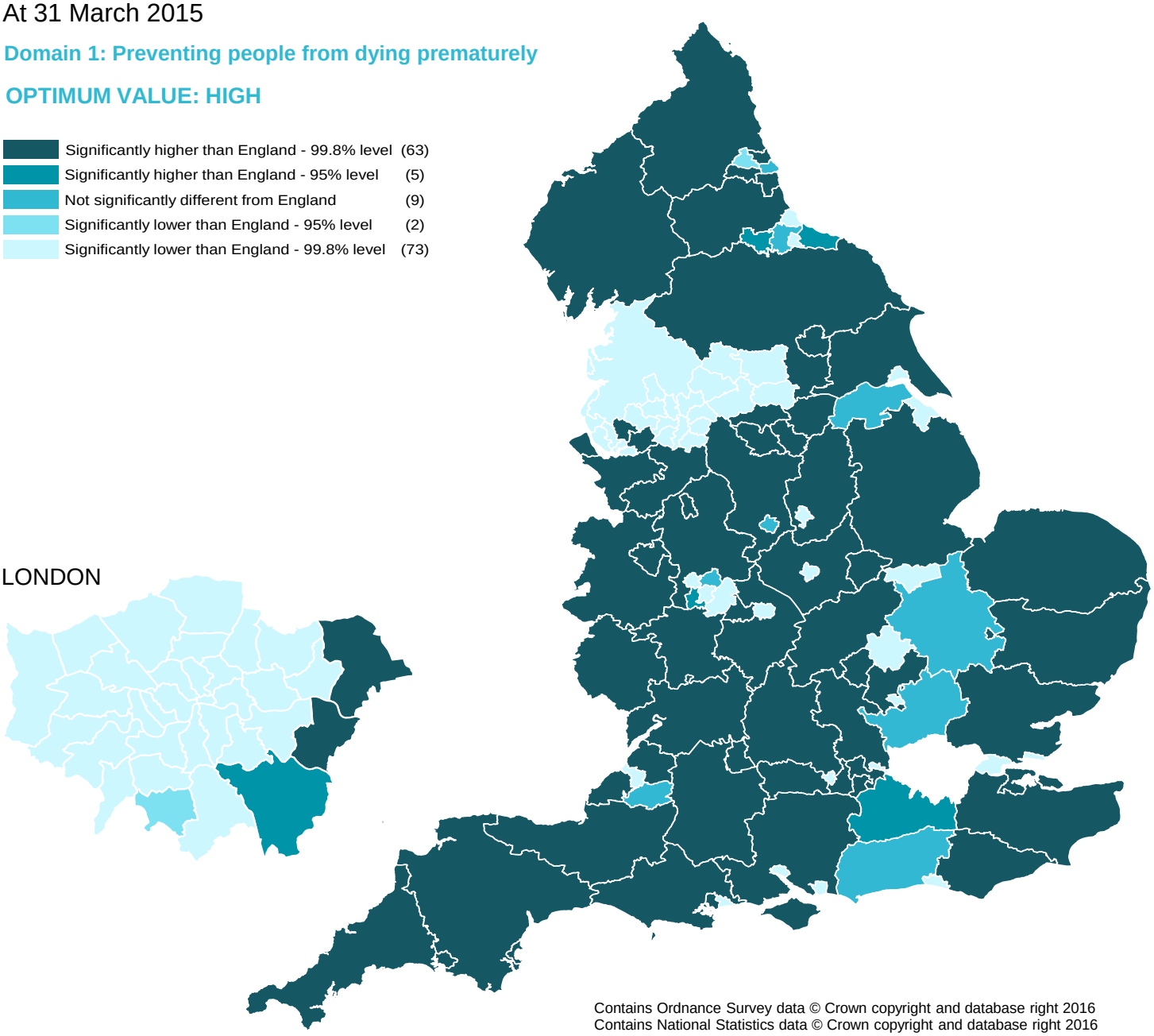
MAP 32: Percentage of eligible women aged 53-70 years screened adequately within the previous three years in the NHS breast screening programme (NHS BSP) by upper-tier local authority

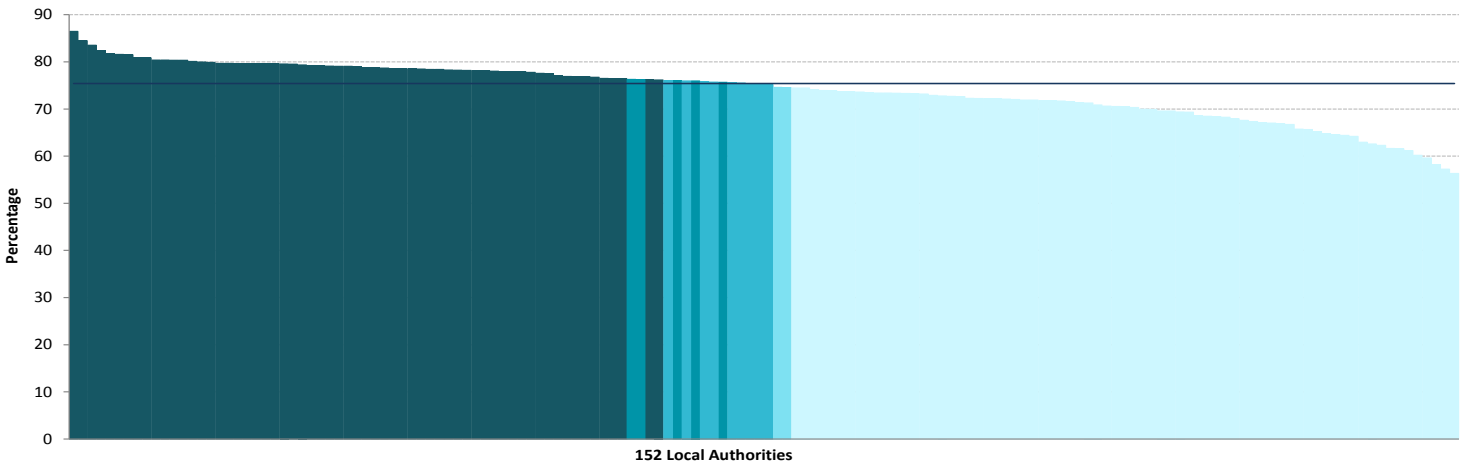
At 31 March 2015

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: HIGH

- Significantly higher than England - 99.8% level (63)
- Significantly higher than England - 95% level (5)
- Not significantly different from England (9)
- Significantly lower than England - 95% level (2)
- Significantly lower than England - 99.8% level (73)





Context

Breast cancer is the most common cancer in the UK. There were 53,696 new cases in 2013.[1] The UK incidence rate is the sixth highest in Europe, and in the last ten years the rate has increased by 4%.[1]

In 2012 in the UK there were 11,716 deaths from breast cancer; 27% of cases are considered to be preventable.[1] In 2010/11 in England and Wales 78% of women survived for ten years or more.[1]

In England breast cancer is less common in women living in the most-deprived areas, although these women once diagnosed have a similar survival outcome when compared with less-deprived women detected at screening. This is not the case where there are different routes of presentation (other than through screening). The outcome for women diagnosed in the most-deprived areas is poorer when compared with women diagnosed in the least-deprived areas: overall, one-year survival is 94% and 97%, respectively.[2]

The NHS breast screening programme (NHS BSP) invites all women aged 50-70 years for breast screening every three years. The aim of breast screening is to reduce mortality from breast cancer by detecting the condition at an early stage when there is the possibility of effective treatment.

In addition the national Age Extension Trial randomises half the population aged 47-49 years and 71-73 years to receive a screening invitation. This randomised control trial is the largest in the world that has been designed to investigate the efficacy of screening women outside the target age of 50-70 years, for which there is currently no evidence of efficacy.

In total, 2.11 million women aged 45 years and over were screened in the programme in 2014/15, an increase of 1.3% when compared with 2013/14.

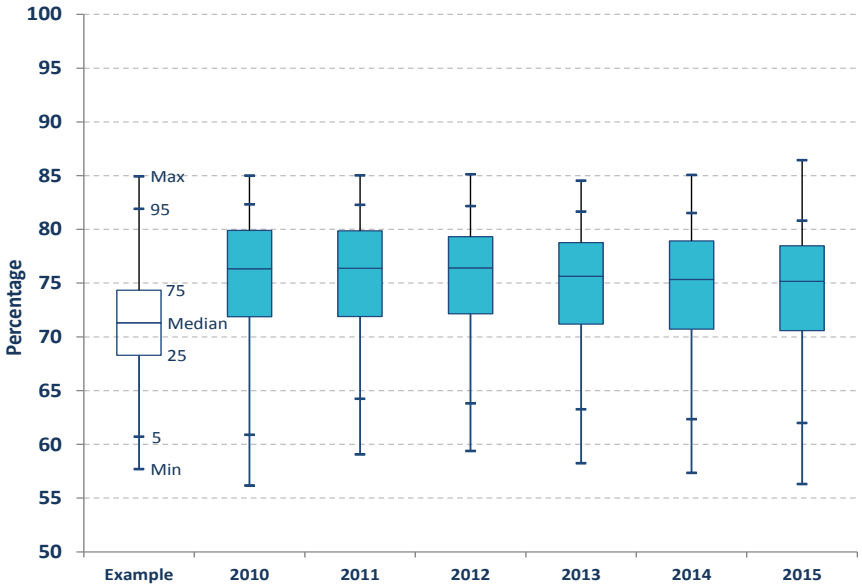
Coverage for women aged 53-70 years was 75.4% at 31 March 2015, a decrease of 0.5% when compared with the same point in 2014 (the national minimum standard is 70% or above).

Magnitude of variation

The map and column chart display the latest time-point (31 March 2015), during which local authority values ranged from 56.3% to 86.4%, which is a 1.5-fold difference between local authorities. The England value at 31 March 2015 was 75.4%.

The boxplot shows the distribution of local authority values for the period 31 March 2010 to 31 March 2015. There was no significant change in any of the three variation measures between 31 March 2010 to 31 March 2015.

Map 32: Boxplot of women screened within previous three years in NHS BSP (%) by local authority



Max-Min (Range)		28.8	26.0	25.7	26.3	27.7	30.1	No significant change
95th-5th percentile		21.4	18.1	18.3	18.4	19.2	18.8	No significant change
75th-25th percentile		8.0	8.0	7.2	7.6	8.2	7.9	No significant change
Median		76.3	76.4	76.4	75.6	75.3	75.2	DECREASING Significant

[1] Cancer Research UK. Breast cancer statistics. http://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/breast-cancer
[2] NCIN Short Report. Breast Cancer (female) routes to diagnosis short report. http://www.ncin.org.uk/publications/routes_to_diagnosis

There was a small but statistically significant decrease in the median of local authority values from 76.3% at 31 March 2010 to 75.2% at 31 March 2015.

Almost one-quarter of local authorities (n=35) failed to meet the national minimum standard of 70% of women to be adequately screened.

The main reason for warranted variation in the percentage of eligible women screened adequately is the proportion of women in the local population who choose to accept the invitation to screening.

Possible reasons for unwarranted variation are differences in:

- strategies used to reach underserved groups in the local population
- local capacity and resources to screen the eligible population within the required 36-month schedule
- changes in the eligible screening population, which may mean that some women are called for screening beyond the required 36-month target
- the socioeconomic profile of local populations, which affects rates of screening acceptance

In addition, the literature accompanying the screening invitation, entitled “NHS Screening: helping you decide”, is designed to allow women to attend screening on the basis of fully informed consent. The influence of this leaflet on acceptance rates may differ according to the profile of the local population served.

Options for action

To reduce variation in the percentage of eligible women screened adequately in the NHS BSP, commissioners need to follow the service specification for the breast cancer screening programme (see ‘Resources’). In addition commissioners need to specify that service providers adhere to all the NHS BSP guidance documents referenced in the national service specification.

It is recommended that NHS England public health commissioners and PHE Area Teams identify strategies and mechanisms that have helped to increase coverage at a local level to ensure that methods are shared in a national forum facilitating the dissemination of good practice.

All screening services need to seek advice and support from the screening quality assurance service where there are issues with adherence to national targets for screening round length.

RESOURCES

- Health & Social Care Information Centre (HSCIC). Breast Screening Programme, England – 2014-15 [NS]. February 24, 2016. http://www.hscic.gov.uk/catalogue/PUB20018
- Public Health England. Clinical Guidelines for Breast Cancer Screening Assessment. Third edition. NHSBSP Publication No 49 June 2010. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/465528/nhsbsp49_June2010.pdf
- NHS England. NHS public health functions agreement 2016-17. Service specification no.24 Breast Screening Programme. https://www.england.nhs.uk/commissioning/wp-content/uploads/sites/12/2016/02/serv-spec-24.pdf
- Public Health England. Breast screening: professional guidance. https://www.gov.uk/government/collections/breast-screening-professional-guidance
- NICE. Clinical Knowledge Summaries. Breast Screening. Last revised November 2011. http://cks.nice.org.uk/breast-screening#!scenario

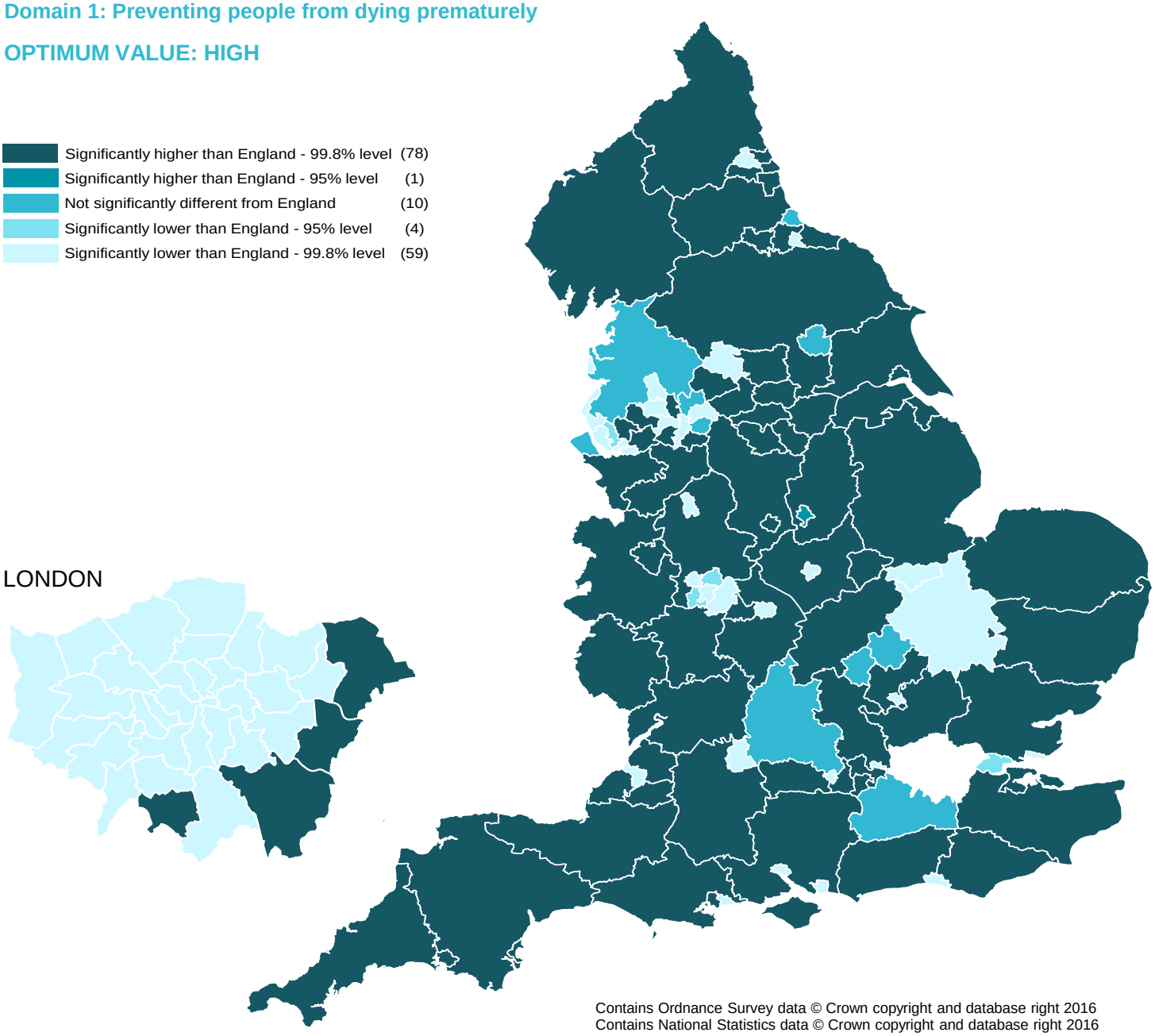
SCREENING SERVICES

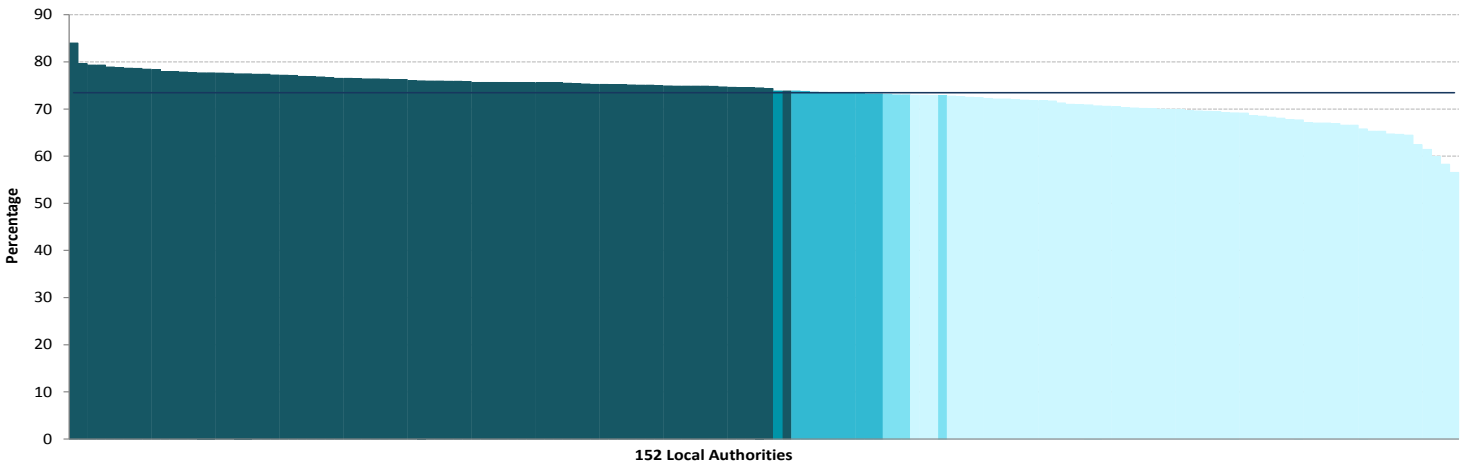
MAP 33: Percentage of eligible women aged 25-64 years screened adequately in the NHS cervical screening programme (NHS CSP) by upper-tier local authority

At 31 March 2015

Domain 1: Preventing people from dying prematurely

OPTIMUM VALUE: HIGH





Context

Cervical cancer is the 20th most common cancer in the UK. There were 3,207 new cases in 2013.[1] The UK incidence rate is the 12th lowest in Europe, and in the last ten years the rate has remained stable.[2]

In 2012 in the UK there were 919 deaths from cervical cancer; 100% of cases are considered to be preventable.[2] In 2010/11 in England and Wales 63% of women survived for ten years or more.[2]

In England cervical cancer is more common in women living in the most-deprived areas.

Women aged 25-64 years are invited for cervical screening: those aged 25-49 years are invited every three years, and those aged 50-64 years are invited every five years. The aim of the NHS cervical screening programme (NHS CSP) is to reduce the incidence of and mortality from cervical cancer.

Since its introduction the NHS CSP has helped to halve the number of cervical cancer cases, and it has been estimated that the NHS CSP saves approximately 4,500 lives per year in England.[3]

In total, 4.31 million women aged 25-64 years and over were invited for cervical screening in 2014/15, and 3.12 million women were tested in the programme, a decrease of 3.3% when compared with 2013/14.

Age-appropriate coverage is defined as the percentage of women in a population eligible for screening at a given point in time who were screened adequately within a specified period (within 3.5 years for women aged 25-49 years, and within 5.5 years for women aged 50-64 years). The minimum threshold is set at 80%. Age-appropriate coverage for women aged 25-64 years was 73.5% at 31 March 2015, a decrease of 0.7% when compared with the same point in 2014. Coverage among women aged 25-49 years was 71.2% at 31 March 2015, a decrease of 0.6% when compared with the same point in 2014, and for women aged 50-64 years it was 78.4%, a decrease of 1.0% when compared with the same point in 2014.

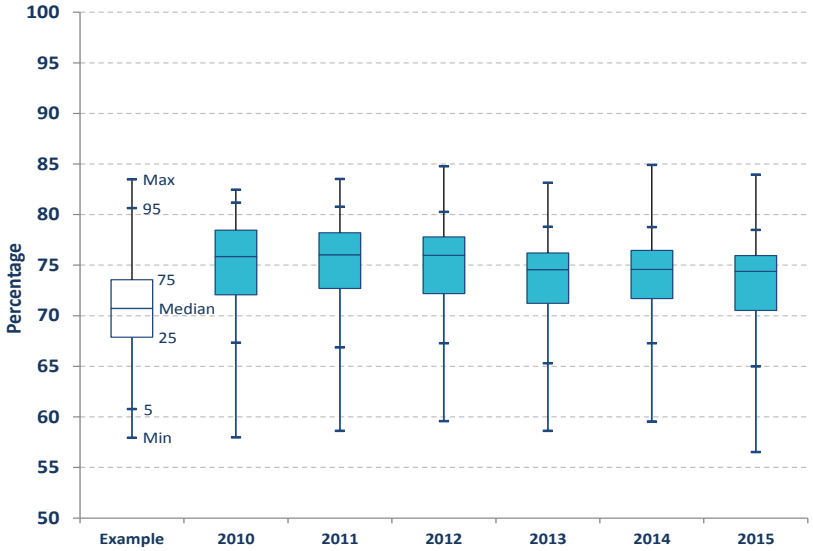
Magnitude of variation

The map and column chart display the latest period (31 March 2015), during which local authority values ranged from 56.5% to 84%, which is a 1.5-fold difference between local authorities. The England value at 31 March 2015 was 73.5%.

The boxplot shows the distribution of local authority values for the period 31 March 2010 to 31 March 2015. There was no significant change in any of the three variation measures between 31 March 2010 to 31 March 2015.

Only one local authority district achieved the minimum threshold rate of 80% at 31 March 2015.

Map 33: Boxplot of women screened adequately in NHS CSP (%) by local authority



		2010	2011	2012	2013	2014	2015	
Max-Min (Range)		24.5	24.9	25.2	24.5	25.4	27.4	No significant change
95th-5th percentile		13.8	13.9	13.0	13.5	11.5	13.5	No significant change
75th-25th percentile		6.4	5.5	5.6	5.0	4.7	5.4	No significant change
Median		75.9	76.0	76.0	74.5	74.6	74.4	DECREASING Significant

[1] Cancer Research UK. Cervical cancer statistics. http://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/cervical-cancer
[2] 'Adequately' defined as: 3.5 years since last test in women aged 25-49 years; 5.5.years since last test in women aged 50-64 years
[3] Peto J, Gilham C, Fletcher O et al. The cervical cancer epidemic that screening has prevented in the UK. Lancet 2004; 364: 249-256.

There was a small but statistically significant decrease in the median of local authority values from 75.9% at 31 March 2010 to 74.4% at 31 March 2015.

The main reason for warranted variation in the percentage of eligible women screened adequately is the proportion of women in the eligible population who choose to accept the invitation to screening.

Possible reasons for unwarranted variation include differences in:

- strategies used to reach underserved groups in the local population
- access to screening
- inappropriate cessation of invitation to the screening programme

Options for action

Commissioners and providers of cervical screening services have a duty to recognise the diversity of their population. Both commissioners and primary care providers need to understand the barriers to women attending for cervical screening, and to initiate strategies to address any barriers identified.

Interventions found to improve most consistently participation in cancer screening in underserved populations are:

- pre-screening reminders
- personalised reminders for non-participants
- GP endorsement of cervical screening

To reduce variation in the percentage of eligible women screened adequately, commissioners need:

- to engage with service providers to ensure there is adequate accessibility to and provision of cervical screening
- to ensure that service providers follow the service specification for the cervical cancer screening programme (see 'Resources')
- to specify that service providers adhere to the colposcopy and management guidance for cervical screening (see 'Resources')
- to engage with service providers to ensure there is adequate training of health professionals responsible for taking the samples

RESOURCES

- Health & Social Care Information Centre (HSCIC). Cervical Screening Programme, England – 2014-15 [NS]. November 10, 2015. http://www.hscic.gov.uk/catalogue/PUB18932/nhs-cervical-stat-eng-2014-15-rep.pdf
- NHS England. NHS public health functions agreement 2016-17. Service specification no.25 Cervical Screening. https://www.england.nhs.uk/commissioning/wp-content/uploads/sites/12/2016/02/serv-spec-25.pdf
- Public Health England. NHS Cervical Screening Programme. Colposcopy and Programme Management. NHS CSP Publication number 20. Third Edition March 2016. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/515817/NHSCSP_colposcopy_management.pdf
- Public Health England. Cervical screening: professional guidance. https://www.gov.uk/government/collections/cervical-screening-professional-guidance
- NICE. Clinical Knowledge Summaries. Cervical Screening. Last revised February 2015. http://cks.nice.org.uk/cervical-screening#!scenario

SCREENING SERVICES

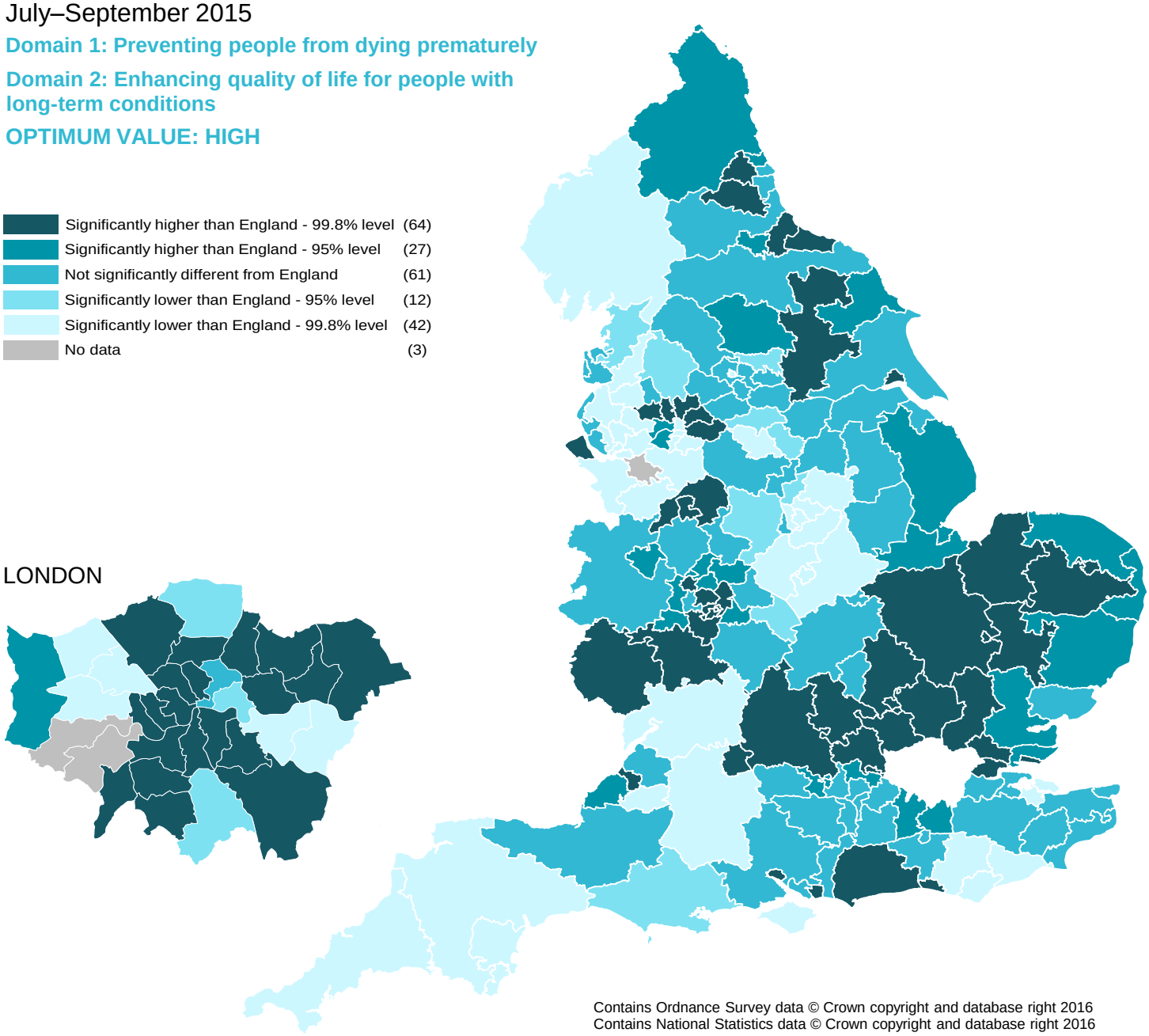
MAP 34: Percentage of babies eligible for testing in the NHS newborn blood spot (NBS) screening programme who had a conclusive result recorded on the Child Health Information System (CHIS) within an effective timeframe[1] by CCG[2]

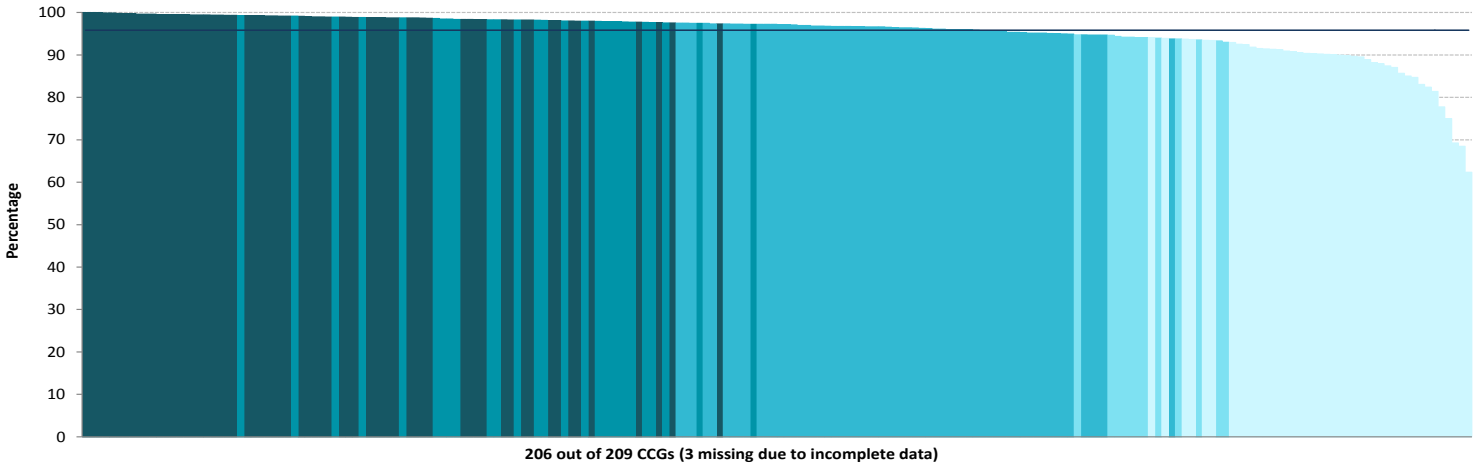
July–September 2015

Domain 1: Preventing people from dying prematurely

Domain 2: Enhancing quality of life for people with long-term conditions

OPTIMUM VALUE: HIGH





SCREENING SERVICES

MAP 35: Percentage of babies who required a repeat test due to an avoidable failure in the sampling process during the NHS newborn blood spot (NBS) screening programme by maternity service

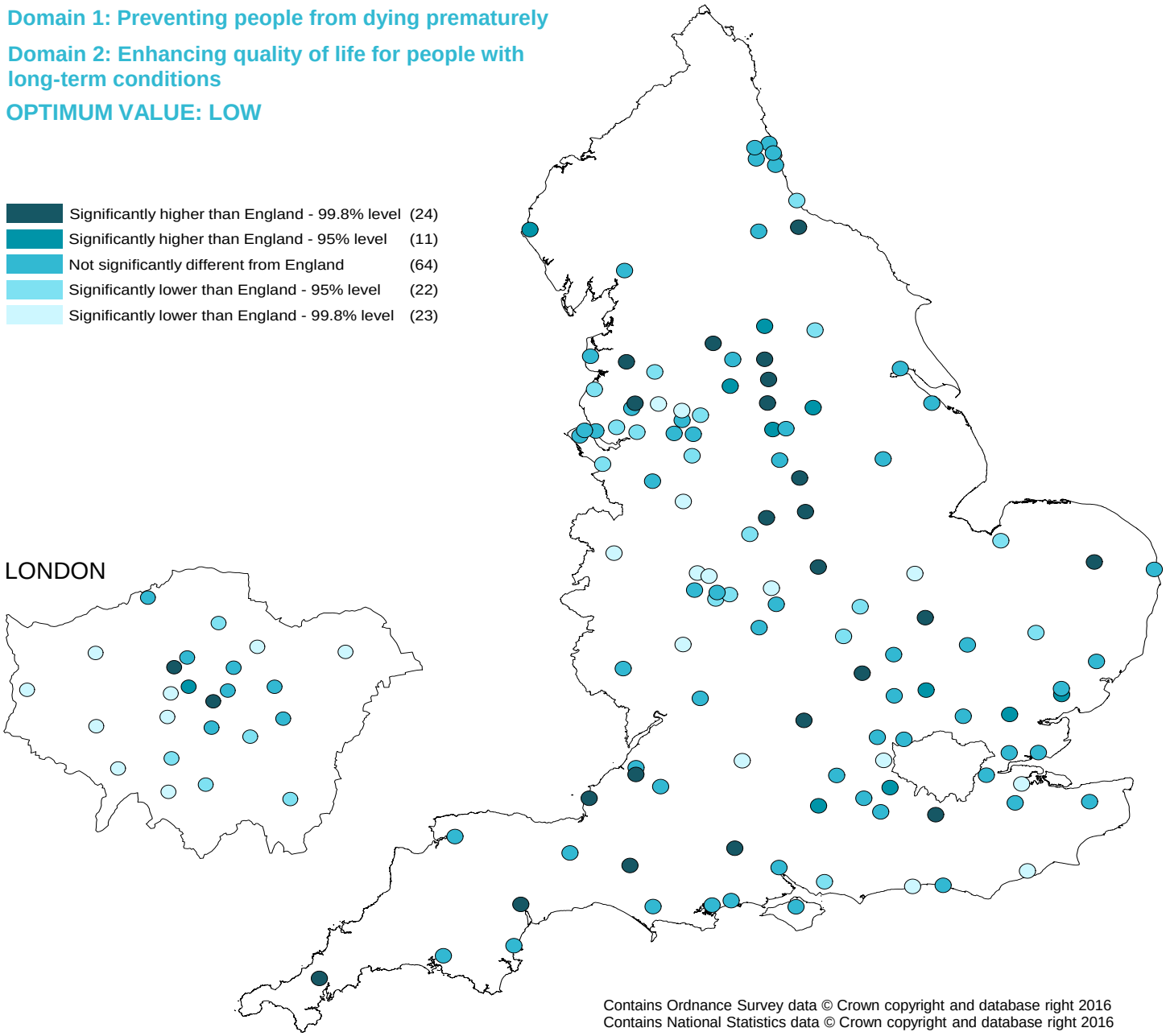
July–September 2015

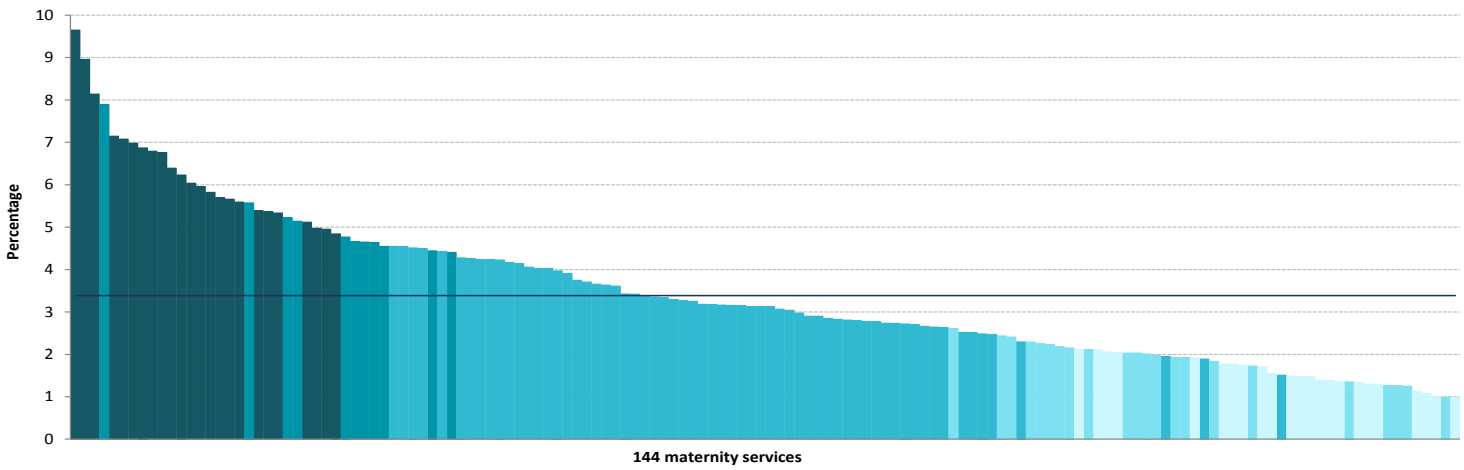
Domain 1: Preventing people from dying prematurely

Domain 2: Enhancing quality of life for people with long-term conditions

OPTIMUM VALUE: LOW

- Significantly higher than England - 99.8% level (24)
- Significantly higher than England - 95% level (11)
- Not significantly different from England (64)
- Significantly lower than England - 95% level (22)
- Significantly lower than England - 99.8% level (23)





Context

The aim of the NHS newborn blood spot (NBS) screening programme is to identify rare conditions that can lead to serious illness, development problems and death. The NHS NBS screening programme screens for nine conditions:

- sickle cell disease (SCD)
- cystic fibrosis (CF)
- congenital hypothyroidism (CHT)
- inherited metabolic diseases (IMDs), which are genetic diseases that affect the metabolism:
  - phenylketonuria (PKU)
  - medium-chain acyl-CoA dehydrogenase deficiency (MCADD)
  - maple syrup urine disease (MSUD)
  - isovaleric acidaemia (IVA)
  - glutaric aciduria type 1 (GA1)
  - homocystinuria (HCU)

Blood is taken from a child's heel at the age of five days (the first day of life is day 0). Parents verbally agree to the test, and assent is recorded in the baby's child health record. Parents can choose not to have their child screened for the conditions: parents can decline screening for SCD, CF and CHT as individual conditions, but for the six IMDs screening can be declined only for the group of diseases rather than individual conditions.

Magnitude of variation

Map 34: Percentage of babies with a conclusive result by CCG

The map and column chart display the latest period (July-September 2015), during which CCG values ranged from 62.4% to 100.0%, which is a 1.6-fold difference between CCGs. The England value for this quarter was 95.8%.

The boxplot shows the distribution of CCG values for the period April-June 2014 to July-September 2015.

The range between the maximum and minimum values widened significantly which is entirely due to a downward trend in the minimum CCG value. A closer examination of individual CCG values reveals that an increasing number of CCG have rates below 80%.

There was no significant change in the 95th to 5th percentile gap, in the 75th to 25th perecentile gap, nor in the median between April-June 2014 to July-September 2015.

One reason for warranted variation in the uptake of NBS screening is parental choice about having their baby screened for rare conditions.

Possible reasons for unwarranted variation in the proportion of babies with a conclusive result are differences in the number of avoidable incidents such as:

- babies who miss screening
- samples failing to arrive at screening laboratories
- samples delayed in transit to screening laboratories
- failure of the equipment, assay or process in the laboratory, but this is very rare
- errors in the notification of birth in the Patient Demographic Service
- failure of the maternity IT system
- failure of the child health information system (CHIS)
- errors in data entry errors for CHIS
- errors in the submission or quality control of data, or missing data, for the key performance indicators

Map 35: Percentage of babies requiring a repeat test by maternity service

The map and column chart display the latest period (July-September 2015), during which the values ranged from 1.0% to 9.6%, which is a 9.9-fold difference between maternity services. The England value for this quarter was 3.4%. Almost 40% (n=57) of maternity services had a higher proportion of babies that needed retesting compared to the England rate.

The boxplot shows the distribution of maternity service values for the period April-June 2014 to July-September 2015. There was no significant change in any of the three variation measures or the median between April-June 2014 to July-September 2015.

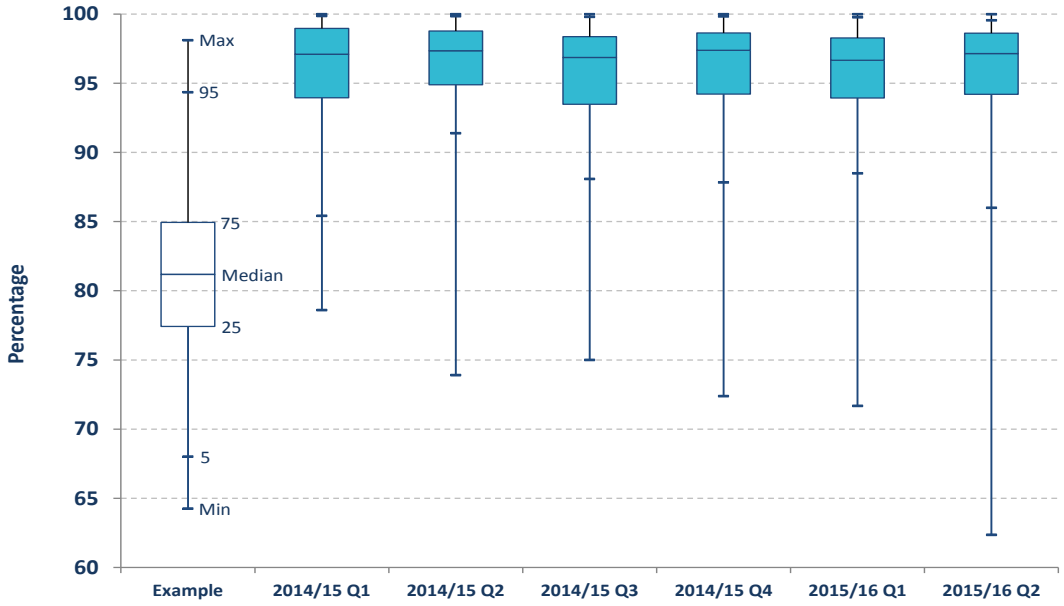
Possible reasons for unwarranted variation in the percentage of babies from whom a repeat blood sample is taken are differences in:

- training and education of health professionals involved in local NHS NBS screening services
- the skill and experience of health professionals involved in local NHS NBS screening services
- the device used to take the samples

Since April 2015, screening laboratories have been following a national consensus on blood spot sample quality criteria for requesting a repeat sample; however, compliance with these criteria is not currently being audited.

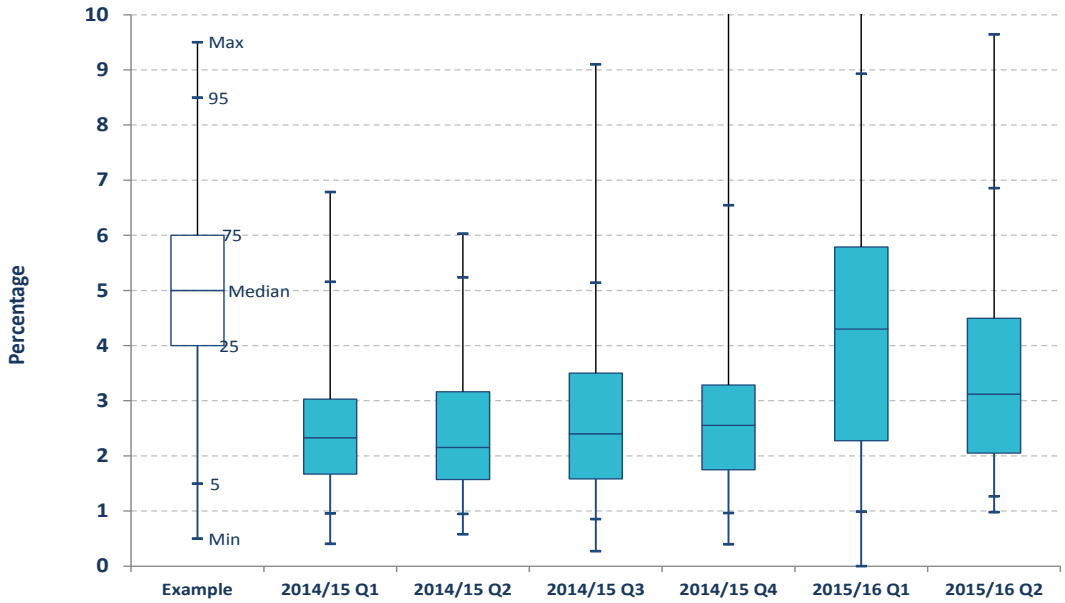
[1] For this indicator phenylketonuria (PKU) is used as a proxy for all tests and the test must be completed by 17 days of age.
[2] Babies need to be registered within the CCG both at birth and on the last day of the reporting period.

Map 34: Boxplot of babies eligible for NHS NBS screening programme with a conclusive result on CHIS within an effective timeframe (%) by CCG



Max-Min (Range)		21.4	26.1	25.0	27.6	28.3	37.6	WIDENING Significant
95th-5th percentile		14.5	8.5	11.7	12.0	11.3	13.6	No significant change
75th-25th percentile		5.0	3.9	4.9	4.4	4.4	4.4	No significant change
Median		97.1	97.4	96.9	97.4	96.7	97.2	No significant change

Map 35: Boxplot of babies requiring a repeat test in the NHS NBS screening programme (%) by maternity service



Max-Min (Range)		6.4	5.5	8.8	32.9	13.9	8.7	No significant change
95th-5th percentile		4.2	4.3	4.3	5.6	7.9	5.6	No significant change
75th-25th percentile		1.4	1.6	1.9	1.5	3.5	2.4	No significant change
Median		2.3	2.2	2.4	2.6	4.3	3.1	No significant change

Options for action

Commissioners need to specify that providers of local NHS NBS screening services:

- adhere to the service specification and care pathway (see 'Resources') for the NHS NBS screening programme
- implement the NHS newborn blood spot failsafe solution (NBSFS; see 'Resources') to ensure that babies affected by any of the conditions do not suffer serious harm from avoidable incidents – if harm does occur it has serious consequences for the baby and the parents, and incurs additional costs for the care and treatment of the affected baby

To reduce the need to take repeat blood samples and avoid any harm to the baby as a result of delays in diagnosis and treatment, providers of local NHS NBS screening services need to ensure that all health professionals involved in the screening programme:

- adhere to the revised guidelines for NBS sampling (see 'Resources')
- undertake continuing professional development for screening (see 'Resources')

Commissioners and providers of local NHS NBS screening services need to ensure that all screening laboratories and CHISs are using the v4.2 status codes and subcodes for reporting screening results (see 'Resources').

RESOURCES

- NHS England (prepared by Public Health England). NHS public health functions agreement 2016-17. Service specification no.19. NHS Newborn Blood Spot Screening Programme. February 2016. https://www.england.nhs.uk/commissioning/wp-content/uploads/sites/12/2016/04/serv-spec-19-chld-blood-spot-screening.pdf
- NHS Screening Programmes. Newborn blood spot screening: care pathway. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/494003/Diagram_NBS_final_V3.pdf
- NHS Screening Programmes. NHS Newborn Blood Spot Screening Programme. Failsafe processes. Version 1.1, August 2011. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/456192/NBS_Failsafe_processes_v1.1.pdf
- NHS Screening Programmes. Continuing Professional Development for Screening. Education and Training for the Newborn Blood Spot Programme. http://cpd.screening.nhs.uk/newbornbloodspot
- NHS Screening Programmes. Status codes for newborn blood spot screening v4.2. December 2014. https://www.gov.uk/government/publications/status-codes-for-the-newborn-blood-spot-nbs-screening-programme
- NHS Screening Programmes. Guidelines for Newborn Blood Spot Sampling. March 2016. https://www.gov.uk/government/publications/newborn-blood-spot-screening-sampling-guidelines
- Public Health England. Output and information requirements specification: for the Child Health Information service and systems. 24 March 2015. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/417076/Child_Health_Information_240315.pdf
- NHS England. Child Health Information Services (CHIS) Provider Services Specification.10 August 2015. https://www.england.nhs.uk/commissioning/wp-content/uploads/sites/12/2013/05/chis-provider-service-spec.pdf

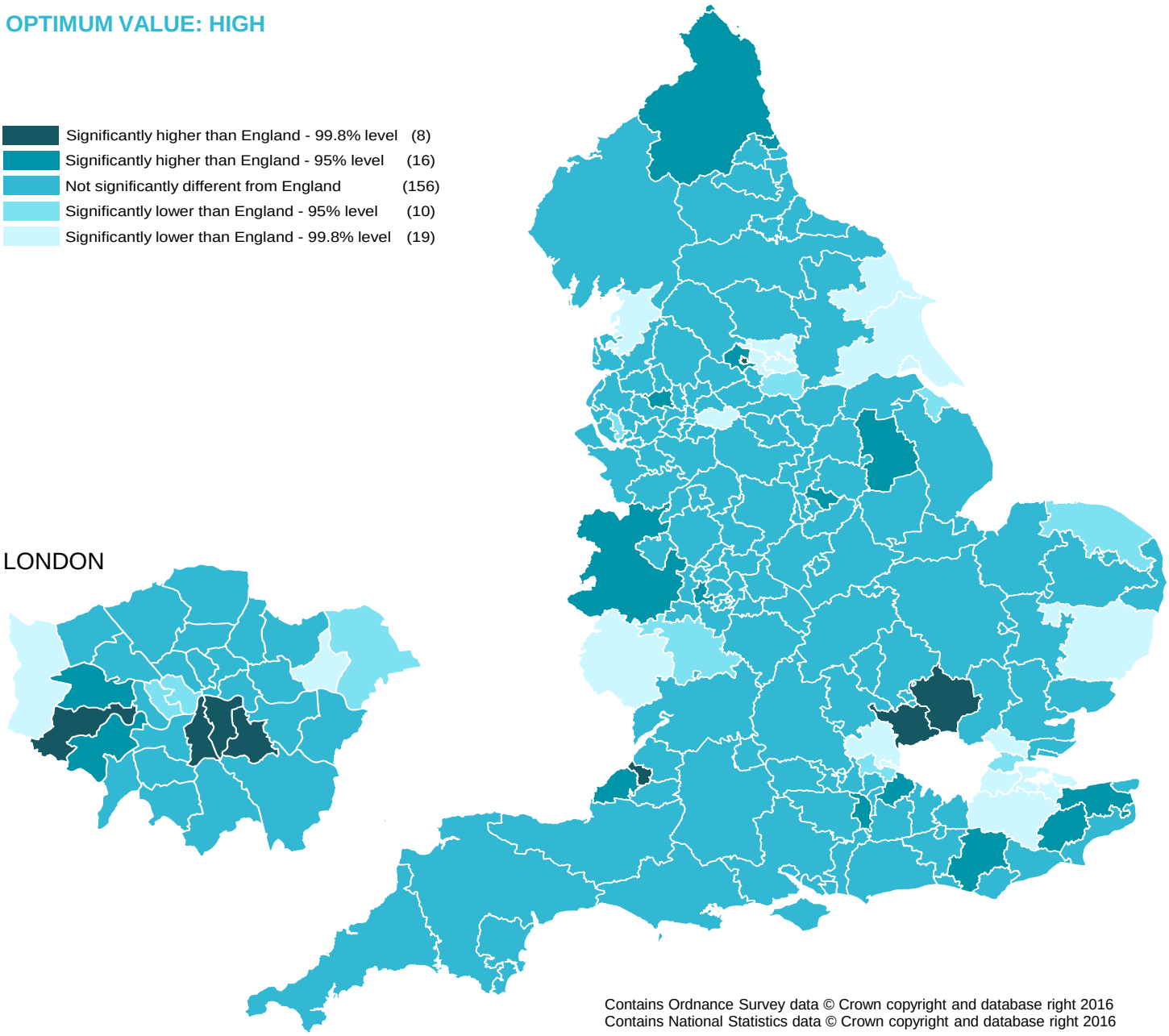
SCREENING SERVICES

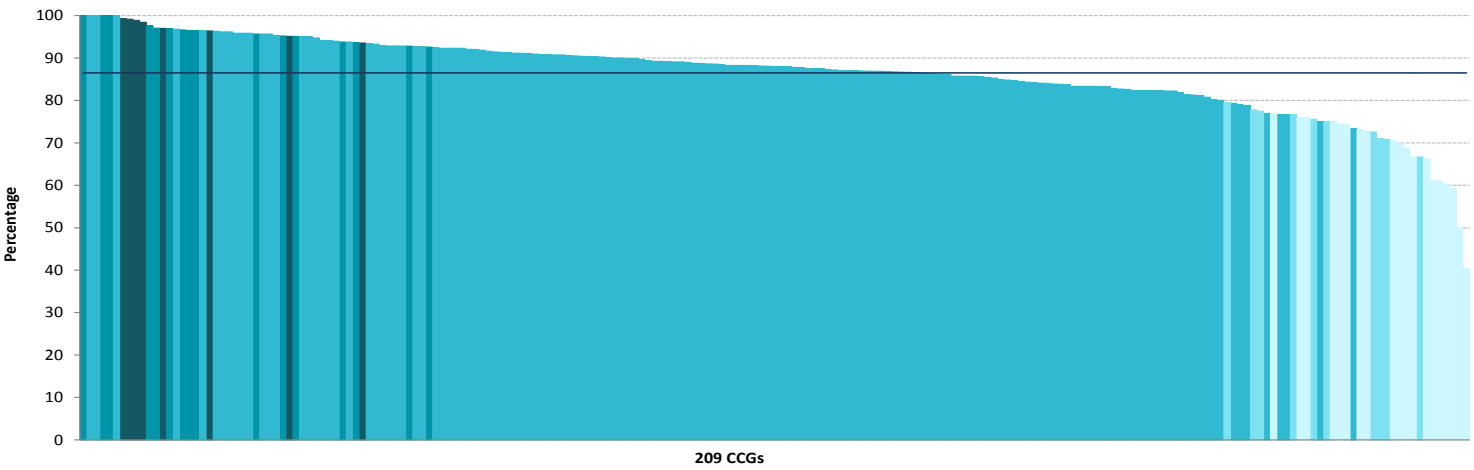
MAP 36: Percentage of referred babies who had an audiological assessment within four weeks of the decision to refer or by 44 weeks' gestational age by CCG

2014/15

Domain 2: Enhancing quality of life for people with long-term conditions

OPTIMUM VALUE: HIGH





Context

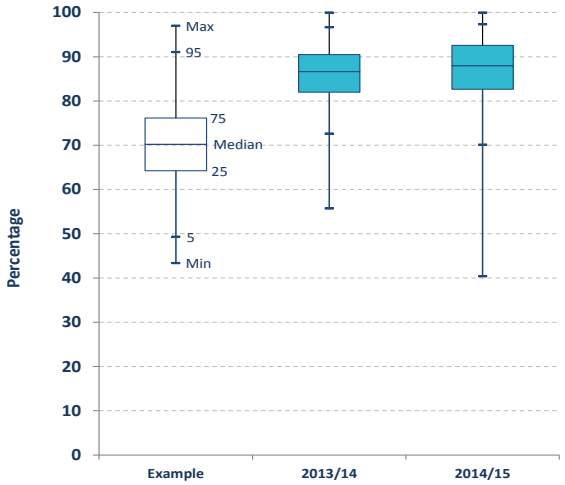
Each year around 1,300 babies are born with permanent childhood hearing impairment. In England 35,000 children are affected by hearing loss, and receive treatment, care and support services from the NHS, social care and education services. About £250 million per year is spent on paediatric audiology and education services for children, and on related family support services.

Early identification by the NHS newborn hearing screening programme (NHS NHSP) has dramatically improved early diagnosis and promoted early intervention to reduce the impact of hearing loss, giving children a better chance of developing speech and language skills, and of making the most of social and emotional interaction from an early age. There are also better outcomes for the family.

The parents of all babies born or resident in England should be offered hearing screening for their baby within four to five weeks of birth. The test can take place in hospital, in an outpatient clinic or at home by a health visitor. Babies that miss screening should receive it as soon as possible, but not after three months of age.

Through the NHS NHSP children are referred to paediatric diagnostic audiology services if they have a poor response in either one ear or both ears at screening. The average referral rate to paediatric diagnostic audiology services is 2.6%: for about 0.7% of referrals, babies do not have a clear response in both ears at screening; for 1.9%, babies do not have a clear response in one ear at screening.

Map 36: Boxplot of referred babies with audiological assessment (%) by CCG



Max-Min (Range)		44.3	59.6	WIDENING
95th-5th percentile		24.0	27.2	WIDENING
75th-25th percentile		8.5	9.9	WIDENING
Median		86.7	88.0	INCREASING

Each year in England around 18,000 children are referred from the NHS NHSP for electrophysiological audiological assessment. Following assessment children are diagnosed as:

- permanently deaf
- in need of further diagnostic testing
- hearing within normal limits

Of the 1,300 children identified as deaf by the NHS NHSP in a year, 770 will have bilateral deafness; of those 770 children, 135 will be profoundly deaf.

The NHS NHSP has programme standards and service specifications (see 'Resources'). The key performance indicator relating to referral for audiological assessment is:

> *"The proportion of babies with a no clear response result in one or both ears or other result that require an immediate onward referral for audiological assessment who receive audiological assessment within the required timescale."*

Reducing the degree of variation in the percentage of babies receiving audiological assessment within four weeks of referral will reduce the level of inequity for newborn babies and their parents who are offered hearing screening, and thereby enable better outcomes to be achieved.

Magnitude of variation

The map and column chart display the latest period (2014/15), during which CCG values ranged from 40.4% to 100%, which is a 2.5-fold difference between CCGs. The England value for 2014/15 was 86.5%.

The boxplot shows the distribution of CCG values for the period 2013/14 to 2014/15.

The statistical significance of changes in the three variation measures or the median was not tested for those indicators with fewer than three data periods.

Reasons for warranted variation include differences in the levels of risk, multi-morbidity and genetic aetiologies in different geographical areas.

Attendance at an assessment can be determined by factors affecting a baby's parents, including constraints on their ability to travel and/or financial constraints.

Possible reasons for unwarranted variation relating to service provision include differences in:

- capacity
- quality of management of audiology assessment services
- prioritisation of services
- peer-to-peer network support
- arrangements for cover
- accessibility of venues for audiological assessment

Options for action

To reduce unwarranted variation in the percentage of babies receiving audiological assessment within four weeks of referral, commissioners need to specify that all hearing screening service providers:

- adhere to the NHS England service specification (see 'Resources'), and supporting documents to ensure that a hearing screening programme is set up correctly and meets the standards set by the national screening team
- follow the care pathways for the NHS NHSP screening and referral process (see 'Resources)
- report on key performance indicators, as set and reviewed by the national screening team (see 'Resources'), explore arrangements for peer-review within service networks of performance and participate in and maintain accreditation to defined quality standards operating under the umbrella of the United Kingdom Accreditation Schemes (UKAS) and Improving Quality in Physiological Services (IQIPS; see 'Resources')

To ensure that hearing screeners are competent and able independently to screen babies, commissioners and providers of local hearing screening services need to make certain that all hearing screeners have completed:

- training in line with programme requirements and standards (see 'Resources')
- an objective structured clinical examination (OSCE; see 'Resources')

It is also important to widen the focus for action and consider the degree of variation from screening to intervention via diagnosis to ensure that the whole pathway to intervention is not subject to unwarranted variation. Therefore, commissioners and service providers need to work together to investigate the interface between local screening services, paediatric audiology services and education services.

RESOURCES

- NHS England (prepared by Public Health England). Public health functions to be exercised by NHS England. Service specification No.20. NHS Newborn Hearing Screening Programme. 2016/17 https://www.england.nhs.uk/commissioning/pub-hlth-res/
- Public Health England. Newborn Hearing Screening: care pathways. Last updated 20 November 2015. https://www.gov.uk/government/publications/newborn-hearing-screening-care-pathways
- National Screening Team. Key performance indicators. The full eSP reference guide is available to NHSP professionals on the extranet. Login page: http://legacy.screening.nhs.uk/nhsp-extranet
- NHS Screening Programmes. Continuing Professional Development for Screening: Newborn Hearing Screening e-learning. Updated January 2016. http://cpd.screening.nhs.uk/nhsp-elearning
- NHS Screening Programmes. Continuing Professional Development for Screening: Screener training. http://cpd.screening.nhs.uk/cms.php?folder=5183
- Health Knowledge. Screening – Angela Raffle. http://www.healthknowledge.org.uk/interactive-learning/screening
- Improving Quality in Physiological Services (IQIPS). https://www.iqips.org.uk/

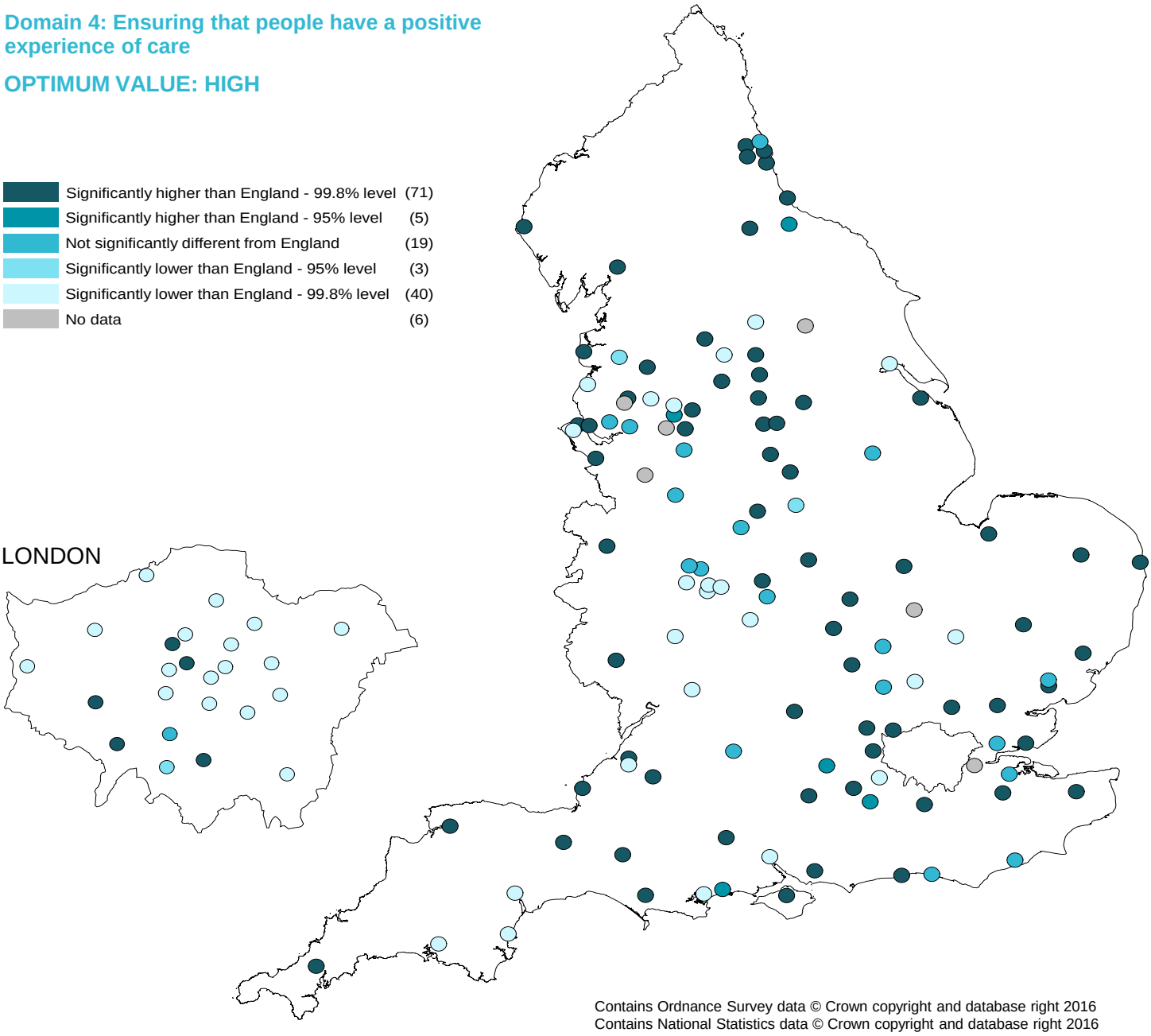
SCREENING SERVICES

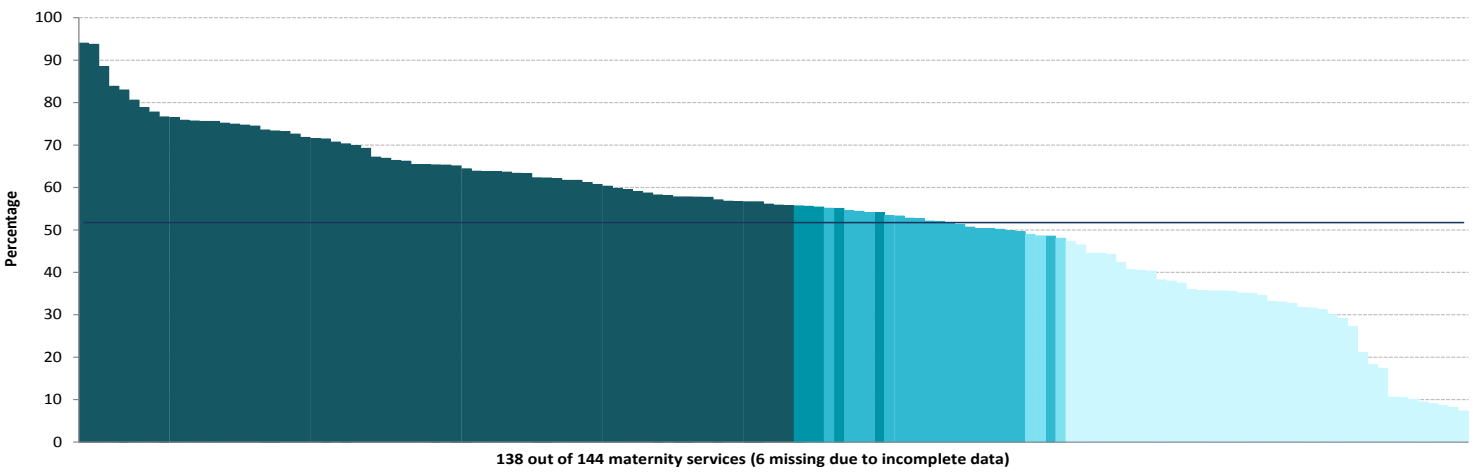
MAP 37: Percentage of women tested in the NHS antenatal sickle cell and thalassaemia screening programme with a conclusive result by 10 weeks' gestation by maternity service

July–September 2015

Domain 4: Ensuring that people have a positive experience of care

OPTIMUM VALUE: HIGH





Context

Sickle cell disease is a group of inherited conditions that affect the quality of haemoglobin, and its capacity to carry oxygen around the body. Sickle cell anaemia is the most severe form of the disease. Other sickle cell conditions that require treatment include haemoglobin SC disease and S beta thalassaemia. In sickle cell disease red blood cells deform and break down intermittently leading to blocked blood vessels. Complications include episodes of severe pain, stroke and respiratory collapse, as well as anaemia and susceptibility to infections. People with sickle cell disease have a reduced life expectancy.

In England sickle cell disease occurs in 1 in 2,000 live births, being most common in people of Black African or Caribbean origin.

Thalassaemia is a group of inherited conditions that affect the amount of haemoglobin produced and its capacity to carry oxygen around the body. Beta thalassaemia major is the most severe type; other thalassaemias include alpha thalassaemia major, beta thalassaemia intermedia and haemoglobin H disorder. In addition to anaemia, symptoms include fatigue, palpitations and shortness of breath. Some people also experience delayed growth, osteoporosis and reduced fertility. Thalassaemia mainly affects people of Mediterranean, Middle Eastern, South Asian and South East Asian origin.

People with a haemoglobin disorder will have inherited two genes for unusual red blood cells, one from the mother and one from the father, who are referred to as genetic carriers of the disease, that is, they have the sickle cell or thalassaemia gene. If both parents are carriers, however, there is a 25% chance (one in four) that the baby will inherit a haemoglobin disorder requiring treatment. The severity of the condition that the baby inherits depends on the combination of genes received from each parent.

People who are genetic carriers usually do not experience health problems, but carriers of the sickle cell gene can do so in situations where there is a lack of oxygen, such as having an anaesthetic or participating in extreme sports.

The NHS Sickle Cell and Thalassaemia screening programme is one of the antenatal and newborn NHS population screening programmes, screening for:

- genetic carriers for sickle cell, thalassaemia and other haemoglobin disorders
- sickle cell disease
- thalassaemia
- haemoglobin disorders

These two indicators[1] focus on antenatal screening for sickle cell and thalassaemia. The aim of antenatal screening is to identify expectant parents who are genetic carriers of an unusual form of haemoglobin in order to offer them reproductive choice. In the first instance screening is offered to all pregnant women, and then to fathers-to-be where antenatal screening shows the mother is a genetic carrier. As part of antenatal screening health professionals ask about family origins and the responses are recorded on a family origin questionnaire (FOQ), which is sent to the laboratory together with the blood samples.

Where both patients are identified as carriers counselling is offered together with prenatal diagnosis for the fetus. If prenatal diagnosis is accepted and the baby is found to have an inherited blood disorder further counselling is offered to the parents, and the option to terminate the pregnancy if required.

The aim is to perform prenatal diagnosis by 12+6 weeks' gestation. To achieve this aim the target is to offer the initial screening test by 10 weeks' gestation, which allows couples to complete all the tests and consider the option of an early termination if they wish.

All newborn babies are screened for sickle cell disorders as part of the NHS newborn blood spot (NBS) screening programme (maps 34 and 35); the test can also identify babies who are carriers for sickle cell. Newborn screening for thalassaemia is not recommended by the UK National Screening Committee but it formally supports the current practice of the reporting clinically significant thalassaemias (including beta thalassaemia major) found as a by product of newborn screening for sickle cell disease.

There is clinical and service guidance for the management of sickle cell disease in childhood (see 'Resources').

Magnitude of variation

Map 37: Timeliness of test

The map and column chart display the latest period (July-September 2015), during which the values ranged from 7.3% to 94.0%, which is a 12.9-fold difference between maternity services. The England value for this period was 51.7%.

[1] In the NHS national screening programmes these are key performance indicators ST2 and ST3.

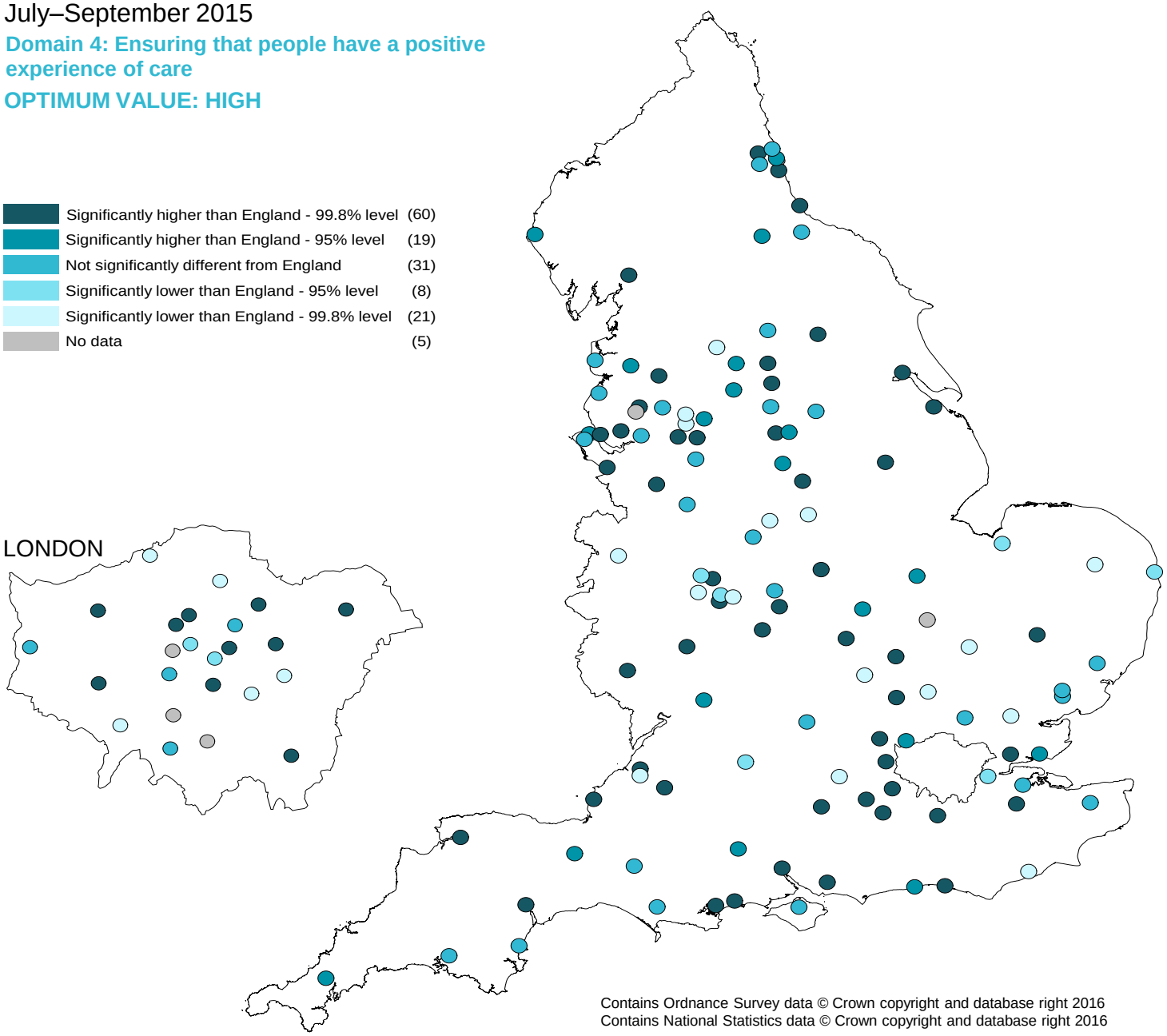
SCREENING SERVICES

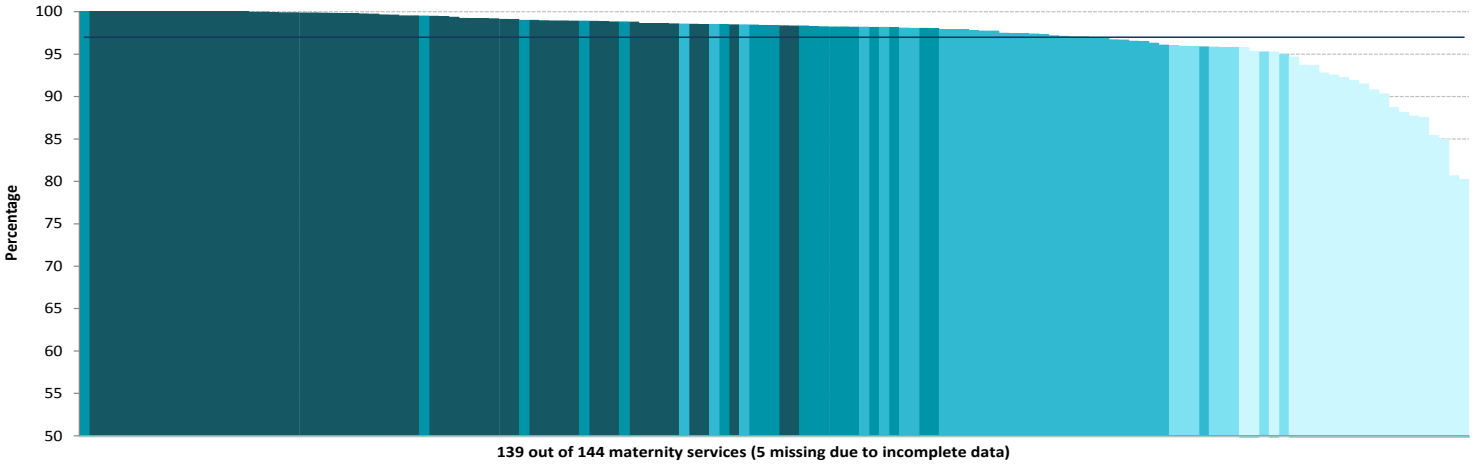
MAP 38: Percentage of samples in the NHS antenatal sickle cell and thalassaemia screening programme submitted to the laboratory with a completed family origin questionnaire (FOQ) by maternity service

July–September 2015

Domain 4: Ensuring that people have a positive experience of care

OPTIMUM VALUE: HIGH





One-third of the reported screening sites (n=46) had less than 50% of women receiving a conclusive test result in the specified time period.

The boxplot shows the distribution of maternity service values for the period April-June 2013 to July-September 2015.

The 75th to 25th percentile gap narrowed significantly indicating a contraction of the middle ranked 50% of maternity services values, closer to the median value.

There was no significant change in either the maximum to minimum range or in the 95th to 5th percentile gap.

There was no significant change in the median maternity service value.

Variation in the timeliness of test has been associated with problems in service delivery, such as:

- lack of direct access to maternity services
- long intervals between a woman presenting at her GP and being booked by maternity services
- lack of understanding by healthcare professionals of the importance of testing early
- differing standards for the timing of antenatal booking

There is also an association between a woman's gestation at the point in time when screening is offered and the uptake of prenatal diagnosis (PND): an early offer of screening is associated with greater uptake of PND.

Map 38: Completion of FOQs

The map and column chart display the latest period (July-September 2015), during which Maternity Service values ranged from 80.2% to 100.0%, which is a 1.2-fold difference between maternity services. The England value for this period was 97.0%.

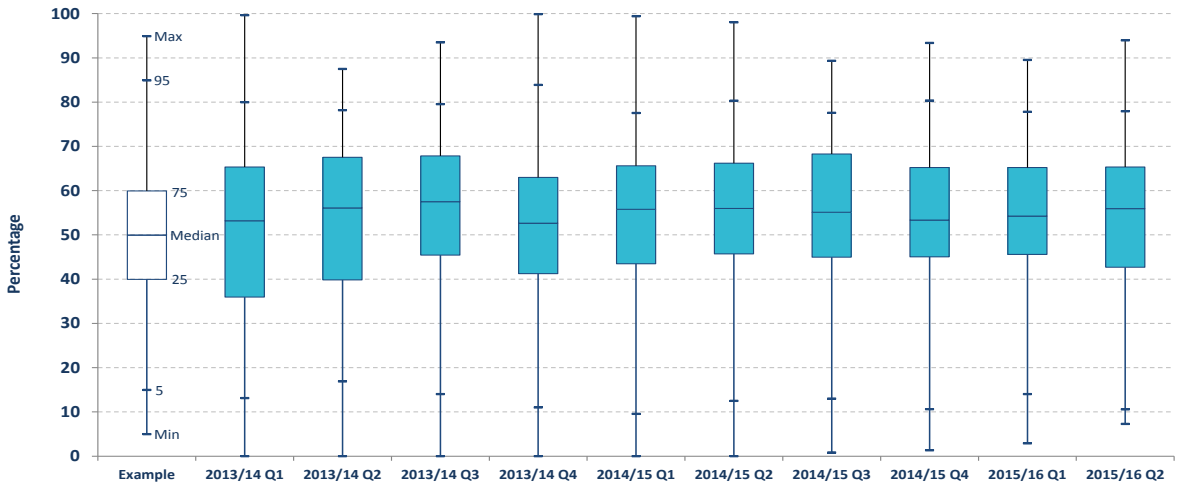
The boxplot shows the distribution of maternity service values for the period April-June 2013 to July-September 2015.

The maximum to minimum range narrowed significantly, which was entirely due to an increase in the minimum maternity service value in the three most recent quarters. The 95th to 5th percentile gap narrowed significantly which was mainly due to a steady increase in the 5th percentile.

There was a very slight increase in the median maternity service value which was statistically significant.

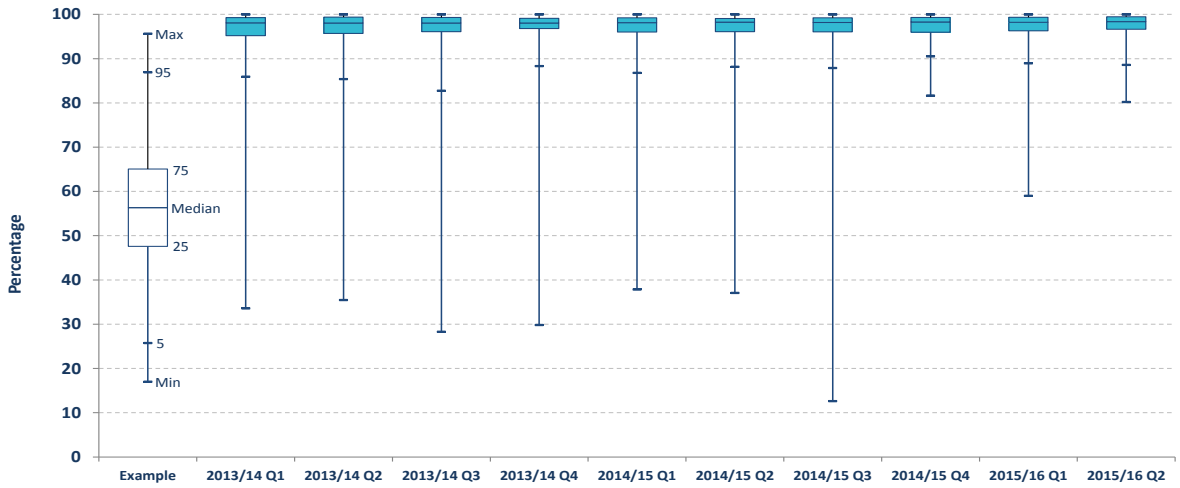
One reason for unwarranted variation in the submission of completed FOQs to the laboratory is failure of health professionals to fill out and send the questionnaire with the blood sample, although education about the importance of FOQs and the development and implementation of an electronic version has increased the number completed and submitted to the laboratory.

Map 37: Boxplot of women in NHS antenatal sickle cell and thalassaemia screening programme with conclusive result by 10 weeks (%) by maternity service



Max-Min (Range)		99.6	87.5	93.5	99.9	99.4	98.0	88.5	92.0	86.6	86.7	No significant change
95th-5th percentile		66.8	61.3	65.5	72.9	68.0	67.8	64.6	69.7	63.8	67.4	No significant change
75th-25th percentile		29.4	27.7	22.4	21.7	22.1	20.5	23.3	20.2	19.6	22.6	NARROWING Significant
Median		53.2	56.1	57.5	52.6	55.8	56.0	55.1	53.3	54.3	55.9	No significant change

Map 38: Boxplot of samples with completed FOQ in NHS antenatal sickle cell and thalassaemia screening programme (%) by maternity service



Max-Min (Range)		66.4	64.5	71.7	70.2	62.2	62.9	87.4	18.3	41.0	19.8	NARROWING Significant
95th-5th percentile		14.1	14.6	17.2	11.7	13.2	11.8	12.1	9.5	11.1	11.4	NARROWING Significant
75th-25th percentile		4.1	3.7	3.2	2.3	3.2	3.0	3.2	3.3	3.0	2.8	No significant change
Median		98.1	98.0	98.1	98.1	98.1	98.3	98.2	98.3	98.2	98.4	INCREASING Significant

Options for action

Commissioners need to specify that service providers adhere to:

- the standards for the linked NHS Antenatal and Newborn Screening Programme (see 'Resources')
- the service specification and the care pathway for the sickle cell and thalassaemia screening programme (see 'Resources)

Commissioners also need to specify that laboratories responsible for testing blood samples and reporting the results of screening follow the recommendations in the "Sickle Cell and Thalassaemia: Handbook for Laboratories" (see 'Resources').

Providers of local sickle cell and thalassaemia screening services need to ensure that all health professionals involved undertake continuing professional development (see 'Resources').

RESOURCES

- NHS Screening Programmes Sickle Cell & Thalassaemia. NHS Sickle Cell and Thalassaemia Screening Programme. Standards for the linked Antenatal and Newborn Screening Programme. Second Edition. October 2011. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/402208/Standards2ndEdition__1_.pdf
- NHS England (prepared by Public Health England). NHS public health functions agreement 2016-17. Service specification no.18. NHS Sickle Cell and Thalassaemia Screening Programme. February 2016. https://www.england.nhs.uk/commissioning/wp-content/uploads/sites/12/2016/04/serv-spec-18-sickle-cell-thalassaemia.pdf
- NHS Sickle Cell and Thalassaemia Screening Programme. Sickle cell and thalassaemia screening: care pathway. Version 1.0/11-2015. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/493993/SCT_AN_pathway_-_version_1.0.pdf
- NHS Sickle Cell and Thalassaemia Screening Programme. Sickle Cell and Thalassaemia: Handbook for Laboratories. Third edition. October 2012. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/398702/LabHandbook2012Edition3v2.pdf
- NHS Screening Programmes. Continuing Professional Development for Screening. Education and Training for the Newborn Blood Spot Programme. http://cpd.screening.nhs.uk/newbornbloodspot
- NHS Sickle Cell and Thalassaemia Screening Programme. Information for healthcare professionals. https://www.gov.uk/government/publications/handbook-for-sickle-cell-and-thalassaemia-screening
- East Midlands Specialised Commissioning Group. The National Haemoglobinopathies Project: a guide to effectively commissioning high-quality sickle cell and thalassaemia services. July 2011. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/409928/NationalHaemoglobinopathiesProjectFinalV2.pdf
- NICE. Sickle cell disease: managing acute painful episodes in hospital. NICE guidelines [CG143]. June 2012. https://www.nice.org.uk/guidance/cg143
- NICE. Sickle cell disease. NICE quality standard [QS58]. April 2014. https://www.nice.org.uk/guidance/qs58
- NICE Pathways. Sickle cell acute painful episode overview. http://pathways.nice.org.uk/pathways/sickle-cell-acute-painful-episode
- Public Health England. A parent's guide to managing sickle cell disease. Third edition, 2012. https://www.gov.uk/government/publications/sickle-cell-disease-managing-the-condition

Case-study: Evaluating major system reconfiguration in stroke services – how the changes were made and their impact on patient care and outcomes

Background

Considerable changes in the provision of clinical care within the English NHS have been discussed in recent years, with proposals to concentrate specialist services, such as major trauma, cardiac surgery and specialist paediatrics, in fewer centres serving larger populations.The case for reconfiguring acute stroke services was strong: there was clear evidence of unacceptable variations in quality of care and clinical outcomes, with many patients not receiving timely, evidence-based care, including rapid access to diagnostic services such as brain imaging. Diagnostic services are central to determining the nature, location and severity of a stroke, all of which may have significant implications for ensuring patients receive appropriate evidence-based care, which may in turn influence patient outcomes.

Major system change in acute stroke care was prompted by the National Stroke Strategy,[1] which noted the importance of stroke services offering immediate access to diagnostic scans. London and Greater Manchester led the way in this process, radically reorganising their stroke services (see Figure CS1). Before reconfiguration, in both areas, patients with suspected stroke were taken to the nearest hospital with an A&E service, then admitted to a specialist stroke unit or general medical ward.

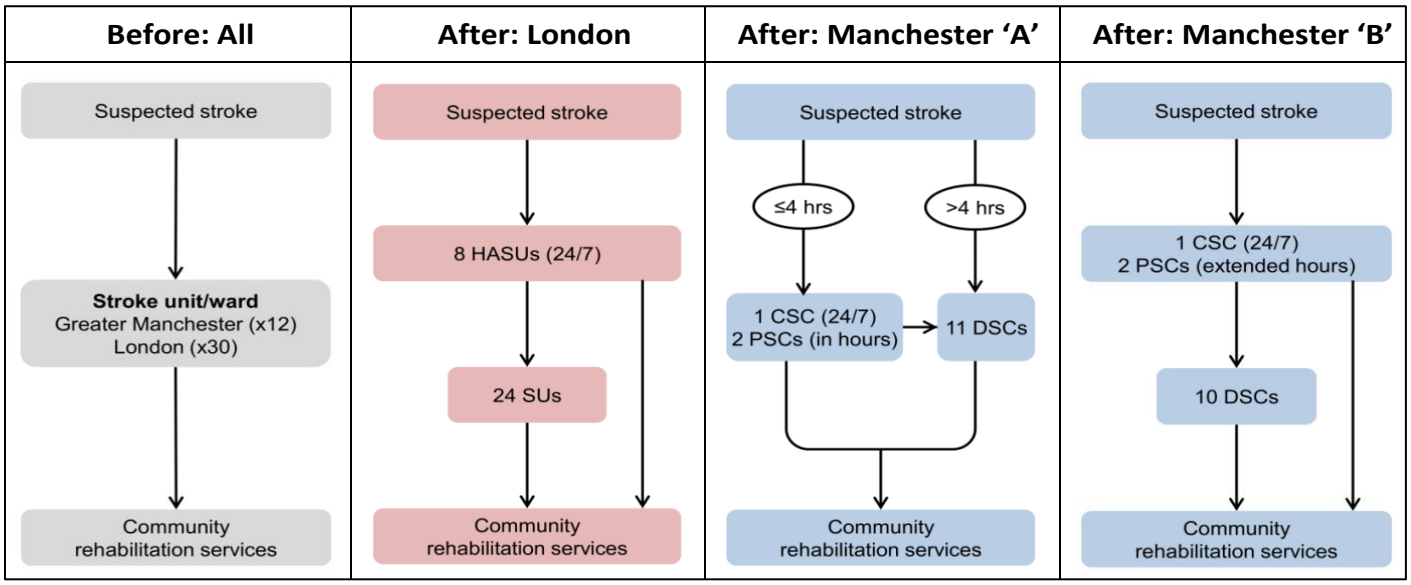
Reconfiguration in London

In London, after reconfiguration in 2010, the following system was implemented, with:

- Eight hyper-acute stroke units (HASUs) set up to provide rapid access to brain imaging, assessment by stroke specialists and interventions, including thrombolysis, 24 hours per day, seven days per week (24/7)
- 24 stroke units established to provide acute rehabilitation services
- the withdrawal of all stroke services at five NHS Trusts

All patients with suspected stroke are eligible for treatment in a HASU; once stable, they are transferred to a stroke unit, nursing home or their own home (see Figure CS1).

Figure CS1: Overview of stroke service models before and after reconfiguration



[1] Department of Health. National Stroke Strategy. 5 December 2007. http://webarchive.nationalarchives.gov.uk/20130107105354/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_081059.pdf

Reconfiguration in Greater Manchester: model 'A'

In Greater Manchester, after reconfiguration in 2010, the following system was implemented (Greater Manchester 'A'), with:

- one NHS Trust hosting a comprehensive stroke centre (CSC), offering hyper-acute stroke services including 24/7 rapid access to brain imaging
- two NHS Trusts hosting primary stroke centres (PSCs), providing hyper-acute stroke services from 7am to 7pm, Monday to Friday
- ten NHS Trusts providing district stroke centre (DSC) services

Patients with suspected stroke arriving at hospital within four hours of developing symptoms were eligible for treatment in a CSC/PSC; once stable, they were transferred to a DSC, nursing home or their own home (see Figure CS1). Patients with suspected stroke presenting outside the four-hour 'window' were taken to the nearest DSC, similar to the care pathway before reconfiguration.

Reconfiguration in Greater Manchester: model 'B'

In March 2015, a revised service model was implemented in Greater Manchester (Greater Manchester 'B'):

- all suspected stroke patients are taken to either a CSC or PSC
- PSC hours have been extended to cover 7am-11pm, 7 days per week
- DSCs are no longer designated to treat patients with suspected acute stroke

With these changes, all patients with suspected stroke in Greater Manchester are eligible for treatment in a hyper-acute unit, which is similar to the care pathway in London (see Figure CS1).

Reconfiguration in the Midlands and East of England

In 2012, NHS organisations in the Midlands and the East of England began discussing proposals to reconfigure stroke services. To date, although planning and modelling exercises have been carried out by local commissioning and hospital organisations, progress in reconfiguring acute stroke services in these areas has been limited.

Aims of the research

This evaluation aims to combine quantitative data on "what works and at what cost?" with qualitative data on "understanding implementation and sustainability" in order to analyse major system change in acute stroke care in a range of settings across the English NHS. The research questions are shown in Box CS1.

Box CS1: Research questions

1. What are the key processes of, and factors influencing, the development and implementation of the stroke service reconfigurations?
2. To what extent have system changes delivered process and outcome improvements, including access to diagnostic services?
3. Have changes delivered improvements that stakeholders (eg commissioners, staff, patients and the public, and reconfiguration leads) think are worthwhile?
4. Have changes delivered value for money?
5. How is service reconfiguration influenced by the wider context of major structural change in the NHS?

Approach

To address these questions, we are using routinely collected data relating to stroke patients in the English NHS before, during and after the reconfigurations were implemented. These data are being analysed to ascertain the effect of reconfigurations on the provision of clinical interventions, patient outcomes, such as mortality and length of stay, and costs of services.

We are also conducting a series of case-studies based on stakeholder interviews, non-participant observations and documentary analysis. The aim of this analysis is to identify drivers for change, and how the reconfigurations were governed, developed, implemented and sustained.

The reconfigurations implemented in Greater Manchester and London in 2010 are being studied retrospectively. The changes implemented in Greater Manchester in 2015 and those planned across the Midlands and the East of England are being studied contemporaneously.

It is likely that health services will continue to be reconfigured:

- other parts of the English NHS are now seeking to reconfigure their stroke services
- other services, such as major trauma, are being reconfigured or there are plans to reconfigure them

The lessons drawn from this evaluation will help ensure that any future service reconfigurations are undertaken in an effective and evidence-based way.

Published findings

Morris et al[2] conducted a controlled difference-in-differences analysis of HES/ONS data (2008-2012) to ascertain the effect of the reconfigurations in London and Greater Manchester on length of hospital stay and mortality at 3, 30 and 90 days for stroke patients. The key findings were:

- length of hospital stay reduced significantly more in London and Greater Manchester than in the rest of England
- mortality in London reduced significantly more than that in the rest of England – a similar reduction was not observed in Greater Manchester

These findings suggest that fully centralised models are associated with better outcomes for stroke patients. Our data on the significantly greater effect of the London changes on mortality and length of stay were reported in the final decision to further centralise stroke services in Greater Manchester[3], and presented as evidence of the potential benefits of centralising specialised healthcare services in the Five Year Forward View.[4]

Ramsay et al[5] undertook a controlled before and after analysis of national stroke audit data (2008-2012) to investigate the effect of the reconfigurations in London and Greater Manchester on the likelihood of patients receiving evidence-based clinical interventions, including rapid access to brain imaging and admission to a stroke unit. The key findings are that after reconfiguration:

- in both areas, patients were significantly more likely to undergo brain imaging within three hours of arrival at hospital than in an urban comparator that had not undergone reconfiguration
- stroke patients in London were significantly more likely overall to receive all clinical evidence-based interventions analysed (including rapid access to brain imaging) than stroke patients in the urban comparator
- stroke patients in Greater Manchester were overall significantly more likely to undergo timely brain imaging than those in the urban comparator; however, on all other clinical interventions assessed, Greater Manchester patients were either significantly less likely to receive evidence-based care than patients in the comparator or there was no significant difference
- HASUs in both metropolitan areas were more likely to provide clinical evidence-based interventions than elsewhere (especially in relation to rapid access to brain imaging), but significantly more patients were treated in HASUs in London (93%) than in Greater Manchester (39%). This was due to the differences not only in the eligibility criteria between the HASU in London (all patients eligible) and those in Greater Manchester (only patients presenting within four hours), but also in adherence to eligibility criteria, with 34% of patients in Greater Manchester who were eligible for treatment in a HASU not receiving treatment in such a unit

[2] Morris S, Hunter RM, Ramsay AIG et al. Impact of centralising acute stroke services in English metropolitan areas on mortality and length of hospital stay: difference-in-differences analysis. *BMJ* 2014;349:g4757 *BMJ* 2014; 349 doi: http://dx.doi.org/10.1136/bmj.g4757 http://www.bmj.com/content/349/bmj.g4757
[3] NHS Greater Manchester, Lancashire and South Cumbria Strategic Clinical Networks. Greater Manchester Stroke Centralisation: Background briefing. March 2015. http://www.hmr.nhs.uk/attachments/article/226/GMISS%20primary%20care%20comms%20May%202015.pdf
[4] NHS England, Care Quality Commission, Health Education England, Monitor, Public Health England, Trust Development Agency. Five Year Forward View. October 2014. https://www.england.nhs.uk/wp-content/uploads/2014/10/5yfv-web.pdf
[5] Ramsay AIG, Morris S, Hoffman A et al. Effects of centralizing acute stroke services on stroke care provision in two large metropolitan areas in England. *Stroke* 2015; 46:2244-2251. doi: 10.1161/STROKEAHA.115.009723 http://stroke.ahajournals.org/content/46/8/2244.full

Turner et al[6] conducted a qualitative analysis of 45 interviews and 316 documents, exploring factors influencing the different models of care for stroke patients selected and implemented in London and Greater Manchester. The key findings were:

- in London system leadership ('top-down', London-wide) was combined with clinical leadership ('bottom-up') to overcome resistance to change, and to align stakeholders in agreeing and implementing the new model
- in Greater Manchester the approach taken was more 'bottom-up', and programme leaders lacked the power necessary to challenge resistance, which meant that less radical changes than those intended were introduced

Fulop et al[7] analysed 125 interviews and 653 documents to study the service models implemented and the implementation approaches employed in London and Greater Manchester. The analysis examined how the service models and implementation approaches influenced local fidelity to the new service models in terms of appropriate referral of patients and services having capacity to provide evidence-based care (termed 'implementation outcomes'); this in turn influenced the contrasting provision of evidence-based care and clinical outcomes ('intervention outcomes') in the two areas.

The model implemented was found to be important in terms of its inclusivity and simplicity:

- in London, where all potential stroke patients were eligible for treatment in a HASU and all HASUs accepted patients 24/7, the referral pathway was easily understood by ambulance and hospital staff, which contributed to 93% of patients reaching a HASU
- in Greater Manchester, only a selection of patients were eligible for HASU treatment and some HASUs operated an in-hours service; both ambulance and hospital staff reported uncertainty about the referral pathway, which contributed to a lower proportion of patients reaching a HASU

The implementation approaches employed were found to be important in terms of launch date, prioritisation of standards and financial incentives, and hands-on facilitation:

- in London there was a single 'big bang' launch date, meaning there was shared understanding of when the new services would 'go live'. Services could not begin to provide care until they demonstrated they met service standards (which were linked to financial incentives), and hands-on service development support was provided by the local stroke network: this meant all services could provide evidence-based care when the single launch date arrived
- Greater Manchester took a phased approach to launching services, which led to ongoing uncertainty about where patients should be taken. Services were permitted to launch without demonstrating local standards had been met, and there was less hands-on service development support: this may have contributed to more variable service development in this area

Further analyses

We will investigate the following issues over the remainder of the study, in order to develop further our understanding of the implementation, sustainability and impact of reconfigurations of this kind:

- cost-effectiveness of changes in London and Greater Manchester 'A'
- patient and carer experience of reconfigured services
- lay involvement in planning and implementing such reconfigurations
- factors obstructing the implementation of changes
- impact of Manchester 'B' on provision of evidence-based care, length of hospital stay and stroke patient mortality
- sustainability of the London stroke services, in terms of its impact on provision of evidence-based care, hospital length of stay and patient mortality

[6] Turner S, Ramsay AIG, Perry C et al. Lessons for major system change: centralisation of stroke services in two metropolitan areas of England. *Journal of Health Services Research and Policy* January 24, 2016, doi: 10.1177/1355819615626189 http://hsr.sagepub.com/content/early/2016/01/22/1355819615626189.abstract

[7] Fulop NJ, Ramsay AIG, Perry C et al. Explaining outcomes in major system change: a qualitative study of implementing centralised acute stroke services in two large metropolitan regions in England. Implement Sci 2016;11:80 doi: 10.1186/s13012-016-0445-z http://implementationscience.biomedcentral.com/articles/10.1186/s13012-016-0445-z

Study website (including study protocol and links to key outputs):
http://www.ucl.ac.uk/dahr/research_pages/stroke_study

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Glossary of Technical Terms

Imaging services

Abbreviated Injury Scale (AIS)

The Abbreviated Injury Scale (AIS) is an anatomical scoring system introduced in 1969. It has been revised and updated against survival so that it now provides a reasonably accurate way of ranking the severity of injury on a scale of one to six, with one being minor, five severe and six an injury from which a patient will not survive. The scale represents the 'threat to life' associated with an injury and is not meant to represent a comprehensive measure of severity.

Contrast medium

A contrast medium (or agent) is a substance used to enhance the contrast of structures or fluids within the body. It is commonly used to enhance the visibility of blood vessels or gastroinstestinal tract.

Double-contrast images

Double-contrast images are taken of the lower intestine using barium and air to look for abnormalities.

Fragility fracture

A fragility fracture is one that results from mechanical forces that would not ordinarily cause fracture in a healthy young adult.

Glasgow Coma Scale

The Glasgow Coma Scale (GCS) is a reliable and universally comparable way of recording the conscious state of a person. Three types of response are measured and added together to give an overall score: the best motor response, the best verbal response and eye opening. A low score denotes a low conscious state. The GCS is used to help predict the progression of a person's condition. The lowest score for each category is one, therefore the lowest total score is three (no response to pain + no verbalisation + no eye opening). A GCS of eight or less indicates severe injury, a GCS of 9-12 indicates moderate injury and a GCS of 13-15 is obtained when the injury is minor.

Graft/grafting

A stent-graft is a tubular structure composed of two parts. The stent is a mesh-like structure made of metal (such as stainless steel). Its function is to provide support to the graft. The graft is composed of a special fabric impervious to blood and lines the stent. The stent-graft is packed in small diameter tubes and expands to its original diameter when released from these tubes. It is threaded into the blood vessel where an aneurysm is located. The stent-graft is expanded like a spring to hold tightly against the wall of the blood vessel and cut off the blood supply to the aneurysm.

Megacolon

Megacolon is abnormal dilation of the colon.

Osteopenia

Osteopenia refers to early signs of bone loss, where bone mineral density is lower than normal but not yet low enough to be considered osteoporosis.

Osteoporosis

Osteoporosis is a condition that affects the bones, causing them to become weak and fragile and more likely to break.

Papilloedema

Papilloedema is swelling of the optic disc(s) secondary to raised intracranial pressure. It is most usually bilateral.

Thrombolysis

Thrombolysis is the breakdown (lysis) of blood clots by pharmacological means. It is often referred to as ‘clot busting’ for this reason.

Endoscopy services

Abdominal radiation injury

Almost all patients undergoing radiation to the abdomen, pelvis or rectum will show signs of acute enteritis (inflammation of the intestine). Therapeutic radiation affects not only malignant tumours but also surrounding normal tissues. In general the higher the daily and total dose delivered to the normal bowel and the greater the volume of normal bowel treated, the greater the risk of radiation enteritis.

Capsule endoscopy

Capsule endoscopy involves swallowing a small capsule containing a colour camera, battery, light source and transmitter. Once swallowed the camera moves naturally through the digestive tract. Approximately eight hours after ingesting the camera patients return and the recording device is removed, the images are downloaded to a computer and evaluated. The capsule is disposable and will be passed naturally in the bowel movement.

Device-assisted enteroscopy

Device-assisted enteroscopy includes double-balloon enteroscopy (DBE), single-balloon enteroscopy (SBE) and spiral enteroscopy (SE). Device-assisted enteroscopy has both diagnostic and therapeutic capabilities. The technique allows an endoscopist access to areas of the small intestine that were previously inaccessible. This technique was introduced almost at the same time as capsule endoscopy and roughly 10% of those patients will need enteroscopy for further evaluation or imparting therapy.

Dysphagia

Dysphagia is the term used to describe difficulty in swallowing. Dysphagia is usually caused by nerve or muscle problems and may occur after a stroke, throat and mouth cancer, gastro-oesophageal reflux disease (GORD) or as a symptom of several different neurological conditions. Pain can cause dysphagia, because pain in the throat may make swallowing difficult.

Endoscope

An endoscope is a medical device consisting of a long, thin, flexible (or rigid) tube with a light and a video camera, which is used to examine the interior surfaces of an organ or tissue. Images of the inside of the patient's body can be seen on a screen. The examination can be recorded so that doctors can review it after the procedure. The endoscope can also be used for enabling biopsies and retrieving foreign objects.

Enteropathy

Enteropathy is any pathology of the intestine.

Eosinophilic oesophagitis

Eosinophilic oesophagitis is characterised by the infiltration of a large number of eosinophils, a type of white blood cell, in the oesophagus. Eosinophils are an important part of the immune system, helping to fight off certain types of infections, such as parasites. A variety of stimuli may trigger this abnormal production and accumulation of eosinophils including certain foods. Eosinophilic oesophagitis means eosinophils infiltrating the oesophagus and causing swelling. People with eosinophilic oesophagitis commonly have other allergic diseases such as asthma or eczema.

Gastro-oesophageal reflux

Gastro-oesophageal reflux disease (GORD) is a common condition in which stomach acid leaks out of the stomach and into the oesophagus. Common symptoms include heartburn and regurgitation caused by stomach acid coming back up into the mouth, creating a sour taste in the mouth and pain and/or difficulty swallowing.

Inflammatory bowel disease (IBD)

Inflammatory bowel disease (IBD) is a term used mainly to describe two diseases: Crohn's disease and ulcerative colitis. Both are chronic diseases that involve inflammation of the gastrointestinal tract. Ulcerative colitis affects only the colon whereas Crohn’s disease can affect the entire digestive tract.

Minimally invasive procedure

A minimally invasive procedure is one that is carried out by entering the body through the skin or through a body cavity or anatomical opening, but with the smallest damage possible to these structures.

Polyps

Polyps are small growths on the inner lining of the bowel or rectum. They are quite common and do not usually cause symptoms. Polyps are not usually cancerous although they may become cancerous if left untreated.

Staging of malignancy

Staging describes the severity of a person’s cancer based on the size and/or extent (reach) of the original (primary) tumour and whether cancer has spread in the body. It is based on knowledge of the way cancer progresses. It gives health professionals a transferrable

common terminology. Staging is important to help plan the appropriate treatment, estimate prognosis and identify suitable clinical trials.

Stricture

An intestinal stricture, also known as a stenosis, is a narrowing of a tubular part of the body.

Transmural disease

Transmural disease involves all the layers of the bowel rather than just the mucosa and sub-mucosa.

Physiological diagnostic services

Ambulatory urodynamics

Ambulatory urodynamics is a test that assesses the way in which the bladder works. Patients pass urine into a special toilet which records the amount and the rate at which urine flows. An ultrasound scan may be done to check the bladder is empty. Two fine tubes are passed, one into the bladder and one into the rectum (back passage). An ‘electronic’ continence pad, connected to a special recorder, will record any leaks while normal activities are performed for several hours.

Cystometrogram or video-cystometrogram

A cystmetrogram is a diagnostic procedure used to evaluate bladder function.

Herceptin

Herceptin, also known as Trastuzumab, is a monoclonal antibody – a type of targeted treatment that can control the growth of cancer cells, which produce excess human epidermal growth factor receptor 2 (HER2).

Narcolepsy

Narcolepsy is a long-term neurological condition that disrupts normal sleeping patterns.

Peripheral nervous system (PNS)

The peripheral nervous system consists of the nerves and ganglia outside of the brain and spinal cord. The main function of the PNS is to connect the central nervous system (CNS) to the limbs and organs.

Stress echocardiography

Stress echocardiography is a test that uses ultrasound to show how well heart muscle is working. It is mainly used to detect a decrease in blood flow to the heart.

Uroflowmetry

Uroflowmetry measures the volume of urine released from the body, the speed with which it is released and how long the release takes.

Valvular heart disease

Valvular heart disease is any disease process involving one or more of the valves of the heart (the aortic and mitral valves on the left, and the pulmonary and tricuspid valves on the right).

Screening

Congenital hypothyroidism (CHT)

Congenital hypothyroidism (CHT) is a condition that is present from birth resulting from an absent or underdeveloped thyroid gland (dysgenesis) or from a thyroid gland unable to make thyroid hormone (dyshormonogenesis); babies with CHT cannot produce enough thyroid hormone to meet the body’s needs.

Coverage

Coverage is the percentage of people in a population eligible for screening at a given point in time, who were screened within a specified period.

Cystic fibrosis

Cystic fibrosis is an inherited condition in which the lungs and digestive system can become clogged with thick, sticky mucus.

Glutaric aciduria type 1 (GA1)

Glutaric aciduria type 1 is a rare but serious inherited condition in which the body is unable to process certain amino acids, causing a harmful build-up of substances in the blood and urine.

Homocystinuria (HCU)

Homocystinuria is a rare but potentially serious inherited condition in which the body is unable to process the amino acid methionine, causing a harmful build-up of substances in the blood and urine.

Isovaleric acidaemia (IVA)

Isovaleric acidaemia is a rare but potentially serious inherited condition in which the body is unable to process the amino acid leucine, causing a harmful build-up of substance in the blood and urine.

Maple syrup urine disease (MSUD)

Maple syrup urine disease is a rare but serious inherited condition in which the body is unable to process certain amino acids, causing a harmful build-up of substances in the blood and urine.

Medium-chain acyl CoA dehydrogenase deficiency (MCADD)

Medium-chain acyl CoA dehydrogenase deficiency is a rare genetic condition present from birth in which a person has problems breaking down fat to use as an energy source.

Phenylketonuria (PKU)

Phenylketonuria is a rare genetic condition present from birth (congenital) in which the body is unable to break down phenylalanine, which builds up in the blood and brain; high levels of phenylalanine can damage the brain.

Screening

Screening is the process of identifying individuals who appear healthy but may be at increased risk of a disease or condition.

Uptake

Uptake is the percentage of people who, having been sent an invitation to participate in screening, take the screening test in response to that invitation.

Glossary of Essential Terms

Introduction

Much of the disagreement that occurs during the commissioning or management of services arises because different people use the same term but have a different understanding of its meaning. This Glossary is provided to help develop a shared or common language. If there is a clear, short or memorable definition from the literature, this has been cited and presented in italics; where definitions in the literature do not meet any of these criteria, the PHE NHS Atlas Team have composed and provided a definition. Where definitions have been adapted from the published literature, they are presented in roman type with the source acknowledged.

Access to healthcare

Facilitating access is concerned with helping people to access appropriate healthcare resources to preserve or improve their health. Access is a complex concept and there are at least four aspects.

1. If services are available in terms of an adequate supply, a population may have theoretical access to healthcare.
2. The extent to which a population gains access to healthcare also depends on 'health literacy', which in turn depends on educational level and language competency. These affect an individual's ability to understand their own needs and to communicate these or to understand, and take action in response to, medical advice. Effective services must be acceptable to the population if they are to make use of them. Acceptability may be influenced by social and cultural norms. Population access may vary due to physical accessibility, in particular, travelling distance. Financial, organisational and social or cultural barriers may also limit utilisation. Thus utilisation is dependent on many factors and not the adequacy of supply. These factors may be unequally distributed across the population and lead to inequalities in access.
3. The services available must be relevant and effective if the population is to gain access to satisfactory health outcomes.
4. The availability of services, and barriers to utilisation, have to be evaluated in the context of differing perspectives, health needs and the material and cultural settings of diverse groups in society.

Equity of access may be measured in terms of the availability, utilisation or outcomes of services. Both horizontal and vertical dimensions of equity require consideration.

Adapted from: Gulliford M, Figueroa-Munoz J, Morgan M et al. What does 'access to healthcare' mean? J Health Serv Res Policy 2002; 7: 186-188.

Appropriate

A procedure is termed appropriate if its benefits sufficiently outweigh its risks to make it worth performing …

Source: Kahan JP et al. Measuring the necessity of medical procedures. Medical Care 1994; 32: 352-365.

Audit

While inspection has traditionally focused on organizational systems and processes, rather than the assessment of internal control systems, audit has usually been the mechanism for examining internal controls (...). However, audit is more associated with stewardship of resources, whereas inspection traditionally is primarily concerned with 'professional and service standards' (...).

Source: Scrivens E. *Quality, Risk and Control in Health Care*. Open University Press: 2005, page 128.

Average, *see* ***Mean***

Box and whisker plot

See ***Introduction to the data*** section.

British National Formulary (BNF)

The British National Formulary is a joint publication of the British Medical Association and the Royal Pharmaceutical Society. It provides prescribers, pharmacists and other healthcare professionals with up-to-date information about the use of medicines.

Burden of disease

The burden of disease is a measurement of the gap between a population's current health and the optimal state where all people attain full life expectancy without suffering major ill-health.

Source: World Health Organization. Health Promotion Glossary Update. [Modified definition (WHO, 2000).] http://www.who.int/healthpromotion/about/HPR%20Glossary_New%20Terms.pdf

Care pathway

... the expected course of events in the care of a patient with a particular condition, within a set timescale.

Source: Kitchiner D, Davidson D, Bundred P. Integrated Care Pathways: effective tools for continuous evaluation of clinical practice. J Eval Clin Pract 1996; 2; 65-69.

Clinical guidelines

... systematically developed statements to assist practitioner and patient decisions about appropriate healthcare for specific circumstances.

Source: Timmermans S, Berg M. *The Gold Standard. The challenge of evidence-based medicine and standardization in health care.* Temple University Press, Philadelphia: 2003.

Commissioner

... to be the advocate for patients and communities, securing a range of appropriate high-quality health care services for people in need [and] to be the custodian of tax-payers' money; this brings a requirement to secure best value in the use of resources.

Source: House of Commons Health Committee. Commissioning. Fourth Report of Session 2009-10. Volume 1. http://www.publications.parliament.uk/pa/cm200910/cmselect/cmhealth/268/268i.pdf

Commissioning

Commissioning in the NHS is the process of ensuring that the health and care services provided effectively meet the needs of the population. It is a complex process with responsibilities ranging from assessing population needs, prioritising health outcomes, procuring products and services, and managing service providers.

Source: Department of Health. Commissioning [Archived content]. http://webarchive.nationalarchives.gov.uk/+/www.dh.gov.uk/en/managingyourorganisation/commissioning/index.htm

Confidence intervals

Confidence intervals give the range within which the true size of a treatment effect (which is never precisely known) lies, with a given degree of certainty (usually 95% or 99%).

Source: Evans I, Thornton H, Chalmers I. *Testing Treatments. Better Research for Better Healthcare.* The British Library: 2006.

Costs

Cost is not solely financial. Cost may be measured as the time used, the carbon produced or the benefit that would be obtained if the resources were used for another group of patients (ie the opportunity cost).

Culture

Culture is the shared tacit assumptions of a group that it has learned in coping with external tasks and dealing with internal relationships.

Source: Schein EH. *The Corporate Culture Survival Guide*. John Wiley & Sons: 1999, page 186.

Deprivation

See also ***English Indices of Deprivation 2015***
Deprivation covers a broad range of issues and refers to unmet needs caused by a lack of resources of all kinds, not just financial.

Source: Department for Communities and Local Government. The English Indices of Deprivation 2010. Neighbourhoods Statistical Release. 24 March 2011. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6871/1871208.pdf

Effective care

The extent to which an intervention, procedure regimen, or service produces a beneficial outcome under ideal circumstances (e.g., in a randomized controlled trial).

Source: Canadian Agency for Drugs and Technologies in Health. *Optimal Therapy Report: Cost effectiveness of blood glucose test strips in the management of adult patients with diabetes mellitus.* Volume 3, Issue 3, May 2009. https://www.cadth.ca/media/pdf/BGTS_Consolidated_Economic_Report.pdf

Efficiency

See also ***Productivity***

… efficiency can be defined as maximising well-being at the least cost to society.

Source: Mitton C, Donaldson C. *Priority setting toolkit. A guide to the use of economics in healthcare decision making.* BMJ Publishing Group: 2004.

English Indices of Deprivation 2015

See also ***Deprivation***

The English Indices of Deprivation 2015 are based on 37 separate indicators, organised across seven distinct domains of deprivation which are combined, using appropriate weights, to calculate the Index of Multiple Deprivation 2015 (IMD 2015). This is an overall measure of multiple deprivation experienced by people living in an area and is calculated for every Lower layer Super Output Area (LSOA), or neighbourhood, in England. Every such neighbourhood in England is ranked according to its level of deprivation relative to that of other areas.

Source: Department for Communities and Local Government. The English Indices of Deprivation 2015. Statistical Release. 30 September 2015. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/465791/English_Indices_of_Deprivation_2015_-_Statistical_Release.pdf

Equity

Equity is a subjective judgment of fairness.

Evidence

Evidence is generally considered to be information from clinical experience that has met some established test of validity, and the appropriate standard is determined according to the requirements of the intervention and clinical circumstance. Processes that involve the development and use of evidence should be accessible and transparent to all stakeholders.

Source: Olsen LA, Goolsby WA, McGinnis JM; Roundtable on Evidence-Based Medicine (2009) *Leadership Commitments to Improve Value in Health Care: Finding Common Ground: Workshop Summary*. National Academies Press. Free to download at: http://www.nap.edu/catalog.php?record_id=11982

Health

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

Source: Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19 June-22 July 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on 7 April 1948. The definition has not been amended since 1948. http://www.who.int/suggestions/faq/en/index.html

Health needs

... objectively determined deficiencies in health that require health care, from promotion to palliation.

Source: World Health Organization (WHO). Health Systems Strengthening Glossary. http://www.who.int/healthsystems/hss_glossary/en/index.html

Healthy life expectancy

See also ***Life expectancy*** *and* ***Life expectancy at birth***

Average number of years that a person can expect to live in "full health" by taking into account years lived in less than full health due to disease and/or injury.

Source: World Health Organization (WHO) Health statistics and health information systems. Health Status Statistics: Mortality. http://www.who.int/healthinfo/statistics/indhale/en/

Inequalities in health

Inequalities in health are objectively measured differences in health status, healthcare access and health outcomes.

Input, Output and Outcome

Input is a term used by economists to define the resources used, such as the number of hospital beds, to produce the output, such as the number of patients admitted per bed per year. The economists' terminology is different from the language utilised in quality assurance, in which the terms structure, process and outcome are used. Input equates to structure and process, i.e. the number of beds and the number of admissions per bed, respectively. However, the outcome is distinct from the output. Outcome includes some measure of the effect the process has had on the patients, for example, the number of patients who were discharged to their own home.

Integrated care

Clinical integration, where care by professionals and providers to patients is integrated into a single or coherent process within and/or across professions such as through use of shared guidelines and protocols.

Source: Kodner DL, Spreeuwenberg C. Integrated care: meaning, logic, applications and implications – a discussion paper. International Journal of Integrated Care 2002; 2: 1-6.

International Classification of Diseases (ICD)

ICD is the foundation for the identification of health trends and statistics globally, and the international standard for reporting diseases and health conditions. It is the diagnostic classification standard for all clinical and research purposes. ICD defines the universe of diseases, disorders, injuries and other related health conditions, listed in a comprehensive, hierarchical fashion that allows for:
- easy storage, retrieval and analysis of health information for evidenced-based decision-making;
- sharing and comparing health information between hospitals, regions, settings and countries; and
- data comparisons in the same location across different time periods.

Uses include monitoring of the incidence and prevalence of diseases, observing reimbursements and resource allocation trends, and keeping track of safety and quality guidelines. They also include the counting of deaths as well as diseases, injuries, symptoms, reasons for encounter, factors that influence health status, and external causes of disease.

Source: World Health Organization. Classifications. http://www.who.int/classifications/icd/en/

Interquartile range (IQR)

The interquartile range (IQR) is a measure of variability, based on dividing a data set into quartiles. Quartiles divide a rank-ordered data set into four equal parts (numbers of observations). The values that divide each part are called the first, second and third quartiles, denoted by Q1, Q2 and Q3, respectively:

- Q1 is the 'middle' value in the first half of the rank-ordered data set
- Q2 is the median value in the set
- Q3 is the 'middle' value in the second half of the rank-ordered data set

The interquartile range is equal to Q3 minus Q1.

Adapted from: Stat Trek. Statistics and Probability Dictionary. http://stattrek.com/statistics/dictionary.aspx?definition=Interquartile%20range

Life expectancy

*See also **Healthy life expectancy** and **Life expectancy at birth***
Life expectancy at a specific age is the average number of additional years a person of that age could expect to live if current mortality levels observed for ages above that age were to continue for the rest of that person's life.

Source: Population Division, DESA, United Nations. *World Population Ageing 1950–2050*, Annex 1. http://www.un.org/esa/population/publications/worldageing19502050/pdf/95annexi.pdf

Life expectancy at birth

*See also **Healthy life expectancy** and **Life expectancy***
... , life expectancy at birth is the average number of years a newborn would live if current age-specific mortality rates were to continue.

Source: Population Division, DESA, United Nations. *World Population Ageing 1950-2050*, Annex 1. http://www.un.org/esa/population/publications/worldageing19502050/pdf/95annexi.pdf

Mean (average)

The mean is the sum of values, eg total size of summed populations, divided by the number of values, eg number of populations in the sample.

Median

A value or quantity lying at the midpoint of a frequency distribution of observed values or quantities, such that there is an equal probability of falling above or below it.

Medical care epidemiology

... studies the use of health care services among populations living within the geographic boundaries of "natural" health care [populations].

Source: Wennberg JE. *Tracking Medicine. A Researcher's Quest to Understand Health Care*. Oxford University Press: 2010.

Network

If a system is a set of activities with a common set of objectives, the network is the set of organisations and individuals that deliver the systems.

Outcome, *see Input*

Output, *see Input*

Overdiagnosis

A condition is diagnosed that would otherwise not go on to cause symptoms or death.

Source: Elmore JG, Fletcher SW. Overdiagnosis in Breast Cancer Screening: Time to Tackle Underappreciated Harm. Annals of Internal Medicine 2012; 156; 536.

Overuse

See also Underuse
Overuse describes a process of care in circumstances where the potential for harm exceeds the potential for benefit. Prescribing an antibiotic for a viral infection like a cold, for which antibiotics are ineffective, constitutes overuse. The potential for harm includes adverse reactions to the antibiotics and increases in antibiotic resistance among bacteria in the community. Overuse can also apply to diagnostic tests and surgical procedures.

Source: Robert Wood Johnson Foundation. Quality/Equality Glossary. April 24, 2013. http://www.rwjf.org/en/library/research/2013/04/quality-equality-glossary.html

Patient decision aid

Patient decision aids are ... intended to supplement rather than replace patient-practitioner interaction. They may be leaflets, interactive media, or video or audio types. Patients may use them to prepare for talking with a clinician, or a clinician may provide them at the time of the visit to facilitate decision making. At a minimum, patient decision aids provide information about the options and their associated relevant outcomes.

Source: Elwyn G. Developing a quality criteria framework for patient decision aids; online international Delphi Consensus process. British Medical Journal 2006; 333: 417-427.

Population healthcare

The aim of population healthcare is to maximise value and equity by focusing not on institutions, specialties or technologies, but on populations defined by a common symptom, condition or characteristic, such as breathlessness, arthritis or multiple morbidity.

Population medicine

Population medicine is a style of clinical practice in which the clinician is focused not only on the individual patients referred but also on the whole population in need.

Preference-sensitive treatment decisions

Preference sensitive treatment decisions involve making value trade-offs between benefits and harms that should depend on informed patient choice.

Source: O'Connor AM et al. Toward the 'Tipping Point': Decision aids and informed patient choice. Health Affairs 2007; 26: 716-725.

Preference-sensitive care

"...elective", or "preference-sensitive" care, interventions for which there is more than one option and where the outcomes will differ according to the option used because patients delegate decision making to doctors, physician opinion rather than patient preference often determines which treatment patients receive. I argue that this can result in a serious but commonly overlooked medical error: operating on the wrong patients – on those who, were they fully informed, would not have wanted the operation they received.

Source: Wennberg JE. *Tracking Medicine. A Researcher's Quest to Understand Health Care*. Oxford University Press: 2010.

Productivity

See also Efficiency
Productivity is the relationship between inputs and outputs, such as the number of operations per theatre per year; efficiency is the relationship between outcomes and inputs, such as the number of successful operations per theatre per year.

Protocol

… protocols are the descriptions of the steps taken to care for and treat a patient. They are sometimes called the 'integrated care pathway' and are designed to:

- *Implement national standards such as national services frameworks and guidelines and appraisals produced by the National Institute for Clinical Excellence (NICE)*
- *Determine care provision by using the best available evidence if national standards are not available*

Developed by multi-disciplinary teams, local protocols reflect local services and staffing arrangements. They identify who carries out key parts of the care or treatment and where they should be delivered. Examples of local protocols are:

- *Patient group directions*
- *Referral advice*

They usually include decision support systems to help make decisions about appropriate care for specific clinical circumstances and may form all, or part of the record of care.

Source: NHS Institute for Innovation and Improvement. Quality and Service Improvement Tools. Protocol-based Care. http://www.institute.nhs.uk/quality_and_service_improvement_tools/quality_and_service_improvement_tools/protocol_based_care.html

Public health

The science and art of promoting and protecting health and well-being, preventing ill-health and prolonging life through the organised efforts of society.

Source: The Faculty of Public Health. What is public health. http://www.fph.org.uk/what_is_public_health

Quality

Quality is the degree to which a service meets pre-set standards of goodness.

Source: Donabedian A, personal communication.

Quality of life[1]

... individuals' perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, level of independence, social relationships, personal beliefs and their relationship to salient features of their environment.

Source: World Health Organization (WHO) Programme on Mental Health. WHOQOL: Measuring Quality of Life. The World Health Organization Quality of Life Instruments (The WHOQOL-100 and the WHOQOL-BREF). http://www.who.int/mental_health/media/68.pdf

Quartile

See also ***Interquartile range***
Quartiles divide a rank-ordered data set into four equal parts. The values that divide each part are called the first, second, and third quartiles; and they are denoted by Q_1, Q_2, and Q_3, respectively.

Source: Stat Trek. Statistics and Probability Dictionary. http://stattrek.com/statistics/dictionary.aspx?definition=quartile

Range

See also ***Interquartile range***
The range is the difference between the highest and lowest value in the sample. The range provides a crude measure of the spread of the data.

Safety

Patient safety can, at its simplest, be defined as: The avoidance, prevention and amelioration of adverse outcomes or injuries stemming from the process of healthcare. … the reduction of harm should be the primary aim of patient safety, not the elimination of error.

Source: Vincent C. *Patient Safety*. Churchill Livingstone: 2006.

Self-management

... self-management is especially important for those with chronic disease, where only the patient can be responsible for his or her day-to-day care over the length of the illness. For most of these people self-management is a lifetime task.

Source: Lorig KR, Holman HR. Self-Management Education: History, Definition, Outcomes, and Mechanisms. Annals of Behavioural Medicine 2003; 26; 1-7. doi 10.1207/S153124796ABM2601_01

[1] Examples of other quality of life definitions can be found at: http://www.scotland.gov.uk/Publications/2006/01/13110743/11

Shared decision-making

In a shared decision, a health care provider communicates to the patient personalized information about the options, outcomes, probabilities, and scientific uncertainties of available treatment options, and the patient communicates his or her values and the relative importance he or she places on benefits and harms.

Source: Wennberg JE. *Tracking Medicine. A Researcher's Quest to Understand Health Care*. Oxford University Press: 2010.

Standard deviation

See also ***Variance***
The standard deviation is a measure of spread, and is the square root of the variance.

Standards

A minimum level of acceptable performance or results or excellent levels of performance or the range of acceptable performance or results.

Source: Kohn LT, Corrigan JM, Donaldson MS (eds) Committee on Quality of Health Care in America, Institute of Medicine. *To Err is Human. Building a Safer Health System.* National Academy Press, Washington: 2000.

Structure

Structure comprises the inter-relation of healthcare facilities through which health services are provided. Healthcare is a localised activity, provided by the organisations that form the general healthcare structure, including hospitals, GP practices, clinics, ambulatory care, rehabilitation centres, home care and long-term nursing care.

Supply-sensitive care

It differs in fundamental ways from both effective care and preference-sensitive care. Supply-sensitive care is not about a specific treatment per se*; rather, it is about the frequency with which everyday medical care is used in treating patients with acute and chronic illnesses. Remedying variation in supply-sensitive care requires coming to terms with the "more care is better" assumption. Are physician services and hospitals in high-cost, high-use regions overused?*

Source: Wennberg JE. *Tracking Medicine. A Researcher's Quest to Understand Health Care*. Oxford University Press: 2010.

Surgical signature

Surgical signatures reflect the practice patterns of individual physicians and local medical culture, rather than differences in need – or even differences in the local supply of surgeons.

Source: Dartmouth Medical School, Center for the Evaluative Clinical Sciences. *The Dartmouth Atlas of Health Care 1998.* AHA Publishing Inc.

System

A system is a set of activities with a common set of objectives for which an annual report is produced.

Underuse

See also ***Overuse***
Underuse refers to the failure to provide a healthcare service or for patients to accept and take up such a service when it would have produced a favourable outcome for a patient. Standard examples include failure to provide or low uptake of, appropriate preventive services to eligible patients (eg cervical smears, influenza vaccinations for older people, screening for hypertension) and proven medications for long-term illnesses (steroid inhalers for people with asthma; aspirin, beta-blockers and lipid-lowering agents for people who have had a recent myocardial infarction).

Adapted from: Robert Wood Johnson Foundation. Quality/Equality Glossary. April 24, 2013. http://www.rwjf.org/en/library/research/2013/04/quality-equality-glossary.html

Unwarranted variation

Variation in the utilization of health care services that cannot be explained by variation in patient illness or patient preferences.

Source: Wennberg JE (2010) *Tracking Medicine. A Researcher's Quest to Understand Health Care*. Oxford University Press.

Value

… value is expressed as what we gain relative to what we give up – the benefit relative to the cost.

Source: Institute of Medicine of the National Academies. Learning Healthcare System Concepts v. 2008. The Roundtable on Evidence-Based Medicine, Institute of Medicine. Annual Report.

Value for money

Value for money is achieved *"by focusing on the productivity of staff and on prevention rather than cure, as well as by carefully allocating resources to people in greatest need and by adopting the most effective approaches."*

Source: The Cabinet Office. Excellence and fairness: Achieving world class public services. 2008, page 12. http://webarchive.nationalarchives.gov.uk/20090121123402/http:/cabinetoffice.gov.uk/media/cabinetoffice/strategy/assets/publications/world_class_public_services.pdf

Variation

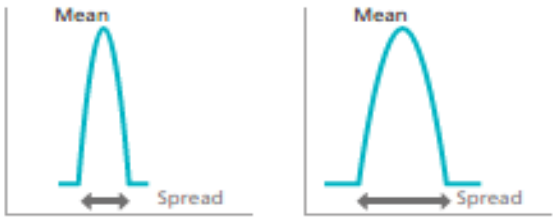
Everything we observe or measure varies. Some of this is random variation. Some variation in healthcare is desirable, even essential, since each patient and population is different and should be cared for uniquely. New and better treatments and improvements in care processes result in variation during the early phases of their introduction.

Adapted from: Neuhauser D, Provost L, Bergman B. The meaning of variation to healthcare managers, clinical and health-services researchers, and individual patients. BMJ Qual Saf 2011; 20 (Suppl 1); i36-i40. doi: 10.1136/bmjqs.2010.046334

Variance

See also ***Range***

The variance is another measure of spread, which describes how far the values in the sample lie away from the mean value. It is the average of the squared differences from the mean and is a better measure of spread than the range.



This figure illustrates how two populations may have the same mean value, but different degrees of variation or spread: the graph on the right shows greater variation than that on the right.

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