Sustainable future for diagnostic radiology: establishing network solutions for radiology services

Faculty of Clinical Radiology
Key points

- Radiology networks would make best use of existing resources given that radiology capacity has not kept pace with the rapidly increasing demand for imaging services.
- Local/regional networking is preferable to outsourcing.
- Teams working together across traditional boundaries have the potential to deliver significant gains for the National Health Service (NHS) and to deliver the required quality of expert reporting.
- Common information and picture archiving systems, standardised clinical governance and standardised reporting practices will be key to establishing successful networks.
- Different information technology (IT) structures and security issues between trusts will need to be overcome and appropriate technical resources will need to be in place.
- Governance issues will require careful consideration, for example, patient safety risks, data security, robust mechanisms for feeding back critical events, near misses and so on.
Background

In the September 2014 document, The case for a new service model, The Royal College of Radiologists (RCR) issued a challenge to UK radiology departments which was summarised as follows.

‘... that existing radiology services should collaborate to form networks of expertise serving a population of several million rather than a few hundred thousand as at present. A grouping of 150–200 radiologists would have the capacity to provide continuous 24-hour cover across the range of required specialties.’

A considerable amount of feedback in support of developing a network solution was received from a broad variety of stakeholders, including:

- RCR Boards and Committees
- Key players at NHS England, the Department of Health, the Health Select Committee and so on
- The main political parties
- Other healthcare agencies, for example, the Care Quality Commission (CQC), Monitor and so on
- Think tanks
- Other colleges and associated bodies
- Trust chief executives and medical directors
- Suppliers and potential suppliers of enterprise network reporting solutions.

Overall there was enthusiasm for the proposals, with constructive suggestions for developing the model and offers from teams with established networks to work with the RCR, for example, in vascular surgery, neuroradiology and trauma care. Practical challenges and other issues of concern were identified.

A working party was established to look at a range of models in which a sustainable future model for the delivery of radiology services could be achieved. A key element was to explore practical ways of establishing networks across a number of existing departments.

This is a rapidly developing field and therefore the aim of this guidance is to give practical examples of how to establish networks without being prescriptive.
Introduction

The 21st century has seen massive changes in the way radiological services are configured and delivered. Developments in IT hardware and software mean that ‘you don’t have to be in the room to be in the room.’ It is now routine practice for radiological studies to be reported in an environment that may not be immediately adjacent to the acquisition source. Added to this is the marked and inexorable increase in referrals for imaging services. The established 20th-century ‘analogue’ system is no longer sustainable.

A contemporary solution is required, making use of state-of-the-art IT services that permit rapid, reliable, high-quality studies to be reviewed at a distance, using networks of quality assured, trained clinical radiologists.

SWOT analysis

Networked solutions have associated strengths, weaknesses, opportunities and threats.

Strengths

Networked solutions allow timely, high-quality studies and reports to be delivered promptly and with precision. By using larger numbers of radiological clusters, both at consultant and trainee level, it is possible to ensure that the projected workload can be delivered within the European Working Time Directive (EWTD) guidelines, with no loss of pertinent training or clinical follow-up for trainees.² It also permits the delivery of timely reports with an appropriate and fair work–life balance for hard-pressed consultant radiologists.

Weaknesses

The radiologist has a pivotal role as a clinician central to timely patient management. Many clinicians find face-to-face discussions with radiologists extremely helpful and essential for management of complex patients. This is a potential weakness of a network but it can be mitigated. Provisions including adequate radiologist time and technological solutions for videoconferencing and so on to facilitate face-to-face discussions must be included in any effective network.

There are also limitations of reporting from a networked platform (whether for a private outsourced network or an NHS collaborative network) which include:²

- Lack of full imaging history
- Lack of previous radiology reports
- Lack of access to clinical information such as blood results, histopathology reports, clinical correspondence, discharge summaries and so on.³

Opportunities

The shortage of radiologists is an issue across the UK and there is regional variation in the number of consultant radiologists per hundred thousand population.⁴ Furthermore, there is heterogeneity within regions where deficiencies in the consultant workforce exist for local reasons, for example, small institutions or unfavourable working environments in larger institutions or both. There is also particular difficulty in maintaining access to specialised reporting such as paediatric radiology. Of the UK consultant workforce, 46% are expected to retire within the next 15 years.⁵ Network solutions would help to address this problem.

Threats

Remote access permits the outsourcing of studies beyond national quality assurance borders and parameters. In these environments, reports cannot be benchmarked or confirmed. As a result of the remote nature of such reporting, often crossing national or international boundaries, issues have arisen regarding accountability for sub-standard reporting.

Networked insourcing is the preferred alternative and would potentially be associated with a higher level of patient safety.

A variety of possible network models can be envisaged, and there are a number of potential models that might be considered according to local needs.

Some examples are set out below.

1. General out-of-hours emergency reporting networks
2. Specialty out-of-hours emergency reporting networks
3. NHS ‘insourcing’ networks for backlog management
4. Multidisciplinary team (MDT) reporting
5. Elective specialty and subspecialty reporting
6. Networks for trainees on call.
Technical aspects

There are several common themes with regard to the specification for a gold-standard comprehensive network that would be capable of including some or all of these functions.

1. There should be an overall view of the total reporting demand and capacity of the whole network, which can be segmented by modality (computed radiography [CR], computed tomography [CT], ultrasound [US], magnetic resonance [MR] and so on), clinical specialty (neuro, gastrointestinal [GI], musculoskeletal [MSK], paediatric and so on) and priority (routine, urgent, critical).

2. There should be a real-time view of reporting capacity, ideally automated by integration with electronic rostering and leave systems and connection to smart phone/network systems that allow real-time location if necessary.

3. Demand should be distributed across the network to the most appropriate radiologist to match capacity and demand.

4. The system should be capable of considerable local configuration to reflect local requirements with regard to available reporting capacity; matching study types to different reports; local business processes; timetables and so on.

5. Reporting workflow should be as closely integrated as possible into the normal workflow of participating radiologists. Ideally the ‘networked’ reporting should be invisible. This is to minimise parochial and silo behaviours and promote a more inclusive sense of the wider team.

An initial survey of the available options includes a range of potential solutions which meet the above ‘gold standard’ to varying degrees, these include:

1. Simple use of existing links with manual administration of workload distribution and report management

2. A fully functional cross-enterprise document sharing (imaging) domain, set up by a group of providers that may or may not be supplied on a single vendor neutral archive (VNA) or a group of federated VNAs

3. A commercial ‘off-the-shelf’ cross-enterprise document sharing (imaging) enabled network

4. Reporting and business management systems such as those used by existing teleradiology companies

5. Web-based administration systems which semi-automate the workload distribution. A number of these are appearing on the market, providing a range of options from generic viewer and radiology information systems (RIS) to varying degrees of integration with a range of host RIS and picture archive and communications systems (PACS) systems. There are relatively few large scale working exemplars at present and none in the UK.

6. Where a health economy has a dominant PACS and/or RIS supplier, there may be options to use proprietary image and report sharing.

7. A bespoke variation of any combination of the above provided by an IT integration company or PACS/modality supplier, with varying degrees of managed service options.

8. Enterprise reporting systems that include the ability to manage workflow and capacity balancing as well as tracking financials. At least one RIS vendor is developing such a product.
Financial considerations

For the first time, in 2014 the RCR workforce census requested information on total departmental spend on outsourcing (for the period 1 April 2013 to 31 March 2014). Included in this consideration was overnight and daytime outsourcing to teleradiology companies as well as additional payments to radiologists already contracted to the department or trust (‘insourcing’).

In summary, for the period 1 April 2013 to 31 March 2014:

- Known expenditure for outsourcing in the UK totalled just over £43 million based on information received from 127 departments.
- The lowest return from a department was £2,000, the highest £1,986,565. Twenty-seven departments spent more than £0.5 million on outsourcing, of which eight spent more than £1.0 million.
- Total expenditure on outsourcing across the UK has been projected to be between £57.6 and £58.3 million.

The projection is based on ascertaining two mean figures – one for the UK using expenditure data submitted by 127 departments, and the other by aggregating the regional mean figures – and applying them to the 172 departments who indicated they outsourced.

- The projected expenditure figures for outsourcing are equivalent to the annual salary of 680 to 689 NHS consultants (point five of the 2014 pay scale for England).

The RCR is firmly of the opinion that this resource would be better invested ‘in-house’, encouraging individual trusts and health boards to make necessary long-term investments in the radiological workforce and infrastructure. It is essential to enlist trust management buy in: there is some anecdotal evidence that some trusts are wary of helping the ‘competition’.
Contractual implications

Consultants currently (usually) work for a single trust or health board, with a direct contractual relationship, including an agreed job plan and indemnification provided by the employer in respect of reporting/performance of radiological procedures on patients under the care of the employing organisation. A networked radiology service as described will require every radiologist within the network to have a contractual relationship with each trust/health board within the network to permit indemnification.

It is likely that trying to allocate individual contracts to individual consultants for the proportion of work performed for each organisation in the network will be impractical, partly as the proportional allocation will vary as workload varies and partly due to the complexity such a system would create. It is more likely that one of the two following options would be used, though for each detail variation is possible.

Employment by a lead employer with honorary contracts

The consultant is employed by a single organisation within the network, but is issued with honorary contracts by each of the other organisations, allowing them access to patient information and indemnification. The employer would be responsible for pay, job planning and appraisal and would be the designated body for revalidation. This is the likely method at the outset of a network, with each organisation retaining its own existing consultants.

Issues would include standardisation of job planning and free exchange of appraisal and revalidation evidence between organisations. Consideration would need to be given to how new appointees would be recruited and by which member organisation.

Alternatively, a single trust within a network may wish to act as lead employer, employing all the network radiologists (as is the current model for trainees). This would simplify some processes, particularly around new appointments.

Employment by an external body with service agreements

The consultants would be directly employed (or be transferred to) a radiology service employer separate from the member trusts/health boards in the network. The employer would carry the indemnity and access to network data would be agreed in service level agreements (SLAs) (as currently occurs with teleradiology agencies). The employer would be directly responsible for pay, job planning and appraisal, and would presumably be required to become a designated body with a responsible officer for revalidation. Risks for the consultant include the potential for being employed outside the NHS contract with loss of the expected benefits, such as access to NHS pension; organisational risks include outbidding by another provider and loss of the ‘local consultant’ benefit described above.
Scenarios where successful networks have been established

Specialist network models

**Nottingham paediatric radiology network**

Nottingham University Hospitals (NUH) provide comprehensive specialist paediatric radiology services for Peterborough City Hospital and the United Lincoln Hospitals. A paediatric radiologist is available at those hospitals on site once a week when they run fluoroscopy and ultrasound lists and an MDT. Training and support are provided to local sonographers, CT, MR and plain-film radiographers. Daily reporting, vetting and protocolling is done remotely. Staff from the local hospitals can liaise with radiologists at NUH on the telephone if they have more urgent queries.

This model provides specialist imaging local to the patients. After some scepticism, local clinicians and radiologists express high levels of satisfaction with the service.

**Advantages**

- Equality of provision across the region
- Patients do not have to travel so far or so often to NUH
- Paediatric neuroradiologists and relevant clinicians may join the MDT via video and this can often speed up referral pathways
- Improved education and support for radiographers
- Reduced number of non-contributory imaging examinations
- Less pressure on facilities at NUH (for example, parking)
- Service is provided by a group of radiologists and so runs 50–52 weeks/year
- Financially the arrangement is satisfactory for all parties, it is cheaper for the local trust and NUH have been able to create new consultant posts from the proceeds.

**Problems reported**

- Several different systems are used for remote reporting which can be time consuming
- Video link for MDT’s is often unreliable, frustrating and difficult to organise between trusts
- Above all, we cannot recruit sufficient numbers of paediatric radiologists to staff the network in spite of increasing demand.

Out-of-hours service local teleradiology network models

**The Belfast experience**

The out-of-hours service in Belfast is centralised at the Royal Victoria Hospital, a level one trauma centre. It is a two tier ‘on-call’ system, with the first point of contact being the registrar and the second the consultant. This service has been operational since August 2012. The rota is a hybrid rota consisting of full shifts and on-call components with separate systems for weekdays and weekends (9 am Saturday – 9 am Monday).

**Nature of the service**

Three hospitals integrate into the service. The Royal Group of Hospitals (which includes the Royal Victoria Hospital and the Royal Belfast Hospital for Sick Children); the Belfast City Hospital (which is the Cancer Centre for Northern Ireland); and the Ulster Hospital.

This represents a catchment area of 400,000 people. During the week, two trainees undertake long day shifts from 9 am to 9 pm. One of these trainees then finishes while the other usually goes home but remains on call. A third trainee then undertakes a 9 pm to 9 am live in shift. At weekends, two trainees undertake 9 am to 9 pm shifts on Saturday and Sunday. Another trainee undertakes a 9 pm to 9 am shift both nights. A fourth trainee is on-call from home on both weekend nights but only called if needed. Consultant back-up is always available. Trainees are off post night shifts and post weekend night shifts.

The out-of-hours service provides cover for the following institutions:

- The Royal Victoria Hospital
- The regional neuroradiological service (based at Royal Victoria Hospital)
- The regional paediatric service (based at the Royal Belfast Hospital for Sick Children)
- Belfast City Hospital
- The Ulster Hospital.

This out-of-hours service is provided as a European Working Time Directive compliant shift and has been designed to strike a compromise between out-of-hours commitment and in-hours training.
Out-of-hours consultant cover is available as follows:

Royal Group of Hospitals:
1. General on-call service for the Royal Victoria Hospital
2. Regional neuroradiology
3. Regional paediatric radiology

Greater Belfast Area:
1. General radiology at Belfast City Hospital and the Ulster Hospital.

Problems

Compatibility of workstations

There are three different PACS systems in operation within Northern Ireland; the Royal Victoria Hospital uses Philips Intellipacs; Belfast City Hospital uses Centricity; the remainder of the Northern Ireland hospital network uses the Northern Ireland picture archiving and communications system (NIPACS). The teleradiology services are based at the Royal Victoria Hospital (RVH) and there were initial practical difficulties with the installation of non-RVH PACS workstations when they did not have service contracts there, however, this was quickly resolved.

Contact routes

Robust routes of contact between the referrer and the reporting radiologist are essential. Three different communication systems are always available. First, there is a direct landline connection; second, there is a mobile interface; and third, there is Vocera Wi-Fi-based communication system.

Politics

There were discussions about which hospital site should be the one where the reporting facility was based. One of the participating hospitals was initially unhappy because their on-call registrars would be based at the Royal Victoria Hospital. However, as they had a maximum of three registrars, by sharing them in the combined registrar pool, the consultants in that hospital were able to move from a partial first on-call to a guaranteed second on-call rota (win-win).

Lessons learned

Although the registrar hybrid shift rota, which requires between 18 and 22 people, now works smoothly, the architect of this network pointed out that the consultant rotas are still in individual hospitals and that his feeling is that there should have been a full city-wide consultant rota established before the system went live. (The city-wide consultant rota remains problematic).

Mersey on-call collaborative

Nature of the service

The on-call collaborative is a Merseyside network of trainees supporting hospitals across Cheshire and Merseyside with on call. The rationale behind the network was to reduce the loss of training time due to on-call demands and to give support to hospitals without an on-call service.

Advantages

- Cohesion between junior and senior trainees enhancing training, potentially allowing junior trainees to start on call earlier in their career with peer-to-peer mentoring
- Less frequent work shifts = more training time in the department.

Problems

- Too many acute trusts across Liverpool and Cheshire/Mersey and too few trainees to provide sustainable on call. EWTD rules breached.
- When trainees are on call, they are on call frequently and are deprived of in-house training the following day.

Existing resources

- Shared Carestream PACS system across the region (except for two sites who host PACS from different vendors)
- Solution – to create a central reporting hub at a neutral site (quieter hospital on call – The Liverpool Heart and Chest Hospital) at which trainees would carry out on call for multiple sites. The idea is that multiple trainees would cover more acute sites remotely from the hub, resulting in busier on-call duties per shift but much less frequent rotas.

Difficulties/barriers experienced

- Having to change the mind-set of clinicians and radiographers and allaying their concerns about a new way of delivering on call without an on-site radiologist
- Trauma centre trust (Aintree) requires a trainee on site, making the collaborative on-call system a two-centred system. This has yet to be implemented and there is no experience yet with this model
- Bringing non Carestream PACS trusts into the collaborative – technical and financial challenges
- Quite busy on-call shifts experienced by some (not all) trainees. Lots of phone calls. This is anticipated to improve as more trusts join the collaborative
- Trainees are remote from acute trusts in the hub and will be virtually remote at Aintree when joining the collaborative. This means that ultrasound will not be covered by trainees out of hours.
General radiology networks

EMRAD

EMRAD is a consortium of seven trusts in the East Midlands: Chesterfield Royal Hospital NHS Foundation Trust, Kettering General Hospital NHS Foundation Trust, Sherwood Forest Hospitals NHS Foundation Trust, Nottingham University Hospitals NHS Trust, Northampton General Hospital NHS Trust, University Hospitals of Leicester NHS Trust and United Lincolnshire Hospitals NHS Trust.

EMRAD has agreed a contract with General Electric (GE) Healthcare to act as prime contractor for a cloud-based PACS, RIS and VNA.

GE will supply its own PACS, dose monitoring, collaboration and MDT software and VNA, a RIS from Healthcare Software Solutions (HSS) and critical results and teaching files from PeerVue for the ten-year contract.

Some of the trusts in the consortium had imaging systems managed by Accenture, the local service provider appointed under the National Programme for IT in the NHS (NPfIT), however, others had made their own arrangements for PACS or RIS or both.

Advantages

- The seven trusts will now have an ‘any patient, any image, anywhere’ technical system, in effect, creating a single regional imaging patient record. Subject to appropriate clinical safeguards and permissions, there will be no technical barrier to cross-region review or even primary reporting if desired. It is expected this will lead to substantial clinical improvements as patients can be reviewed and treated at any location within the EMRAD region.
- Communication across the EMRAD boundaries will be improved; the collaboration software allows for the creation of supra-regional sharing of images and reports, as well as supra-regional MDT support.
- Procurement as a consortium enabled the trusts to approach the market as a single entity. ‘We hoped that would be more attractive to suppliers as well as increasing our purchasing power – and this was indeed the case.’
- Consensus on technical infrastructure allows for significant economies of scale in both deployment and design.
- A cloud based system has enabled concentration more on network resilience and the capabilities of the network rather than on hardware.
- Keeping the consortium clinically focused – supporting patients and clinical networks – has led to increased cohesion and collaboration between trusts, rather than competition. Creation of region-wide agreements on data sharing, information and operational governance and so on has helped to keep trusts working together and in the same direction.

Disadvantages

- Not yet fully operational, so disadvantages unquantified.

South Yorkshire network working together programme

Background

This is an initiative sponsored by the chief executives of seven South and Mid Yorks Trusts. These are Barnsley, Doncaster and Bassetlaw, Mid Yorks, Rotherham, Sheffield Children’s Hospitals and Sheffield Teaching Hospitals. There are several components to this of which radiology and imaging is a part.² It relies on:

1. Strong managerial direction from all the trusts
2. Excellent professional and managerial relationships between trusts
3. Good local radiological leadership.

This network is in the early stages of development.

Advantages

1. Enables provision of specialist reporting across the trusts
2. Redistribution of breast imaging (screening and symptomatic).

There is a marked imbalance between Sheffield Teaching Hospitals Foundation Trust (STHT) and the other trusts in terms of workforce (STHT having a full complement while others have vacancies). There are now firm discussions on the redistribution of activity across the region. Reporting of both symptomatic and screening images is facilitated by a robust and practical local IT networks between the hospitals. There will have to be movement of radiologists/advanced practitioners to undertake clinics and assessments. The specific and very demanding targets and timescales associated with both symptomatic and screening Breast imaging will require efficient management of the services.

Problems reported

1. Technological

Locally this is not a significant problem. The MDT network has formed the basis for robust IT infrastructure. There are some problems with linking to the NHS Breast Screening Programme (NHSBSP) network.

2. Organisational

Potential for poor awareness and acceptance from certain radiological and other imaging groups. Requires good and meaningful engagement.
3. Cultural
Various groups could potentially feel excluded. Potential to lose local expertise and resilience.

4. Potential de-skilling
There is the risk that there will be de-skilling of more general radiologists, lack of resilience and a potential trend for the more complicated and difficult imaging flow towards the centre, potentially downgrading the local hospitals. This will lead to local hospitals appearing less attractive to radiologists, potentially giving rise to recruitment problems and lack of local resilience.

5. Financial
This process requires robust and practical contracts with pragmatic arrangements for cross charging.

6. Potentially creating illegal monopolies.
Creating co-operation rather than the previous ethos of competition could be legally challenged. Manufacturers could potentially claim that such a monopoly does not allow for a fair and open market place for the purchasing of equipment, whether it is high-volume low-cost consumables such as contrast or high-cost capital purchases such as MR scanners.

The Oxford academic health science network: imaging network (IN)
The Oxford AHSN Imaging Network is one of the nine clinical networks in the Oxfordshire AHSN best care programme. Each partner radiology department has a network radiology consultant and the IN has a manager, an administrator, a data manager and is shortly to appoint a network fellow.

The imaging network aims to take the opportunity provided by the AHSN to increase collaboration among the radiology departments, to standardise pathways and protocols and improve their adoption into practice. The large number of patients served by the network, (3.5 million) will also enable research questions that require large patient cohorts to be answered, such as, ‘What is the optimal imaging protocol for lung cancer follow-up post radical treatment?’

An immediate aim of the IN is to make radiology departments more user friendly and improve public understanding of the services provided. To help with this, videos will be made of patients undergoing imaging tests and these will be available to view via YouTube and links from each hospital, and are being incorporated into patient information leaflets. Currently three videos have been made, two in MRI and one in positron emission tomography–computed tomography (PET-CT). Further network videos will include CT, US (both adult and paediatric) and nuclear medicine (NM) (both adult and paediatric).

A long-term aim of the IN is to help the departments across the network cope with the ever-increasing volume of imaging and the need to provide more comprehensive reports, by providing a pan-network service of reporters to provide specialist reports and on-call cover.

The difficulties encountered so far have been staff recruitment and retention and the usual pressure of work for those involved.
Summary

It is to be hoped that a number of local health economies will look at one or more of these options and engage collaboratively with suppliers to assess the financial and technical viability of a reporting network.

A detailed specification for such a collaboration is in preparation and the working party producing this guidance would be keen to facilitate any shared learning and mutual support that different potential networks could offer to each other.

There will be a strong correlation between the degree to which the solution meets all of the gold-standard criteria and the expense and complexity of the initial set-up.

There is an urgent need to explore ways in which the long-term benefits of such a system can be articulated in such a way as to make a compelling case for the necessary up-front investment. This has already been done for pathology networks by the Carter review and it has taken five years for the principles to start being put into practice at scale.7
References


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