Title

Investigation into determinants of quality in medical imaging services: the case for Northern Ireland

Helena Brown
B00649491
03 February 2015
Module code: PUP836

Word count:

	Word count
List of tables	155
List of figures	160
Acknowledgements	168
Abstract	418
Introduction	590
Chapter 1	2718
Chapter 2	568
Chapter 3	2629
Chapter 4	3300
Chapter 5	388
Abbreviations	120
References	921
Appendices	4392

This work is being submitted in partial completion of the regulations for the Masters in Public Administration.

Contents

List of Tables

List of Figures

Acknowledgements

I would like to show my appreciation to the following people for their advice and support during the work and research for this paper:

Dr Gordon Marnoch, Reader in Public Policy, School of Criminology, Politics and Social Policy; Professor Colin Knox, Professor of Comparative Public Policy, School of Criminology, Politics and Social Policy; Jackie Johnston, Director of Secondary Care, Health Policy Group, Department of Health, Social Services and Public Safety; Dr John Lawson, Consultant Radiologist, Belfast Health and Social Care Trust; Jeanette Robinson, Radiographer, Southern Health and Social Care Trust; Jennifer McCrea, Deputy Principle Statistician, Hospital Information, Information and Analysis, Department of Health, Social Services and Public Safety; Richard Cardwell, Assistant Statistician, Project Support Analysis, Information and Analysis, Department of Health, Social Services and Public Safety; Brian Cleary, Information Technology Group, Department of Health, Social Services and Public Safety; Sean Ferrin, Deputy Principle, Secondary Care, Department of Health, Social Services and Public Safety; and all the kind people in focus groups who participated in completing electronic surveys.

Abstract

Medical imaging encompasses diagnostic and therapeutic services and is an essential component of clinical care for our ever-expanding healthcare system. Due to a growing ageing population with complex healthcare needs, the number of patients in Northern Ireland who will require some form of imaging technique is expected to increase dramatically in the future and delays in imaging services can have a serious impact on the quality of care.

This study identifies four determinants of quality in imaging services as: safety, communication, workforce and patient experience, and further sub-divides each category into driver groups. However the study also learns that safety, communication and workforce have a major influence on patient experience and reviewing extant literature demonstrates that patient satisfaction has important consequences to health outcomes and in this context further study is recommended.

Fieldwork included semi-constructive interviews to establish direction and focus groups were surveyed. Other tools such as SWOT and PESTLE were used to aid study decisions and SMART principles helped develop an online survey. Survey questions specific to the four dimensions of quality were applied to imaging facilities in Northern Ireland to baseline the perception of quality at an operational level.

This study shows that safety, communication and workforce factors associated with medical imaging are either well regulated or being taken forward in a Department of Health, Social Services and Public Safety review in areas such as regional accreditation; workplace setting; and, storage, access and reporting of images. However cultural change to direct staff towards extended working practices and modernising the service remains, alongside developing the workforce skill mix, which together have the potential to improve the quality of patient care and provide a service responsive to need and resilient into the future.

Similarly to deliver a quality service and reduce pressure healthcare commissioners should factor imaging into business development cases where imaging services play an important role, for example in staging cancer disease and monitoring efficacy of treatment.

This study explored patient experience and expectations, albeit from a professional viewpoint and recommends further work to directly measure patient opinion using an external organisation such as the Patient Client Council. That work should then be incorporated into the development of the framework document which will provide strategic direction for imaging services.

The interface with professionals has focused minds from a range of disciplines and services on the importance of a quality imaging service. It is acknowledged that further work is required however the study has been effective in identifying the determinants of quality in medical imaging services.

INTRODUCTION

Medical imaging has become an essential component of clinical care for our ever-expanding health service and encompasses diagnostic, monitoring and therapeutic services. A growing ageing population with more complex needs indicates that the number of patients in Northern Ireland (NI) who will require imaging services will increase dramatically over the next number of years.

Development of new treatments and therapies present significant challenges globally and healthcare organisations need to ensure not only clinical effectiveness but that they represent value for money and deliver quality outcomes. Imaging can be considered a rate determining factor in the patient pathway and improvements in service have the potential to reduce waiting times, improve throughput and deliver earlier treatment with subsequent improved outcomes for many patients. Even more significant is that delays in imaging services can have a serious impact on the quality of patient care.

Definition of imaging services and their uses

Imaging services in healthcare use a number of techniques (Appendix A) to diagnose, monitor and treat clinical conditions. Most images are produced by professionally trained and registered radiographers and some are reported by the radiographer; however most images are reported by radiologists who are specially trained doctors or senior clinicians under agreement. Many radiologists further specialise into particular fields, for example paediatric, neuro and interventional radiology.

Imaging services are mainly provided in hospital settings, however they are not ‘stand-alone’ services but part of an integrated approach to treatment and care of patients which overlap primary and community settings, secondary (hospital) and tertiary services (specialist centres in major hospitals). Imaging services are fundamental to modern clinical care and it is expected that technology and scientific improvements will lead to an increase in demand.

Importance of the research

To deliver effective policy development and meet business objectives the Department of Health, Social Services and Public Safety (DHSSPS) derives direction and purpose from various sources to generate strategic plans, the Commissioning Plan Direction Targets[1] and Indicators.[2] Health and Social Care (HSC) organisations draw on these to develop their own business plans.

Following backlogs and delays in reporting plain x-rays in two HSC Trusts in 2011 the Regulation and Quality Improvement Authority (RQIA) independently reviewed handling and reporting arrangements for plain x-ray investigations in all Trusts. The term 'reported' relates to the formal report signed off by a radiologist or trained radiographer, sometimes after the image has been acted upon. Delays in reporting may have an impact on the outcome of patient treatment and care.

The subsequent RQIA report recommended that *"The DHSSPS should develop a strategy for the future provision of Imaging Services in Northern Ireland which incorporates a new workforce plan for radiology".*

Aims and objectives

The objective of this research is to contribute to DHSSPS policy development which will direct future provision of an efficient and effective imaging service to meet the needs of the population and address the aforementioned RQIA (2011) recommendation.

The aim of this study is to investigate the determinants of quality in NI imaging services; review extant literature to examine global services, standards and opinion; benchmark against other UK regions; and provide input to the formal DHSSPS regional medical imaging review (RMIR).

The research will consider imaging services via qualitative and quantitative methodologies focusing on clinicians, practitioners, administrators and policy makers. Benchmarking information concerning quality assurance mechanisms will also be

[1] The Health and Social Care (Commissioning Plan) Direction (Northern Ireland) 2014
[2] The Health and Social Care (Indicators of Performance) Direction (Northern Ireland) 2014

examined. Recommendations stemming from the research will be submitted to the RMIR board for consideration.

Chapter 1

Literature review

Introduction

Definition of quality

Juran (1986) proposed quality as a measure of fitness for purpose and Crosby (1984) suggested quality is about conformance to requirements. The International Standards Organisation ISO 8402-1986 defines quality as:

> "*The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs."*

Nonetheless, quality is dependent on the position of the observer - as one who delivers or one who receives.

Quality improvement

Quality improvement is always a consideration for any service and improving quality is most often taken forward as a project, with well known models such as *The Six Dimensions of Quality* (Maxwell, 1992) and the *Chain of Quality* (Groocock, 1986) to help focus the process. However, authors such as Seagull and Nagy (2010) warn of the temptation to base the project on technological problems, with pre-conceived resolutions, rather than on the human components of the issues that are being examined for improvement. Seagull and Nagy (2010) describe the pitfalls of not properly involving stakeholders in the decision making process and discuss the Six Sigma movement (Trusko B, 2007), which is based on the Pareto principle (also known as the vital few and the trivial many) that roughly 80% of the effects come from 20% of the causes, developed by Joseph Juran during the 1940s and which has become a common rule of thumb in business and management (Juran, 1951). With regard to imaging (radiology) in particular Trusko utilised the Six Sigma approach to improve patient waiting times and speedier turn-around times for imaging reporting which led to a 25% increase in input and a 21.5% decrease in cost per radiology procedure.

Service quality

Patient satisfaction is an important component of healthcare delivery with feedback surveys providing information about patients' values and expectations (Donebadian, 1982).

According to Wong (2002) services are often segregated into 'technical quality' and 'functional quality', i.e. product (or service) and the way in which it is delivered. Wong notes technical quality "*include factors such as outcome measures, average length of stay and readmission rates"* and functional quality as *"professionals' attitudes towards patients, facility cleanliness, and quality of hospital food"* and that patients focus on functional quality because they may not have the expertise to evaluate technical quality. Wong contends that although technical quality is peer reviewed and audited, functional quality is not a priority for clinicians; however when patient satisfaction is the driver for quality improvement clinicians should include functional quality when evaluating patients.

Wong discusses a study that measured the functional quality of a hospital ambulatory imaging service in Brisbane using a tool called Servqual, which evaluates quality using a customer satisfaction model developed by Parasuraman (1991). 'Expected performance' is compared to 'perceived performance' and gap scores applied to quantify the results. Wong concludes that questionnaire length is an important factor in measuring scores, with a longer questionnaire only being useful if expectation trend is necessary. Wong suggests it is more useful to gauge customer satisfaction using simple measurements.

Quality measures relevant to medical imaging

When evaluating and measuring medical imaging quality there are many elements to be considered, for example:

quality of: equipment or instruments and maintenance (calibration, validation);
product, i.e. the image from which further analysis will be made;
outcome / interpretation of the image;

method for storing and reporting data;
reporting results to professional colleagues;
service administration (waiting lists, post exam referral);
communication with the patient (patient satisfaction);
service facilities;
assessment when imaging should (or should not) be used and if overuse is an issue.

The literature review

A strategy was developed to examine existing literature to establish the determinants of quality in medical imaging services globally and thereby create a platform from which evaluation of existing imaging services in NI could emerge. Before commencing the review it was anticipated the exploration would link standards and good practice to quality of medical imaging services.

For this investigation 69 papers and other material were reviewed, 37 were global, 19 related to the UK and 13 directly to Northern Ireland; material reviewed identified the determinants of quality. This literature review will interpret the extant literature which may contribute to strategic decisions for the NI healthcare system. The review will utilise primary and secondary research and reports and identify determinants and measures of quality via qualitative and quantitative data.

Financial drivers or efficiency savings were not examined as they were not deemed relevant to the objective of examining determinants of quality of imaging services, but rather were more appropriate for a full review of regional imaging services. Historically radiology has been the source of bottlenecks and delay in the patient pathway and it is clear that increasing productivity and efficiency has the potential to contribute indirectly to the expected NHS efficiency savings between 2011 and 2014 (Grant et al, 2012).

During the early stages of this literature review it became clear that a considerable number of academic and professional papers and reports have been published on various aspects of quality in many different types of imaging services. However the dominant features of quality within medical imaging services became apparent and these were grouped into the following categories: safety, communication, workforce,

and patient experience, with the composition of each group further divided according to the characteristics of the key aspects of the particular group.

Figure 1: How four major components/categories combine to influence quality in medical imaging services.

The majority of academic papers and professional reports examined were consigned to one of the above categories (although some overlap was evident) and the literature review process refined to classify the material - from which a selection has provided the principal information. The following sections and figures 2 to 5 demonstrate the categories and sub-groups.

SAFETY

Figure 2: Determinants of quality in medical imaging services: SAFETY and key components of the sub-groups entitled Equipment, Best Practice and Regulation.

Radiological reporting discrepancies

Discrepancy in radiological reporting is not unusual and the Royal College of Radiologists (2006) published a guidance document on standards with a primary aim to reduce error and therefore increase patient safety. Discrepancies can occur when a retrospective review or subsequent information about patient outcome leads to a different opinion to that which was originally determined; however not all reporting discrepancies are errors (RQIA, 2011). Potential causes for discrepancies include poor imaging technique, excessive workload or poor working conditions, observation or interpretation errors, inadequate clinical information, or ambiguous wording in the report (Royal College of Radiologists, 2006).

A study quoted from an outpatient setting over a six month period showed that an electronic alert system generated 1,196 abnormal image alerts (from 123,638 radiologic studies); after four weeks 92 lacked timely follow-up and of these 28% led to new diagnosis – 42% of which were cancer (Basu et al, 2010).

Accreditation

Sloper and Katanick (2011) advocate professional, peer-led, accreditation to provide assurance to service users that the quality of service has been examined and verified, including the manufacture and commissioning of equipment, workload capabilities and workforce skills, and that accreditation is a tool used to create, maintain and improve standards that guide effective safety and quality of services.

COMMUNICATION

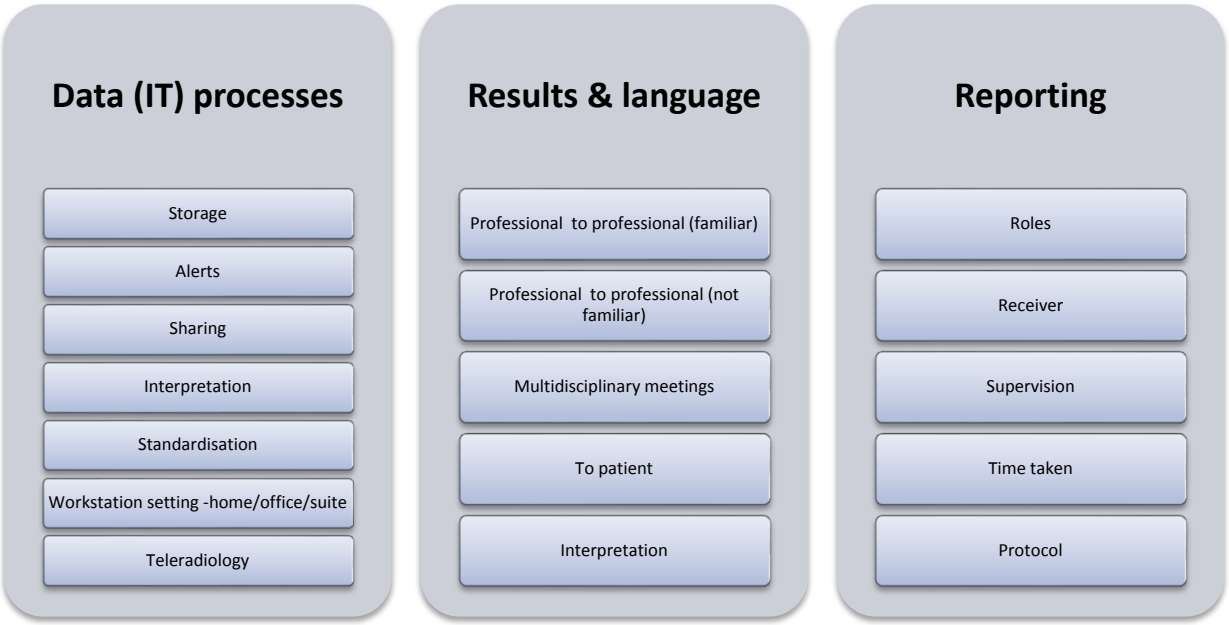


Figure 3: Determinants of quality in medical imaging services: COMMUNICATION and key component of sub-groups entitled Data Processes, Results & Language and Reporting.

Impact of Targets on imaging departments

Target initiatives are used globally to improve quality; typical healthcare examples are Emergency Department (ED) waiting times or 'red flag' cancer diagnostic and treatment times (Upponi & Shaw, 2010; Sutton, 2010; DHSSPS, 2012; DoH, 2012; NHS Scotland, 2013). The setting of targets can contribute to pressure on imaging departments and Upponi and Shaw (2010) and Sutton (2011) observe dramatic performance improvement and increased capacity which they have attributed to increased equipment levels with subsequent improved workflow through radiology departments, however it is not clear if the targets had an impact on procuring additional equipment.

Conversely, innovations such as digital imaging and communications in medicine (DICOM) (Kuzmat, 2000), radiology information systems (RIS), picture archiving and communication systems (PACS), digital dictation and voice recognition software have also played a key role in the reported performance up-turn (Sutton, 2010). Considerable investment has been made to introduce PACS UK-wide and some regions have undertaken to harmonise and integrate a wide range of extant PACS and RIS (Sutton, 2010). Sutton (2010) advises that the Northern Ireland equivalent, NIPACS, has been developed to provide a virtual system across the province.

A perceived outcome of PACS and RIS is a reduction of diagnostic waiting times by outsourcing to independent organisations (Upponi & Shaw, 2010; Sutton, 2010) leading to a rise in the number of UK-based organisations providing remote services, known as teleradiology (Upponi & Shaw, 2010). This is particularly useful for smaller institutions affected by the European Working Time Directive (2000) impacting on overnight or out-of-hours imaging requirements due to junior doctor cover. The significance of the role of teleradiology in future service delivery is an important consideration for reporting, reducing waiting times and patient outcomes (Upponi & Shaw 2010, Sutton 2010).

Category overlap

A good example of overlap is communication of results to patients, as this falls within both Communication and Patient Experience dimensions. The quantitative research of Basu et al (2011) demonstrates how communication can be separated into hard evidential data (Communication) and softer anecdotal information that is more suitable to the Patient Experience.

Through quantitative research in an out-patient imaging department in the United States, Basu et al (2011) ascertained that the vast majority of patients attending imaging departments prefer to receive their results as soon as possible, and sooner than was the case at that time, irrespective of who delivered the results. Data examined by the authors demonstrated that in 2009 the average report turnaround time exceeded 33 hours for CT and MRI, whereas their study indicated that patients would prefer to have results communicated within a few hours.

WORKFORCE

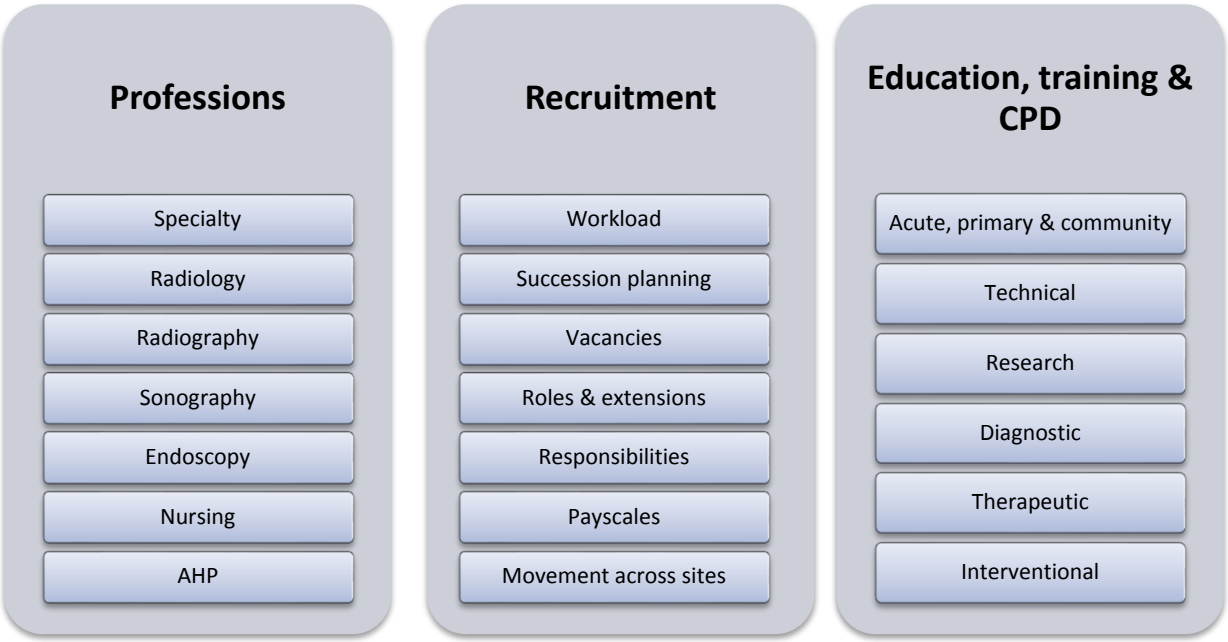


Figure 4: Determinants of quality in medical imaging services: WORKFORCE and components of the sub-groups entitled Professions, Recruitment and Education.

Productivity

Scientific and technological advances have challenged the NHS to become more efficient and promote equality through standardised roles within the workforce, with the role of radiologists evolving to regular participation in multi-disciplinary patient care (Upponi and Shaw, 2010; Khan and Hedges, 2013). Upponi and Shaw (2010) cite census results demonstrating a shortfall in radiology numbers in the UK in comparison to international figures; Australasia employed 67 radiologists and the United States 100 per million population, whereas the UK regions employed 44 (England), 33 (Wales), 54 (Scotland) and 56 (Northern Ireland). Khan and Hedges (2013) reported the figure for England, at 36 radiologists per million as one of the lowest ratios in the Western world, however further exploration discovered this data was somewhat old, having been cited by Nakajima (2008) from data published in 2004 (Appendix B). More recent data published by RCR (2012) report a UK total of 47 (Appendix B), with NI (60) remaining in the strongest UK position.

To overcome the shortfall some imaging departments have introduced new reporting procedures where selectively trained radiographers have a role in reporting plain x-rays, CT and MRI cases. These radiographers have access to trained radiologists and are regularly audited (Khan and Hedges, 2013). According to Upponi and Shaw (2010) delegating reporting in certain areas such as emergency skeletal x-rays is a pragmatic approach to resolve the paucity of trained radiologists, with a direct consequence of releasing radiologists to concentrate on more complex cases.

Roles and responsibilities: what patients know

Basu et al (2011) discuss the role of radiologists and observe that up to half of patients are not aware that radiologists are physicians trained to interpret their imaging examination. In the context that patients prefer to receive results early the authors suggest their research provides an empirical opportunity for the role of radiologists to become more visible, with the prospect of increased patient satisfaction and improved healthcare quality through timely reporting of results. Developing a new model for direct patient communication has been criticised because of the potential to increase radiologists' workload, but Basu et al have accounted for centres who report increased referral volumes consequential to implementing this new model of direct communication.

PATIENT EXPERIENCE

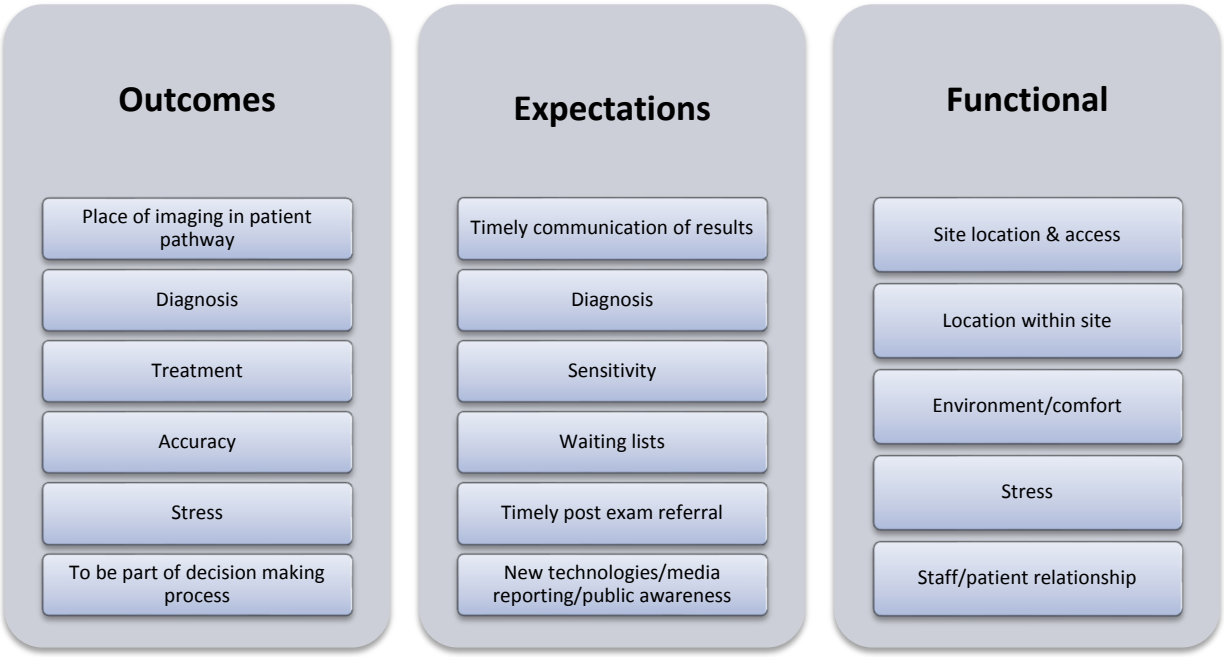


Figure 5: Determinants of quality in medical imaging services: PATIENT EXPERIENCE and components of the sub-groups Outcomes, Expectations and Functional.

Communication of results to patients

Basu et al's (2010) research critically evaluated current communication of imaging results to patients and considered the negative physical and mental impact caused by delays. The authors determined if results were communicated to patients within their preferred timescale it is unlikely the referring physician would deliver those results.

Basu et al (2010) quote a study examining the value of radiologists delivering results directly to the patients. Findings included reduced patient stress and communication failures, speedier delivery of the most accurate information, and the inclusion of patients in decision-making processes. The researchers also assessed whether online patient access to results would be beneficial, however it was noted this is would render radiologists invisible and that patients value 'face time' interaction to enable discussion.

Basu et al concluded that although radiologists who practice interventional radiology, paediatric radiology, ultrasound and mammography generally communicate results

directly to patients, this is not the case with diagnostic radiology such CT and MRI, where the radiologist seldom sees the patient.

Other category overlaps

Grant et al (2012) outline reviews and reports such as the national framework produced by the NHS Modernisation Agency (2003) and the Audit Commission report (2002) that have identified “lean thinking” and process mapping methodologies for improving service, leading the authors to suggest a five percent improvement in radiology productivity could represent a saving of around £55 million per year (figures based on UK-wide radiology spend in 2008/9). The authors describe how evaluation methods such as process mapping contribute to improved service design and quality of service, including reduction of unnecessary complex investigations, patient pathway redesign, waiting list management, better use of resources and training, standardised inter-hospital imaging protocols and reporting formats, and modernisation of information and communication technology (ICT) systems for the purpose of storing, reporting and transferring imaging to other units.

Conclusion

This literature review identifies imaging as a major rate determining factor on the patient pathway, and improvement in access to and results from imaging departments has the potential to reduce waiting times, improve throughput, and most importantly allow treatment to commence faster with better outcomes for many patients.

The review identifies and categorises the determinants of quality in imaging services as Safety, Communication, Workforce and Patient Experience, and further sub-divides each category into driver groups, each with a number of key themes. It is acknowledged that there is some overlap between categories.

It is not obvious if setting targets has been responsible for improved patient outcomes and the argument whether workforce issues or IT systems are behind improved imaging department throughput remains unresolved. Despite a notional improvement in services

resulting from PACS/RIS implementation and fit-for-purpose diagnostic imaging, supply and demand continues to be imbalanced and Sutton (2010) suggests stricter referral guidelines may address some of the volume related issues. The significance of the role of teleradiology for future service delivery is also an important consideration for reporting, reducing waiting times and patient outcomes (Upponi & Shaw 2010, Sutton 2010).

What is perhaps even more significant (and distressing from the patient's perspective) is that diagnostic imaging represents a major step in the patient pathway for treatment delivery and delay can have serious outcomes for patient care. Figure 6 demonstrates how Safety, Communication and Workforce influence Patient Experience however because Patient Experience is a 'softer' determinant it is difficult to measure. Paradoxically it may be considered the most important outcome. Safety is highly regulated and audited and it is relatively straightforward to put systems in place to ensure conformance, therefore further work in this area is best served by being taken forward as part of the regional review. Likewise, certain aspects of Workforce such as roles and responsibilities are likely to be systematically reviewed under the regional review.

However this literature review shows that patient satisfaction has important consequences to health outcomes

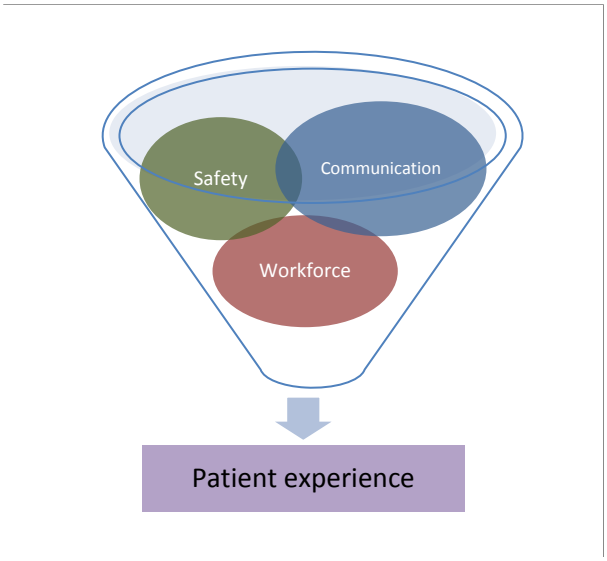


Figure 6: Demonstration of how safety, workforce and communication combine to deliver patient experience. Patient experience includes both soft and hard components which lead to patient outcome, including therapy where appropriate.

Chapter 2

Methodology

This research has been conducted as a work-based project to provide information to the DHSSPS policy development of a regional framework for imaging services in NI. Twenty eight key health and care stakeholders sit on a regional medical imaging review board (RMIR) to oversee this policy development; these decision makers represent commissioning, finance, performance management, service improvement, human resources, investment, health protection, providers, nursing, medicine, AHPs and regulators within the HSCB, PHA, RQIA, PCC, Trusts and DHSSPS.

The RMIR has created five discrete, specialty based workstreams (Radiology, Interventional Radiology, Paediatrics, Obstetrics and Cardiology) with around 42 members and a key objective to develop papers that scope the current position of imaging services in NI, describe an optimum service, conduct a gap analysis and suggest ideas to prepare for future technological advances. The specialty workstreams are supported by interface workstreams in Finance, Workforce, ICT and Capital Investment and terms of reference apply to all workstreams.

In consideration that primary research for this study would be provided by people principally involved in policy development for the framework, ethical approval was not sought and this research will be restricted to the university supervisor, examiner and the DHSSPS.

The structure of the RMIR enabled primary and secondary research to maximise professional and academic evidence and draw upon applied and theoretical knowledge of national and international best practice to provide a basis for the following broad approach: benchmarking to provide comparison for NI services; strategic sampling for individual interviews with beginning and end users; key stakeholder survey to catalogue opinion and testimony; and multi-disciplinary focus groups to discuss local operational issues.

Interviews were conducted with a beginner and an end user, i.e. an imaging services manager and a Consultant Radiologist, to gain basic information and establish direction

for further fieldwork. A framework of open questions (Appendix C) was used to conduct semi-constructive interviews in which a flow of information about the research and the type of data required provided enough flexibility to probe and discuss the responses and imparted a better understanding of imaging services to the researcher.

These interviews led to a subsequent set of questions (Appendix D) targeting members of the Radiology workstream and contributing to a position paper on current service provision. The workstream was specifically targeted because of its broad remit - Radiology and Radiography plus other areas not included in the remaining specialist workstreams e.g. oncology - and because of its wide professional membership, many of whom sit on the Modernising Radiology Clinical Network (MRCN), a collaborative group responsible for implementing policy and Review recommendations who are well placed to provide the most up to date information and expert opinion.

A further questionnaire to baseline the perception of quality at an operational level was distributed electronically to a multi-disciplinary focus group (RMIR and associated workstreams; sample size approx. 70 people) to provide quantitative data. Appendix E gives a description of the survey however in summary, most questions were closed and the survey was split into two sections; the first collected background information such as gender, age, profession etc; and the second asked specific questions based on the dimensions of quality identified by the literature review. SMART principles (Doran 1981) were used when developing the survey and questions were checked for accuracy by statisticians, ITC and clinical expertise. A risk assessment limited participants to use HSC computers due to internet permissions and government information management guidance.

Chapter 3

Data analysis and findings

The literature review identified four determinants of quality in imaging services as Safety, Communication, Workforce and Patient Experience with key themes such as equipment, data processes, vacancies and comfort. A survey was developed to confirm whether the literature review had correctly identified these determinants of quality for imaging services.

Fifty four from a distribution of around 70 people responded to the survey, giving an approximate 77% return. The sample size was good given the distribution count however it could not be utilised for any major in-depth analytical techniques such as correlation tables, although frequency and pivot tables were considered acceptable for demonstrating counts or trends for illustration purposes.

In certain categories indicator numbers were too small to form sound conclusions, for example ‘not very important’ or ‘don’t know’ indicators had many single responses. Therefore to comply with government data protection regulations which are designed to protect identities, careful analysing and reporting was employed where numbers were very small. Collated responses are attached at Appendix F.

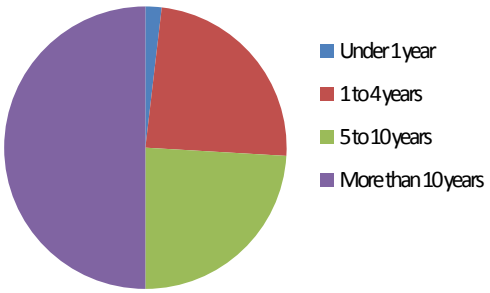
Results to background questions

Questions one to three about current profession, employment status and primary role establish the survey population and collect background information which can inform other results e.g. whether profession or role has an impact on opinion.

Four respondents noted administrative and six managerial roles, however assumptions about these being only managerial or administrative may not be accurate, only that part of their role is managerial or administrative, for example a radiographer may also be a manager. 70% (38) of respondents were hospital consultants and 9% (5) were radiographers, suggesting a majority (43, 80%) were directly involved with imaging services through ordering, reading or delivering scans. Length of service (figure 7)

shows that 50% (27) have been employed in their primary role for more than 10 years and further analysis reveals that 21 (78%) of these were either consultants or radiographers. This question, coupled with respondents' age profile and current profession, aimed to investigate if those involved in imaging were in the later stages of their career and whether these were factors in the vacancy figures for Radiology both in NI and in the other UK countries. This is further debated in the discussion chapter under Workforce.

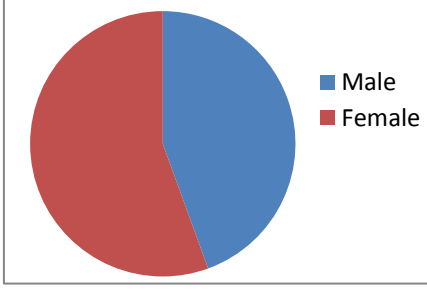
Figure 7: Work Experience of Respondents in primary role



The results also show that fewer than five people work part time and all are female; this is insufficient evidence to test if part time work or gender has an effect on the quality of service.

The majority of respondents were female (30, 56%). There were equal numbers of male and female hospital consultants however all radiographers (5) were female. There were half the number of male managers (2) compared to female managers (4). The five male non-consultants include engineering, medical advisor, administration and managerial roles. The 11 female non-consultants roles include radiography, administration, manager and radiology.

Figure 8: Gender of respondents



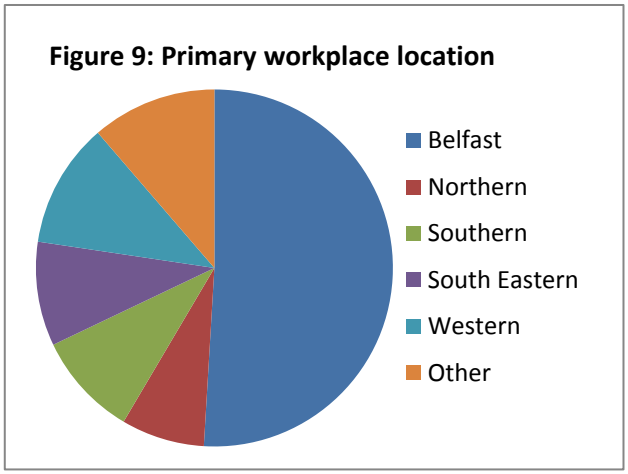
The gender split is almost even within 'more than 10 years' service with 14 males to 13 females, and '5 to 10 years' service having seven males to six females. However in the category '1 to 4 years' there are only two males to 11 females, and for 'under 1 year' there is one male and no females.

The age profile of respondents is consistent with the statistics from the professional role and length of service, with the majority of those in the largest group (48%) 40-49 being consultants (23 out of 26, 88%). The age group with the next highest number of respondents was the 50–59 age group (33%), broken down to nine males and nine females; however further analysis shows that the group did not mirror the 40-49 age group, with two thirds of the males being consultants (6) compared to just over one-fifth of the females (2). Table 1 sets this out in more detail.

Age group	No's	%	Female	Male
20-29	1	1.85	1 (100%)	0
30-39	8	14.81	5 (63%)	3 (37%)
40-49	26	48.15	15 (58%)	11 (42%)
50-59	18	33.33	9 (50%)	9 (50%)
Over 60	1	1.85	0	1 (100%)

Table 1: Analysis of age profile in relation to professional role

The majority (27) work in the Belfast HSC Trust which is explained by the fact that the Trust is the regional centre for many specialties. The spread across the remaining Trusts and Others is relatively even as figure 9 demonstrates. There were 17 respondents who worked between Trusts.



Results to Quality Section

Questions eight to 11 specifically relate to the four dimensions of quality identified in the literature review: safety, communication, workforce and patient experience and were designed to test if the literature was correct in the opinion professional expertise.

SAFETY

Question eight divides key components of Safety into equipment, best practice, and regulation. Elements of these categories have the potential to establish a baseline of quality to guide investigation of an accreditation system for NI. It was considered that most respondents would have good knowledge of Safety matters such as professional regulation but may be unfamiliar with others like calibration therefore this question looked to gathering professional opinion for later evaluation.

Equipment: Table 2 shows the highest number of responses for 'very important' was *accuracy/precision* (38, 70%), followed by *validation/calibration* (32, 59%), *Site-in the right place* (31, 57%) and *ratio of equipment* (27, 20%). The highest responses for 'important' were *throughput* (28, 52%), followed by *modern equipment* (26, 48%), and *replacement schedule* (25, 46%). *Accreditation* drew 24 responses for both 'very important' and 'important. Four respondents selected 'not very important' and two selected 'don't know' for *modern equipment* giving a total of 11% for this category.

EQUIPMENT	Very important	Important	Not very important	Not important at all	Don't know
Modern equipment	22	26	4	0	2
Throughput	25	28	0	0	1
Replacement schedule	24	25	3	0	2
Site infrastructure /equipment in the right place	31	22	0	0	1
Validation/calibration	32	16	3	0	3
Accuracy/precision	38	15	0	0	1
Accreditation	24	24	3	1	2
Ratio equipment to population	27	23	3	0	1

Table 2: Analysis of the key component 'Equipment' from the Safety dimension.

Best practice: Table 3 shows the majority of respondents indicated 'very important' or 'important' for all components. Results for *accuracy of reporting* and *timely reporting* drew 96% and 81% 'very important' respectively.

BEST PRACTICE	Very important	Important	Not very important	Not important at all	Don't know
Standards	34	20	0	0	0
Guidance	33	21	0	0	0
Appropriate use	40	14	0	0	0
Timely reporting	44	10	0	0	0
Accuracy of reporting	52	2	0	0	0
Reporting language	31	20	3	0	0

Table 3: Analysis of the key component 'Best Practice' from the Safety dimension

Regulation: The results for the *statutory* component were 28 'very important', 23 'important' and three 'not very important. For *professional* the results were 32 'very important' and 22 'important'. There were zero selections for the remaining indicators.

COMMUNICATION

Question nine divides key components of Communication into data processes, results and language, and reporting. This study is a consequence of the RQIA report into backlog and delays of plain film reporting in 2011, which identified communication as an issue, therefore this question aimed to confirm Communication categories and their value.

Data processes: table 4 shows the indicator which respondents selected most frequently as 'very important' was *interpretation* (61%) with the least being *teleradiology* (30%), Just over one quarter of respondents thought *workstation setting* is 'not very important'.

DATA PROCESSES	Very important	Important	Not very important	Not important at all	Don't know
Storage	21	25	5	1	2
Alerts	29	19	4	0	2
Sharing	27	22	3	0	2
Interpretation	33	18	0	0	3
Standardisation	26	21	4	0	3
Work station setting	18	21	14	0	1
Teleradiology	16	28	9	0	1

Table 4: Analysis of the key component 'Data Processes' from the Communication dimension

Results and language: two areas each attracted approximately three quarters of the 'very important' responses: *sufficient information with the request* (80%) and *interpretation of the report* (74%) as demonstrated on table 5. These are significantly higher than the remaining indicators, with the nearest being 63% for *multidisciplinary meetings* again 'very important', although five also thought this category was 'not very important'. One component, *to patients – to aid understanding* was considered as 'not very important' to eight respondents.

RESULTS & LANGUAGE	Very important	Important	Not very important	Not important at all	Don't know
Sufficient clinical info with request	43	11	0	0	0
Professional to professional - familiar	24	27	2	0	1
Professional to professional - unfamiliar	22	28	2	0	2
Multidisciplinary meetings	34	15	5	0	0
To patients – to aid understanding	16	29	8	1	0
Interpretation - report	40	13	1	0	0

Table 5: Analysis of the key component 'Results and Language' from the Communication dimension

Reporting: similar to previous questions the majority of responses were in the 'very important' or 'important' indicators. The eight who recorded *protocol – structured reporting* as 'not very important' were consultants. One respondent felt *protocol – pathway for imaging services* was 'not important at all'. *Time taken* had the highest number of respondents (93%) who selected 'very important' or 'important'.

REPORTING	Very important	Important	Not very important	Not important at all	Don't know
Protocol – structured reporting	19	27	8	0	0
Protocol – pathway for imaging services	25	24	3	1	1
Roles – knowledge throughout steps in pathway	18	33	2	0	1
Receiver – requesting clinician to report asap	34	20	0	0	0
Supervision	17	34	2	0	1
Time taken	11	39	3	0	1

Table 6: Analysis of the key component 'Reporting' from the Communication dimension

WORKFORCE

Question 10 on Workforce recruitment aimed to confirm if the constituents had been correctly identified and to measure their importance in terms of quality. The aim was to identify if there is an appetite for partnership working across the region and if role extension was considered important.

Recruitment: similar to previous questions, most responses for this section were again spread across the 'very important' or 'important' indicators, with small numbers recorded for the remainder. The highest number of 'very important' responses (47, 87%) was for *sufficient for workload*. Other significant results were for *succession planning* and *filling vacant posts* each of which secured 36 'very important' choices.

RECRUITMENT	Very important	Important	Not very important	Not important at all	Don't know
Sufficient for workload	47	6	1	0	0
Succession planning	36	17	1	0	0
Filling vacant posts	36	18	0	0	0
Pay scales – effect on recruitment	23	25	5	0	0
Roles & extensions – extended reporting	17	25	7	1	4
Movement across sites	18	27	6	1	2

Table 7: Analysis of the key component 'Recruitment' from the Workforce dimension

PATIENT EXPERIENCE

For question 11 participants were asked to respond using a different, hypothetical approach – to answer how they felt patients (in their care) would rate the importance of each category provided in the questions in term of quality. The question sought confirmation that the categories were accurate; there was expectation that responses may help design a patient-centred survey.

Outcomes: the key feature is that between 78% and 87% of respondents 'strongly agree' that *diagnosis, treatment* and *accuracy* are important quality indicators for imaging services, with opinion being more evenly distributed between 'strongly agree' and 'agree' in relation to the remaining options. At least one person chose 'strongly disagree' for all of the components in this section.

OUTCOMES	Strongly agree	Agree	Neither	Disagree	Strongly disagree
Imaging in patient pathway	25	22	5	0	2
Diagnosis	47	6	0	0	1
Treatment	42	11	0	0	1
Accuracy	45	8	0	0	1
Stress anticipation /understanding/wait for result	29	22	2	0	1
Part of decision making	21	25	4	1	3

Table 8: Analysis of the key component 'Outcomes' from the Patient Experience dimension

Expectations: once again *diagnosis* received the highest number of 'strongly agree' responses, although in this case it related to how respondents perceived patient expectations. *Timely results communication* also rated highly (80%). *Knowledge* did not have any clear preference; ratings were fairly evenly distributed across the first three options with almost 10% disagreeing. Three of the components related to different aspects of '*waiting times'*; two of these, *image report to consultant examination* and *referral by consultant to receiving appointment for imaging* attracted 63% (34) and 59% (32) responses respectively, with *referrals/follow-up/monitoring* scoring 46% (25). *Sensitivity* also had more respondents selecting 'strongly agree' than 'agree' and one person opted for 'strongly disagree'.

EXPECTATIONS	Strongly agree	Agree	Neither	Disagree	Strongly disagree
Timely results communication	43	11	0	0	0
Diagnosis	47	7	0	0	0
Sensitivity	29	22	2	0	1
Wait – referral to imaging appt	32	22	0	0	0
Wait – imaging report to consultation	34	20	0	0	0
Wait – follow up/monitoring	25	26	2	1	0
Knowledge – internet/media public awareness	15	19	14	1	5

Table 9: Analysis of the key component 'Expectations' from the Patient Experience dimension

Functional experience: table 10 below shows there were no outstanding preferences in these categories, with the highest number of responses for 'strongly agree' and 'agree' combined being 52 (96%) each for *hospital site access* and *staff/patient relationship.*

FUNCTIONAL EXPERIENCE	Strongly agree	Agree	Neither	Disagree	Strongly disagree
Hospital site location	24	22	8	0	0
Hospital site access	29	23	2	0	0
Location of imaging within site	17	26	11	0	0
Comfort of imaging facility	15	29	9	1	0
Stress parking/waiting room wait/return to work	16	32	3	1	1
Staff/patient relationship	34	18	1	1	0
Hospital site location	24	22	8	0	0

Table 10: Analysis of the key component 'Functional Experience' from the Patient Experience dimension

Question 12 asked respondents if they knew about the review before participating in the survey, to which 61% replied yes.

Question 13 asked which of the four dimensions of quality was most in need of quality improvement, with workforce having the highest number of responses (30) and the lowest being patient experience (6), with safety (10) and communication (8) both relatively low.

Question 14 asked participants which dimension of quality they thought would benefit most from the current review of imaging services in NI. The key response was workforce (23) followed by communication (12), patient experience (11) and safety (8).

Question 15 asked participants to rate the four dimensions of quality in imaging services according to 'excellent', 'good', 'satisfactory' and 'poor'. The results are shown on table11. The most notable finding is that 19 people recorded workforce with a 'poor' rating, although 21 people also rated workforce as satisfactory; these ratings correlate to some extent with the previous questions about need for quality improvement and the likely beneficiary of the regional imaging review. The quality of patient experience has generally been rated as 'good' or 'satisfactory' and communication is rated 'good' in the main. One person rated *safety* as 'poor'.

Rate quality of imaging service in current role	Excellent	Good	Satisfactory	Poor
Safety	16	28	9	1
Communication	8	30	13	3
Workforce	5	9	21	19
Patient experience	1	25	24	4

Table 11: Analysis of the ratings of quality in the four dimensions of quality

Question 16 asked participants to comment on any other issues they considered should be included in the research study in relation to investigating the determinants of quality in imaging services. There were 29 responses of which 24 (83%) were consultants or clinicians. Comments were mixed however they can be organised into main themes: workforce; ITC; protocols; specific specialties and environment, all of which have an overarching operational element but also are in within boundaries of the four descriptors of quality used for this study; Workforce, Communication, Safety and Patient Experience. The comments will form part of the discussion in the next chapter.

Chapter 4

Discussion

Introduction

This chapter will discuss the survey findings and give consideration to comments on other research areas which should be included. The discussion will explore how the four dimensions of quality identified in literature have an important role not only in imaging services but also in the wider context of the whole system, including the importance of providing public assurance on safety and quality of services. Issues around workforce, communication, safety and patient experience will be examined, as will benchmarking and partnership working, with recommendations where possible. The discussion will end on other important strategic policy developments which fall within the remit of the imaging review.

The effect of the small sample size and the composition of the target audience produced a case study rather than a true random sample. Medical imaging is not a technical service but a clinical service which interprets information provided by imaging equipment and it is practical to direct this study from the perception of those directly engaged in delivering the service as an initial approach. Further work should progress to survey patients using the resources of organisations such as the Patient Client Council (PCC), to include gap analyses to determine what, if any, effective changes could benefit patient experience and the quality of the service.

Survey responses and comments

There were no unusual disclosures relative to gender or workplace location; half were based in the Belfast Trust which is to be expected given that Belfast is the regional centre for many specialties such as cancer, cardiology etc.

The final comments section of the survey were mainly consultants or clinicians who voiced a range of comments; these are organised into main themes for this discussion and are amalgamated with the main descriptors of quality identified early in this study; Workforce, Communication, Safety and Patient Experience.

WORKFORCE

The workforce of an imaging department comprises a mix of skilled professionals with Radiologists and Radiographers at the fore. Radiologists are central to discussions on patients' clinical pathways and anecdotally around 15 to 20 per cent of their time is spent preparing for and attending these. Nationally a shortage of Radiologists (RCR 2014) exists, therefore to consolidate the available workforce it is important to optimise skill mix to provide an effective and efficient service and release Radiologist expertise to focus on the challenges of more complex cases. Thus ensuring sufficient workforce capacity would require succession planning to include extended roles and backfill arrangements.

Radiology training follows general medical training and survey results suggest there may be correlation between training times and age profiles of Consultants; Figure 10 sets out UK medical career pathways[3] and illustrates the typical duration of undergraduate education and post graduate training, which is dependent on specialty vacancies with more than 60 specialties and 35 sub-specialty medical practices in place (Greenaway, 2013). This is reflected in the survey where more than 70% involved in imaging were over 40 years and half of all respondents were in their primary role for more than 10 years, with 78% being consultants or radiographers. The complexity of post graduate medical training may account for some of the older age profiles for consultants; this and factors such as lower retirement age than other professions, the ability to take sabbaticals or long term breaks (Greenaway, 2013) plus maternity breaks and parenthood combine to make a solid argument for increasing training numbers for general (i.e. non-specialist) radiologists.

Recruiting into Radiography is not as challenging as Radiology; training has a shorter time-span and a career pathway has been in place for some time where opportunities exist to develop radiographer roles and improve skill mix to include some reporting, with subsequent benefits to the service such as reducing demands on Radiologists.

Survey responses for service in primary roles less than four years suggest almost four times as many females than males were recruited in the last four years (three male, 11

[3] Information and figure taken from the General Medical Council's State of Medical Education and Practice in the UK, 2011 and 2012.

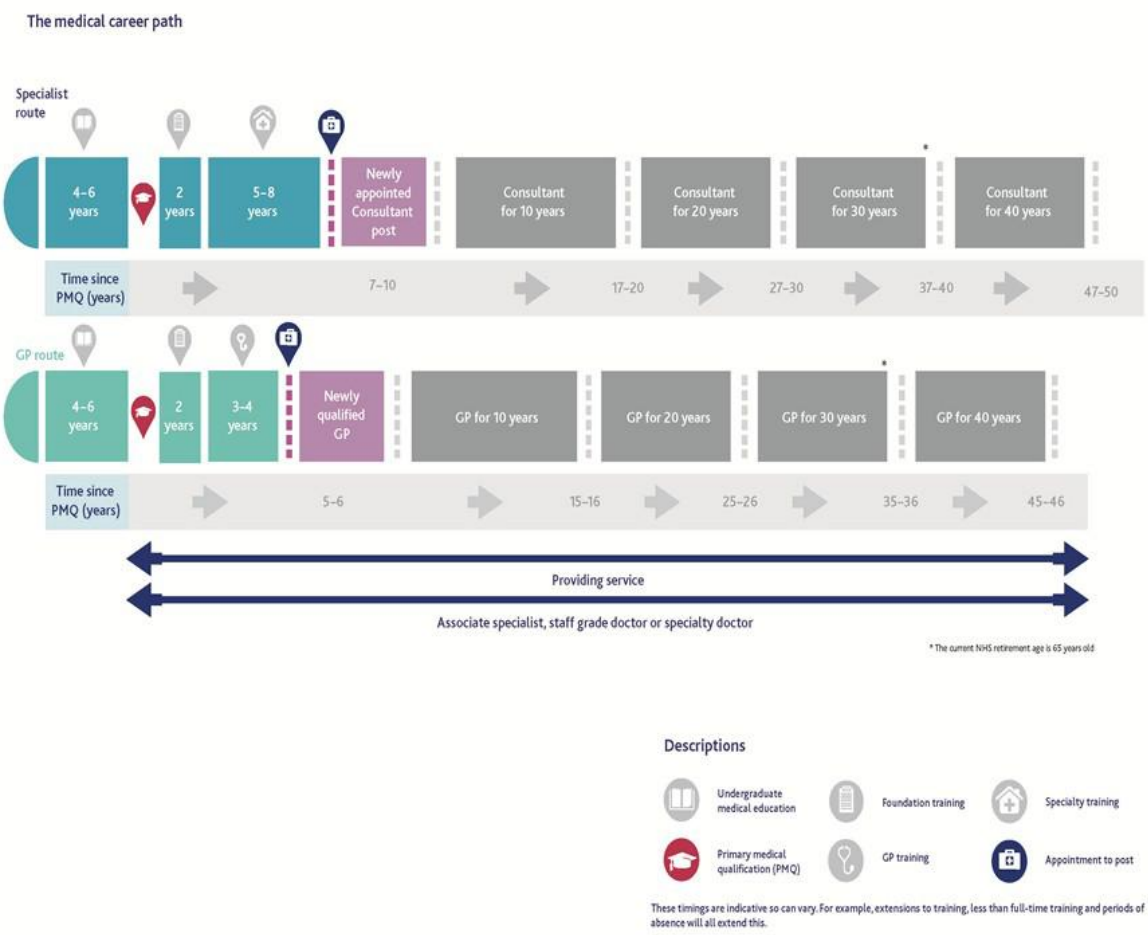


Figure 10: The UK Medical Career Path (General Medical Council, 2012 p.80)

female: 79% female). This correlates with the March 2014 published statistic of 79% NIHSC workforce being female. Analysing the survey's raw data on service length also reveals that seven of the 14 respondents were in the 30-39 group and five in the 40-49 age group, again suggestive of long lead-in periods for these roles.

MRCN has identified up to 22 vacancies in Radiology in NI, a number of which are long term. The impact of vacancies is a reduction in capacity and an increase in diagnostic waiting times however some are being addressed by commissioning services from the independent sector with a consequent burden on funds. The survey asked participants to rate the importance of extending reporting (i.e. formal sign off of a reported image) to specially trained radiographers to which eight consultants recorded *not very important* or *not important at all*. This appears to be inconsistent as evidence suggests that increasing workforce skills through role extension would be an important factor in

reducing diagnostic waiting times; this anomaly may be attributed to cultural resistance to change. The survey also asked respondents the effect that pay scale exerts on recruitment; there were five *not very important* responses, however anecdotal evidence suggests parity with pay-scales in England would benefit recruitment in NI, though confirming evidence was not obtainable.

Initial explorative and anecdotal fieldwork suggested a silo mentality was prevalent amongst HSC services; this was the rationale behind expanding question seven about primary workplace location to ask if respondents worked between Trusts. The response that 17 (31%) people did so provided some satisfaction and encouragement that positive partnership working could be the driving force taking forward recommendations and outcomes from the RMIR.

One interesting comment suggested *"the study should look at outcomes for each service and highlight excellence."* This suggests sharing good practice would improve services and would be a suitable study for the RMIR Workforce workstream to take forward.

Other comments relating to workforce issues include job roles, skill mix and training, in addition to general workforce recruitment constraints to delivering a quality service. Comments relating to specific specialties such as Interventional Radiology, Paediatrics and GP access are being evaluated by the RMIR and MRCN.

ITC and COMMUNICATION

Almost half of all comments related to the current situation with NIPACS and the anticipated benefits when full regional integration is achieved. These include the provision of 24/7 on-call and regional availability of radiology services, which is expected to be attainable through ITC systems such as NIPACS and the new Electronic Care Record (ECR) which is expected to be implemented during 2015/16.

NIPACS is well on its way to being province-wide with only two hospitals in Belfast not integrated into the regional system. However the impact of having three different systems is hampering the smooth transition to regional NIPACS, and anecdotally this is particularly difficult for the regional centres. An integrated regional system should

improve throughput, leading to improved waiting times for diagnosis and treatment, reducing clinical risk and improving patient safety, with a subsequent improvement in quality of service.

With regard to quality within planned, routine or follow-up examinations for patients attending imaging services, there is a question as to whether a case exists for central (regional) booking whereby patients can access their nearest imaging service which is then reported by a radiologist, possibly at a different location, and accessed by the referrer, all via NIPACS. Knowledge of appropriate examination is essential for safe and effective delivery of imaging services and currently it is not clear how this could be achieved.

Further examination of the nine respondents who selected *not very important* for the importance of teleradiology revealed that eight were consultants, which was surprising considering the role of teleradiology in communication and NIPECS enabling diagnostic availability 24/7. This is emphasised by the global demand for imaging services seeming to be growing faster than the number of radiologists in training. Anecdotal evidence had suggested that some European countries such as Holland are experiencing difficulty in placing Radiology graduates, however further exploration found no corroboration, though appraising recruitment cycles, Deaneries and markets within the EEU may provide a favourable return for NI Radiology recruitment.

It was interesting that one quarter of respondents rated the importance of workstation setting as *not very important.* Scrutinising the raw data revealed 10 of the 14 were consultants (71%), however when taking into account the fact that 70% of participants were consultants it could be deduced that this response follows the trend. Nonetheless previous research had shown that discrete workstations, or protected ‘reading rooms’, sheltered Radiologists from interruption can improve output; anecdotal conversations have conveyed how workstation setting can affect not only the number, but also the quality of reporting.

Due to the study results a SWOT analysis on NIPACS (Appendix G) demonstrated that a recommendation to implement regional NIPACS as soon as possible would resolve issues relating to reporting, diagnostic waiting times, access to imaging, system/workforce overload and sharing, and most importantly patient safety.

Coincidently the first paper submitted to the RMIR by the Radiology workstream also highlighted this as a recommendation.

PROTOCOLS and SAFETY

Most aspects of safety are well governed; all tests using ionising radiation are heavily regulated and must be clinically justified by a designated referrer. This is designed to contain over-use of ionising radiation per examination, but questions remain about exposure of individual patients who require frequent imaging to monitor progress, with oncology being a particularly high user of imaging techniques for staging cancers, guiding therapy, radiotherapy, biopsies etc. Where there are high cure rates there is late risk of cancer from diagnostic imaging, which has led in some instances (testicular cancer) to specialist follow-up protocols to limit the number of scans and reducing the area to be scanned significantly (input paper to RMIR).

The majority of the recommendations in the RQIA report into reporting arrangements for Radiological investigation (December 2011) are the responsibility of the HSCB as commissioner and the HSC Trusts as providers and will be taken forward through routine commissioning and governance arrangements, and business planning within HSC organisations. The MRCN has been established to take these forward locally and the DHSSPS will seek assurance on implementation through accountability arrangements and the RMIR.

Protocols and procedures were a recurrent theme for survey respondents. Protocols for imaging services are currently varied according to hospital or Trust operational procedures. However there is an overall deficiency of regional standards and guidance, indeed one of the recommendations of the RQIA investigation (2011) was to "*develop a strategy for the future provision of imaging service for Northern Ireland".*

Commissioning an accreditation system to take into account Royal College best practice agreements and provide reassurance of compliance with regulations may resolve this paucity of regional guidance. At present no accreditation system for imaging services exists in NI and both this study and the Radiology paper submitted to the RMIR recommended adoption of accreditation. Accreditation ensures that a series

of standards are maintained in relation to technical, professional and safety concerns, and is also a major contributor to quality of service

Accreditation also takes account of peoples' expectation of good healthcare and has an important role in setting standards and assessing performance. According to Radiology workstream input paper 1 "a*ccreditation is about improving how care is delivered to patients and the quality of care they receive and is not just about assessing quality but is a valuable tool for promoting and improving quality*." Sophisticated accreditation is a feature in many areas of healthcare in the UK, USA, Australia, Canada and New Zealand where accreditation schemes measure and evaluate quality and its management, focusing on patients and their pathways through the healthcare system. As of December 2014 16 services have achieved accreditation across England, 10 have signed contracts and a further 70 are at various stages of engagement. It is reported that the increasing use of accreditation across the UK has been driven by the Francis Report (2013). In Wales and Scotland imaging service accreditation is being negotiated at the highest level.

In terms of accountability and governance a regional accreditation scheme is likely be cost effective benefit by reducing the need for RQIA inspections of imaging departments. Although an accreditation scheme for imaging services would not have a whole system approach, i.e. the whole health service of NI, it has the potential to impact patient flow and delayed discharge issues by ensuring systems and procedures are in place to maximise the service therefore contributing to the improvement of the quality of the health and care system and, by definition, the quality of patient experience.

Survey comments included devising protocols for reporting incidental findings whilst reviewing and monitoring patients, with particular reference to CT scans in oncology; protocols for providing urgent information when a serious problem is found on a scan; and protocol for on-call urgent scans, all of which have elements of patient safety. Some of these issues can be directly linked to ICT and NIPACS and an ICT package known as 'results acknowledgement' is being piloted as a viable resolution, however unpredictable results for the survey question on reporting had eight participants (consultants) who felt structured protocol for reporting was *not very important*.

There were many comments on operational issues such as the effect of working towards extended working days and seven day reporting, scanning patients closer to

home to reduce unnecessary travel, better organising and management of imaging services across the region to reduce delays and waiting times. All of these are under discussion and consideration within several strategic policies currently in development and are therefore beyond the discussion of this study. However commissioners of services should make certain that appropriate imaging modalities for diagnosis, monitoring and follow-up is factored into the development of business cases; this includes considering equipment time/scans and clinical and non-clinical staff to deliver a quality service. This applies equally to commissioning new drugs, for example cancer drugs, where imaging plays an important role in staging disease and monitoring efficacy of treatment.

PATIENT EXPERIENCE

The results chapter explained how the scale for patient experience was changed to a hypothetical approach to accommodate the nature of the target audience. To provide a more accurate measure of patient experience further work is required. A patient representative for the PCC sits on the RMIR board and this presents an opportunity to engage with wider patient and user focus groups to gather patients' views.

Survey question nine about communication of results and language to patients to encourage understanding was rated as *not very important* by eight people and further analysis identified all eight were consultants, which may suggest patients are perceived as not having sufficient knowledge to assimilate the information offered at the consultation when delivering examination results. This is supported anecdotally when patients are advised to have a friend or relative accompany them when attending result consultations to ensure the message and advice is understood.

Composing the questions in the Patient Experience section was complicated because of the third person feature of the leading question and the use of 'softer' language in the 'functional experience' sub-section and it is acknowledged that participants may not have identified with the purpose and the language of this section because of their profession, suggestive by the spread of scores for the question on the importance of patient knowledge as a result of internet or media public awareness. Alternatively

participants may not have recognised that the question was asking for their views on how a patient might answer the question.

PERFORMANCE and BENCHMARKING

Many business and management theories imported from the private sector have been used to derive a performance based approach to delivering health and care. However in reality the NHS system is not a profit-making operation but a range of person-centred, safe and effective services where the use of targets and indicators is intended to measure quality and drive continuous improvement; this is sometimes misunderstood, for example underperformance in one area can be blamed by the efforts to meet targets in another.

Diagnostic services in NI are subject to targets and indicators on 16 selected diagnostic services, published quarterly in a statistical release. The 2014/15 Ministerial target detailed in the Commissioning Plan Direction states that:

> *"from April 2014, no patient should wait longer than nine weeks for a diagnostic test, and all urgent diagnostic tests are reported on within two days of being undertaken."*

The 2014/15 Ministerial indicators of performance (ref) measure:

> *"(i) percentage of routine diagnostic tests reported on within 2 weeks of the test being undertaken and (ii) percentage of routine diagnostic tests reported on within four weeks of the test being undertaken."*

The Northern Ireland Waiting Times Statistics report for quarter ending June 2014 reported that "*the quality of imaging waiting times and reporting times have improved in recent years."* The improvement may be due to targets and indicators, but equally may be a result of improved equipment and techniques or the NIPACS mechanism for managing imaging services allowing for more sophisticated datasets to be collected.

NHS England publishes statistics[4] for the percentage of tests that have been 'reported' on the same day as the examination. Over the period of one year figures show that patients undergoing ultrasound are more likely to have their examinations reported on the same day as the test (87-89%), whilst PET scan figures are much lower (7-12%). Variation between modalities is most likely due to the competence required for the tests and reports, with PET requiring highly qualified specialists whereas ultrasound is used by a wide range of health professionals. However the variation demonstrates the need for sound workforce planning for imaging services to include expertise, grade and skill mix.

It is not possible to directly compare statistics in NI with those in England due to divergence in modality and data collection, however examination of NI urgent turnaround reporting during the quarter ending September 2014 gives 36,257 urgent diagnostic tests reported on, of which 91.6% (33,207) were reported on within two days.

Ongoing technological advances have seen an increase in the use of imaging equipment over the last number of years and new techniques have subsequently led to a significant increase in the number of machines and examinations. Trends in the more common imaging modalities in NI can more easily be demonstrated in Figure 10 overleaf.

OTHER

Towards the end of the survey two related questions with subtle variation asked participants to rate which dimension is most in need of quality improvement and which is most likely to benefit from the RMIR. By far the most popular response to both questions was workforce, demonstrating the need to address the problems within this dimension. However it should also be noted that all four dimensions, being fundamental principles of quality, have an impact on all health and care services and expectations for improvement are progressive and relentless.

Other high level health strategies currently hold priority for government in NI and many of them are inextricably linked to medical imaging. These include the Unscheduled Care

[4] *Diagnostic Imaging Dataset Statistical Release*

Task Force established to focus on compliance with Ministerial four and twelve hour A&E targets with policy under development for unscheduled care across the Province; Transforming Your Care which is the long term plan for modernising health and care into the future; the eHealth and Care Strategy which expects to redesign services to better meet the needs of the individual, focusing on improving health and wealth through the use of information and communication technology and other strategies including cross border work such as the Paediatric Children's Cardiac Services which is an emotive subject often subject to media interest.

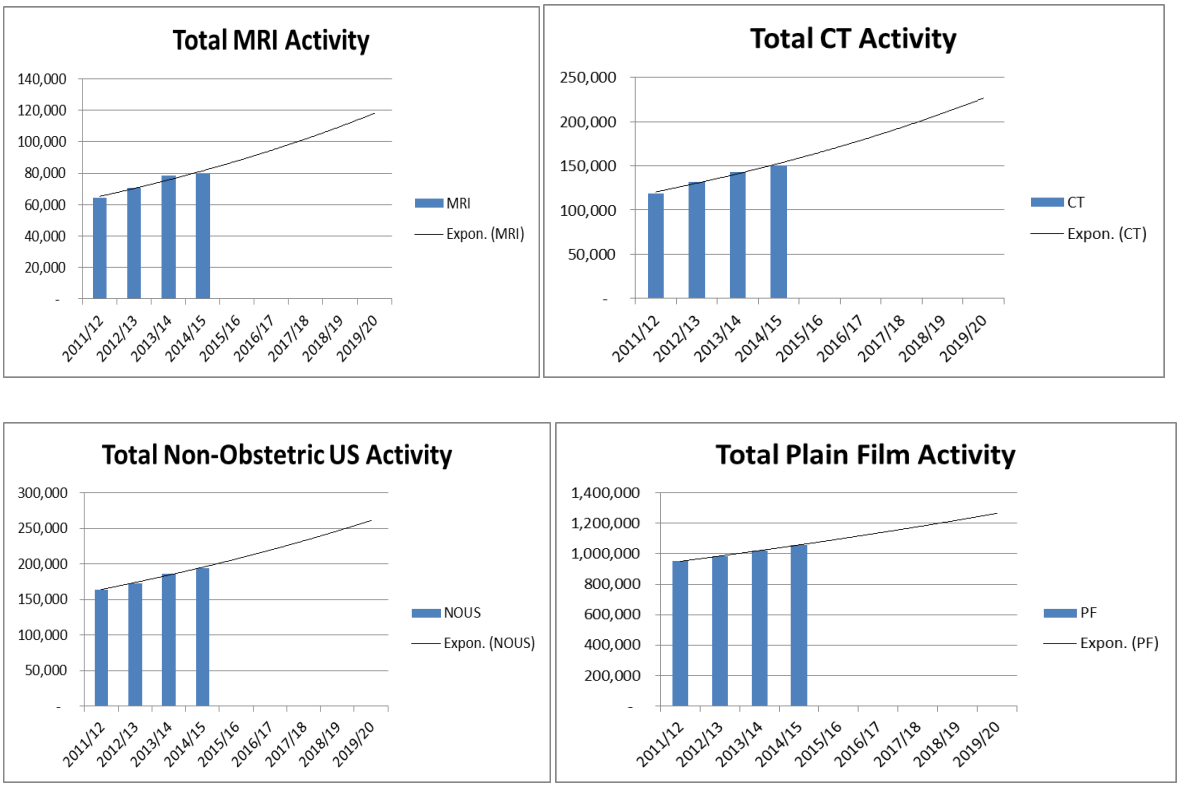


Figure 11: Activity Trends in NI (Source RMIR paper 1 of 4: Context by Dr R McNally, J Robinson & M Wright)

Chapter 5

Conclusion

Healthcare has medical, social, ethical, business, financial and political implications. Safety and quality are global themes sustaining healthcare systems and NI equally has strategic policies to manage and govern on many levels, for example patient flow is reliant on imaging services for diagnosis and monitoring, hospital admission and discharge, with some being subject to specific Ministerial targets.

The purpose of this investigation was to establish the determinants of quality in medical imaging services for NI. Reviewing the literature helped to identify four dimensions, safety, communication, workforce and patient experience. These were tested by semi-structured interviews and surveys. A SWOT analysis examined a specific component of communications and a PESTLE analysis verified membership of the focus group.

This study shows that safety, communication and workforce are either well regulated or being accounted for in the Departmental review (RMIR); this research has independently gathered similar findings as the Radiology workstream, e.g. the value of accreditation and increasing skill mix via training.

Extended working practices are defining modern healthcare and tackling cultural change should be prioritised to reduce constraints to service modernisation and multi-skilled teamwork that have the potential to improve patient safety and patient outcome. To provide a service which is responsive to need and is resilient for the future skill mix should be addressed; vacancies are creating a need for incentives to attract trainees and up-skill the existing workforce. In addition ensuring imaging requirements are factored in when planning new services or drug availability should be highlighted when policy is being developed.

This study has explored patient experience and expectations, albeit from a professional viewpoint and a specific output is a recommendation to directly measure patient opinion on the quality of imaging services by an external organisation such as the Patient Client Council. This work should then be incorporated into the development of the framework document which will provide strategic direction for imaging services.

Finally the survey and subsequent interaction with professionals has focused minds from a range of disciplines and services on the importance of a quality imaging service and has created an appetite and impetus to improve quality by developing a framework document to guide the future of the service. It is acknowledged that further work is required however the study has been effective in identifying the determinants of quality in medical imaging services.

Abbreviations

AHP	Allied Health Professional
CPD	Continual Professional Development
CT	Computed Tomography
DHSSPS	Department of Health, Social Services and Public Safety
DoH	Department of Health (England)
ECR	Electronic Care Record
ED	Emergency department (formally known as A&E)
HSC	Health and Social Care
HSCB	Health and Social Care Board
ITC	Information, Technology and Communication
MDT	Multi-disciplinary teams
MRCN	Managed Radiology Clinical Network
MRI	Magnetic Resonance Imaging
NI	Northern Ireland
NIPACS	Northern Ireland picture archiving and communication systems
PACS	picture archiving and communication systems
PCC	Patient and Client Council
PHA	Public Health Agency
RCR	Royal College of Radiologists
RIS	Radiology information system
RMIR	Regional Medical Imaging Review
RQIA	Regulation and Quality Improvement Authority
TYC	Transforming Your Care
UCTG	Unscheduled Care Task Group

References

Basu, P.A., Ruiz-Wibbelsmann, J.A., Spielman, S.B., Van Dalsem, V.F., Rosenberg, J.K. and Glazer, G.M. (2011) Creating a Patient-Centred Imaging Service: Determining What Patients Want. *American Journal of Radiology:196:605-610*

Business Dictionary (2015) *Quality.* Available from: http://www.businessdictionary.com/definition/quality.html [Accessed January 2015]

Council of Europe (2000) *European Working Time Directive.* European Parliament (2000/34/EC)

Crosby, P. B. (1984) *'Quality Without Tears',* McGraw-Hill.

Donebadian, A. (1982) *Explorations in Quality Assessment and Monitoring. Vol II. The Criteria and Standards of Quality.* Michigan: Ann Arbor, Health Administration Press.

Doran, G. T. (1981) There's a S.M.A.R.T. way to write management's goals and objectives, Management *Review, Volume 70, Issue 11(AMA FORUM), pp. 35-36.*

Food and Agriculture Organisation of the United Nations (2015) *International Standards Organisation's definition of quality:* Available from: http://www.fao.org/docrep/w7295e/w7295e03.htm [January 2015]

General Medical Council (2012) *The State of Medical Education and Practice in the UK* London. General Medical Council

Grant, L., Appleby, J., Griffin, N., Adam, A., and Gishen, P. (2012) Facing the Future: the effects of the impending financila drought on NHS finances and how UK radiology services can contribute to expected efficiency savings. *The British Journal of Radiology, 85, 784-791*

Greaves, C., Gilmore, J., Bernhardt, L. and Ross, L. (2013) Reducing imaging waiting times: enhanced roles and service-redesign. *International Journal of Health Care Quality Assurance 26 (3), 195-202*

Greenaway, D. (2013) *The Shape of Training: Securing the Future of Excellent Patient Care, Annex D, Theme 2.* General Medical Council.

Groocock, J. M., (1986) The Chain of Quality. New York: John Wiley & Sons.

Health and Social Care Board (2013) *Transforming Your Care: Vision to Action*. Belfast: Health and Social Care Board [September 2014]

Health and Social Care eHealth and Care: *Information for better care.* Belfast: Health and Social Care Board. Available from: http://www.ehealthandcare.hscni.net [January 1015]

Horn, R. (2010) *Researching & Writing Dissertations.* London: CIPD.

Information Standards Board for Health and Social Care (2012) *National Cancer Waiting Times Monitoring Dataset Specification.* London: Crown Copyright, ISB 0147 Amd 23/2011.

Juran, J.M. (1986) 'The Quality Trilogy', *Quality Progress,* Vol 19, No 8, pp. 19-24.

Khan, S.H.M. and Hedges, W.P. (2013) Workload of consultant radiologists in a large DGH and how it compares to international benchmarks. *Clinical Radiology,* 68, e239-e244.

Kuzmat, P. A. D. R. (2000) The Use of Digital Imaging and Communication in Medicine (DICOM) in the Integration of Imaging into the Electronic Patient Record at the Department of Veteran Affairs. *Journal of Digital Imaging,* 13, (No 2, Suppl 1 (May)), pp. 133-137.

Maxwell, R.J. (1992) *Dimensions of Quality Revisited: from thought to action*. Quality in Health Care (1) pp. 171-177.

Mid Staffordshire NHS Foundation Trust (2013) *Report of the Mid Staffordshire NHS Foundation Trust Public Inquiry*: Crown Copyright.

NHS Modernisation Agency, Service Improvement Team (2003) *Radiology: A National Framework for Service Improvement.* NHS Modernisation Agency. Available from: www.modern.nhs.uk/radiology. [September 2014]

NHS England (2014) *Diagnostic imaging Dataset:* Available from: http://www.england.nhs.uk/statistics/statistical-work-areas/diagnostic-imaging-dataset/ [December 2014]

nidirect (2014) *Health minister announces new model for delivery of paediatric congenital cardiac services (PCCS).* Belfast: Crown Copyright. Available from: http://www.northernireland.gov.uk/news-dhssps-141014-health-minister-announces [January 2015]

Northern Ireland. Department of Health, Social Services and Public Safety (2013) *Departmental business plan 2011-15: Revised milestones for 2013/14 focal year.* Belfast: Department of Health, Social Services and Public Safety.

Northern Ireland. Department of Health, Social Services and Public Safety (2014) *The Health and Social Care (Commissioning Plan) Direction (Northern Ireland) 2014.* Belfast: Department of Health, Social Services and Public Safety.

Northern Ireland. Department of Health, Social Services and Public Safety (2014) Review of Imaging Services: *Radiology Workstream: Paper 1 of 4 – Current Context: 8 October 2014.* Belfast: Department of Health, Social Services and Public Safety.

Northern Ireland. Department of Health, Social Services and Public Safety (2014) *The Health and Social Care (Indicators of Performance) Direction (Northern Ireland) 2014.* Belfast: Department of Health, Social Services and Public Safety.

Northern Ireland Health and Social Care Workforce Census (2014) Available from: http://www.dhsspsni.gov.uk/index/statistics/workforce.htm

Parasuraman-A; Berry-Leonard-L; Zeithaml-Valarie-A (1991) "Understanding Customer Expectations of Service," *Sloan Management Review*, 32(Spring), 3, 39-48.

Regulation and Quality Improvement Authority (2011) *An Independent Review of Reporting Arrangements for Radiological Investigations: Phase 1 Overview Report,* March 2011. Belfast: The Regulation and Quality Improvement Authority.

Regulation and Quality Improvement Authority (2011) *An Independent Review of Reporting Arrangements for Radiological Investigations: Phase 2 Report, December 2011*. Belfast: The Regulation and Quality Improvement Authority.

Royal College of Radiologists (2006) *Standards for Reporting and Interpretation of Imaging Investigations.* London: The Royal College of Radiologists.

Royal College of Radiologists (2008) Board of the Faculty of Clinical Radiology, Clinical radiology annual census 2008. London: Royal College of Radiologists.

Royal College of Radiologists (2014) *Patients waiting too long for test results*. Available from: http://www.rcr.ac.uk/docs/newsroom/pdf/Backlog_survey_press_release_FINAL.pdf [November 2014]

Seagull, F and Nagle, P (2010) Don't Ignore the "Process" to Quality Improvement. *American College of Radiology*. August 2010 Volume 7, Issue 8, Pages 644–645

Sloper, T.A., and Katanick, S. (2011) *IAC Accreditation: Setting the Standard of Care in Daignostic Imaging*. Ellicott City. Greenbranch Publishing LLC.

Sutton, L. N. (2011) PACS and diagnostic imaging service delivery – A UK perspective. *European Journal of Radiology.* 78, 243-249.

The Scottish Government (2013) HEAT Standard: Cancer Waiting Times, The Scottish Government. Available from: http://www.scotland.gov.uk/About/Performance/scotPerforms/partnerstories/NHSScotlandperformance/CancerwaitingtimesStandardcancer

Trusko B, P. C. H. J. G. P., 2007 *Improving healthcare quality and cost with Six Sigma.* Indianapolis: FT Press.

United Kingdom. Audit Commission (2002) *Radiology: review of national findings.* London: Audit Commission.

Upponi, S. and Shaw, S. (2010) Radiology Provision in the United Kingdom: An Overview. *Journal of American College of Radiology*. 7, 565-572.

Wong, J., 2002. Service quality measurement in a medical imaging department. *International Journal of Health Care Quality Assurance,* 15(4/5), pp. 206-212.

Appendices

Appendix A Radiological and non-radiological Imaging Modalities

Medical imaging techniques are used to diagnose, monitor and treat disease and are critical processes for both clinical and research purposes. Modalities scope across radiology and non-radiology techniques.

It should be noted that many diagnostic and interventional imaging modalities are adjunctive and/or dependant on one other and are therefore difficult to categorise to non-radiology or radiology; for example '*magnetic resonance image-guided transcutaneous focused ultrasound ablation for uterine fibroids'* (interventional procedure guidance IPG231) uses two modalities – MRI and ultrasound - and it is not unusual for more than one technique to be operational in a particular procedure.

SECTION 1

Radiology techniques

X-ray – plain film or film-screen (radiograph) uses ionising radiation and is the most commonly known imaging technique; for most of the 20th Century it was the only imaging technique available. Film-screen radiography is being replaced by digital radiography (DR) with an image displayed on a computer screen rather than plain film. X-ray is still considered the best option for diagnosing some forms of arthritis, pneumonia, bone tumours and fractures, and skeletal anomalies.

Fluoroscopy - a special application of x-ray where radio-contrast agents are administered orally or by injection to demonstrate dynamic processes such as blood vessel anatomy and function, the genitourinary system and the gastrointestinal tract.

Dual-energy X-ray absorptiometry (**DEXA**) – uses x-ray beams with different energy levels to measure bone mineral density. It is a technology used to diagnose and monitor

osteoporosis and can also be used to measure total body composition and fat content, although this application is controversial and subject to debate.

Mammography - is low energy x-ray of the breast often used to screen for breast cancer and for other diagnostic or follow-up studies. Historical plain film is being replaced by full field digital imaging (FFDM) and newer modalities include breast MRI and breast tomosynthesis examination.

Interventional radiology (IR) – is a minimally invasive technique commonly used for diagnosis and treatment of vascular disease, tube placement, stents, biopsies etc where imaging techniques are used to guide needles and catheters to the site. Sometimes diagnosis and treatment is simultaneous and IR is known to reduce infection, maximise recovery and reduce bed stays, with many patients attending day procedure units. NICE produces interventional guidance based on safety and efficacy, however cost or cost-effectiveness is not considered.

Computed tomography (CT) – uses x-rays and computing algorithms to produce a cross-sectional image (tomogram), often using radio-contrast agents to enhance anatomical differentiation from which multi-planar and 3-D images can be created. CT is the preferred option for urgent and emerging conditions such as cerebral hemorrhage, pulmonary embolism, aortic dissection appendicitis, diverticulitis and obstructing kidney stones. It should be noted that although CT is more sensitive to variation and can produce more detailed images in a short time, patients are exposed to more ionising radiation with CT than radiographs; a fact that patients are often not aware of.

Ultrasonography – uses high frequency sound waves to produce multi-planar and 3-D images of soft tissue structures. The technique does not use ionising radiation and is therefore considered a safer option, being the modality of choice for monitoring foetal development. It is also commonly used for cardiology examination, however the modality has limitations; the physique of the patient is an important factor in image quality, with obesity reducing quality because of the action of fatty tissue absorbing sound waves, and the inability to image through bone and air, e.g. lungs and bowel loops.

Magnetic resonance imaging (MRI) – does not use ionizing radiation but instead uses strong magnetic fields, radio signals and computing algorithms to produce multi-planar and 3-D images and gives the best soft tissue contrast. MRI is widely used and has become an important tool for examining the musculoskeletal system and neurological diagnostics. The magnetic field system means that care must be taken for patients who have metal containing implants such as pacemakers, cochlear implants, medication pumps or other hardware, however many of these limitations are being overcome with modern design.

Areas of potential advancement include **functional imaging, cardiovascular MRI, and MRI-guided therapy.**

Nuclear medicine – uses radioactive tracer labelled substances administered to the patient that target specific body tissue, to measure and evaluate heart, lungs, thyroid, liver, gallbladder and bone physiological function. The tracer is detected by a gamma camera and processed to produce a multi-planar image known as SPECT (single-photon emission computed tomography).

To improve diagnostic accuracy these images can be fused with a CT scan taken almost simultaneously, however this is only available in the most modern machines.

Positron emission tomography (PET) – is also a nuclear medicine imaging technique using positrons to improve resolution. The patient is injected with a radioactive, biological substance which concentrates in metabolically active tissue such as cancer tumours and the detected radiation emitted is collected to produce multi-planar and 3-D images. PET can be combined/fused with CT (PET/CT) to improve diagnostic accuracy and fusion technology has led to PET/MRI fusion which is currently used in academic and research settings, but has the potential to play a vital role in medical imaging for brain, breast cancer screening and small joint imaging of the foot.

Teleradiology – transmission of (digital) medical images for interpretation and reporting via internet connections and is often used for 24hour cover of emergency departments, intensive care units and expert specialty interpretation of complicated or unusual or cases. Expensive high quality sending and receiving stations are required, but the advantages of having a 24hr service may outweigh the high costs involved.

SECTION 2

Non-radiological techniques

Endoscopy – is a rigid or flexible tube incorporating a light and/or a camera which is inserted directly into an organ or cavity for examination, unlike other most other medical imaging devices. Often a second channel for holding an instrument to allow treatment such as cauterising, taking biopsies or removing foreign objects is present. Endoscopy is widely used for many applications including gastrointestinal, respiratory, urinary, female reproductive and other tracts and systems. It is also used in plastic and orthopaedic surgery and is often referred to as 'keyhole surgery' and can be used in conjunction with other imaging modalities.

More recent developments have included the use of tele-surgery, in which the surgeon can be in a different location than the patient and operating a robotic system, disposable endoscopy which reduces the risk of infection, 'capsule endoscopy' which uses a magnetically guided capsule endoscope (MGCE) to wirelessly control, monitor and image, and wireless oesophageal ph measuring devices inserted using endoscopes. In addition images can be combined with other image techniques to assist surgeons with treatment, for example a tumour structure can be shown in the endoscopic video during procedure. Studies on collecting 3-D data for accurate measuring of internal geometries are currently being researched.

Elastography – an emerging imaging modality used to map the elastic properties of soft tissue. It includes ultrasound elasticity imaging (UEI) which is further divided into 'transient elastography' used in liver assessment, 'strain imaging' used in breast examination, 'acoustic radiation force impulse (ARFI)' to characterise liver rigidity and 'supersonic shear imaging' used for breast, thyroid, liver, prostate and musculoskeletal imaging. Other modalities are magnetic resonance elasticity (MRE) imaging for soft tissue measurement and tactile imaging which translates the sense of touch into digital images for prostate, breast, vagina and pelvic floor support structures and myofascial trigger points in muscle.

Thermography/thermology/infrared imaging – in medicine thermology is a diagnostic tool which uses highly sensitive cameras operating at near-infrared wavelength/light to

produce images of body areas that have irregular blood flow and is often used by sport doctors to determine areas that have inflammation. Thermography can be used to assess burn wound depth and healing potential (NICE MTG2).

Optical coherence tomography (OCT) uses near-infrared light to produce real-time, high-resolution, cross-sectional imaging of tissue microstructure and is used to guide biopsy and surgery, and in post-treatment surveillance in various clinical applications, for example as an adjunct to colposcopy. It can be used in ophthalmology and interventional cardiology to help diagnose artery disease.

Most recently, NICE has developed guidance (IPG 481, Feb 2014) on the safety and efficacy of OCT for two indications: (i) to assess stenotic lesions in the coronary arteries and to image the result of stent deployment during percutaneous coronary interventions and (ii) to provide additional and complementary information to coronary angiography immediately before angioplasty. NICE interventional procedures guidance makes recommendations on the safety and efficacy of the procedure and does not cover funding issues.

Other techniques which are not strictly imaging techniques because they do not produce an 'image' **can** also be considered as forms of medical imaging because of the parameters used to produce **'maps'** or graphs that aid diagnosis.

Echocardiography (ECG) – uses ultrasound to image the heart via 2-D, 3-D and Doppler imaging to visualise blood flow and is considered safe for patients of all ages and is therefore widely used for many diagnostic and monitoring purposes. The equipment used for ECG is portable and is one of the most commonly used imaging modalities worldwide.

Electroencephalography (EEG) – records electrical activity along the scalp by measuring voltage fluctuations that result from ionic current flows within the neurons of the brain. In neurology the main diagnostic application is for epilepsy however it is also used to diagnose abnormal changes in body chemistry that affect the brain, Alzheimer's disease, confusion, head injuries, infections and tumours. It can also evaluate sleep disorders, investigate periods of unconsciousness and monitor the brain during brain surgery.

Magnetoencephalography (MEG) – maps brain activity by recording magnetic fields produced by naturally occurring electrical currents. The technique can be used in conjunction with other modalities such as PET, EEG, and MRI as an advanced non-invasive technology for diagnosing and treating brain disorders such as epilepsy. MEG is also a research tool for brain activity measurement, to pinpoint sources in primary auditory, somatosensory and motor areas, and combined with functional MRI (fMRI) creates functional maps of the human cortex during complex cognitive tasks. Recent studies have been successful in distinguishing multiple sclerosis, Alzheimer's disease, schizophrenia, Sjögren's syndrome, chronic alcoholism and facial pain from healthy control subjects indicating a role in diagnostics in the future.

Imaging techniques that are less well known include:

Laser speckle contrast imaging (LSCI) – is a non-invasive tool used for dynamic imaging of blood flow which utilises laser speckle properties based on light absorption to measure flow rate. It is used mainly for research but has some clinical applications such as monitoring cerebral blood flow during neurosurgery and assessment of skin microvascular function. Limitations include penetration depth and poor depth resolution however the ability to directly assess cerebral flow velocities without the need for exogenous contrast agent is attractive.

Photoacoustic imaging – a hybrid biomedical imaging modality with non-ionising laser pulses being delivered to tissue, generating ultrasonic waves that are collected to form images. Recent studies have shown that photoacoustic imaging can be used for tumor (angiogenesis) monitoring, mapping blood oxygenation, functional brain imaging, and detecting melanomas.

Functional Near-Infrared Spectroscopy (fNIR or fNIRS) – is a relatively new non-invasive modality that measures brain activity via responses associated with neuron behaviour. The technique works on the same sensitivities as fMRI and both are comparative methods however fNIR is expensive and is more readily portable although it has limitations due to light emitter power.

Appendix B Radiology workforce data

The table below has been reproduced from a paper by a Japanese working group (Nakajima, 2008) and demonstrates Radiology workforce data from 27 different countries, with the ratio of Radiologists per million population having been provided by the Organisation for Economic Cooperation and Development (OECD) reference year of data is 2004. The term Radiologist does not distinguish grade, for example Consultant, or Registrar, or Trainee.

Table 1. Results of survey

	Units per million population				Radiologists			
Country	MR (2004)	*year	CT (2004)	*year	Radiologists	Radiologists per million population (2004)	*year	Reference No.
Australia	3.7		20.8	*95	1 300	64		11
Austria	14.9		28.5		920	113		12
Belgium	6.8	*03	29.8	*03	1 467	141		12
Canada	4.9		10.8		1 910	60		13
Czech Rep.	2.8		12.6		1 300	127		12
Denmark	10.2		14.6		1 050	194		12
Finland	14.0		14.2		718	137	*02	9
France	3.2		7.5		7 500	125		12
Germany	6.6		15.4		5 000	61		12
Greece	2.3	*02	17.1	*02	2 500	226		12
Hungary	2.6		6.8		1 200	119		12
Iceland	20.5		17.1		36	123	*02	9
Ireland	—		4.3	*90	180	45		12
Italy	10.2		20.6		9 000	156		12
Japan	35.3	*02	92.6	*02	4 598	36	*06	10
Korea	11.0		31.5		2 626	55	*03	14
Luxembourg	11.1		28.8		45	100	*02	9
Netherlands	—		9.0	*93	1 000	61		12
Poland	1.9		6.9		3 000	79		12
Portugal	3.9	*03	12.8	*03	1 000	95		12
Slovakia	2.0	*03	8.7	*03	380	71		12
Spain	7.7		13.3		3 500	82		12
Sweden	—		14.2	*99	1 200	133		12
Switzerland	14.3		17.9		670	91		12
United Kingdom	5.0		7.0		2 161	36		12
United States	26.6		32.2		28 000	95		15

MR, magnetic resonance; CT, computed tomography; OECD, Organisation for Economic Cooperation and Development
Reference year of data is 2004, except for those shown with *

The following table has been reproduced from a report by the Royal College of Radiologists (2012) and demonstrates Radiology workforce data across the four UK countries. This data is specific to Consultant Clinical Radiologists and shows NI as being in the strongest position with 60 Consultants per million population. The UK total is 47 per million.

Table 14. WTE consultant clinical radiologists per 100,000 across UK, 2012[1,3]

Region/country	WTEs	Population[a]	WTEs per 100,000 population
England – East Midlands	166	4,410,612	3.8
England – East	222	5,787,144	3.8
England – London	466	7,832,487	6.0
England – North East	122	2,600,233	4.7
England – North West	354	6,962,848	5.1
England – South Central	183	4,112,460	4.5
England – South East Coast	160	4,347,587	3.7
England – South West	260	5,221,895	5.0
England – West Midlands	251	5,445,991	4.6
England – Yorks & Humber	259	5,289,015	4.9
Northern Ireland	109	1,823,600	6.0
Scotland	302	5,313,600	5.7
Wales	142	3,074,100	4.6
UK total	2,997	63,705,000	4.7

a. The most recently published population figures at region level pre-date those at country level, therefore the sum of populations may not equal the UK total.

Appendix C Semi-constructive questions for site visits to imaging departments

Category overlap key: Safety = S; Communication = C; Workforce = W; Patient experience = P. Some categories overlap into other categories. Where this happens column 2 labelled “Overlap” demonstrates where the overlap lies using the key.

SAFETY			
No	**Overlap**	**Question**	**Response**
1		What standards are worked to? (professional, regulatory) Are any accredited programmes specifically relevant?	
2	W, P	How does the imaging department decide on the number of patients?	
3		Who / how is the number of scan iterations per patient/diagnosis decided?	
4		How many machines are there and is there any difference in the usage, e.g. is any equipment set aside for ED or other specialty use only?	
5		What is the population/equipment ratio for this region/ hospital? Is it within national best practice?	
6	W, P	How many patients are seen in a typical day, categorised to ED, in-patient, GP and research?	
7		What happens when a critical machine breaks down?	
8	C	Who decides equipment replacement and what is the procurement process?	
9		Who scopes the specifications and business cases for new equipment? Are all stakeholders involved in the scoping exercise? Are the stakeholders qualified to make decisions about equipment specifications?	
10		Are new technologies considered when scoping new equipment?	

11	C, W	Is there awareness of the NICE Diagnostics Assessment Programme and the accredited Medical Technologies Advisory Committee (MTAC) methods guides? (dg1 – dg11 have been issued).	
COMMUNICATION			
12	W	Do staff liaise with other departments / organisations / community other than booking scans? E.g. Multi-professional meetings, senior department meetings, etc .	
13		Do staff in this imaging department know their role in the patient pathway?	
14		When did NIPACS go live in this imaging department? Is it having a negative or positive impact on service?	
15		Do any staff report from home?	
WORKFORCE			
16	S, P	What are the operating hours? Is the department 24/7? Is it likely to be or does it have the capacity in respect of patient numbers etc?	
17	S	What workforce is required for service delivery in this imaging department? Is it being maintained?	
18	S	What are the grade levels in this imaging dept. Is there any evidence of radiology as a career path?	
19	C, S	Do any radiographers report in the absence of radiologists? Should there be role extensions? Who would backfill?	

20	S, C, P	If there were an opportunity to improve the service, for example if there were dedicated diagnostic imaging hubs, how would moving/working across sites be regarded? How would a shared service be regarded?	
PATIENT EXPERIENCE			
21	S, C, W	How is priority determined?	
22	W	Is the location of the facility convenient for all users?	
23		Is the physical environment of this facility comfortable for patients?	
24		Is there any evidence that this imaging department is a rate determining step for any of the patient routes, e.g. in-patient, ED, GP processes?	
25		Has a process map of the imaging department ever been carried out?	
26		Where is this imaging department in terms of location within the facility/hospital, how old is the facility/hospital?	
OTHER			
27		What are the issues in this particular imaging department, e.g. maternity cover, succession planning etc.	
28		What are the barriers to providing the department's vision of the best service? Locally and regionally.	
29		Are there any risks associated with these issues and barriers, i.e. doing or not doing something about them?	
30		Does the imaging department have a quality officer? If not does the hospital or Trust?	

Appendix D Radiology Workstream questionnaire

Q1: Is the current method of commissioning fit for purpose?

Q2: Should tariff / cost & volume based methods be considered?

Q3: Are we reporting examinations that do not need a report?

Q4: How do we quality-assure Trust and external reporting?

Q5: How are Trusts dealing with sub-specialist radiology?

Q6: Are support specialist networks in place?

Q7: Can someone else report without impact in quality and safety?

Q8: Why is growth continuing? Are there examples of referral control through education of referrers?

Q9: Are we performing too many examinations and can it be controlled?

Q10: Are we not performing enough examinations or not performing them quickly enough?

Q11: Are the time-based targets correct and do they reflect what a quality service would deliver?

Q12: What will be the level of demand in 2 years, 5 years and 10 years?

Q13: Is there sharing of learning between Trusts?

Q14: Are we sure we have safe systems and processes?

Q15: Is there a need for planned audit across the region?

Q16: How are we using PACS? Locally, across Trusts and regionally?

Q17: Is PACS working optimally? What are the frustrations and opportunities for improvement?

Q18: Are there specific issues to having different PACS systems?

Q19: Are there examples of cross-Trust co-operation?

Q20: What has changed to accommodate TYC?

Q21: What has been the impact of TYC?

Q22: What is the present level of direct access for GPs?

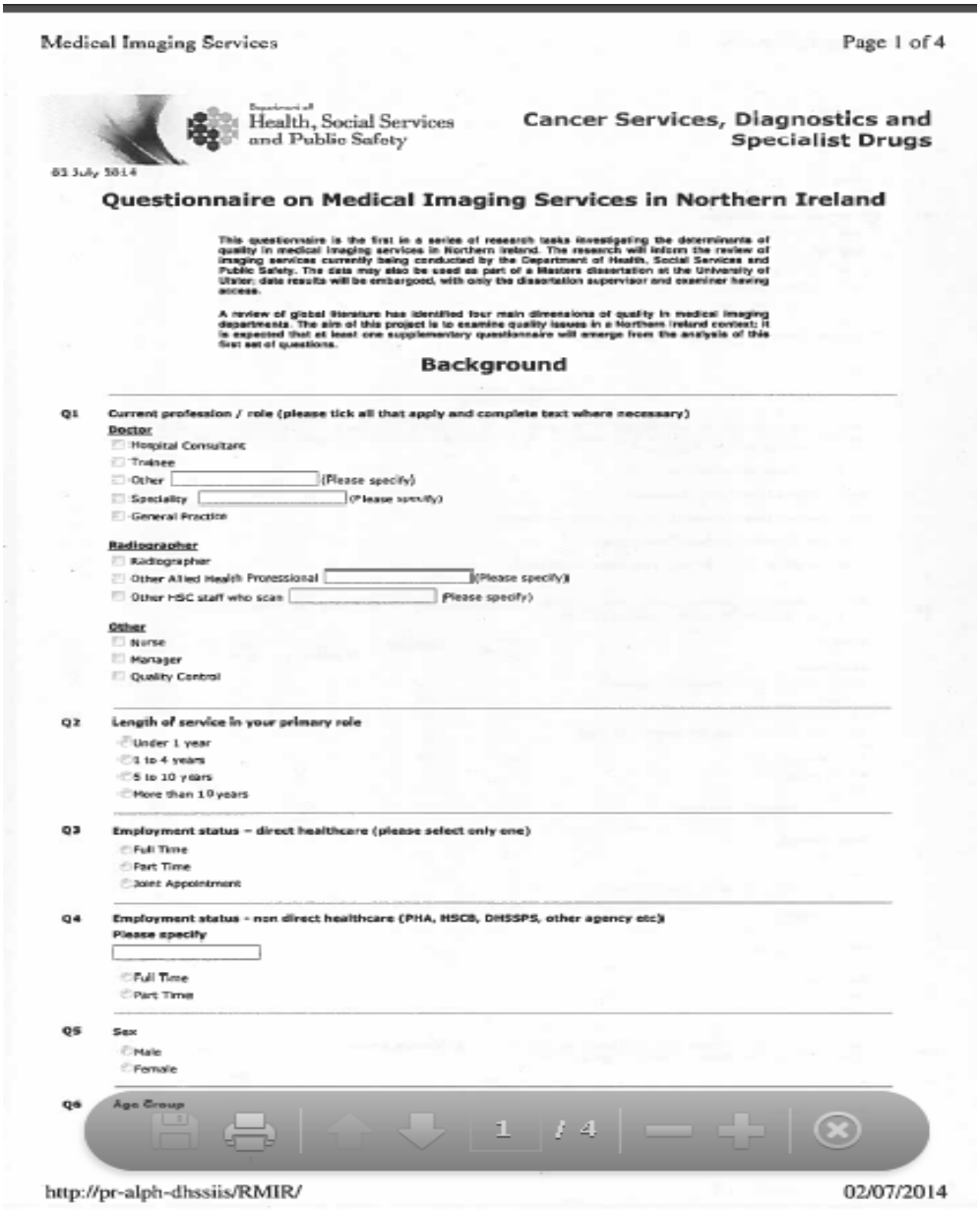
Q23: Have RQIA recommendations been satisfied?

Q24: What remains to be done?

Appendix E Online survey questions

The online survey was developed to gather the opinion of the members of the Regional Medical Imaging Review board (RMIR) from a professional perspective to baseline the perception of the quality of imaging services in NI and to confirm if the literature review had correctly identified the determinants of quality for imaging services.

Quantitative questions were a mix of numerical, categorical, multiple-choice and five-point Likert-scale types and a small number open ended questions to provide qualitative information were also included. The following four images (1-4) are an exact copy of the online survey hosted by the DHSSPS Extranet and information explaining the rationale behind each question can be found on the pages after image 4.



Medical Imaging Services Page 1 of 4

Department of Health, Social Services and Public Safety

Cancer Services, Diagnostics and Specialist Drugs

03 July 2014

Questionnaire on Medical Imaging Services in Northern Ireland

This questionnaire is the first in a series of research tasks investigating the determinants of quality in medical imaging services in Northern Ireland. The research will inform the review of imaging services currently being conducted by the Department of Health, Social Services and Public Safety. The data may also be used as part of a Masters dissertation at the University of Ulster; data results will be embargoed, with only the dissertation supervisor and examiner having access.

A review of global literature has identified four main dimensions of quality in medical imaging departments. The aim of this project is to examine quality issues in a Northern Ireland context; it is expected that at least one supplementary questionnaire will emerge from the analysis of this first set of questions.

Background

Q1 Current profession / role (please tick all that apply and complete text where necessary)

Doctor
- Hospital Consultant
- Trainee
- Other (Please specify)
- Speciality (Please specify)
- General Practice

Radiographer
- Radiographer
- Other Allied Health Professional (Please specify)
- Other HSC staff who scan (Please specify)

Other
- Nurse
- Manager
- Quality Control

Q2 Length of service in your primary role
- Under 1 year
- 1 to 4 years
- 5 to 10 years
- More than 10 years

Q3 Employment status – direct healthcare (please select only one)
- Full Time
- Part Time
- Joint Appointment

Q4 Employment status - non direct healthcare (PHA, HSCB, DHSSPS, other agency etc)
Please specify
- Full Time
- Part Time

Q5 Sex
- Male
- Female

Q6 Age Group

1 / 4

http://pr-alph-dhssiis/RMIR/ 02/07/2014

Image 1: *Covering explanation and questions 1 to 5 questionnaire of Medical Imaging Services in NI*

- 20 - 29
- 30 - 39
- 40 - 49
- 50 - 59
- Over 60

Q7 **Primary workplace location**

- Belfast HSC Trust
- Northern HSC Trust
- Southern HSC Trust
- South Eastern HSC Trust
- Western HSC Trust
- Other [ ] (Please Specify)

Do you work between the Trusts?

- Yes
- No

Quality

The next section is concerned with quality. For the purpose of this study four dimensions of quality in relation to imaging services have been identified: Safety, Communication, Workforce and Patient Experience. Please note a small amount of overlap exists between some categories.

The key components the four dimensions are:

Safety: Equipment; Best Practice; Regulation.

Communication: Data Processes (IT); Results & Language; Reporting.

Workforce: Recruitment; Education, Training & CPD.

Patient experience: Outcomes; Expectations; Functional experience.

Q8 The following section contains information about the components of **SAFETY**. Please indicate how you would rate their importance in relation to quality in imaging services.

SAFETY	Very Important	Important	Not Very Important	Not Important at all	Don't know
Equipment					
Modern Equipment (i.e. less than 5 years old)					
Throughput					
Replacement schedule					
Site/infrastructure - is the equipment in the best place					
Validation/calibration					
Accuracy/precision					
Accreditation					
Ratio of equipment to population					
Best Practice					
Standards					
Guidance					
Appropriate use - sufficient clinical information provided with request to justify the examination					
Timely reporting					
Accuracy of Reporting					
Reporting language					
Regulation					
Statutory					
Professional					

Q9 The following section contains information about the components of **COMMUNICATION**. Please indicate how you would rate their importance in relation to quality in imaging services.

COMMUNICATION	Very Important	Important	Not Very Important	Not Important at all	Don't know
Data processes					

Image 2: *Questions 5 to 8 of questionnaire on Medical Imaging Services in NI*

Storage					
Alerts					
Sharing					
Interpretation					
Standardisation					
Workstation setting (e.g. home, office, suite)					
Teleradiology					
Results & language					
Sufficient clinical information provided with imaging request to enable informed reports					
Professional to professional (familiar with the specialty language)					
Professional to professional (unfamiliar with the specialty language)					
Multidisciplinary meetings					
To patients – to encourage understanding					
Interpretation – report					
Reporting					
Protocol – structured reporting					
Protocol – pathway for imaging services					
Roles – knowing responsibilities within each step of the imaging pathway					
Receiver – requesting clinician responsibility to act on imaging report as soon as possible					
Supervision					
Time taken					

Q10 The following section contains information about the components of **WORKFORCE**. Please indicate how you would rate their importance in relation to quality in imaging services.

WORKFORCE	Very Important	Important	Not Very Important	Not Important at all	Don't know
Recruitment					
Workload – sufficient workforce to meet workload					
Succession planning					
Vacancies – filling of vacant posts					
Pay scales – the effect on recruiting into vacancies					
Roles & extensions – extending reporting to specially trained radiographers					
Movement across sites to extend imaging service					

Q11 The following section contains information about the components of **PATIENT EXPERIENCE**. Please indicate how you think the patients in your care would rate their importance in relation to quality in imaging services.

PATIENT EXPERIENCE	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
Outcomes					
Place of imaging in the patient pathway					
Diagnosis					
Treatment					
Accuracy					
Stress – anticipation of result/length of time taken to provide information/understanding of result					
Part of the decision making process					
Expectations					
Timely communication of results					
Diagnosis					
Sensitivity					
Waiting time – from referral by consultant to receiving appointment for imaging					
Waiting time – from image report to consultant examination					
Waiting time – for planned imaging referrals (e.g. follow up/monitoring imaging)					
Knowledge e.g. internet/media/public awareness					

Image 3: *Questions 9 to 11 of questionnaire on Medical Imaging Services in NI*

Functional Experience					
Hospital site location	○	○	○	○	○
Hospital site access	○	○	○	○	○
Location of imaging facility within the site	○	○	○	○	○
Comfort of imaging facility	○	○	○	○	○
Stress e.g. parking/length of wait in waiting room/returning to work following imaging appointment	○	○	○	○	○
Staff/patient relationship	○	○	○	○	○

Quality Improvement

Q12 Before being asked to complete this questionnaire were you aware of the current review of imaging services in Northern Ireland?

○ Yes ○ No

Q13 In relation to imaging services which of the four dimensions below do you think is most in need of quality improvement?

○ Safety ○ Communication ○ Workforce ○ Patient experience

Q14 Which of the four dimensions do you think is most likely to benefit from the current review of imaging services in Northern Ireland?

○ Safety ○ Communication ○ Workforce ○ Patient experience

Q15 In your current role how do you rate the imaging service in terms of quality?

	Excellent	Good	Satisfactory	Poor
Safety	○	○	○	○
Communication	○	○	○	○
Workforce	○	○	○	○
Patient experience	○	○	○	○

Q16 In relation to investigating the determinants of quality in imaging services, what other issues would you like to see included in this research study besides those already referred to in this questionnaire?

Q17 If you would like to see the results of this questionnaire please add your email address

Submit

Thank you for your time. If you have any queries about this survey please contact Helena Brown, Secondary Care Directorate, Room 1, Annex 1, Castle Buildings, Stormont. BT4 3SQ. Telephone: 028 905 21301

ITGroup, Annexe 5, Castle Buildings

***Image 4**: Part of question11 and questions 12 to 17 of questionnaire on Medical Imaging Services in NI*

Description of rationale behind survey questions

The questions were designed following interviews with a Consultant Radiologist and a hospital imaging department manager who advised on professional matters and who tested and guided on a number of revisions to the original design. In addition Statistician and IT colleagues advised on the format of questions (e.g. Likert-Scale, multiple choice etc), distribution issues such as access to Departmental web links and methods for collecting and analysing data.

The survey was targeted to very busy professionals where time constraints may have discouraged participation - therefore survey questions were designed to be short and quick to answer and participants were advised that it could be completed in 10 – 15 minutes.

Questions one to eight were designed to gather background information that could be used to measure trends or hypotheses for the remaining questions on the dimensions of quality as identified in the literature review.

Q 1 Multiple-choice and also semi open-ended because of the target audience and wide range of professionals expected to participate, especially the number of different grades of medics within the health service. This question intended to collect information that could be used to categorise the Quality sections.

Q2 Categorical and numerical because of the lead-in times for health service training, this question also indicates a certain level of expertise.

Q3 Categorical: to strengthen Q2 re direct hospital staff and also to establish if there is a link between females and part-time working practices.

Q4 Categorical: to identify respondents not directly involved with imaging through hospital work.

Q5 Categorical: gender to use for analyses if required.

Q6 Numerical: prior knowledge of the target audience and training lead-in times, this question was devised to apply to the dimensions of quality questions and test if age was a factor in responses, especially in relation to workforce issues such as vacancies.

Q7 Multiple choice and free text box for ‘other’ plus categorical ‘yes’ ‘no’ for working between Trusts: this question was trying to establish regional working patterns and

whether a silo mentality exists within imaging services – according to the Business Dictionary[5] a silo mentality is:

> "*A mind-set present in some companies when certain departments or sectors do not wish to share information with others in the same company. This type of mentality will reduce the efficiency of the overall operation, reduce morale, and may contribute to the demise of a productive company culture."*

The next set of questions were based on the dimensions of quality identified in the literature review and gathered opinions and comments on their importance in relation to quality in imaging services.

Questions eight to 10 were Likert-Scale: five point scale - *very important, important, not very important, not important at all* and *don't know.* It was expected that respondents would be able to easily identify with the questions through their own experiences.

Q8 Questions on the components of the quality dimension 'Safety'. The test was to confirm if the three components and corresponding constituents had been correctly identified and to measure their importance in terms of quality.

Q9 Questions on the components of the quality dimension 'Communication'. The test was to confirm if the three components and corresponding constituents had been correctly identified and to measure their importance in terms of quality.

Q10 Questions on the components of the quality dimension 'Workforce'. The test was to confirm if the constituents had been correctly identified and to measure their importance in terms of quality. Because of the generally wide parameters of workforce issues this question was narrowed down to those which would directly affect respondents or where respondents would an opinion.

During the planning phase for the survey contact with RMIR colleagues resulted in question 10 focusing on recruitment only, despite the literature identifying 'professions' and 'education, training and CPD' categories. The grounds for this decision was to create a survey to encourage timely participation and avoid confusion, e.g. to minimise overlap with other questions. Furthermore it was considered too difficult to deliver meaningful results from 'education, training and CPD'.

[5] http://www.businessdictionary.com/definition/silo-mentality.html

Q11 The Likert-Scale to question 11 about Patient Experience was changed to *strongly agree, agree, neither agree or disagree, disagree* and *strongly disagree.* The change was necessary because respondents were being asked to rate how they thought patients in their care would rate the components and constituents – the deliberate change in format was intended to make respondents notice the change and think differently about answering the question. This question was very difficult to word because the researcher believed further work was required in relation to patient experience which could not be carried out without ethical approval, however evidence was required to enable the hypothesis to be taken forward.

Q12 Categorical: A check on whether respondents were aware of the DHSSPS review.

The next two questions were subtly different wherein the first asked which of the four dimensions of quality <u>needed</u> improvement and the second asked respondents' opinion about which would be <u>likely</u> to benefit from the Review.

Q13 Multiple choice:

Q14 Multiple choice:

Q15 Four point Likert-Scale: *excellent, good, satisfactory, poor.* This intended to draw out respondents' view on the importance of the four dimensions from the perspective of their own role.

Q16 Open ended free text box: respondents were asked to comment on any other issue they would like to see taken forward by the research.

Q17 Free text box for respondents to add their email address if they wished to see the results of the survey.

Appendix F Collated responses

The table of collated responses contains personal identifiable information therefore it cannot be attached to this document. However a redacted version may available from Helena Brown on request, depending on justification and permissions.

Appendix G SWOT analysis on NIPACS

SWOT analysis for quality in imaging services. Quality is expected to improve once the region is digitally connected. Safety should improve by ensuring treatment commences sooner and patients are exposed to a smaller amount of ionising radiation; previously there were regular occasions when more tests were performed than necessary through duplication. Regional NIPACS provides an opportunity to provide better access to imaging equipment nearer to the patient's home, which is an underlying principle of the Transforming Your Care strategy; this is likely to lead to quicker reporting because Radiologists will be able to access the digital scan from any suitable terminal in the region.

A 'super fix' may be possible using bespoke digital technology to interconnect the existing three systems to the regional NIPACS system, however this is likely to take time and in the interim difficulties such as waiting times for diagnostic tests and delivery of results will be exacerbated.

Key: The Regional Medical imaging Review = RMIR

STRENGTHS	**WEAKNESSES**
The RMIR is a Ministerial project with the authority and mechanisms to make recommendations to commissioners and service. Regional NIPACS is almost complete, with only 2 Belfast PACS requiring integration. A regional process is safer because of the number of imaging examinations are likely to be reduced. Regional NIPACS will improve patient safety and aid more rapid reporting. Protocols and procedures with agreed standards are consistent with improved patient safety and experience. Diagnostic waiting times are likely to reduce when NIPACS is fully integrated. NIPACS has the capability to synchronise with the new electronic care record (ECR)	The current 3 digital systems have the potential to impact patient safety and treatment. The current 3 digital systems add a level of inefficiency of time management for Radiologists because of the need to check 3 systems rather that 1. The current 3 digital systems mainly affect the busier, regional centres in Belfast. A regional NIPACS may require a 'super fix' before full integration.
OPPORTUNITIES	**THREATS**
The RMIR can work towards a regional model, NIPACS. The current service is already considered a successful integrated system in the other UK regions even though some steps remain, therefore completing full integration of NIPACS can offer global recognition for NI healthcare and for the ITC companies involved. NIPACS can integrate with other ITC solutions to enhance patient safety and clinical excellence. NIPACS has the ability to store all digital information including non-imaging.	The current financial climate is a barrier to recommendations that include large investment. Previously agreed long-term contracts with suppliers have the potential to hamper regional NIPACS.