



Department of
Health

An Roinn Sláinte

Mánnystrie O Poustie

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STRATEGIC FRAMEWORK FOR IMAGING SERVICES IN HEALTH AND SOCIAL CARE

Final Report

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FOREWORD

This is a time of considerable reform in health and social care, and the Health and Social Care transformation agenda, *“Health and Wellbeing 2026: Delivering Together”*, places a high priority on developing a new approach to planning and delivery of imaging services.

The scope, complexity and application of medical imaging has grown significantly over the last 30 years. Advances in information technology and digital electronics now allow clinicians a previously unimaginable insight into any part of the body. These technological developments have enabled earlier, more accurate diagnosis and more appropriate interventions for almost all major health conditions and it is not overstating the case to say that medical imaging plays an absolutely vital role in the provision of modern healthcare.

This Framework now proposes a number of important recommendations aimed at ensuring imaging services remain safe, effective and sustainable in the long term. It will require new ways of working as well as investment in workforce and underpinning information technology systems. It will also require a focus on developing effective local and regional, clinical and corporate, governance arrangements. The recommendations set a challenging agenda, but they are the right thing to do if we wish to ensure that every patient can access the same high quality of imaging regardless of where they live in Northern Ireland.

Work on the review of imaging services started in 2014, and I would like to thank all those who have contributed this review over the past four years. I am grateful for the time and effort of the healthcare professionals who have engaged in partnership throughout this important project and brought it to its conclusion in this strategic framework document.

Richard Pengelly

Permanent Secretary of the Department of Health

Executive Summary

In December 2013, the Minister of Health, Social Services and Public Safety approved terms of reference for a review of health and social care (HSC)¹ imaging services. The aim of the review was to develop a 10 year strategy for imaging services in Northern Ireland.

Methodology

The initial task of the review was to scope the modalities and services to be considered and identify the most effective methodological approaches to achieve this. A number of clinical workstreams were subsequently established to take forward discrete elements of its work. These included:

- Radiological imaging
- Paediatric imaging
- Interventional radiology
- Cardiac imaging
- Obstetric imaging

Each of the workstreams has worked over two years to develop proposals and recommendations to improve the efficiency, effectiveness and standard of patient care. They worked to a 4-step methodological approach which examined:

- **Current service:** *baseline assessment*
- **Optimal service:** *essential components of a high quality service*
- **Gap analysis:** *what we need to get us there.*
- **Future proofing/horizon planning:** *emerging challenges*

The reports produced by each workstream have been strengthened by an analysis of key supporting issues in information and communication technology, workforce and capital. These workstream papers are the foundation of the review's work and can be found at the following link <https://www.health-ni.gov.uk/consultations>. We have drawn on this detailed work to develop this overarching strategic framework setting out our vision for safe, effective and patient-focussed imaging services for Northern Ireland. There are three key components to this vision which are set out below.

¹ Abbreviations are available in Appendix 1.

Guiding Principles

The initial key priority for the review was to establish the type of imaging services we would wish for the people of Northern Ireland. Underpinning this vision we have developed a number of quality-based guiding principles to shape the design, configuration and delivery of HSC imaging services for the next decade. These principles draw from the Department's vision *Quality 20:20* and represent best practice for imaging services in Northern Ireland. These principles are set out below.

1. Imaging procedures must only be undertaken when there is an identified clinical need. The method of investigation should ensure the optimum imaging quality appropriate to the clinical circumstances.
2. Imaging procedures should only be undertaken in clinically appropriate settings which are as close to the patient's choice of location as is safe and effective to provide.
3. Imaging procedures must only be undertaken and reported by those with the appropriate clinical skills and expertise.
4. Imaging investigations should be performed and reported to an appropriate standard regardless of location or time.
5. Imaging services must form an integral part of a robust wider care pathway, centred on continuity of care.
6. All relevant diagnostic and patient information should be available to clinicians each time a patient accesses healthcare. This should include access to the full imaging history comprising both reports and images.
7. All imaging tests should be performed and reported in a timely fashion commensurate with clinical need and the wider care pathway.
8. Imaging services must operate within an agreed and transparent governance framework.

Thematic priorities and Strategic Recommendations

Having identified the quality-based guiding principles underpinning safe and effective services the second key task of the review was to draw from the findings of each of the workstreams the key strategic recommendations whose implementation will ensure that the guiding principles set out in section 1 can be realised. These recommendations have been structured under five key themes which are set out below:

Workforce

1. It is recommended that the HSC takes urgent action to close the unfilled vacancy positions in the radiology workforce. This should include:
 - further increases in the total number of national training places in radiology in the NI Radiology Training Scheme up to 46 by the intake of August 2017, increasing to 54 by 2020;
 - an international recruitment campaign commencing in year 1 of the framework aimed at filling at least 15 clinical radiology posts over the next 4 years;
 - by end 2017 the HSC should develop local and regional workforce retention strategies to promote and facilitate recently retired radiologists to continue to work on a reduced basis following their retirement. This should aim to deliver on average 3 PAs per week per radiologist for at least 3 years after their retirement.

2. HSC Trusts should put in place the necessary arrangements to ensure that there is a clear understanding of the deployment, education and training of radiographers at all levels, together with the associated resources and implications.
 - This should include a structured career progression pathway for radiographers, through locally available specialist training in specific areas and at all levels to promote and optimise skill mix opportunities within imaging teams.
 - Building on the progress made with fluoroscopy and ultrasound reporting, the HSC plan should include working towards ensuring that between 20-40% of plain film examinations are reported by radiographers by 2020.

3. The HSC should put in place the necessary training and workforce planning mechanisms to ensure that sufficient numbers of cardiac physiologists and medical physics staff are available to meet the needs of service with respect to functional imaging techniques and medical physics support for imaging services including ultrasound.

Networks of Care

4. The HSC should put in place a regional hub and spoke network model for the delivery of interventional radiology services in Northern Ireland by 2018/19.
5. The HSC should put in place appropriate clinical pathways and supporting network models to ensure children can access safe clinical paediatric radiology services, in and out-of-hours.
6. The HSC should build on the work of the Modernising Radiology Clinical Network in prioritising the development of specialist reporting networks for key radiology modalities including:
 - regional plain x-ray reporting network by September 2018
 - MRI regional reporting network by end 2019
 - CT regional reporting network by end 2020
7. The HSC should establish a regional obstetric imaging clinical network to take forward the development of a new service model for obstetric imaging and ensure regional uniformity in the quality and provision of care.
8. The HSCB should finalise the implementation of local service models for cardiac magnetic resonance and echocardiography by 2017. The planning estimates for these services should be reviewed on a yearly basis.
9. The HSC should put in place enhanced pathways for patients with chest pain which include early access to imaging investigations in line with the regional model developed by the cardiology workstream.

ICT

10. The HSC should aim to put in place a single regional Northern Ireland Picture Archiving and Communication System (NIPACS) solution across all sites in Northern Ireland with sufficient integration with the Electronic Care Record (ECR) system so that both images and reports can be reviewed on ECR alongside other patient information.
11. NIPACS should also be expanded to include the administration, storage, processing and viewing of all appropriate medical images in obstetrics, cardiology and other appropriate fields.

Investment

12. Proposals for the future development of the imaging needs of the population must be considered in line with the guiding principles outlined in section 1 of this framework.
13. Recurrent funding should be made available so that imaging services can provide the required level of examinations and reports to meet current and projected demand and address backlogs where they exist. This will include optimising use of the imaging equipment base, promoting skill mix, and ensuring that requirements for 7 day access to services and out-of-hours arrangements are able to be delivered.
14. HSC Trusts should continue to implement the strategic planning framework for major diagnostic imaging equipment. There should be regional oversight and co-ordination of the capital base to ensure that imaging assets are utilised effectively.

Governance

15. The HSC should develop and implement a regional phased programme of imaging accreditation by year 1 of the framework with all HSC Trust sites accredited by December 2019.
16. Where regional or local networks of care are established they must be accompanied by robust clinical guidance and appropriately agreed care pathways.

17. HSC Trusts in collaboration with an imaging network board (see recommendation 19) should undertake detailed local consultation with primary and secondary care imaging referrers to ensure robust referral pathways are in place including appropriate methods of results acknowledgement.
18. HSC imaging services should foster a research culture with close integration between clinical and research departments.
19. The Department should establish a regional medical imaging network or 'imaging board' to oversee implementation of the recommendations of the review to provide continuing professional advice and support on issues such as workforce, equipment and strategic planning.

Overall Vision

The guiding principles and strategic recommendations identified within this framework are each a part of an overall vision for a high quality imaging service. Their implementation will transform how imaging services are planned and provided.

Each recommendation is set out within themes which we recognise are vital components to achieving this transformational agenda. In ICT for example we have the potential to be an international innovator by fulfilling the potential of NIPACS; ensuring a single RIS/PACS solution across all acute sites, integrated with our care record systems and expanded into new clinical areas such as cardiology and obstetrics.

We recognise too how these technological advances will underpin and support innovative models of workforce recruitment, retention and training, and better ways of organising existing human resources. That is why a fundamental focus of this review has been on the development of enhanced clinical networks to provide regional resiliency and specialist support underpinned by robust guidance and clinical pathways.

These 'networks of care' offer better ways of making use of scarce specialist expertise, of standardising care and improving access for patients across the region.

They can create the systems that ensure patients receive timely and appropriate investigations and are referred, when necessary, to other specialist services within robust pathways.

These networks will also enable a greater spread of innovation and create an environment that allows self-organisation, development and learning; features that have been shown to improve outcomes for patients and to assist with staff retention.

We know too that none of this comes without investment. We recognise that a key priority for investment must be in closing the vacancy positions in key posts and in enhancing the available skill mix. In the longer term we recognise that we will need effective systems and processes as well as underpinning standards in place to ensure we make effective planning decisions. Effective governance, both local and regional, will be vital to underpin all of this work.

Imaging board

Making this vision happen will require the HSC to take forward a considerable volume of work to secure the necessary investment, design the clinical networks and new clinical pathways etc. This will require support from colleagues across all HSC organisations. It will also require a driving force at the regional level. The review has therefore proposed the establishment of an Imaging Board. This board will have a range of functions, however its primary focus will be on leading the implementation of the findings and recommendations of this review.

INTRODUCTION

Purpose

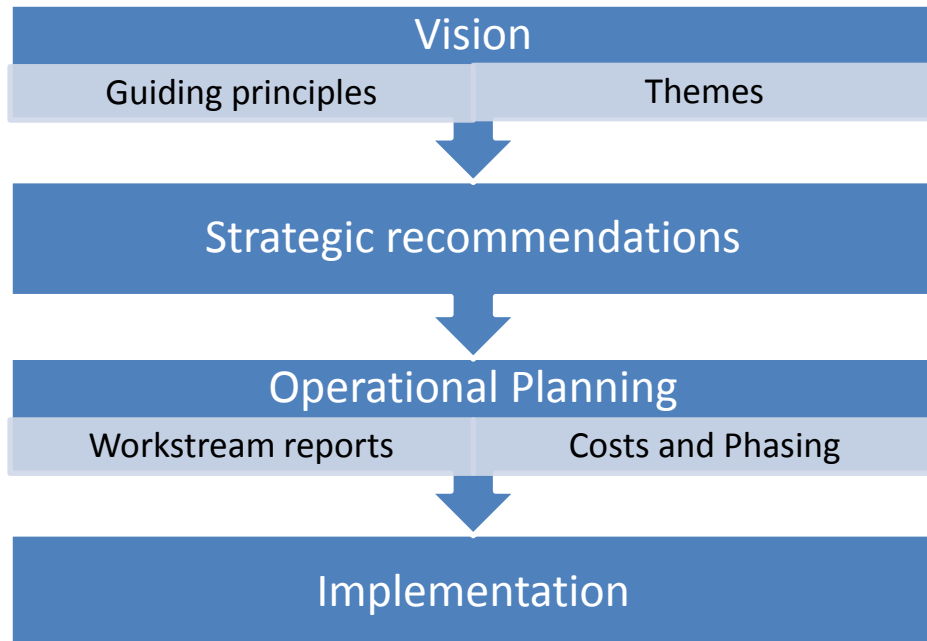
- 1.1 This document provides an overarching strategic framework for the design, configuration and development of HSC imaging services for the next ten years, subject to contractual and procurement requirements and available resources.

Outline and Methodology

- 1.2 The framework does not stand alone. It is underpinned by a substantial body of work including detailed reports, recommendations and findings from 5 clinical workstreams as well as other supporting papers which, taken together, represent a detailed roadmap to achieve high quality imaging services for the people of Northern Ireland. These reports can be found <https://www.health-ni.gov.uk/consultations>.
- 1.3 The framework draws on this detailed work to develop a strategic vision for safe, effective and patient-focussed imaging services for the people of Northern Ireland. It is presented in three sections.
- 1.4 Section 1 of the document outlines quality-based guiding principles which will be used to shape the design, configuration and delivery of HSC imaging services for the next decade. These draw from the Department's vision *Quality 20:20* and represent best practice standards for how imaging services should be provided for the people of Northern Ireland.
- 1.5 Section 2 draws on the workstream reports and papers to identify a number of key themes for action across imaging services. Strategic recommendations are made within each of these whose implementation will ensure that the guiding principles set out in section 1 can be realised. In doing so the framework illustrates how many of the issues and challenges discussed in each of the workstream reports are symptomatic of wider strategic issues which must be addressed systematically if they are to be resolved.

1.6 Section 3 of the framework encapsulates the various inter-related areas of action that have been drawn together by the Review.

1.7 The 'framework' within which the findings and recommendations of the imaging review are set out can be described as:



BACKGROUND & STRATEGIC CONTEXT

Review of Imaging Services

- 2.1 In 2011, in response to public concern at delays in the reporting of plain x-ray images in a number of Health and Social Care (HSC) Trusts, the Minister of Health, Social Services and Public Safety commissioned the Regulation and Quality Improvement Authority (RQIA) to undertake a two-phase review into the reporting arrangements for radiological investigations across the HSC.
- 2.2 In March 2011 the RQIA published the first phase of its report which focussed on an assessment of the handling and reporting arrangements for radiological imaging investigations across each of the HSC Trusts. The second phase report which followed in December 2011 dealt specifically with imaging reporting issues in two, and later a third, HSC Trust. Together the two phase report(s) contained 26 recommendations aimed at enhancing and improving the delivery of radiological imaging in Northern Ireland.
- 2.3 In response to the findings and recommendations of the RQIA report(s) the Minister established, in late 2012, a review of HSC imaging services. The establishment of the review sought to address directly recommendation 1 of the RQIA phase 1 report which stated that *"[the Department] should develop a strategy for the future provision of imaging services in Northern Ireland which incorporates a new workforce plan for radiology"*.
- 2.4 In April 2013 a Modernising Radiology Clinical Network (MRCN) was established by the Health and Social Care Board (HSCB) and was initially tasked with driving forward the recommendations outlined in the RQIA Review and specifically to address the Phase 2 recommendation that *"all relevant HSC organisations should consider the establishment of a NI Managed Clinical Network for Radiology"*.
- 2.5 In recognition of this and other important policy, financial and strategic developments across the HSC the Department undertook a scoping exercise to update and amend the terms of reference for the imaging review. This was completed in the summer of 2013 and a project board was established which

met for the first time in February 2014. External quality assurance was assured by the formation of an external expert reference group.

- 2.6 The overarching aim of the review is to develop recommendations for service development and configuration which will form the basis of a 10-year strategy for imaging services in Northern Ireland.

Defining Medical Imaging

- 2.7 Medical imaging is an integral part of modern healthcare. It involves a number of techniques which can be used to acquire images of the internal structure of the body as well as information regarding function. These techniques are used in the diagnosis and staging of disease and monitoring of the effectiveness of treatment. They can also be used for medical intervention and treatment. Medical imaging therefore plays a vital role in the provision of modern health care.

- 2.8 Imaging is primarily carried out in radiology departments in hospitals which deliver a wide range of services from plain x-rays through to complex interventional radiology procedures (minimally invasive treatments performed while imaging the patient). Imaging services are also provided in other clinical settings such as cardiology and obstetrics.

- 2.9 Diagnostic medical imaging is a clinical service which requires the expertise of imaging clinicians. Within an x-ray department the majority of images are procedures carried out by radiographers, allied health professionals (AHPs) who have undergone specialist training in imaging. The majority of complex procedures and reports are performed by radiologists who are doctors that have undergone additional specialist training. Increasingly specially trained radiographers are becoming involved in more complex procedures and reporting.

- 2.10 In addition to the work carried out in radiology departments, imaging services are also provided at the point of care. This predominately relates to ultrasound scanning (both obstetric and non-obstetric) and within the hospital environment includes work undertaken at ward level, outpatient departments, operating

theatres and in the emergency department. The types of medical imaging are set out in **Appendix 2**.

Safety

2.11 It is important for patients to be assured that the services they receive are safe and effective and performed to a high standard. Many diagnostic imaging investigations use ionising radiation and for this reason there are a number of quality and safety requirements and legal obligations which directly apply to diagnostic imaging. It is vital to ensure that patients continue to be imaged as safely as possible and to consistently high standards.

Organisational and methodological approach to the Imaging Review

2.12 The Imaging Review is an example of a project management based approach to policy making. In order to lead and conduct this policy review the Department established a project board in late 2013, which met for the first time in early 2014. Membership of the project board is comprised of representatives from the Department, HSC Board, Public Health Agency and providers as well as local professional representation from the Royal College of Radiologists and the Society and College of Radiographers, RQIA, the Patient and Client Council and other key stakeholders. The full membership of the project Board is set out in **Appendix 3**.

2.13 The initial key challenge for the project board was to define the scope and remit of its work, including the modalities and services to be reviewed and the most effective organisational and methodological approaches to achieving this. In doing so the project board established a number of workstreams, set out below, to take forward discrete elements of its work. These workstreams were:

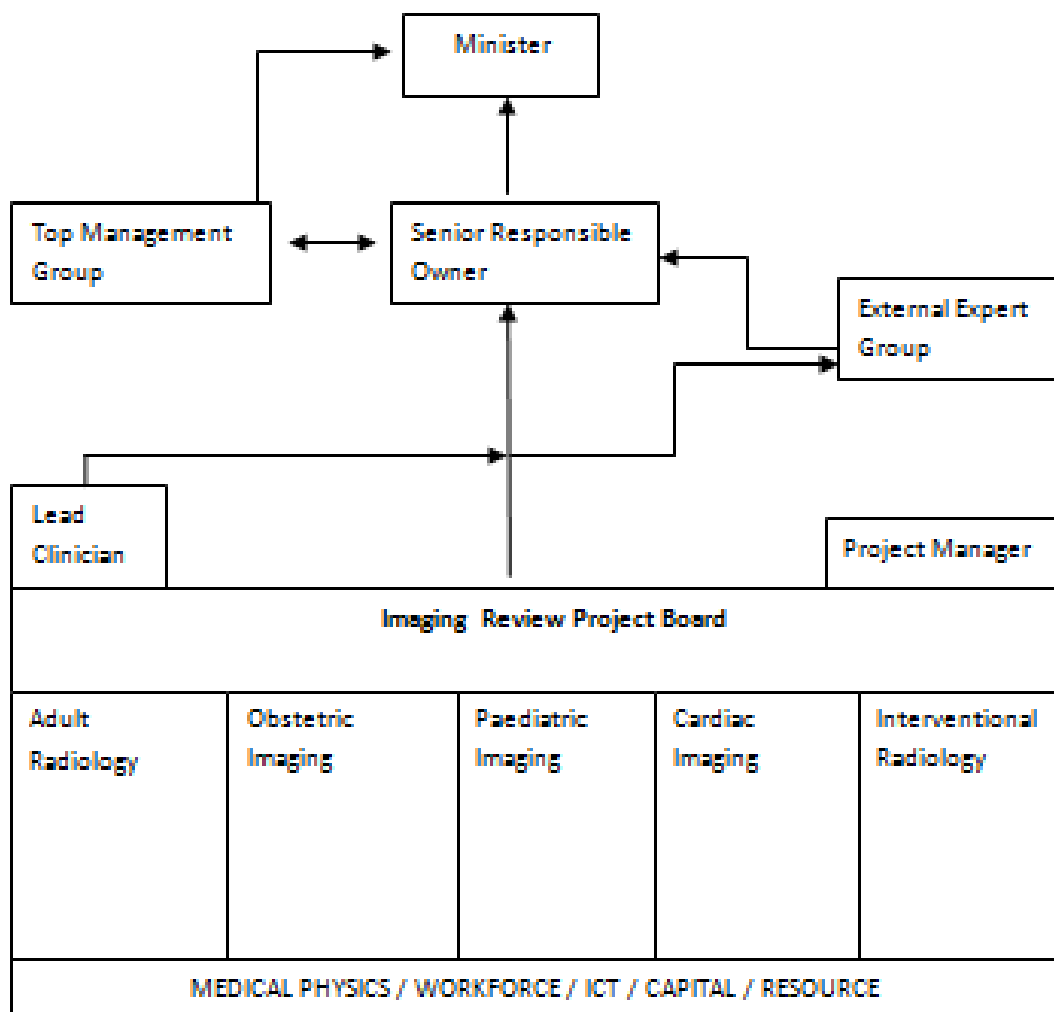
- **Radiological imaging:** including adult diagnostic radiology and the interface with oncology.
- **Paediatric imaging**
- **Interventional radiology**
- **Cardiac imaging**
- **Obstetric imaging**

2.14 These workstreams were underpinned by thematically focussed work areas including:

- **Information and communication technology (ICT)**
- **Workforce**
- **Capital/investment**
- **Medical physics**

2.15 In order to ensure that the work of the review was benchmarked against national standards the review also established an external reference group to provide expertise on radiology and radiography issues. The project structure is set out schematically below:

Project Management Structure of the Imaging Review



Methodology

2.16 The project board agreed at the outset a methodological approach to its work which was based on workstreams conducting their review and structuring their analysis into four steps each of which would be the subject of a paper or report with accompanying findings and recommendations. These steps were:

- **Current service:** *where we are* – report/analysis of the current service configuration, demand/capacity, capital resource, workforce etc.
- **Optimal service:** *where we would like to be* - paper outlining what an optimised service would look like, including taking account of regional approach, professional role expansion etc.
- **Gap analysis:** *what we need to get us there.*
- **Future proofing/horizon planning:** the emerging challenges which will have significant impact in later years

Exclusions

2.17 The project board agreed that the review would not consider non-HSC procured imaging, general dental practice imaging or non-radiology based physiological testing (e.g. respiratory function, neurophysiology etc). Other than activity commissioned by HSC, there is no authority by which to measure imaging activity carried out by the private/independent sector and to ensure management of a realistic timeframe for the review, it should be limited to accessible areas.

SECTION 1: HEALTH AND SOCIAL CARE IMAGING SERVICES – STRATEGIC GUIDING PRINCIPLES FOR A HIGH QUALITY SERVICE

- 3.1 The application of quality standard approaches, first in industry and later throughout wider society, has been a key driver for technological, economic and societal advance.
- 3.2 Their implementation in healthcare has been likewise transformative. From the advent of quality standards in processes governing the chemical composition of medications for example, or those relating to the regulation and licensing of medical practice; through to the highly complex, multi-faceted clinical, quality, data and governance standards in the modern health and social care (HSC), it is clear that a quality standards approach continues to be essential to the delivery of good healthcare.
- 3.3 In recognition of the need for a renewed and continuous focus on driving improvement in services the Department, in 2011, published its ten year strategy for improving the quality of health and social care entitled “*Quality 20:20*”. It identified three key elements which made up a quality service. These were:
- **Safety** – avoiding and preventing harm to patients and clients from the care, treatment and support that is intended to help them.
 - **Effectiveness** – the degree to which each patient and client receives the right care (according to scientific knowledge and evidence-based assessment), at the right time in the right place, with the best outcome.
 - **Patient and client focus** – all patients and clients are entitled to be treated with dignity and respect.
- 3.4 It was within this quality context, and against a background of concerns identified by the RQIA, that the Minister for Health, Social Services and Public safety initiated a review of HSC imaging services.

- 3.5 A core aspect of the review has been the benchmarking and analysis of the issues facing HSC imaging services against the core quality aspects identified in *Quality 2020*.
- 3.6 This section of the framework translates this benchmarking analysis into a set of guiding principles which will underpin the future planning and delivery of imaging services. Whilst many of these are already embedded throughout the HSC, this is not universally the case and it is important when developing a regional imaging strategy that these are explicitly drawn out.
- 3.7 These guiding principles will assist in the design, planning and delivery of quality imaging services and assist with the elimination of unwanted variation in the provision of care.

Guiding Principles for HSC imaging services

- 1. Imaging procedures must only be undertaken when there is an identified clinical need. The method of investigation should ensure the optimum imaging quality appropriate to the clinical circumstances.**

Safety requirements, particularly regarding exposure to ionising radiation, coupled with the elimination of costly, invasive or time consuming investigations mean that it is essential that imaging procedures are only undertaken when there is a clinical justification. It is also important that the investigation should be performed on equipment which is fit for purpose and clinically appropriate.

- 2. Imaging procedures should only be undertaken in clinically appropriate settings which are as close to the patient's choice of location as is safe and effective to provide.**

Planning the provision of imaging procedures is complex. How, where and when procedures are undertaken and reported depends on a range of factors including the type of investigation, the individual patient's clinical and social care needs, the suitability of the clinical setting, the feasibility of deployment

and operation of large scale equipment and ICT infrastructure, as well as the availability of the clinical expertise to oversee and to report the results of the procedure.

However central to this is that the patient and by extension their home, family and community is at the centre of the care environment. This means that the HSC, working alongside primary care providers, will scope, plan and develop the necessary evidence-based care pathways at a local and regional level to ensure that where possible services are delivered at locations which reflect patient circumstances and choice. It is important to note that there will be circumstances when quality considerations, primarily safety, require regional or hospital network approaches to the delivery of the service.

3. Imaging procedures must only be undertaken and reported by those with the appropriate clinical skills and expertise.

It is an absolute requirement of a quality imaging service that those providing it are appropriately trained and qualified to do so. The increasing specialisation of clinical practice however means this can be difficult to realise across all acute sites and specialties on a 24/7/365 basis.

To do so will require the HSC to work closely with the clinical community to develop appropriate standards, pathways and models of service delivery particularly in sub-specialties as part of wider strategic programme of change.

4. Imaging investigations should be performed and reported to an appropriate standard regardless of location or time.

A fundamental requirement of quality is consistency in the standard of care. The HSC must work to develop appropriate standards built from clinical practice and ensure that methods of audit and accreditation are in place to ensure these standards are met.

5. Imaging services must form an integral part of a robust wider care pathway, centred on continuity of care.

Access to appropriate and timely diagnostic imaging investigation is vital to ensure that patients are appropriately assessed, diagnosed and treated. It is important that the imaging aspect of treatment is seamlessly integrated with their care pathway to ensure good patient experience.

The HSC must ensure that the role, scope and timing of diagnostic imaging investigations is clearly recognised and defined within patient-focussed care pathways.

6. All relevant diagnostic and patient information should be available to clinicians each time a patient accesses healthcare. This should include access to the full imaging history comprising both reports and images.

It is important that clinicians have as much information about the patient's history as possible to enable an accurate diagnosis and guide the most appropriate therapeutic intervention as well as the most accurate prognosis. The HSC will need to work with clinicians to determine appropriate clinical and information governance pathways.

The use of ionising radiation in imaging procedures makes this even more important. The HSC must ensure that modern information and communication methods are exploited to their fullest so that all investigations are recorded and the results and images available to reporting clinicians, thus preventing unnecessary repeat examinations and potentially dangerous exposure to radiation.

7. All imaging tests should be performed and reported in a timely fashion commensurate with clinical need and the wider care pathway.

Timely investigation and reporting is important however these timeframes should be driven by clinical need. The HSC will need to work to develop appropriate standards and targets which will support this principle.

8. Imaging services must operate within an agreed and transparent governance framework.

Good governance is a vital component of quality services. As the importance of network approaches to the provision of care increases, necessitating joined-up working across acute sites, specialties, health sectors and Trusts boundaries, the HSC will need to develop innovative solutions to governance challenges. The interface within and between secondary and primary care is an important area which will require to be strengthened for example in embedding results acknowledgement.

SECTION 2: DELIVERING QUALITY: STRATEGIC PRIORITIES FOR HSC IMAGING SERVICES

- 4.1 The previous section identified quality-based guiding principles to underpin the future planning and delivery of imaging services. In this section we develop this work further by drawing out from the workstream reports the key thematic priorities across imaging services. We then make strategic recommendations whose implementation will ensure that the guiding principles set out in section 1 can be realised.
- 4.2 In doing so the framework illustrates how many of the issues and challenges discussed in each of the workstream reports are symptomatic of wider strategic issues which must be addressed systematically if they are to be resolved. These key themes and the associated recommendations are set out below.

Workforce

- 4.3 The HSC essentially is its workforce. Its' tens of thousands of staff deliver an immensely complex and varied set of services to the whole population, from maternity services through to end of life care. There are few citizens who will not come to rely on health and social care services at some points in their lives.

Managing this workforce and the services it provides in a manner that can respond to the immediate needs of the population, whilst planning and facilitating the delivery of new healthcare services, all within constrained financial budgets is a continuous process and one of the most complex logistical challenges known to public services.

- 4.4 Therefore a key thematic focus of the imaging review has been on its workforce, primarily clinical radiologists and radiographers who are principally responsible for the delivery of imaging services.
- 4.5 This analysis has shown significant workforce pressures across the spectrum of imaging services which are mirrored across the UK and wider. Acute problems have been identified in sub-specialty areas such as paediatric, interventional

and breast radiology however these challenges are part of a larger workforce deficit in clinical radiology posts across the province.

- 4.6 Over the period of the review the number of unfilled vacancies in clinical radiologist posts has ranged from 21 to 42. This means that over that time approximately 25-30% of all clinical radiologist posts in Northern Ireland were vacant and there has been a significant reliance on locums. This is an unsustainable situation.
- 4.7 Similarly it has not been possible to provide the full range of interventional radiology procedures across all HSC Trusts in the region due to a lack of trained interventional radiologists, with numbers being insufficient to enable a formal out-of-hours service regionally. In paediatric imaging, the regional and national shortage of trained consultants with a sub-specialist interest in paediatrics has caused significant sustainability issues across the region. Within radiography there are shortages of specialist staff in key modalities which restrict skill mix optimisation, as well as a lack of locally based opportunities for training advanced practitioners.
- 4.8 Outside of radiology, the workforce challenges in functional cardiac imaging, obstetric imaging and medical physics continue to reduce the effectiveness and efficiency of the services which we need to provide to our patients.
- 4.9 Whilst the particular causes of each of these problems may be different and specific to the individual relevant clinical area, there are fundamental and underlying reasons and issues behind them.
- 4.10 The review has shown a significant increase in demand for imaging services driven by demographics and the changing profile of disease morbidity as well as advances in clinical practice and in the application of medical imaging technologies. These advances have led to complex and time consuming investigations becoming increasingly common. Recent examples include the expansion of computed tomography to replace barium enema and increased demand for cardiac imaging.

- 4.11 Other pressures include the changing professional roles of the radiologist, radiographer, ultrasonographer and specialist nurse as they continue to adapt to the pace of change in modern medical practice. This manifests itself in the form of increasing levels of specialisation and sub-specialisation of practice as well as in new roles in the multi-disciplinary care and clinical management of patients.
- 4.12 The review has found that regional workforce planning has not been sufficiently responsive in addressing and mitigating these pressures. In recognition of this the Department took action to increase radiology training posts by two in 2015, three in 2016 and four in 2017; therefore since August 2017 the number of doctors in national training places for radiology has risen from 37 to 46 in Northern Ireland in line with recommendation 1. This is only a first step however and it is a key recommendation of the review that the imaging workforce requires significant enhancement in order to be able to sustain and improve the quality of imaging services.
- 4.13 Overall the review has identified several key elements which will need to be taken forward collectively to ensure we have the workforce necessary to deliver the vision articulated by this framework. Many of these will involve new ways of working.
- 4.14 The review recognises, for instance, that we have an opportunity to make better use of the skills of senior doctors who are leaving the service to retirement. We also recognise the importance of building network approaches to the delivery of care and increasing the skill mix in image reporting. We will also need to look at key enablers such as improving the ICT infrastructure. The remainder of this section discusses these approaches and how they can be achieved.
- 4.15 In the immediate term however a number of specific actions will need to be taken forward as a matter of urgency to help address the workforce challenges in imaging services. The review therefore makes the following recommendations.

Recommendation 1

It is recommended that the HSC takes urgent action to close the unfilled vacancy positions in the radiology workforce. This should include:

- further increases in the total number of national training places in radiology in the NI Radiology Training Scheme up to 46 by the intake of August 2017, increasing to 54 by 2020;
- an international recruitment campaign commencing in year 1 of the framework aimed at filling at least 15 clinical radiology posts over the next 4 years;
- the HSC should develop local and regional workforce retention strategies to promote and facilitate recently retired radiologists to continue to work on a reduced basis following their retirement. This should aim to deliver on average 3 PAs per week per radiologist for at least 3 years after their retirement.

Recommendation 2

- HSC Trusts should put in place the necessary arrangements to ensure that there is a clear understanding of the deployment, education and training of radiographers at all levels, together with the associated resources and implications:
- This should include a structured career progression pathway for radiographers, through locally available specialist training in specific areas and at all levels to promote and optimise skill mix opportunities within imaging teams.
- Building on the progress made with fluoroscopy and ultrasound reporting, the HSC plan should include working towards ensuring that between 20-40% of plain film examinations are reported by radiographers by 2020.

Recommendation 3

The HSC should put in place the necessary training and workforce planning mechanisms to ensure that sufficient numbers of cardiac physiologists and medical physics staff are available to meet the needs of service with respect to functional imaging techniques and medical physics support for imaging services including ultrasound.

Networks of Care

- 4.16 The last decade has seen radical shifts in how health services are delivered and structured in Northern Ireland and throughout the UK, yet even this pace of change has struggled to fully keep up with the evolution of clinical practice.
- 4.17 There has been an increasing acceptance of the need to move away from hospital-facility focussed models of healthcare, towards models which are wrapped around the patient and designed in such a way as to maximise access to high quality services. Central to this vision, is the expansion of network solutions which support the delivery of care for patients.
- 4.18 One example of this has been in the development of managed clinical networks that link primary, secondary and tertiary care. These include the Modernising Radiology Clinical Network (MRCN), cardiology and obstetric ultrasound networks each of which have made a significant contribution to this review.
- 4.19 A key paper was published by the Royal College of Radiologists (RCR) in September 2014. In it the RCR outlined the case for a new service model for imaging services in the UK. They noted that as imaging procedures increased in complexity, it was becoming challenging for individual hospitals to deliver the range of specialist support in a timely fashion across all clinical presentations. This was most evident in relation to out-of-hours services. The RCR proposal was that existing radiology services should collaborate to form networks of expertise serving much larger populations.
- 4.20 The findings of the imaging review have much in common with the college report. Each of the review's workstreams has scoped the relevant demand and workforce pressures. These scoping exercises coupled with an assessment of the configuration of acute services has indicated that if services are to be sustainable and viable in the long term then new models of working will be needed, particularly with regard to out-of-hours services, and/or in vulnerable sub-specialty areas.
- 4.21 Put simply there is recognition that not every service can be maintained in every current acute site on a 24 hour basis. This is not a question of resources,

although to attempt to provide such a solution would be prohibitively expensive, it is rather a fundamental recognition of the requirements of safe clinical practice. The clinical evidence suggests that it is only through networked models that the full spectrum of safe care can be sustained for a population our size.

4.22 The structure and operation of these network models will differ depending on the specific requirements of each service and must proceed from the guiding principles set out in Section 1 of this framework. Generally, however, the benefits of network based approaches is well understood; the enhanced co-operation and integration affords considerable opportunities for shared learning, reduces variation in practice, and builds service and workforce resilience to name but a few.

4.23 In the case of interventional radiology (IR) the review has concluded that the extent and persistence of the workforce challenges in that sub-specialty means a regional hub and spoke network model is the most effective way to deliver safe and sustainable services to the people of Northern Ireland.

4.24 The detailed underpinning evidence is available in the report of the IR workstream, however the essential argument is that the number of practicing IR consultants across the region, the volume of clinical cases and the need for a safe clinical out-of-hours rota, mean that a concentration of a skills within a hub is essential for clinical safety and wider service resilience. This model will also allow for a range of elective interventions to be sustained at a local level, striking the right balance between the issues of quality and accessibility discussed in section 1.

4.25 In paediatric radiology similar challenges in maintaining safe and effective in hours services in some Trusts and out-of-hours services regionally means that the HSC must consider an increased role for regional network solutions.

4.26 In adult radiology a key consideration of the review has been how the skills of the approximately 125 consultants in Northern Ireland can be better used to provide regional network solutions to reporting pressures or gaps across HSC

Trusts. Such innovative network solutions will require careful design and ongoing commitment from the clinical community, as well as strong leadership from Trusts, HSCB, PHA and DoH. The review has detected a genuine appetite for innovations that can improve the quality of service to patients, reduce reliance on external suppliers and enhance in-house services to support sustainable services for the future.

- 4.27 The HSCB has worked closely with the Modernising Radiology Clinical Network (MRCN) to develop an initial 'proof of concept' pilot for a regional reporting network for plain x-rays. It is anticipated that the learning from this pilot will be used to inform the development of wider regional reporting networks in more specialist modalities.
- 4.28 Networks of care solutions apply equally to clinical areas outside of radiology. The work of the obstetric imaging workstream has identified the need for both local and regional network solutions to ensure appropriate levels of scanning for all expectant mothers. These linked local networks supported by regional professional networks will be critical in the delivery of effective obstetric imaging services.
- 4.29 The cardiology workstream has also identified the key service benefits to be achieved through the use of hub and spoke models in cardiac magnetic resonance imaging (CMR) and in echocardiography by 2017. Considerable work has also been undertaken by the workstream to develop enhanced local pathways for patients presenting with chest pain. These pathways aim to maximise the clinical benefits afforded by early access to appropriate imaging investigations, and will benefit from effective local access arrangements for CT.
- 4.30 Finally, in implementing the framework, it will be important to consider the possible opportunities of cross border networks. As the only part of the UK with a land border with another EU member state, Northern Ireland is well placed to collaborate with the Health Service Executive where opportunities present themselves. While this can present challenges in terms of the compatibility of different systems, the current cross-border service provided by the North West Cancer Centre shows that this is both possible and desirable where it can

deliver benefits for patients in both jurisdictions. In view of the UK's plan to exit the European Union, it will also be important to monitor if and how this may impact on services provided in Northern Ireland.

4.31 The efficacy of networks in many of these areas will be dependent on other key enablers and these are discussed later in this document. Critical to their success will be well understood governance structures. The review makes the following recommendations.

Recommendation 4

The HSC should put in place a regional hub and spoke network model for the delivery of interventional radiology services in Northern Ireland by 2018/19.

Recommendation 5

The HSC should put in place appropriate clinical pathways and supporting network models to ensure children can access safe clinical paediatric radiology services, in and out-of-hours.

Recommendation 6

The HSC should build on the work of the Modernising Radiology Clinical Network in prioritising the development of specialist reporting networks for key radiology modalities including:

- a regional plain x-ray reporting network by 2018
- a MRI regional reporting network by 2019
- a CT regional reporting network by 2020

Recommendation 7

The HSC should establish a regional obstetric imaging clinical network to take forward the development of a new service model for obstetric imaging and ensure regional uniformity in the quality and provision of care.

Recommendation 8

The HSCB should finalise the implementation of local service models for CMR and echocardiography. The service planning estimates for these services should be reviewed on a yearly basis.

Recommendation 9

The HSC should put in place enhanced pathways for patients with chest pain which include early access to imaging investigations in line with the regional model developed by the cardiology workstream.

Information and Communication technology

4.32 All modern imaging departments rely on digital imaging equipment and utilise electronic Radiology Information Systems (RIS) and Picture Archiving and Communication Systems (PACS). These systems are essential for the safe and effective administration, reporting and archiving of imaging examinations and their rollout has been transformative to patient care.

4.33 The history and background to the development of the RIS/PACS systems locally have been discussed in detail in the individual workstream reports. Northern Ireland currently has three separate RIS and PACS systems operating across the HSC.

4.34 All Trusts currently operate a RIS/PACS system known as the Northern Ireland Picture Archiving System (NIPACS).

4.35 Within the Belfast HSC Trust three sites are on NIPACS. The Royal Victoria Hospital is on a separate RIS/PACS and the Belfast City Hospital, including the cancer centre is on a third RIS/PACS. To date it has not proved possible to effectively integrate these systems either together or with NIPACS.

4.36 The review has identified a single RIS/PACS system within the HSC as a clinical necessity. This is essential for the full development of networks and the creation of a fully joined-up imaging service. It forms a key section in each of

the reports of the radiology workstream where lengthy, detailed and robust arguments are advanced regarding its priority.

4.37 The workstream reports show why a single system would improve efficiency and patient safety through the elimination of workflow impediments, reduction of unnecessary requests, avoid duplication of examinations and enhanced resiliency of services. It is particularly relevant to note that until this is achieved, the radiotherapy centre in Altnagelvin and the Cancer Centre in Belfast will be operating different PACS systems.

4.38 The review has also identified the significant benefits which could be realised by expanding access to a single RIS/PACS solution for obstetrics, cardiology and other relevant specialties. These provide strong arguments for the necessary investment.

4.39 However most critically the networks of care envisaged within this framework will not be fully possible without a single functional ICT infrastructure. Therefore full implementation of the vision, values, standards and innovations of this framework are reliant on a single RIS/PACS. We therefore make the following recommendations.

Recommendation 10

The HSC should put in place a single regional NIPACS solution across all sites in Northern Ireland with sufficient integration with the electronic care record (ECR) system so that both images and reports can be reviewed on ECR alongside other patient information.

Recommendation 11

NIPACS should also be expanded to include the administration, storage, processing and viewing of all appropriate medical images in obstetrics, cardiology and other appropriate fields.

Investment

4.40 The HSCB has worked closely with the MRCN since its establishment in undertaking a population based capacity planning approach to determining

imaging services requirements. The key focus of this work is to address the current and future demand for imaging services, as well as to facilitate increased access for patients and referrers as part of the strategy to deliver 7-day access to services.

- 4.41 For radiology services this has focused both on increasing access at weekends as well as extended working weekdays. A key service aim is to incrementally build capacity to meet increasing demand, including having agreed productivity levels to ensure consistent and optimum utilisation of clinical session time. This is being supported by revenue and capital investment plans.
- 4.42 It is vital that all aspects of service provision are effectively quantified and funded appropriately to ensure out-of-hours, unscheduled care and extended access to service is secured. Similar approaches will be required for obstetric and cardiac imaging as well as more specific detailed work in sub-specialty areas.
- 4.43 However as noted throughout this framework the workforce capacity issues, advances in clinical practice alongside year-on-year expansion in aggregate demand will require new models of care be developed. Future planning for imaging must support these models. This will include a move toward more regionally planned service models in obstetrics, paediatric and interventional radiology as well new network models across adult radiology.
- 4.44 Given this the future planning of imaging services must proceed from the guiding principles set out in section 1.
- 4.45 Investment in a resilient equipment base is also essential to the proper functioning of imaging services. In recognition of this the Department established a Strategic Asset Management of Medical Devices (SAMMD) initiative in 2010/2011, focused on the replacement of a limited range of imaging and diagnostic equipment categorised as clinically and technically redundant and which would be considered as vital to maintaining service delivery to patients. This approach has resulted in significant improvements in

the age profile and the technology utilised in a range of diagnostic imaging modalities.

- 4.46 The review team has concluded that further planning is required on significant investment areas such as CT and MRI. It is clear that the capital financial context remains very challenging for future years however notwithstanding the availability or otherwise of an appropriate funding stream, HSC Trusts should be managing their equipment assets as an integral part of their business and delivery planning.
- 4.47 The scheduling of replacement and the investment in new equipment needs to be carefully planned to ensure service continuity, balanced against the opportunities for achieving further value for money through regional procurement, leasing arrangements or consideration of a regional/cluster Managed Equipment Service (MES) programme which would need to be explored as part of the business case process.
- 4.48 In reviewing the initiative and in consideration of the requirement for the continuing strategic equipment management by HSC Trusts it is clear that a refocused longer-term equipment management programme is required, taking into consideration the investment decisions surrounding the physical infrastructure.
- 4.49 To assist HSC Trusts a strategic planning framework for major diagnostic imaging equipment such as MRI and CT scanners has been developed which indicates a significant level of funding required in the initial years to meet the objective of maintaining the equipment age profile within acceptable limits. Its successful implementation will require the coordinated approach of all stakeholders including regional and local planning teams, Trust Directors of imaging services and imaging professionals.
- 4.50 The review also recognises that the increasing focus on networks of care and regional capacity and resiliency will require a level of co-ordination at a regional level.

Recommendation 12

Proposals for the future development of the imaging needs of the population must be considered in line with the guiding principles outlined in section 1 of this framework.

Recommendation 13

Recurrent funding should be made available so that imaging services can provide the required level of examinations and reports to meet current and projected demand and address backlogs where they exist. This will include optimising use of the imaging equipment base, promoting skill mix, and ensuring that requirements for 7 day access to services and out-of-hours arrangements are able to be delivered.

Recommendation 14

HSC Trusts should continue to implement the strategic planning framework for major diagnostic imaging equipment. There should be regional oversight and co-ordination of the capital base to ensure that imaging assets are utilised effectively.

Governance

- 4.51 Section 1 of this framework emphasised the importance of effective systems of governance for imaging services. Good governance has a number of aspects including, but not limited to, the setting of appropriate standards, ensuring evidence-based practice, proper risk management, effective audit and patient involvement.
- 4.52 The review has given detailed consideration to these issues and identified a range of proposals on how the governance of HSC imaging services could be strengthened to support the strategic vision outlined in this document.
- 4.53 In the first instance we believe that imaging services would benefit from a patient-focussed assessment and accreditation programme designed to help medical imaging services ensure that their patients receive consistent high quality care delivered by competent staff working in safe environments.

- 4.54 Accreditation is an important quality indicator, both for HSC Trusts as providers and for the HSC as a whole. It is also a vehicle for ensuring that there is an appropriate level of standardisation in practice regionally. This consistency of approach, both clinically and organisationally, will be an important supporting component to networks of care. Accreditation can also provide an evidentiary mechanism for ensuring services are planned and provided in line with our strategic guidelines.
- 4.55 The HSCB is currently considering the most effective model for this and is working with the relevant accreditation bodies.
- 4.56 This framework has discussed the potential that networks of care have to offer in terms of risk mitigation, quality improvement and service resilience. This approach will mean that the future planning, co-ordination and delivery of imaging services will increasingly need to take place within hospital and clinical networks.
- 4.57 The development of referral guidelines and clinical pathways for imaging procedures will be an essential governance component of these network approaches. Best practice shows the benefits they bring. The evidence suggests that further development of clinical pathways within appropriate clinical environments has the potential to deliver significant quality improvements including increased decision support for referrers, appropriate and timely primary care access to complex imaging and greater multi-disciplinary working. Primary care electronic referral to imaging has the potential to improve the safety and flow of referrals from primary to secondary care. GP direct access to imaging services would also potentially reduce the need for a first outpatient appointment and also at least one review to discuss the result with the patient.
- 4.58 The review is also of the view that research is an important indicator of good clinical governance in imaging services. The evidence suggests that patients who receive care in research-active institutions have better health outcomes than patients who are treated in a non-research environment. Participation in research has also been shown to give patients a better understanding of their

condition, improve patient satisfaction and allow all of us as service users to give something back to our NHS by contributing to the development of better treatments. Research also raises much needed funds to help sustain critical services.

4.59 By embedding research in imaging services therefore we can drive up the standard of healthcare for our patients, improve the patient experience and leverage income for the HSC.

4.60 Finally, and most importantly, the review has concluded that there is a compelling case for the establishment of a regional imaging board for Northern Ireland. This body would fulfil a range of governance roles and functions which will be vital to achieving the vision in this framework, including:

- working at regional and local planning levels to deliver a 5 year workforce and investment plan for imaging services which takes account of the recommendations of this review;
- working at regional and local planning levels to support the establishment of appropriate regional networks of care across the region, including adult, paediatric and interventional radiology, cardiology and obstetrics networks;
- overseeing the development of appropriate clinical guidance and regional patient imaging pathways to support networks of care;
- advising on quality and safety of imaging services both in the HSC and the independent sector, including service accreditation;
- encourage collaborative research to enhance evidence-based practice and its rapid diffusion into clinical practice;
- providing professional leadership for, input to and influence over imaging services and development at policy, strategic and operational levels;
- planning and implementing cross-professional training and education.

4.61 Overall these governance initiatives should improve efficiency and reliability of services. They are summarised in the following recommendations.

Recommendation 15

The HSC should develop and implement a regional phased programme of imaging accreditation by year 1 of the framework with all HSC Trust sites accredited by December 2019.

Recommendation 16

Where regional or local networks of care are established they must be accompanied by robust clinical guidance and appropriately agreed care pathways.

Recommendation 17

HSC Trusts, in collaboration with an imaging board (see recommendation 19) should undertake detailed local consultation with primary and secondary care imaging referrers to ensure robust referral pathways are in place including appropriate methods of results acknowledgement.

Recommendation 18

HSC imaging services should foster a research culture with close integration between clinical and research departments.

Recommendation 19

The Department should establish a Medical Imaging Network or 'Imaging Board' to oversee implementation of the recommendations of the review to provide continuing professional advice and support on issues such as workforce, equipment and strategic planning.

SECTION 3: FULFILLING THE VISION

- 5.1 The guiding principles and strategic recommendations identified within this framework are each a part of an overall vision for a high quality imaging service across the province. Their implementation will transform how imaging services are planned and provided.
- 5.2 Each recommendation is set out within themes which we recognise are vital components to achieving this transformational agenda. In ICT for example we have the potential to be an international innovator by fulfilling the potential of NIPACS; ensuring a single RIS/PACS solution across all acute sites, integrated with our care record systems and expanded into new clinical areas such as cardiology and obstetrics.
- 5.3 We recognise too how these technological advances will underpin and support innovative models of workforce recruitment, retention and training, and better ways of organising existing human resources. That is why a fundamental focus of this review has been on the development of enhanced clinical networks to provide regional resiliency and specialist support across the region underpinned by robust guidance and clinical pathways.
- 5.4 These 'networks of care' offer better ways of making use of scarce specialist expertise, of standardising care and improving access for patients across the region. They can create the systems that ensure patients receive timely and appropriate investigations and are referred, when necessary, to other specialist services within robust pathways.
- 5.5 These networks will also enable a greater spread of innovation and create an environment that allows self-organisation, development and learning; features that have been shown to improve outcomes for patients and to assist with staff retention.

- 5.6 We recognise that a key priority for investment must be in closing the vacancy positions in key posts and in enhancing the available skill mix. In the longer term we recognise that we will need effective systems and processes as well as underpinning standards in place to ensure effective planning decisions. Appropriate governance, both local and regional, will be vital to underpin all of this work.
- 5.7 The successful implementation of this framework will require HSC wide support from clinicians and managers alike as well as a driving force at a regional level. We therefore have emphasised the role for a new regional imaging board with strong clinical leadership. In designing this imaging board careful consideration will need to be given to how existing clinical networks such as the MRCN will function.
- 5.8 It will be important that the agencies responsible for implementing each recommendation carefully consider the underpinning clinical evidence and recommendations from the workstream reports when developing comprehensive implementation plans of the review's strategic recommendations.
- 5.9 Some of the costs relating to this framework for imaging services are inextricably linked to other regional strategies across health care and where appropriate they have the potential to be incorporated and accounted through those strategies. However it is estimated that the recurrent cost of full implementation of the recommendations are expected to be in the region of £16m per annum. Non-recurrent costs on full implementation are expected to be in the region of £0.6m– notwithstanding further cost issues that may emerge through normal business in the interim. However these figures are subject to affordability as well as contractual and procurement requirements, both in financial terms and in recognition of local and global constraints on resources.

SUMMARY OF RECOMMENDATIONS

Workforce

1. It is recommended that the HSC takes urgent action to close the unfilled vacancy positions in the radiology workforce. This should include:
 - further increases in the total number of national training places in radiology in the NI Radiology Training Scheme up to 46 by the intake of August 2017, increasing to 54 by 2020;
 - an international recruitment campaign commencing in year 1 of the framework aimed at filling at least 15 clinical radiology posts over the next 4 years;
 - the HSC should develop local and regional workforce retention strategies to promote and facilitate recently retired radiologists to continue to work on a reduced basis following their retirement. This should aim to deliver on average 3 PAs per week per radiologist for at least 3 years after their retirement.
2. HSC Trusts should put in place the necessary arrangements to ensure that there is a clear understanding of the deployment, education and training of radiographers at all levels, together with the associated resources and implications.
 - This should include a structured career progression pathway for radiographers, through locally available specialist training in specific areas and at all levels to promote and optimise skill mix opportunities within imaging teams.
 - Building on the progress made with fluoroscopy and ultrasound reporting, the HSC plan should include working towards ensuring that between 20-40% of plain film examinations are reported by radiographers by 2020.
3. The HSC should put in place the necessary training and workforce planning mechanisms to ensure that sufficient numbers of cardiac physiologists and medical physics staff are available to meet the needs of service with respect to functional imaging techniques and medical physics support for imaging services including ultrasound.

Networks of Care

4. The HSC should put in place a regional hub and spoke network model for the delivery of interventional radiology services in Northern Ireland by 2018/19.
5. The HSC should put in place appropriate clinical pathways and supporting network models to ensure children can access safe clinical paediatric radiology services, in and out-of-hours.
6. The HSC should build on the work of the Modernising Radiology Clinical Network in prioritising the development of specialist reporting networks for key radiology modalities including:
 - a regional plain x-ray reporting network by 2018
 - a MRI regional reporting network by 2019
 - a CT regional reporting network by 2020
7. The HSC should establish a regional obstetric imaging clinical network to take forward the development of a new service model for obstetric imaging and ensure regional uniformity in the quality and provision of care.
8. The HSCB should finalise the implementation of local service models for CMR and echocardiography. The planning estimates for these services should be reviewed on a yearly basis.
9. The HSC should put in place enhanced pathways for patients with chest pain which include early access to imaging investigations in line with the regional model developed by the cardiology workstream.

ICT

10. The HSC should put in place a single regional NIPACS solution across all sites in Northern Ireland with sufficient integration with the electronic care record (ECR) system so that both images and reports can be reviewed on ECR alongside other patient information.

11. NIPACS should also be expanded to include the administration, storage, processing and viewing of all appropriate medical images in obstetrics, cardiology and other appropriate fields.

Investment

12. Proposals for the future development of the imaging needs of the population must be considered in line with the guiding principles outlined in section 1 of this framework.
13. Recurrent funding should be made available so that imaging services can provide the required level of examinations and reports to meet current and projected demand and address backlogs where they exist. This will include optimising use of the imaging equipment base, promoting skill mix, and ensuring that requirements for 7 day access to services and out-of-hours arrangements are able to be delivered.
14. HSC Trusts should continue to implement the strategic planning framework for major diagnostic imaging equipment. There should be regional oversight and co-ordination of the capital base to ensure that imaging assets are utilised effectively.

Governance

15. The HSC should develop and implement a regional phased programme of imaging accreditation by year 1 of the framework with all HSC Trust sites accredited by December 2019.
16. Where regional or local networks of care are established they must be accompanied by robust clinical guidance and appropriately agreed care pathways.
17. HSC Trusts, in collaboration with an imaging network board (see recommendation 19) should undertake detailed local consultation with primary and secondary care imaging referrers to ensure robust referral pathways are in place including appropriate methods of results acknowledgement.

18. HSC imaging services should foster a research culture with close integration between clinical and research departments.
19. The Department should establish a regional medical imaging network or 'imaging board' to oversee implementation of the recommendations of the review to provide continuing professional advice and support on issues such as workforce, equipment and strategic planning.

GLOSSARY OF ABBREVIATIONS

AHP	Allied Health Professionals
BCH	Belfast City Hospital
CMR	Cardiac magnetic imaging
CT	Computed tomography
DoH	Department of Health
ECR	Electronic Care Record
HSC	Health & Social Care
HSCB	Health & Social Care Board
HSCT	Health & Social Care Trust (Belfast, Northern, Southern, South Eastern, Western)
ICT	Information and communications technology
IR	Interventional radiology
MRCN	Modernising Radiology Clinical Network
MRI	Magnetic resonance imaging
NI	Northern Ireland
NICE	National Institute Of Clinical Excellence
NIMDTA	Northern Ireland Medical & Dental Training Agency
NHS	National Health Service
NIPACS	Northern Ireland Picture Archiving & Communications System
OOH	Out-of-hours
PHA	Public Health Agency
RCR	Royal College of Radiologists
RIS	Radiology Information System
RQIA	Regulation & Quality Improvement Authority
RVH	Royal Victoria Hospital
SAMMD	Strategic Asset Management of Medical Devices
UK	United Kingdom

Types of Medical Imaging

X-Ray

Plain X-rays or radiographs require the use of ionising radiation and this is the most commonly known imaging technique. Examples of its use include x-rays of the bones to look for fractures or degenerative change and chest x-rays to look for signs of pneumonia or heart failure.

Fluoroscopy

Fluoroscopy is a special application of x-ray where continuous x-ray exposure can give real time (live) images. Contrast agents can be administered orally or by injection to demonstrate dynamic processes for example during a barium meal. It can be used during surgical or medical procedures to see the position of inserted medical equipment or devices e.g. in orthopaedics, cardiology or urology. Like radiography, it is a planar (or projection) method in which body structures are superimposed upon each other in the images.

Computed Tomography (CT)

CT provides a cross-sectional (or slice) view of the internal body structures, thus overcoming the problem of superimposed structures that is inherent in plain film radiography and fluoroscopy. During a CT scan x-rays are passed through the body from multiple directions and high-speed computing is used to produce a series of “slices”. These images can often be viewed in multiple planes and further more complex post-processing can be performed before the final report is prepared. Although CT was first developed over thirty years ago, significant advances continue to be made providing opportunities to explore new imaging techniques and to improve patient care in many fields of medicine.

CT is often used in urgent and emergency conditions as well as in the diagnosis and follow-up of patients with suspected cancer. It can also be used to guide biopsy and drainage procedures. It should be noted that although CT provides a lot of clinical information, patients are exposed to much more ionising radiation with CT than with plain radiographs.

Ultrasound Imaging

Ultrasonography uses high frequency sound waves to visualise internal organs of the body. It produces cross-sectional (live) images which can be used for diagnosis or to guide the positioning of inserted medical instruments e.g. for taking tissue biopsies. By utilising the Doppler-effect (the change in frequency of sound waves when they are reflected by moving structures) it is possible to measure the flow rate of blood in arteries and veins. Ultrasound imaging is considered a relatively safe procedure compared with methods that use ionising radiation (such as x-rays) and is the modality of choice for monitoring foetal development. It is increasingly used for musculoskeletal examinations of joints. 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 in absorbing sound waves, and the inability to image through bone and air, e.g. lung and bowel loops.

Mammography

Mammography is an X-ray technique for imaging breast tissue and has been undertaken on dedicated equipment since 1969. It is low energy x-ray of the breast, often used to screen for breast cancer and for other diagnostic or follow-up studies. The application of computers has revolutionised diagnostic imaging equipment and techniques. As part of a regional programme, historical plain film is being replaced by full field digital imaging (FFDM). New imaging modalities have been developed including breast MRI and breast tomosynthesis examination.

Magnetic Resonance Imaging (MRI)

MRI is a non-invasive diagnostic imaging modality which uses a high magnetic field, radio waves and a computer to produce detailed images of internal body structures. MRI provides much greater soft tissue contrast than CT, making it especially useful in neurological, musculoskeletal, cardiovascular and some oncological diseases. Images are directly acquired in any plane and no ionising radiation is used. One development with MRI is the use of magnets of high strengths e.g. 3 Tesla machines, which can give increased quality images in certain applications. The high magnetic field means that care must be taken to identify patients with metal

containing implants such as pacemakers or cochlear implants as this will often contra-indicate the examination.

Interventional Radiology (IR)

IR is a minimally invasive technique commonly used for diagnosis and especially for the treatment of an increasing number of conditions. Vascular interventions include the ability to treat patients with complex conditions such as aortic aneurysms. Interventional neuro-radiologists can treat patients with ruptured intra-cranial aneurysms and some patients with strokes. Non-vascular intervention includes the placement of drainage tubes in obstructed kidneys or abscesses deep within the body. RIG tubes can be placed by radiologists to provide non-oral feeding. Many radiologists will use imaging techniques to guide needles and catheters to the site of concern in biopsy or drainage procedures. Sometimes diagnosis and treatment is carried out as part of the same procedure and IR is known to reduce infection, maximise recovery and reduce bed stays, with many patients attending day procedure units.

Nuclear Medicine (Radionuclide Imaging)

A radioactive tracer is combined with different compounds to form a radiopharmaceutical that localizes to a particular anatomic or diseased structure. The gamma radiation emitted by the target body organ or system, following the injection of the radioactive pharmaceutical, is detected using a gamma camera which shows the distribution of the radiopharmaceutical within the body. This information is processed to produce an image. The radiation doses used are usually relatively modest. This can be used to examine the heart, lungs, thyroid, liver, gallbladder or bone.

Nuclear Medicine requires the administration of short lived radioactive materials (called radiopharmaceuticals) in order to demonstrate information about the metabolic activity or function of an organ or system. The radiopharmaceutical is chosen so as to be appropriate to the clinical condition of the patient and is usually administered by intravenous injection. It accumulates in the organ or body system of interest and emits gamma rays (which are similar in nature to x-rays).

Radiopharmaceuticals require specialised facilities for their production and special licences for their administration.

Pharmaceutical Contrast Agents / Media and Radiopharmaceuticals

The administration of pharmaceutical contrast agents or contrast media help visualise organs and blood vessels with more clarity and greater image contrast. They can be administered by many routes but are commonly given orally or via intravenous injection. Pharmaceutical contrast agents are used in many diagnostic imaging investigations, including many fluoroscopic, CT and MRI examinations. Ultrasound contrast agents have also been developed but are not often used.

Dual Energy X-Ray Absorptiometry (DEXA)

DEXA is a specialised low radiation dose form of planar digital radiography used for measuring bone mineral density. It is used primarily for diagnosis of osteoporosis, estimating fracture risk and monitoring the effect of some treatments. Modern DEXA scanners incorporate the ability to acquire digital radiographic images of the spine in order to indicate the presence of vertebral fractures.

SPECT (Single Photon Emission Computed Tomography)

SPECT is a sophisticated type of nuclear medicine imaging commonly used to assist diagnosis in nuclear medicine. It generates tomographic and 3D nuclear medicine images to enhance diagnostic accuracy.

Positron Emission Tomography (PET) and PET-CT

PET is a more sophisticated type of nuclear medicine slice imaging technique. It uses very short-lived radioactive materials attached to a biologically active molecule to allow the visualisation of metabolic processes in the body by producing images of the distribution of radiopharmaceutical. 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. Like other nuclear medicine imaging techniques PET gives functional information about the biological behaviour of tissues and the activity of disease processes. However, PET scanners utilise a ring of gamma radiation detectors and are dedicated for this purpose. As with SPECT, when combined with

an x-ray CT scanner (PET/CT), as is now generally the case, functional and anatomical images can be acquired at the same time and fused to display the anatomical site of functional abnormality. Fusion technology has also led to PET/MRI which is currently used in academic and research settings, but has the potential to play an important role in medical imaging for example in the brain and potentially for breast cancer screening as well as specialised indications such as small joint imaging of the foot.

Tele-radiology

Tele-radiology is the transmission of (digital) medical images via internet connections for interpretation and reporting in a remote location. It can be used to provide 24 hour cover for emergency imaging or to obtain expert speciality interpretation of complicated or unusual cases. It is also used to permit radiologists to provide reporting cover from home or other remote sites where required. It is currently used in Northern Ireland to provide cover for CT and also Plain Film reporting by NHS and IS partners. It requires access to high quality PACS workstations to be truly effective.

APPENDIX 3

IMAGING REVIEW - PROJECT BOARD MEMBERSHIP

Professional representation		
Name	Representative role	Other relevant information
Dr John Lawson	Co-Chair and lead clinician for the imaging review	Radiology Specialty advisor to the CMO
Dr Ronan McNally	Adult radiology workstream radiology lead	Consultant Radiologist South Eastern Trust
Jeannette Robinson	Adult radiology workstream radiography lead	Radiographer Manager Southern HSC Trust
Dr Seamus McAleer	Adult radiology workstream cancer advisor	Senior Lecturer and Consultant in Clinical Oncology Belfast Trust
Dr Mark Harbinson	Cardiology workstream lead	Senior Lecturer QUB and Consultant Cardiologist Belfast Trust
Dr Anne Paterson	Paediatric workstream lead	Sub-directorate lead for Paediatric Radiology in the RBHSC and Specialty Co-ordinator for Radiology in the Belfast Trust
Dr John Manderson,	Obstetrics workstream joint lead	Consultant Obstetrician (Fetal Medicine Subspecialist) and Lead for Obstetric Ultrasound South Eastern Trust Chairman NI Obstetric Ultrasound Forum
Dr Stephen Ong	Obstetrics workstream joint lead	Consultant Obstetrician, Belfast Trust
Jackie McGeagh	Obstetrics workstream joint lead. Public Health Consultant	PHA
Dr Anton Collins	Interventional radiology workstream lead	NI Medical and Dental Training Agency (NIMDTA) training Programme Director for Radiology
Dr Adam Workman	Medical Physics advice to all workstreams	Regional Medical Physics Service – Head of Radiological Sciences and Imaging
Hall Graham	Head of Primary Care	Regulation and Quality Improvement Authority (RQIA)
Dr Eddie O'Neill	Primary Care	HSCB
Des O'Loan	ICT Strategy and Programme Control	HSCB
Beth Malloy / Sara Long	Commissioning	HSCB
Maria Wright	Service Improvement	HSCB and Modernising Radiology Clinical Network (MRCN)
Dr Muhammad Sartaj	Public Health Consultant	PHA
Nicky Harvey	Imaging ICT	Business Services Organisation, NIPACS Regional Service Manager
Professor John E Moore	Patient representative	Patient Client Council (PCC)

Department of Health representation		
Catherine Daley / Deborah McNeilly	Senior Responsible Owner and Co-Chair	Healthcare Policy Group
Jackie Johnston	Project Director	Healthcare Policy Group
Sean Ferrin	Project Manager	Healthcare Policy Group
Helena Brown	Researcher and Assistant Project Manager	Healthcare Policy Group
Peter Barbour	Workforce	Healthcare Policy Group
Dr Martin Bradley	Medical advisor	Chief Medical Officer's Group
Brian Godfrey	Safety Strategy Unit	Chief Medical Officer's Group
Jennifer McCrea	Hospital Information	Resources and Performance Management Group
Adrian Murphy	Infrastructure Investment Directorate	Resources and Performance Management Group
Hazel Winning	Allied Health Professional Lead	Nursing, Midwifery and AHP Advisory Directorate
Jemima Keyes	Nursing Officer	Nursing, Midwifery and AHP Advisory Directorate
External expert reference group		
Dr Pete Cavanagh	Retired consultant radiologist (England)	Former vice-president of the Royal College of Radiologists
Dr Richard Clements	Consultant radiologist (Wales),	Chair of the Welsh Standing Committee of the Royal College of Radiologists.
Mr Richard Evans OBE	Professional Body Representative	Chief Executive Officer of the Society and College of Radiographers
Dr Beatty Crawford	Former Associate Professor of Radiology, University of Connecticut, USA	Retired Consultant Radiologist

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