Transforming imaging services in England: a national strategy for imaging networks

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NHS England and NHS Improvement

Contents

Foreword

Imaging services have evolved and transformed over the last 30 years, both to keep pace with new technology and to support the evolution of new diagnoses and treatments. With ever increasing demands, an ageing population and an increase in the complexity of imaging examinations radiology services have already started to develop innovative approaches to meeting some of those challenges.

We have seen the evolution of collaborative networks in paediatrics, neuro-radiology and Interventional Radiology (IR), as well as a coming together of shared 'on call' services, for both acute 'on call' and to provide seamless provision where skilled resources are scarce. There have been pioneers who have tested ideas more formally through the Vanguard programme or continued to develop their networks in a less formal way. However, there are many lessons to be learned from all of these endeavours, as we encourage and support trusts to continue to build imaging networks. This National Strategy for Imaging Networks highlights some of the benefits to both individual imaging departments, but most importantly to our patients, by delivering services in this networked way.

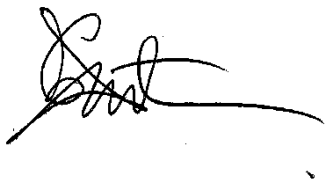
This is not something new but starts to formalise and give a strategic direction to what many imaging departments and networks are already developing. We plan to take this supportive approach to enable networks to learn from each other and to facilitate that learning, so that we do not 'reinvent the wheel' and work in silos but accelerate the progress that some imaging networks are already making.

As with many areas of healthcare, there is variation, some of which is warranted and appropriate, and some of which is not. By sharing our information and learning from each other we can start to improve and collaborate on some of the solutions.

There are some unprecedented challenges facing the imaging workforce, which will also need to be addressed to ensure the sustainability of imaging services. There will need to be a significant increase in the number of radiologists and radiographers in training, to make up for the current shortfall.

Initiatives to retain the current workforce – as highlighted in the interim NHS People Plan[1] - are also a priority. However, there has never been a better time to collaborate to use our resources to best effect.

We hope that you will welcome this national approach and support, which aligns with the overarching principles of the national diagnostics strategy which is being created to coordinate diagnostics related elements of the Long Term Plan.



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Summary

This strategy sets out a proposal for implementing collaborative imaging networks on a national basis across England. This approach will deliver better quality care and better value services for patients and provide hardworking NHS staff opportunities to develop their career and increase their productivity.

It proposes a geographical footprint based on patient flows for a range of conditions including cancer, stroke, major trauma, acute cardiology and maternity services. It uses the data from the NHS England and NHS Improvement national imaging data collections to model some of the opportunities for skill mix, procurement (both capital equipment and outsourcing), shared capacity and demand, as well as outlining the support and infrastructure required to develop and deliver imaging networks.

This will be based on the experiences of existing imaging networks and the work of the 'Early Adopter' imaging networks commissioned by NHS Improvement in January 2018, as well as previous experience of what has worked well in other clinical networks, such as 'heart and stroke networks' and 'cancer networks'.

The strategy sets out a proposal for the creation of formal imaging networks in two phases: phase 1 creating 24 networks by 2022, moving towards consolidation of those 24 into 18 imaging networks in phase 2, by 2023. The approach to developing the proposed networks can be found at Appendix 1. Detailed composition of those networks will be published in the Imaging Network Implementation Guidance and will be co-produced in partnership with regional stakeholders in early 2020.

The benefits are summarised as:

- Improved sustainability and service resilience
- Staffing consistency and flexibility supporting enhanced personal development
- Staff retention through flexible working and flexible retirement opportunities

- Sharing and levelling of resources for both staff and equipment
- Economies of scale in procurement for both capital equipment and outsourcing
- Reducing unwarranted financial variation of both pay & non-pay costs
- Ensuring equal access for all patients, irrespective of geography
- Locally acquired images, with distributed reporting networks, which allows access to sub-specialty opinion irrespective of location
- Shared capacity and management of imaging reporting backlogs to optimise reporting turnaround times
- Management of outsourcing and insourcing in a planned and financially sustainable way
- Maintaining high quality learning and training environments
- A cohesive approach to quality improvement across imaging networks

The proposed networks have been considered in the context of trust mergers and reconfigurations, as well as patient pathways for cancer, stroke, trauma, cardiac and maternity services. It is proposed to improve access to local acquisition of the images and services, with reporting of those images distributed through a network or networks for sub-specialty services such as paediatrics.

The infrastructure and areas for consideration for these emergent imaging networks are outlined, with suggestions for the support required, if they are to be delivered as a priority to contribute to improving diagnostic waiting times and report turnaround times. This will have a direct impact on patient care, improve cancer outcomes, access to acute and emergency care, as well as stroke services.

NHS England and NHS Improvement will consider pricing and commissioning models which incentivise a networked delivery model for imaging services. Integrated Care Systems (ICS) have been asked through the planning guidance to provide imaging network plans for investment in capital equipment, staffing and human resource plans for imaging and a plan for image sharing.

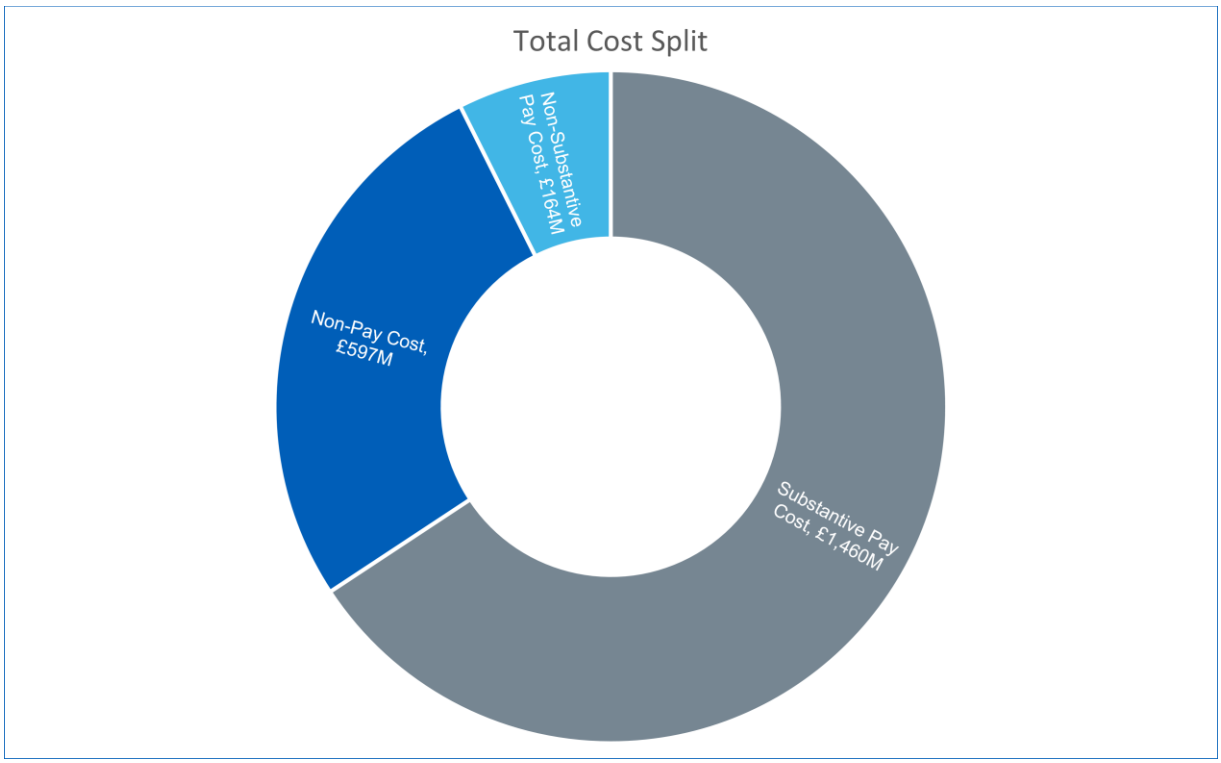
NHS England and NHS Improvement have been working with NHS Digital to develop a toolkit that will support imaging networks to develop a plan for image sharing.

1. The current landscape

1.1 National spend on imaging services

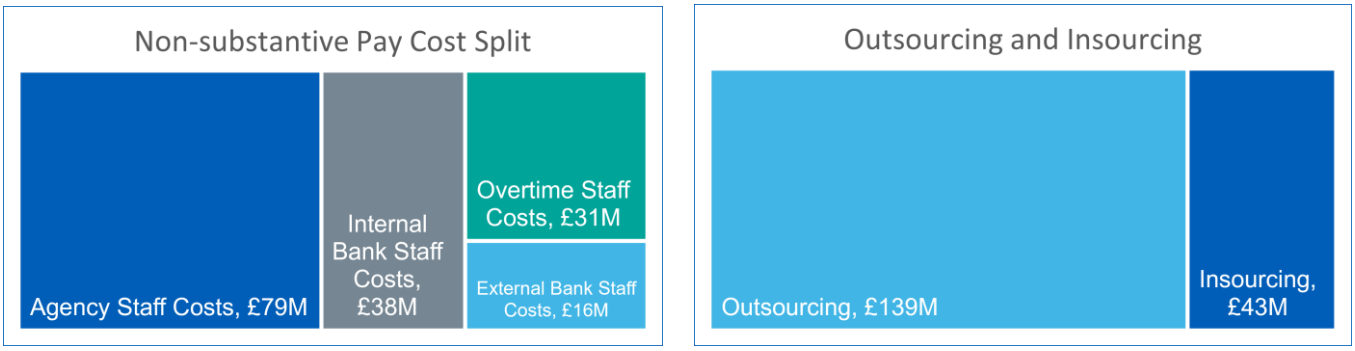
The NHS spends around £2 billion per annum delivering imaging services within the NHS (independent providers are excluded from this figure where commissioned directly). Over two thirds of that funding is spent on staffing and around £150 million on non-substantive pay costs, including agency, overtime and bank staff, which contributes to our increasing spend on outsourcing and insourcing to meet existing demand. With rising activity this level of funding is not likely to be sustainable, neither financially nor in terms of delivering a sustainable service.

Figure 1: Costs of Imaging Service Delivery by Pay, Non-Pay



Source: National Imaging Data Collection 2017/18, NHS Improvement

Figure 2: Breakdown of non-substantive pay by type, Outsourcing and insourcing total cost



Source: National Imaging Data Collection 2017/18, NHS Improvement

1.2 How services are delivered

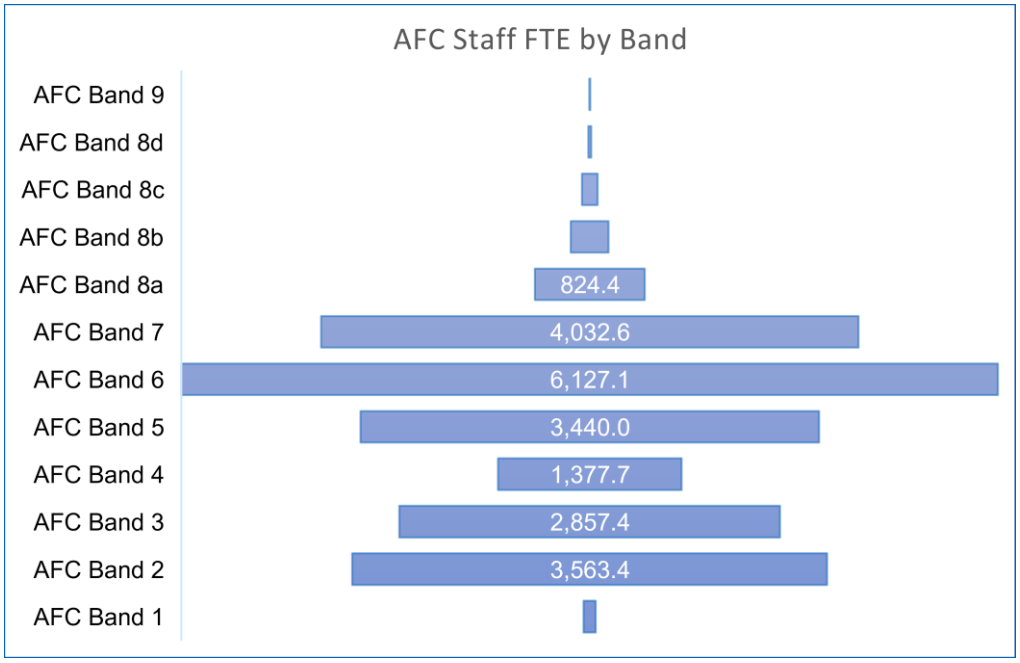
Imaging services in England are typically delivered by NHS trusts or foundation trusts as independent units delivering the service for their local population, with a dedicated professional workforce. Some informal networks are in place for lower volume more specialised work (neuro-radiology, interventional radiology (IR), paediatrics etc.).

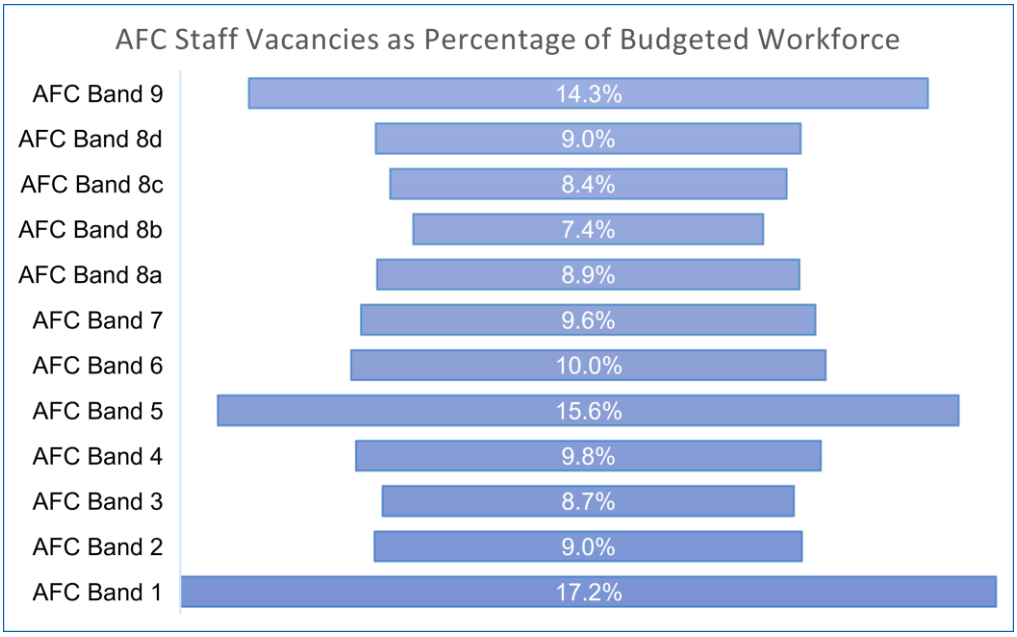
1.3 Current workforce

Following two national imaging data collections we now have accurate figures regarding vacancy rates and know that these vary between trusts and between sites for radiographers, other radiology staff and radiologists.

These high vacancy rates are putting increasing pressure on delivering timely imaging services and it therefore is becoming increasingly important to use this workforce to best effect.

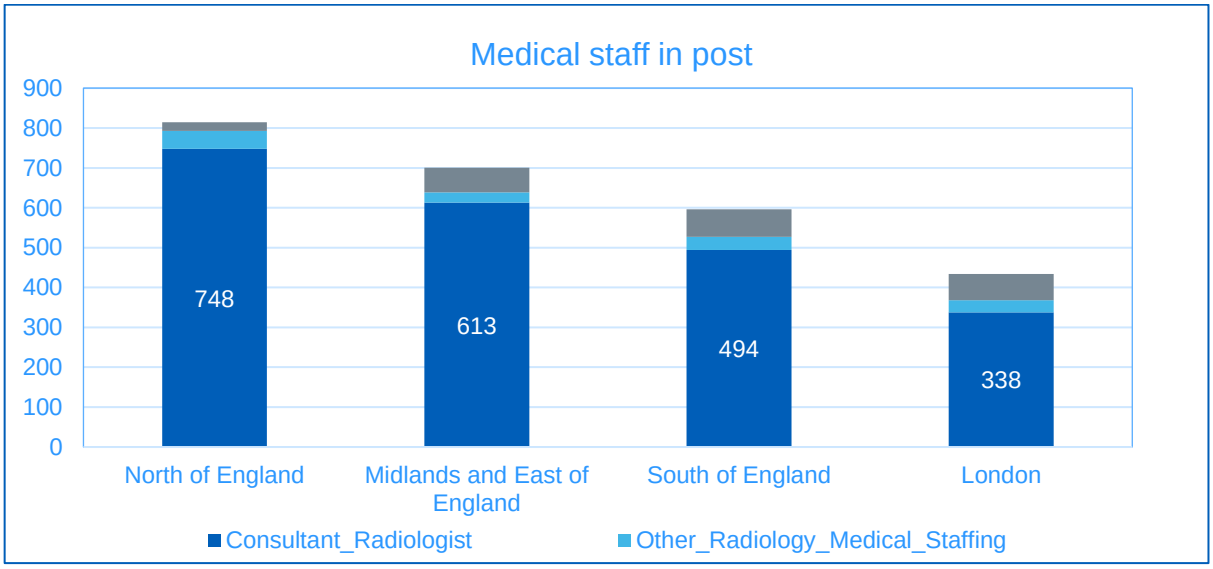
Figure 3: Mean vacancy rates by FTE (Non-Medical)

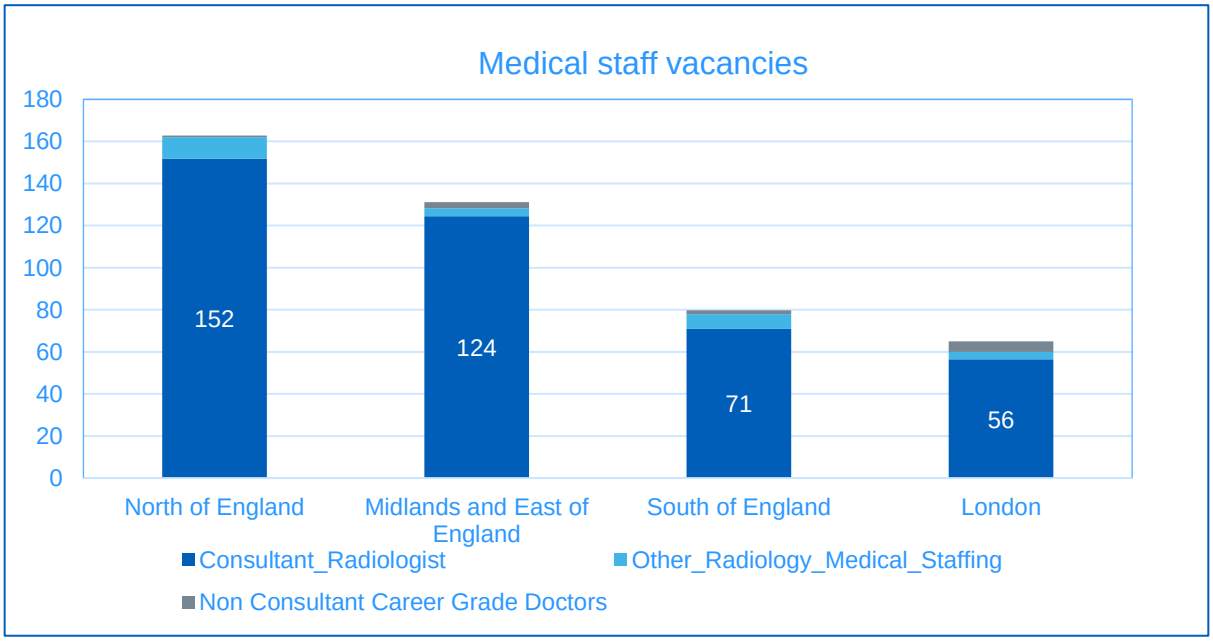


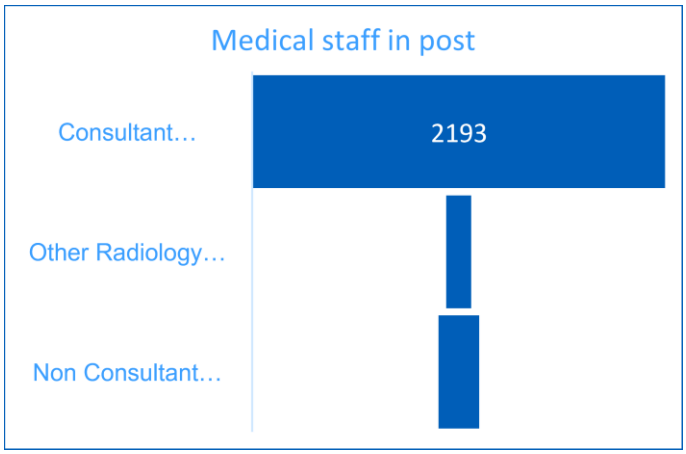


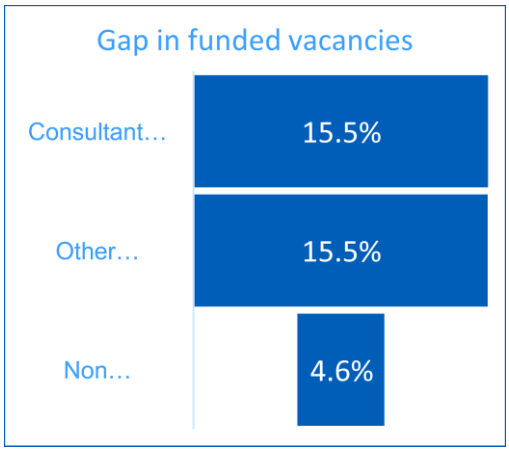
Source: National Imaging Data Collection 2017/18, NHS Improvement

Figure 4: Medical staff in post with mean vacancy rate (excluding doctors in training)



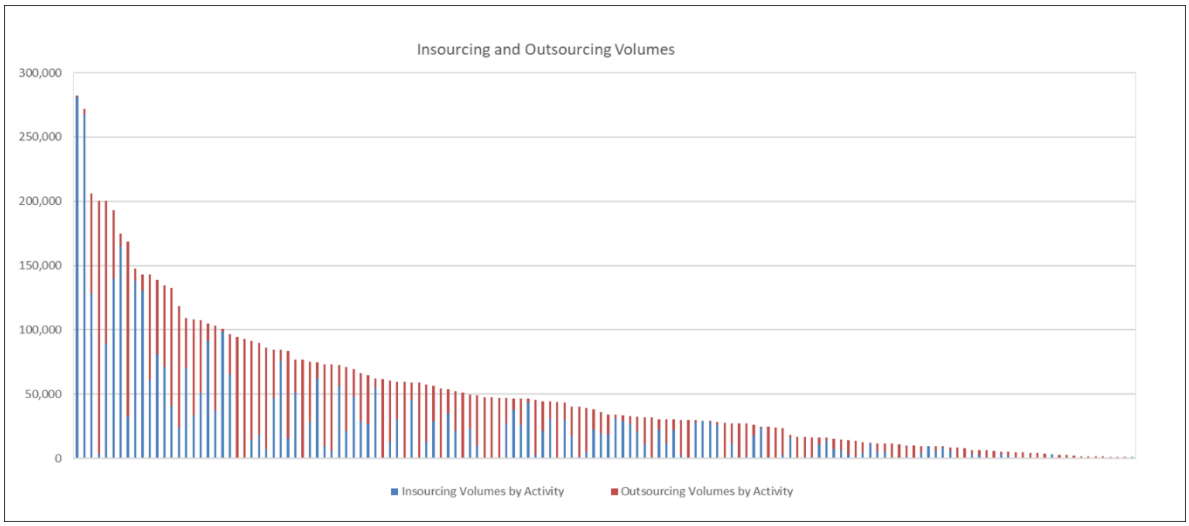






Source: National Imaging Data Collection 2017/18, NHS Improvement (return from 132 trusts), October 2018 ESR = 2826 Consultants + 81 SAS = 2907 (active assignments)

Figure 5: Volume of images outsourced and insourced by trust



Source: National Imaging Data Collection 2017/18, NHS Improvement

Where local workforce and / or capacity is insufficient trusts may seek to insource (i.e. pay their own staff extra-contractually for additional capacity) or outsource to the independent sector (equipment (fixed and/or mobile), reporting, or both) to make up the shortfall. There are a variety of ways in which trusts have engaged with outsourcing providers (whole services e.g. MRI, out of hours, ad hoc backlog reporting, temporary equipment capacity etc.)

Some of the challenges of delivering imaging services in this way can lead to competitive behaviour with regards to staff, where grading and salaries are driven upwards with different payments for staff who are broadly undertaking the same role. This can lead to unnecessary and often wasteful turnover in the system.

Similarly, other drawbacks mean that there are high degrees of variation in staffing roles, skill mix and grading as well as variable access to services for patients creating unacceptable variation, dependent on a trusts' ability to recruit and retain staff.

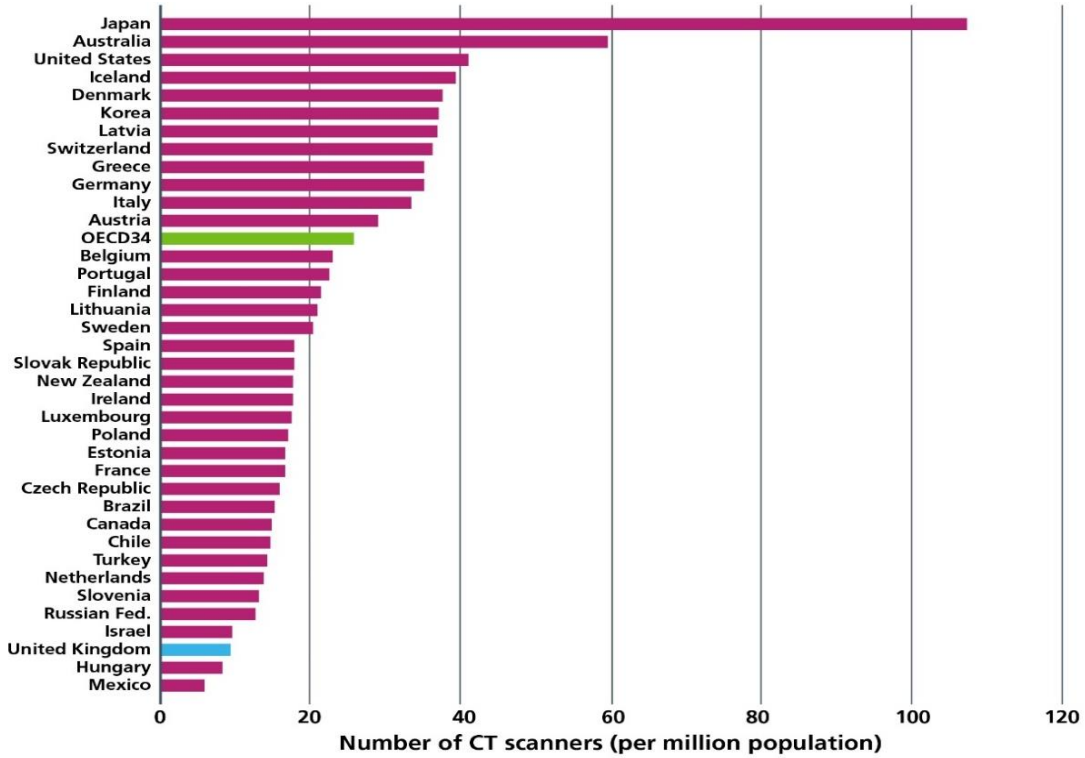
1.4 Equipment

In parallel to an unsustainable workforce position there are also challenges with the age of imaging capital equipment currently being utilised in England, with a significant proportion of CT, MRI and general X-ray equipment being older than 10 years old. We know from OECD data and from two recent national data collections that our asset base in England needs updating with at least 14% of CT and 34% of MRI being 10 years or older, and that we rank poorly when compared to other international countries.

To begin to address this challenge the Prime Minister announced on the 27th September 2019 a major investment in diagnostic equipment for CT and MRI scanners, as well as mammography equipment to the sum of £200m over the next two years. This funding will begin to significantly address the backlog of aged equipment.

https://www.gov.uk/government/news/prime-minister-pledges-funding-for-cancer-screening-overhaul.

Figure 6: International comparison of the number of CT scanners per million population in 2015 (nearest year)



Note: The OECD average is calculated for the 34 OECD countries for which data were available. The UK data used in this comparison are from 2014.

Source: The Long Term Plan, NHS England and NHS Improvement, January 2019

Replacement of equipment at 10 years was the historic Royal College of Radiologists (RCR) and the European Society of Radiology (ESR) guidelines for capital equipment replacement. Beyond this age equipment is less efficient and prone to breakdown, and the radiation dosage is likely to be higher than for similar newer equipment that remains within previous guidance, i.e. that is less than 10 years old. Current guidance from the Biomedical Engineering Advisory Group (BEAG)[2] recommends such equipment should be replaced at 7 years.

Noting that capital equipment such as CT scanners are now routinely used for extended days, increasing demands from ‘on call’ and to provide services over 7 days means that these assets are likely to be used more than equipment in previous decades.

[2] Biomedical Engineering Advisory Group, Life Span of Biomedical Devices, Guidance Paper, March 2004

There are some trusts where the age of imaging equipment raises a serious concern, as 100% of their radiology equipment is over 10 years old.

Transfer of images can also be problematic and there have been occasions where the transfer of images has been delayed, relying on the 'push system' of the Image Exchange Portal (IEP), leading to delays in diagnosis and subsequent treatment, as prioritisation of urgent cases has not been possible with existing systems.

1.5 Current networks

There are a number of individual trusts that have come together to form collaborations or networks. Most began either to find a solution to stretched 'on call' services, be that general emergency 'on call' or specialist IR provision, or due to the end of the National PACS Programme, where they were required to re-provide the data storage for images locally. Many trusts thought that this was best achieved by working with neighbouring trusts in collaboration.

Merseyside and Cheshire STP

Merseyside and Cheshire STP developed a 'hub-based' on-call system for its network of acute imaging services. Four registrars now provide 'on-call' cover across all sites during the 'day shift'. This ensures their training is not compromised by these duties and increases the trusts' compliance with the European Working Time Directive.

With the success of this collaborative project, the STP was encourage to create a network strategy going forward and is now one of NHS Improvement's 'early adopters'.

What began for some networks as a joint re-procurement exercise to achieve best value for money has led to other joint working and for them to begin to establish new working practices more formally, either through 'memoranda of understanding' or by putting in place a more formal governance structure.

Other networks have come together in an organic and piecemeal way, with some 'pump priming' resources and support as part of the NHS England Vanguard programme. This could make them vulnerable if they are unable to continue to be resourced, as they are only just getting established and developing relationships of mutual trust.

East Midlands Radiology Consortium (EMRAD)

In 2013, several trusts in the East Midlands formed the radiology consortium EMRAD to facilitate contract procurement and manage participant trusts' relationship with suppliers. EMRAD was created as a separate, neutral organisation, with its own chief executive, programme team and medical director.

While the individual trusts still held the supplier contracts and remained accountable for clinical risk, they could initiate a contractual review using the collective power of the consortium to ensure suppliers met their agreed obligations. The strong collaborative working relationships that developed during procurement negotiations resulted in the retention of the consortium model post procurement.

The EMRAD model has delivered significant benefits for the consortium, including:

- collective negotiation of a contract has saved the participant trusts £3 million per annum (for the next 10 years) compared to previous contracts
- contract payment was negotiated to depend on whether performance outcomes are met and with the supplier effectively managing areas of clinical risk
- better understanding of variation in the costs of backlog outsourcing and the models available to manage this, enabling savings across the consortium
- clinical improvement, e.g. from better access to acute imaging within stroke pathways.

2. The case for change

Following two national imaging data collections we have the first complete picture of the size and scale of some of the challenges which imaging departments across England face.

With workforce shortages and an ageing capital equipment base, coupled with ever rising demand, collaboration in networks needs to be rolled out as a priority in a co-ordinated and planned way. It will also be essential to base those networks around patient pathways, rather than trust preferences as imaging is a key component in achieving improvements in cancer diagnosis and treatment, delivering major trauma services, supporting stroke diagnosis and treatment, as well as being essential to delivering cardiac and maternity services.

The data collection confirms large variations between individual trusts and differences in both pay and non-pay costs, which demonstrate opportunities for delivering efficiencies that can be re-invested back into imaging services to help to ensure their future sustainability.

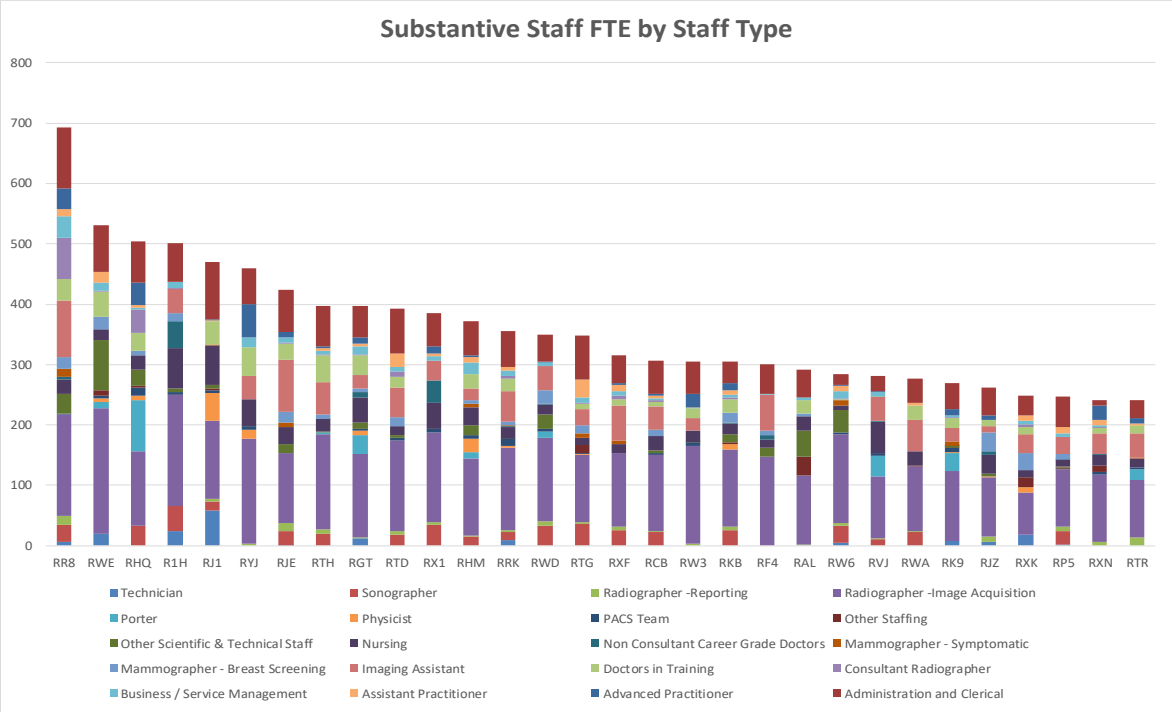
2.1 Workforce

Having looked at the high vacancy rates for both radiographers, radiologists and other imaging staff in the previous section we can also see that there is a large variation in how staff are deployed across England.

When looking at the workforce data there is significant variation in skill mix, grades and roles, which means that organisations competing for staff can be paying more for staff who are broadly undertaking the same role.

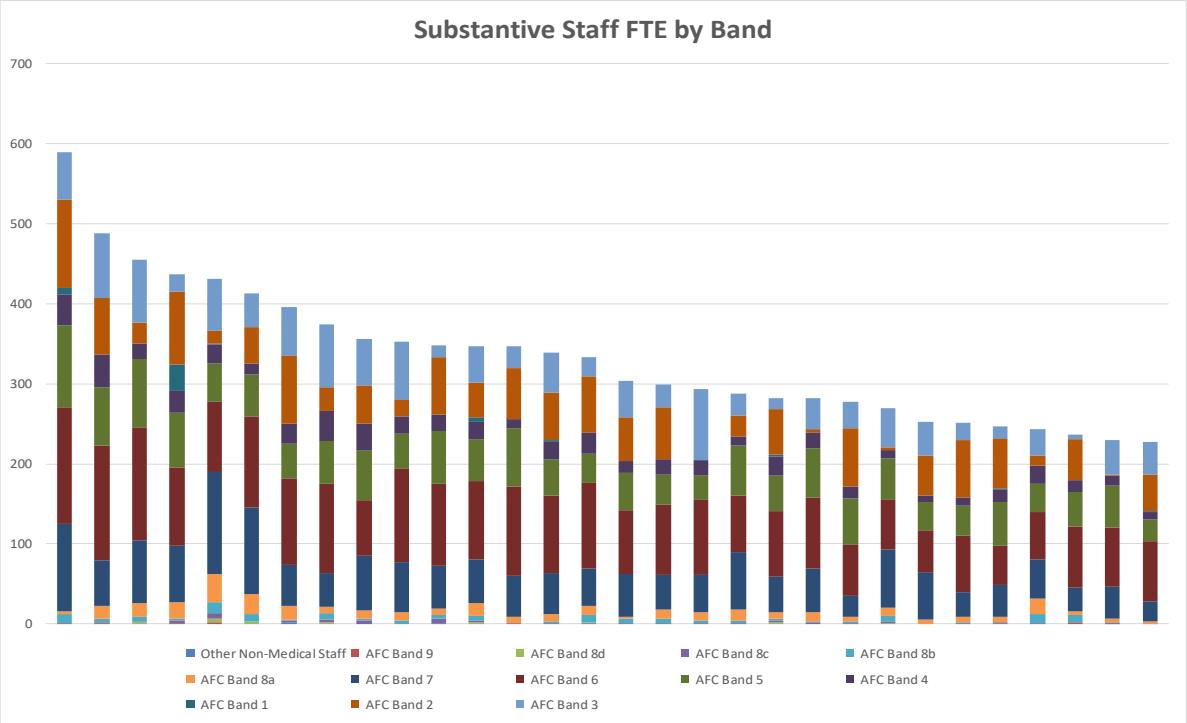
Variation in how the workforce is deployed is shown in both the use of advanced practice roles, as well as assistant practitioner and support roles.

Figure 7: Non-medical staff by role



Source: National Imaging Data Collection 2017/18, NHS Improvement

Figure 8: Non-medical staff by Agenda for Change band

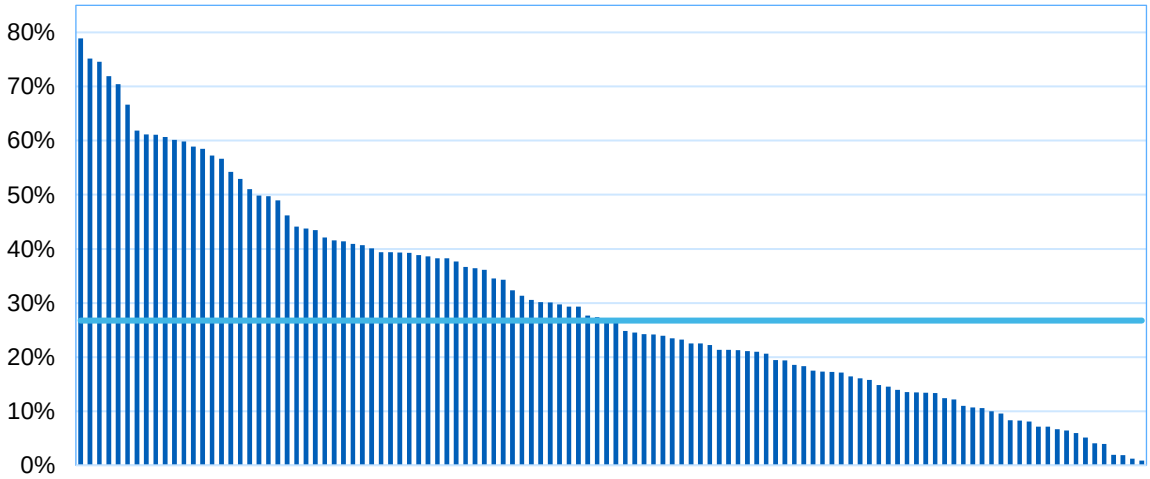


Source: National Imaging Data Collection 2017/18, NHS Improvement

2.2 Reporting and skill mix

Our research suggests there are departments where radiographic staff have undertaken post graduate reporting qualifications and have demonstrated their competence but are not having their skills utilised. This would appear to be wasteful of a highly skilled resource.

Figure 9: Percentage of plain x-rays reported by reporting radiographers, number of reports by reporter type for each trust



Source: National Imaging Data Collection 2017/18, NHS Improvement

We also know from speaking to front line managers and clinicians that they are finding it increasingly difficult to find independent sector companies to report certain types of examinations and this will drive up the cost of outsourcing due to market forces. We know from the data that there is significant variation in both the volumes of outsourcing (as a percentage of an organisation's activity) and what organisations are charged for the same type of report.

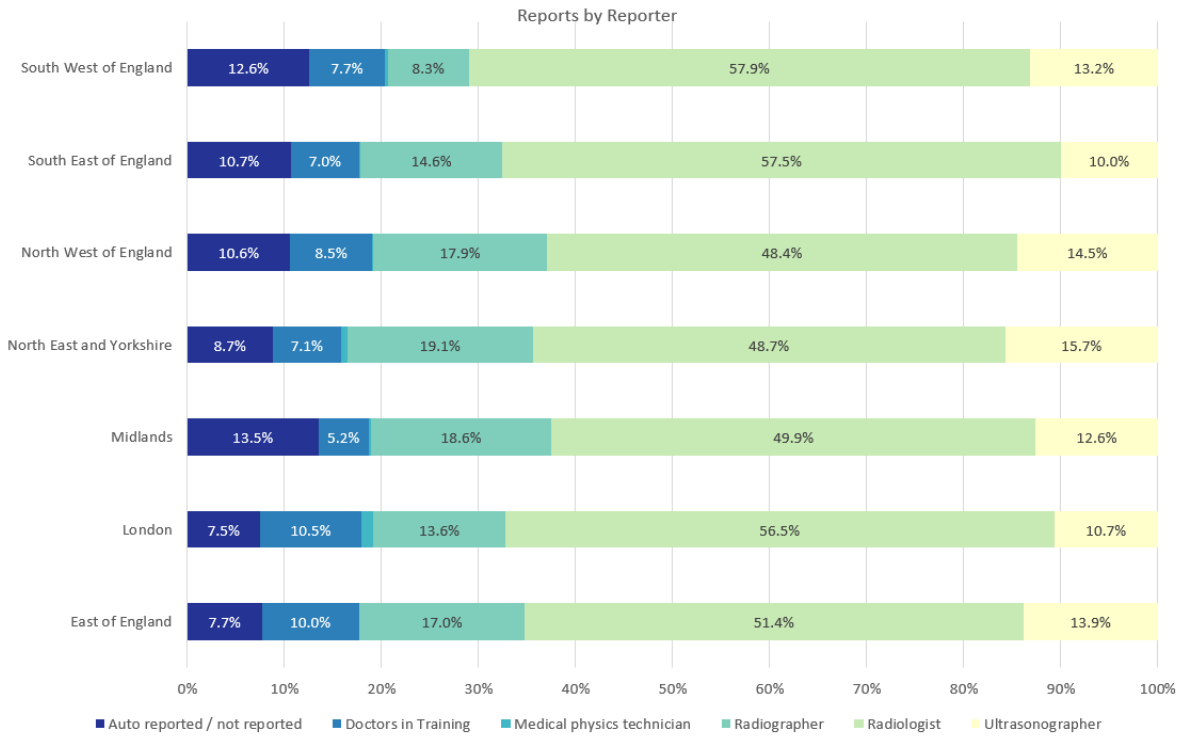
There are also differences by region, that would be worthy of further investigation, with higher levels of unreported / or auto reported studies in London, where there are lower rates of radiographer reporting. Future data collections will provide more current and detailed information on delegated reporting (which can be known as 'auto reporting'), as large backlogs and unreported films are a patient safety issue[3].

[3] Portsmouth X-ray check mistakes 'within error rate', 28th April 2018. https://www.bbc.co.uk/news/uk-england-hampshire-43929623 https://www.sor.org/news/breast-screening-workforce-will-not-be-able-cope-backlog-following-crisis-unless-urgently-reinforced

A working sub-group of National Imaging Optimisation Delivery Board (NIODB) will be bringing recommendations back to the board on which examinations are clinically appropriate to be issued with a report delegated to another clinician.

It is not possible to understand at a national level how many legal claims are made due to missed findings or delays in reporting, but what we do know is that over the last 5 years claims made against imaging departments in England exceeded £300m.

Figure 10: Percentage of reports by reporter type by NHS Regions



Source: National Imaging Data Collection 2017/18, NHS Improvement

2.3 Equipment opportunities

We have considered the age of the capital equipment in the previous section. Where trusts are replacing equipment on an individual basis, they may not be able to leverage the best value for money that could be achieved through buying in higher volumes.

As an individual trust it is difficult to get a regional or national picture of who else may be looking to replace equipment at the same time and hence leverage ‘economies of scale’.

From the data collected in the two national collections we know that the cost of a CT or MRI scanner has not increased significantly over the last 4-5 years, however there is significant variation in terms of the cost of replacement scanners. The average cost of a CT scanner in one region was £490k compared with £650k in another region. With MRI scanners the range for a replacement scanner was £800k to £850k, which suggests that there may be some opportunity for considering standardised specifications for replacement scanners (undertaking a similar case mix of patients) to reduce any unwarranted variation and to exploit opportunities for joint purchasing arrangements. NHS England and NHS Improvement have started to develop standardised specifications for CT and MRI Scanners with clinical expert groups and in partnership with Category Tower 7. These will be made available to improve and support purchasing decisions.

We know that finding capital for replacement of imaging equipment has become increasingly difficult to prioritise for some trusts and that England performs poorly when compared with other international countries. There is work underway to understand the level of investment required to improve this position.

3. The benefits of imaging networks

Imaging services in England have changed hugely over the last 10 years with changes in technology for the acquisition of images as well as the technology that allows remote reporting of those images, so that acquisition is uncoupled from reporting. The continual rise in activity (a proxy for demand) and workforce shortages with a lack of both radiographers and radiologists have been well documented[4] [5] Several publications over the last few years have set out some of the benefits for sustainability of imaging services being organised into networks [6] [7]

Early lessons from those networks who have been the pioneers and 'Vanguards' of attempting to pursue this strategy have been shared, but until now there has been no National Strategy for how this should be supported and designed, nor has there been any attempt on a national basis to try to quantify the potential benefits.

The data in the previous section has shown some of the challenges that imaging services face, as well of some of the variation between individual services. By working in networks there are areas that can start to be addressed and examples of where trusts have configured and developed suitable governance arrangements to do so.

Having reviewed some of the early and emergent imaging networks, the benefits considered to be:

3.1 Workforce

- Making the best use of reporting capacity, due to the shortages of radiologists, reporting radiographers.

[4] Clinical Radiology: Workforce Census 2016 Report. Published October 2017.
https://www.rcr.ac.uk/system/files/publication/field_publication_files/cr_workforce_census_2016_report_0.pdf

[5] 2020Delivery (for Cancer Research UK), Horizon Scanning, An evaluation of imaging capacity across England (2015)

[6] Sustainable future for diagnostic radiology Establishing network solutions for radiology services
https://www.rcr.ac.uk/system/files/publication/field_publication_files/bfcr1512_sustainable_network.pdf

[7] Dalton Review – RCR Clinical Proposal, Radiology in the UK – the case for a new service model, July 2014
https://www.rcr.ac.uk/system/files/publication/field_publication_files/bfcr1512_sustainable_network.pdf

- There are multiple initiatives to increase national training numbers for radiologists, train more reporting radiographers and to develop more 'academy style' multidisciplinary training opportunities[8,9,] Two of our 'Early Adopter' networks are incorporating their local academy into their imaging network initiatives to see how they can make better use of it across the wider network.

- Reducing the cost of outsourcing (currently £139m) by using 'insourcing' resources within the network.

- There will be opportunities to explore insourcing to other partners within the network, with reciprocal arrangements being agreed through memoranda of understanding (MOU) or other formal commercial models. Established networks such as the East Midlands Radiology Consortium (EMRAD) have successfully delivered shared backlog reporting between their partner trusts, encouraging both radiologists and reporting radiographers to contribute to this initiative.

- Utilising reporting radiographer capacity (available in some providers, but not others).

- There appear to be opportunities to increase the levels of radiographer reporting, as there is significant variation. In general radiography reporting alone it ranges from 80% to 0% with significant variation based on geography. There remain opportunities in other modalities where radiographer reporting rates are much lower, but where it has been demonstrated to be achievable.

- National standards for all staff reporting across and within all imaging networks and multidisciplinary teams, so that there is confidence in the quality and consistency of reports.

[8] Cancer Workforce Plan, Phase 1: Delivering the cancer strategy to 2021. Health Education England. Published December 2017. https://hee.nhs.uk/our-work/cancer-workforce-plan

[9] National Review of Radiology Academies. Health Education England. June 2018 https://hee.nhs.uk/our-work/radiology-academies-review

- The Royal College of Radiologists and College of Radiographers are currently developing a standards framework for reporting musculo-skeletal imaging studies.
- Increasing the opportunities and uptake of the role of assistant practitioners to support the development of practitioners taking on more advanced practice roles and supporting their own role development.
- The number of assistant practitioner roles are relatively low and show significant variation between trusts. The role of assistant practitioners in breast imaging is much more widespread.
- Staffing consistency across networks will encourage fairness and reduce high turnover rates, but could lead to staff working flexibly across sites, which would support their professional development, should they wish to do so.
- Several imaging networks are exploring developing ‘staff passports’ to allow staff to work between different trusts in a network with the appropriate governance arrangements in place, while reducing the need to undertake mandatory training multiple times.
- There are also opportunities for flexible working and sorting out the practicalities for staff such as car parking and travel between sites.
- This would allow staff to work flexibly between sites and support ‘home reporting’ which could help to alleviate some of the staffing shortages, as well as to improve productivity and patient safety by reducing interruptions during reporting sessions. This needs to be balanced with guaranteeing access to clinical opinion on site and access to supervision and mentoring for staff in training.
- Creating better training opportunities for staff by giving them the ability to work across different sites and gain experience and training to work in areas that they would not gain access to working on their base site. e.g. access to specialist neurology or oncology centres, major trauma centres or specialist paediatric services.

3.2 Service resilience

- Reducing rising backlogs of unreported images, thus reducing delayed diagnosis and risk to patients of their images being reviewed by clinicians without the appropriate training.

- Improving service resilience, where small or remote sites are struggling to recruit, meaning that some services will not be sustainable, and patients will be required to travel. With an ageing population and increasingly complex co-morbidities and people living with cancer, this fails to deliver the local care that is desirable.

- Increased financial resilience utilising economies of scale on any outsourcing still required to fill capacity gaps by purchasing as a network in a planned way and not as an individual provider.

- Newer equipment, purchased across a network, also offers increased functionality including dose reduction features, as well as enhanced imaging packages and software that will support and enhance detection of certain pathologies, or assist with monitoring changes between sequential scans. This will support increased productivity.

- Improved IT interoperability which will enable rapid transfer of images in an emergency situation compared with the current system, which can back up and result in images not being available to inform urgent clinical decision making.

- The planning of new developments that are likely to increase demand on services, such as Lung Health Check, Rapid Diagnostic Centres and improving access to mechanical thrombectomy for patients who have experienced a stroke.

3.3 Benefits to patients

- Services are sustained locally, so patients can have their scans locally, but they can be reported anywhere where there is the expertise. This means access to specialist opinion across a much wider geography.

- Faster turnaround times for reports, after having their test which reduces anxiety and uncertainty for patients while waiting for their test results.
- Reduced risk of missed diagnosis, as all images will be reported by a suitably trained clinician as well as having opportunities to share with specialists to obtain their sub specialist opinion.
- Images and other test results (e.g. digital pathology) will all be available to the clinician at the point of treatment, reducing multiple visits for treatment and reducing the number of out -patient visits.
- Patients will start their treatment earlier, due to more rapid diagnosis, which gives patients better outcomes and reduces uncertainty about the next steps on their care pathway.
- Developing a capital asset plan for replacement equipment across an imaging network will ensure that the oldest equipment is prioritised for replacement and patients have access to state of the art equipment, which reduces scan times, reduces radiation dose and produces the highest quality images for diagnoses.

We know from applications to participate in our ‘Early Adopter’ programme that there is an appetite from the frontline services to take on this networked approach, having received 22 expressions of interest.

Working with our four successful networks we have developed an understanding of the areas where support will be required and by connecting these newly forming networks there is a real opportunity to take a ‘do once and share’ approach so that networks aren’t going through the learning in silos, but they are supported to share their knowledge, learning and resources with each other.

3.4 Artificial Intelligence and adoption of emerging technology

There are many applications for the use of artificial intelligence in clinical practice being tested for mainstream use in the NHS.

At this current point there are none in large scale use, nor has there been extensive testing with the public on the acceptability of utilising this technology to enhance or support diagnoses. However, the rapid spread of this technology is enhanced by the delivery of imaging services through imaging networks because they:

- Give access to larger databases of images for the rapid testing (machine learning) and spread (application)
- Are appropriate for use across a network geography e.g. Patients with a stroke where clinical pathways are organised across networks, reduce risk of a skewed variation of demographics across a larger network population
- Provides a clear governance structure to ensure appropriate use and monitoring of such technologies, to ensure safe use and to oversee appropriate patient engagement.

Machine learning (ML) will improve over time, particularly utilising the large data sets developed within imaging networks allowing machines to develop more complex algorithms. There are multiple applications which will:

1. Enhance clinical diagnosis – highlighting regions of interest
2. Improve predictive measurements – linking conditions and pathologies
3. Prioritise more high-risk patients for immediate report – in a mixed worklist
4. Predict those patients who may not attend, thus allowing strategies to be deployed to improve access for all patients and increase productivity
5. Support the workforce to be better utilised – ‘first read’ applications

Please refer to Appendix 2 for current and emerging applications. Section 5.9 Designing for the Future gives areas for consideration in future planning.

4. Network proposal

For the reasons outlined in the previous sections our proposal is that acute trust-based imaging departments should align themselves into collaborative imaging networks. We would also include within these networks any proposals for rapid diagnostic centres (RDCs) to support 'one-stop' diagnostic centres as developed from the Accelerate, Coordinate and Evaluate (ACE) Wave 2 cancer pilots.

It is essential to ensure there is enough capacity across the network to support these new delivery models without compromising the wider system. We set out a proposed national configuration based on patient pathways and volumes of activity (number of images acquired, and reports generated) and consider 24 networks to be appropriate to deliver the opportunities afforded by scale, but without the networks being too large to manage and safely utilise the data associated with these configurations. In time, once established we believe that further consolidation to 18 networks could be more appropriate when advances in technology could allow for greater consolidation across a wider geographical area to deliver even greater benefit for imaging services. Each network has been considered for patient pathways for cancer, stroke, trauma, cardiac, vascular and maternity services.

Within the development of these emerging networks it will become increasingly important to plan for community provision to support primary care networks and ambulatory care facilities and to consider service provision outside more traditional models. Some pathway redesign will be required to support this work.

4.1 Phased approach

The initial networks are proposed as phase 1 of the programme, however, phase 2 outlines where some of those networks could come together in the future to make a larger single network. Those networks have been identified at this stage so that the design or technical decisions made in phase 1 should not be such that it prevents further development in phase 2. For some of these networks it could be that there is already significant progress being made that we would not wish to see delayed by enlarging the network at this stage. This development will be planned in partnership with those networks from the outset to determine local feasibility.

5. Setting the networks up: what needs to be considered

We understand that some imaging networks have already been established, while others will be at the beginning of their journey. To support networks to take the next steps in either formally establishing, or continuing to run and improve, their imaging network, we have suggested areas that they will need to consider during the set up and early development phase.

5.1 Imaging Network Leadership Team

Early networks have tried to form with staff members trying to establish the networks on top of their existing roles. This has meant that they are slow to form and develop, as there is no dedicated resource identified. As the workload mounts individual trusts become reluctant to release staff due to staffing shortages (both managers and clinicians). As a minimum dedicated team, we would propose for a medium to large network:

- Lead clinician (0.6WTE – 1.0WTE)
- Deputy Lead Clinician / Liaison in each trust (0.2WTE)
- Managerial Lead / Programme Lead (1.0WTE)
- IT / PACS Lead / Project Manager (1.0WTE)
- Workflow co-ordinator & Business intelligence lead (2.0WTE)
- HR/ Workforce / OD Project Lead (1.0WTE)
- Admin and project support (1.0WTE)

- Ad hoc sessional payments (or agreed dedicated time) at a session per week for:
    - Protocol alignment
    - Pathway standardisation
    - Quality Improvement Lead / Accreditation

An ongoing team would be required beyond ‘set up’ to ensure that there is clear leadership, co-ordination and accountability for this development through an appropriate governance framework.

Consideration will need to be given regarding where this team is physically located to deliver the operational needs of the network.

5.2 Leadership development

To establish these new networks, the leadership team will require support to develop clinicians who are currently likely to be Clinical Directors or Radiology Service / Divisional Managers in trusts. These individuals will need to have the training and skills to lead a service that is to be delivered in a totally different way, requiring consensus and agreement from member trusts.

It is likely they will be leading 8-10 radiology managers, 800 – 1,500 staff and approximately 80 – 150 Consultant Radiologists. Managing risk through clear governance structures and overseeing practical delivery will be essential.

A leadership development programme should be designed and initiated to give peer support, share knowledge and learning, as well as develop the right values and behaviours for excellent leadership. Influencing around collaboration and highly developed communication skills will be essential at the outset.

5.3 IT and interconnectivity

Without adequate IT infrastructure, and interconnectivity between partner organisations, Imaging Networks cannot operate.

Identifying an appropriate IT platform to support timely and reliable image sharing and workflow management/levelling is a fundamental requirement for establishing a successful imaging network.

There are currently a number of ways for individual imaging departments to share their images with each other. The image exchange portal (IEP) has been commonly used for transfer of images to follow a patient transfer.

However, this can be slow and time consuming as the images need to be 'pushed' from the referring centre and 'retrieved' by the receiving destination. A further limitation of the IEP is that it does not enable reports to be edited or reported. To allow for image sharing that will facilitate the benefits of networking at scale, much larger volumes of images will need to be transferred or shared to create 'shared work lists' and optimise workload levelling. This will need to be achieved in an automated way, by setting rules around skills available and time deadlines.

The main ways of doing this at present are to have the same Picture Archive and Communication System (PACS) and Radiology Information System (RIS) manufactures in the networked trusts with a Vendor Neutral Archive (VNA), from where the studies can be accessed for all parties. Alternatively, an interoperability platform can be utilised that will pull images from a variety of disparate PACS and RIS systems and hold a copy of them on a server (or cloud). Once the images have been reported, the original images are stored on the originating PACS. However, it is important to note that these platforms are at a relatively immature stage of development and current implementations are largely bespoke solutions, developed to compliment local IT capabilities. As a result of this variability, the development of a generic specification for use in category tower 7 is problematic.

With these current IT arrangements imaging services are not able to maximise the potential that is available for image sharing solutions. Therefore, as an alternative NHS Digital has developed a 'toolkit' which will support networks in assessing their local technological capabilities and requirements and support them in developing an approach to meeting their needs either with existing technologies or through procurement of novel or additional IT capability.

An appropriate solution for each network will need to be resourced. NHS England and NHS Improvement will work with Category Tower 7 to identify 'economies of scale' in procuring these solutions. Category tower 7 will host Supplier Engagement

activities and support networks through the procurement process, working closely with NHS Digital to exploit their knowledge in this technical area.

5.4 Operational and governance models

Formalised networks in diagnostics are more successful in enabling change towards efficiency and reducing unwarranted variation, where they can go beyond making recommendations and have the autonomy to take decisive action on factors impacting on imaging services.

A strong governance and reporting infrastructure will be required with a clear accountability framework and risk management mechanism feeding into a senior executive board at a local (network) level. A governance or commercial model will need to be agreed and delivered to ensure alignment with the emerging commissioning and provider models through the Integrated Care Systems (ICSs).

Clear alignment to other clinical networks will need to be incorporated, including with the Cancer Alliances, Stroke and Trauma Networks. This infrastructure will be determined locally and regionally. Support from the NHS England and NHS Improvement Regional Diagnostics Leads will be available to share and facilitate appropriate operating models.

As the Integrated Care Systems develop, revised commissioning models are likely to be required that are appropriate to commission network wide solutions, rather than the current commissioning arrangements which are generally with individual organisations. This may require Service Level Agreements to be in place and for ‘fee for service’ models to be developed.

It has been demonstrated in other clinical areas that a more formal governance structure enables networks to develop fully and retain a commitment to the network, even when individual trusts within that network experience particular challenges, or indeed they do not appear to be benefitting in the shorter term. The medium to longer term benefits such as access to shared resources, joint procurement benefits, shared backlog reporting and service resilience may not always be immediately apparent but will be realised as the network develops.

5.5 Ensuring quality & safety

Developing joint protocols and image sharing where images may be acquired in one location and reported in another will require clear systems and processes to ensure patient safety and to ensure that studies do not get missed and go unreported, due to the mis-management of ‘orphan studies’ or images and reports being imported in different formats e.g. pdf attachments.

Each network will need to consider whether they create a new role to oversee this function and ensure that there is oversight and active management. This role could also co-ordinate capacity and demand across a network using a business intelligence or workflow management dashboard to facilitate workload levelling.

Networks should ensure that their systems are robust and open to scrutiny. Consideration should be given to applying for joint accreditation for all imaging services across the network which would provide a quality assurance check to the service as a whole.

NHS England and NHS Improvement will be working with the RCR and SCoR to support the implementation of the Quality Standard for Imaging (QSI) (formerly ISAS), with a view to facilitating networks undertaking joint quality improvement initiatives and gaining accreditation, once they have established an appropriate governance structure and operating model. Currently, UKAS is the accrediting body for QSI.

Consideration will need to be given to how trainees and staff in training will be supervised, especially where those undertaking the supervision may not be on the same site. There are examples of how this has been achieved for ‘on call’ arrangements and by using radiology academies, that could be used to shape delivery models.

5.6 HR / OD and workforce

Networked solutions will mean new ways of working for many staff, including more flexible working practices such as ‘working from home’ with remote reporting and cross-site working. As outlined in the previous section there is much work to be done around ‘staff passports’ to ensure that sound governance procedures remain in place, but staff can work between different sites and trusts.

Although these practices can bring positive personal development and training opportunities, it is acknowledged that some staff may prefer not to change their working practices and others may need support in acquiring new skills and training, in order to do so.

Standardisation of job descriptions and job roles, so that staff are appropriately rewarded and clear about their duties within a network will be required. Each network should put in place a staff support / assistance scheme to ensure staff are appropriately supported through any change. Flexible working opportunities may help with flexible retirement options, such as ‘retire and return’ or enable more family friendly working practices.

5.7 Change management

The proposed reconfiguration of imaging services suggests more than an IT solution to creating networks. There will be significant change in terms of how people work and deliver services.

As with all change initiatives people will respond differently to the pace and scale of the change and will need to be actively engaged and supported through that change.

NHS England and NHS Improvement will develop a suggested ‘Change Management’ package identifying the areas of focus to support both staff and imaging networks through the change. This will be closely aligned with the Human Resources (HR) /Organisational Development (OD) and Workforce strategy for each imaging network and will need to align with both the HEE local initiatives, including the Cancer Workforce Strategy. NHS England and NHS Improvement will ensure that any advice and support align with the NHS People Plan.

As Sustainable Transformation Partnerships (STP) develop into Integrated Care Systems (ICS), it will be vital that imaging networks continue to adapt to support the direction of how services will be delivered across the system. An ‘Imaging Network Board’ with representation from appropriate stakeholders and a clear governance structure will help to ensure alignment.

The team could be hosted by a trust in the network, however, some networks have found that an identity that is ‘trust agnostic’ can be helpful in creating a network identity and support the building of clinical relationships and how staff work and collaborate with each other.

5.8 Procurement and capital assets

The current installed capital equipment for imaging has significant challenges as outlined in the previous sections. There are ‘opportunities of scale’ to ring fence capital to allow procurement through Category Tower 7 and leverage the optimum value for money that can be afforded by developing a standard specification and procuring at scale. There will be benefits to be gained from networks procuring the same or similar equipment that allow staff to rotate between several sites and be familiar with acquisition protocols. By using similar equipment and agreeing standards of how images are displayed for reporting, networks could also support and alleviate some of the challenges of cross-site and cross-trust reporting.

Imaging networks should consider how their equipment is best deployed across the network and develop a five to ten-year plan to optimise where and how new equipment is deployed. This should also consider where best to site any additional scanners or how to develop new services such as Lung Health check, Rapid Diagnostic Centres and increased use of cardiac CT and CT angiography to support the increased uptake of mechanical thrombectomy for people who experience a stroke. These plans should be undertaken in partnership with cancer alliances, heart and stroke networks and in conjunction with Integrated Care Systems and other relevant clinical partners.

5.9 Designing for the future

Developing interconnectivity solutions between trusts into imaging networks is critical not only to optimise shared reporting opportunities but to enable the exploitation of new technologies such as machine learning (ML)/ artificial intelligence (AI) and Computer Assisted Diagnosis (CAD). These are emergent technologies dependent on ‘big data’ and the ability to standardise, manage and manipulate it moving forwards.

Currently the most established clinical areas where the technology could enhance clinical safety and capacity are:

- Breast imaging – first / second read[10]
- Safe placement of naso-gastric tubes[11]
- Detection and monitoring of lung nodules

In addition, there are applications where AI can prioritise patients for reporting based upon the detection of an abnormality, or lack of abnormality being present e.g. fresh bleeding into the brain. The ability of AI to automatically select appropriate scanning protocols, based upon clinical details should reduce the vetting of imaging study requests. AI algorithms are being developed automatically to correct for certain image artefacts which should help to enhance image quality and avoid the need to repeat certain scans e.g. breathing artefacts and metal artefacts on CT and MRI scans.

There will be opportunities now, and in the future, to develop partnerships with industry and academic institutions, to exploit commercial opportunities for the benefit of the NHS, academia and the economy, which align with the Life Sciences Industrial Strategy[12] . Imaging networks should consider the impact of this and work via the Academic Health Science Networks (AHSNs) and with NHS Digital to ensure appropriate use, storage and consent issues are managed while not stifling the innovation pipeline of new technologies that could have positive patient and productivity benefits. The report to the House of Lord Select Committee on Artificial Intelligence suggests that the NHS is in a good position to use this new technology[13] .

To spread this technology rapidly and to optimise the benefits across a network and nationally, it will be essential to have the enabling technology that provides the infrastructure, as described in section 5.3.

[10] Computer vision and Artificial Intelligence in Mammography fihttps://www.ajronline.org/doi/pdf/10.2214/ajr.162.3.8109525

[11] **NPSA/2011/PSA002: Reducing the harm caused by misplaced nasogastric feeding tubes in adults, children and infants.** Since the completion date for that Alert's actions (1 September 2005), the NRLS has received reports of a further **21 deaths** and **79 cases of harm** due to feeding into the lungs through misplaced nasogastric tubes. The main causal factor leading to harm was misinterpretation of x-rays.

[12] Life Sciences Industrial Strategy – A report to the government from the life sciences sector. Published August 2017. https://www.gov.uk/government/publications/life-sciences-industrial-strategy

[13] House of Lords Select Committee on AI, 'AI in the UK, ready willing and able?'. Published 16 April 2018

This infrastructure should be viewed as a priority for both immediate benefits and to ensure patients will benefit in the future from emergent opportunities.

As diagnosis, treatment and care become more personalised, it will become increasingly important to align different diagnostic tests and manipulate 'big data' such as whole genome sequencing (WGS) to allow targeted treatment of both cancer and other diseases as we develop expertise in this area. It will therefore be essential, where possible, to consider how imaging networks align with pathology networks and centres for genomic testing to ensure the future integration of diagnostics which will be key to a more personalised approach[14].

5.10 Future workforce

Networked solutions will require clinical imaging staff to work in new ways across multiple organisations and will provide opportunities for knowledge and skills to be shared across geographies. Networking service provision across multiple trusts will help to standardise working practices (protocols, operating procedures, governance) and harmonise deployment of staff more efficiently than can occur within single organisations. With clinical imaging activity predicted to continue to increase in both volume and complexity in the foreseeable future, this will help organisations better manage both ongoing long-term growth in clinical imaging services as well as fluctuations in short-term demand.

The current (June 2018) clinical imaging workforce is experiencing vacancy rates of 12.5% (radiologists) and 15% (radiographers). Networked services will need to continue to provide high-quality learning environments that will support increases in workforce numbers and skills. Significant and consistent growth in the clinical imaging workforce is required to plug the current gap, to meet the future forecast increased demand for imaging investigations and procedures and to respond to patient expectations of greater engagement to support self-management of their health and care. Clinical Imaging networks are ideally suited to offer academy-style multi-professional learning environments with shared training resources that support learners across more than one organisation.

[14] Improving outcomes through personalised medicine, Working at the cutting edge of science to improve patients' lives. NHS England, September 2017.

In addition to continuing to accommodate the ‘new supply’ pipeline (clinical radiology trainees and student radiographers) networked services will also need to continue to support ‘lifelong education and training’ throughout the careers of their existing workforce. Networked services need to provide their staff with protected time to develop new skills, develop and implement new roles and reconfigure multi-professional teams. In response to the anticipated impact of workload growth and implementation of innovative & new technologies. such as hybrid imaging, artificial intelligence and personalised (genomic) medicine.

6. Support for implementation

As with other clinical networks, the collaborative imaging networks will require some dedicated resource to support their establishment. Those networks that have been the most successful have established a formal governance structure and reporting mechanism through a board with an identified executive sponsor.

The setting up of networks will need some support so that they are established as efficiently as possible to meet the commitment to imaging networks in the Long Term Plan. Sharing of good practice through both national and regional mechanisms, to support consistency of approach while allowing solutions to be appropriately tailored to meet regional requirements will be key. This will ensure that the networks support any national requirements or strategies and align with the overall operating system e.g. Integrated Care Systems. Co-ordination between networks will allow for sharing of best practice with a 'do once and share' approach to avoid individual networks working in silos.

NHS England and NHS Improvement will develop toolkits and templates to support set up and monitor progress to ensure commitments to establishing the networks are met across England. It will work closely with the Cancer Alliances and other clinical networks to ensure key targets are being achieved. NHS England and NHS Improvement will liaise and work with other Arm's Length Bodies (ALBs) and professional organisations to co-ordinate this operational delivery model.

Each of the NHS regional teams have the support of a Regional Diagnostics Implementation Lead who will work to support the implementation of the proposed networks. They will also engage with regional stakeholders and ensure that each network has an appropriate governance structure into the regional teams. They will support local activities such as regional engagement activities to disseminate knowledge transfer and the sharing of best practice / resources and toolkits.

The Regional Diagnostics Implementation Leads will support the imaging networks by liaising with the appropriate regional boards and committees, such as the Cancer Board and the Regional Medical Directors.

They may also provide bespoke support to individual imaging networks as they form and establish their leadership team.

Each imaging network will be given an ‘early insight report’ based on their data submitted to the national data collections but analysed by each proposed network. The regional leads will support with oversight of any business cases for transformation fund submissions, linking networks into regional finance teams. They will provide updates to the regional teams on progress. More detail of the support available will be outlined in the Imaging Network Implementation Guidance once finalised in early 2020.

7. Alignment with system partners

The delivery of collaborative imaging networks will require the input and support of other key system partners such as the Royal College of Radiologists (RCR) and the Society and College of Radiographers (SCoR) as well as other Arm's Length Bodies (ALB's) such as Health Education England (HEE), Care Quality Commission (CQC), NHS England and NHS Improvement (NHSE/I), NHS Digital (NHSD) and NHSX.

To enable the alignment and sharing of the recent data collections, work has been undertaken to ensure the appropriate information governance arrangements are in place to make this possible. This will ensure that the data burden is reduced on clinical departments from multiple data requests from different agencies. The intention is to reduce the data burden further by moving to more timely data collections that will be data downloads from Radiology Information Systems (RIS). The current and future data collections will be made available to service providers and imaging networks through the Model Hospital portal https://model.nhs.uk.

The intention is for the different key system partners to work in a co-ordinated way through the board but acknowledging that they will retain their individual functions and accountability as outlined in statute. The development of this strategy has been undertaken in partnership with and endorsed by the National Imaging Optimisation Delivery Board, which will provide oversight and advice on implementation, as well as supporting the spread of good practice through the individual organisations that it represents.

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10) Computer vision and Artificial Intelligence in Mammography
https://www.ajronline.org/doi/abs/10.2214/ajr.162.3.8109525

11) NPSA/2011/PSA002: Reducing the harm caused by misplaced nasogastric feeding tubes in adults, children and infants. Since the completion date for that Alert's actions (1 September 2005), the NRLS has received reports of a further 21 deaths and 79 cases of harm due to feeding into the lungs through misplaced nasogastric tubes. The main causal factor leading to harm was misinterpretation of x-rays.

12) Life Sciences Industrial Strategy – A report to the government from the life sciences sector. Published August 2017.
https://www.gov.uk/government/publications/life-sciences-industrial-strategy

13) House of Lords Select Committee on AI, 'AI in the UK, ready willing and able?'. Published 16 April 2018

Glossary

ACE Wave 2 – a pilot programme led by NHS England and Cancer Research UK to test new ways of delivering diagnostic services and earlier diagnoses

Category Tower 7 – (formerly NHS Supply Chain) Contract holder for DHSC procurement initiative to drive best value for money for NHS purchasing in imaging

CHD – Coronary Heart Disease

CT – Computerised Tomography (a scan using radiation)

'Early Adopter' Imaging Networks – Four imaging networks that are working with NHS England and NHS Improvement to test a range of initiatives across a network of trusts working together on imaging.

IR – Interventional Radiology – image guided interventions or treatments undertaken in the imaging department (or in theatres) under imaging control. E.g. angioplasty, biopsy

MRI – Magnetic Resonance Imaging (a scan using a high strength magnet)

National Imaging Data Collection – A data collection recently developed and undertaken by NHS England and NHS Improvement (this includes information on staffing, activity, finance and capital assets)

National Imaging Optimisation Delivery Board – A stakeholder board set up by NHS England and NHS Improvement to steer the direction of the Imaging Transformation Programme following the Carter Review

PACS – Picture Archiving and Communications System (a storage and transfer system for digital and computerised images)

Plain x-ray – images taken using Computerised Radiography (CR) or Digital Radiography technology (DR)

Ultrasound – a scan using high frequency sound waves (sonar)

Vanguards – An NHS England initiative to test innovative models of service delivery and care

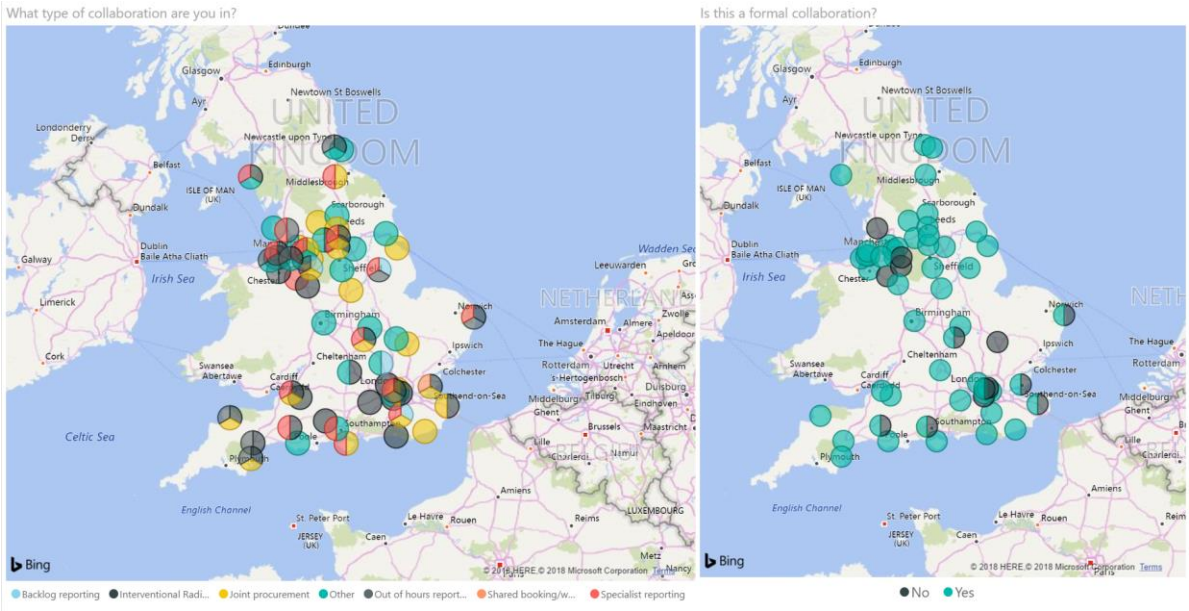
Appendix 1

Method statement for imaging networks

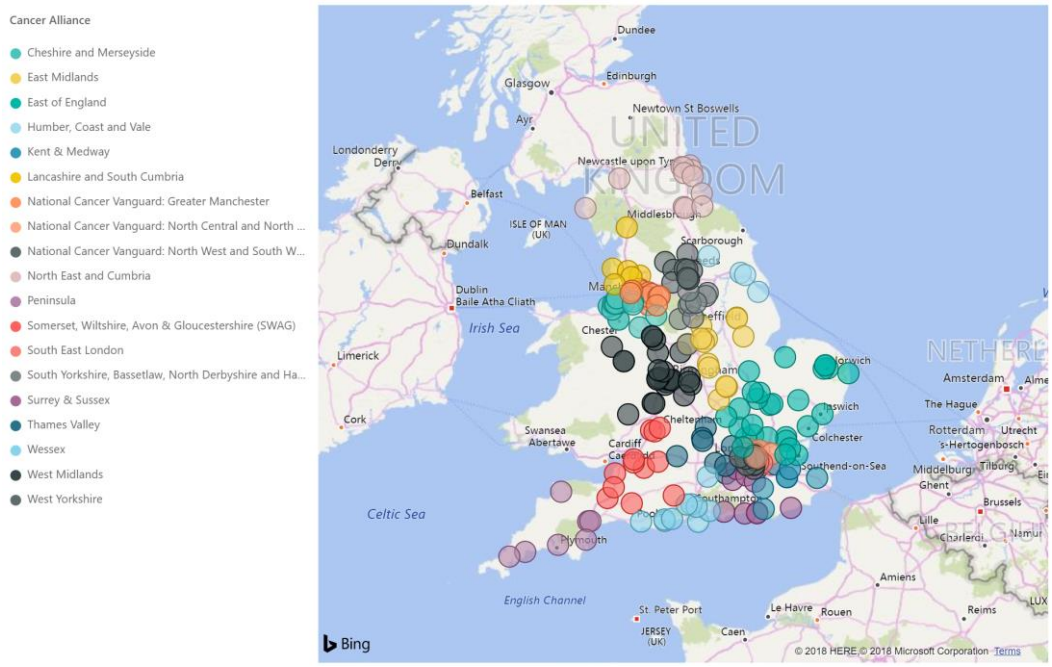
The proposed national imaging networks were formulated through a 4-step methodology process involving already existing formal alliances, geography, size and capacity.

Step 1: Current imaging networks, collaborative arrangements and clinical networks

Utilising data from the national imaging data collection and bid submissions from early adopters, an analysis was conducted on the imaging alliances and networks that already exist throughout the NHS both formally and informally.



An analysis of the current Cancer Alliances and STPs was done to ascertain where these collaborations exist either within or outside of the borders of these national arrangements.

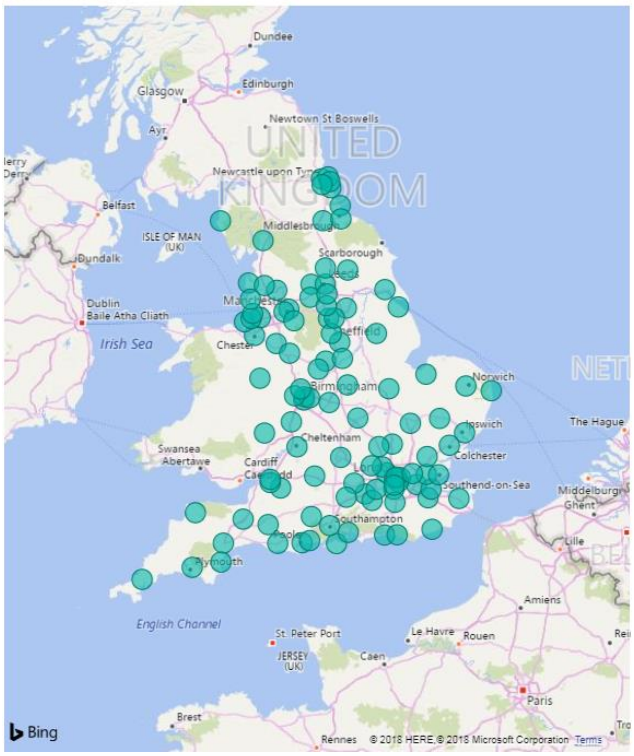


Consideration was also taken for the existing Primary Percutaneous Coronary Interventions Centres [PPCI] which are established across most of the UK as the default treatment for ST elevation MI and represents about 27% of all PCI activity. There are 69 PCI centres in the UK to whom ambulances bring patients with STEMI to be treated by primary PCI.

PPCI Centres

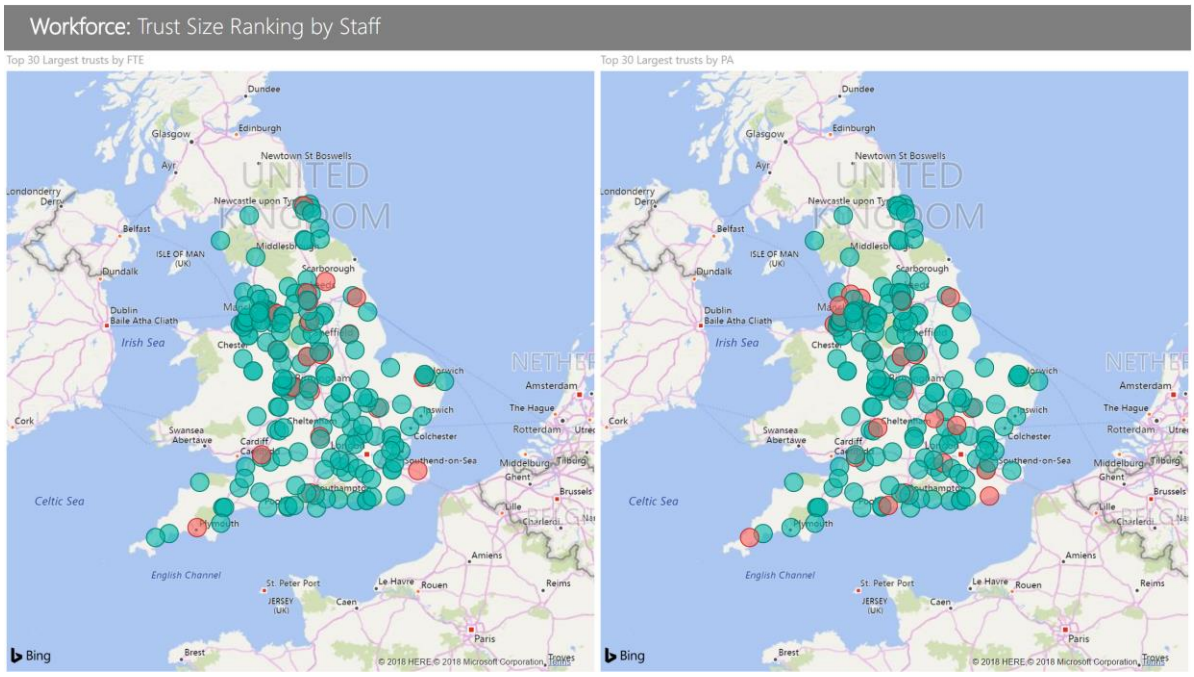
An analysis of the Hyper-Acute Stroke Units [HASU] was also conducted to ensure an adequate spread across networks.

SU Centres



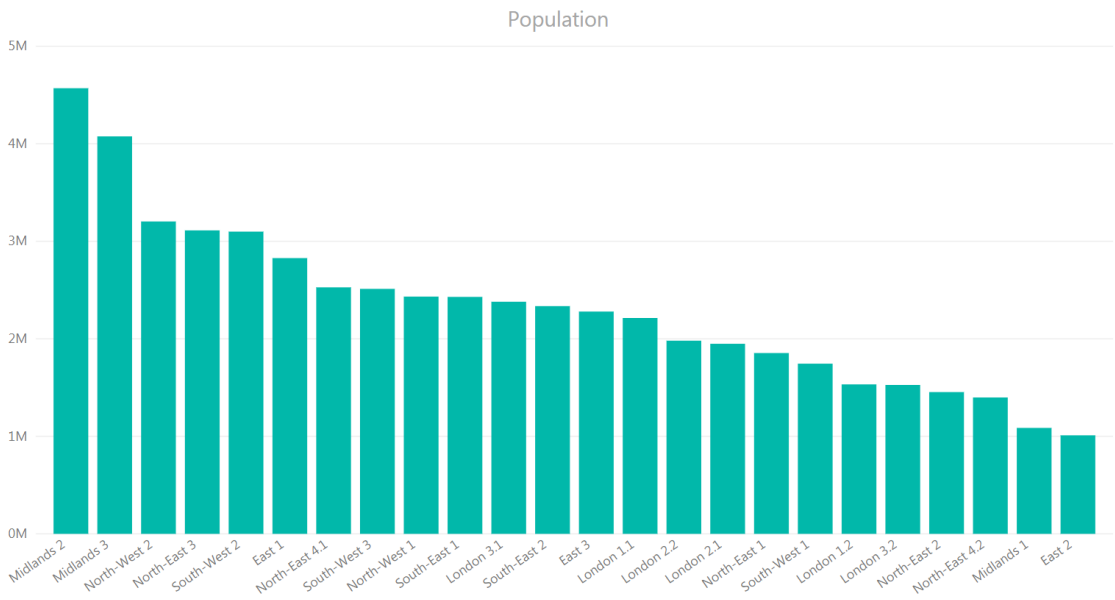
Step 2: Trust size

Following an understanding of the current collaborative layout, an analysis was conducted on which trusts are the biggest in each area of England by several criteria (FTE, PAs, activity, operating expenditure), to ensure an element of uniformity of size of the imaging networks and to spread the largest providers.



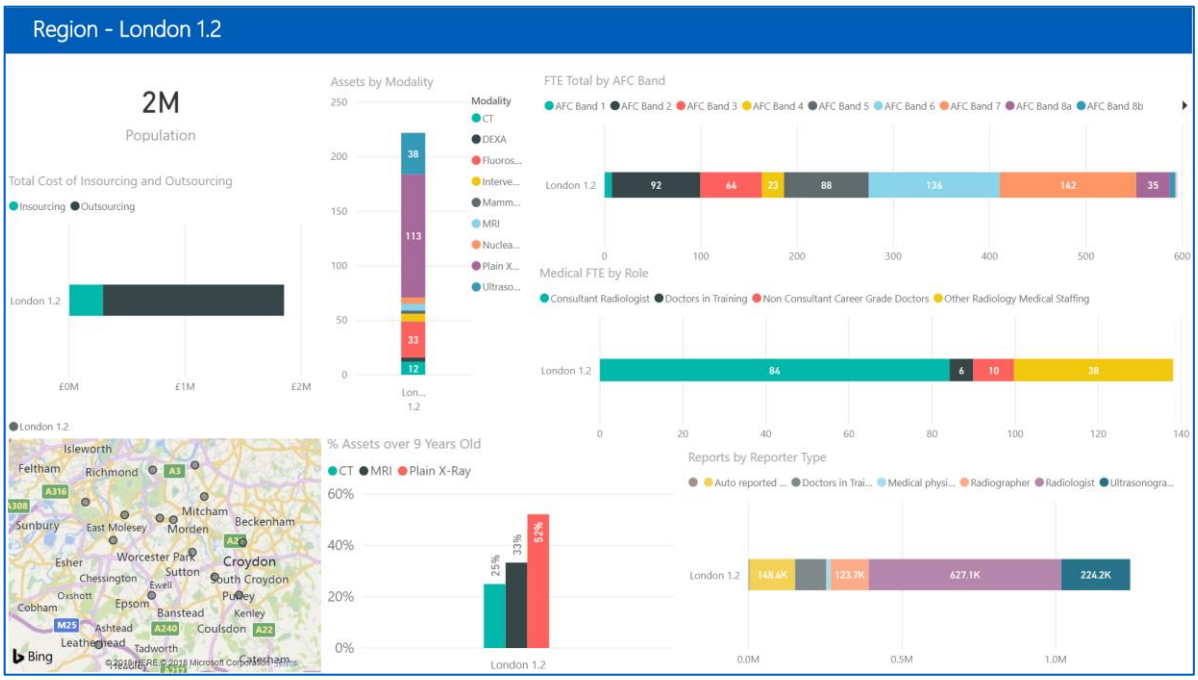
Step 3: Geography and population

Utilising the analyses already conducted, factoring in geographical layout of service sites collected through the national imaging data collection and the patient population served by each trust, proposed imaging networks were formulated.



Step 4: National quality assurance

The proposed networks were then assessed against further criteria to ensure their robustness. These criteria included the location of major trauma centres, the equipment in each member trust by modality, the outsourcing and insourcing spend, RIS system compatibility, vacancies and reports by reporter type.



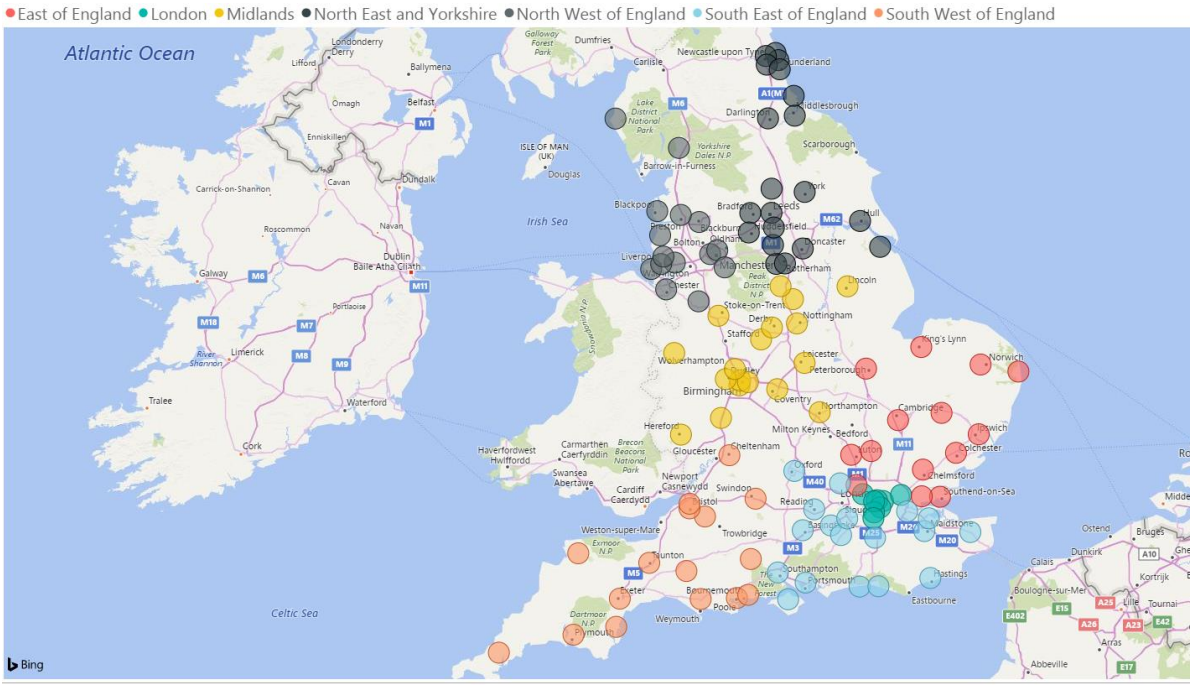
Sub-speciality network consideration

There will be a need for national sub-speciality networks for clinical areas such as paediatrics and neurology that should form in conjunction with the proposed imaging networks outlined.

The regions

NHS England and NHS Improvement view the service across 7 regions. These are:

- North West
- North East
- Midlands
- East of England
- South West
- South East
- London



Appendix 2

Patient prioritisation and risk management

Artificial intelligence is being used to prioritise reporting work lists and support and manage risk of patients with a 'suggested abnormality'. The imaging studies still require a full report by a radiologist or advanced practice radiographer, but the software package utilises an algorithm based on machine learning which allows studies to be prioritised. This allows the most urgent studies to be prioritised and brought to the top of the reporting worklist while studies that appear to be normal will still require a report but will appear on the list as more routine. The system allows the imaging departments to set the rules for their clinical priorities and to assign the study to a radiologist with particular sub-specialty knowledge. E.g. a patient who appears to have an abnormality in the brain could be directed to a neuro-radiologist and prioritised for reporting within an hour. This system has the potential to be adopted on a network wide basis and support the management of 'high risk' patients across a network. This is of importance where a trust within the network may have developed a long backlog of unreported images.

Supporting lung health check

There are artificial intelligence applications that are currently being tested, but not yet in clinical use, that can use software packages that have been trained using large data banks of images to highlight areas of potential interest on low dose CT scans used in the detection of lung nodules (or potential lung cancers) during a Lung Health check consultation. This does not negate the need for a formal report from a radiologist or advanced practice radiographer, but by highlighting the potential areas of concern, will reduce the time to report the study by acting as an 'initial read'. This software can augment the reporter, reducing time taken to report, but can also undertake a set of measurements for other risk markers and can determine whether they are within normal parameters. E.g. calcium scoring of the coronary arteries and the diameter of the thoracic aorta.

Improving productivity and access

Artificial intelligence can be used to increase the productivity of lists of imaging studies by reducing the number of patients who do not attend for their appointment, allowing the administrative staff to target likely non-attenders or to ‘overbook’ any lists where patients are likely not to attend, so valuable appointment slots are not wasted. This utilises the demographic of patients and uses the history of patients less likely to attend for different examinations, but also looks at the previous history of individuals attendance. This application can support departments to target any ‘hard to reach’ populations and understand what might be required to improve access. This application could be used to increase the uptake of screening programmes as well as patients who are symptomatic. Applying this across networks could help networks to understand where to target different patient groups across the network and flex capacity e.g. where evening or weekend appointments may help, which types of patient may travel out of their immediate area for an earlier appointment etc.

Breast imaging

Currently there are artificial intelligence applications which are being trained using extensive repositories of historical breast images (mammograms) to compare the outcomes with the existing reports and to improve their accuracy. This has been possible by accessing databases across an imaging network, which gives access to far more images than would have been possible from using a single site or breast imaging service. It is envisaged that if the appropriate accuracy levels could be reached that an AI application could be used to support one of the reports required for breast screening where images are ‘double reported’ currently by a breast radiologist or advanced practice radiographer. Any image reported using AI would have a second read by a trained clinician, who would also be required to undertake and supplementary procedures such as breast ultrasound or to a breast biopsy. Access to data bases of images that are network wide would allow improved access to training databases, due to the volume of images generated.

Managing patients with stroke

To assist in rapid diagnosis for patients who have had a stroke there are now available downloadable apps which use artificial intelligence to determine whether the stroke is due to a brain haemorrhage or an embolus (or clot).

This is important as it determines which patients could be suitable for mechanical thrombectomy and should be transferred to a centre which undertakes that procedure and those who can be managed and treated successfully at the hospital where they are admitted. This application does not replace the knowledge of the neuro radiologist or stroke physician but can provide some enhancement in accessing support in an area where access to specialist opinion out of hours can be challenging, particularly in the timescales within which the patient requires review (prior to treatment or transfer for treatment). Work is being undertaken to increase access to suitably trained clinicians for access to mechanical thrombectomy, but this app could be a valuable tool to support a clinician making a diagnosis

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