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An Investigation of Implementation within the UK Radiography Profession

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An Investigation of Implementation within the UK Radiography Profession

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Declaration

'Yr wyf drwy hyn yn datgan mai canlyniad fy ymchwil fy hun yw'r thesis hwn, ac eithrio lle nodir yn wahanol. Caiff ffynonellau eraill eu cydnabod gan droednodiadau yn rhoi cyfeiriadau eglur. Nid yw sylwedd y gwaith hwn wedi cael ei dderbyn o'r blaen ar gyfer unrhyw radd, ac nid yw'n cael ei gyflwyno ar yr un pryd mewn ymgeisiaeth am unrhyw radd oni bai ei fod, fel y cytunwyd gan y Brifysgol, am gymwysterau deuol cymeradwy.'

Rwy'n cadarnhau fy mod yn cyflwyno'r gwaith gyda chytundeb fy Ngrichwyliwr (Goruchwylwyr)'

'I hereby declare that this thesis is the results of my own investigations, except where otherwise stated. All other sources are acknowledged by bibliographic references. This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree unless, as agreed by the University, for approved dual awards.'

I confirm that I am submitting the work with the agreement of my Supervisor(s)'

Abstract

Background

Implementation science (IS) aims to research and promote evidence-based healthcare. Practice 'context' is known to directly impact research uptake. There is a paucity of evidence demonstrating how IS and related theories are contributing to evidence adoption in medical radiography practice.

Study Aim

This study investigated the state of implementation in UK radiography practice by researching practice context (as described by the PARIHS (IS) framework); revealing factors which might enable or hinder evidence adoption in clinical practice; and promoting effective policy.

Method

A standalone mixed method systematic review was undertaken to investigate the state of IS and related theory use in radiography. A convergent mixed methods design was used for the main study. The *quantitative* arm employed a modified 'Context Assessment Index' (CAI) instrument in a national survey of radiographers (n=152 valid responses). Data were then used to calculate a national Context Index (CI) for radiography, and practice related information. The *qualitative* arm used semi-structured interviews (n=20) and Thematic Analysis to elicit views about current practice and factors which might impact evidence-based interventions in radiography. Data were then combined to gain additional insight, and significant issues were interpreted with Systems Theory lenses. A dissemination event with key stakeholders was also undertaken.

Findings

There was little evidence in the systematic review indicating that IS and related theories were making an impact on evidence-based radiography. Research was mainly of low quality, however data was gathered highlighting implementation interventions that had been tried in practice, together with key barriers and enablers.

The national CI for radiography was relatively high (a positive indicator for practice related evidence adoption) and specific factors with high and low scores enabled context mediators to be identified. Statistical testing showed the modified instrument was robust and applicable to professions outside nursing.

Three themes were identified in the qualitative data, highlighting the impact that context has at all levels of influence such as government policy, organizational behaviour, and workplace context. The powerful roles that individuals have on radiographer practice showed issues of professional dominance, apathy, and emergence. Combining data from both arms highlighted a disparity between a relatively strong quantified CI, and the enduring implementation and contextual challenges, found in the qualitative data. This study also highlighted the potential insensitivity of the CAI to individual actor traits. The dissemination and engagement event with a key national body showed promise in embedding implementation as a core component of future policy for evidence use in the profession.

Conclusions

Policy makers, organizations and radiographers should be aware that implementation efforts within other health and care domains might not easily or directly translate to the radiography context. There is potential for strong implementation in radiography with a need to facilitate and empower radiographer leaders at all levels in the health system. The reported radiography contextual barriers and enablers should inform future research in this regard. This study is unique in that PARIHS, and Systems Theory lenses, were used to guide the research and interpret qualitative data, and the first study to calculate the CI for radiography in the UK. This study adds to the body of knowledge on implementation in the radiography setting.

Acknowledgements

Firstly, I would like to thank the dedicated radiographers who generously gave up some of their time to participate in this study.

I would like to offer sincere gratitude to my academic supervisors, Professor Christopher Burton, and Dr Lynne Williams. Their expertise, and enthusiasm in the field of implementation, was a steady source of inspiration for me throughout the professional doctorate journey. I would also like to thank Professor Jo-Rycroft Malone for her guidance and inspiration at the outset of the course, and of course for her research and publications on the PARIHS framework itself. The support of other academic staff including Dr Sion Williams; Dr Rob Couch; Nyree Hulme, and Heledd Owen Griffiths was also invaluable and much appreciated. Furthermore, the support of my colleagues on the course, including those at the outset, and those who survived to the end including, Dr Sian Davies and Dr Angela Roberts, was essential and much valued! The advice of Professor Brendan McCormack, and Dr Paul Slater, in the application, adaptation and testing of the modified radiography CAI instrument, was also invaluable in this study.

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Er Cof am Goronwy Wyn Jones.

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Abbreviations & Glossary

AEC – Academic Ethics Committee (University)
AHP – Allied Health Professions / Professionals
C – Context (PARIHS Construct) & (CAI - Culture in 3 Factor Model)
CAI – Context Assessment Index / or CAI individual Item e.g. CAI 37 is CAI statement #37
CAS – Complex Adaptive Systems (Theory)
CASP – Critical Appraisals Skills Programme (Research Quality Assessment Tools)
CFA – Confirmatory Factor Analysis
CFI - Comparative Fit Index
Ch. – Chapter
Chi-square (X^2) – Absolute Fit Index
CI – Context index
Ci – Confidence Interval
CP – Collaborative Practice (CAI 5 factor construct)
CPD – Continuous Professional Development
CT – As in Computerised Tomography (Scanner /Scanning)
E- Evaluation (PARIHS Construct) & (3 Factor CAI model)
E3 – (CAI – Evaluation in 3 Factor Model)
E5 – Evaluation (CAI 5 factor construct)
EBM – Evidence Based Medicine
EBN – Evidence Based Nursing
EBP – Evidence Based Practice
EBRP – Evidence Based Radiography Practice
EFA – Exploratory Factor Analysis
EIP- Evidence Informed Practice (CAI 5 factor construct)
eta squared (statistic) – represents the proportion of variance (range 0 to 1)
F – Facilitation (PARIHS Construct)
GFI – Goodness-of-Fit Statistic
i-PARIHS - A revised version of the original PARIHS framework, called the Integrated Framework
IR – Implementation Research
IS – Implementation Science
ISRRT - The International Society of Radiographers and Radiological Technologists
KMO - Kaiser-Meyer-Olkin – (measure of sampling adequacy)
Kt – Knowledge Transfer
KT - Knowledge Translation
L – Leadership (PARIHS Context Sub-element) & (CAI 3 Factor Model)
MCAR - Missing Completely at Random
MDT – Multi-Disciplinary-Team
ME – Margin of Error
MLMs - Middle-Level Managers (clinico-managers)
MMR – Mixed Methods Research
MR or MRI – Magnetic Resonance Imaging (Scanner / Scanning)
NFI - Normed-Fit-Index
NHS – National Health Service (UK)
NICE - National Institute for Health and Clinical Effectiveness (UK)
P# - Participant & Number (Qualitative Data)
PARIHS - The 'Promoting Action on Research Implementation in Health Services' Framework
PB – Practice Boundary (CAI 5 factor construct)
PDR – Personal Development Review
PDSA – Plan Do Study Act (cycle)
PgC – Post Graduate Certificate
PRISMA - Preferred Reporting Items for Systematic Reviews and Meta-Analyses
ProfDoc – Professional Doctorate
QUAN – quantitative arm of the study (Mixed Methods conventional notation system)

QUAL – qualitative arm of the study (Mixed Methods conventional notation system)
QUAN+QUAL – representing a concurrent mixed methods study (equal status)
RCN – Royal College of Nursing (UK)
RCR – Royal College of Radiologists (UK Professional Body)
RCR - The Royal College of Radiologists (UK)
RMR - Root mean square residual
RMSEA – Root Mean Square Error of Approximation
RP – Respect for Persons (CAI 5 factor construct)
SCoR – Society and College of Radiographers (UK Professional Body & Trade Union)
SEM – Structural Equation Modelling
SNA – Social Network Analysis
SRMR – Standardised Root Mean Square Residual
STTI - Sigma Theta Tau International
TLI – Tucker–Lewis index
U/S – Ultrasound (Scanning) or Sonography
WIDER - Workgroup for Intervention Development and Evaluation Research

Foreword

In undertaking a Professional Doctorate pathway for career development, the purpose of this project was to satisfy the educational and personal development aspirations of the author as a healthcare professional. The programme was grounded in 'Implementation Science', with a strong emphasis on developing expert clinicians to practice at an advanced level, supported by rigorous training in applied academic research .

The programme gave the opportunity for the academic school at the university, to "further embed the international strength of our research into the synthesis and implementation of evidence for the development of healthcare practice and organisations" (Course Handbook). The purpose of the project in this context, therefore, was to provide an opportunity for health professionals to synthesise advances in implementation by demonstrating advanced scholarship, rather than to "add to the body of knowledge" per se, as in traditional PhD pathways, where the generation of original knowledge is the main focus. There is an anticipation that by undertaking the implementation project however, that there will be an advancement in knowledge in terms of "what works in implementation through immersion in implementation work". The aims and objectives of this project was therefore linked to this expected academic programme outcome.

1. Chapter 1 – Background

1.1 Study Overview

This study advances knowledge on the implementation state of the radiography profession in the UK, and the context within which radiographers practice at multiple levels within the healthcare system. It offers new insights into an area previously unexplored, from an implementation science perspective, and illuminates the context by 'shining a new light' on what is known about how evidence is used, accessed, and operationalised in an arguably unique radiography practice setting.

The study begins by exploring the nature of evidence use in healthcare, and relating this to practice, and then moves on to explore the knowledge and theory surrounding implementation currently, and the wider implications of needing a functional, and receptive context to evidence use and practice change. There is much discourse in research surrounding the utility and effectiveness of implementation models and frameworks theorised to guide effective and sustained practice improvement, and this will be critiqued in this section, before moving on to explain the rationale of this study, including relevant supporting literature. This chapter will then introduce and justify the implementation framework chosen to underpin the thesis, together with its constructs, shown to facilitate the adoption of evidence-based practice, leading on to the research question and the aims and objectives of this thesis, together with the project organising framework. Each chapter is then summarised to orientate the reader.

1.2 Part A: Introduction

The practice of radiography in the UK has arguably its own unique background and state of evolutionary advancement (Field & Snaith, 2013), with evidence of its advancing scope of practice development, having a major impact on the quality and timeliness of diagnosis and treatment (Snaith, Milner, & Harris, 2016). More accurate and timely diagnosis, is 'key' to releasing potential health gains, however the evidence base and methods of evaluating the efficacy of diagnostics, trail behind research into treatments and outcomes (Heneghan & Godlee, 2013). The National Health Service has published a long term plan, in which early and accurate diagnosis aligned with evidence based interventions is shown to be paramount in improving health outcomes (National Health Service (England), 2019). Healthcare delivered on the basis of best quality evidence has arguably never been more important, and reports still persist of unexplained variations in practice with increasing costs and drains on resources (Heneghan & Godlee, 2013). 'Reducing patient harm' is a factor that has been identified as a major area for reducing costs and improving healthcare outcomes (Nabhan et al., 2012). This chapter will initially introduce concepts surrounding the development and delivery of evidence-based healthcare relating to health professions and lead on to critique relevant research into the major theories and methods proposed for translating sound evidence into practice and relate this to the current state of radiography practice. The notion of 'evidence' itself, in the context of optimised patient care, will also be critiqued and later explored in relation to the postulated theories on adoption principles, and methods hypothesised and shown to be effective in successfully implementing evidence-based practice. Recent systematic reviews into implementation strategies shown to be effective in a range of Allied Health Professions (Jones, Roop, Pohar, Albrecht, & Scott, 2015; Scott et al., 2012), did not include radiography, thus leaving a gap in this knowledge area and an area for exploration in this study.

1.2.1 Evidence Based Radiography Practice

Radiographers have been practicing in the UK for over one hundred years, with the professional body being established in 1920 by the formation of the Society of Radiographers (SCoR), and later in the 1960's with statutory regulation under the Council for Professions Supplementary to medicine (Nixon, 2001). The current UK regulator's (Health and Care Professions Council, 2018b) definition of radiography is stated as:

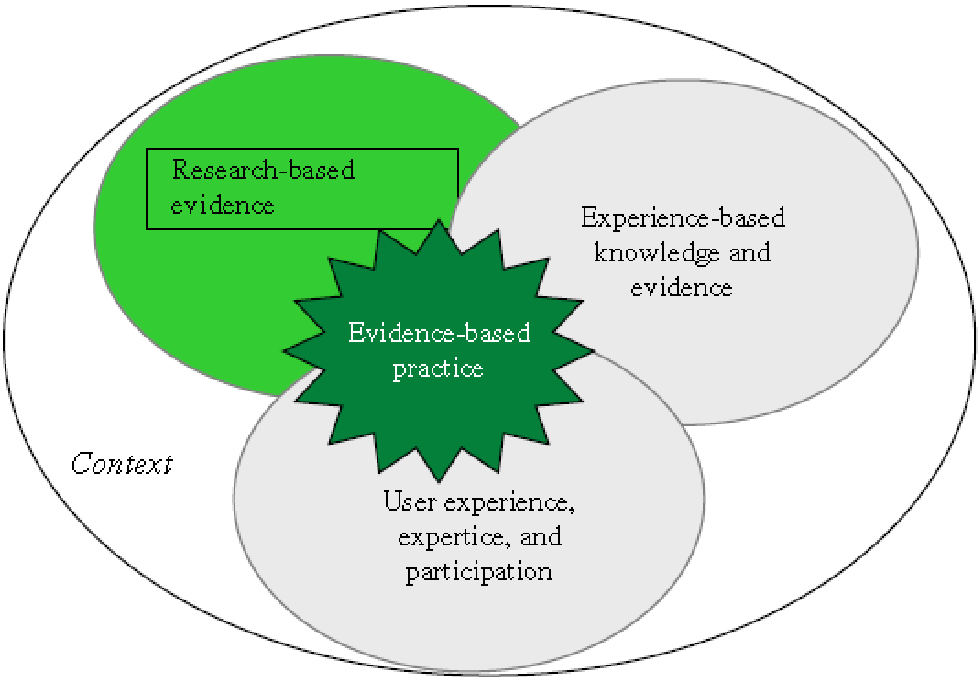
"Therapeutic radiographers plan and deliver treatment using radiation"

&

"Diagnostic radiographers produce and interpret high-quality images of the body to diagnose injuries and diseases"

As recently as 2008, authors were stating that the perceived low professional status of radiographers, together with a lack of self-esteem, was negatively impacting on the profession's ability to assume new roles and responsibilities in order to implement the latest EBP, even though they were expected to do so (Sim & Radloff, 2009). Historically, professional statutory regulation alone, has not been seen to increase the status of a profession in its recognition, nor its ability to self-develop, and radiography has suffered with its practitioners often being conceptualised as "passive technicians implementing the designs of others" (p.31) (Nixon, 2001). Hafslund, Clare, Graverholt, and Wammen Nortvedt (2008) suggest that, as radiographers develop evidence-based practice as a core component of radiography training and practice, the development of the profession as a discipline, should rapidly ensue thereafter, seemingly key in supporting the NHS's long term plan, in developing roles to provide for future service demand and increasing complexity (National Health Service (England), 2019). It has been suggested that the route to professional recognition is related to a profession's ability to define its attributes and show its efforts towards achieving professional recognition (Millerson as cited in Sim & Radloff, 2009). A review of the historical emergence and contemporary challenges in radiography practice is presented in Appendix 1. further examining radiography as a distinct profession, both in the UK and internationally, and links to potential contextual challenges, further supporting the rationale for this study, and in particular its relationship with other actors within radiological sciences. There is paucity of evidence generation and evidence use in the practice of radiography, and historically, there has been over reliance on tradition and subjective experience as a practice norm (Hafslund et al., 2008). In order to develop expertise in a profession, there needs to be critical reflection and active challenging of pre-suppositions by examining: professional relationships; individual and group psychology; power relations and ethics extant within normal practice (Yielder & Davis, 2009). In their paper on evidence based radiography Hafslund et al. (2008) discussed EBP in Radiography, and introduced the concept of 'clinical context' into their model (Figure 1).

Figure 1 Evidence Based Radiography - Halfslund et.al (2008)

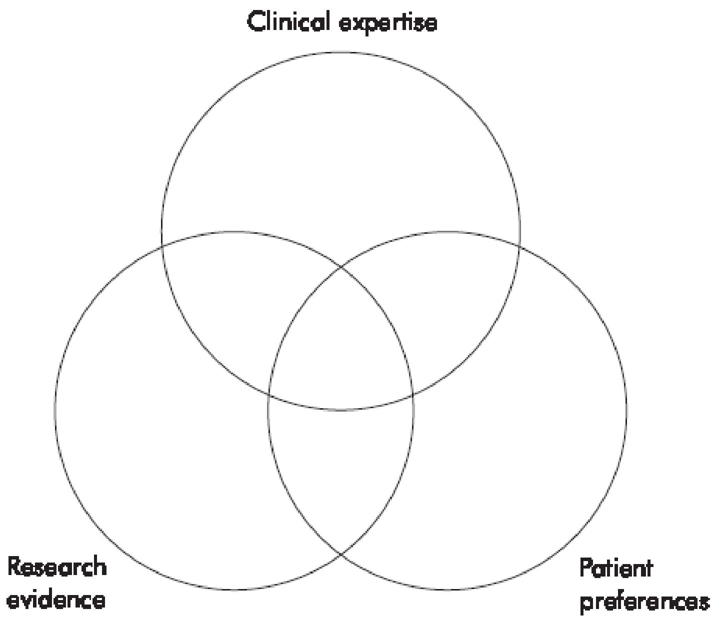


Theory and research show that clinical or practice context is an important factor when implementing evidence-based practice. Context, at various levels, has been shown to be a an important factor in evidenced health interventions, however, it is an often neglected factor when implementation research (IR) is designed or conducted (Johansson, Åström, Kauffeldt, Helldin, & Carlström, 2014; Rycroft-Malone, 2007) . There is little or no research evidence examining the context of the radiography profession specifically in IR terms. The importance of clinical context to evidence use will be discussed later in this chapter. The paucity of research relating to KT adoption, effective KT strategies and clinical context of the radiography profession led to the development of the aims and objectives of this professional doctorate project, which are presented later in this chapter.

1.2.2 The Development of Evidence-Based Practice

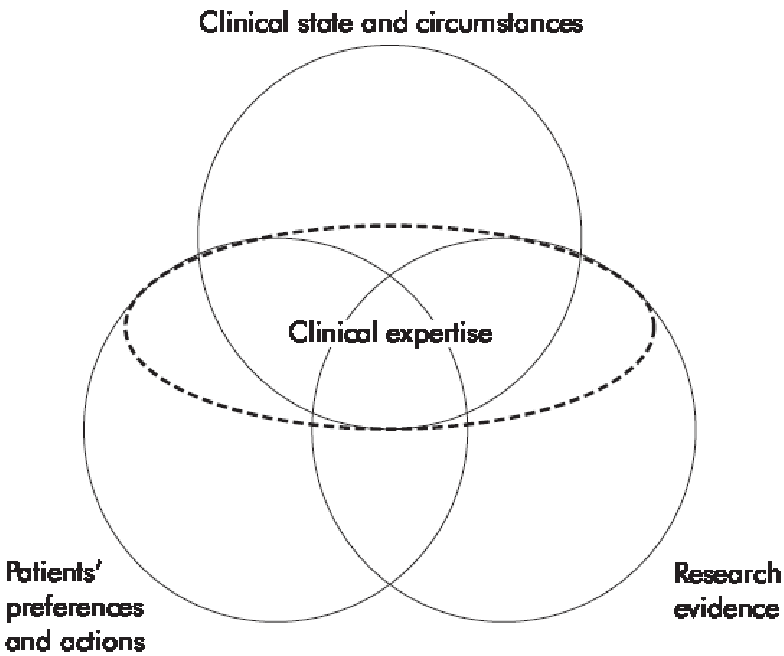
For over half a century clinicians have considered and tried various methods to develop the efficacy of medical interventions (Elstein, 2004). Variation in health care delivery was widespread, and the over use of treatments can be shown when clinicians do not follow approved guidelines or protocols (Elstein, 2004). The now familiar phrase 'Evidence Based Medicine' (EBM) was first used by Gordon Guyatt in the early 1990's whilst developing a physician's training scheme in Canada (Smith & Rennie, 2014). He wanted to improve the programme so that future clinicians managed patients using evidence that showed that treatments worked instead of following convention (Smith & Rennie, 2014). 'Evidence Based Medicine' was finally adopted after the initial terminology 'Scientific Medicine' was rejected by the faculty (Smith & Rennie, 2014). Guyatt's work was, itself, founded on the papers published in the 60's by David Sackett and colleagues in Canada on 'critical appraisal'. They had pioneered medical training programmes by concentrating on: the problems of patients; epidemiology and statistics in order to improve outcomes (Smith & Rennie, 2014).

Figure 2 Early Model of the Key Elements for Evidence Based Clinical Decisions (Haynes, Devereaux and Guyatt 2002)



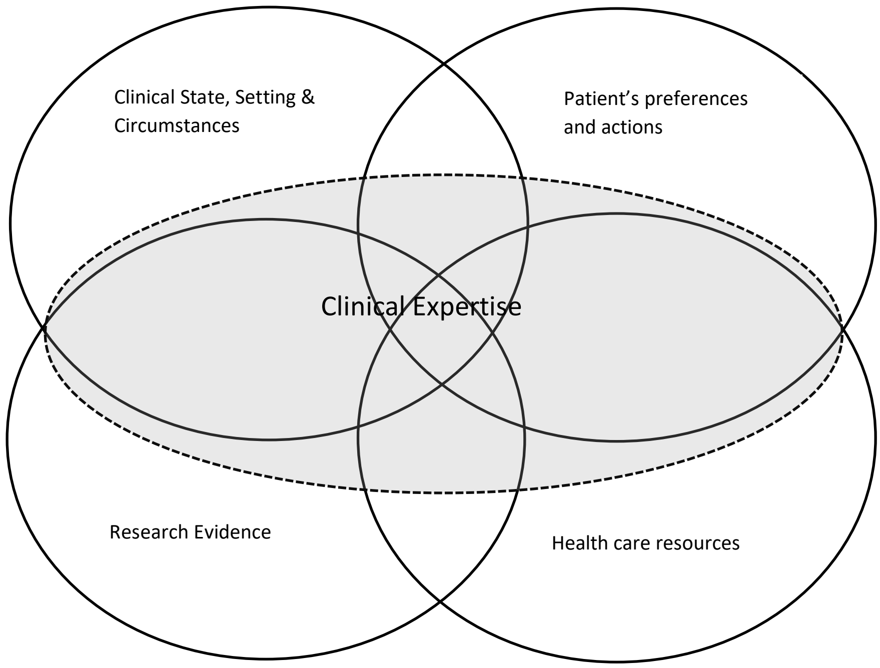
Early attempts at using evidence to inform practice, focussed on research relevant to a presenting clinical problem, and applying the research output to solve the problem. However this approach did not take account of 'traditional' clinical decisions, physiological rationale and the clinical experience of the individual practitioner (Haynes, Devereaux, & Guyatt, 2002). Later derivatives of EBM (Figure 2) showed that reliance on evidence on its own was inadequate, and that evidence application, also needed sound clinical skills to diagnose the condition, together with an appreciation of the patient's needs to promote acceptance (Haynes et al., 2002). In their updated model (Figure 3), Haynes et al (2002) depicted a more advanced scenario, demonstrating the integration of further thinking: "*the integration of best research evidence with clinical expertise and patient values*" (p.36). They stated that this version of their model should be used as a 'prescriptive' rather than 'descriptive' guide in clinical decision making and help avoid individual clinician preferences (rather than clinical expertise) unduly perpetuating wide practice variations, and therefore, patient outcomes. This version included expanded definitions and it focussed on the individual and healthcare provider, as well as taking account of: patient state, and circumstances; clinical setting; the patient's preferences and actions; what research showed; and individual clinician expertise (Rycroft-Malone & Bucknall, 2010) .

Figure 3 An Updated Model for Evidence Based Clinical Decisions (Haynes, Devereaux and Guyatt, 2002)



Given that early definitions and models failed to fully understand that contextual influences such as patient circumstances or the resources of the provider, as examples, continually change and are different in most situations, the updated model (Figure 3), made some progress in this regard. Di Censo, Guyatt, and Ciliska (2005) further developed the Haynes et al. (2002) model by introducing 'healthcare resources' as a component, with the 'clinical expertise' component (centrally overlaid on the diagram) bringing together all components (Figure 4). This model for EBP was later incorporated into an international position statement by the Sigma Theta Tau International (STTI) organisation in 2008 (Rycroft-Malone & Bucknall, 2010).

Figure 4 The interrelationship between EBP and clinical expertise – (DiCenso et al., 2005).

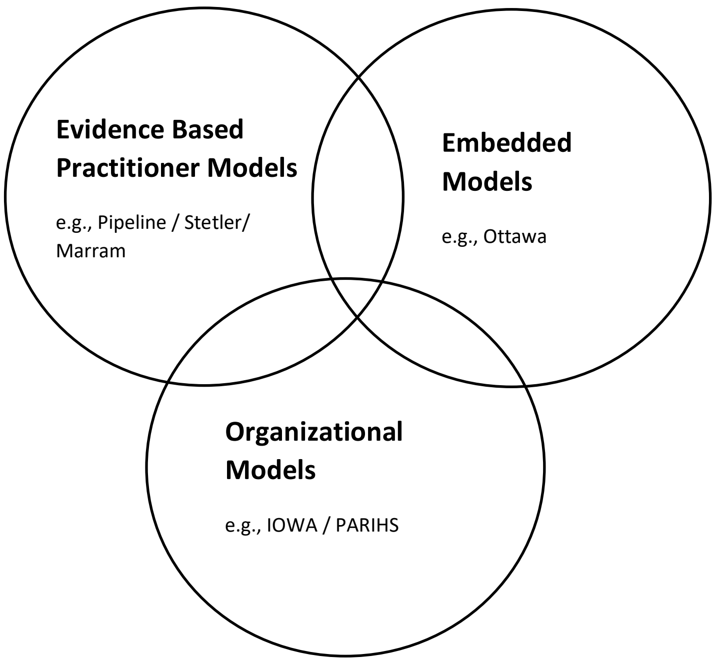


The tenets of EBM are also applicable to other healthcare settings, by various actors, including nursing (Van Achterberg , Schoonhoven, & Grol, 2008) and the allied health professions (Smith, 2008; Snaith, 2016) with Hafslund et al. (2008) 'coining' the useful context specific phrase "evidence based radiography practice" (EBRP) |(p.344). Initial critique of EBP in nursing was positive, however there was also scepticism with perceptions that EBP led to: "Cook-book nursing…an over reliance on randomised controlled trails and systematic reviews…[and that EBP]…Isn't new It's what we have been doing for years" (p.38) (Di Censo, Cullum, & Ciliska, 1998). However, in their review of these initial comments, (Di Censo et al., 1998), give an early assertion that 'clinical expertise' is a vital component in addressing the individual components of their model for EBP (Figure 4). Elstein (2004) further supports this view in that the strength of EBP is that it supports the independent decision making of the clinician based on the presenting case.

1.2.3 The Outcomes and Impact of EBP – Towards Implementation

In recent decades, EBP has been used in healthcare on the premise that it will optimise patient outcomes, and maximise finite health system resources (Bick & Graham, 2010; Birken & Currie, 2021). The main driver for adoption of EBP has come from political and policy initiatives with agencies such as the National Institute for Health and Clinical Effectiveness (NICE) being set up in England and Wales, and the US Agency for Healthcare Research and Quality, as examples, being set up abroad (Bick & Graham, 2010). The remit of such agencies is to evaluate evidence and make recommendations on best practice in terms of clinical effectiveness and cost effectiveness (Bick & Graham, 2010). Even though considerable resources are applied to health research, a large body of evidence shows that the transfer of evidence into practice can be protracted and unsystematic (Bick & Graham, 2010; Graham et al., 2006). There is a need to evaluate the outcome of the use of evidence in clinical settings, as there are numerous examples of interventions introduced with EBP, based on assumptions that there will be net benefit, rather than implementation based on evidence of the positive impact on the range of outcomes, and taking account of the views of a range of stakeholders (Bick & Graham, 2010). Some health interventions have been shown to be inappropriate, unnecessary or even harmful, and research in the USA and Europe has demonstrated that 30 to 45 % of patients receive care which is not based on clinical evidence from research studies (Bick & Graham, 2010). There have been assumptions that barriers to implementation of EBP mainly surround the individual healthcare professional (deficit in knowledge, attitude, lack of skills), however even though these are relevant, research into evidence implementation, shows that there are multiple barriers evident (Grimshaw, Eccles, & Tetroe, 2004). Barriers may also manifest at levels outside the control of individual practitioner e.g. at various other points in the healthcare system (financial, skill mix, resources, communication, information issues) generating attention with policy makers and leading to concepts such as ‘Knowledge Transfer’ (Kt), ‘Implementation’ and ‘Quality Improvement’ (Grimshaw et al., 2004). Impact has connotations of ‘force’ and ‘magnitude of change’, however the impact of the use of evidence to improve care or treatment outcomes, with positive effects on professionals and organisations, can be regarded as the ‘difference’ that the use of the evidence makes (Wilkinson, Johnson, & Wimpenny, 2010). Impact can be of some magnitude, and have reach and influence, and ‘seeing’ the difference made by research utilisation in practice can be subtle and not easily realised by clinicians (Wilkinson et al., 2010). Conceptualising impact as ‘difference’ also allows a spectrum of impacts to be unveiled and therefore by revealing and examining these, the impact that the implementation of the original research has made can be examined and understood (Wilkinson et al., 2010). Researchers as the university of St Andrews have proposed a Typology of implementation models (Figure 5), thereby identifying the main attributes of each model, and categorising them into three broad types of conceptual models (Wilkinson et al., 2010). Understanding the different models facilitates exploration of the nature of their impact in terms of implementing EBP by understanding their elemental nature and their possible actions (Wilkinson et al., 2010).

Figure 5 Implementation Model Typology. Wilkinson et al (2010)



Various impacts of EBP are often indirect, long-term and as a result difficult to identify, even though they are present, however they can also be missing or limited and hide opportunities for change (Davies & Nutley, 2008). Davies and Nutley (2008) also contend that there is a need for more sophisticated studies exploring the use and impact of EBP exploring how evidence-based knowledge “flows and interacts” in complex social systems, highlighting a potential research gap in the radiography practice setting.

1.2.4 Knowledge Translation & Implementation Research in Relation to the Study

Exploration of the literature reveals that various professional groups rarely use standardised terminology when referring to Knowledge Translation (KT), however the following definition has been suggested: "exchange, synthesis and ethically-sound application of knowledge – within a complex system of interactions among researchers and users" (p.28)(Estabrooks, Thompson, Lovely, & Hofmeyer, 2006). Implementation then aims to understand the influences on clinicians relating to their choices, beliefs judgement processes, and then factor these to ascertain useful combinations of ways to initiate and sustain behavioural changes required to improve EBP (Estabrooks et al., 2006) . The Canadian Institute of Health Research (CIHR) in their definition explain that this is a dynamic and iterative process, that includes the synthesis of information, leading on to dissemination and application to improve healthcare and health systems (Gupta & Camp, 2013). Evidence consistently shows gaps between 'what we should' be doing in practice to 'what we are' actually delivering in practice, with organisations around the world becoming more aware of the futility of investing in the generation of new knowledge, without assurances that this can be implemented into day to day practice (Gupta & Camp, 2013) This paradigm shift in recent years has been pivotal in the development of Implementation or KT science (Gupta & Camp, 2013). Roger's work on 'Diffusion of Innovations' explains why evidenced practice recommendations are not easily adopted, and why unproven care or treatment is subject to wide acceptance in community practice (Dingfelder & Mandell, 2011). Rogers shows that in order to accept a proven intervention, there needs to be a process of: acceptance; adoption; implementation and maintenance (Dingfelder & Mandell, 2011).

1.2.5 Implementation Frameworks

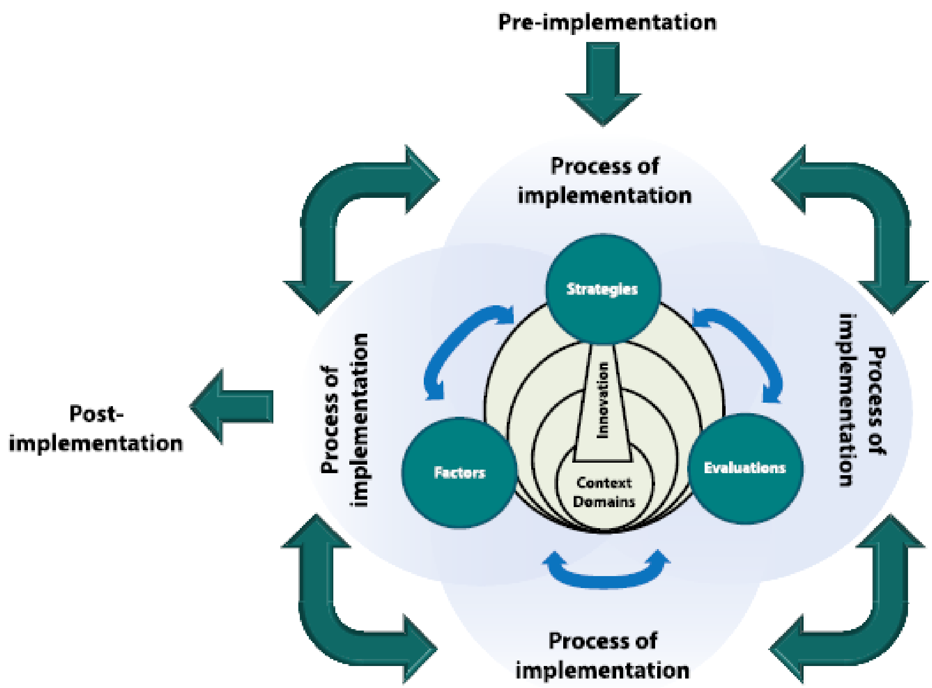
The evolution of frameworks supporting KT strategies have been variously developed in specific disciplines, with targeted innovations in various contexts giving rise to multiple disparate frameworks being theorised and utilised (Moullin, Sabater-Hernández, Fernandez-Llimos, & Benrimoj, 2015). Organisations selecting an implementation framework, suitable for their context and targeted innovation, can find this challenging, and sometimes need multiple frameworks to fully address their particular implementation need, as similar concepts are covered to varying degrees, in various frameworks, and thus might not suit an innovation in a particular setting (Birken et al., 2017; Moullin et al., 2015). In their systematic review of implementation frameworks designed for healthcare, Moullin et al. (2015) found that commonly, the frameworks contained the following attributes (concepts), however they differed in comprehensiveness of use in the framework (weight), and in terms of the order in which they were operationalised:

- Process of Implementation - stages and steps (& order)
- Innovations to be implemented
- The context of the implementation effort
- Influencing factors
- Strategies
- Evaluation(s)

Moullin et al. (2015)

As a result of their comprehensive review of implementation frameworks Moullin et al. (2015) produced a ‘Generic Implementation Framework’ (Figure 6) to support organisations in selecting an appropriate framework for their unique healthcare setting, in that it highlights the concepts to be considered fully in any KT strategy, showing the strengths and weaknesses of any chosen model in relation to the individual context of the organisation:

Figure 6 Generic Implementation Framework - Moullin et. al 2015



1.2.6 The 'Promoting Action on Research Implementation in Health Services' Framework (PARIHS)

The PARIHS conceptual framework was conceived and developed by a research team at the Royal College of Nursing (RCN) Institute in the nineties with the belief that the successful implementation of research into clinical practice could not be reliant on producing strong evidence alone (Kitson, Harvey, & McCormack, 1998). Nilsen and Bernhardsson (2019) cite PARIHS as being one of the few frameworks to define practice context as an important determinant of implementation effectiveness and is a useful guiding theory for context assessment tools in the field (and in this respect, providing a guiding theoretical framework for aspects of this study). The team showed that the interplay of three key constructs: the *quality of evidence*; the *context* or environment in which the KT strategy is to take place and implementation method or *facilitation* was key to successful implementation. Kitson et al. (1998) also stated that as there was no evidence to support precedence of one construct over the other and that the three should take equal status. Later, a larger team, further developed and refined the theoretical framework with evidence for theoretical rigour and conceptual clarity for the constructs emerging (Rycroft-Malone, 2004), and further refinements being the inclusion of metrics to diagnose and treat an organisation's readiness for change adoption (Harvey & Kitson, 2016). The PARIHS framework, and its utility in this study, will be explored further later in this chapter (supported by Appendix 2). Ch.2 will present a systematic review of what is known currently about implementation in UK radiography.

1.2.7 Complexity Theory

A diverse group of researchers including: biologists; social scientists and physical scientists, came together in the 1980's to study 'complex systems', from the microscopic biological cellular systems, to the diverse systems of human society (Chandler, Rycroft-Malone, Hawkes, & Noyes, 2016). Later, the thinking behind complex systems was applied to the healthcare setting, allowing a better understanding of the implementation of interventions embedded in their particular context (Chandler et al., 2016). In their introductory review article, making sense of the emerging 'complex adaptive systems' (CAS) theory applied to the healthcare setting (Plsek & Greenhalgh, 2001), CAS is described as being useful in providing "important concepts and tools for responding to the challenges of health care in the 21st century" (p. 625) (Plsek & Greenhalgh, 2001). Plsek and Greenhalgh (2001) suggest that "new conceptual frameworks that incorporate a dynamic, emergent, creative, and an intuitive view of the world must replace traditional "reduce and resolve" (p. 625) approaches to clinical care and service organisation" (p. 625) (Plsek & Greenhalgh, 2001). May (2013) explains that the aim of theory development in IR, is to determine a sound set of "conceptual tools" (p.2) enabling researchers, and those in the practice setting, to "identify, describe and explain important elements of implementation processes and their outcomes" (p.2). May (2013) argues that "implementation never refers to a single 'thing' that is to be implemented" into a social system of any kind (p.2) but rather a "complex bundle" or "ensemble of material and cognitive practices" (p.2). Chandler et al. (2016) used 'complexity', as a theoretical lens to interpret their research into the use of implementation in complex social healthcare systems, and later on in this chapter, the usefulness of a similar approach to interpreting the findings of this study, will be explored.

1.3 Part B: Implementation Research

1.3.1 Theory Driven Implementation

Kanouse, Kallich, and Kahan (1995) over twenty years ago, were reviewing research extant into how to best improve the diffusion of new evidence into practice, to improve care and patient outcomes. Kanouse et al. (1995) discovered that there was a large gap in knowledge at the time, of what worked for whom and in what setting, and recommended further research into behavioural science related to the diffusion of knowledge. Just producing evidential material, and widely distributing, was shown to be not enough to maximise user uptake, and the individual elemental changes required were largely unknown (Kanouse et al., 1995). Grol (1997), reviewed the available literature in the nineties, on approaches and theories supporting the implementation of guidelines to improve medical practice and found that: "different players used different approaches…. based on beliefs [rather] than scientific evidence" (p.418); implementing changes required more than single actions, with good planning needed, using a number of interventions; obstacles to change should be identified prior to change, and that "evidence-based medicine should be complemented with evidence-based implementation" (p.418). Estabrooks et al. (2006) in their major review (at the time) of KT theory in healthcare, stated that there still remained "no overarching knowledge translation theory" (p.25), and that there was a range of theoretical perspectives across disciplinary boundaries in existence. Estabrooks et al. (2006) explained that theories were difficult to "locate and use" (p.25) due to the varying disciplinary boundaries, with discipline-specific terminology, issues of lack of 'definitional clarity' and the context specific 'implicit assumptions' within. Estabrooks et al. (2006) concluded with a call for theory development, with a need for theory capable of developing and testing KT interventions, which are 'multi-theoretical'- thus possessing greater power in differing and complex healthcare settings: "it is critical to find a fit between the theoretical perspective and the context in which it is to be applied" (p.33) (Estabrooks et al., 2006). Estabrooks et al. (2006) asserted that the first step in successful KT initiatives should be to understand the context into which research is to be implemented, and then select an appropriate (bespoke) KT theory. There can be barriers to combining theoretical approaches in KT, however these can usually be surmounted, increasing the likelihood of success (Estabrooks et al., 2006). Wallin (2009) explains the necessity for definitional clarity surrounding KT and IR, with KT emphasising the importance of knowledge exchange between knowledge producers and knowledge users, with knowledge synthesis and adoption being complex within a system of social interaction. IR on the other hand should be conceptualised as the scientific study of research uptake in clinical practice, with the complementarity of KT and IR influencing the overall aim of "improving [the] quality of healthcare" (p.577) (Wallin, 2009). Rycroft-Malone (2007) explains, that there has been increasingly "loud calls for the use of theory" (p.78) by implementation researchers in the field, arguing that theory is needed to guide the testing and design of IR strategies, enabling the generalisation of findings. Others have made a case for theory driven IR, as it would seem that much previous research in the field was based on nothing more than "an expensive version of trial and error….[with] no a priori reason to expect success" (p.108) (Eccles, Grimshaw, Walker, Johnston, & Pitts, 2005). Other reviews of IR shows that researchers often fail to give attention to the theoretical foundations of their work, with little or no detail about the related context, and therefore whether the work is generalisable or not (Rycroft-Malone, 2007). Rycroft-Malone and Bucknall (2010) give definitional clarity to 'theory' in the milieu of IR, whereby theory can be defined as "a way of seeing through a set of relatively concrete and specific concepts and propositions that describe or link those concepts" (p.25), with concepts being the "building blocks" (p.25) of theory. "A good theory provides a clear explanation of how and why specific relationships lead to specific events" (p.2) (May, 2013). Theory can be relevant to implementing EBP by: using "theory-based intervention development" (p.24) improving the quality of clinical evidence; using theory to possibly identify "appropriate outcomes, measures and variables of interest" (p.24); evaluating implementation processes to understand what processes actually work in implementing EBP successfully (Rycroft-Malone & Bucknall, 2010). Theory in KT and IR can have different purposes such as: descriptive, explanatory or predictive theories (Rycroft-Malone & Bucknall, 2010). Implementation methods with poor theoretical foundations, can lead to a lack of understanding as to why or why not interventions or IR efforts are effective (Nilsen, 2015). An example of theory-guided evaluation of IR would be in the field of growing interest into the influence 'context' on the adoption of EBP (Rycroft-Malone & Bucknall, 2010). Theory designed to understand the influence of context on EBP may generate better understanding leading to the design of theory backed contextually individualised interventions in various settings (Rycroft-Malone & Bucknall, 2010). The potential role of context in influencing KT and IR is further evaluated later in this section.

Implementation researchers such as Damschroder et al. (2009); Greenhalgh, Glenn, MacFarlane, Bate, and Kyriakidou (2004); Rycroft-Malone (2004) have built on 'Realist' and

‘Diffusion of Innovations’ theories (May, Johnson, & Finch, 2016). However, theory may not always work, as it may inherently be ‘faulty’, there may be a theoretical incompatibility with the context of implementation, and the theory in this respect may not be well operationalised in the particular intervention, leading to lack of outcome clarity (Rycroft-Malone & Bucknall, 2010). With many theories supporting IR, the selection of the most appropriate theory to match the implementation challenge can be difficult, and methods have been proposed to aid the process, however this can sometimes lead to a mere reduction in the available choices than correct selection per se (Rycroft-Malone & Bucknall, 2010). When considering complex systems and interventions, a suite of theories are likely to be required, necessitating an overarching implementation proposition, perhaps using a framework to guide theory utilisation, populated by mid-range theories (Nilsen, 2015; Rycroft-Malone & Bucknall, 2010). Mid-range theories allow data to be collected and tested from concrete empirical indicators (McKenna & Slevin, 2011). An example of a suitable framework in this situation would be the PARIHS framework (Rycroft-Malone & Bucknall, 2010), briefly introduced early in this chapter, developed from Diffusion of Innovations theory, organisational theories and humanistic theory (Rycroft-Malone & Bucknall, 2010). More recently, work has been done by researchers categorising theories and frameworks (Nilsen, 2015); proposing a generic implementation framework (Moullin et al., 2015) and presenting a ‘general theory’ of implementation (May, 2013). Nilsen (2015) provides a useful contemporary taxonomy, distinguishing between models and frameworks, and categorising their underpinning theory to aid selection and application, in research and practice, with the aim of “foster[ing] cross-disciplinary dialog among implementation researchers” (p.1). Nilsen (2015) organises implementation theories into five categories (Table 1) showing the origin, aims and complexity of the field of various theories, models, and frameworks:

Table 1 Five Categories of theories, models and frameworks used in implementation

Category	Description	Examples*
Process Models	Specify steps in the process of translating research into practice. Aim: to describe and/or guide translation	Huberman , Landry, Davies, Majdzadeh, CIHR, K2A, Stetler, ACE star, KTA, IOWA, OTTOWA, Grol & Wensing, Pronovost, Quality Implementation Framework
Determinant Frameworks	Specify types of determinants acting as barriers and enablers influencing implementation outcomes. Some specify relationships between determinants. Aim: understand and/or explain influences on implementation outcomes e.g. predicting outcomes or interpreting outcomes retrospectively	PARIHS, Active Implementation Frameworks, Understanding User-context framework, Conceptual Model, Grol Framework, Cochrane framework, Nutley framework, Ecological framework Durlak/Dupre, CFIR, Gurses framework, Ferlie and Shortell framework, Theoretical Domains Framework.
Classic Theories	Originating from fields external to implementation e.g. psychology, sociology, organisational theory. Aim: applied to provide understanding and/or explanation of aspects of implementation	Theory of Diffusion, social cognitive theories, theories concerning cognitive processes and decision making, social networks theories, social capital theories, communities of practice, professional theories, organisational theories
Implementation Theories	Theories developed by implementation researchers (by adapting existing theories or concepts) Aim: to provide understanding and/or explanation of aspects of implementation.	Implementation climate, Absorptive Capacity, Organisational Readiness, COM-B, Normalisation Process Theory.
Evaluation Frameworks	Specify aspects of implementation that could be evaluated to determine implementation success	RE-AIM, Precede-Proceed, Proctor Framework

NB Sourced from: (Nilsen, 2015)

*(*Original authors not quoted – available in original article)*

Nilsen (2015) reveals the complexity and diversity of implementation theory and methods that are proposed and available for researchers to select according to the specific implementation challenge, as well as categorising the groups to 'make sense' of the approach chosen. However, rather than give importance to the taxonomy proposed, Nilsen (2015) suggests that it is useful to understand that there is a more important need to consider the theories and frameworks in relation to their theoretical assumptions, aims and eventual utility, aligned with the chosen problem. May (2013) in his proposal for a 'General Theory of Implementation' links a set of previously described theoretical constructs and shines a new light on how they may be linked in a novel structure or theory. Inherent in this new general theory, is the introduction of Normalisation Process Theory (NPT) and the concept of 'agency' in how human agents react in a complex system with intrinsic barriers (May, 2013). Attributes to the success of a 'general theory' include the explanation of a complex set of phenomena, in a context independent way, with a cognitive model making sense of the phenomena (May, 2013). May (2013) in his seminal work, concludes with a final proposition that "The implementation of a complex intervention depends on agents' continuous contributions that carry forward with time and space" (p.9), further explaining that complex interventions are likely to be normalized into routine practice if agents promote the change, and that continuous intervention is required to avoid abandonment. Whilst drawing on the possible limitations of his general theory, May (2013) draws attention to the possible incompatibilities of psychological and sociological theory relating to the dominance of 'cognition and agency' and 'social processes integration' in IR. Also at an applied level, the phenomena are numerous, complex and changeable, so much so, as not to be able to be fully captured in a unified model (May, 2013). However May (2013) suggests the result of his analysis and general theory proposal, has strength in that it is drawn on mid-range theories, and that it can be operationalised as such, with its modest theoretical claim. There is a gradually increasing realisation, in the healthcare community, that an alternative approach to the "traditional paradigms" (p.21) of scientific enquiry is required, in order to understand the true complexity of social situations (Williams, Rycroft-Malone, & Burton, 2017). The 'realist' paradigm emerging from 'critical realism', has recently been promoted as having the virtue of "focussing attention on the interplay between structure and agency, and on the research generative mechanisms" (p.21), thus showing potential in connecting nursing inquiry with other fields, due to the realist approach having strengths in transcending methodological worldviews (Williams et al., 2017).

1.3.2 Sceptical Views of Implementation

Scepticism surrounding KT, and IR, mainly surrounds the lack of evidence supporting the application of theory to implementation, and that the application of theory can be arbitrary and subjective (Rycroft-Malone & Bucknall, 2010), with a view by some that implementation efforts should be based on common sense, logic and rigorous evaluation (Bhattacharyya, Reeves, Garfinkel, & Zwarenstein, 2006). Oxman, Fretheim, and Flottorp (2005) in their appeal for a less 'theoretical approach' to knowledge utilization, argue for the use of practical judgement and collaboration, using "sound logic and rigorous evidence to help people make informed choices about care" (p.115). Interestingly however Oxman et al. (2005) diminish the acceptance of the mainstream view of the complex nature of healthcare systems, they do not see this as an impediment of knowledge adoption per se. Some opponents to IR argue that applying theory driven interventions to guide and influence complex health systems will have a constraining effect due to inherent theoretical rigidity, however Rycroft-Malone and Bucknall (2010) contend that this depends very much on your philosophical worldview. Rycroft-Malone and Bucknall (2010) explain that a positivist approach could lead to a rigid and inflexible model design for IR with researchers stuck in the deterministic mindset. However – applying a constructivist epistemological approach, embedded in the objectivist paradigm - facilitates an interpretive approach to understanding IR complexity, "prioritize[ing] connections and patterns" (p.31) (Rycroft-Malone & Bucknall, 2010). There are various ways to use, develop and apply IR theory, including deductive and inductive methods, or a hybrid approach, paying attention to "what, how and why questions" (p.32) using theoretical frameworks and mid-range theory (Rycroft-Malone & Bucknall, 2010). Currently, "a wave of optimism exists in implementation" (p.9) that the sound application of theory and its contribution to reducing the 'research to practice gap', will continue (Nilsen, 2015).

1.3.3 Healthcare Context - Definition and Characterisation of the Problem

The importance of evaluating context in implementation is extant in much of the literature applying theory to understanding barriers and facilitators to evidence use (Nilsen & Bernhardsson, 2019). Researchers have, for many years, tried to discover the nature and character of mechanisms suspected of influencing behaviour change, and practice 'context' "is a problem for implementation science" (p.1) (May et al., 2016). Research into the influence of context on implementation in healthcare is still in its infancy (Van Achterberg et al., 2008). Healthcare context, in relation to implementing researched evidence, is seen as being multi-layered :

- Individuals – multiple healthcare professionals, non-clinical staff, patients.
- Organisation – infrastructure, technology, computerized information systems, delivery of treatments to patients, culture and working practices.

From (Chandler et al., 2016)

Context is difficult to define, it can be interpreted at different levels, in different ways and in different settings (Kent & McCormack, 2011a) with most people agreeing that "context is a slippery notion that needs to be pinned down in some kind of operational definition" (p.5) (Health Foundation, 2014). Context exists within complex 'multi-layered' systems (Pfadenhauer et al., 2015). The Health Foundation (2014) after an extensive review in search of a definition more related to biomedicine, suggest that "context refers to all those variables (z) that influence or could influence the 'independent' (x) and 'dependent' (y) variables directly under study" (p.6), where 'context' could be thought of as the intervening variables. This definition, related to the positivist paradigm, leads us to consider context as an objective entity, with tangible factors, being receptive to manipulation or shaping (Health Foundation, 2014). Contemporary thinking on context in implementation, has increasingly moved towards a constructivist paradigm of 'subjectivity', illustrating that context can be "constructed and reconstructed in narrative and stories, and how it sometimes can be confabulated into true experiences, even if fictitious in nature, having an effect on the situation (Health Foundation, 2014). Also viewing context through a constructivist lens allows us to understand context as a personal and social entity, and that there are "no common or universal set of contextual interpretations shared by everyone" (p.8) adding to the complexity of this concept (Health Foundation, 2014). Researching context as an entity, needs an 'etic' as well as 'emic' approach to understand the social and physical system, needing to discover the 'insider view or perspective', not necessarily visible from an outsider's etic research lens (Health Foundation, 2014). Context has been described as a 'backdrop' to a clinical setting or its environment, however the backdrop should also be conceptualised as having a shaping influence able to interact with an object, able to negatively and positively influence implementation efforts, with an absorptive capacity to change, and therefore sensitive to change efforts (Pfadenhauer et al., 2015). In this respect context should not be conceptualised as a 'backdrop' per se – as it is not an inert prop, rather it has potential to react, modify, facilitate or constrain interventions as a dynamic entity (Pfadenhauer et al., 2015). A recent review of implementation frameworks also supports the notion of context as being active, with the majority of implementation frameworks conceptualising context in this way (Nilsen & Bernhardsson, 2019). Wood, Ferlie, and Fitzgerald (1998) argue that practitioners "do not rely simply on the implementation of disembodied, global theory….they are not fooled by 'god tricks' promising vision from everywhere and nowhere, but want to see the connections between what is advocated, and their own situated knowledges" (p.1734), emphasising a pragmatic perspective. Wood et al. (1998) base this premise in that practitioners look for a "locatable position" (p.1734) suggesting that knowledge users practice in fluid domains, using various judgements, inherited tacit knowledge, and actions based on decision 'crafting'. In this respect, KT cannot simply be seen as "uncomplicated dissemination of findings to a largely passive and receptive audience" (p.1734) (Wood et al., 1998). Practitioners have a bearing on knowledge reception and absorption, and they "must be engaged" (p.1737) (Wood et al., 1998). A robust method is required to understand the clinical context and meld it to being absorptive and receptive to the new knowledge, in this regard, context has been discussed as a "potent mediator" (p.915) in implementation (Rycroft-Malone, Harvey, et al., 2004). More recently, in their concept analysis, Pfadenhauer et al. (2015) found that 'context' in IR is a concept that is "only partially mature with definitions and terminology varying widely and blurred boundaries with neighbouring concepts, such as setting and environment" (p.11) showing that in their research the "characteristics, preconditions and outcomes of context are not clearly delineated" (p.11). Many practice change or implementation models exist, but not many give explicit detail or processes on how to assess contextual issues or factors, highlighting the need for more research into the influence of context on IR (Kent & McCormack, 2011a). Many attempts to define context, in relation to IR, are confounded by its complexity and scope (May et al., 2016).

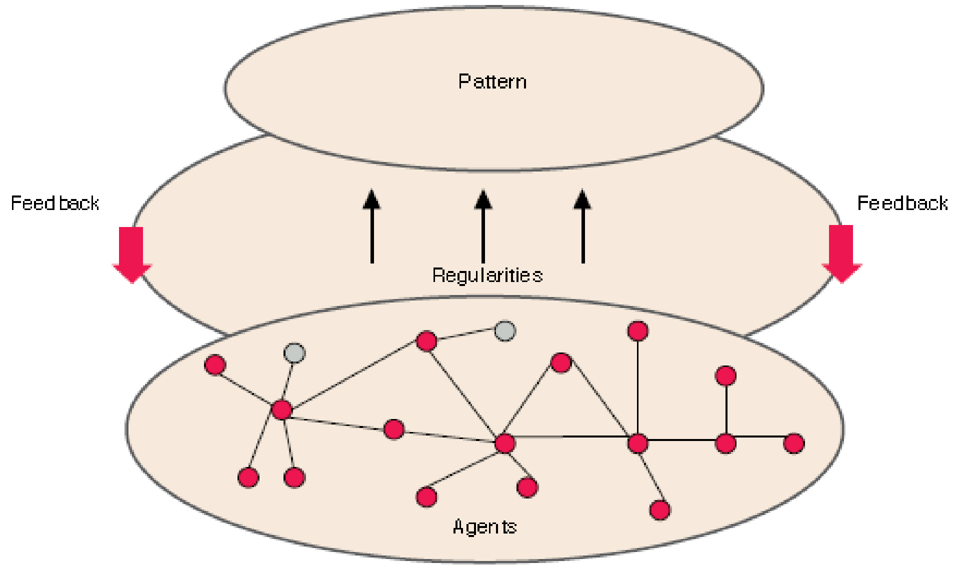
1.3.4 Understanding Applied Context

As shown earlier, implementation context has been shown to be complicated, and evaluating context for EBP, requires the inclusion of many factors at many levels (May et al., 2016). Researchers have developed theoretically driven tools in an attempt to 'measure' and understand context in the clinical setting (Estabrooks, Squires, Cummings, Birdsell, & Norton, 2009; Helfrich, Li, Sharp, & Sales, 2009; McCormack, McCarthy, Wright, & Coffey, 2009). Kitson et al. (2008), in their evaluation of theoretical and practical challenges of the application of the PARIHS framework in practice, suggest that 'context', as a framework element, could be evaluated (to assess 'readiness to change'), by engaging with team members verbally and interactively, to try to determine team members': "assumptions, prejudices, views about existing practice, and the proposed change" (p.8). This might be by reviewing responses to questions, translated to a grid, and plotting the position the team is 'judged' to reside in terms of the PARIHS framework, and their readiness to change (Kitson et al., 2008). Sparse evidence exists from controlled experiments evaluating context in implementation efforts, this is possibly due to the fact that these are designed to exclude context per se rather than examining the nature of applied context (Health Foundation, 2014). In their extensive review of 'context' in healthcare, The Health Foundation (2014) did not find any systematic review describing methods for evaluating contextual influences in implementation, however they did find two significant reviews of methods to assess context (French et al., 2009; Shekelle et al., 2010). McCormack et al. (2009) published their work on the development and testing of the Context Assessment Index (CAI), an instrument developed using the PARIHS framework as a conceptual model, able to describe and measure implementation context. The CAI is discussed extensively in Ch.3. More recently others have adapted and tested the usability, reproducibility, and psychometric properties of the CAI in different contexts and languages (Hølge-Hazelton et al., 2019; Kajermo et al., 2013).

1.3.5 An Interpretive Lens for Implementation Research – Systems

In order to interpret the complex interactions of individual and organisational behaviours influencing the uptake of research in clinical practice, an explanatory theoretical lens is useful to guide the analysis and understanding of the underlying phenomena, as used by Chandler et al. (2016) in their study of surgical fasting times. Chandler et al. (2016) adopted the PARIHS conceptual framework as the guiding implementation theory for their study and used Complexity Theory (CT) as an explanatory lens, to interpret the complex situational phenomena, of a multi-layered healthcare organisation. According to May et al. (2016) the mechanisms of implementation methods, moving implementation forward, exist in contexts that can be considered to be part of a 'complex adaptive system' (CAS), and that actors functioning in the CAS shape, and are shaped, by mechanisms inherent in these systems. There is criticism of CT used as an implementation framework per se, in that there is not enough empirical evidence to support its use in informing implementation processes (where CT concepts were part of the implementation process itself), however, paradoxically it seems useful otherwise, in the evaluation of implementation per se (Brainard & Hunter, 2016). At its simplest, CT explains organisational relationships, patterns and iterations, based on the worldview that the universe is made up of systems such as weather, biology and social systems (The Health Foundation, 2010). Human actors and their actions within a business or organisation can be thought of as a system in itself, as they are connected by their interrelated actions (Senge, 2010), and their individual actions, often unpredictable, can affect the context in which other actors operate (Plsek & Greenhalgh, 2001). The acceptance of systems as being 'complex' and always adapting to their environment, has led to the term CAS, representing systems functioning within a complexity theory paradigm (Dooley, 1997; Gear, Eppel, & Koziol-Mclain, 2018; The Health Foundation, 2010; Trochim, Cabrera, Milstein, Gallagher, & Leischow, 2006). A CAS is most frequently described as a "dynamic network of agents, acting in parallel, constantly reacting to what the other agents are doing, which in turn influences behaviour and the network as a whole" (p.6) (Figure 7) (The Health Foundation, 2010). CAS theory facilitates organisational analysis, by taking account of the aforementioned patterns and relationships in a system, without giving great weight to 'cause and effect' (The Health Foundation, 2010), and by the analysis of 'feedback loops' in the investigation of complex contributary factors (Moore et al., 2014).

Figure 7 Simple Representation of the Components of a CAS (The Health Foundation, 2010)



The characteristics of CAS has been described by The Health Foundation (2010), after undertaking a major 'evidence scan' of the application of CT and CAS in healthcare systems, and these are listed below:

- a large number of elements which interact dynamically
- any element in the system is affected by and affects several other systems
- non-linear interactions, so small changes can have large effects
- openness, so it may be difficult to define system boundaries
- a constant flow of energy to maintain the organisation of the system
- a history whereby the past helps to shape present behaviour
- elements in the system are not aware of the behaviour of the system as a whole and respond only to what is available or known locally.

NB Sourced from (The Health Foundation, 2010)

Chandler et al. (2016) developed a general explanatory framework, using the core concepts of CT, contextually suited to healthcare as a social system: "self-organization; interaction; emergence; system history; and temporality" (p.472), and the core concepts in their work were then applied to the process evaluation of themes found in their research. There is some criticism that there is little empirical evidence showing the value of complexity theory in guiding implementation efforts, however Moore et al. (2014) show that 'process evaluation' shows promise in developing the evidence base by examining 'feedback-loops' with qualitative data to determine complex causal relationships (Moore et al., 2014). The tendency for the reductionist paradigm to dominate research into complex phenomena, by only examining the constituent components of a system, is counterbalanced by CT, with its 'total system' approach to understanding reality (Chandler et al., 2016; Trochim et al., 2006). Furthermore, a reductionist viewpoint in attempting to understand complex systems as 'linear models' or 'clockwork' entities that are predictable in nature, has limitations, therefore necessitating an understanding that complex systems are unpredictable, autonomous, and can be creative and flexible, and that this can be embraced by CT (Plsek & Greenhalgh, 2001). Claims that systems thinking lacks rigour as it is not rooted in conventional scientific thinking is challenged by Trochim et al. (2006), noting that its epistemology is closely aligned with that of "scientific or analytic thinking" (p.540) having regard for a universal view of complex system attributes and phenomena, being a "legitimate form of enquiry" (p.540) (Trochim et al., 2006). Much rigour has been applied and seen in sophisticated systems based experiments, with established technical roots found in the mathematical, physical, biological and social sciences (Trochim et al., 2006).

1.3.6 Utility of PARIHS in the Study

Earlier in this chapter, PARIHS was introduced as a theory informed conceptual framework suitable for guiding the exploration of the context of a system, its 'readiness' for change acceptance or adoption, and its purported ability to represent the complexity of the change processes involved in implementing evidence (Helfrich et al., 2010; Rycroft-Malone, 2004). The complexity of efforts in implementing research endorsed practice is represented by the multidimensional nature of the PARIHS framework (see Appendix 2) (Rycroft-Malone, 2004). The individual components that need attention during an implementation process are represented in the framework in detail (Rycroft-Malone, 2010). Nilsen and Bernhardsson

(2019) in their scoping review of determinant (implementation) frameworks, cite PARIHS as one of the few frameworks specifically referring and defining context, whereas the majority refer to the implementation environment generally, and without specificity. The theoretical ability of PARIHS to define context, and understand its very nature in clinical practice, was exploited by the team developing the quantitative instrument used in this study and will be described later in Ch.3. The utility of PARIHS as a diagnostic heuristic (Rycroft-Malone, 2010) was also exploited in this study as the guiding a priori coding framework for analysis of the qualitative data. Context therefore is a problem for behaviour change research in healthcare, PARIHS has been researched widely, in designs seeking to eliminate contextual confounders, and was therefore an underpinning guiding framework throughout this work. A deeper exploration of PARIHS can be found in Appendix 2.

1.3.7 Study Rationale

EBP and the adoption or diffusion of research evidence into clinical practice has been shown to be problematic. Much clinical care and intervention has not been shown to be based on research evidence and can lead to sub-optimal outcomes or even harm. IR aims to bridge the gap between what is done and what should be done in clinical practice, and much research has been done, and is ongoing, into the effectiveness of implementation models and frameworks in the clinical setting. The author, as a practicing clinical radiographer, therefore sought to understand the implementation efforts used in UK radiography practice, and the assumed complex social contextual backdrop in which the profession might reside. Recent systematic reviews of allied health professions, investigating implementation strategies, did not include radiography specifically, therefore leaving a gap in knowledge. The aim is to then make recommendations, based on the study findings, to promote evidence adoption into practice, and promote further research into implementation in radiography by engaging with key stakeholders, to encourage an implementation strategy for the profession in the UK.

1.3.8 Chapter Summary

This chapter gave an overview of EBP and the difficulties surrounding evidence implementation and adoption. Theoretical frameworks have been shown to influence the uptake of evidence, by trying to understand and explain the underlying complex systems, and by promoting methods for change. Not much is known about KT in UK radiography. Section two further explored IS as a method and theory for promoting KT. EBP does not ‘diffuse’ naturally into a system - it needs careful and sustained bespoke theory driven implementation efforts applied to the setting or context. Context has been shown to be a powerful mediator in KT strategies, therefore knowledge of its manifestation in complex healthcare systems, enables tailored interventions prior to KT efforts, thus promoting the ‘acceptance’ of change. Various tools exist in the systematic attempt to understand context, which is thought to reside at multiple levels within a dense social system. Context can be thought of not only as a ‘backdrop’ to a clinical setting, but also as an ‘active/reactive’ entity, dynamically interacting with the environment and its agents. PARIHS has been shown to have diagnostic capability prior to implementing new evidence into practice, having also been described as a ‘determinant’ framework. The PARIHS framework gives definitional clarity to context, with its theorised sub-elements, facilitating the development of an instrument, the CAI, described for the purpose of assessing context in different health settings. The CAI has been extensively tested, and shown to have robust content, and face validity. To date the CAI has not been applied extensively in healthcare settings, with no evidence extant, for its use in assessing the context of radiography practice in the UK. The theory underpinning the CAI, resides in the objectivist epistemology, with its inherent strength in evaluating user perspectives, and narrative. There is little knowledge evident surrounding KT strategies shown to influence EPB in UK radiography practice.

1.4 Study Aims and Objectives

Research Question:

"What is known about implementation within the practice of Radiography in the UK"?

Aims:

- To investigate the implementation 'context' of the radiographic profession in the UK
- To evaluate the KT interventions that have been tested in UK Radiography practice.
- To engage with key stakeholders to explore how the research findings can make a difference to implementation strategy in the profession.

Objectives:

- Investigate what research is evident showing that 'implementation' theory is making a difference to evidence based radiographic practice in the UK
- Determine the national and sub-national Context Assessment Index (CAI) of the radiography profession in the UK
- Create a 'systems overview' of radiographic practice in relation to implementation of new evidence into practice
- To explore exemplary issues or developments specific to the radiographic profession which illustrate the 'implementation context'
- Engage with key professional stakeholders, highlighting the research output and its relevance to UK radiography practice, and explore opportunities which might inform a national 'implementation strategy' for the profession

1.5 Data Collection Overview & Project Organising Framework

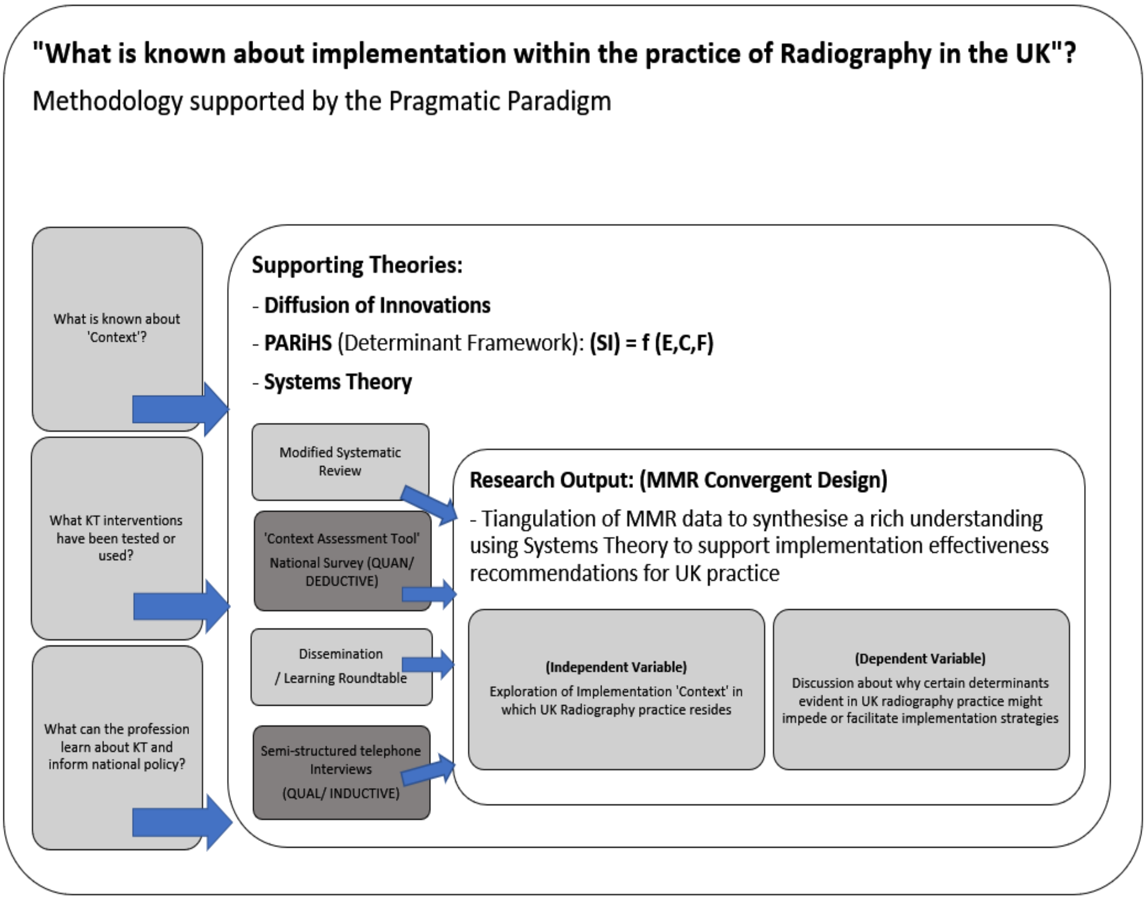
The following illustrates the approaches used to gather data with links to the methodology and methods discussed later in Ch.3. Table 2 links the chosen methods used to address each objective of this study, and is a useful guide in this respect, to orientate the reader at the outset. This is discussed in more detail in Ch.3.

Table 2 Data Collection Matrix

Objective	Data Source / Sample
1. Investigate what research is evident showing that 'implementation science' theory is making a difference to evidence based radiographic practice in the UK	SYSTEMATIC REVIEW
2. Determine the national and sub-national Context Assessment Index (CAI) of the radiography profession in the UK	NATIONAL CAI SURVEY (QUAN) (QUESTIONNAIRE)
3. Create a 'systems overview' of radiographic practice in relation to implementation of new evidence into practice	(QUAN+QUAL) ANALYSIS
4. To explore exemplary issues or developments specific to the radiographic profession which illustrate the 'implementation context'	SYSTEMATIC REVIEW & (QUAN+QUAL) ANALYSIS
5. Engage with key professional stakeholders, highlighting the research output and its relevance to UK radiography practice, and explore opportunities to inform a national 'implementation strategy' for the profession	STAKEHOLDER DISSEMINATION EVENT - NATIONAL

Figure 8 illustrates concisely how the methodology and methods chosen to address the research question relate to one and other, and links the inductive and deductive approaches, to generate data in this convergent mixed methods study, and are referred to later in this thesis.

Figure 8 Project Organising Framework 'A' - Methodology & Method Focus



2 Chapter 2 – Systematic Review of Radiography Implementation

2.1 Chapter Overview

In this chapter, the systematic review objectives, methods, quality assurance and findings are discussed in relation to the review questions, and an overview of the impact of the review is discussed in Ch.5. The systematic review was undertaken as a standalone method, and the data did not inform the empirical arms of this project in this respect, however the findings of the review were considered in relation to the study as a whole in the discussion and conclusion sections of this thesis. This mixed methods review was designed to synthesise diverse published information relating to implementation in radiography and adds to the body of knowledge in this respect, by revealing the state of IR in radiography, the KT strategies that worked or did not work, and illuminating barriers and enablers found in current practice. The review revealed a paucity of research relating to IS in radiography and a need to further promote and embed IR in radiography practice and policy.

2.1.1 Review Questions & Objectives:

“Determine what research is evident showing that ‘implementation science’ theory is making a difference to evidence based radiographic practice in the UK?”

2.1.2 Objectives:

- To review the literature showing how KT theory is making a difference to evidence-based radiography practice by:
    - Investigating the effectiveness of KT theory applied to radiography contexts (including models and frameworks utilised)
    - Understand what KT interventions have been utilised in radiography and how effective they were, and at what level e.g., macro, meso, micro level
    - Describe how the KT interventions worked (or not), what the modifying variable was, and in what context it worked
    - Reveal contextual issues, barriers, and enablers to implementing EBP
    - Highlighting KT interventions shown to work in radiography, which might offer practitioners or researchers further guidance, in developing future KT strategies which might be effective

2.1.3 Background to the Review

Conventional literature reviews have existed for many years summarising research on a particular subject by examining various publications, and are considered highly subjective, being based on the author's prior knowledge and therefore are biased in respect of their findings and conclusions (Munn et al., 2018). Other methods exist in relation to scoping literature to identify gaps in knowledge, examine the body of literature on a given subject and clarify concepts (Munn et al., 2018). Although scoping reviews require rigorous methods per se, systematic reviews involve a team approach to use a clear method to minimise bias, synthesizing evidence in a reliable form, to reliably inform practice or future research (Munn et al., 2018). Although this project was limited in scope and resources, volunteer academic staff assisted with reviewing the included and rejected articles and with the various verification tools ensuring rigour and quality.

The following stages were followed in undertaking this mixed methods type systematic review based on (Gough, Oliver, & Thomas, 2012):

1. Initiate review – form review team
2. Formulate review question(s) and review method
3. Design Search Strategy – search and screen using eligibility criteria
4. Describe study characteristics – and characterise using published KT taxonomy
5. Quality assessment – using various tools for Qualitative and Quantitative research
6. Narrative Synthesis of Findings – including the development of identified KT strategies used in radiography
7. Discuss the relevance of the findings – and make recommendations to stakeholders

There is controversy surrounding the feasibility or validity of combining research evidence from diverse research methodologies (Pope, Mays, & Popay, 2007), however, in order to understand and interpret the complexity of how KT interventions are applied in different contexts, it was useful to do so in this review, and this method has gathered more scientific support recently (Booth, 2016; Gough et al., 2012). The mixed methods synthesis used (Gough et al., 2012) was in keeping with the philosophy of wider inclusion. As well as empirical studies, non-propositional evidence was included in the review to illuminate the context as much as was possible, in a very narrow and specialist area of allied health practice. Non-propositional knowledge included theorised methods or expert opinion for implementing strategies or change, conveying the beliefs or thoughts of individuals, not necessarily empirically tested (Glock, 2008). The PRISMA standards for undertaking and reporting systematic reviews was adhered to as far as was practicable (Moher, Liberati, Tetzlaff, & Altman, 2009).

This review therefore aimed to synthesise knowledge from a wide range of studies that might be relevant to answering the research question. Studies relevant to practice and research in the UK were prioritised, as well as studies exploring how radiographers consume, engage in, and implement evidence-based practice in their own contexts. Some studies were also included that did not-directly involve radiographers in the research process, but the output of which, might inform what might work for radiographic practice and related fields. No 'review protocol' was published for this academic study, and the method included KT strategies relevant to both branches of radiography in the UK. The review question and the inclusion and exclusion criteria in the selection of evidence was influenced by the 'PICO' acronym (population/ intervention(s)/ comparison(s) and outcomes (Pope et al., 2007). A context and perspective sensitive acronym 'SPICE' (setting/ perspective/ intervention or phenomenon of interest/ comparison/ evaluation) further guided the selection and inclusion of qualitative studies where relevant (Booth, 2006, 2016). A narrative review of the findings was considered appropriate as the review included diverse forms of published evidence. The taxonomy of KT classification proposed by Powell et al. (2012) was also used as a framework to guide the narrative synthesis. This review was not intended to fully investigate the quality of the included research, nor the empirical evidence supporting the KT strategies found to be used in the radiography context per se, as the aim was to illuminate the current state of implementation in radiography.

Much research surrounding KT strategies and their effectiveness is centred around medicine and nursing, with nursing being a large professional group (Thompson, Estabrooks, Scott-

Findlay, Moore, & Wallin, 2007). Others have more recently undertaken reviews of KT strategies in allied health professions however radiography (as an allied health profession) was not specifically included (Jones et al., 2015; Scott et al., 2012). Although the previous reviews had an international perspective, radiographic practice, as argued earlier, has its own unique context based on its historical development nationally, and internationally. Also as shown earlier, regulation by the state and the status of advanced professional development in the UK (driven by need) compared to other countries, arguably presents a unique contextual backdrop. Radiography in the UK is also characterised by two branches, Therapy and Diagnostic, each with its own distinct body of knowledge and practice, rising from common historical developmental roots, and professional association. Some countries have these two branches as distinct professions in their own right.

2.1.4 Identification of Studies

2.1.4.1 Data Sources and Searches

Assistance was sought from an information scientist with expertise in systematic reviews and data searching. Previous detailed data searching strategies as designed by Jones et al. (2015); Scott et al. (2012) (with search terms relating to KT interventions or strategies) were rewritten and modified to include UK radiography specific search terms. International nomenclature such as: 'technologist'; 'technician'; Radiologic Technologist (RT); or other radiology related medical professionals such as 'radiologist' and support staff such as 'radiography helper' or 'radiography assistant' was excluded from searches. Free-text key words and MeSH searches were conducted in five electronic databases: MEDLINE; EMBASE; PSYCHINFO; BNI; and CINAHL published between 2000 to September 2018 and restricted to English language only (see example search strategy in Appendix 3). Grey literature was searched in: OpenGrey; NICE(NHS); SCoR website; and hand searches of British Journal of Radiology, Radiography Journal, and Implementation Science Journal. A wide date latitude was used to gather as much relevant research in the KT field since its emergence in the past twenty years. Morrison et al. (2012) found no evidence of systematic bias when restricting language to English in medical related systematic reviews, and therefore this restriction was justified in this study.

2.1.4.2 Inclusion Criteria /Exclusion Criteria /Selection Methods

Studies were included or excluded in the review if they met the criteria listed in (Table 3) below. Studies were not excluded based on study design (as in previous similar reviews in the allied health professions), it was desirable to capture wide and diverse forms of evidence that might otherwise be missed (Jones et al., 2015; Scott et al., 2012), and as radiography has arguably been an emerging profession in terms of research base (Sim & Radloff, 2009), a dearth of high quality IR was anticipated in this systematic review.

Table 3 Evidence Inclusion /Exclusion Criteria[1]

Study Design	Primary research studies/secondary research studies / experimental / quasi-experimental / non-experimental designs e.g. case study/qualitative methods / surveys /expert reviews etc.
P I C O (Quantitative Studies):	
Participants	Therapeutic Radiographer; Diagnostic Radiographer; Radiographer; Consultant Radiographer; Imaging Professional; Advanced Practice Radiographer; Advanced Radiographer; service users.
Interventions	Interventions/strategies with a primary purpose of translating research (or enhancing research uptake) into clinical practice /promoting evidence-based medicine (radiography); offering novel approaches to EBP utilisation; Examples of potential interventions include reminders, use of multidisciplinary teams, educational programmes, researcher-clinician interventions.
Comparison	No KT theory or framework use / no planned KT strategy /alternative KT strategy or intervention
Outcomes	Empirically assessed change or KT strategies with potential to change (by way of quantitative or qualitative data) at the professional/process level (e.g., change in clinical practice), patient level (e.g., improved response to the clinical practice intervention) the economic/organisational level (e.g., change in costs/restructuring)/ National Level (change in policy or regulation).
Exclusions	Not original research or data, not peer reviewed, not English language, published prior to 2000, not UK based study (or study not applicable to UK practice), not relevant to UK radiography practice (therapy or diagnostic branch).
S P I C E (Qualitative Studies):	
Setting	Clinical practice of radiography and associated specialties in the UK and associated home countries. Education/ Higher Education Institutions and Policy. Professional Regulation /policy. Government Policy. Macro, Meso and Micro contexts.
Perspective	The workplace experience of practicing radiographers, service users, managers, organisations, regulators and policy makers, views of experts. The views of individuals within the system.
Intervention / Phenomenon of Interest	Interventions/strategies with a primary purpose of translating research (or enhancing research uptake) into clinical practice /promoting evidence-based medicine (radiography); offering novel approaches to EBP utilisation; methods for understanding practice context at macro / meso / micro level. Examples of potential interventions include reminders, use of multidisciplinary teams, educational programs, researcher-clinician interventions, qualitative studies elucidating the views of radiographers. Context specific Barriers and Enablers to implementing EBP or practice improvement efforts; KT translations seen to work by clinical teams, managers, educationalists and organisations. Methods for understanding practice context at macro / meso / micro level. Or sustained service improvement over time.
Comparison	No interventions or strategies evaluated by qualitative studies.
Evaluation	Improved implementation of EBP and reduced or diminished barriers to practice change or improvement efforts – including contextual factors illuminating enhanced implementation methods, or obstacles caused by various factors e.g. individual behaviour, organisational behaviour, policy level issues etc. Impact of change on service users / organisations and professionals.

[1] Adapted for UK radiography context and based on (Jones et al., 2015; Scott et al., 2012)

Duplicates were removed from the results of the electronic searching. The titles and abstracts of the identified studies were then screened by one reviewer (DJ) against the inclusion and exclusion criteria, and consistency checked by a second reviewer (LW). If the second reviewer queried an excluded article, then the full text article was obtained, and consensus was reached by the two reviewers. One article was queried by the second reviewer, and on obtaining the full article, it was jointly agreed to include the originally rejected paper for full review. Full study articles were obtained for the remaining studies which were thought to meet the inclusion/exclusion criteria. These were screened again, and the rejected studies were consistency checked by a third reviewer (CB).

2.1.4.3 Data Extraction

A data extraction form was designed and piloted with some sample studies to facilitate a consistent approach to analysing the included studies. Subsequent modifications and refinements were made, and the final form, is shown in Appendix 4. One reviewer (DJ) then extracted the data using the form and this was later transcribed into MS Excel^{TM} spreadsheets and tables using MsWord^{TM}. The quality and consistency of data extraction, and quality appraisal, was confirmed by the second reviewer (LW) by comparing the original data to the extracted data on the forms.

2.1.4.4 Intervention Reporting and Quality Assessment

KT interventions or strategies described in the included articles were classified according to (Powell et al., 2012), utilising their taxonomy of KT strategies shown to be used in implementation. Powell et al. (2012) provide a concise but comprehensive list of theory informed implementation strategies, grouped under the following six strategy classifications: *'Plan'; 'Educate'; 'Finance'; 'Restructure'; 'Quality Management' and 'Attend to Policy Context'*. Each main strategy is discussed in their comprehensive compendium, describing the attributes of the strategy and multiple sub-strategy classifications, allowing ease of grouping classification and replicability, however they did not evaluate the effectiveness of each strategy per se (Powell et al., 2012). The classification allowed grouping and classification of the KT strategies used in the included articles, when producing the results of this review. Interventions were reported if they were exploratory in nature or applied in practice (e.g. an article describing a survey exploring the context, would be included as a KT strategy, as well as those reporting interventions which were shown to implement a change in practice). 'Discrete' strategy, involving one process or action versus 'multifaceted' (complex) strategies or interventions were also reported (Grimshaw, Eccles, Lavis, Hill, & Squires, 2012; Powell et al., 2012). Powell et al. (2012) also introduced the term 'blended intervention' to describe a purposely selected and packaged implementation effort, using a suite of strategies guided by an implementation model, and this classification was also used in this review. The quality of KT intervention reporting in the included studies was assessed using the 'Workgroup for Intervention Development and Evaluation Research (WIDER) recommendations (Albrecht, Archibald, Arseneau, & Scott, 2013). Albrecht et al. (2013) produced and tested a checklist to assess the functional components required to accurately report behaviour change intervention studies, and aid future replicability. Fields included in the data extraction form allowed an assessment against the WIDER recommendations at extraction stage by the 1st reviewer and checked by the second reviewer, and the result was recorded in a matrix (Appendix 5). Papers meeting all four WIDER categories, and therefore standard, were reported with a 'Yes' in the WIDER result table in Appendix 5.

Analytical tools evaluating published research in medicine and healthcare, allow the quality of included studies to be appraised by systematically examining the methods used by authors to minimise biases in their work, potentially adversely or incorrectly interpreting or reporting the results, or results reported out of context (Gough et al., 2012; Katrak, Bialocerkowski, Massy-Westropp, Kumar, & Grimmer, 2004). In order to prevent, or avoid as far as possible, transferring incorrect information into clinical practice (through synthesis of primary studies), the use of critical appraisal tools aim to mitigate the risks involved (Katrak et al., 2004). However, in a synthesis which aims to include diverse and non-research sources of evidence, quality selection and article rejection can be problematic and counterproductive (Pope et al., 2007). Additionally, the selected tools should be validated in terms of construction, reliability of interpretation and have appropriate guidelines for their use in practice (Katrak et al., 2004). Advice regarding objectively rating (scoring) the quality of published literature (and rejecting it based on a cut-off level), is controversial and generally discouraged by experts, or at best to be used selectively and interpreted with caution (Baker, Young, Potter, & Madan, 2010; Centre for Reviews and Dissemination, 2009) and this review did not attempt to do so. Scoring outcomes can be seriously misleading and, where methods (as in this review) aimed to have a broad inclusion, scoring could have led to some studies falling below the cut-off level, thus potentially losing important contextual information that might otherwise have been included (Greenland, 1994; Pope et al., 2007). The CASP checklists (Critical Appraisal Skills Programme, 2018) are not designed as a method of scoring the quality of research, rather they offer a method for appraising the overall quality of research of different types e.g. Qualitative / Quantitative / Systematic Reviews / Cohort studies etc. and have been developed and tested by a group of experts over many years using many iterations of refinement. The CASP checklists used in this review were comprehensive in scope and empirically based, being generic enough to be applicable to various methods found in research (Masood, Thaliath, Bower, & Newton, 2011). They however need a researcher with sound knowledge of research methods to correctly utilise the checklists, and they can be prone to subjective interpretation between reviewers (Masood et al., 2011). The CASP checklists helped decide whether initially continuing with the appraisal of a particular paper was appropriate (or safe), and this approach, as suggested by Pope et al. (2007), allowed the contextual flaws of a particular article to be judged against the review question, and including it or not based on its value to the review with any potential weaknesses in method being made clear to prospective readers. The CASP tools guided judgements about the 'strengths and weaknesses' of the included articles, and any subsequent discussions between reviewers, regarding decisions about rejection or not. Records were kept of any strengths and weaknesses for later reporting in the synthesis (Pope et al., 2007). An example of a completed checklist is included in Appendix 6. The 'AGREE' reporting checklist was used to appraise any included papers reporting clinical practice guidelines and their implementation, (Brouwers, Kerkvliet, & Spithoff, 2016). The 'study design classification tool' (flow chart) proposed and tested by Hartling, Bond, Santaguida, Viswanathan, and Dryden (2011) was used to classify the individual included study method typology.

2.1.4.5 Data Analysis and Synthesis

Articles meeting the minimum quality assessment criteria were included in the review, and relevant data was extracted as shown in Figure 9 and transcribed into data extraction tables, allowing sorting and analysis, and a final summary is shown in (Appendix 7). In this study all the selected studies were included (n=18) regardless of methodological quality. The level at which KT strategies were intended was recorded and discussed in the analysis: *Macro* – National or Policy Making level; *Meso* – regional or local organisational level; *Micro* – departmental or function level (practitioner / patient / service user) (Pope, Robert, Bate, Le May, & Gabbay, 2006). Studies were then grouped by evidence type: *empirical* evidence included qualitative, quantitative and mixed methods, audit studies etc. and *non-propositional evidence* (Higgs & Titchen, 1995) to include untested reviews and expert opinions. Single vs multifaceted KT strategies or interventions were analysed according to the classification of KT strategy identified. This included: an exploration of the underpinning KT theories (and associated implementation models and frameworks) used, and the KT strategies found; the frequency of KT strategy use by classification type; whether they made a difference to practice; the barriers and enablers found; contextual insights into why implementation efforts might and might not work in radiography and an appraisal of the strengths and weaknesses of the included studies (method design and potential flaws). Due to the heterogeneity of the included papers and outcome measures, and the various research paradigms utilised by authors, a meta-analysis was deemed inappropriate. A narrative analysis guided by the Centre for Reviews and Dissemination (2009) framework was then undertaken, and an assessment of the robustness of the synthesis as recommended by Pope et al. (2007) is presented in the discussion section to address the review objectives as far as was possible. This includes suggestions for further research possibilities emerging in the included studies, as well as that found in this review. Finally, a critical reflection on the strengths and weaknesses of this review is presented in the conclusion, together with the contribution to existing knowledge.

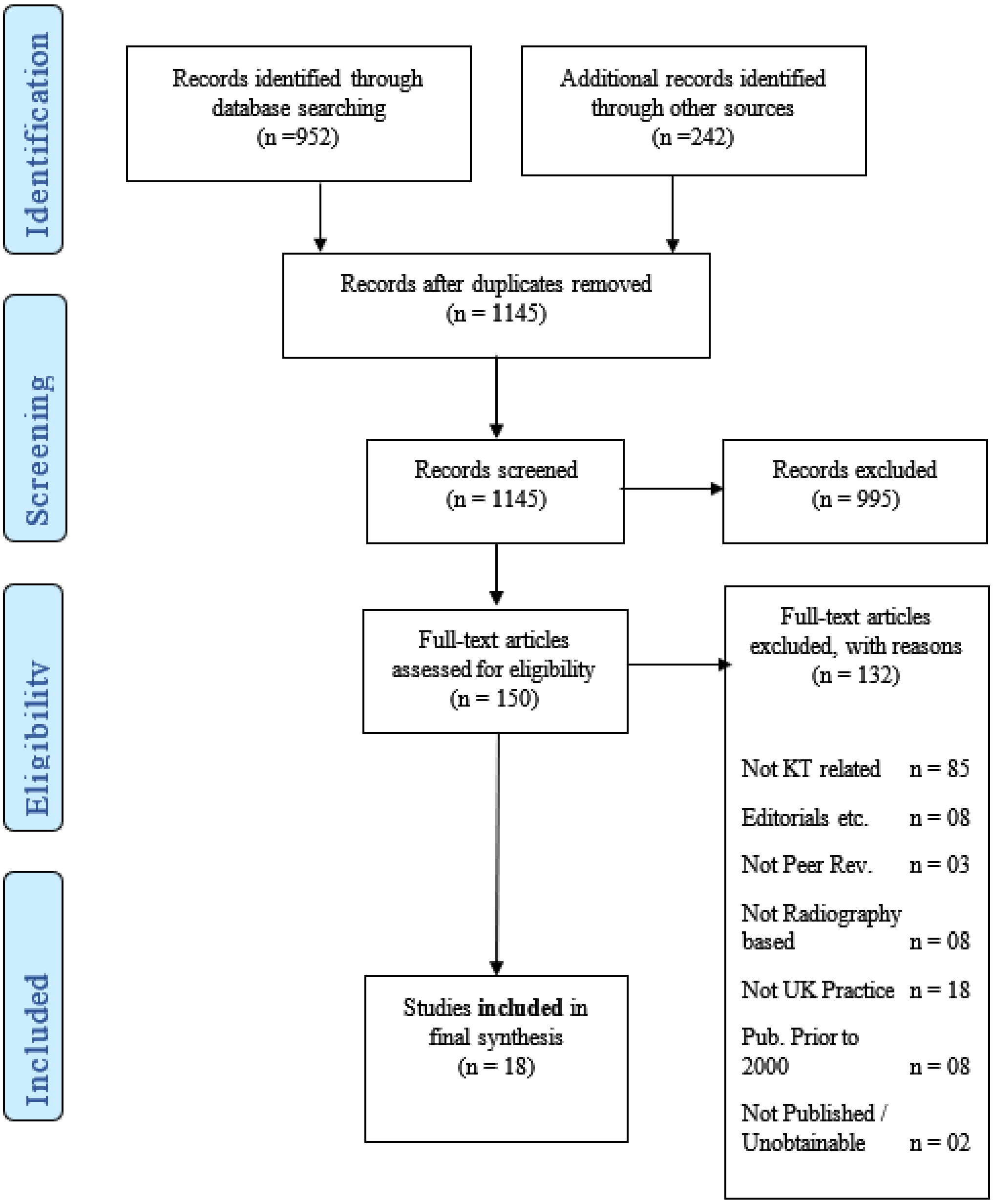
Figure 9 Data Extracted from Included Studies

2.1.5 Results of the Review

2.1.5.1 Details of Included and Excluded Studies

A PRISMA diagram (Moher et al., 2009) was produced, to illustrate the flow of information leading to the selection of the final studies, through the recommended stages of: identification; screening; eligibility checking and final inclusion (Figure 10). A total of 1145 records were identified after removal of duplicates. All 1145 records were screened using information available in the record titles and abstracts. Of these, 995 records were excluded, and full articles were retrieved for the remaining 150 records. The full text articles were then fully appraised (with checks by a 2nd reviewer), and 132 items were excluded with reasons recorded (see Figure 10). The final 18 articles were then included for data extraction and synthesis. Most excluded articles at full review were not related to KT interventions or strategies (n=85).

Figure 10 PRISMA Search Strategy



2.1.5.2 *Descriptive Findings of the Review*

Of the 18 included studies, n=15 were empirical by design: (Barlow & Owens, 2018; Bolderston et al., 2018; Bridge et al., 2017; Elliott, Wilson, Svensson, & Brennan, 2009; Ellis, Ashmore, & Bray, 2006; Goldsworthy, Roe, McGrail, McCormack, & Walther, 2016; Henwood & Taket, 2008; Hickman & Harvey, 2007; Jones & Robinson, 2008; McNair et al., 2015; Plant & Lossing-Rangecroft, 2001; Powell, Ahmad, Gilbert, Brian, & Johnston, 2015; Snaith, Hardy, & Lewis, 2015; Society and College of Radiographers, 2015; Twomey, 2003) and 3 were non-propositional articles (Brealey, 2001; Dean & Routsis, 2010; Nightingale, 2008), (data extracted in Appendix 7). Of the empirical studies included, there was n=1 quantitative study (RCT) (Powell, Ahmad, et al., 2015); n=3 quasi-experimental studies (non-controlled before and after studies) (Goldsworthy et al., 2016; McNair et al., 2015; Twomey, 2003); n=8 non-experimental studies (surveys etc.) (Barlow & Owens, 2018; Bolderston et al., 2018; Bridge et al., 2017; Elliott et al., 2009; Henwood & Taket, 2008; Hickman & Harvey, 2007; Jones & Robinson, 2008; Snaith et al., 2015) and the remaining empirical studies were theory informed audit cycles n=2 (Ellis et al., 2006; Plant & Lossing-Rangecroft, 2001) e.g. PDSA, and a systematic review n=1 (Society and College of Radiographers, 2015). The three non-propositional articles (Brealey, 2001; Dean & Routsis, 2010; Nightingale, 2008) were: an expert review; a quality management framework and an implementation plan for new technology and training. Eleven of the studies were pre-implementation 'exploratory' studies, gathering evidence, assessing the context, or designing tools etc. (Barlow & Owens, 2018; Bolderston et al., 2018; Brealey, 2001; Bridge et al., 2017; Dean & Routsis, 2010; Elliott et al., 2009; Henwood & Taket, 2008; Hickman & Harvey, 2007; Nightingale, 2008; Snaith et al., 2015; Society and College of Radiographers, 2015). Seven studies reported an implementation effort (Ellis et al., 2006; Goldsworthy et al., 2016; Jones & Robinson, 2008; McNair et al., 2015; Plant & Lossing-Rangecroft, 2001; Powell, Ahmad, et al., 2015; Twomey, 2003). The specific KT intervention strategies utilised or recommended by authors found in the review were extracted into a table, and classified according to the taxonomy (Powell et al., 2012) (Table 4). Barriers and enablers to KT were also listed in a table (Table 5) and grouped into the following emergent themes: Theory; Professional; Patient/Service User; Evidence/Evidence-Access and Organisation/Context.

Table 4 KT Strategies Found and Classified According to Powell et al. 2012

Study No.	Reference	Intervention Strategy Typology & sub-classification	Status	Specific Strategy Planned, Recommended or Operationalised (& Modifying Variable(s))
1	Twomey (2003)	**Plan Strategies** • Select Strategies • Build Buy In • Initiate Leadership • Develop Relationships **Educate Strategies** • Educate • Inform and influence Stakeholders **Quality Management Strategies**	Operationalised in Practice	Locally Developed Framework/Implement EBP Guidelines/embed in commissioning model/ Stakeholder Meetings / Patient Participation / re-audit / enforce / use local press to advertise change in patient expectation
2	Society and College of Radiographers (2015)	**Plan Strategies:** • Gather Information • Select Strategies • Build Buy In **Educate Strategies:** • Develop Materials • Educate • Inform and influence Stakeholders **Quality Management Strategies**	Practice Guidelines Published (based on Systematic Review undertaken)	Published Systematic Review suggests implementation strategy to include providing: • a summary document outlining the key findings • a practice guideline • a dressings recommendation list • a presentation for use at conference / events / website • poster and associated handouts • patient information summary leaflet • suggested impact measures • suggested possible contextual barriers (organisational and cultural)
3	Powell, Ahmad, Gilbert, Brian, and Johnston (2015)	**Educate Strategies**: • Develop Materials • Educate • Inform and influence Stakeholders	Operationalised in Practice	Used Educational DVD sent to patients to improve or develop Self-efficacy* / Stress Management Techniques / improve MRI scan compliance and resultant image quality **(Educational Material based on Theory to Improve Patient Self-Efficacy & Relaxation Techniques)*

4	Plant and Lossing-Rangecroft (2001)	**Plan Strategies** • Gather Information • Select Strategies • Build Buy-in • Initiate Leadership • Develop Relationships **Educate Strategies** • Develop Materials • Educate • Educate Through Peers • Inform and influence Stakeholders **Restructure Strategies** **Quality Management Strategies**	Operationalised in Practice	Design of an Research & Development implementation framework blueprint/ facilitation of project / networking / consensus building /workshops /use of 'barriers to research utilisation questionnaire' /network setup/ communication improved / breaking down inter professional and inter-regional barriers / team education to break down barriers and increase R&D knowledge / local champions to sustain change/ adoption of academic link/ audit and feedback of the network's internal communication system – highlighting difficulties in sustaining effective infrastructure
5	Elliott, Wilson, Svensson, and Brennan (2009)	**Plan Strategies** • Gather Information **Quality Management Strategies**	Operationalised in Practice	Undertook national survey questionnaire of UK practicing sonographers, from various contexts, to understand the context of research generation and participation, utilisation and perceived barriers to the above. Capturing and sharing local knowledge.
6	Nightingale (2008)	**Educate Strategies** • Develop Materials • Educate • Inform and Influence Stakeholders	Expert Opinion/ Guidance	Adaptation and promotion of a 'step-by-step' framework for 'Evidence-Based' protocol design for practitioner use in radiography at the micro level /educational / published
7	Barlow and Owens (2018)	**Plan Strategies** • Gather Information • Select Strategies • Build Buy-in • Initiate Leadership	Operationalised in Practice	Gather Information – in depth interviews to understand local context prior to change/ understand context using tailoring strategies to overcome barriers and understand preferences /Staff recruitment / communication aids (posters) /consensus discussions/ restricting access hours /mandate change

8	McNair et al. (2015)	**Plan Strategies** • Gather Information • Select Strategies • Develop Relationships **Educate Strategies** • Develop Materials • Educate • Educate Through Peers • Inform and Influence Stakeholders **Restructure Strategies** **Quality Management**	Operationalised in Practice	Baseline assessment of training needs, 'hands on experience' ; educational workbook/log book (Reference tool for relevant protocols, journal articles, materials on anatomy, CT-scan anatomy, information on bladder cancer, notes on modified radiotherapy technique and guidelines for registering images correctly to pathology and anatomy) / Self-directed study/didactic lectures/ knowledge & skills assessment / competence records / ongoing audit and CPD of practice/ MDT support /Coaching /collaboration with a higher education institution. Quality Audit of Individual Performance Extended roles /skills of radiographers
9	Ellis, Ashmore, and Bray (2006)	**Plan Strategies** • Gather Information • Select Strategies • Develop Relationships **Educate Strategies** • Develop Materials • Educate • Educate Through Peers • Inform and Influence Stakeholders **Restructure Strategies** **Quality Management**	Operationalised in Practice (PDSA Cycle)	Quality Improvement Method PDCA (Cyclical) using semi-structured interviews / benchmarking with other departments / educational teamwork / higher education Master's level in pharmacology/ patient group directives set up for drug prescribing/ clinical supervision-mentoring / multidisciplinary team to replace consultant and support emotional demanding role / pilot the role 1st then extend/ Flow chart as protocol decision maker/ Multidisciplinary team to educate / extended & advance role/ PGD to give drugs/ Collaborative approach Patient feedback gained by interviews.

10	Jones and Robinson (2008)	**Plan Strategies** • Gather Information • Select Strategies • Build Buy-in • Initiate Leadership • Develop Relationships **Educate Strategies** • Develop Materials • Educate • Educate Through Peers **Restructure Strategies** **Quality Management**	Operationalised in Practice	Used a reflective practice framework to guide the review of consultant practice role. Action Research cycle (observe, reflect, plan, act, evaluate) used retrospectively to reflect and learn from implementation effort. 'Facilitation role' by a Consultant Radiographer (AHP) cited as effective in promoting change with collaboration and leadership being the main benefits. KT strategies used were: Consultant Role (nationally defined) with service improvement as a core function; Action Plan; Networking; Infiltrating Clinical Nursing Practice Strategic Meetings; Evidence Gathering; educational presentations to varying grades of clinical staff; e-mails to inform staff of new change to clinical protocols; updated internet pages; medical rep. training staff in techniques on wards; audit.
11	Goldsworthy, Roe, McGrail, McCormack, and Walther (2016)	**Plan Strategies** • Gather Information • Select Strategies • Build Buy-in • Initiate Leadership • Develop Relationships **Educate Strategies** • Develop Materials • Educate • Educate Through Peers **Restructure Strategies** **Quality Management**	Operationalised in Practice	Flow-chart to create a 'lean process' multi-step development method to drive project/ Economic challenges requiring value for money driving innovation or change/Scoping Review to gather evidence/ collaborative decision making at MDT/ use of a tool to assess impact of implementing local research projects on service/ instruction information how to use tool / education through presentation at MDT. Use of facilitation to guide implementation (research radiographer appointed)

12	Bolderston et al. (2018)	**Plan Strategies** • Gather Information **Educate Strategies** • Develop Materials • Educate • Educate Through Peers • Inform and Influence Stakeholders	Operationalised in Practice	International Journal – Online ‘Twitter ‘Club used Thematic Analysis to understand advantages and disadvantages of a Twitter Club – vs Traditional Face to Face Journal Clubs. Examined barriers and enablers for successful implementation and sustainability
13	Henwood and Taket (2008)	**Plan Strategies** • Gather Information **Educate Strategies** • Develop Materials	Research Based Theory Generation	Qualitative research into radiographer’s perceptions of CPD/ what radiographers understood CPD to be/ and perception of impact on local EBP. Proposal of a ‘*CPD process model’* for radiography – highlighting dynamic and interacting components and links to policy. Providing a mechanism for recognizing and improving outcomes from CPD activity. How CPD links into EBP in radiography.
14	Brealey (2001)	**Plan Strategies** • Gather Information • Select Strategies • Build Buy-in • Initiate Leadership **Educate Strategies** • Develop Materials • Educate • Educate through peers **Restructure Strategies** **Quality Management**	Research Based Quality Management Framework Generation	Development of a theory informed local framework for implementing and sustaining an evidence based and quality managed radiographer reporting service – recommended strategies include: *Defining* a local team to collaborate / *Adopting Guidelines and Standards* using a Taxonomy of standardised reporting standards / *Recommending Dissemination Strategies* e.g. educational intervention / CPD/ publications etc. /*Methods for implementation* e.g. reminders / feedback to the imaging team / collecting performance data etc. NB not tested – based on theoretical model (Quality Management rather than KT)

15	Snaith, Hardy, and Lewis (2015)	**Plan Strategies** • Gather Information • Initiate Leadership **Educate Strategies** • Inform and Influence Stakeholders **Restructure Strategies** **Quality Management**	Research Based Context Assessment	National survey to understand how radiographer extended role (reporting) has been implemented in the NHS. Higher Education providers need to provide appropriate education in devolved nations. Education needs to provide wider scope of reporting e.g. beyond appendicular skeleton – as education restricts practice scope. **Radiographer reporting (interpretation) needs to move beyond 'task substitution' to 'embedded practice'**. Implementation efforts need to address contextual issues of professional dominance.
16	Dean and Routsis (2010)	**Plan Strategies** • Gather Information • Select Strategies • Build Buy-in **Educate Strategies** • Develop Materials • Educate • Educate Through Peers • Inform and Influence Stakeholders **Finance Strategies** • Facilitate Financial Support **Restructure Strategies** **Quality Management Strategies**	Research Based Context Assessment	Conduct local needs assessment/ Visit other sites / Develop effective educational materials / Conduct educational meetings/ Use train the trainer / Shadow Other Clinicians / Work with educational institutions/ Fund and contract for the clinical innovation/ Revise professional roles / Develop and organise quality monitoring systems / Audit and feedback / Remind Clinicians
17	Bridge et al. (2017)	**Plan Strategies** • Gather Information • Develop Relationships **Educate Strategies** • Educate • Educate Through Peers • Inform and Influence Stakeholders **Restructure Strategies**	Research Based Context Assessment	Assess for readiness and identify barriers (online survey audit tool – of international expert users) / Build a Coalition/ Develop Academic Partnerships/ Use train-the-trainer/ Create a learning collaborative/ Use Mass Media/ Work with Educational Institutions/ Consider location and availability of VERT (simulation system) as a substitute for training on real equipment

18	Hickman and Harvey (2007)	**Plan Strategies** • Gather Information • Select Strategies **Educate Strategies** • Educate Through Peers	Research Based Practice Assessment	Application of national guidance to local context/ information gathering (local retrospective audit against NICE guidance to see if this would change future practice if evidence applied) / inform local practice

Table 5 Barriers and Enablers to KT Found in the Systematic Review

Barriers Identified to Implementing EBP in Radiography (UK)	
Professional Related	Found in: (1st Author)
Inter-professional barriers between AHPs (to collaborative working)	Plant (2001); Jones (2008)
Skills / Training Issues (inadequate / unavailable / limited scope limiting practice)	Elliott (2009); Snaith (2015); Dean (2010)
Professional dominance Issues	Snaith (2015)
Lack of motivation – professional Level	Jones (2008); Bolderston (2018)
Barriers to Research Involvement at Practitioner Level	Elliott (2009); Goldsworthy (2016)
Communication Not Effective / Trusted	Barlow (2018); Bolderston (2018)
Apathy / Resistance to change process (Practice Level)	Jones (2008)
Social – power differential discouraging engagement with research or EBP activity	Bolderston (2018)
CPD – not well undertaken or understood	Henwood (2008)
Role substitution (rather than embedded role) leading to implementation issues	Snaith (2015); Dean (2010)
Patient / Service User Related	
Lack of Confidence – Patient Level (e.g. not trusting in extended roles)	Ellis (2006)
Resource Related	
Time Pressures	Elliott (2009); Bridge (2017)
Human resources or skills not matched or utilised even though there is a service need	Snaith (2015); Bridge (2017)
Resource /Staffing/ Finance Issues/Workloads/Location and Availability of resource (access)	Elliott (2009); Barlow (2018); Goldsworthy (2016); Bolderston (2018); Dean (2010); Bridge (2017)
Competing demands for resources when planning to undertake research (between project applications)	Goldsworthy (2016)
Evidence & Evidence Access Related	
Professionals not Knowing How to Access Evidence or Information	Plant (2001); Bolderston (2018)
Evidence Difficult to Source	Bridge (2017)
Ethics Approval Process	Elliott (2009)
Evidence Difficult to Apply/ Interpret / Understand	Elliott (2009)
Organisational / Context Related	
Organisational Support Lacking / Impeding implementation	Elliott (2009) Bolderston (2018); Snaith (2015); Bridge (2017)
Geographical Issues – hindering implementation	Snaith (2015); Bridge (2017)
Skills available – but context not receptive	Snaith (2015)

Enablers Identified in Implementing EBP in Radiography (UK)	
Theory Related	
Untested Implementation Framework, action plan to implement change, or conceptual model to understand context	Twomy (2003); Society and College of Radiographers (2015); Jones (2008); Goldsworthy (2016); Henwood (2008); Brealey (2001); Dean (2010); Barlow (2018);
Quality Management Frameworks e.g. PDSA	Ellis (2006); Jones (2008); Brealey (2001)
Multifaceted Implementation Effort (packaged)	McNair (2015); Ellis (2006); Jones (2008); Brealey (2001) ; Dean (2010)
Facilitator role (formal or informal)	Elliott (2009); Jones (2008); Goldsworthy (2016); Henwood (2008); Dean (2010)
Professional Related	
National Guidelines	Hickman (2007); Society and College of Radiographers (2015); Twomy (2003)
National Role Specification Mandating Research Involvement /Service Change as a core role (Advanced / Consultant AHP/Facilitator)	Elliott (2009); Jones (2008)
Instruction / tuition/ education/ presentation to guide correct use of tools / protocols	Goldsworthy (2016); Brealey (2001); Dean (2010); Bridge (2017)
Education at Professional /Service Provider Level	Society and College of Radiographers (2015); McNair (2015); Ellis (2006); Jones (2008); Goldsworthy (2016): Bolderston (2018); Dean (2010)
Communication Aids (e.g. posters / e-mails/social media/ reminders/ flow charts etc)	Ellis (2006); Goldsworthy (2016); Barlow (2018); Brealey (2001); Bridge (2017)
Collaborative Working /Building Consensus e.g. MDT	McNair (2015); Jones (2008); Goldsworthy (2016); Bolderston (2018); Brealey (2001); Dean (2010); Bridge (2017); Barlow (2018)
One to One teaching /Coaching/ mentoring/ CPD	McNair (2015); Ellis (2006); Henwood (2008); Dean (2010)
Strategic Clinical Team / MDT Supporting new Clinical Initiative	Ellis (2006); Jones (2008); Brealey (2001); Dean (2010)
Higher Education / Training Supporting new Clinical Initiative	Ellis (2006); Dean (2010); Bridge (2017)
Persistence to maintain change effort	Jones (2008); Bolderston (2018); Henwood (2008)
Professionalism / Sense of pride in a profession/ Motivation to betterment	Henwood (2008)
Taxonomy or Guide to support implementation or standardisation of quality	Brealey (2001); Bridge (2017)
Patient/ Service User Related	
Education at Patient /Service User Level (Undertaken or Recommended)	Powell (2015); Society and College of Radiographers (2015); Bridge (2017)

Resource Related	
Resource Matched to Service Need	McNair (2015); Goldsworthy (2016)
Evidence & Access to Evidence Related	
Benchmarking with other Service Providers /Visit other sites	Ellis (2006); Dean (2010); Bridge (2017)
Research Involvement (required) to Gain Further Qualifications	Elliott (2009)
More Experienced Staff / Older Staff More Likely to Research	Elliott (2009): Bolderston (2018)
Full Time Staff More Likely to Research	Elliott (2009)
Higher Training Likely to Encourage Research Involvement or Utilisation	Elliott (2009); Jones (2008)
Team Approach Enabling Research	Elliott (2009); Goldsworthy (2016); Bolderston (2018); Plant (2001)
Involving external actors in facilitating change or education e.g. external company to train staff / reps. using – outsourced knowledge	Jones (2008); Dean (2010); Bridge (2017)
Evidence Gathering	Goldsworthy (2016); Henwood (2008); Brealey (2001); Dean (2010); Bridge (2017); Snaith (2015); Hickman (2007)
Journal Clubs / Twitter Journal Clubs / Online Forum – encouraging EBP / Research Dissemination	Bolderston (2018); Bridge (2017)
Evidence supporting implementation	Snaith (2015); Bridge (2017); Hickman (2007)
Organisational / Context Related	
Behaviour Change Interventions	Twomy (2003); Powell (2015); Goldsworthy (2016)
Embedding Changes in Commissioning Model	Twomy (2003); Dean (2010)
Local context already receptive to change / Wanted change	Twomy (2003); Goldsworthy (2016)
Context Assessment	Powell (2015); Brealey (2001); Dean (2010); Hickman (2007)
Restricting Access to Services or research initiation e.g. gatekeeping by Clinical Staff or restricting opening hours to increase feasibility/ tool to assess effect of research project on local service (prior to running)	Twomy (2003); Barlow (2018); Goldsworthy (2016)
Legislation Enabling Role Development e.g. Drug Administration / Prescribing /interpreting	Ellis (2006); Brealey (2001)
Restructuring career pathways	Snaith (2015)
Networking / Inter-professional communication including purposive infiltration	Jones (2008); Bolderston (2018)
Legislations mandating CPD	Henwood (2008)
Feedback Systems or loops	Brealey (2001)

2.1.5.2.1 Methodological Quality and the Quality of Published KT Intervention Reporting

As discussed earlier, the included articles were not quality rated, as this has been found to be unreliable, and risks introducing exclusion bias into a review aiming to include diverse evidence in a profession where IR is sparse. CASP checklists were used to assess methodological strengths, weaknesses, and bias, in the included articles, and a concise synopsis was presented in the extraction tables for each article (Appendix 7). A subjective 'traffic light' system was used for filtering the merits and flaws of each paper, with: *Green* being sound research with minimal flaws; *Amber* being of mediocre strength with some flaws but not fatal and *Red* for studies with fatal flaws or judged to have insufficient evidence presented to fully satisfy confidence in the interpretation of the included study. No grading inference was made from this method, however it was useful in highlighting evidence quality during the synthesis process. Where evidence is presented later, it will be interpreted in the context of its appraised potential strengths and weaknesses, and this includes evidence classed as being low in the hierarchy of evidence also e.g. expert opinion (non-propositional) peer reviewed articles.

The quality of intervention reporting was recorded in a table showing agreement with the WIDER standard in Appendix 5. The WIDER standard (Albrecht et al., 2013) comprises 4 categories that should be adequately reported in studies describing the functional components of behaviour change interventions: a *detailed description of the intervention; a clarification of assumed change processes; access to intervention manuals* or *protocols* and a *detailed report of the active control condition(s)*. All four criteria have to be met to satisfy the standard. Exploratory articles not aiming to assess an intervention were marked with an asterisk and excluded from the evaluation (n=11) (Appendix 5). None of the included studies met the full WIDER criteria. Only two studies met 3 out of 4 of the criteria (McNair et al., 2015; Powell, Ahmad, et al., 2015) which were implementation studies using quasi-experimental and experimental studies respectively (RCT). Three studies met 2 of the 4 criteria (Goldsworthy et al., 2016; Plant & Lossing-Rangecroft, 2001; Twomey, 2003) which were quasi-experimental and audit studies, and the remainder did not meet any of the criteria (n=2). *Descriptions of the interventions* was the criterion met most often in the evaluation, in 4 out of 7 cases.

2.1.5.2.2 KT Theory & Frameworks Used or Discussed, & Their Effectiveness

None of the included articles reported using a theoretically informed or tested model or framework to guide the implementation of evidence into practice. One published study protocol was excluded however as a 'near-miss' (Taylor et al., 2016) which otherwise would have been useful to this review. This study used Normalisation Process Theory (NPT) as an overarching implementation framework to embed evidence-based practice in the follow-up and care of men with prostate cancer after radiotherapy. Unfortunately, the project did not directly involve radiographers or the wider radiotherapy team, and therefore it was excluded for this reason. Direct contact was made with the principal researcher to confirm this, and the final results of the full study was not yet published at the time of writing this review. The team also reported that the implementation framework they were using had not yet been tested using a RCT. This study might be of value to future implementation efforts in the radiography context when published.

2.1.5.2.3 Descriptive Narrative Analysis of the KT Strategies Found

Using the Powell et al. (2012) classification taxonomy, the most frequently used primary KT strategies found were, *Plan Strategies and Educate Strategies* (Table 6). At the secondary classification level: *gather information, educate, and develop materials* were the most commonly used KT strategies. Nearly all of the included studies used methods to: plan change, gather information relevant to the change and develop suitable educational methods and materials (Table 6). The strategies seen less frequently at the secondary level - were those likely to address the context: restructure; build buy-in; initiate leadership; develop relationships and facilitate financial support.

Table 6 Frequency Data for the Primary and Secondary-Level KT Classifications[2]

'Primary' KT Strategy Taxonomy	*frequency*
Plan Strategies	16
Educate Strategies	16
Quality Management Strategies	11
Restructure Strategies	9
Finance Strategies	1
Attend to Policy Context Strategies	0

'Secondary-Level' KT Strategy Taxonomy	*frequency*
Gather Information	15
Educate	13
Develop Materials	12
Select Strategies	11
Inform and Influence Stakeholders	11
*QM**	*11*
Educate Through Peers	10
*Restructure**	*9*
Build Buy-in	8
Initiate Leadership	7
Develop Relationships	7
Facilitate Financial Support	1
Modify Incentives	0
*Attend to Policy**	*0*

**Main categories without listed sub-categories*

[2] (Powell et al., 2012)

Plan Strategies were found in all but two of the included studies. According to Powell et al. (2012), these are: efforts to understand the context by gathering information; selecting appropriate KT strategies for the implementation; developing the necessary relationships by building buy-in and developing leadership. The Society and College of Radiographers (2015) gathered information by undertaking an extensive systematic review into the evidence surrounding skin care in patients undergoing radiotherapy. Others utilised qualitative and quantitative research methods as KT strategies to gather information relating to the context or innovation by undertaking literature reviews, scoping reviews and thematic analyses of interview or social media data (Barlow & Owens, 2018; Bolderston et al., 2018; Goldsworthy et al., 2016) and national surveys (Elliott et al., 2009; Snaith et al., 2015). Others used surveys to specifically understand the barriers and enablers in their specific contexts (Bridge et al., 2017; Plant & Lossing-Rangecroft, 2001). Local information was gathered by McNair et al. (2015) and Dean and Routsis (2010) in the form of training needs assessment prior to implementing evidence based change to practice. Information gathered from a pilot study was used to inform the ongoing implementation of radiographer led radiotherapy treatment follow-up clinics by Ellis et al. (2006). Benchmarking with other departments or healthcare sites and site visits as a form of gathering information prior to planning implementation was found useful by Ellis et al. (2006) and Dean and Routsis (2010). Jones and Robinson (2008) found a reflective practice framework, used as part of a theory informed action research cycle, valuable in information gathering whilst reviewing the implementation of the role of a consultant radiographer. Hickman and Harvey (2007) gathered evidence retrospectively, by auditing prior referrals for imaging, against the latest NICE practice standards in the imaging of head injuries, in order to inform the potential implementation of new evidence and its likely effect on future care and resource use. Brealey (2001) proposed information gathering by users of his proposed quality framework in implementing quality standards in radiography reporting, and others used a theory informed reflective practice framework to gather evidence prior to implementing change in imaging post nasogastric tube placement in patients (Jones & Robinson, 2008).

Eleven studies *selected strategies* as part of implementation planning. Formal implementation blueprints were utilised mostly, with examples such as locally developed implementation frameworks (Plant & Lossing-Rangecroft, 2001; Twomey, 2003), baseline assessments of training needs and implementation plans for training (McNair et al., 2015) and developing a blueprint for educational materials and assessment (Dean & Routsis, 2010), guiding the planning process and subsequent implementation using these strategies. Barlow and Owens (2018) *tailored strategies* to overcome barriers and understand and cater for staff preferences in their qualitative staff interviews prior to implementing change to working practices in a GP open access radiography service. In order to understand the impact of applying the latest NICE clinical practice guidelines in a busy emergency radiology service, Hickman and Harvey (2007) undertook a retrospective projection of changes to potential referrals for skull radiography and CT scanning, thus modelling and simulating change as a planning strategy.

Initiating leadership according to Powell et al. (2012) includes recruiting, designating, and training leaders and mandating change. Local champions in radiotherapy departments (amongst a regional group of health professionals) were recruited and trained as leaders, with improved research knowledge, to sustain change by Plant and Lossing-Rangecroft (2001) in their implementation of a research network for AHPs. Jones and Robinson (2008) reported the recruitment of a consultant radiographer, as a leader implementing and sustaining change in evidence-based nasogastric tube placement and diagnostics, as also reported by Goldsworthy et al. (2016) in the appointment of a research radiographer to promote their clinical research implementation assessment tool. Only two studies used organisational leadership (meso/micro level) to mandate change, thus implementing best practice guidance. The gatekeeping of radiology referrals by radiology services, showed a 35% reduction in referrals over a sustained period (Twomey, 2003); mandating change also improved access to MSK imaging by primary healthcare services (Barlow & Owens, 2018).

Examples of plans addressing the context by *building buy-in* were: using stakeholder engagement meetings (Twomey, 2003); initialising research network meetings and research champions as facilitators (Plant & Lossing-Rangecroft, 2001); consensus meetings to understand staff concerns (Barlow & Owens, 2018; Ellis et al., 2006); staff coaching and involvement at MDT meetings (Goldsworthy et al., 2016; McNair et al., 2015) and shadowing other clinicians to gain confidence and understand the need for change (Dean & Routsis, 2010). *Building relationships* as intervention strategies was evident in studies such as Ellis et al. (2006) who collaborated with higher education institutions in their implementation of radiographer led follow up clinics. A novel and potentially potent strategy (in the radiography context) for building coalition was to infiltrate 'clinical nursing practice strategic meetings' at organisational level to develop relationships into being ‘receptive to change’ across professions (Jones & Robinson, 2008), and others collaborated internationally in reaching consensus on the utility and application of virtual technology in radiotherapy training and planning treatment (Bridge et al., 2017).

Educational strategies are important in the incorporation of evidence into the everyday practice of healthcare professionals and are used to inform stakeholders about the KT effort (Davis & Davis, 2010). These are categorised by Powell et al. (2012) into: *developing educational materials*; using specific educational methods; collaborating and sharing knowledge with other clinicians; informing local opinion leaders and using various methods such as mass media to influence various stakeholders. Many authors developed educational materials as a strategy for implementing change. Various authors, aiming to improve practice at a macro level, distributed clinical guidelines, practice standards and protocol production guidelines as educational materials (Nightingale, 2008; Snaith et al., 2015; Society and College of Radiographers, 2015). Others produced educational electronic media (DVD) sent to patients to improve MRI scan compliance and image quality with significant outcomes (X^2 (1,83) =7.84 $p < 0.001$) (Powell, Ahmad, et al., 2015). Teams developing new techniques and extended roles in a radiotherapy unit used educational workbooks, log-books and technique files with pathology specific educational materials as an educational KT strategy (McNair et al., 2015). Ellis et al. (2006) developed educational ‘flow charts’ in an effort to aid decision making by radiographers implementing a radiographer led radiotherapy follow up clinic, whilst Brealey (2001) produced a local taxonomy standard for managing the quality of a radiographer reporting service. Examples of educational methods supporting KT efforts found in radiography were: workshops and professional meetings (McNair et al., 2015; Plant & Lossing-Rangecroft, 2001; Twomey, 2003); didactic lectures (in collaboration with a university) (McNair et al., 2015); educational presentations to various grades of clinical staff (Jones & Robinson, 2008); team education to break down inter-professional barriers (Plant & Lossing-Rangecroft, 2001) and ‘train the trainer’ in Dean and Routsis (2010) pilot study commissioned by the NHS to implement new radiotherapy treatment technology in the UK. Education supported by peers involved: shadowing of expert clinicians by radiographers in developing new treatment techniques gaining expertise and confidence (Dean & Routsis, 2010); informing local opinion leaders by infiltrating a clinical nursing strategic meeting to influence practice change out of the radiography context (Jones & Robinson, 2008) and creating a learning collaborative by the development of a mass media 'Twitter' journal club (Bolderston et al., 2018). A multidisciplinary team supporting approach for the implementation of extended radiographer roles also involved coaching as a means of educating through peers (McNair et al., 2015). Using mass media (local newspaper) was mentioned by Twomey (2003) as a method of informing the local public regarding expectations from an imaging service, and being active participants in the KT endeavour, however there was no evidence presented as to whether this had an actual effect on patient behaviour in their study. Involving patients as active participants in the change process was evident in the study by Powell, Ahmad, et al. (2015) by improving self-efficacy prior to imaging.

Powell et al. (2012) identify numerous strategies for using *financial* incentives as leverage in implementing clinical innovations, and *restructuring* strategies encouraging role development, changing physical structures, and providing equipment. Only one study was found in this review (Dean & Routsis, 2010) reporting the governmental commissioning (as an incentive of financial support) promoting a new radiotherapy technique, leading to the creation of new roles and educational programmes for the new evidence-based innovation of Tomotherapy in the UK. However numerous studies reported: creating new clinical teams (Brealey, 2001; Plant & Lossing-Rangecroft, 2001); revising or extending clinical roles and developing skills within the team (Dean & Routsis, 2010; Ellis et al., 2006; Jones & Robinson, 2008; McNair et al., 2015). Examples such as the appointment of a consultant radiographer to facilitate and champion change and advancing radiographer roles into treatment follow-up clinics being exemplars of the four-tier structure endorsed by the College of Radiographers (UK) (Thom, 2018). An interesting clinical research assessment tool was developed by Goldsworthy et al. (2016) allowing the relay of clinical data to researchers regarding the impact of proposed trials on the clinical service – the utility of which assessed evidence and available resources prior to implementing clinical projects in a radiotherapy department.

Strategies for *monitoring quality* in implementation endeavours can be utilised to install data systems and support networks to monitor the ongoing quality of care or change in service delivery, ensuring EBP continues to function with fidelity (Powell et al., 2012). Various strategies or tools were utilised by authors to develop quality monitoring systems, capture and share local knowledge and use cyclical tests of change to confirm or fine tune the implementation. McNair et al. (2015) set-up an ongoing quality monitoring system for extended role radiographers in 'plan of the day' radiotherapy interventions, ensuring that accuracy of patient treatment was maintained by auditing individual practice and rating performance on an ongoing basis. Others used theoretically informed cyclical tests of change using PDSA/PDCA and action research cycles to reflect and learn from the implementation effort and a locally implemented framework for promoting and sustaining radiographer reporting of images (Brealey, 2001; Ellis et al., 2006; Jones & Robinson, 2008). In order to understand the quality of research generation and utilisation at a local level Elliott et al. (2009) undertook an extensive national survey of UK sonographers (radiographers) to capture and share localised information with the wider community in order to promote evidence based clinical practice. Whilst Snaith et al. (2015) captured local information by undertaking longitudinal analysis or radiographer image reporting in the UK. Ellis et al. (2006) took a snapshot of local knowledge by using semi-structured interviews gaining the views patients and benchmarked against other departments to collect locally appropriate information on extended roles for radiographers in review clinics. Audit and feedback as a means to quality manage implementation efforts was used by many authors. Twomey (2003) audited the implementation of new evidence-based referral criteria in a regional primary care trust; McNair et al. (2015) and Ellis et al. (2006) continuously audited extended roles in plan of the day radiotherapy treatment of bladder cancer and radiotherapy follow-up clinics respectively and Dean and Routsis (2010) audited ongoing radiographer pathology recognition and delineation in a national pilot for implementing Tomotherapy. Plant and Lossing-Rangecroft (2001) audited the internal communication of their R&D network and highlighted difficulties in sustaining effective infrastructure. Team quality management strategies found in the literature included clinical supervision of teams supporting the innovation (Ellis et al., 2006; McNair et al., 2015) and advisory boards or workgroups overseeing ongoing implementation or service change such as sustaining the implementation of a R&D network with radiotherapy radiographer involvement (Plant & Lossing-Rangecroft, 2001) or the ongoing support in the implementation of a research implementation tool (Goldsworthy et al., 2016). Several authors described using tools as strategies to manage KT quality. The Society and College of Radiographers (2015) recommended using the 'RTOG tool' (radiation morbidity scoring schema) to monitor the implementation of their skincare advice, and recommending the data be added to a national database. McNair et al. (2015), Ellis et al. (2006) and Brealey (2001) used practice based tools such as a 'taxonomy of reporting standards', flow-charts and precision protocols as supporting strategies to ensure quality in implementation was maintained. Centralising technical assistance through the use of an R&D group with embedded experts helped develop research utilisation in five allied health professions (Plant & Lossing-Rangecroft, 2001). The use of e-mails and internet pages was used as a quality management strategy by Jones and Robinson (2008) by way of reminding clinicians in the correct care of patients with nasogastric feeding tubes and Brealey (2001) illustrated the use of a reporting framework to remind and guide radiographers when implementing a reporting service. Using an implementation or 'improvement advisor' as a KT strategy, Jones and Robinson (2008) embedded this role within the scope of practice of a consultant radiographer and Plant and Lossing-Rangecroft (2001) established 'local champions' as links monitoring and sustaining change in their R&D network, and the appointment of a 'research radiographer' helped the wider team adhere to the new research assessment tool that had been implemented (Goldsworthy et al., 2016). Finally, team meetings were utilised by Plant and Lossing-Rangecroft (2001) and Goldsworthy et al. (2016) who used a series of meetings and workshops and as a means of promoting quality and sustaining innovations.

Attending to *'Policy Context',* as described in the classification taxonomy, has the potential to promote clinical innovations through the cooperation and facilitation by accrediting bodies, licencing authorities and enablement through changes in the legal infrastructure (Powell et al., 2012). None of the included studies discussed KT strategies which influenced policy context.

2.1.5.2.4 Contextual Issues, Barriers, and Enablers of KT Strategies in Radiography

The extracted data relating to issues with potential to negatively or positively interact with the context or setting were extracted into a table (Table 5). Context as defined by Kitson et al. (1998) represents "the environment or setting in which the proposed change is to be implemented" (p. 150). Examples of issues found in the included articles related to lack of organisational support, or organisations impeding implementation, such as: lack of support by managers to facilitate research resources (Elliott et al., 2009) or enable sufficient time for staff to participate (Bolderston et al., 2018) and perceived cultural differences between professions, such as physicians dominating journal clubs (Bolderston et al., 2018). Snaith et al. (2015), in their longitudinal analysis of the implementation of radiographer role development (formal image interpretation), found issues of ongoing professional dominance and protectionism by the medical profession, with issues such as: lack of support; reserving image reporting for medical trainees; evidence for radiologists not wishing radiographers to report (image interpretation) or actively discouraging it; wide geographical variation in extended roles and scope of reporting practice and organisational staffing levels hindering role development. Interestingly, also the lack of standardisation in the scope of educational courses, limited the implementation of radiographer reporting and that culturally, radiographer image interpretation is still seen as task substitution rather than enabling innovation in service delivery, which needs embedding in the routine practice of radiographers (Snaith et al., 2015). In an effort to widen the implementation in virtual reality teaching and planning of radiotherapy techniques, Bridge et al. (2017) found the geographic location, staff access and technical support to be a barrier to the implementation of the novel innovation. Basic physical resources required for an innovation, such as pre-radiotherapy bowel cleansing to enhance treatment, can be hindered by lack of basic resources, such as enough toilets near the treatment bunker. (Goldsworthy et al., 2016). There were numerous examples found of positive contextual implementation innovations. Behaviour change interventions were used by organisations to enhance evidence or innovation adoption. An implementation framework was used by Twomey (2003) to address the local context and behaviour, prior to implementing new radiology referral criteria, with such efforts as local advertising to influence patient expectations, and engaging with stakeholders to negotiate practice change with a positive reduction in inappropriate referrals. Goldsworthy et al. (2016) piloted their radiotherapy research assessment tool amongst potential antagonists within a multi-professional review group to learn from potential issues with its introduction. Powell, Ahmad, et al. (2015) developed an 'MRI [scan] Self-Efficacy Questionnaire' to understand potential barriers and facilitators to patients complying with scanning instructions and situations with positive effect. In one study, the national health service (UK), required the project group to assess the wider context to identify processes that would optimise the uptake of Tomotherapy in healthcare (Dean & Routsis, 2010). In an effort to understand how new national guidance (NICE) on the management of imaging in head injury, Hickman and Harvey (2007) evaluated their local service, by undertaking a retrospective study applying the new criteria, to understand the effect on future practice implementation, and understand implications for the service. Advantaging innovation by embedding changes in a commissioning model was illustrated by Twomey (2003) and Dean and Routsis (2010). Areas where legislation can hinder or enable innovation includes: drug prescribing; drug administration; image interpretation and mandating CPD by regulators (Brealey, 2001; Ellis et al., 2006; Henwood & Taket, 2008).

Barriers to evidence utilisation found included those relating to professionals, patients or service users and surrounding evidence utilisation. Examples of professional related issues were varied: inter-professional barriers between AHPs leading to poor collaboration (Jones & Robinson, 2008; Plant & Lossing-Rangecroft, 2001); skills issues (lack of / lack of available courses/ training limiting scope of practice) (Dean & Routsis, 2010; Elliott et al., 2009; Snaith et al., 2015) and lack of motivation or apathy by radiographers (Jones & Robinson, 2008). Human resource issues were also noted at the professional level, including: time pressures to implement (Bridge et al., 2017; Elliott et al., 2009); human resource skills not matched or utilised for the service need (Bridge et al., 2017; Snaith et al., 2015) and professional dominance issues with medical staff (Snaith et al., 2015). At a service user level, patients reported a potential barrier with a perceived lower confidence in a non-medical professional in delivering care (Ellis et al., 2006). Barriers relating to evidence or evidence generation were related to: social power differentials perceived between AHP's and physicians in a journal club (lack of confidence leading to lack of engagement with evidence) (Bolderston et al., 2018); radiographers not knowing how to access evidence (Bolderston et al., 2018; Plant & Lossing-Rangecroft, 2001); evidence being difficult to source or access (Bridge et al., 2017) and evidence being too difficult to understand/ interpret or apply at the practitioner level (Elliott et al., 2009).

Enablers of innovation seemed to be more evident in the reviewed articles and clustered around the following themes: theory; professional; patient / service user; resources and evidence. Although no formal implementation framework or theory was applied in any of the included articles, there was evidence of theory used to inform local change processes. Examples of implementation efforts using frameworks to guide the process included: recommendations for implementation of skin care (Society and College of Radiographers, 2015): use of a locally devised 'action plan' to improve care in nasogastric tube placement (Jones & Robinson, 2008); the design and testing of a radiotherapy research assessment tool (Goldsworthy et al., 2016) and the use of quality management frameworks (e.g. PDSA) by Ellis et al. (2006); Jones and Robinson (2008) and (Brealey, 2001). Theory promotes the use of multifaceted intervention strategies (Grimshaw et al., 2012) and the following studies are examples of those using multi-component implementation efforts to recommend or implement change (Brealey, 2001; Dean & Routsis, 2010; Ellis et al., 2006; Jones & Robinson, 2008; McNair et al., 2015). Examples of facilitation efforts as KT strategies were also evident, such as the use of facilitation roles to enhance research uptake (Dean & Routsis, 2010; Goldsworthy et al., 2016; Henwood & Taket, 2008). There were numerous examples where education, communication and collaborative working were discussed in relation to enabling evidence use at the professional level. National guidance with 'pre-packed' educational materials e.g. conference presentations, posters and leaflets promoting new evidence use, was issued as part of an implementation plan by the Society and College of Radiographers (2015), however there has been no research to test impact. McNair et al. (2015) used a packaged training method to ensure quality and ongoing safety in radiographer led 'plan of the day' bladder treatment, showing ongoing accuracy of delivery after training over a three-year period (91% ($p<0.001$) concordance after implementation). At the patient and service user level, educational materials sent to patients prior to an MRI scan, to implement research evidence, improved self-efficacy and scan quality versus a control group in a randomised controlled trial ($X^2(1,83) = 7.84$ $p<0.001$) (Powell, Ahmad, et al., 2015). Educating GPs regarding referral criteria for imaging, and patient expectations regarding using collaboration and mass media helped reduce unwarranted radiology referrals by 35% in a primary care setting (Twomey, 2003). Resources matched to research successful implementation was promoted by Goldsworthy et al. (2016) and McNair et al. (2015). The use of evidence as a positive enabler of implementation was an interesting insight in the included articles. Elliott et al. (2009) revealed how sonographers were enticed to undertake research as a means to gaining higher qualifications, and that more experienced or older staff and full-time staff, were more likely to undertake research in their study on evidence use. A team approach to utilising evidence using local facilitators maintaining an R&D group, showed the value of collaboration in research evidence consumption (Plant & Lossing-Rangecroft, 2001). And Bolderston et al. (2018) showed the value of debating evidence in an international electronic journal club amongst radiographers as a strong enabler versus traditional journal clubs.

2.1.6 Discussion, Review Limitations & Reflection

This systematic review adds to the current body of knowledge, by exploring the state of IS and the use KT strategies in radiography practice, and expands on the work of previous implementation researchers in the allied health field (Jones et al., 2015; Scott et al., 2012; Upton, Stephens, Williams, & Scurlock-Evans, 2014) who identified KT interventions in other professions allied to medicine, notably: dietetics; occupational therapy; pharmacy; physiotherapy; and speech and language therapy. Others have undertaken similar reviews to understand evidence use and barriers and enablers in Occupational Therapy and Nursing (Mathieson, Grande, & Luker, 2019; Upton et al., 2014). Radiography as an allied health profession was not included in any of these reviews, and as discussed in Appendix 1, has arguably its own unique epistemology, developing body of research knowledge, artistry, and technical foundation. The research identified in this review was generally of low quality, and there was no specific reference to assessing the impact of KT interventions supported by implementation theory. Generalising what is known in the nursing context to the practice of radiography in the UK is likely to be unreliable, as professional groups are known to use and apply research findings differently in their varying social networks and or contexts (Thompson et al., 2007; West, Barron, Dowsett, & Newton, 1999). It was anticipated at the outset (with prior knowledge of the radiography research base in the UK), that there was likely to be a paucity of IR in radiography science. In this systematic review, it was intended to understand what effectiveness studies could add to the understanding of implementation in the 'UK radiography practice context', and to use qualitative research data to supplement what can be known from quantitative (or Cochrane) type reviews of effectiveness (Noyes, Popay, Pearson, Hannes, & Booth, 2011). There is no specific synthesis approach recommended by Cochrane for this scenario, as there is currently a lack of robustness in the evaluation of these approaches (Pollock & Berge, 2018). There is much debate surrounding the scope of the type of evidence suitable for inclusion in systematic reviews, and this surrounds the apparent confusion regarding the purpose of individual reviews (Pope et al., 2007). The relativist/constructivist viewpoint suggests that aggregation can diminish the inherent quality or contextual specific meanings of individual qualitative studies when combined, however a more realist epistemological interpretation can facilitate a perspective that synthesis can promote a greater understanding of the underlying meanings and truths common to the included studies (Pope et al., 2007). Similar issues exist in combining research from the qualitative and quantitative investigative paradigms, however the more recent acceptance of mixed-methods research, lends itself to combining data from both paradigms in a synthesis such as this (Pope et al., 2007). Diverse forms of evidence, including non-research evidence, can illuminate 'what works', 'why and how it works', 'when and for whom'?, which is of particular interest to policy makers and those seeking to implement interventions in diverse contexts (Pope et al., 2007; Rycroft-Malone, 2015).

2.1.6.1 Quality Reflection reporting of KT research using WIDER

In order to minimise bias in this review and to ensure as far as possible that the robustness of included studies was appraised, the quality of KT intervention reporting was also measured against the WIDER checklist (Albrecht et al., 2013). This has shown promise in assessing the 'replicability' of implementation studies and has also been utilised by other researchers in the field in similar reviews (Jones et al., 2015; Scott et al., 2012). The WIDER standard has also been adopted by several journals as the recommended scheme to ensure consistency and transparency in reporting IR (Proctor, Powell, & McMillen, 2013). This study adds to the body of knowledge in this field, with the application of the WIDER standard to the literature found in the field of IR in UK radiography. None of the included articles met all four categories of the WIDER standard (see Appendix 5), thus illustrating the need for standardisation and replicability in studies specifically aiming to assess implementation efforts in radiography. The only two studies which met 3 out of the 4 WIDER criteria were implementation studies using quasi-experimental and experimental (RCT) methods, however none of the included studies were based on methods or frameworks theorised to guide implementation per se. The WIDER criteria could not be applied to the eleven exploratory articles, as there was no implementation act other than exploratory data assessing potential implementation efforts. A potential bias in the application of the WIDER standard is possible, as it is dependent on the linguistic detail found in the included studies, and this was also found to be the case by Jones et al. (2015). Linguistic harmony in implementation reporting was far from evident in the radiography evidence found in this review, and it would be reasonable to believe or recommend that using standards of reporting schema such as the WIDER method, and the use published taxonomies, could advance the field by guiding authors to more standardised linguistic approaches of conceptualising and reporting their work (Albrecht et al., 2013; Proctor et al., 2013).

2.1.6.2 Methodological Quality of Research Found

Consumers of research need to have a fundamental understanding of the possible flaws within the work, and need to assess the risk of bias and issues of allocation, and randomisation, to fully understand potential flaws, which is possible even in the output of the most well established research teams (Harrison, Reid, Quinn, & Shenkin, 2016). The quality of design and conduct of research, has the potential to profoundly affect the meanings, interpretation and findings, and therefore the inherent confidence that can be attributed to the work (Harrison et al., 2016). In order to assess the research quality of the individual included articles in this review, given their methodological heterogeneity, a more subjective approach was taken to assess authenticity, credibility and relevance to the research question, rather than the more positivist criteria familiar to quantitative researchers such as inter-observer reliability and construct validity (Mays, Popay, & Pope, 2005). As discussed earlier, this review did not attempt to grade the quality of the included studies. The use of a selection of 'CASP' checklists and other specialist checklists e.g., the 'AGREE checklist', allowed the subjective appraisal of the included studies, in order to assess potential strengths and weaknesses, with observations recorded. Lack of external validation, and the their potential to 'over-standardise' research, has been criticism of the use of quality checklists (Harrison et al., 2016), however the CASP tools have been widely used, and being mindful of potential limitations, they proved useful in this review. Only seven implementation studies were found in this review, and arguably they were not pure implementation studies as understood by the KT community, rather they reported implementing new initiatives, but not founded on general implementation theory per se. Authors of these studies however did self-report some methodological weaknesses, for example the Powell, Ahmad, et al. (2015) study explained that their results were not generalizable and needed further research, as their project was based in a single context, and in a small section of the NHS, however their work used a robust RCT method, rated highly in the accepted hierarchy of evidence pyramid weighting (Centre for Reviews and Dissemination, 2009). Other studies found to be implementing evidence into practice were based on quasi-experimental methods (lower in the hierarchy of evidence ranking), such as McNair et al. (2015) in their study of 'plan of the day' treatment implementation, which was a small localised study, without control group, but this added useful evidence in terms of understanding the contextual issues and likely KT strategies which might work and have the potential to work in larger and more robust studies in the future. The eleven exploratory non-comparative studies included in the review, used methods found to be methodologically 'weak', lacking robustness, with little justification for generalization in the wider radiography context. Some were not well reported or described, and useful data were not reported e.g., the actual results of audits. Non-propositional articles included expert opinion papers discussing areas which might be of value to researchers in the field in the future e.g. the Nightingale (2008) expert opinion article into clinical protocols, or the Brealey (2001) radiography reporting quality framework, ranked low in the hierarchy of evidence, and being somewhat dated, still offered useful information to study and were therefore included.

Implementation science (IS) and research, and the application and effectiveness of strategies to promote EBP has been shown to be hindered by the plethora of models, frameworks, terminology and heterogenous interventions used in the field (Lokker, McKibbon, Colquhoun, & Hempel, 2015). The Lokker et al. (2015) scoping review identified 51 different classification schemes and taxonomies shown to be used in KT research, however they concluded that there was no optimal approach as to how and when to use the schemes, nor how they functioned in what circumstance, but they did recommend their use as a systematic approach, using consistent terminology for characterising interventions. The consolidated taxonomy proposed by Powell et al. (2012) was found useful in categorising and naming the strategies found with consistency, and this review is the first to apply such a classification scheme to implementation interventions found in UK radiography practice, although others, internationally, have used the taxonomy to examine barriers and enablers in an imaging service in America (Probst et al., 2015). Slaughter et al. (2017) further developed the Lokker et al. (2015) review, assessing the quality of the included classification schemes, and recommended a list of 35 schema suitable for use by researchers. The Powell et al. (2012) taxonomy used in this review, was recommended as having sufficient validity and quality by achieving a score of 6 out of a possible 7 by Slaughter et al. (2017), who also reported, at the time, the taxonomy being cited 117 times in the literature and being suitable for assessing interventions at the organisational, system and practice level, thus adding evidence to justify its use in this review. A potential limitation arose due to the subjective nature of applying classifications to the interpreted findings within studies, however the use of a concise table to record findings, and the taxonomic statements describing the meaning of the classifications used as a guide, aided consistency of approach. The taxonomy has more recently been refined by Powell, Waltz, et al. (2015) in order to further clarify the terminology used, however the original version was utilised in this review due to its wide application in extant research. In congruence with other reviews of KT strategies in allied healthcare, 'education' was found was found to be the most prevalent in this review (Jones et al., 2015; Scott et al., 2012). 'Planning' was then the most commonly found intervention followed by 'quality management'. As found by Bunger et al. (2017) in their study using the same classification system, this review found that few 'finance' strategies and no 'policy or context' strategies were evident. The relationship between implementation processes and their contexts is complex, and was discussed in Ch.1. May et al. (2016) contend that IR is "an important laboratory for investigating actors' contributions and dynamic features of context that shape self-organisation in complex adaptive social systems" (p.9). This concept is be explored in depth in Ch.1, however, suffice it to say that this review found no evidence that strategies intending to address the 'policy context', or influence this with funding, was used in the radiography research found, thus strongly suggesting a further area for research specifically in radiography.

Nearly all of the studies appraised in this review used multifaceted strategies to: review the context; recommend change processes or directly implement a change in practice. There is much controversy surrounding the theorised superiority of multifaceted interventions versus single interventions in implementation efforts (Harvey & Kitson, 2015; Rycroft-Malone, 2015; Squires, Sullivan, Eccles, Worswick, & Grimshaw, 2014). Squires et al. (2014) found no compelling evidence for the superiority of multifaceted approaches in their overview of systematic reviews (cautioning against complexity), however Harvey and Kitson (2015) explain that this position is simplistic and fails to understand the complexities of KT, and that complex challenges logically need complex or multifaceted interventions. As highlighted earlier - understanding the theory and complexity of how and why interventions work, when and for whom - is likely to be of prime importance here (Rycroft-Malone, 2015). Even having a 'kitchen sink' approach to packaging or lumping interventions together, in the hope that they might work, is unlikely to succeed without "better crafting and articulating our approaches to intervention development, design implementation and evaluation" (p.2) allowing systematic reviews to be more accurately reported and informing the wider implementation community accordingly (Rycroft-Malone, 2015).

2.1.7 Chapter Summary

The systematic review adds to the body of knowledge, by adding radiography to a list of professions where: the state of evidence use, KT strategies and their effectiveness, and the state of IR use, have been identified. Contextual practice issues as to why, or why not, particular interventions worked, together with potential barriers and enablers were also revealed. Recommendations from this review should aid policy makers and the wider profession in planning and promoting future IR within the body of knowledge relating to radiography practice. The impact of the review is discussed further in Ch.5 in the context of the wider findings of this project.

3 Chapter 3 - Research Methodology - Justification for Chosen Approach and Methods

3.1 Chapter Overview

The philosophical paradigm supporting the chosen methods in this study, is justified in this chapter, together with an appreciation of how the stance fortified the research process and ensured that research was coherent and followed the organising framework, together with an understanding of the most optimal approaches to answering the research question and fulfilling the aims and objectives set out in Ch.1. This chapter then goes on to describe the mixed methods used in detail, including a (Quan) survey utilising a tested Context Assessment Instrument, and (Qual) Interviews using Thematic Analysis, to reveal a rich merged understanding of current context in UK radiography. Figure 8 (p.32) illustrates the methods used for each arm of the study and are explained and justified in greater detail later in this chapter.

3.2 Research Approach, Philosophical Perspectives, and the Stance Adopted for the Project

Investigating broad assumptions requires detailed methods and research approaches and these can be viewed as "plans and procedures" related to the research approach (Creswell, 2014). Philosophical ideas are not always apparent in research but they have an influence on the design and undertaking (Creswell, 2014) and therefore this section will explore the epistemology and ontological perspectives relevant to this study and the resultant chosen methodology and methods.

The relatively undisputed paradigm dominance of the twentieth century, was the positivist approach to, the gathering, analysis and robust interpretation of quantifiable numerical information using a quantitative method (QUAN) (Teddlie & Tshakkori, 2009). Positivist researchers were of the view, that social research should be examined by scientific method, with meticulous attention to hypothesis testing using quantitative data, with methodology being immune to 'researcher values', hence their 'objective' stance (Teddlie & Tshakkori, 2009).

Later postpositivists embraced the criticism that ‘researcher values’ could affect the conduct of their quantitative experiments (Teddlie & Tshakkori, 2009). Researchers were also interested in the latter part of the twentieth century in establishing qualitative paradigms, and they were “highly critical” of positivism and its perceived superiority (Teddlie & Tshakkori, 2009). Qualitative researchers (QUAL) gathering and interpreting narrative information, assumed the worldview, described as ‘constructivism’, with its proponents believing that “researchers individually and collectively construct the meaning of the phenomena under investigation” (Teddlie & Tshakkori, 2009).

A ‘Mixed Methods Research’ (MMR) approach to inquiry necessitates the acquisition of both quantitative and qualitative information, which are then integrated by methods with individualised philosophical and theoretical underpinnings (Creswell, 2014). MMR has been shown to be powerful in understanding complex phenomena that would otherwise not be revealed by the traditional methods of research enquiry alone (Shannon-Baker, 2015)

There has been much ongoing debate about the value or credibility of straying from the purism and polar opposite views of objectivists and constructivists, in promoting their own paradigms as being superior, in the pursuit of quantitative or qualitative truths, respectively (Johnson & Onwuegbuzie, 2004). The traditional purists advocate the ‘incompatibility thesis’ that the quantitative and qualitative paradigms are incompatible and cannot be combined (Florczak, 2014; Johnson & Onwuegbuzie, 2004). Incompatibility allegations seem to surround the epistemological questions regarding the subjectivity or objectivity of perceived knowledge, and the ontological questions relating to social research and experimental causality (Biesta, 2010). Biesta (2010) explains the importance of understanding the “purposes of the research” and the importance of “acknowledge[ing] that decisions about the wider purposes of the research provide the framing for the specific research questions, not the other way round” (P.11) (Biesta, 2010).

The incompatibility thesis has been widely discredited as scholars have shown that MMR is a valid proposition (Schoonenboom & Johnson, 2017; Teddlie & Tshakkori, 2009). Johnson and Onwuegbuzie (2004) argue that there is ‘strength’ and ‘richness’ in combining data from both traditional research paradigms, and that their inherent weaknesses can be mitigated. More recently Creswell and Clark (2011) maintain that MMR, for over twenty years, has now evolved through many phases, and stands as a research paradigm on its own. MMR was originally defined with a “method and methodological orientation”, with later emphasis on the “priority of the quantitative and qualitative data in a study” (Teddlie & Tshakkori, 2009), however Creswell and Clark (2017) in their latest orientation, emphasise the “intent” of the study rather than its “vague and confusing priority”. MMR is complementary to qualitative and quantitative studies, and can be considered to be the ‘third’ paradigm, able to make sense of the inherent weaknesses, of the quantitative (QUAN) and qualitative (QUAL) paradigms used in isolation (Johnson & Onwuegbuzie, 2004). Its main utility has been summarised as being ‘complementary and ‘confirmatory’ in this respect (Gunasekare, 2015).

A useful representation of research approaches used in nursing is shown in an excerpt of a table by (Welford, Murphy, & Casey, 2012) (Table 7) together with paradigm perspectives, and ontological, epistemological and methodological assumptions of the various approaches to nursing research questions applicable to radiography:

Table 7 Research Approaches in Nursing (excerpt)

Research Question	Paradigm / theoretical Perspective	Ontology	Epistemology	Methodology	Methods
What is the truth? What is plausible? What can we establish with certainty?	Positivism	‘Real’ ordered and ‘regular’ world	Objective / dualist	Experimental, manipulative, scientific verification of hypotheses	Quantitative such as experiments and surveys. Strong focus on reliability and validity
How do people cope, deal with or describe their situations?	Pragmatism	Practical World, situational responsive-ness	Subjective, practical	Different methods are appropriate for different situations – mixed methods	Qualitative and Quantitative approaches, such as interviews observations and questionnaires
How can understanding and meaning from multiple perspectives explain an experience?	Interpretivism/ constructivism	Individuals attach meaning to their actions	Multiple perspectives	Case Study	Multiple, including interviews, observations, documentary analysis and questionnaires

NB Sourced from (Welford et al., 2012)

Creswell and Clark (2017) suggest that their latest iteration of the definition of MMR should contain “core characteristics” (Table 8) representing a fusion of diverse views incorporating MMR: methods; designs; and philosophical worldviews.

Table 8 Definition of Core Characteristics of MMR

• Collects and analyses both qualitative and quantitative data rigorously in response to research questions and hypotheses
• Integrates (or mixes or combines) the two forms of data and their results
• Organizes these procedures into specific research designs that provide the logic and procedures for conducting the study, and
• Frames these procedures within theory and philosophy

NB: Sourced from (Creswell & Clark, 2017)

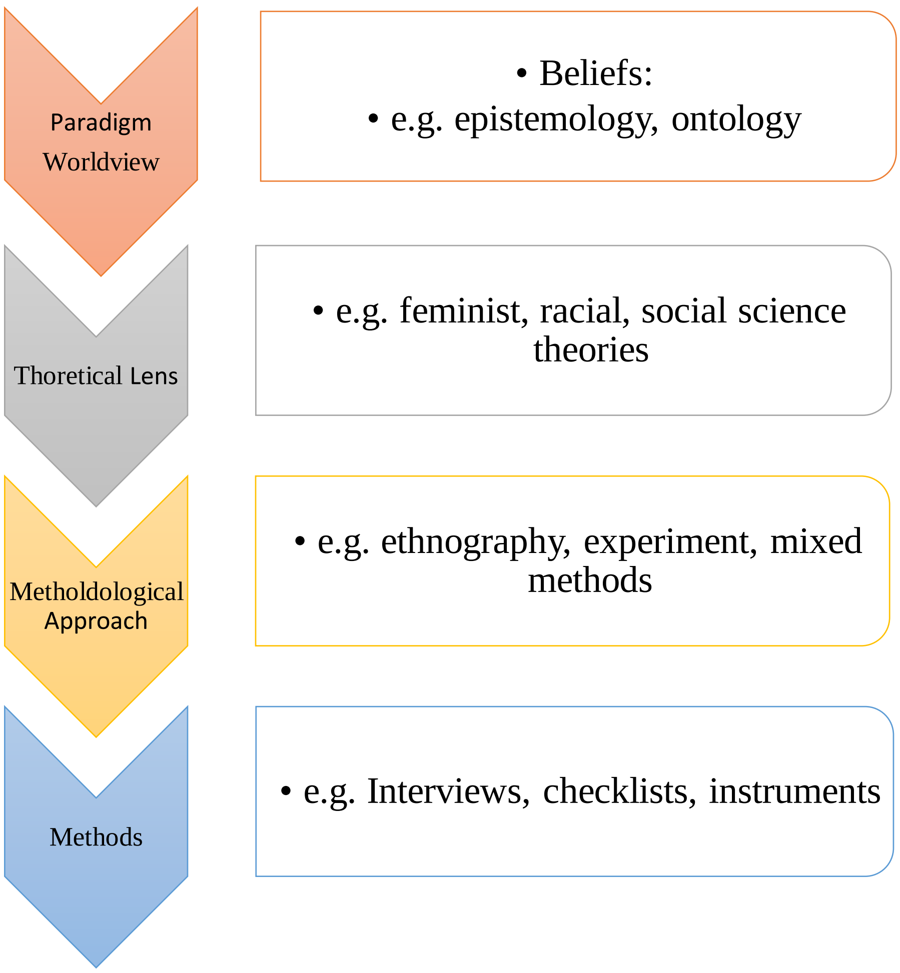
Whilst supporting MMR generally, Caruth (2013) suggests that some methodological difficulties can arise with: concurrent techniques possibly requiring a larger team; resource demand (time, financial); knowledge level required to undertake research in multiple paradigms; the ongoing resistance of the purist stance as to the credibility of the output, and the combined ethical considerations and challenges spanning quantitative and qualitative paradigms within MMR.

3.3 Ontology, Epistemology and Philosophical Worldviews Supporting Mixed Methods

All research is founded on philosophical assumptions, and researchers need to be aware of this backdrop as they acquire new knowledge and relate their actions to their philosophical stance (Creswell & Clark, 2011).

Creswell and Clark (2011) describe a simplified framework originated by Crotty, outlining how philosophy should be considered in the design of MMR (Figure 11).

Figure 11 Four Levels for Developing Research Study (Creswell & Clark, 2011)



Pragmatism has been proposed as the "natural philosophical partner" (p14) to MMR, with its inductive, abductive and deductive logic being suited to discovering patterns in data, whilst being able to test hypotheses and theories and revealing a plausible set of explanations in eventual understanding (Johnson & Onwuegbuzie, 2004).

Pragmatism is presented as a collection of beliefs held by many researchers, initially developed by historical philosophers such as John Dewey, William James and Charles Sanders Peirce (Creswell & Clark, 2017). The paradigm derives from many ideas, including "what works" (p.43), valuing subjective and objective knowledge and utilising diverse methods (Creswell & Clark, 2011). Dewey believed that "everyone's experience is equally real" (P.15) (Biesta, 2010) and that different accounts of the same issue does not necessarily mean that they are less accurate or less real (Biesta, 2010). His initial outlook and perspective on the world, did not take an 'either or view' (as in subjectivism and objectivism) therefore removing perceived superiority between different paradigms, with a view that no paradigm can be superior, and that knowledge is subject to the ways in which we engage with the world (Biesta, 2010).

> Dewey's pragmatism particularly helps us to think in a radically different way about the notion of truth and emphasises that research can ever provide us only with insights into what has been possible, not about what is or will be the case (P.21) (Biesta, 2010).

Creswell and Clark (2017) and Teddlie and Tshakkori (2009) suggest the following attributes (Table 9) of MMR using a pragmatic worldview:

Table 9 Mixed Method Attributes

- Both quantitative and qualitative research methods may be used in a single study
- The research question should be of primary importance – more important than either the method or the philosophical worldview that underlies the method
- The forced-choice dichotomy between postpositivism and constructivism should be abandoned
- The use of metaphysical concepts such as truth and reality should also be abandoned
- A Practical and applied research philosophy should guide the methodological choices

NB: Sourced from (Creswell & Clark, 2017)

With some MMR studies collecting both quantitative and qualitative data in the same phase, and then moving on to synthesise the data into a collective understanding using both paradigms, their theorised philosophical incompatibility as described earlier by Johnson and Onwuegbuzie (2004) can be realised with the pragmatic (all encompassing) pluralistic worldview described by Creswell and Clark (2011), where multiple data forms can be gathered to best answer the research question.

The traditional worldviews of conventional research contrasted with MMR, as conceptualised by Morgan (2007) is shown in (Table 10), and is a useful basis for further discussion of how these can be theoretically reconciled in MMR, using the 'pragmatic theoretical' lens on the world.

Table 10 A Pragmatic Alternative to Key Issues in Social Science Methodology

	Qualitative Approach	Quantitative Approach	Pragmatic Approach
Connection of Theory and data	Induction	Deduction	Abduction
Relationship to research process	Subjectivity	Objectivity	Intersubjectivity
Inference from data	Context	Generality	Transferability

NB: This table was sourced from (Morgan, 2007)

A pragmatic viewpoint is that logic should not be viewed as an ‘either-or’ contrast between induction and deduction, rather, that at any point in time, research using a pragmatic approach resides at various points between the ‘inductive-deductive’ cycle (Teddlie & Tshakkori, 2009). The pragmatic worldview approach to MMR facilitates research that may start at any location on the inductive-deductive cycle using theories or conceptual frameworks or with facts or observations, and using different methods simultaneously (Teddlie & Tshakkori, 2009). The pragmatic abductive logic allows a researcher to determine causes to surprising events by working back to a probable reason of an earlier observed result (Teddlie & Tshakkori, 2009). A useful summary and comparison explaining abductive logic would be that, “abduction creates, deduction explicates, and induction verifies” (P.89), producing a comprehensive enquiry (Teddlie & Tshakkori, 2009).

3.4 Evolved Contemporary Mixed Methods Designs

In their latest review of MMR, Creswell and Clark (2017) explain the emergence of understanding and new categorisation of designs as ‘fixed’ – where the use of qualitative and quantitative research is predetermined at the outset of a research study and undertaken as planned - and ‘emergent’ where a quantitative or qualitative study might be later supplemented with another approach to further understand research output, which might otherwise be inadequate singularly.

Creswell and Clark (2017) have also highlighted new ‘typology’ and ‘interactive’ approaches to MMR design. The former is characterised by designs which can be selected and adapted to a study’s purpose and the latter involves focusing on the ‘parts’ and ‘processes’ of a study.

The latest iteration of MMR typology proposed by Creswell and Clark (2017) shows a consolidated typology, classifying three core ‘parsimonious’ designs:

- Explanatory Sequential Design
- Exploratory Sequential Design
- Convergent Design

(p59 Creswell & Clark, 2017)

The MMR design chosen for this project will be described and justified in the method section.

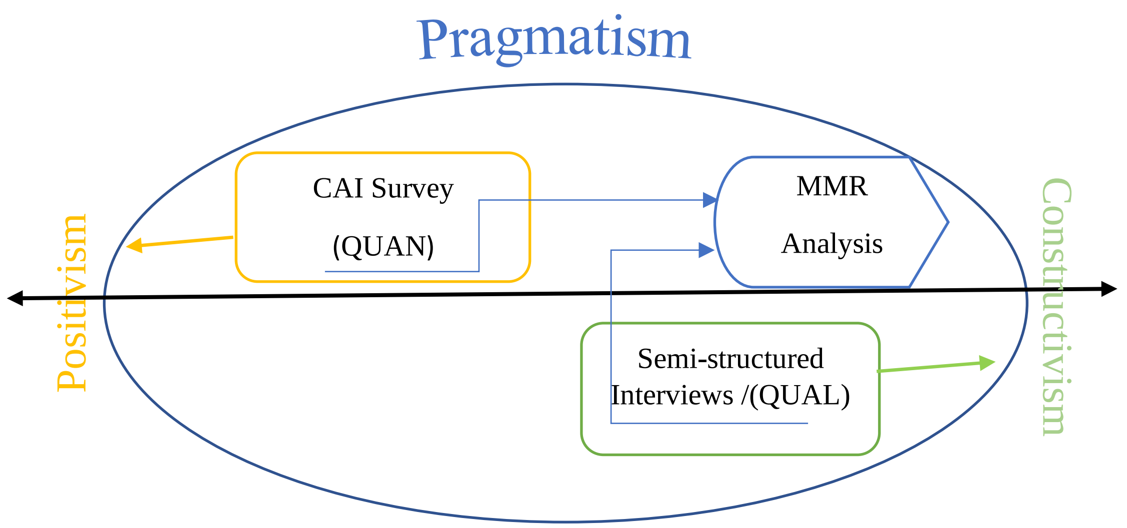
3.5 Philosophical & Methodological Underpinnings for this Project

The pragmatic philosophical approach was used as a ‘paradigm umbrella’ (Creswell & Clark, 2017) for guiding this study, although it is acknowledged that some authors warn against erroneously viewing philosophical pragmatism as a paradigm suitable for underpinning mixed methods research per se (Biesta, 2010) . Rather Biesta (2010) prefers an understanding of a “set of insights that can help us to have a more precise discussion about the strength and weaknesses of mixed methods approaches” (P.2).

As shown previously, MMR is suitable for guiding the fusion of each conventional research paradigm, into a comprehensive understanding of the combined data, and its greater understanding as a whole (Creswell & Clark, 2011), and this approach proved insightful and added greater depth of understanding by seeking to review and understand the implications of each arm of the study as a ‘combined whole’. The approach to studying the research questions and delivering the outcomes to the stated project aims, embraced the traditional worldviews of both the Postpositivists and Constructivists and their respective philosophical assumptions by combining the output of each of chosen methods using a Pragmatic worldview overall. Creswell (2014) explains that because “pragmatism is not committed to any one system of philosophy” (p.11) that researchers using MMR are free to “draw liberally from both quantitative and qualitative assumptions” (p.11).

Figure 12 shows the project architecture, that is, how the QUAN and QUAL methods used, relate to the philosophical foundations of this project, with the pragmatic paradigm facilitating a rich understanding, whilst acknowledging the traditional philosophical ‘leanings’ of each individual method’s traditionally associated worldview:

Figure 12 Pragmatic Paradigm Supporting the Project Architecture



NB: Modified from a diagram in (Schmeltz, 2012)

This approach facilitated a 'new understanding' of the project research questions using inductive-deductive reasoning along a continuum between the positivist and constructivist paradigm (Figure 12). Creswell and Clark (2011) also advocate that multiple worldviews be used in MMR, and that these should relate to the type of MMR being undertaken rather than to the individual researcher's philosophical stance. It is possible to use multiple paradigms to shape and construct MMR procedures, for example if a quantitative based survey is used initially as a strand of data gathering, then a postpositivist worldview would be appropriate, and then later using qualitative research to understand the survey strand (findings), would imply a more constructivist position (Creswell & Clark, 2011). Pragmatism as a philosophy can therefore support more specific understandings and perspectives about the validity of different research designs and strategies, by supporting MMR researchers to "ask better and more precise questions about the philosophical implications and justifications of their designs" (P.114) (Biesta, 2010).

Therefore the philosophical stance taken in this project, acknowledges the pragmatic choices taken within the method, and places the researcher at the heart of the data, melding new knowledge from the results of both paradigm approaches including an appreciation and justification of the effects of any disadvantage that may bear on the study output and any inferences or generalisations made (Tashakkori & Teddlie, 2003).

3.6 Methods

3.6.1 Justification of the Research Design Chosen for this Project

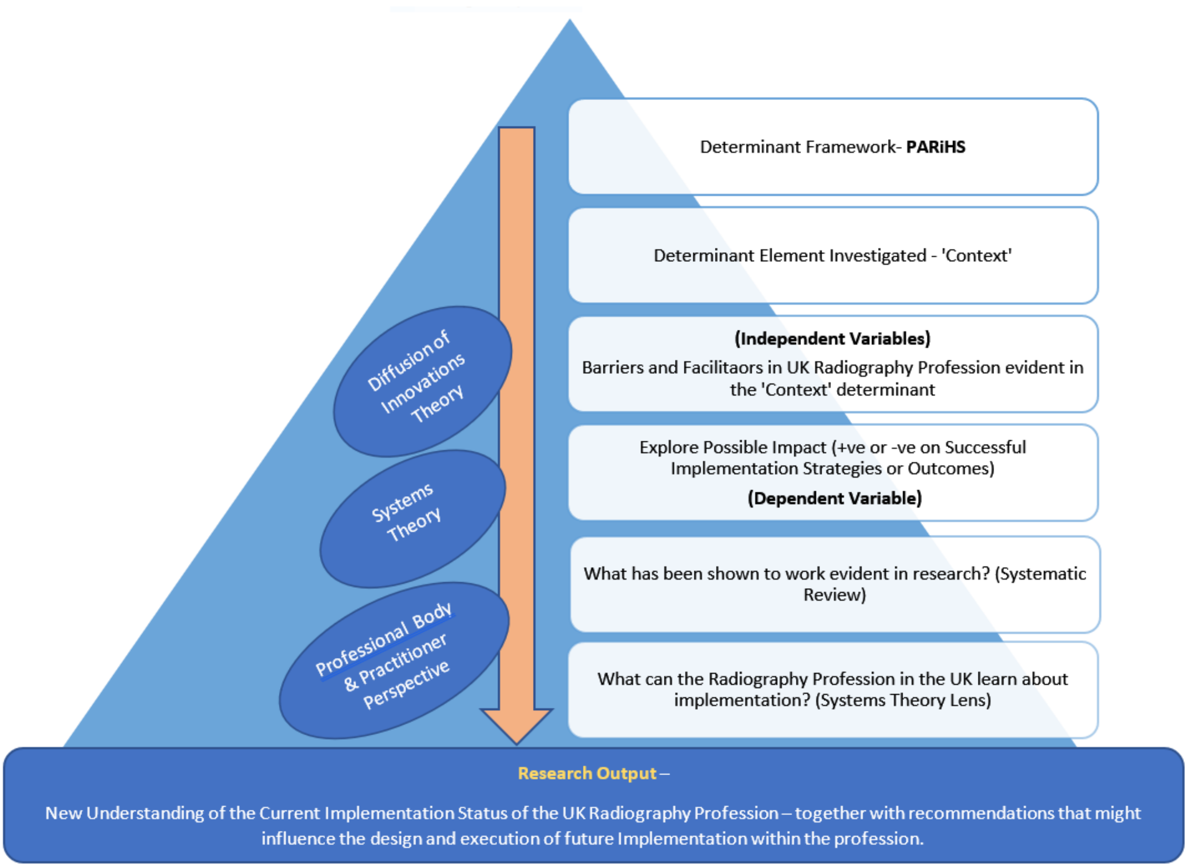
It is important to justify the use of MMR to answer the research questions of the project, as MMR is not always the most suitable method (Creswell & Clark, 2017). MMR is applicable to a wide range of situations, including Health Sciences (Creswell & Clark, 2017), and is increasingly seen as a legitimate research choice amongst traditional researchers, with superior insight being more possible than the traditional methods used alone (Caruth, 2013). However, this requires the methodological expertise of both traditional research paradigms (QUAN/QUAL) for effective application and analysis, hence the assertion that MMR is a more advanced method of achieving extensive results (Caruth, 2013). MMR has shown strength in researching complex social and organisational phenomena, and the decision to adopt this methodology, should be related to the "research question, purpose and context" (p.2) (Venkatesh, A. Brown, & Bala, 2013). And in IS research, Aarons, Fettes, Sommerfeld, and Palinkas (2011) explain that MMR is useful for confirmatory evaluation of models and evaluating implementation approaches.

Berman and Smyth (2015) not only highlight the utility of conceptual frameworks in connecting theoretical territories to methodological design, but also link the usefulness of conceptual frameworks to the practicing professional, in aiding thinking about professional practice linked to their research. Conceptual frameworks are also seen as a method of linking research methods to the work of others (Berman & Smyth, 2015), and in this project, strong links exist with the PARIHS framework (Ch1. and Appendix 2) and its underpinning theories linked to clinical practice. Social science theory, and theories of adoption or diffusion can be used as conceptual models supporting an MMR project which can influence the nature of the questions asked in the method, guiding what "the researcher seeks to find in a study" (P.44)(Creswell & Clark, 2017). The conceptual link with theory in this project, is illustrated in the project organising framework 'B' illustrated in Figure 13 below, with an emphasis on the underpinning supporting (and connected) theories. Conceptual frameworks are also successfully related to research in professional practice and have been shown to move the practitioner "beyond relational thinking into extended abstract thinking as doctoral study progresses" (p.131), they also support self-audit, ensuring cohesion within the body of work

(Berman & Smyth, 2015). Project organising framework 'A' (Figure 8) (p.32), highlighted earlier in Ch.1, has a methodological and method emphasis, illustrating the chosen epistemological research design linked to philosophical assumptions. The rich contextual data gathering possibilities of a pragmatic approach to combining traditional research paradigms with a Mixed Methods convergent is design is shown. Figure 8 (p.32) links the inductive and deductive method approaches chosen to generate data in order to understand what is known about implementation within the practice of Radiography in the UK, using abductive reasoning, facilitated by the pragmatic paradigm. Samuels's (2000) view of abduction in the pragmatic paradigm is that deduction and induction both play a part.

The above interpretation of abduction in relation to this project resonated with the ontological perspective of the researcher, and with the overall aims and objectives. For the above ontological and epistemological reasons, MMR was chosen as the methodology to further explore and reach deeper understanding and the generation of new knowledge in relation to the project aims and objectives as stated in Ch.1.

Figure 13 – Project Organising Framework 'B' -Theory Level



3.6.2 Chosen Design Typology

The Convergent MMR design was chosen, with its strengths in investigating phenomena residing in IS and its challenges. Palinkas et al. (2011) and Dobbins et al. (2009) found that MMR was useful to gain a deep understanding as to: why implementation ventures succeeded or failed; identifying what factors influenced positive outcomes in implementation, and exploring existing conceptual implementation models, to a greater depth.

In their study of MMR use in IR, Palinkas et al. (2011) studied 22 papers published in peer reviewed journals, and concluded that they had found 5 major reasons to use MMR in IR. These include: 1) using quantitative methods to measure intention or implementation outcomes, and qualitative methods to understand the processes; 2) conducting both exploratory and confirmatory research looking at phenomena related to IR and generating a conceptual model with testable hypotheses, and confirming validity by testing the hypotheses; 3) examining intervention content and context, with qualitative data useful to explore the context where implementation is intended, and quantitative methods examining the intervention outcomes; 4) incorporating the perspectives of evidence/ IR consumers and 5) MMR being used to compensate for weaknesses in each opposing paradigms by using triangulation and convergence methods . Palinkas et al. (2011) further concluded that within the studies they evaluated, "[MMR] often reflected a balanced structure and use of convergence, complementarity, expansion, and sampling to understand [the] barriers and facilitators of implementation" (p.50).

A frequently used MMR approach is the 'Convergent Design' (formally referred to as concurrent or parallel design), with its roots in the 1970's (Creswell & Clark, 2017). The convergent method is used "to obtain different but complementary data on the same topic" (p.122) (Morse, 1991). The convergent design is particularly useful for corroboration, validation and for examining relationships between variables (Creswell & Clark, 2017).

Creswell and Clark (2017) also highlight the following additional usefulness of the method:

- “When the researcher has limited time for collecting data in the field and must gather both types of data in one visit”
- “When the researcher needs both quantitative and qualitative forms of information from every participant”
- “When the researcher has skills in both quantitative and qualitative methods of research”
- “When the mixed methods team has individuals skilled in both quantitative and qualitative research”

(p. 68-69) Creswell & Clark, 2017)

A convergent MMR design was chosen where the QUAN and QUAL arms of the research project would be executed concurrently, being mindful of the resources and time available for execution, and each design section was independent of the other until the final results were analysed separately, and further insight was gained by comparing/merging (Figure 14):

Figure 14 MMR Design Chosen

	Convergent Design – parallel databases variant (Mixed Methods) (Creswell & Clark, 2017)				
QUAN	Data Collection – CAI Instrument (Survey/Questionnaires)	Analysis – descriptive & inferential statistics /Calculation of CAI Index/correlational / factor analysis		***Systematic Review*** considered in relation to the overall findings (KT Interventions found / State of IR in Radiography)	
			Results Merged & Compared (Triangulation /narrative analysis in the Discussion Section)	Analysis, Interpretation – Generation of new knowledge/ theory /models	**OUTPUT:** ProfDoc Thesis/ Potential Peer reviewed publications / Influence on national guidance & Policy
QUAL	Data Generation – Semi-structured telephone interviews n=20	Analysis – Thematic Analysis		***Learning/Collaboration /Dissemination Event*** Reported	

The convergent design is useful when both strands of research are brought together (QUAN+QUAL) to be compared or combined (Creswell & Clark, 2017; Tashakkori & Teddlie, 2010). There are at least two strands (usually relatively independent) to convergent methods, each with its own research question, data, and analysis being separate (Tashakkori & Teddlie, 2010). Meta-inference is then made by bringing together the results of both strands in order to address the research question originally set (Teddlie & Tshakkori, 2009). The 'parallel-databases variant' synthesizes and compares the two independent sets of results, to examine the overarching MMR question, and brings a richer understanding of the research outcome in the discussion section (Creswell & Clark, 2017).

3.6.3 Data Collection

This section will set out, explain, and justify, the various methods adopted to collect data in this MMR project.

3.6.3.1 Data Collection Purpose

The overall intent was to generate answers to the research questions stated in the aims and objectives, ultimately answering the overarching MMR question (Creswell & Clark, 2017). It is important that researchers do not lose sight of this central tenet, and continuously check that their data and samples are suitable for answering the research aims and objectives, which was useful in this study (Creswell & Clark, 2017). Table 2 in the 'Aims and Objectives' section (Ch.1) (p.31) clarifies the data sources and samples that were used to answer the objectives of this study.

3.6.3.2 Temporal Relationship of the Data Sampling

The chronological order of the data collection strands is not critical in the convergent design and data can be collected simultaneously or with some time lapse (Teddlie & Tshakkori, 2009). Table 11 shows the temporal relationship of the data acquisition of the QUAN and QUAL strands, together with the other related data gathering methods (systematic review, and dissemination event). The time lapse between the national survey and semi-structured interviews was relatively small (c 3months). The Systematic Review was standalone and did not inform the data collection in the Quan and Qual arms of this study.

Table 11 Temporal relationship of data sampling methods

Ethical Approval Granted for Project	**Systematic Review**	**Conduct National CAI Survey Data Collection - (QUAN)**	**Conduct semi-structured telephone interviews - (QUAL)**	**National Dissemination/ Collaboration Event**
July 2017	Sept 2018 to May 2019	September to November 2017	January and February 2018	October 2018

3.6.4 Theoretical Presuppositions in Relation to Chosen Methods

As discussed in Ch.1 and Appendix 2, the PARIHS framework, conceptualised by users and authors, can be thought of as a "theoretical and practical heuristic to guide research and practice development" (p.2) (Kitson et al., 2008). Other conceptual frameworks exist, however PARIHS has been credited with the ability of not only mapping elemental interrelationships and their embedded theoretical relationships affecting KT strategies, but also having the potential to be used as a pragmatic device by researchers (Kitson et al., 2008). The PARIHS team proposed that "facilitation will be more effective following a diagnosis of the context into which the new knowledge is being introduced and an assessment of practitioners' understanding of and acceptance of the evidence/new knowledge itself" (p.10) (Kitson et al., 2008). Examination of the PARIHS theoretically developed sub-elements for context: culture; leadership and service evaluation, as found in general UK radiography practice, was one aim of this project. This underpinning theory and concept provided the foundation to the chosen and adapted methods, as well as investigating the role that the other PARIHS constructs played in radiography (Evidence and Facilitation).

3.6.5 Systematic Review

As is conventional, the method used for the systematic review will be reported in a separate chapter (Ch.2).

3.6.6 Sampling

3.6.6.1 Population and Sample

It was important to understand the connection between sampling strategy, and the ability of research output to be representative, with the credibility of the inferences made being important in the QUAL strand of the project and the internal validity of the inferences made in the QUAN strand (Teddlie & Tshakkori, 2009). The conclusions that can be drawn from a MMR study are limited to the ability of the sampling strategy used to answer the overall research question (Creswell & Clark, 2017). When designing sampling strategies using online methods, the mode of data collection and sampling design should be considered separate issues, and they are not a priori related (Vehovar & Manfreda, 2008).

A population of c27,000 'radiographer' members of the SCoR was purposively sampled. In quantitative studies, researchers use power and sample size estimations to determine the number of subjects required to answer the research question, with small samples leading to larger confidence intervals, and statistical effects needing large differences to be apparent (Jones, Carley, & Harrison, 2003). Increasing the number of subjects can improve precision and estimates of differences within populations (Jones et al., 2003). Serdar, Cihan, Yücel, and Serdar (2021) provide a useful guide to calculate appropriate sample sizes in survey type research, with a quality appraisal of online calculator tools. The most commonly quoted margin of error (ME) is 5% and confidence intervals (Ci) set at 95% (Serdar et al., 2021). Using a verified online tool (Roasoft®) evaluated by Serdar et al. (2021), the recommended sample size for the online survey was 379 participants, at the above ME and Ci for a population of c27,000 (response distribution set at 50%). An ME greater than 10% is usually regarded as unacceptable (Serdar et al., 2021). Statistical rigour and coding reliability is discussed later in this chapter.

The intent was to generate unequal sample sizes in each strand of the MMR study, with anticipation that a representative sample could be drawn nationally for the QUAN strand, and a plan, based on available resources (time and finance), to sample n=12 individuals, nested within the QUAN strand for the QUAL interviews. It was not the intended purpose to draw interview respondents from the survey strand for comparing reliability between the same respondents. Later a decision was made to increase the QUAL sample size to n=20 interviews, to compensate for the low response rate from the Welsh and Northern Irish population.

There does not seem to be a universal credible tool or criteria for selecting a sample size for semi-structured interviewing and subsequent Thematic Analysis (TA). In their extensive review of the subject, Fugard and Potts (2015) suggested a “simple quantitative approach to inform sample size choice for thematic analyses” (p.680) by offering a ‘tool’ to support decision making based on expected ‘themes’ anticipated in the process. However, leading experts and proponents of TA (Braun & Clarke, 2016) point out that this approach is seemingly incompatible with TA, with TA’s roots firmly embedded in the qualitative paradigm, arguing that quantitative sampling standards do not easily cross the philosophical divide. Braun and Clarke (2016) argue that Fugard and Potts (2015) treat TA as a “homogenous entity” (p.739) and that they treat ‘themes’ as a particular or fixed entity that is “ontologically real” (p.740). Braun and Clarke (2016) for this reason explain that their tool cannot be reliable as the TA coding and thematic development processes “are organic, exploratory and inherently subjective, involving active, creative and reflexive researcher engagement” (p.741), therefore making assumptions about ‘anticipated themes’ prior to data collection is not practical or methodologically safe. Hammersley (2015) also argued that this approach was “worthless” (p.687) and that qualitative researchers should be free to adjust the number of interviews required during the research process as “themes do not stand alone: as the analysis develops they become increasingly integrated into the narrative that provides answers to a set of developed research questions” (p.688).

Qualitative research generally uses relatively smaller samples with no general rules, sometimes one participant or piece of text, is sufficient for analysis in depth (Braun & Clarke, 2013). Braun and Clarke (2013) suggest that it is routine in qualitative interviewing for sample sizes of between 15 and 30 participants, and this is sufficient to "generate patterns across data" Braun and Clarke (2013 Chapter 3, Section 2, para. 2) citing several research examples.

Saturation is very important in qualitative research and there is no fixed rule regarding this (Marshall, Cardon, Poddar, & Fontenot, 2013). In their extensive review of the use of interviews in qualitative research, Marshall et al. (2013) concluded that for grounded theory interviews and for a single case study, 15-30 interviews seemed to be the norm, and that generally the reporting and justification for chosen sample sizes seemed to be "sloppy" in the literature (p.11). Marshall et al. (2013) also supported the earlier view that good qualitative research should theoretically aim to achieve saturation.

3.6.6.2 Reaching the Sample

The SCoR facilitated aspects of the project in recognition that there was interest in the work relating to UK radiography practice. The professional body agreed to facilitate:

- An advert in their monthly national magazine (Synergy), reaching c27,000 members, for two consecutive months (paper and electronic versions)
- Contact with senior national officers of the professional body for the Dissemination /Engagement event.
- Provision of the use of a conference room at the SCoR headquarters in London

Contact was made with the population for both the initial online survey and subsequent telephone- interviews, by means of:

- Advertisement in the National SCoR magazine (Synergy) Appendix 8
- Advert on the SCoR website and link to the online survey

An offer of a free ‘draw’ within the advert, was used as an incentive to recruit, with a prize of a tablet computer. Financial or material incentives can increase response rates to online surveys (Vehovar & Manfreda, 2008), with research showing improvement with incentives over relatively short periods of time. One respondent was randomly selected, by generating a random number using an online tool, to select an individual, to receive the prize. The prize was subsequently posted to the individual, and also thanking them for their participation.

During the data collection phase using the online survey, regular checks were made to track the response rate. After the first month there had only been c40 responses, and a decision was (made in consultation with the SCoR) to raise the profile of the advert by using the SCoR’s Twitter™ platform. With various professional officers ‘tweeting’ and ‘re-tweeting’, raising the profile of the advert, at the end of the second month there were c182 responses to the online survey.

Within the online survey, there was a facility for respondents to select a ‘tick box’, to volunteer to participate in a future telephone interview. When undertaking the interview strand, initially n=12, and subsequently n=20 respondents were selected from those agreeing to interview, and to avoid bias, these were purposively sampled to have approximate equal numbers (within the sample constraints) of: gender; pay-grades; practice sub-specialties; years of experience and a representative sample of diagnostic and therapeutic radiographers. Additional ethical approval was sought and granted by the AEC to increase the interview sample size.

3.6.7 QUAN Instrument – CAI (Questionnaire)

3.6.7.1 Instrument Selection and Justification for Use

Although there are other proposed methods in the literature of assessing implementation context (see Ch.1), the (CAI) tool (McCormack et al., 2009), was selected as the instrument of choice for the questionnaire as it has strong links with the PARIHS framework and its constructs. There have been no recent systematic reviews undertaken on the effectiveness of context assessment tools per se (Health Foundation, 2014). In their major review of research undertaken on 'context', in the UK health setting, the Health Foundation (2014) suggest that the CAI tool is "probably the single best validated instrument for QI [Quality Improvement] context assessment" (P.62).

In order to examine the 'context' construct, as defined by McCormack et al. (2002) and Kitson et al. (2008), it was decided to use the CAI tool as the foundational structure of the participant questionnaire. The tool has been developed to provide clinicians with a method to assess and understand the context in which they work (McCormack et al., 2009) and is useful as a diagnostic tool (Kent & McCormack, 2011b)

McCormack et al. (2009) developed the instrument specifically designed to assess and understand context as conceptualised in the PARIHS framework. The tool has a 37-item model structure (4-point Likert scale), and has been extensively tested, in the practice context of continence promotion in nursing (McCormack et al., 2009). The design of the instrument is suitable for use in a variety of settings, however McCormack et al. (2009) stated that at the time of design and testing, it had not been tested in other clinical settings, however feedback from initial users, included suggestions that the CAI could be of value in other healthcare settings. The developing team also stated that "by developing the CAI, we have begun the process of providing a means of assisting practitioners in assessing and understanding the context in which they work and the effect this has on implementing evidence into practice" (p. 33) (McCormack et al., 2009). Subsequently, Kajermo et al. (2013) in their translation of the CAI into Swedish, adapted some factors to make it applicable to Swedish nurses in the acute setting and stated that they recommended it as suitable for clinical contexts, and also reported that users found it easy to use. Similarly Hølge-Hazelton et al. (2019) more recently translated the CAI and tested its usability in a Danish context.

Factors relating to the context sub-elements in PARIHS were developed by the project team, with an initial list of over 300 items being reduced to 88 after removing repeated items, and amalgamation (McCormack et al., 2009). After further extensive statistical testing and refinement, including factor analysis, 37-items remained, each covering five factors representing aspects of the PARIHS context sub elements (McCormack et al., 2009). The five remaining factors were: collaborative practice; evidence-informed practice; respect for persons; practice boundaries and evaluation, each represented by the 37 statements in the instrument (McCormack et al., 2009).

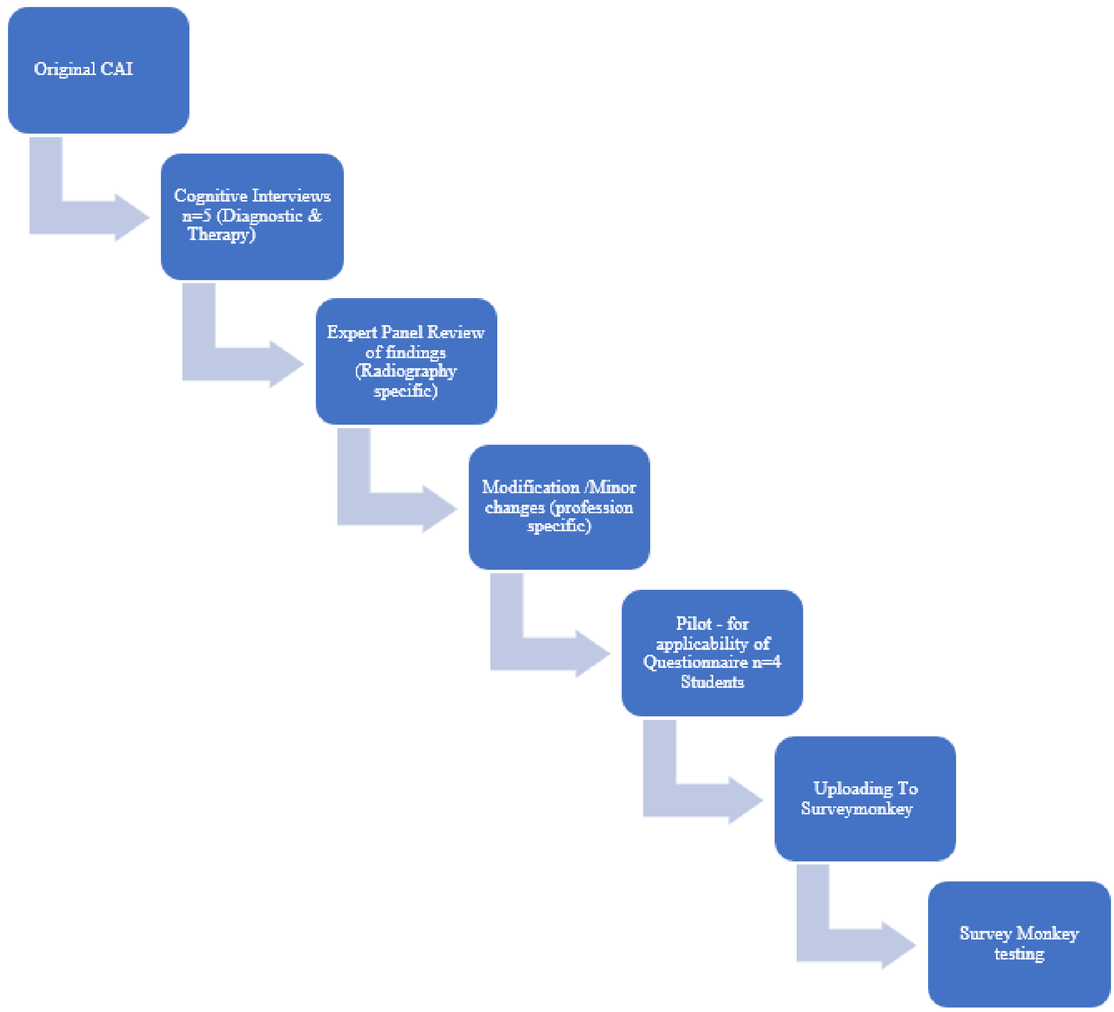
McCormack et al. (2009) concluded in their original research into the utility of the CAI, that the tool had been shown to be reliable and have robust validity, however they acknowledged that their study was the first to develop and test a CAI tool specifically examining the PARIHS construct of context in a clinical setting. Finally, McCormack et al. (2009) concluded with a recommendation for more research into evaluating context using the CAI tool, in order to address the limitations of their study and to test it in different cultures (specificity). The original paper discusses the testing and validity of the original CAI instrument in detail (McCormack et al., 2009). The following section explains how the CAI was modified to be context specific for radiography in this study.

3.6.7.2 Modification and testing of the CAI (radiography specific)

Initial exploration as to the suitability of the CAI as the quantitative instrument for this MMR project, raised issues of appropriateness (external validity) to the particular clinical setting of radiography departments, and this has been highlighted as an area of consideration when using the CAI for research in other clinical settings (Kajermo et al., 2013; Kent & McCormack, 2011b; McCormack et al., 2009). Kajermo et al. (2013) adapted the CAI for use in the Swedish nursing setting, however this adaptation had issues not only of clinical culture differences, but also in that of language translation of the instrument, and the team recommended that there should be further evaluation to ensure sound content and construct validity. The Swedish project, after translating the CAI items, used cognitive interviews (n=7) in order to "identify words or items that were difficult to understand or that were prone to miscomprehension" (p.43) and the resultant modifications to the CAI statements were mainly minor, and some explanation as to the meanings of the terminology were used later (Kajermo et al., 2013).

In their research into interprofessional working in diagnostic radiography, Strudwick and Day (2014) found that there was a "general lack of understanding of the roles of others" amongst professional groups (p.239) and highlight that in order to work together, professionals "need to know what each profession does" (p.239). Others have shown that professionals often do not understand each other's roles even though they worked quite closely, e.g. physicians and nurses on an intensive care ward (Eggertson, 2012). Having had early informal discussions with clinical radiographer colleagues surrounding the CAI items, and their conceptual clarity to individual radiographers, feedback showed that there was some lack of understanding surrounding the comprehension of statements and relating these to the role and culture of a radiography department. Also, as radiography has two branches in the UK (diagnostic and therapeutic) each with its own foundational training and culture, it became apparent that there would be a need to ensure that the use of the CAI in the radiography context was appropriate. It was therefore decided to test the original CAI tool by undertaking informal fieldwork, of local volunteer colleagues, as to the applicability of the statements to radiographers. Figure 15 Shows how the CAI was modified and tested prior to undertaking the national online survey.

Figure 15 Process of Modifying and Piloting the Modified CAI



3.6.7.3 *Informal Fieldwork of volunteer colleagues*

Five volunteer radiographer colleagues (2 Therapy/3 Diagnostic) agreed to participate in the initial fieldwork to ascertain if the statements within the 37-item CAI tool had any conceptual ambiguity in the radiographer setting by using 'think aloud' (cognitive interviewing). Drennan (2003) showed that using cognitive interview techniques can help reduce non-response or non-completion of questionnaires and it can help identify likely problems in the design. Cognitive interviewing can help the researcher obtain the perspectives of the respondent on questionnaires, rather than that of the researcher, and is useful for translating instrument statements to culturally diverse groups (Drennan, 2003), and as shown earlier, this is a potential problem that Kajermo et al. (2013) found whilst translating the CAI for use with Swedish nurses.

The five volunteers were individually asked to go through each statement of the original CAI, and for each statement they were asked to 'think aloud' relating to their thoughts about their interpretation of the statements as relating to their particular professional culture. Handwritten fieldnotes were taken, with each volunteer attributed a participant code number, to ensure anonymity. Statements were recorded ad verbatim, and the only interaction between researcher and volunteer was to remind the individual only to respond with the meaning of the question and not to answer the question out loud.

The fieldnotes were then displayed in a table (see Appendix 9 for excerpt) and an expert panel was convened (academic supervisors n=2 and the researcher all with knowledge of the CAI & IS), to compare the cognitive interview statements of the five individuals relating to each of the 37-item CAI. Statements about each of the 37-items were discussed by the group, and a decision was made for each item whether to modify the statement to suit the radiography context or not. The results were then used to modify the final Radiography specific CAI as shown in Appendix 10. Table 12, shows the final items that were changed. As can be seen, the changes were minimal, in order to maintain the original integrity of the CAI, as the purpose of this study was not to test its face content or validity per se – however efforts were made to make some of the CAI statements more relational to radiographers than nurses.

Table 12 Analysis of CAI modification post Cognitive Interviewing

ANALYSIS	
Unchanged CAI statements	n = 24
Minor nomenclature changes e.g. substitute 'nurse' for 'radiographer' or add 'imaging' / 'therapy' to 'care'	n = 11
Reworked question to make more understandable to radiographers	n = 2

These were the only 2 reworked item statements:

Original item 7*:* *"Education is a priority"*

Modified item 7*:* *"Education of the team, is seen as important, and a priority in your department"*

Original item 10*:* *"HCPs in the MDT have equal authority in decision making"*

Modified item 10*:* *"In your MDT (multi-disciplinary team meetings e.g. breast / trauma) radiographer members have equal authority in decision making"*

Examples of minor nomenclature changes are shown below and were mainly made to make them more specific to radiography and not nurses, and in some cases to make them more generic e.g. delete 'nurse' insert 'HCP' (health care professional).

Original item 27: **"***Evidenced-based knowledge on care is available to staff"*

Modified item 27*:*** **"**Evidenced-based knowledge on care /imaging / treatment is available to staff"

(the above example showing additional words to make the statement more related to diagnostic radiographers (imaging) and to therapy radiographers (treatment).

Original item 5: *"The nurse leader acts as a role model of good practice"*

Modified item 5: *"The HCP leader acts as a role model of good practice"*

(the above example should make the item generic to the healthcare setting)

The final view of the expert panel was that the minor changes made, should maintain the integrity of the original CAI, the only changes made were to make the instrument more applicable to radiography practice in the UK, and to try to maximise response rate from the national survey to follow.

The final modified instrument, together with a demographic section, free text section and participant information can be seen in Appendix 11, and this was uploaded to the webservice Surveymonkey™ and fully tested for functionality. Further information is provided in 'reaching the sample' below.

3.6.7.4 Piloting the modified CAI instrument

Four final year undergraduate radiography students from the University volunteered to complete the online survey, and complete a piloting questionnaire (see Appendix 12) to give rating and feedback on:

- ease of accessing the survey online – finding the webpage
- the clarity of the background information section
- the functionality of the web pages – did it work well without bugs?
- format and content of the introductory part (respondent demographic section)
- format of the of the main question section
- recorded time to undertake the survey
- General Comments

Feedback from the pilot questionnaires was favourable, and comment examples are given in Table 13. No modifications were required to the online instrument, and the final survey format, including background information; participant information; demographic section and ethics section.

Table 13 Quotations from the pilot questionnaire

• “the highlighted link took me immediately to the survey” • “easy to access and find on a phone”
• *“The introductory part explained everything clearly, including what the question was, how it worked, and about signing up for further questions”* • *“The introduction part was well written, easy to follow and was formatted appropriately for the content and audience”*
• *“it took about 10 minutes to complete”* • *“about 10 to 15 minutes to complete”*
• *“The format and fluidity of the questions in the main section was very good, readable, understandable and presented very well”* • *“The format was good with short questions that were easy to understand”*

3.6.8 QUAL – Semi-Structured Interviews

3.6.8.1 Design

Semi-structured interviews are designed to obtain responses subjectively about a phenomenon or situation that individuals have experienced (McIntosh & Morse, 2015). This is by means of using a detailed interview guide or 'frame' as a focus for the interview question stems (McIntosh & Morse, 2015). Interviewees respond freely to open-ended questions, with the use of probes by the researcher as required, to examine the overarching aims of the interview framed by the interview guide (McIntosh & Morse, 2015). Interviews have been used extensively to gather quantitative or qualitative data, and are useful for examining the context of a situation or phenomenon, and for illuminating the responses from questionnaires or surveys (Todd, 2015) and this is suited to the design of this MMR project.

Flexibility is facilitated in a semi-structured interviewing method, and allows the researcher to 'follow' themes or issues initiated by respondents, especially those not anticipated at the outset (Todd, 2015). Interviewers are free to diverge slightly from the script, whilst trying to maintain replicability, and are able to paraphrase, re-phrase in order to generate understanding or maintain understanding between interviewees (McIntosh & Morse, 2015). Probing further, either scripted or unscripted elicits deeper understanding by generating ad hoc questions further examining the theme in discussion, with unscheduled prompts relying on the improvisation ability of the researcher (McIntosh & Morse, 2015).

This interview method is widely reported in research (Todd, 2015) and the descriptive/interpretive (Constructivist) typology was used for this project, epistemologically privileging the respondent, as the 'knower' (McIntosh & Morse, 2015). The research 'frame' at the outset is assumed to be 'limited knowledge' and this is enriched and expanded by the participant's experience and perspective on the research questions, generating new themes, categories and hypotheses to gain further insight into the situation (McIntosh & Morse, 2015).

3.6.8.2 Interview Schedule

The interview schedule was designed to elicit rich contextual information relating to UK radiographer practice. The PARIHS framework (Kitson et al., 2008) and the 'CAI tool-pack' (McCormack, McCarthy, Wright, Coffey, & Slater, 2008b) informed the design of the semi-structured interview schedule, to ensure that key factors were covered in the discussion to ensure the 'Context' construct, as conceptualised in PARIHS and the relevant CAI factor statements, were covered and probed during the interview discussion. In their review of the utility of the PARIHS framework in the field, Ullrich, Sahay, and Stetler (2014) found that PARIHS and its underlying constructs, had amongst other uses, guided the development of interview tools.

The design of the interview schedule and its contents was informed by gaining the advice of an experienced post-doctoral researcher at the University, involved in a large interview-based research project. The advice received allowed restructuring of the schedule, and elaboration where required with further advice as to maintaining threads of discussion and how to probe effectively. See Appendix 13 for final version of the interview schedule. The wording used to gain verbal consent was also agreed with supervisors. The interview schedule was piloted with volunteer work colleagues (n=2) which was useful in fine tuning and rehearsing the interview conversation flow. No significant changes were necessary.

3.6.8.3 Typology

Semi-structured telephone (rather than face to face) interviews were conducted (n=20) due to the convenience of reaching the sample which was geographically located throughout the UK. This method of interviewing can be limited in detecting detailed information, or to fully understand the emotional implications, otherwise possible in 'face to face' type interviews (Todd, 2015). Others have compared telephone to 'face to face' interviews and found no difference in the quality of information obtained, and advocate the use of telephone interviews for national surveys, as they are cost effective, require little travel, and the equipment required is modest (Todd, 2015). Due to the smaller scale of a professional doctorate project (compared to PhD), and lack of resources, telephone interviewing was a suitable method. Each participant was contacted to arrange an appropriate appointment by email, and the subsequent interview took place in a private area organised by both parties. Some interviews had to be interrupted due to work-based interruptions or family issues, where this occurred, the discussion commenced from a convenient location within the schedule, after recapping the previous conversation.

3.6.8.4 Thematic Analysis

TA is a widely used method of analysing and interpreting qualitative data, is not bound by any particular theoretical presupposition, and is cited as being flexible, uncomplicated and accessible (Clarke & Braun, 2018). Clarke and Braun (2017, 2018) emphasise however that this does not mean that analytical approaches using TA are atheoretical, but rather flexible and applicable to various research paradigms. TA as conceptualised by Braun and Clarke (2006), was developed for use within the qualitative paradigm specifically, emphasising an organic method of code application and theme development, stressing the active role of the researcher in the process, the researcher as an ‘active resource’, and not a potential source of bias (Clarke & Braun, 2017, 2018). With TA, *codes* contribute towards the conceptualisation and development of the eventual *themes*, which aim to capture patterns of meaning supported by a central organising concept, not simply summarising the data, but interpreting the data guided by the research question (Clarke & Braun, 2017). TA has also been used in inductive and deductive analyses where latent and manifest meanings are developed from data (Clarke & Braun, 2017). More recently Clarke and Braun (2018) have defined three ‘schools’ of TA to include: (1) ‘Coding Reliability, (2) ‘Big-Q TA Reflexive (Braun & Clarke Method) and (3) ‘Codebook’ approach. The Braun and Clarke (2006) ‘Big-Q’ reflexive method of TA was utilised as the qualitative analytical method for QUAL arm of this MMR study.

The Braun and Clarke (2006) six-stage method of TA was followed:

1. Familiarization with the data.
2. Code Generation.
3. Theme Searching.
4. Reviewing Themes (mapping against the dataset).
5. Defining & Naming Themes.
6. Producing the Final Report.

3.6.9 Data Display, Reduction and Analysis

3.6.9.1 Survey

The Surveymonkey™ data from the online CAI questionnaire was downloaded into MS-Excel and SPSS-IBM programs with encrypted password protected data files and stored securely on university servers. The data obtained consisted of numerical ordinal data for the Likert 4-point scale used in the original and modified CAI instrument, 'Strongly Disagree' / 'Disagree' / 'Agree' / 'Strongly Agree' (SD = 1, D = 2, A=3, SA=4), and textual information representing demographic data and free text boxes for commenting etc. by respondents. There were no negatively worded statements in the instrument, and therefore no score reversal prior to analysis was required. The data was then analysed using SPSS™ (v25) statistical analysis software, M-plus™ statistical analysis software (version 7.11) and MS-excel™. The CAI specific 'analysis tool' was also used to analyse the Likert data from the UK radiography context relating to the 37-item tool (McCormack et al., 2008b). The summed scores of the total CAI instrument responses were analysed following the method shown in the CAI guide (McCormack, McCarthy, Wright, Coffey, & Slater, 2008a). Summed scores for each of the PARIHS constructs: Culture, Leadership and Evaluation were plotted along a continuum 'weak to strong', reflecting the PARIHS interpretation for these items see Ch.4.

3.6.9.2 Missing Data

In most research with humans, it is uncommon to obtain a full dataset from every case, and problems such as: software bugs; difficult to understand statements in surveys; human error or boredom, can be some causes of missing values (Hayati Rrezvan, Lee, & Simpson, 2015; Kline, 2010; Pallant, 2016). SPSS automatically recognises empty data cells. Small omissions per case are unlikely to have a significant effect on data e.g. < 5%, however larger omissions, or the unnecessary deletion of data can introduce bias and loss of statistical power potential (Kline, 2010). Methods of dealing with incomplete data make an assumption that the 'missingness' is ignorable, and are either 'missing at random' (MAR) and 'missing completely at random' (MCAR) (Kline, 2010). In MCAR, an assumption is made that "the probability of missingness is independent of the observed and missing data" (p. 4) (Hayati Rrezvan et al., 2015). Little's MCAR test can be used to examine whether the missing data is missing completely at random (Kline, 2010), and rejecting the null hypothesis with an insignificant result suggests the dataset is suitable for imputation in Structural Equation Modelling (SEM) (such as Confirmatory Factor Analysis (CFA)) (Enders, 2001). There are many methods of imputing missing data to prevent power loss in statistical calculations, and Expectation Maximisation (EM), is a common two step iterative algorithm, which is relatively insensitive to non-normality, and shows promise in use with datasets with less than 30% of data within cases missing, and used typically by most researchers (Enders, 2001; Hasan, Ahmad, Osman, Sapri, & Othman, 2017; Li & Lomax, 2017). EM imputation is appropriate when the data is MAR or MCAR (Penny & Atkinson, 2012). The cut-off for missing values was set at a more conservative level of 20% (max) in the survey. In SEM/CFA more often than not in the applied research setting, assumptions that data samples are drawn from a normally distributed population are rarely satisfied (Li & Lomax, 2017). Due to the complexity and lack of reporting of sensitivity testing in the literature, this was considered beyond the scope of this project.

3.6.9.3 Interview Data

Interview audio was recorded digitally in .wav file format and stored on encrypted university drives. Data digitally transferred for transcription was also password protected and encrypted and transferred to a professional research secretary in the employment of the University. Word-processed transcripts were also encrypted, anonymised with a participant code (#), and password protected, in MS-Word™ files. Interviews were transcribed into MS-Word format by two professionally trained university research secretaries, using conventional interview transcription formatting. The anonymised data was then imported into ATLAS-ti™ qualitative research analysis software for codifying and qualitative TA based on the method described by (Braun & Clarke, 2006; Clarke & Braun, 2018). Where interpretation of the audio data was unclear by the typist, abbreviations such as ‘S.L.’ (sounds like) were used in the transcript to indicate a word or phrase that could not be confirmed. These sections were scrutinised at the reading /confirmatory stage by the researcher against the original audio recordings, and some were found to either be context specific which were clear to the researcher and not the typist, or due to poor audio quality, in which case the data section was not coded, these sections were noted in the analytical memos used.

3.6.9.4 Data Statistical Assumptions

As the data generated in both strands of the MMR study are based on a non-statistical sample using purposive sampling, the purpose of the final analysis using MMR will be to illustrate a new understanding of IS in the UK radiography context.

3.6.9.5 Rigour

3.6.10 Merging Procedures

MMR merging procedures using the convergent method in order to answer the research question, requires the researcher to use one of two methods, “namely comparing the two sets or by transforming one of the data sets and conducting further analyses (Creswell & Clark, 2017). Table 14 highlights further the intent of merging the data from both strands:

Table 14 Intent of Integrating MMR Convergent Design
• To develop results and interpretations that expand understanding
• To develop results which are comprehensive
• To develop an outcome which is validated and confirmed
NB Sourced from (Creswell & Clark, 2017)

Data from both strands of this convergent MMR study were analysed and represented in separate QUAN and QUAL sub-sections of Ch.4, and the integration and mixing phase of the MMR strands was undertaken as part of a combined data table, and the narrative analysis of the findings in the discussion section (Ch.5). Guest, MacQueen, and Namey (2012) suggest this approach as a plausible method of combining two separate datasets in MMR, and this seemed to be the most effective method of combination with the data found in this research project.

3.6.10.1 Statistical rigour - QUANT

The reliability of a questionnaire or consistency of responses to a set of questions (variables) intended to measure a given effect or concept can be tested for reliability (Shelby, 2011). Scale reliability indicates possible random error, and the internal consistency or structure of an instrument, can be tested using Cronbach's coefficient *alpha*, giving an indication of the average correlation between all items making up a scale (Pallant, 2016), although there is contention in the literature regarding the utility of *alpha* in this respect, however there is evidence that alpha can represent "average degree of interrelatedness" (p. 114) provided there are no negative covariances (Sijtsma, 2008). Cronbach's alpha is often used in the human dimensions literature as a statistical device for reporting the reliability of a multiple item scale (Shelby, 2011), and in this respect it is a useful method for testing the internal consistency of questionnaire responses. There is much debate in the in the literature about what constitutes a reliable value for *alpha* in this research context (range 0.0 to 1.0), with levels at 0.65 to 0.70 and above generally considered adequate, however other statisticians rely on 0.80 and above to represent a reliable scale and others quote as low as 0.60 to be acceptable to reject the null hypothesis, thus showing a 'badness of fit' as a desirable outcome (Shelby, 2011). Structural Equation Modelling (SEM) is a technique of choice in the social sciences for determining model fit (Hooper, Coughlan, & R. Mullen, 2008). Exploratory and Confirmatory Factor analysis (EFA, CFA), in SEM, are data reduction techniques, capable of reducing a large set of variable data into a set of factors or components easier to comprehend and categorise (and as such is not a method of hypothesis testing per se), useful in the development and testing of scalar psychometric instruments (Osborne, 2015; Pallant, 2016). EFA can be used in the initial stages of instrument design and testing, exploring relationships between variables that might emerge, and CFA, although more complex, has increased sophistication in confirming theory further on in the development of an instrument (Pallant, 2016). CFA was chosen to analyse the modified CAI instrument data, to examine or confirm its factor structure in relation to the original CAI instrument, and also to look for further evidence of its suitability to measure 'context' and the underlying theoretical assumptions therein.

'Absolute' fit indices, such as: Chi-square (X^2); Root Mean Square Error of Approximation (RMSEA) and the Goodness-of-Fit Statistic (GFI) are useful in determining optimal a priori sample data fit, demonstrating superiority of model fit, measuring appropriateness of fit to the model versus no fit at all (Hooper et al., 2008). However, these are often prone to rising (overestimation of fit) errors with increasing sample sizes (Hooper et al., 2008), and more parsimonious models were used to further confirm the model fit or otherwise. ‘Incremental’ or ‘Relative’ fit indices such as the Normed-Fit-Index (NFI) and the Comparative Fit Index (CFI), use a null-hypothesis that all variables are uncorrelated. CFA was used to test the hypothesis of a relationship existing between the observed variables and latent constructs or factors emerging in the survey data (Suhr, 2019). The initial appropriateness (factorability) of the data for SEM was tested using Bartlett’s Test of Sphericity (appropriate at significance level $p < 0.05$), and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (range 0 to 1; appropriate at 0.6 and above with ≥ 0.6 being *mediocre* sampling adequacy; ≥ 0.7 *middling* adequacy; ≥0.8 being *meritorious* and ≥ 0.9 being *marvellous* according to Kaiser and Rice (1974) . There is little agreement over sample size requirements in CFA (with some stating as low as 100 participants), however after their comprehensive research Mundfrom, Shaw, and Ke (2005), recommended using a ‘variables-to-factor ratio’ of at least 7 and a sample size between 150 to 180, to give excellent agreement even with low factor communality (factors are interpreted as ‘component-variable correlations’). Stevens (2009) advocates the use of CFA when there is strong underlying supporting theory and is a proponent of using the absolute magnitude and number of components method for reliable interpretation of CFA (at least four factor loadings >0.6 or the average of the 4 largest loadings (in absolute value) being >0.6).

Hooper et al. (2008) suggest that it is neither appropriate nor practical to quote every statistic output from statistical programs in relation to SEM, and caution against the bias of selecting results more favourable to fit a particular interpretation. However, quoting more than one index of fit is appropriate to represent different aspects of the model fit, and quoting the X^2 result is essential according to Hooper et al. (2008), and they give a useful reference to interpreting meaningful output, including the ‘relative/normed X^2’ (X^2/df) which minimises the impact of sample size on the X^2 index (ratio range 2-5), RMSEA (≤ 0.06) and SRMR (≤ 0.08). In order to be transparent, a selection of indices was reported in the findings section, however the X^2, RMSEA and SRMR will be discussed in chapter 4, mainly in relation to significant findings from the data, as this is recommended as a valid combination in the literature (Hooper et al., 2008). Also the incremental fit index CFI was included in order to increase robustness by using an index reported to be least affected by sample size influences (Fan, Thompson, & Wang, 1999). The CFA data, was analysed using a ‘Quartimin’ oblique rotation, producing superior results to the 'Orthogonal' method of rotation (Osborne, 2015) allowing for the factors to be correlated (Pallant, 2016).

3.6.10.2 Coding Reliability QUAL

The interview transcripts were all read through to gain familiarity prior to coding. The analysis program offered means to store interview transcripts, organise and interrogate the interview data, and import the initial guiding coding framework for labelling individual data items (Silver & Lewins, 2014). The analysis program was then used for line-by-line coding using the TA method described by Braun and Clarke (2006); Clarke and Braun (2018). Codes were selected either from the initial coding framework, used as a guiding framework utilising the PARIHS constructs and sub-elements, labelled 'high' and 'low' (Rycroft-Malone & Bucknall, 2010) or from inductive 'open' coding. A large number of 'Open' codes were created 'organically' by the researcher as ideas were developed from the data, and these inductive codes contributed mostly to the final thematic development. Infrequently 'in-vivo' codes were created where salient items were apparent in the data e.g. code - "sycophants". Code meanings were given in the initial coding framework or tagged within a field in the analysis program. Codes were considered, re-visited and merged where duplication occurred, and codes were grouped within the computer program into code families e.g. 'Professional' used as a prefix and the related code as a suffix e.g. 'Professional – dominance' / 'Professional – reliance', 'Professional – apathy' etc. This method allowed electronic sorting within hierarchies, and the visualisation of potential developing sub-themes and theme contenders. Analytical memos were used comprehensively to organise and capture interpretive, salient, and latent meanings in the data, together with analytical notes relating to cross-participant thoughts, and examples that came to mind from other literature of similar themes (see Appendix 14 for example). The analytical memos were also stored within the analysis software package. When analysing the codes and developing themes, the analytical memos were invaluable in formulating ideas and concepts, and signposting to new ideas whilst sculpting the data (Braun & Clarke, 2013). It is pertinent to note that analysis software does not undertake complex analytical tasks, rather it is a useful organising and interrogation tool, that can aid the process by hyperlinking data items within cases and between cases (Silver & Lewins, 2014). The analytical memos were also manually coded to ensure consistency in theme development and confirm themes that were emerging in the main data, were reflected in the researcher notes. Finally, a high-level manual grouping of sub-theme elements using sticky paper notes for mapping, was used to organise the final three themes and sub-theme elements (Appendix 15), with the computer program thereafter being used as a retrieving method to search for the selected codes attributed to themes and sub-themes, and their associated hyperlinked data segments (transcript quotations) used in the final analysis using data excerpts. The combination of manual and electronic methods seemed to resonate with the personal preferences of the researcher. A table of final themes, sub-theme categories, and number of contributing final codes is shown in Appendix 16 and this was a useful guide to aid data organisation and analysis in Ch.4.

3.6.11 Ethical Considerations

A full research proposal was made to the Academic Ethics Committee (AEC) (application number: 2016-15862), and this was granted without further information being required (Appendix 17). No other ethical approval was required as the study did not involve patients, staff of the Health Board or the general public. The project was restricted to a sample of health professionals, within a learned society, and radiography student volunteers from the University.

Permission to run the online survey via advertising in Synergy magazine was given by the SCoR, and permission to use and modify the CAI instrument was sought and approved by Prof. B. McCormack, at the University of Ulster.

Permission from the AEC to increase the sample size from 12 to 20 interviews was sought and granted by the chair of the ethics committee (Appendix 18).

The researcher also undertook training with the NHS National Institute for Health Research to gain the 'Good Clinical Practice' certificate, to ensure that good governance surrounded the execution and reporting of the project outcomes (see Appendix 19)

Provision was made also in the project design to have an awareness of sensitive or upsetting issues that might be conveyed to the researcher during an interview, and methods of dealing with a situation such as this should it arise was covered in the ethics proposal. Any unethical professional situation or matters concerning the safety of any individual would be communicated to supervisors and or the appropriate professional body/regulator as per recommendations.

3.6.12 Dissemination Strategy & Learning Event

Please refer to Appendix 20 for a narrative and outcomes of the dissemination and learning event, and outcomes which were influential in guiding the qualitative study and understanding the professional body perspective in the UK.

3.6.13 Chapter Summary

This chapter provided the methodological stance of the study and that underpinning the chosen methods. The methods used were justified and explained thoroughly to give the reader a clear understanding of the origin of the data and findings that follow in the next chapter.

4 Chapter 4 - Findings

4.1 Chapter Overview

This chapter, in two main parts, presents and describes data from the national survey of UK radiographers, and the main themes formed from the semi-structured interview findings. The first section describes the participant demographic, and respondent professional practice related statistics, and then the data is analysed using inferential statistics to gain further insight into the sample. The determined CAI scores are then described, followed by an assessment of the reliability of the CAI instrument and its internal consistency. The second section describes the findings from the analysis of the qualitative data using TA, and the conceptualised themes and sub-themes that were found in relation to answering the research questions set in Ch.1. Finally, this section provides data supporting merging from both arms of this MMR study.

4.2 Results – Survey (QUAN)

Survey data was downloaded from Surveymonkey™ and saved as SPSS™ and MS Excel data files. The datafiles were anonymised for analysis, and the original data was saved on secure university servers. Excel spreadsheets containing participant contact data (for interviews) were encrypted and password protected.

4.2.1 Sample Characteristics

4.2.1.1 Sample Size and Missing Values

The total responses from the survey were n=182 (Table 15). Responses failing the survey parameters n=2 were rejected with one case being unqualified at the time of response and the other case was not a radiographer practicing in the UK. n=20 had zero data and these cases were deleted (these were likely to be an artefact of respondents being counted by visiting the web page but deciding not to input any responses). A further n=8 cases were deleted listwise, as they had >20% missing values in the survey responses (Table 16). The former appeared to be partial incomplete responses due to abandonment part way through rather than randomly missed answers.

Table 15- Total UK Survey Response

Total UK Survey Responses:		**182**
Void	Not Qualified	1
Void	Non-UK	1
Void	No data	20
Void	>20% missing values	8
	Total partial data responses	26
	Total for Imputation	152
	Totals remaining with full and partial data	160
	Totals with full original data	134

Table 16 - Cases Removed with > 20% Missing Data

N = 8	Number of Items Missing	% Missing
	14	37.8
	14	37.8
	20	54.1
	20	54.1
	26	70.3
	26	70.3
	26	70.3
	31	83.8

The remaining data n=152 were tested with Little's Missing Completely at Random (MCAR) test to ascertain if the remaining data was suitable for imputation of missing values to obtain a complete dataset for analysis. Little's test was undertaken on the 160 cases with partial data and also repeated on the final dataset with the cases removed with >20% missing values (Table 17). Rejecting the null hypothesis with an insignificant result $p > 0.05$, suggested the dataset was suitable for imputation in Structural Equation Modelling (SEM) (such as Confirmatory Factor Analysis (CFA)). The MCAR statistic at $p = 0.09$ for the final data with cases with greater than 20% missing values removed (n=152) suggested the null hypothesis for Little's MCAR test could be rejected, and the remaining data used for imputation could be assumed to be missing completely at random.

Table 17 - Little's MCAR Test Results

	Little's MCAR Statistic		
160 cases with more than 20% missing values	X^2 *546.356*	*df 505*	*P = 0.099*
Final 152 data items with >20% removed	X^2 *488.692*	*df 448*	*P = 0.09*

Missing data imputation on the remaining n=152 cases was then undertaken using the Expectation Maximisation method (see Ch 3). The margin of error (ME) was calculated for a sample of n=152 respondents and was found to be 7.93% using the *Roasoft*® tool evaluated by Serdar et al. (2021) (ME <10% advised).

4.2.1.2 Participant Profile

Of the n=152 cases included for analysis, n =138 (90.8%) reported that they were trained in the diagnostic branch of radiography and n=14 (9.2%) reported practicing in radiotherapy (Table 18).

Table 18- Reported Branch Practiced

Professional Branch	n	%
Diagnostic	138	90.8%
Therapy	14	9.2%

n=109 (71.7%) respondents identified as being female, and n=43(28.3%) identified as male, with no one declining to respond to this question (Table 19).

Table 19- Reported Gender Identity

Reported Gender Identity	n	%
Prefer Not to Say	0	0%
Female	109	71.7%
Male	43	28.3%

The ratio of respondent gender and radiographer subspecialty was compared to National statistics (see Appendix 21). The sample showed similar characteristics to the national data. The ratio of female to male radiographers practicing in the general population (HCPC female n=27,215 (75%); male n=9100 (25%), SCoR membership (Personal Communication 2019), female n=20,548 (79%); male n=5520 (21%)) compared favourably with the sample ratios in this study, female 71.7% and male 28.3% (Table 19). The ratio of radiographer subspecialty within the sample also compared similarly with the national data: SCoR membership: 87% diagnostic; 13% therapy, and respondents in this study at 90.8% diagnostic and 9.2% therapy (Table 18). Also, the total number of registered radiographers practicing in the UK (n=36,229) (Health and Care Professions Council, 2019) were not dissimilar in magnitude to the total national practicing radiographer membership of the SCoR (n=26,068), which formed the population from which the sample was obtained for this study.

Table 20 represents the proportions of responses from the home nations within the UK. n=125(82.2%) were from radiographers practicing in England; n=6(3.9%) were from radiographers practicing in Northern Ireland; n=15(9.9%) of the responses were from radiographers practicing in Scotland and n=6(3.9%) were from radiographers practicing in Wales.

Table 20 - Proportion of Home Country Responses

UK Home Country Responses:	n	%
England	125	82.2%
Northern Ireland	6	3.9%
Scotland	15	9.9%
Wales	6	3.9%

The sample age profile (Table 21) shows that the majority of practicing radiographers responding were in the following two age groups: 26-35 age range n=60 (39.5%) and with n=39 (25.7%) practicing in the 36-45 age group.

Table 21- Reported Age Range Frequencies

Age	*Frequency*	*%*
18-25	22	14.5%
26-35	60	39.5%
36-45	39	25.7%
46-55	22	14.5%
56-65	9	5.9%

Table 22 shows the frequency of respondents reporting in each range of time since qualifying as a radiographer. The summed highest majority response to the survey was from the 0 to 10 years since qualifying group (n=89, 58.5%). The apparent disparity between the age profile (Table 21) and the number of years qualified was likely due to mature entry into the profession, i.e., it was unlikely in the population that age was related to number of years since qualifying.

Table 22 - Reported Number of Years Since Qualifying as a Radiographer

Years Since Qualifying:	*frequency*	*%*
0-5 years	56	36.8%
6-10 years	33	21.7%
11 to 15 years	19	12.5%
16 to 20 years	16	10.5%
21 to 25 years	9	5.9%
26 to 30 years	12	7.9%
31 to 35 years	3	2.0%
36 to 40 years	4	2.6%
41 to 45 years	0	0.0%
46 to 50 years	0	0.0%

4.2.1.3 Employment

The survey asked respondents to indicate their main employer type (NHS or Private Sector), together with the common practice areas of radiography e.g. acute hospital, community etc. Some respondents had selected the 'NHS' option together with 'PRIVATE' – and these responses were checked against the employer's name given for each respondent to confirm employment type, and to ensure that there was no evidence of the respondent being employed by both (some confusion might have arisen with the assumption in the survey that all respondents would understand the terminology for private practice). Where respondents worked in other organisations 'Other', e.g., Health and Safety Executive or Higher Education, the survey requested the participant to answer a 'yes/no' question regarding whether they continued to practice radiography clinically, and if they answered 'yes' their responses were included in the survey, to ensure that the data only included valid responses from radiographers practicing clinically in the UK. Most responses were from radiographers employed within the NHS n=139, 91.4% of the sample, and n=13, 8.6% of radiographers reported being employed in the Private Sector (Figure 16).

Figure 16 - Proportion of NHS to Private Sector Responses

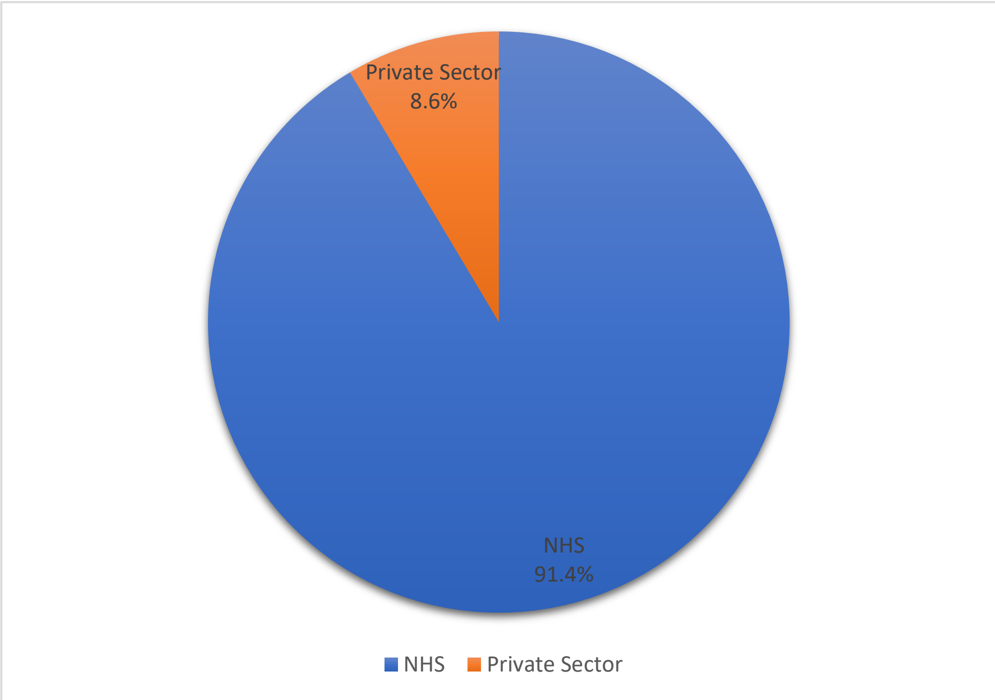


Table 23 – Reported Employer Sector Types 'other'

Employment Sector (other):	
Acute Hospital	30
Community Hospital	5
Armed Forces	0
Academic research	1
Healthcare Regulator	1
Remote island hospital	1

n=30 radiographers reported being employed in acute hospital settings (Table 23), n=5 in community hospital settings, and n=1 in each of academic research, healthcare regulation, and remote island hospital. The majority of the responses were therefore from the NHS, including the Acute Hospital setting, with small representation from the private sector.

Table 24- Reported NHS Pay Grade (AFC)

Pay Grade NHS:	n =	
Not Disclosed	11	7.2%
Band 5	27	17.8%
Split B5/6	2	1.3%
Band 6	52	34.2%
Split B6/7"	2	1.3%
Band 7	47	30.9%
Band 8a	7	4.6%
Band 8b	4	2.6%
Band 8c	0	0.0%

All radiographers in the NHS are employed at the graduate entry level of 'Agenda For Change' (AFC) band 5 and above, n=27 reported being at this grade, and the majority (65%) were in Band 6 & 7 (Table 24), suggesting a representative normal sample of the practice grades. Practice / Pay grades are not a good indicator of experience in themselves, as grade inflation is possible where recruitment and retention is an issue.

4.2.1.4 Education and Training Background

Table 25- Country of Original Training / Qualification

Country:		
Australia	2	1.3%
EU	2	1.3%
Ghana	1	0.7%
Hong Kong	1	0.7%
UK	146	96.1%

By far, most respondents were trained in the UK n=146 (96.1%) (Table 25), with a few respondents from the EU, Australia, Hong Kong and Ghana amounting to the rest of the sample (3.9 %), suggesting that the sample was representative of the UK radiography workforce by training and education background.

Table 26- Qualification Profile of the Sample

Initial Qualification to Practice	n =	
Qualifying Professional Diploma (DCR)	23	15.1%
Undergraduate Entry (BSc)	127	83.6%
Postgraduate Direct Entry (MSc)	2	1.3%
Holding Sub-specialty Qualifications		
No	79	52.0%
Yes	73	48.0%
Respondents Reporting Holding Advanced Degrees:		
No	123	80.9%
Yes	29	19.1%
Reported Advanced Degree Type:		
Doctorate	3	2.0%
MSc	23	15.1%
MSc/MA	1	0.7%
Respondents Reporting Holding a Supervisory Qualification		
No	139	91.4%
Yes	13	8.6%

Table 26 shows the qualification profile of the UK radiography workforce surveyed. The majority of radiographers qualified with an undergraduate degree n=127 (83.6%), with just under a half of the sample (48%) holding sub-specialty postgraduate qualifications (e.g. Postgraduate certificate/diploma). 19.1% of the sample reported having an advanced degree, of these the majority was MSc (15.1%), with n=3 (2%) of the sample holding doctoral level qualifications. Only 8.6% of the sample reported having supervisory or management qualifications / training.

4.2.2 UK Radiography Context Assessment Index

Using the CAI instrument method proposed by McCormack et al. (2008a) , the response of each participant to each of the 37-item questionnaire was scored using a four-point Likert type scale (SA=4, A=3, D=2, SD=1). The individual item scores were then grouped into three constructs (Culture/Leadership/Evaluation) for each participant and a percentage score was calculated for each construct. The percentage scores were then averaged per participant to give a Total CAI score (following the original CAI instrument weighting method). The descriptive statistics for the Total CAI scores for the sample (n=152) are shown in Table 27.

4.2.3 CAI Sample Normality

Table 27- Total CAI Score Descriptive Statistics

			Statistic	Std. Error
CAI Context	Mean		70.2787	0.83647
	95% Confidence Interval for Mean	Lower Bound	68.6260	
		Upper Bound	71.9314	
	5% Trimmed Mean		70.3650	
	Median		70.1150	
	Variance		106.352	
	Std. Deviation		10.31270	
	Minimum		41.84	
	Maximum		97.72	
	Range		55.88	
	Interquartile Range		14.49	
	Skewness		-0.022	0.197
	Kurtosis		-0.180	0.391

The 95% confidence interval, and 5% trimmed mean appeared to be satisfactory and close to the mean (70.27) and median (70.11) for the Total CAI score, indicating that there was no extreme effect from outliers. The Skewness and Kurtosis was close to zero indicating that the distribution was close to normality (Table 27), further confirmed by the Kolmogorov-Smirnov statistic in Table 28, with a non-significant result of p=0.2 ($p > 0.05$) indicating normality (Pallant, 2016), also illustrated by the central tendency shown in Figure 17- Histogram of the Frequency of the total CAI Scores.

Table 28- Statistical Test for Normality of the CAI Total Scores

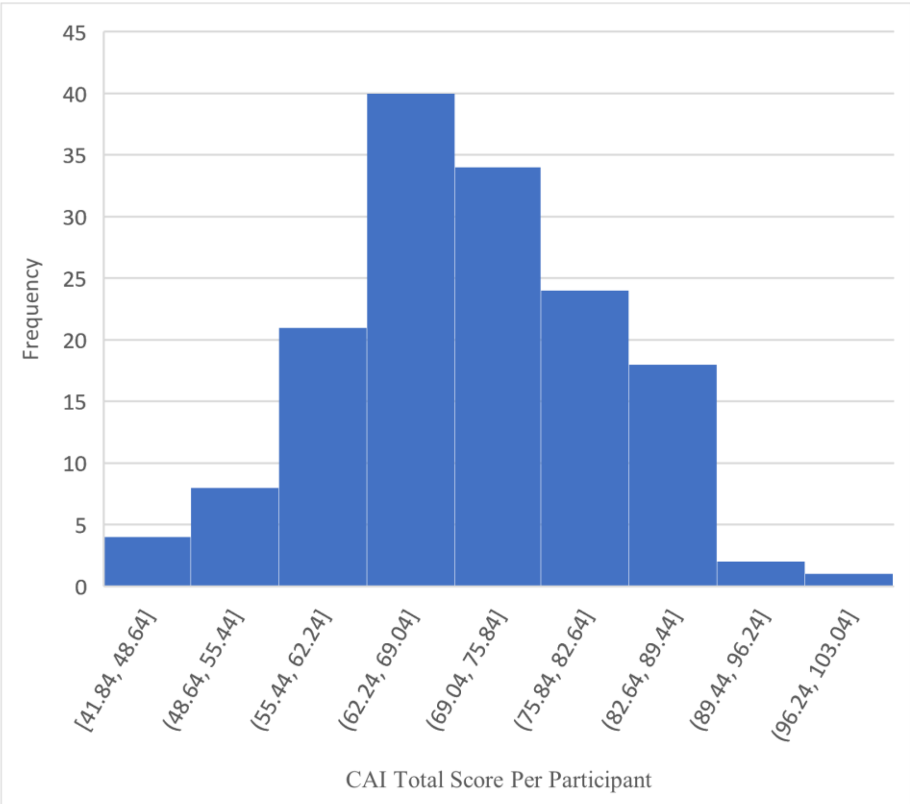
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CAI Context	0.036	152	.200*	0.995	152	0.920

Tests of Normality

*. This is a lower bound of the true significance.

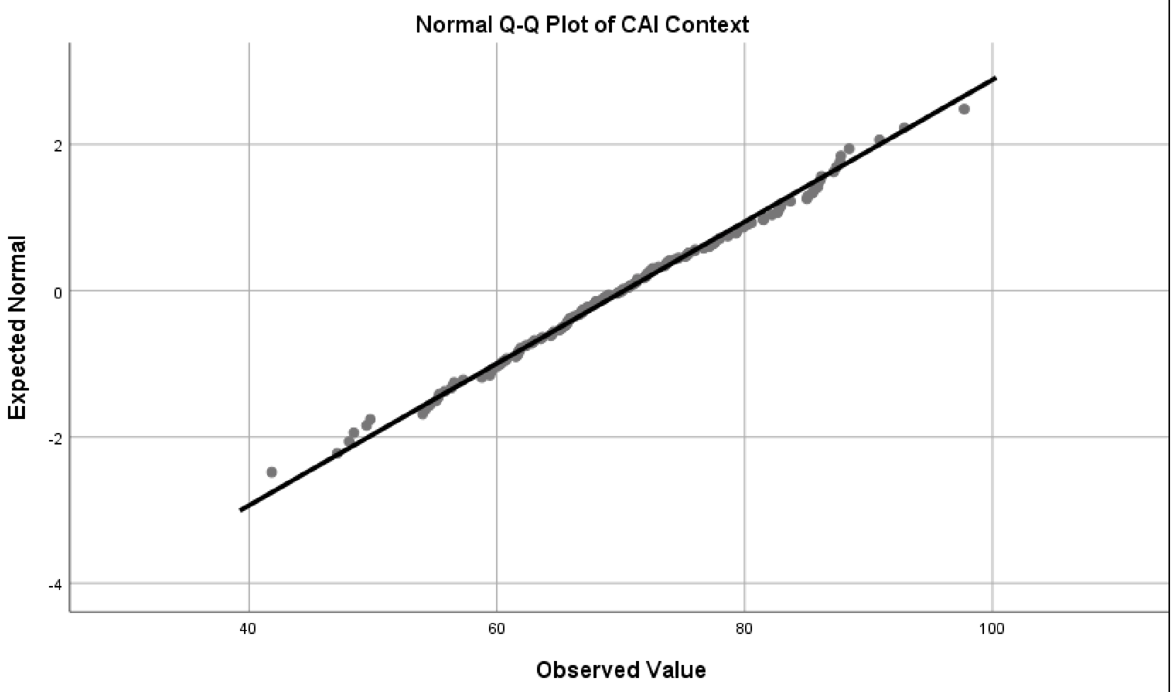
a. Lilliefors Significance Correction

Figure 17- Histogram of the Frequency of the total CAI Scores



The normal probability plot (Figure 18), of the observed value plotted against an expected value from the normal distribution showed little deviation from the central line, again indicating normality with little dispersion or outliers.

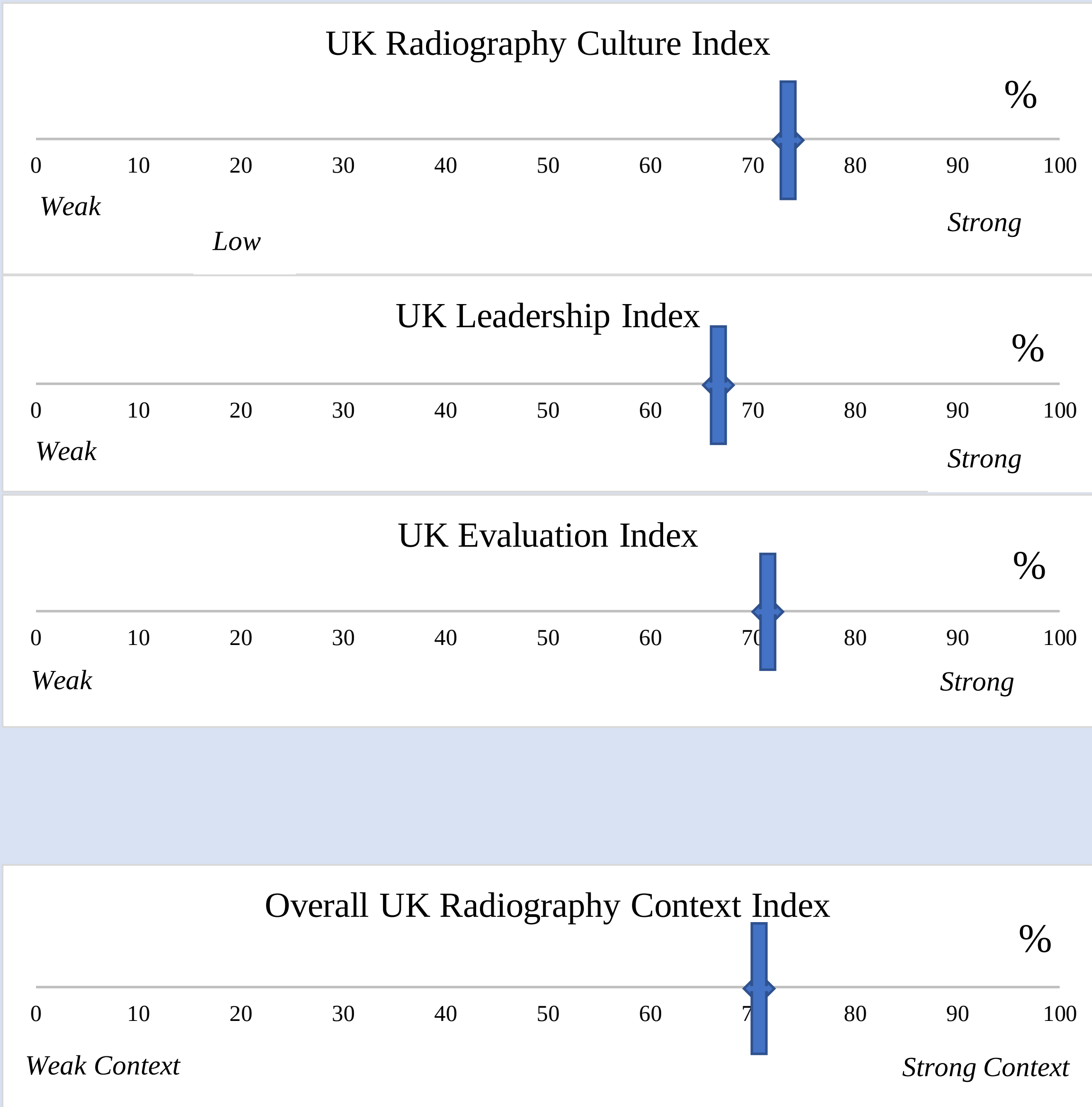
Figure 18 - Normal Q-Q Plot of Total CAI scores



Each of the individual CAI items n=37 (each with a sample size of n=152) were objectively assessed for normality by examination of each item *Skewness* and *Kurtosis* (see Appendix 23). Z scores for skewness and kurtosis were generated using SPSS using the formula *Z Skew* = Skew/Std. Error of Skew, and *Z Kurtosis* = Kurtosis/Std. Error of Kurtosis. For sample sizes up to n=300, the null hypothesis for normality can be rejected at absolute *Z value* above ± 3.29 (at p>=0.05) (Hae-Young, 2013). Nearly all the individual CAI items were within the significance level of p=0.05, with the exception of CAI 15 (*Z-Skew* -3.44) and CAI 32 (*Z-Skew* – 3.53) which were just outside the range. All the CAI items were within the Kurtosis tolerance, except for one item CAI 1 (*Z-Kurtosis* 3.31) which was also just outside the range of normality. The parametric statistical tests (t-test / ANOVA) used are said to be relatively robust to moderate departures from normality (Hae-Young, 2013). A subjective assessment of the normality histogram of CAI 1 showed a relatively characteristic normal histogram, with a satisfactory Q-Q plot with some low scoring outliers. The subjective assessment of the normality histogram of CAI 15 and 32 showed a positive skew to the right of midline, with relatively normal Q-Q plots.

4.2.4 The UK Radiography CAI Continuum & Context Index

Figure 19 - UK Radiography CAI Continuum Plots (CI)[3]



3 (McCormack et al., 2009; Rycroft-Malone, 2004)

The final result of the CAI radiography survey is shown in Figure 19 and Table 29. The result for the non-imputed data (each of the 37 item CAI questionnaire completed) and the imputed data showed a near identical overall score for each of the CAI constructs (C,L,E). One result, representing the *Leadership* construct was marginally lower at 67.35%, however this still remained in the upper two thirds of the mean score values. The results showed that the indices for UK radiography were all near the upper quartile of the index, indicating a medium/high (near strong context). Individualised home country total CAI scores for each of the CAI constructs (or CAI total scores) were not calculated due to the small number of respondents from Scotland, Northern Ireland, and Wales (each <10% of the total sample) (Table 20).

Table 29 - Final UK Radiography CAI Result (CI)

Full data n = 134				*all %*			
UK Overall Culture Mean	73.53	UK Overall Leadership Mean	67.35	UK Overall Evaluation Mean	71.24	UK CAI Context	70.71
Median	73.44	Median	67.83	Median	71.20		
Mode	73.44	Mode	64.26	Mode	67.64		
Imputed Data n = 152				*all %*			
UK Overall Culture Mean	73.04	UK Overall Leadership Mean	67.05	UK Overall Evaluation Mean	70.74	UK CAI Context	70.28
Median	73.44	Median	67.83	Median	69.42		
Mode	73.44	Mode	64.26	Mode	67.64		

In order to ascertain the highest and lowest scoring CAI item statements, the descending means per item was calculated to identify each item (Table 30).

Table 30- Upper and Lower Quartile Mean Scores and CAI Statements (descending means)

CAI Statement	*n*	*Mean*	*SD*	
Upper Quartile Mean Scores:				
15	152	3.48	0.598	There is high regard for patient's privacy and dignity (RP; C)
26	152	3.45	0.560	Staff welcome and accept cultural diversity (RP; E3)
3	152	3.20	0.613	A proactive approach to care / imaging / treatment is taken (CP, C)
12	152	3.14	0.704	A staff performance review process is in place which enables reflection on practice, goal setting and is regularly reviewed (E; C)
1	152	3.14	0.603	Personal and professional boundaries between HCPs are maintained (PB; C)
16	152	3.14	0.691	HCPs and healthcare support workers understand each other's role (PB; C)
36	152	3.12	0.597	HCPs share common goals and objectives about patient care (RP; C)
8	152	3.11	0.733	There are good working relations between clinical and non-clinical staff (RP; E3)
32	152	3.10	0.715	Guidelines and protocols based on evidence of best practice (patient experience, clinical experience, research) are available (EIP; E3)
Lower Quartile Mean Scores:				
24	152	2.64	0.758	Staff use reflective processes (e.g. action learning, clinical supervision or reflective diaries) to evaluate and develop practice (E; C)
25	152	2.61	0.781	Organisational management has high regard for staff autonomy (PB; E3)
23	152	2.59	0.833	The development of staff expertise is viewed as a priority by radiography leaders (EIP; C)
28	152	2.56	0.683	Patients have choice in assessing, planning and evaluating their care and treatment (CP; C)
17	152	2.48	0.820	The management structure is democratic and inclusive (EIP; L)
37	152	2.47	0.803	Structured programmes of education are available to all HCPs (EIP; E3)
22	152	2.44	0.706	Discussions are planned between HCPs and patients (CP; L)
10	152	2.12	0.778	In your MDT (multi-disciplinary team meetings e.g. breast / trauma) radiographer members have equal authority in decision making (CP: L)
35	152	1.89	0.723	The organisation is non-hierarchical (EIP; E3)

Letters in brackets represent the question position in the respective models. Five-factor constructs: collaborative practice (CP); evidence-informed practice (EIP); respect for persons (RP); practice boundaries (PB) and evaluation (E5). Three-factor model constructs: culture (C); leadership (L); and evaluation (E3).

4.2.5 Inferential Statistics

4.2.5.1 Comparing Mean CAI total scores between Male and Female Respondents

An independent samples t-test was conducted to evaluate the difference in mean total CAI scores between male and female radiographers (Table 31). There was no statistical difference between the scores for males (n=43) (M 70.099; SD 9.45) and females (n=109) (M 71.549; SD 10.659), t (150) = 0.779, p = 0.437 (two tailed). The eta squared statistic was 0.003 (≤ 0.01 regarded as small effect size) (Pallant, 2016).

Table 31- Independent Samples t-test between M & F total CAI scores

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
%CAI Total Score	Equal variances assumed	.544	.462	.779	150	.437	1.45012	1.86151	-2.22805	5.12829
	Equal variances not assumed			.821	86.229	.414	1.45012	1.76700	-2.06242	4.96267

4.2.5.2 Comparing Mean Total CAI Scores Between Public and Private Sector Practice

An independent samples t-test was conducted to evaluate the difference in mean total CAI scores between radiographers practicing in the public and private sectors (Table 32). There was a significant statistical difference between the scores of public sector radiographers (n=139) compared to private sector (n=13). Public sector (M 69.552; SD 10.170); private sector (M 78.043; SD 8.796), t (150) = -2.908, p = 0.004 (two tailed). The eta squared statistic was 0.05 (0.06 regarded as a moderate effect) (Pallant, 2016).

Table 32- Independent Samples t test Comparing Practice Sector mean CAI scores

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
CAI Context	Equal variances assumed	.029	.865	-2.908	150	.004	-8.49056	2.91977	-14.25975	-2.72136
	Equal variances not assumed			-3.281	15.167	.005	-8.49056	2.58781	-14.00106	-2.98006

4.2.5.3 Comparing the Mean Total CAI Scores Between Therapy and Diagnostic Radiographers

An independent samples t-test was conducted to evaluate the difference in mean total CAI scores between radiographers practicing in the different branches of radiography (Table 33). There was no significant difference between the scores of both groups; therapy (n=14) (M 71.356; SD 12.469), diagnostic (n = 138) (M 70.169; SD 10.116), t (150) = -0.409, p = 0.683 (two tailed). The effect size was very small (eta squared 0.0011).

Table 33- Independent Samples t-test Comparing the Mean CAI Score for Therapy and Diagnostic Radiographers

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
CAI Context	Equal variances assumed	2.124	.147	-.409	150	.683	-1.18708	2.90062	-6.91844	4.54428
	Equal variances not assumed			-.345	14.788	.735	-1.18708	3.44207	-8.53286	6.15870

4.2.5.4 Comparing the Mean CAI total Score Between Groups – Number of Years Since Qualifying

Table 34 - Table Describing the Total CAI Scores Between Groups in Years Since Qualifying as a Radiographer

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
0-5 years	56	74.5182	9.20596	1.23020	72.0528	76.9836	54.02	97.72
6-10 years	33	66.8752	9.89109	1.72182	63.3679	70.3824	49.49	85.91
11 to 15 years	19	67.4605	8.48143	1.94577	63.3726	71.5484	47.12	82.19
16 to 20 years	16	67.8488	10.84121	2.71030	62.0719	73.6256	48.08	85.09
21 to 25 years	9	69.5100	12.69565	4.23188	59.7513	79.2687	48.45	90.89
26 to 30 years	12	67.3875	12.81983	3.70077	59.2422	75.5328	41.84	88.43
31 to 35 years	3	70.9500	7.23428	4.17671	52.9791	88.9209	63.03	77.21
36 to 40 years	4	72.0100	9.20764	4.60382	57.3586	86.6614	60.79	81.52
Total	152	70.2787	10.31270	.83647	68.6260	71.9314	41.84	97.72

The mean total CAI scores were compared between the groups according to length of time since qualifying as a radiographer in years (n=152), (Table 34). A one-way between groups analysis of variance ANOVA statistical test was undertaken, to examine the mean scores between ‘years since qualified’ groups. The Levene test for homogeneity of variances was tenable p = 0.753 (p >0.05) justifying the use of the ANOVA statistic for this data. The ANOVA statistic was significant F 2.521 (7, 144) p=0.018 (< p = 0.05)) confirming a statistical difference between groups (Table 35). Post hoc testing using a multiple comparisons table using the Hochberg method (Thissen, Steinberg, & Kuang, 2002) (better suited to unequal sample sizes), (Table 35) showed that there was a significant difference between the mean scores for '0 to 5 years group' (M 74.518; SD 9.205) and the '6 to 10 years' group* (M 66.875; SD 9.891) (p=0.017). The effect size calculated using eta squared was 0.11 (>0.14), classified as a large effect size (Pallant, 2016).

Table 35 – One-Way ANOVA Test Between CAI Total Means / Years Since Qualifying Groups

ANOVA					
CAI Context					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1753.134	7	250.448	2.521	.018
Within Groups	14305.995	144	99.347		
Total	16059.129	151			

***Extract from the multiple-comparisons table** (SPSS) – *Hochburg*

Years Qualified		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower	Upper
0-5 years	6-10 years	7.64306*	2.18737	0.017	0.7046	14.5816
	11 to 15 years	7.05769	2.64629	0.209	-1.3365	15.4519
	16 to 20 years	6.66946	2.82547	0.414	-2.2931	15.6321
	21 to 25 years	5.00821	3.57947	0.991	-6.3461	16.3626
	26 to 30 years	7.13071	3.17064	0.508	-2.9268	17.1882
	31 to 35 years	3.56821	5.90676	1.000	-15.1685	22.3049
	36 to 40 years	2.50821	5.15857	1.000	-13.8552	18.8716

4.2.5.5 *Comparing CAI Means Between Home Countries*

Table 36- Describing the Total CAI Scores Between Home Countries

CAI Context

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
England	125	70.9622	10.46752	.93624	69.1091	72.8152	41.84	97.72
Wales	6	68.3317	10.45769	4.26934	57.3570	79.3063	55.37	81.52
Scotland	15	64.9113	8.34760	2.15534	60.2886	69.5341	49.79	85.90
N.Ireland	6	71.4050	9.26632	3.78296	61.6806	81.1294	59.53	85.09
Total	152	70.2787	10.31270	.83647	68.6260	71.9314	41.84	97.72

The mean total CAI scores were compared between the 'Home Country' groups (n=152). (Table 36). A one-way between groups analysis of variance ANOVA statistical test was undertaken, to examine the mean CAI scores between 'Home Country' groups. The Levene test for homogeneity of variances was tenable p=0.847 (p>0.05) justifying the use of the ANOVA statistic for this data. The ANOVA statistic was not significant *F* 1.654 (3, 148) p=0.18(>p=0.05) showing there was no statistical difference between groups (Table 37). However, 'Scotland' had the lowest overall CAI mean score (M 64.911; SD 8.347) and Northern Ireland had the highest overall CAI mean score (M 71.405; SD 9.266). The effect size calculated using eta squared was 0.03 (<0.06 classified as medium to small effect) (Pallant, 2016). There was a large variation of participant numbers within comparison groups however (n= 6 to 125).

Table 37- One Way ANOVA Comparing CAI Means Between Home Countries

ANOVA

CAI Context

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	520.876	3	173.625	1.654	.180
Within Groups	15538.253	148	104.988		
Total	16059.129	151			

4.2.5.6 Comparing the CAI Means Between pay bands

Table 38- Describing the Total CAI Between Pay Bands /Grades

CAI Context	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Band 5	27	73.6696	10.63868	2.04742	69.4611	77.8782	54.02	97.72
Split B5/6	2	57.4500	2.94156	2.08000	31.0211	83.8789	55.37	59.53
Band 6	52	68.8183	9.52188	1.32045	66.1674	71.4692	47.12	87.39
Split B6/7	2	61.8700	7.62261	5.39000	-6.6164	130.3564	56.48	67.26
Band 7	47	67.5877	10.21911	1.49061	64.5872	70.5881	41.84	87.69
Band 8a	7	78.5229	6.04482	2.28473	72.9323	84.1134	70.61	88.43
Band 8b	4	70.9900	7.20576	3.60288	59.5240	82.4560	60.72	77.58
Total	141	69.6206	10.16341	.85591	67.9285	71.3128	41.84	97.72

The mean total CAI scores were compared between the radiographer reported ‘Pay Bands/Grades’ for the NHS (n=141) (Table 38). A one-way between groups analysis of variance ANOVA statistical test was undertaken to examine the mean CAI Scores between the reported pay grades. The Levene test for homogeneity of variances was tenable p=0.425 (p>0.05) justifying the use of the ANOVA statistic for this data. The ANOVA statistic was significant *F* 2.874 (6, 134) p=0.011(<p=0.05), showing a significant difference between the mean CAI score total in the pay band groups (Table 39). Post hoc testing using a multiple comparison table (Hochberg) did not show any significant differences between any particular pay band. The Hochberg test is a conservative test when the sample sizes are different (Thissen et al., 2002). The lowest overall mean CAI total score was from the ‘Split B5/6’ group (M 57.450; SD 10.638) and the highest mean CAI total score was within the ‘Band 8a’ group (M 78.522; SD 6.044) – however there was an unequal sample size between both groups, and the sample size was much smaller than that of the largest group (B6 n = 52). The effect size calculated using eta squared was 0.11 (0.14 and above regarded as a large effect) (Pallant, 2016).

Table 39- One Way ANOVA Comparing CAI Means Between Pay Bands / Grades

ANOVA					
CAI Context					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1649.016	6	274.836	2.874	.011
Within Groups	12812.257	134	95.614		
Total	14461.274	140			

4.2.6 Reliability of the Modified CAI Instrument

4.2.6.1 Strength of the Intercorrelations among the Items – (Factorability of the Items)

In order to determine the suitability for analysis of the modified CAI data with CFA, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity, was undertaken on the dataset with imputed missing values (n=152).

Table 40 Testing for Sample Size Suitability for SEM

KMO and Bartlett's Test*		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.883
Bartlett's Test of Sphericity	Approx. Chi-Square	2788.116
	df	666
	Sig.	0.000

**Imputed missing values dataset*

Table 40 shows the KMO statistic to be 0.883, with values at ≥0.8 considered to be '*meritorious'* sampling adequacy for factor analysis, showing a strong measure of sampling adequacy (Kaiser & Rice, 1974) . The Bartlett's test of sphericity is significant at p<0.01, with a recommended significance level of $p<0.05$ for the data to be suitable for factor analysis techniques (Pallant, 2016).

4.2.6.2 Cronbach's alpha Statistic – Internal Consistency of the Instrument

Table 41 represents the aggregated values of the Cronbach's alpha reliability statistic, for each of the modified CAI survey items grouped into the 5-factor model (used in the original CAI instrument):

Table 41 Cronbach's Alpha for the 5 factor Model

CAI question items grouped into 5 factors	Alpha (α)	Alpha based on standardised items	Number of Items
Factor 1 Collaborative Practice	0.83	0.831	9
Factor 2 Evidence Informed Practice	0.87	0.870	11
Factor 3 Respect for Persons	0.68	0.683	7
Factor 4 Practice Boundaries	0.75	0.738	6
Factor 5 Evaluation	0.51	0.504	4

Table 41 represents the analysis of each of the items relating to the 5 factors using Cronbach's alpha coefficient. Three of the five factors were acceptable (Collaborative Practice; Evidence Informed Practice; Practice Boundaries). Factor 1. Collaborative Practice, α 0.83 (n=9), Factor 2. Evidence Informed Practice α 0.87 (n=11), Factor 3. Respect for Persons α 0.68 (n=7), Factor 4. Practice Boundaries α 0.75 (n=6) and Factor 5. Evaluation α 0.51 (n=4). ($\alpha \geq 0.7$ considered acceptable value for rejecting the null hypothesis). There were no negative values in the inter-item correlation matrices for each factor, indicating that the instrument items within factors, were measuring the same underlying characteristic (Pallant, 2016). Given the relatively wide range of quoted cut off levels for alpha in the literature, (0.6 to 0.9), Factor 3. could be considered an adequate value at α 0.68.

Table 42 Cronbach's Alpha Mean Inter-Item Correlations (Factor 5)

	Mean	Minimum	Maximum	Range	Maximum / Minimum	N of Items
Inter-Item Correlations	0.202	0.116	0.298	0.183	2.583	4

Table 43 Cronbach's Alpha - Item Total Statistics for Factor 5

Factor 5	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
CAI 9	8.52	2.092	0.380	0.151	0.353
CAI 12	8.24	2.460	0.305	0.103	0.431
CAI 18*	8.65	2.639	0.194	0.039	0.522
CAI 24	8.74	2.314	0.320	0.114	0.415

Factor 5 showed a low α coefficient (Table 41), and in cases where the number of items is low (in this case n=4), quoting the mean inter-item correlation value can be useful (Pallant, 2016). The mean value (Table 42) was α 0.202 (min 0.116 to max 0.298 range 0.183) suggesting a weak correlation for this factor. As the purpose of the study was to use the modified psychometric instrument on a different population and context to the original instrument, it was not deemed appropriate to remove an item with low alpha coefficient, as this would not allow direct comparison with the original tool. The item with the lowest statistic in Factor 5 was item CAI 18* (Table 43) and removing this item would not have had much of an effect on the final alpha coefficient for Factor 5 (α 0.522 if CAI 18* item deleted vs α 0.502 with the item included).

4.2.7 Comparison of Internal Consistency with Other Researchers' Findings

Table 44 represents a comparison of Cronbach's alpha coefficient against the original CAI tool, and subsequent modified and published Swedish and Danish versions (the only other published versions to date), as well as the coefficients found in the modified radiography version*. There appeared to be a consistently moderate to strong correlation for each factor's alpha across studies when compared to the original CAI. It can also be seen that factor 5 had consistently the lowest alpha coefficient in the modified versions, compared to the original.

Table 44 Comparison of Cronbach Alpha Coefficient with the Original CAI & other Research Findings in Similar Applications with a Modified Version

CAI Factor	Item (n)	Original[4] CAI α	UK Radiography* CAI α	Danish[5] CAI α	Swedish[6] CAI α
Factor 1	9				
Collaborative Practice		0.91	0.83	0.83	0.82
Factor 2	11				
Evidence Informed Practice		0.88	0.87	0.89	0.84
Factor 3	7				
Respect for Persons		0.81	0.68	0.77	0.68
Factor 4	6				
Practice Boundaries		0.80	0.75	0.78	0.69
Factor 5	4				
Evaluation		0.78	0.51	0.64	0.57

[4] (McCormack et al., 2009)
[5] (Hølge-Hazelton et al., 2019)
[6] (Kajermo et al., 2013)

4.2.7.1 *Structural Equation Modelling*

CFA was undertaken on the modified CAI data, using the original five factor model proposed by (McCormack et al., 2009), including the items associated with factors: Collaborative Practice; Evidence Informed Practice; Respect for Persons; Practice Boundaries and Evaluation. Each construct was examined in turn to maximize the respondent to item ratio. Appendix 22 lists the CAI components and their individual factor loadings from CFA according to the 3 and 5 factor models.

The model fit data for the five-factor model gave an excellent result (Table 45) using SEM, with RMSEA=0.000 p=0.994 ('excellent fit'), CFI=1, SRMR=0.003 showing strong fit statistics with the original CAI five-factor model, and the X^2 value of 0.018 df=2, with a X^2/df of 0.009 p=0.9912 also indicating the likelihood of a good overall model fit (Table 46).

Table 45 Confirmatory Factor Analysis - 5 Factors

	SEM Result with Mplus™	Accepted Threshold Levels[7]
RMSEA Estimate **SRMR**	0.000 0.003	(<0.06 and <0.03 = excellent) (< 0.08)
90 Percent C.I.	0.000 to 0.000	
Probability of RMSEA ≤ 0.05	0.994	(> 0.05)
CFI	1.000	(> 0.95)
TLI	1.251	(> 0.96)

Table 46 Chi-Square Test of Model Fit - 5 Factors

	SEM Result with Mplus™	Accepted Threshold Levels[7]
Value X^2	0.018 (X^2/df = 0.009)	
Degrees of Freedom	2	
P-Value	0.9912	(> 0.05)
Scaling Correction Factor for MLR	1.3184	

[7] (Hooper et al., 2008)

The modified CAI data, was also tested for model fit, against the three factor model theoretically more closely aligned with the PARIHS framework element 'Context' and its sub elements: Culture; Leadership and Service Evaluation (McCormack et al., 2002).

Table 47- Confirmatory Factor Analysis - 3 Factor Model

	SEM Result with Mplus™	Accepted Threshold Levels[7]
RMSEA Estimate **SRMR**	0.027 0.041	(<0.06 and <0.03 = excellent) (< 0.08)
90 Percent C.I.	0.000 to 0.085	
Probability of RMSEA ≤ 0.05	0.676	(> 0.05)
CFI	0.989	(> 0.95)
TLI	0.983	(> 0.96)

The three-factor model also gave a very good result (Table 47) using the same SEM method (although not quite as strongly as the five-factor model), with RMSEA = 0.027 p = 0.676, CFI = 0.989, SRMR = 0.041. The $\boldsymbol{X^2}$ value of 15.534 df=14, with a $\boldsymbol{X^2}$/df =1.109 p = 0.3427 also indicating the likelihood of a good overall model fit with the three-factor model (Table 48).

Table 48 - Chi-Square Test of Model Fit 3 Factor Model

	SEM Result with Mplus™	Accepted Threshold Levels[7]
Value X^2	15.534 (X^2/df = 1.109)	
Degrees of Freedom	14	
P-Value	0.3427	(> 0.05)
Scaling Correction Factor for MLR	1.0953	

4.2.7.2 SEM Rigour

As discussed in Ch.3, the reliability of SEM sampling can be determined by a combination of sample size, the 'ratio of variables per factor' and the combined strengths of each factor loading (α). Table 49 gives the 'variables to factor ratios' for the CAI survey, with sample size n = 152 at a ratio of 7.4 (for the 5 Factor Model), representing 'excellent' agreement even with low communality according to Mundfrom et al. (2005). In order to further examine the sampling adequacy and reliability of the SEM used, the method described by Stevens (2009) (see Ch.3), of examining the integrity of the CFA result against the level of α for each factor loading, within the 5 and 3 factor models, is shown in Table 50. Stevens (2009) states that components with at least four loadings >0.6 (or the average of the 4 largest loadings) are reliable with samples n=>150. Reliability was shown in CP, EIP, and PB within the 5-Factor Model; and within C and E for the 3-Factor model (Table 50).

Table 49 Analysis of the Factor Ratios

Variables to factor ratio		
Sample Size	*n*	152.00
Variables (CAI Items)	*n*	37.00
Factor Model	*n*	5.00
Factor Model	*n*	3.00
	5 Factor Model Ratio	7.40
	3 Factor Model Ratio	12.33

Table 50 - Interpretation of the Factor Loadings

5 Factor Model	Factor Loading α	Condition Met[8]:
Item	*Factor 1 - CP*	
6	0.758	
14	0.745	
19	0.686	
28	0.668	4 x factor loadings > 0.6
	Factor 2 -EIP	
7	0.772	
11	0.608	
29	0.750	
34	0.700	
37	0.672	4 x factor loadings > 0.6
	*Factor 3 -RP**	
		No Condition Met*
	Factor 4 - PB	
13	0.724	
16	0.574	
25	0.817	
30	0.616	4 largest loadings (average) >0.6
	*Factor 5 – EV**	No Condition Met*
3 Factor Model	**Factor Loading α**	
Item	*Factor 1 - C*	
3	0.626	
12	0.654	
21	0.69	
23	0.694	
31	0.777	
34	0.631	
36	0.633	4 x factor loadings > 0.6
	*Factor 2 – L**	
		No Condition Met*
	Factor 3 - E	
4	0.617	
14	0.611	
20	0.624	
30	0.697	
32	0.649	4 x factor loadings > 0.6

[8] (Stevens, 2009)

4.3 Findings - Semi Structured Interviews (QUAL)

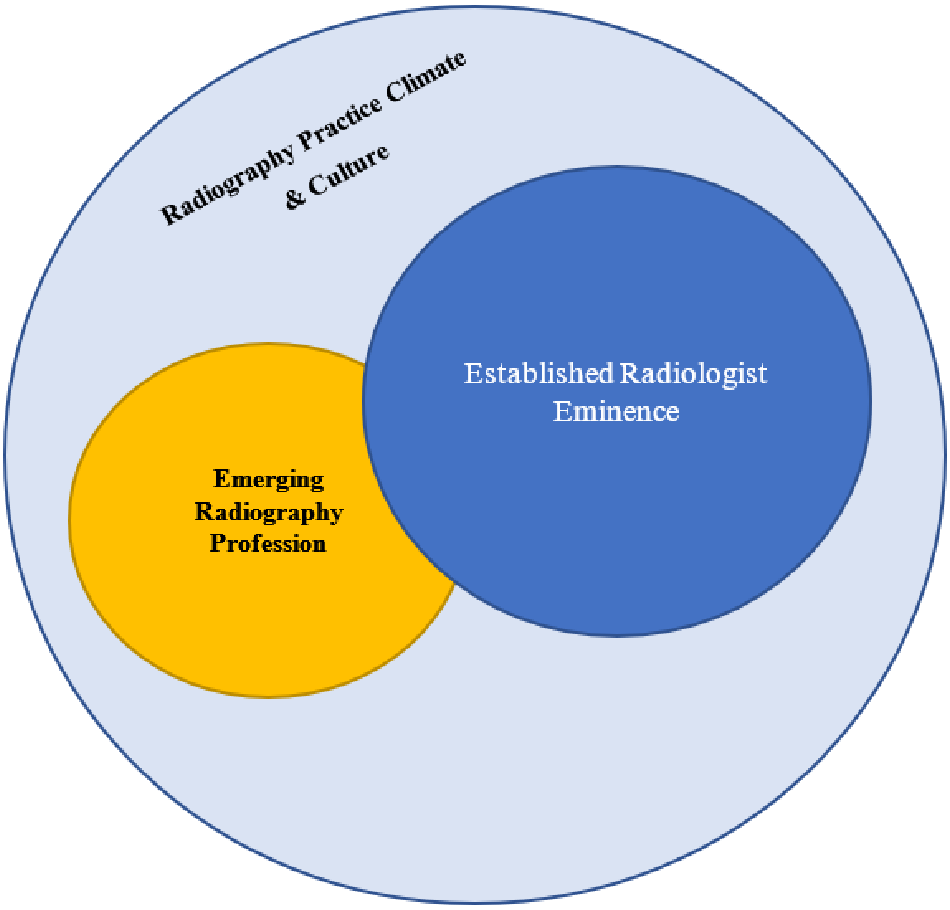
4.3.1 Participants

Of those agreeing to be contacted for interview in the survey, n=20 consented to semi-structured interview from a total sample of n=152 radiographers (not all consented to be contacted). A cross section of respondents was selected for interview, as far as was possible, to include: diagnostic and therapeutic radiographers in approximate proportion to the population norm; gender; various grades of experience or seniority by NHS pay band & years of service and sub-specialty. No one volunteered for interview from Wales or Northern Ireland. All participants were NHS pay scale B6 and above (or private sector / HEI equivalent). The final detailed sample demographic is shown in (Appendix 24).

4.3.2 Identified Themes

Three main overarching themes were developed and conceptualised from the interview data using TA. Ch3. Describes the methods used for data analysis including code generation, coding reliability and thematic development. Figure 20 represents the overarching themes where a background of practice climate and culture, at various levels, pervaded and encompassed a culture where medical consultants (radiologists) were seen to be in established roles and having pre-eminence in the national and local context. This overshadowed the role, autonomy, and development of radiographers. Radiographers were found to have issues of self-confidence, and overreliance on others, however positive signs of professional emergence, were seen.

Figure 20 –Three Themes Identified using TA



4.3.3 Theme 1 Radiography Practice Climate & Culture

Theme one represents the context that radiography resides and was considered to be a backdrop that influenced radiographer practice, autonomy, and ability to utilise and implement evidence. Aspects of various levels of context (macro, meso, micro) were seemed to affect radiographer practice positively or negatively (Figure 21).

Figure 21 - Theme 1 - Radiography Practice, Climate and Culture

4.3.3.1 External Forces (macro)

The 'external forces' sub-theme represents external governmental and regulatory influences and internal organisational and cultural artefacts that permeate the contextual backdrop of radiography, including behaviours that some interviewees refer to as 'historical' or 'superstition'. This was seen to pervade the profession function of radiography, without good cause or benefit to the service or patient. This includes the drive or pressure for service change, and the opposing external or contextual forces which seem to interact positively or negatively with implementation or change efforts.

Radiographers practicing in radiotherapy felt that government or NHS backed initiatives to implement new evidence or technology was useful in driving change and standardised practice within NHS networks, however they felt that there might be a lack of standardisation of treatment due to the fragmented NHS, in and between the home nations, and that where national external backing was lacking, technological change as a result was also likely to lag:

> *Therapy Radiographer – England (P#3)*
>
> *[NHS treatment networks]… there will be a much more standardisation of protocol, so lots of really good things that this will address…I mean the NHS England is steering it.*

> *Therapy Radiographer – England (P#4)*
>
> *There's been other therapies that has been mooted as important such as intraoperative breast and things, but I hear little of it at the moment. I often don't know if these new initiatives are given enough backing.*

And an example in diagnostics, shows that where national governmental targets drive change, resources tend to follow locally, even if expensive equipment such as a CT scanner is involved:

Diagnostic Radiographer – Scotland (P#11)

to it was a bit controversial for a long time, whether there should be a scanner or not…but things like thrombolysis [in stroke diagnosis] targets made it very hard…for them not to have it.

A few radiographers highlighted situations where outdated regulation stifled individual practice and autonomy and had a negative impact on patient care and workflow, even though the original intent of the law was to protect service users. In this example a radiographer felt that the medicines regulations surrounding patient group directions (PGD), allowing registered healthcare professionals to administer medicines under protocol, were unduly restrictive and served to interfere with patient workflow and team resources, the sentiment that asking a consultant to attend was just a 'tick-box exercise':

Diagnostic Radiographer – England (P#6)

we had a fifteen-year-old patient for [intravenous…contrast], and physically they're an adult, but because…the PGDs there…you have to be 16 or over to…I mean it's a technical thing, it's not even evidence based I suppose…but we then have to get a … radiologist or someone to come and inject,

Some radiographers referred to a cultural or system memory effect in their contexts, where historical misconceptions had filtered down the generations of radiographers, examples given related to clinical technical practice not being based on evidence and frustrations regarding a cultural artefact where radiographers intrinsically accept system norms with some challenging the status quo:

Diagnostic Radiographer – Scotland (P#11)

What's going to be effective and what isn't…I think people do it based on superstition or based on…or makes the patient feel better to have done something, rather than really being sure that it will be effective.

Regarding radiographers' role in sharing imaging information with patients, one participant felt that there was a communal system memory effect (within the contextual backdrop), which perpetuated the misconception, no one really understood why radiographers continued to practice in this way even though not compelled by any instrument:

> *Diagnostic Radiographer – England (P#17)*
>
> *it's like a communal…sort of memory type thing. Everyone seems to think that Radiographers can't say anything…when in fact there is nothing out there to say that they can't say anything…I don't know where it came from originally…but it seems to be something that's really stuck.*

One participant felt that the employing organisation, had a role to influence the ability of individuals 'stuck in their ways' to adopt change, and that the employer as a contextual actor, needed to set goals, encourage change and actively deal with individuals who supressed or resisted change, but agreed this could be difficult:

> *Diagnostic Radiographer – Scotland (P#14)*
>
> *… it's quite an interesting subject, because I think you can learn from other people's evidence and certainly change your practice. But it's also quite difficult, when you've been doing things in a certain way…and perhaps you've got a whole department virtually doing things one way; sometimes persuading them to change can actually be a little bit like…you're holding back the tide*

One participant worked for an oncology charity, and as a result in their unit, they received referrals from many sources including the NHS and private sectors, and a multi-professional and multi-skill set cohort of radiologists practiced as part of a larger 'visiting' team, than was usual in conventional practice. She felt that having a larger team, with multiple contextual origins, was more receptive to implementing new ideas and evidence without getting stuck in old ways of working or routine, and that her role was more autonomous as a result:

Diagnostic Radiographer – England (P#8)

because our radiology group is such a big mixture of radiologists, they're a little bit more open to trying new things, because they can't get stuck in one way…because we do things in so many different ways, that they're a little bit more open to trying. We do get to change how we work quite a lot.

The notion of 'drive' or 'pressure' to change practice and implement evidence such as undertaking new imaging techniques or extending scopes of practice within the team seemed to be either based on 'soft pressure' from visiting students bringing in new knowledge as they rotated through regions, or the 'hard pressure' of government targets to support evidence utilisation, or the lack of medical skills available.

One participant enjoyed the rapport with visiting student radiographers, who were able to bring new ideas and suggestions of new ways of working or evidenced technique from other departments they visited during their training. This seemed to be a very open culture and receptive to evidence from various sources and fostering team working, nevertheless the soft pressure of qualified staff to listen and implement if appropriate was evident, facilitated through a local radiography improvement group:

Diagnostic Radiographer – England (P#15)

…we get a lot of ideas from the younger ones who've worked at other hospitals…So…my role…is to be open to those suggestions and explore than rather than, in the past, it…seen as…no, we don't do it that way

'Hard Pressure' from regulators and government targets seemed to push changes in practice, implementing new technology or expanding existing technology. Also, external auditing by professional regulators helped ensure continual professional development, promoting best practice:

Diagnostic Radiographer – England (P#9)

we use a lot of evidence-based practice, I mean…we're…constantly changing what we do…working for a cancer service in particular is heavily scrutinised…we're constantly looking at little things we can do to make things better

Therapy Radiographer – England (P#4)

[regarding HCPC audits of CCPD]… I think again the attitude a lot of it is just sit tight and hope we don't get audited. While I'm attempting to promote in my role is 'ok so let's just get one prepared, so if you are audited, it won't completely ruin your Christmas.'

A recurring theme in terms of evidence implementation in the area of role extension in radiography, seemed to be the pressure of increasing demand and shortages of consultant radiologists to undertake image interpretation and other interventional roles in radiology. Backlogs in reporting radiographs, and waiting lists for certain procedures was a constant contextual pressure for evidence-based role development:

Diagnostic Radiographer – England (P#13)

…my role came on the back of a lack of being able to recruit radiologists, but a lot of the other roles they've had…My role in particular was directly related to lack of radiologists though…

Diagnostic Radiographer – England (P#2)

..to meet the workload they [radiologists] need support and they're fully satisfied that following appropriate training that radiographers are capable of doing the same work…[locally]

There was much animosity evident in the data surrounding tur wars regarding role extension and role boundaries. Participants reported how the respective professional bodies (RCR/SCoR) had been at odds, and many participants seemed aware of this as a national issue. Controversy was reported by participants regarding the apparent result of a three-year appointment of a ‘traditionalist’ president of the RCR, making her views known publicly, and shaking the already well-established foundations of radiographer reporting in the UK. Participants were quite stupefied as to the sensibility of the RCR’s position and were quite resolved to continue their practice evidenced by service need and well-established governance conventions. The animosity seemed greater in Scotland:

> *Diagnostic Radiographer – Scotland (P#1)*
>
> *…up here we have a lot of animosity between certain members of Radiology staff and the Radiographers.*
>
> *Diagnostic Radiographer – Scotland (P#16)*
>
> *…very disappointed in…recent statement from the Royal College of Radiologists that said Radiographers will never be able to report to the same standard as Radiologists…But I feel we argued the case back very well to that.*
>
> *Diagnostic Radiographer – England (P#12)*
>
> *…things that have come out of the Royal College of Radiologists that haven’t been as supportive…some of them have been downright antagonistic.*

One participant felt that there was ‘gulf’ or division between the two professions and professional organisations, and that management was generally unaware or ‘blind’ to this – and was likely to be disinterested as long as targets were met:

> *Diagnostic Radiographer – Scotland (P#1)*
>
> *…I don’t think management really know about the gulf between the Radiographers and Radiologists…because we get the work done, that makes them happy…they don’t look into it too much more than that…*

Even though there was national professional animosity reported participants felt that the reality of the workplace was that local radiologist colleagues did not support the national view denigrating the skills of radiographers:

> *Diagnostic Radiographer – England (P#13)*
>
> *there's been a lot of friction between the two [Colleges]. The new…President of the RCR has come in, she's very against Radiographer reporting, which has probably put things back a few years…so, things have definitely gone downhill between the two professions…discussions with Radiologists, not just at my own Trust but others, that absolutely disagree with what she says.*

One participant noted that the leadership of the RCR was probably trying to protect *"what they see as their own…their own turf" (P#13)* and that radiographers had a well-established body of evidence to support their own practice:

> *Diagnostic Radiographer – England (P#13)*
>
> *…it's just protectionism of what they see as their own role and their own turf. I don't think there's any evidence behind what they say. It has been proved time and time again that Radiographers have got the abilities and skills to be able to Report…*

One participant, whilst discussing the role of professional bodies in supporting EBP, noted that they felt that the SCoR was not in touch with current practice and didn't understand the work pressures, and the inability of radiographers to be able to spend much time ensuring their practice was based on the latest evidence:

> *Diagnostic Radiographer – England (P#6)*
>
> *[regarding SCoR recommending clinical guidelines]…I…don't…feel that they're in touch with what practice is going on…what staffing levels are like, what sort of availability of stuff is going on.*

Another felt that the SCoR was useful in terms of professional indemnity, but would not be the first point of call to search for new clinical evidence in radiography even though their role was stated as a specialist radiographer looking at image quality, adapting techniques and introducing new protocols, suggesting a lack of awareness of the mission of the SCoR to promote the practice of radiography or that its output was not seen as relevant in the workplace:

> *Diagnostic Radiographer – England (P#15)*
>
> *If I'm honest, I don't really look at it that much….a lot of it doesn't really relate to…my role. So…I am in the Society…but more for the indemnity if I'm honest [Not for practice knowledge or evidence]*

Much discussion surrounding the positive role that professional bodies had in the radiography context was seen around promoting and holding annual or specialist conferences to disseminate information, the publication of journals and magazines to promote evidence adoption, collaborating with universities and other organisations to develop specialist courses or research and providing local incentives to guide and reward evidence adoption in the workplace:

> *Diagnostic Radiographer – England (P#5)*
>
> *…we are reviewing gynae ultrasound reporting guidance and so people who went to the recent conference have brought information back from that, some of which we discussed at a recent meeting, but some of the information I feel that it might have just been things that have been presented at the conference.*
>
> *Diagnostic Radiographer – England (P#9)*
>
> *…If it was anything…Radiography-based I'd start with…our main Radiography journal, any sort of articles that have been written…[or]…symposium…*
>
> *Diagnostic Radiographer – Scotland (P#16)*
>
> *…the College…it's definitely their role to pass that on to Radiographers and make sure that we are up to date with the new guidelines.*

Participants valued having a local practitioner having a professional link with their professional body such as a 'learning rep' or a visiting expert from the professional body promoting EBP, and thought that professional bodies should collaborate with universities to commission specialist courses for radiographers:

Diagnostic Radiographer – Scotland (P#1)

[regarding Scottish SCoR officer]…she would happily come and talk to you if you ask her to…she spoke at one of the CPD things that we did about writing for 'Synergy'[magazine]…and she was happy enough, and it was good, and I think it did help a lot of people.

Diagnostic Radiographer – Scotland (P#16)

[regarding SCoR]…possibly do more in terms of funding, possibly do more to…certainly from the point of view of…a university, to help us to create those courses.

Some interviewees described having nationally recognised awards from professional bodies as being relevant to promote and reward good practice in the workplace, and felt that this was also a positive aspect of the role of a professional body in radiography, especially where recognition was not evident from their own managers locally:

Diagnostic Radiographer – Scotland (P#16)

…I nominated the MRI team…we…deserved to be recognised and…for our hard work…but one of the reasons that I did it as well was…to have national recognition … when we weren't getting recognition from our managers for our hard work.

Contrasts emerged in the data regarding the development of the individual, and EBP, in the NHS and Private sector. Participants who had experienced working for the NHS and private sector, suggested that the private sector was more focussed on financial profitability than evidence implementation, and individual development, and one radiographer felt that it was easier to implement new knowledge in the NHS for this reason:

Diagnostic Radiographer – England (P#7)

… I think there's much more support in the current job in the NHS to improve and to develop services…we're actively encouraged to…improve and learn new things, and …develop personally…in the private sector…that wasn't always the case…we were there just to do a job basically… you've got companies who want to make profit. You have doctors who want to make a profit…

Participants also reported a lack of opportunity to develop roles in the private sector, with consultant radiologists taking a more active image acquisition role such as directly undertaking ultrasound scans (contrasting with not in the public sector), as part of their private practice, also possibly being part of patient expectation. As a result, the radiographer in the private sector undertook the more traditional radiography roles in supporting the radiologist:

Diagnostic Radiographer – England (P#8)

…I think there's a lot more stuff that radiologists do that is private work…that they will specifically do. So, we have ultrasound, but it's…it's radiologist led…We haven't got any…radiography sonographers. And things like any interventional work they do, it's radiologists.

However, another participant in the private sector, reported more opportunity for autonomy, as they worked more remote from the oversight of radiologists (mobile unit), and therefore felt more autonomy, otherwise deferred to the radiologist if they were more available such as in the NHS:

Diagnostic Radiographer – England (P#8)

…we have some mobile scanners as well…you're a lot more isolated away from the radiologists…You are making a lot more decisions…on your own which, if anything, is a little bit more empowering because they…they trust your knowledge and your training that you can do the right…[MRI] sequences, if that makes sense?

4.3.3.2 Evidence Based Practice

There were many salient issues in the data surrounding radiographer access to research evidence and the ability and drive to engage in research at a practitioner level. Also, many participants noted the inability to implement new evidence or best practice, due to financial or other resource issues such as lack of time.

Quite a substantial number of participants said that having direct access to evidenced research to inform practice in the workplace was difficult, significantly so compared to the easier access they had as a student during their university training. Participants reported that access in their workplace was mainly to the abstracts of published journals only, making it difficult to scrutinise the quality of the research, however there was a general understanding amongst staff that non-peer reviewed research was of questionable quality:

> *Therapy Radiographer - England (P#2)*
>
> *when I was doing the MSc I had the use of the University library…to look for any literature, I know I can use Athens through the hospital, but it does get harder to access or be able to read anything other than abstracts*
>
> *Diagnostic Radiographer – England (P#10)*
>
> *…it's more difficult when you're not…a student, because obviously you have access to University…databases, journals and things…our hospital sort of library…is not all that great….I found it more difficult to find things when I've not been a student, online journals…apart from finding…what you can through Google, which obviously isn't always the best way…I have, I personally find that quite a big barrier.*

When participants were asked to comment on their general thoughts about evidence-based radiography, the issue of not being able to access peer reviewed journals, with ease, and without having to pay a fee was a strong recurring theme as a barrier to EBP in radiography:

Diagnostic Radiographer – England (P#11)

[regarding access to journals]…probably just going to come back to access of these, these journals, which is never particularly easy. You might find what you think is a pertinent piece of research and then you'll have to pay for it…I do think that…the cost of this research…that accessing the papers is probably a barrier.

Another participant, although with intermittent access to published research articles through postgraduate study, said that she found that there was a contrast in the access available through her NHS employment and postgraduate student status, with clinical staff unable to fund their own access, and more importantly with evidence that employers are reluctant to do so as well, thus again illustrating the potential barriers in the radiography context to be able to access peer reviewed quality research in order to implement the latest EBP.

Diagnostic Radiographer – England (P#13)

… studying…I've always had University access to things like Science Direct…Whereas the Trust access via Open Athens isn't quite to the same extent…I don't have the money to do it…and…I don't think the department would want to be paying out…unless you could persuade them that, from the abstract…I…really need to have this article…they're not going to want to be…forking out…

One participant said that it probably put a lot of radiographers off undertaking local research with the view of improving practice (and publishing in journal articles) due to the difficulty in obtaining research articles for their review:

Diagnostic Radiographer – England (P#9)

…because it takes so much longer to…find what you want...If I was asked to…write an article now…I…would really struggle with finding references… literature…to back it up…I would struggle…

Participants generally felt that having time at work to access existing evidence and create new evidence in the form of audits, and possibly sharing the data in published articles or conference poster presentation was stifled due to the lack of clinical time to engage with the practice of reviewing published articles and generating new evidence in the workplace. However, it was encouraging to see that some engagement had taken place with such activity as entering academic posters at conferences, although some radiographers found it hard to be released from work to attend conferences even though they wanted to:

> *Diagnostic Radiographer – Scotland (P#1)*
>
> *…because a lot of the time…the staff are completely overwhelmed, and don't have the time…to look at…enough CPD, or to understand what recent stuff has come out regarding what we're doing and why we should be changing things.*
>
> *Therapy Radiographer – England (P#4)*
>
> *[regarding work time to undertake audit & publish …Probably not, because again it's work, it's time, it's pressure, they would have to go and do it in our own time, off their own back…*
>
> *Diagnostic Radiographer – Scotland (P#1)*
>
> *…although I've never been to UKRC…[national conference]…I have submitted two posters into it…I've never actually been because we couldn't get away for the staff[ing]…so… it was only one hour that I was allowed to go, and it wouldn't be… worth going.*
>
> *Diagnostic Radiographer – England (P#7)*
>
> *… time is always going to be a huge barrier for…obtaining evidence, processing…and analysing it…*

One participant felt that there was an endemic culture within radiography to let other professionals (ironically often accused of professional dominance by radiographers) to get on with generating new knowledge and publish research on their behalf. However, this was partially due, to the demands of clinical practice, and the difficulty of producing research of the type and quality or subject matter to be accepted by journals, as a core issue.

> *Therapy Radiographer – England (P#4)*
>
> *…it's quite hard to actually produce something new…it's just the slog and the grind…it comes down again to 'radiographers treat patients'…they don't mess about with academic stuff…and again it's in the culture…and there's still a…bit of sitting back and letting the doctors do that sort of thing, which I think is very wrong…we let them get on with it…*

Participants observed that it was fairly challenging in radiography to introduce new evidence into their own practice as 'individual' radiographers, although considering themselves to be individually autonomous, the practicalities of working in large teams made this difficult. Rotating through many imaging modalities as part of organisational workflow, there was a feeling and general understanding amongst participants that this necessitated a different way of implementing EBP, as there needed to be group consensus amongst multi-professionals in order to safely introduce new practice with consistency and for team clarity:

> *Diagnostic Radiographer – Scotland (P#16)*
>
> *…Our team is…absolutely massive…if you…take it as a small team of core MRI Radiographer…and our modality lead, yes, absolutely it would be our role. But our huge team of rotational staff, no, they wouldn't take it upon them to do that.*

A recurring theme in the data was the lack of financial resources to implement new practices such as the latest radiotherapy techniques or diagnostic procedures. Such issues as local hospitals being disadvantaged by being on the periphery of tertiary centres of excellence, thus with the inference that they were less favourably resourced, and other issues surrounding the English NHS 'tariff' system of funding, with resources for evidence-based practice (in terms of staffing improvement initiatives) not being accounted for financially in this system. However, participants were also keen to iterate that there was a will and desire to follow 'gold standard' practice, nonetheless services always seemed to be under-resourced, with examples of not having the appropriate new technology to implement best practice, or lack of staff or staff with the appropriate training (due to lack of staffing resources) to implement the latest practice:

> *Therapy Radiographer – England (P#3)*
>
> *[funding]…stands between us and best practice…we could…do with…more training for nurses…[to introduce a new radiotherapy practice]…and they…say, if we had funding…for a nurse we could do this for you. And then the tariff will never cover it…certainly it's a barrier.*
>
> *Diagnostic Radiographer – (P#10)*
>
> *we've…got the resources to be practicing in line with all the evidence base all of the time…. I think we do incredibly well a lot of the time, but there's certainly room for improvement…there's some really good guidelines from the National Bowel Cancer Screening Programme…but giving someone the time and resources to implement those properly…is…one of our biggest barriers*

One of the relatively less experienced participants made an insightful observation and suggested that traditional practice (routine X-rays), was such a long-standing technique, that it was a 'barren field' in terms of research avidity or diminishing interest. There was a realisation that practice had progressed to more technologically advanced methods, and that riches in terms of research insight, were more likely to be found now in the contemporary aspects of modern imaging arsenal. This also related to an aspect of practice discussed later in terms of 'generational issues' and led to the use of the code '*barren field'*, and could also be linked to the general low morale of radiographers and suspected apathy, who continue to practice in this traditional field, an aspect of which will also be discussed later in the 'emerging radiography profession' theme:

Diagnostic Radiographer – Scotland (P#1)…

[traditional radiography]…a lot of the research is 'done-with' in plain film nowadays…it's like the 'old hat'…whereas CT and MR…[complex technology]…kind of take a lot of the research time…and they've 'gone off' the research of the basic plain film…

4.3.3.3 Public Nescience and Professional Obscurity

Participants mooted negative views and impressions regarding their own profession. An interpretation of the data suggested that there was an aspect of 'public' obscurity, and a general lack of understanding of the role and ability of the radiographer amongst clinical colleagues in the wider healthcare system and society generally.

Diagnostic Radiographer – England (P#18)

…it's a traditionally held attitude, that nobody in the world could possibly be as intelligent or as knowledgeable as a doctor is….the attitudes of the public tend to support that…and always will…and you still get…oh, 'well I think I ought…I need to have a doctor look at this, you know'…

A participant's concern regarding the lack of understanding regarding the role of the radiographer and the profession's status and credibility as an autonomous practitioner was illustrated by a regrettable involvement in a local competence issue involving a medical consultant. She found that her role, and her value within the organisation, wider society (e.g., solicitors) and the regulatory system, was judged inferiorly, in terms of how the profession was viewed in comparison to the medical profession, during adverse events in the organisation, and subsequent investigations that ensued:

Diagnostic Radiographer – England (P#18)

RES: [regarding clinical incidents]… Trusts and the solicitors that work for Trusts will rally behind medical staff…when it comes to bad practice or litigation…Whereas…the easiest option is just to terminate you if you were…a lesser person and you'd made a similar mistake…They'd probably just say oh, I'm sorry, but that's it, you're out…

INT: do you feel…that society and…the system…holds medical doctors in a different light, in a different sort of status to Radiographers?

RES: Yes. Yes, absolutely.

Another example of how patients, and the public, might view radiographers to have a more inferior role (questionable credibility) than other professions, is the historico-cultural and systematic context in which most diagnostic radiographers' practice. It is a cultural artefact within radiography – that radiographers are not allowed to, or discouraged from commenting on the product of their work (diagnostic images or data), usually because this might unduly distress a patient if there was bad news, or indeed the perception that the radiographer might not have the training or skills to do so accurately (Price, 2001). This aspect is further discussed through the viewpoint of the individual under the 'Demi-Profession' (part of wider medical dominance issues) however in this context the effect is to potentially reduce societal confidence and the status of the profession as a whole in the perception of the general public of radiographers as low-skilled "button pushers":

Diagnostic Radiographer – England (P#17)

[comment on what she perceives patients think about her role]…it…makes us…seem like either we're stupid…or…just…button pushers…and…They just took the pictures, they knew nothing…you know, and it does make me cringe myself….You can say look…we don't report them, it will go to the…the consultants to do reporting…

Diagnostic Radiographer – Scotland (P#16)

[radiographers]…they are definitely…told to be like that, that…because there's just…this culture that we can't…we're not allowed to tell the patients what's wrong with them….I think it's…Radiography culture, definitely; and…possibly the way we're viewed by other professions.

One participant explained that she had concerns about the apparent lack of knowledge that other health professionals have regarding the role of the radiographer, and that the potential lack of understanding could negatively impact on patient services, with colleagues not understanding the potential of the radiographer, and perhaps for radiographers to be overlooked in terms or role development or extension in relation to implementing new evidence:

Diagnostic Radiographer – Scotland (P#16)

RES: [regarding role visibility]… it's probably less clear to other professions because there's…I…feel that other professions don't understand what we do…and I see that…in the NHS and I see that as…from a lecturer point of view…with our students as well.

INT: Yeah. And does that negatively impact on patient care do you feel

RES: Yes actually. Yes.

Many participants expressed a concern that the public and other professions had a diminished understanding of the skillset of the radiographer, and that the status of the profession or its prominence in society is therefore diminished.

Diagnostic Radiographer – England (P#5)

You may get recommended practice for healthcare professionals regarding public health [improvement] and because the public don't see that as our role, it's not easy and not necessarily supported either, having the conversation with patients about…signposting for public health issues, that's not an easy one to implement.

Participants therefore felt that this could affect the way that patients expect to have their care delivered, and that the public might not be receptive to health-related advice offered by radiographers, and the negative connotations of a demi-professional appear in the latent understanding of the discourse surrounding this perception of radiographer's practice.

4.3.3.4 Team Working & Leadership (meso/ micro)

Whilst exploring the contextual backdrop of radiography, team dynamics and its potential effect on implementing evidence in radiography emerged as a sub-theme including, sub-theme elements surrounding: positive and negative teamwork; professional role boundary, clarity and fluidity, and how generational differences influence the context, in terms of being receptive to change. There were examples of good and counterproductive teamwork as regards evidence-based practice in the data. Teamwork seemed to be most productive when there was good communication in flat hierarchical structures, in which staff seemed to respond to and flourish, and conversely, radiographer teamwork seemed to be less effective when: there was poor team feedback; working with other professionals such as radiologists; working remotely; working in small cliques; and when being managed by a non-radiographer.

A participant explained that they felt that extended-role teams worked effectively (especially when working in advanced roles with medical doctors) when there was no need to resort to hierarchical job titles. This could potentially also have an impact on how radiographers extending their roles are perceived by the public, as essentially when both professions are undertaking a similar role, the differences in background training are not accentuated to influence negatively on patient perception of skill and competence of the radiographer - and the importance people place on titles connected with status, where there was no real effect on clinical outcomes:

Diagnostic Radiographer - England (P#9)

[advanced practitioner mammographer working with a consultant radiologist in clinic]…if they're in clinics together you can't tell the difference…they both work… exactly the same. They support one another…they ask each other questions…there's…apart from the actual job title and a few differences in the role…[you]…wouldn't know that there was any difference between them, they all work really well together

Others felt that collaborative working encouraged a good culture and teamwork ethos, with teams feeling that listening to one another was important as regards to being receptive to new ideas, especially when there is a prevalent skill-mix of competing ideas and skillset, with the notion of encouraging and supporting those who want to improve. Some participants felt that working in teams was actually more robust in terms of delivering EBP.

Diagnostic Radiographer – England (P#6)

…we all work together…there's a really good culture, so…you know…Keen to share knowledge that…you've gained personally…and keen to learn new practice. Being open to new practice and developments.

Diagnostic Radiographer – England (P#7)

…if someone comes forward with anything then it will be listened to. We often…have frequent meetings to discuss things which…was…in a multidisciplinary team, and they have various skill mixes.

Diagnostic Radiographer – England (P#15)

[regarding teamwork & EBP]…the feedback I've had from people above is that the way we do it is better because we do it as a group…rather than just individuals…So, any ideas from anybody within imaging come to it and say, well, I've had this idea… and then we explore it and…

One participant suggested that it was important to consider team dynamics in terms of powerful individuals and that these individuals might still be able to contribute constructively within the team, and needed to be listened to, but needed balancing. Here the notion of 'acceptance' and 'collegiality' of differing personality types as being a necessary ingredient for a successful team, harnessing the 'collective power' for optimising interventions:

Diagnostic Radiographer – England (P#8)

…We've definitely got some stronger personalities, but I think to be honest, if they're right then they make a good point, and if they don't make a good point…there's always people that are going to have different opinions about things, but we generally work around it.

Another salient point arising from the data was a sense of needing to be altruistic within at team facilitating optimal team dynamics and a sense of the 'collective-self' within a team, with non-compliant team members affecting the general team dynamic in radiography. One participant stated the importance of 'team-building' and the notion that this was something that was done casually with social activities, but not necessarily identified as purposely intended:

Diagnostic Radiographer – England (P#9)

…certainly…within our team…if we're the one that's leading for the day…we will make sure everybody else is okay really before ourselves…there is the odd person that's not that way, and…that rubs off on the whole team

Diagnostic Radiographer – Scotland (P#11)

…we unconsciously do a lot of those things that people would say were team building…We've never specifically called it team building…But…we have…a social life outside work that almost, pretty much everyone participates in …

Teamwork was suggested to be negatively impacted within a small specialist radiotherapy team, through disjointed team structures and the inherent impact of funding on the team's ability to work across professional boundaries, to optimise patient services. For example, in a radiotherapy department, where radiographers work very closely with medical physicists, a participant bemoaned the fact that although they worked well as a team, the fact that the physicists were employed and funded through a separate department meant that their resourcing and availability were misaligned as a result, with negative team impact and possible sub-optimal teamwork in terms of implementing new initiatives:

Radiotherapy Radiographer – England (P#3)

[physicists]…they're a separate department…So that's created an interesting dilemma because they're funded differently, so what they are prepared to do and not prepared to do…So with brachytherapy it's very much multi-disciplinary but there's interesting grey areas where…in general we do work really well together but there's also this 'we're not paying for that, you pay for this piece of equipment,' it's all down to that really.

Another radiographer had an issue with a local department, even though it was closer to home, she would rather travel to a department with a more favourable culture and put this down to 'small-town thinking' with stagnation and outdated practice being rife. This seems counterintuitively juxtaposed perhaps with a larger team being 'well-led' by a team leader seeking evidence on behalf of the wider autonomous team, and a smaller team stagnating even though ironically, they might have more freedoms to seek and practice more autonomously, as an individual practitioner?

Diagnostic Radiographer – England (P#17)

it's a really hard place to work…it's actually my local Trust…and I don't want to scan there because the…the atmosphere is just so awful… it's a local, small DGH, you know, in a small town…that the people that have all been there for a very, very long time…and I think things have happened over the years, and things have just festered and…I think they're very set in their ways…

There was evidence that poor team feedback negatively impacted on the local culture, and that feedback in some circumstances was only given by electronic mail, suggesting poor team interaction and coherence, especially when radiographers practice on mobile scanning units, implying a sense of isolation from not being involved in physical team interaction.

> *Diagnostic Radiographer – England (P#8)*
>
> *…we'll generally get an e-mail…if it's good or bad…to tell you about it. If it's something where there's been a complaint made…I know when I was still doing them…you just hear things through e-mails…you weren't going to staff meetings and stuff if you weren't there...*

Others found that there was negative team interaction between radiographers and radiologists, with the imaging team feeling isolated from the medical consultants and feeling that asking opinions and interacting generally was felt to be a wasting the consultant's time.

> *Diagnostic Radiographer – England (P#13)*
>
> *…some Radiologists…think that Radiographers coming to them, asking them questions, is a waste of their time…I know that from my own research, where Radiologists' comments have said that…that Radiographers have commented that Radiologists aren't very approachable…and they're made to feel like they're wasting their time…*

An interesting aspect found was that a few participants said that they felt that being managed by a radiographer, at senior level, was more likely to be effective and promote team acceptance, role development and have a grasp of clinical issues. There was a general feeling that radiography could only be understood by radiographers and therefore good management and team coherence therefore seemed contingent on this:

Diagnostic Radiographer – Scotland (P#1)

…a lot of the problems up here are with management…not particularly being Radiographers…one of our top bosses…I don't know if she really understands the clinical aspect…And then…the other manager is a Nursing Manager…so…different again to the way that we work…

Diagnostic Radiographer – Scotland (P#11)

…our hospital manager was a cook on a fishing boat who became a catering manager, who is now hospital manager, right. And if he was…a listening person that might not be a problem, but…but he's not, and he doesn't know how to deal with clinical stuff…

4.3.3.5 Role Clarity, Fluidity and Role-Creep

Much of the data surrounded the concept of 'where roles begin and end' (boundaries), and the need for radiographers to develop their knowledge and skills to be in alignment with ever evolving patient, technological and service needs. Issues were found surrounding boundary definition; leadership effect on evolving roles within boundaries; the necessary or inevitable fluidity of boundaries; governance surrounding boundary shifting, international perspective and what happens when boundaries are overstepped.

Radiographers generally felt that a team-based approach to agreeing and defining role extension and role boundaries was usual, and this generally involved the professionals and managers in a radiology department:

Diagnostic Radiographer – England (P#12)

[regarding who sets the boundaries]…it's…a discussion between the managers and the Radiologists and the Radiographers.

One participant commented that poor leadership and communication had a negative effect on role boundaries in radiography, culminating in a general lack of support for the team, and sometimes the effect was not just on role extension, but also on the effectiveness of radiographer autonomy, due to stifled roles and imposed boundaries, serving to restrict practice and becoming a source of conflict within teams:

Diagnostic Radiographer – England (P#15)

there's a lack of…communication and a lack of leadership, lack of clarifying roles….Lack of support…a lot of the time.

Diagnostic Radiographer – Scotland (P#16)

…there's…definitely boundary issues with…lack of understanding between the terms 'management' and 'leadership', and…where we see our modality leads, they're…restricted in the roles that they can do from middle management…

The concept of 'role boundary and fluidity' emerged as a sub-theme element of the radiography context, in terms of comments from multiple participants relating to the necessity for radiographers to evolve their roles to suit locally agreed scopes of practice, not only in terms of service need, but also in terms of what could be agreed in collaboration between local professionals and management. Practice boundaries were seen to be localised to individual departments, with the latitude of scope evolving as required for local service delivery requirements, with a consequential effect of possible lack of 'scope of practice' standardisation nationally within the profession. There was also an altruistic consciousness in a particular team that radiographers would be content not to develop scope or cross certain role boundaries when there was a need to train others e.g., radiology registrars (medical staff):

Diagnostic Radiographer – England (P#10)

…we're in the process of setting up some new services at the moment…I think when you're setting those services up it can sometimes be quite difficult to work out where the boundary is…in getting those guidelines in place, but I think that's part and parcel of a new service.

Diagnostic Radiographer – England (P#20)

INT:…Who do you think defines that role? Is it the profession or is it another profession?

RES: It might be a mixture of both to be honest…so, there's only three Radiographers work in our department, and I don't think any of us would be looking to expand our role clinically…certainly not beyond what it already is, just basically scanning and cannulation…And also, because we…get a lot of registrars training here, so I don't think there's any need for us to expand either…because of that.

There was also a sense within the data that some participants saw role extension, and development, in terms of role-boundaries being 'ring fenced' within a framework of guidelines constraining practice. Their perception however was more about professional 'self-protection' rather than 'constraint', with practitioners not stepping over the boundary being consequently legally protected should things go wrong. Interestingly, radiographers regarded the 'consultant radiographer', by definition, as having more independence (within the system) and being able to act more autonomously, with implicit wider latitude of practice, and perceived less likely to be challenged legally when things go wrong:

Diagnostic Radiographer – England (P#5)

…unless you've got a radiographer at a consultant level…there is still that they are working within a sort of more defined role. Unless you know…as long as they're acting within guidelines, they're covered, and the guidelines once perhaps you get to a consultant radiographer level then perhaps more autonomous than individually responsible…

Participants generally understood the need for role development and felt that effective governance was key in promoting extended roles and defining role boundaries. Clearly defining the new role and ensuring that this was communicated was seen as key by one individual, as well as ensuring that standard operating procedures and supporting documentation was in place, also ensuring updated practice such as drug administration (beyond the traditional role of the radiographer), facilitating a more patient centred service:

Diagnostic Radiographer – England (P#10)

…As long as the governance structure is there to support it…And that everyone knows exactly what that role is.

Diagnostic Radiographer – England (P#12)

…we've got our standard operating procedures, we've got examination protocols and guidelines. We've got the additional documentation to support the use and administration of...medication, so like antispasmodics during procedures. And we regularly go on clinical skills updates just to make sure that we are all…still maintaining our competencies in these [extended role] areas.

Participants were also acutely aware (as they developed their advanced knowledge) of the need to understand the boundary location and to constantly guard against 'overstepping' the professional boundary in terms of acting beyond their knowledge and skills envelope, and professional background, with an appreciation that the extended boundary area occupied by radiographers, might mean that they were not fully aware of the full body of clinical knowledge that a medically trained person might have:

Diagnostic Radiographer – England (P#12)

…I can appreciate now that… the more I have studied…I realise…I have got a different background, there are things that won't occur to me because I haven't got that medical background

The lack of knowledge surrounding existing and extended roles within radiography in the eyes of the public and other professions, was discussed earlier, however this sub-theme element also emerged in the practice boundary domain. One participant suggested that there needed to be much more clarity regarding the role of the radiographer and that role boundaries needed to be sign posted and promoted to give system confidence, in the developing roles:

Diagnostic Radiographer – England (P#18)

…I don't think they're very clear… I think there needs to be more clarification about …who we are and what we do…and our levels of responsibility. And what the difference between extended scope of practice is, extended roles, and new roles, like the Consultant Radiographer, where there's…lot more responsibility of being in a consultant role.

Practice boundary was also conceptualised by some individuals as being a line that if crossed would result in disciplinary action or the individual would not be supported by their manager. This seemed to be an area of practice that radiographers seemed to view as a 'grey area' in which one might not be able to control the system's response to extended scope actions, especially if they were deemed to be questionable or the subject of misadventure or complaint, and only the most confident radiographers would take on new roles for this reason:

Diagnostic Radiographer – Scotland (P#14)

….when things go wrong…you've probably overstepped the boundary…And I sometimes feel that the backup you get from your manager is not what it should be…they don't really…support your staff

….the junior staff are very worried that if they misinterpret [practice boundaries in protocols]…And I think there's pretty much an even split between the Radiographers who are keen to take that responsibility, because they're confident in their own practice…and Radiographers who are less confident and…a bit more wary of the 'what if?', and so it's always a difficult one.

One participant noted the importance of conceptualising role boundaries not necessarily within a profession but also beyond traditional roles, for example into the wider scope of a 'generic' healthcare professional, able to give sound health advice beyond traditional confines of medical imaging or treatment, however she did feel that radiographers were being 'pressurised' to undertake this role:

Diagnostic Radiographer – England (P#19)

... it's exploring its boundaries and seeing what happens and…there's a kind of pressure…to…do a bit more empowerment with Radiographers and try and get them to extend their role a little bit…more…, just more…cultural understanding and…public health awareness…and all that sort of…having their roles extended in that way, with the patient engagement on that side.

The concept of 'role-creep' was mentioned by more than one participant in relation to practice boundaries, and the importance for radiographers to guard against being pressurised or pushed by service need to widen practice scope, thus crossing a 'comfort boundary' without correct training:

Diagnostic Radiographer – England (P#12)

…going into the remit of fluoroscopy…they're quite keen to say oh, yeah, well you can do this, therefore…what I want you to do is not that dissimilar. So, there has been pressure to extend my role outside of…the GI stuff

4.3.3.6 Generational Issues

A generational sub-theme element was evident in the data, where younger, less experienced radiographers seemed more open to change, and expected change as a normal aspect of professional practice, whereas the older generation seemed less receptive to change, especially those in the more established areas of the profession e.g. conventional radiography, which was perceived as having reached its zenith and therefore a 'barren field' for progress as discussed earlier. There was much respect for the previous generation of trained radiographers, in that their knowledge of clinical practice was recognised – however the perception was that they were contented in their role and did not see the need for change, or felt uncomfortable with implementing change:

Diagnostic Radiographer – Scotland (P#1)

…I work in quite a young department, which is a very good thing because the staff are beginning to look at moving forward...before…I worked in a hospital where there wasn't a lot of younger people… and they were happy just…doing what they'd done previously without thinking about how to change it…I think it's… 'I've done this for so long…why are we changing it?...Is this going to make everything else change?'

One participant noted that implementation was sometimes better received once someone else had implemented it and shown the need for change supported with appropriate training, but there still seemed to be more of a reluctance amongst more established staff:

Diagnostic Radiographer – Scotland (P#1)

…they have been okay with the change once it's been implemented… and they've got the training and they understand it. It's just that fear of change…I think it's more of the implementation thing, because there's…a lot of the older Radiographers are…hugely trained, I mean they know more than the vast majorities of Radiographers…so, they do know what they're doing…

Diagnostic Radiographer – England (P#15)

…a lot of our Radiographers who actually want to do some sort of project, you know, something for CPD, have just…they're not that long out of university, so they're aware that everything has got to be justified in evidence…and that's what drives it really…some of the older Radiographers will just…happily say we're going to do it that way…

Diagnostic Radiographer – England (P#15)

…an uphill task with…a lot of the older Radiographers…[accepting]…why we wanted to change it…and…what evidence we've got.…The best way that myself and my colleagues saw to do it was…by…showing them…the evidence…there was in the radiograph…[clinical demonstration].

Other participants saw generational issues in inter-professional team-working contexts, where the newer generation of radiologists were more approachable and there seemed to be fewer barriers in terms of status and elitism. There was a general feeling that younger radiologists were more open to relationship building and role development by radiographers:

Diagnostic Radiographer – England (P#7)

…it's…improving, the two-way communication, and…certain generations are much better…the newer cohort of radiologists are much more amenable and proactive in building bridges and communicating with peers and colleagues around them. Whereas, say, ten years ago that wasn't always the case with doctors that I've worked with.

Diagnostic Radiographer – England (P#7)

Well, it's just the…manner of which…verbally communicated between colleagues. So, we could...mention, or as a question to…a younger doctor and they'll be willing to give you an answer, they'll explain it, they'll give you time, whereas…in my experience, sometimes with the older generation, they've just either ignored me (laughs), or just been so blunt and rude that's…made me reluctant to ask them questions again

Some participants felt also that the demeanour of younger radiologists towards radiographers was influenced by the radiologist that they were being mentored by in terms of learned behaviours, and their acceptance of local norms in attitudes towards the radiographers, with a general feeling that older radiologists passed on prejudices of the previous generation in terms of scope of practice, and were against radiographers crossing the boundary:

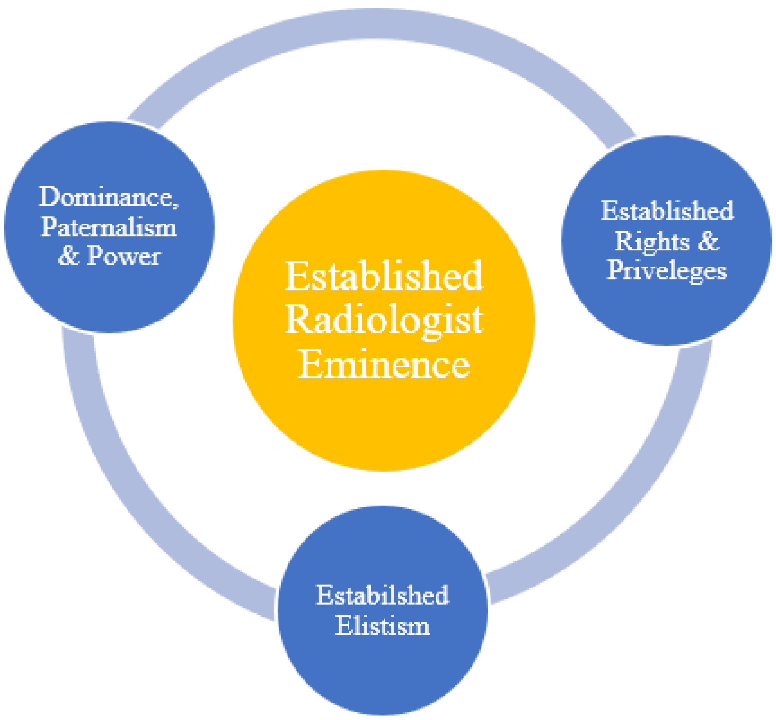
Diagnostic Radiographer – Scotland (P#1)

…the Reg's…are guided by their consultant...depending on what Consultant they get…kind of leads into how they think about us…[radiographers].…They're all very aware of our technical ability…to take an x-ray and that's that….And I think…they're very against us doing what they see as the main part of their job…

4.3.4 Theme 2 Established Radiologist Eminence

Theme two (Figure 22) reflects the pivotal role of the (Consultant) radiologist in the radiology department and how their established rights and privileges leads to dominance, paternalism and power over the radiology service and the radiography workforce. A sense of elitism pervaded the data with a sense of societal expectation of privilege and command over the whole radiology service.

Figure 22 - Theme 2 - Established Radiologist Eminence



4.3.4.1 Established Rights and Privileges

Participants felt that radiologists did not like to have their professional opinions challenged by radiographers, and they also felt that radiologists seemed to have a right to 'case ownership' and take ultimate responsibility for patient outcomes. Examples in the data seemed to directly affect patient care in the opinion of some participants, with resultant friction in the team:

> *Diagnostic Radiographer – England (P#17)*
>
> *…Radiologists do not expect to be challenged in any way…and I have gone in with referrals that…had been protocolled incorrectly or…you know, didn't think that… the giving of...[IV contrast media]…was justified… and they've been absolutely…surprised that…that I've come in and…questioned…you know, is this really what you want?*
>
> *Diagnostic Radiographer – England (P#18)*
>
> *[regarding a radiographer's decision to recall a patient for additional imaging]…It just creates bad feeling. There have been actual…arguments…it is not right in a professional environment…actually arguing…and…we've had…Radiologists saying well, I'm the one in the hot seat, I'm in charge today, so…my name goes on there and…I'm not bringing it…[the patient]…back.*
>
> *Diagnostic Radiographer – England (P#5)*
>
> *…because ultimately, they…[radiologists]…feel that the patients are theirs, they have responsibility for them.*

One participant felt that radiologists saw themselves as being more professionally accountable than radiographers:

> *Diagnostic Radiographer – England (P#5)*
>
> *…[regarding role extension]…maybe this belief that they…[radiologists]…are ultimately professionally responsible, or more professionally responsible than we…are for all patient outcome[s].*

The data also seemed to suggest that radiologists had the right to relinquish roles as they so decided, and participants felt that they tended to pass down old roles to radiographers which were less desirable to perform. There was also evidence to suggest that radiographers felt that radiologists had a right to financial incentives, such as waiting list initiatives, and for this reason held onto roles (that could otherwise be relinquished to radiographers) for financial gain:

Diagnostic Radiographer – England (P#12)

…Certain Radiologists are very supportive of enhanced roles and extended roles. I think it comes from the [fact]…they want to do the fun stuff, let's…try and get somebody else to do the…either the messy stuff or the not quite so fun stuff…

With others only relinquishing roles only if there was no financial disincentive (radiologist's rights to riches):

Diagnostic Radiographer – Scotland (P#1)

[regarding reluctance to relinquish chest radiography reporting]…a couple of them just are trying to protect themselves…From what I know from working here, a lot of their overtime is reporting chest x-rays…I think it's maybe a monetary thing behind it.

Participants suggested that radiologists might feel challenged or have a sense of insecurity in that other professions seemed to be diminishing their roles:

Diagnostic Radiographer – England (P#18)

…there is a certain amount of professional jealousy where Radiologists are concerned, and they do feel threatened…by Radiographers coming in and taking on what were traditionally their roles.

4.3.4.2 Established Elitism

Participants discussed how radiologists had ultimate autonomy and authority in their eyes, with a monopoly on medical knowledge, and being able to control knowledge sharing with other professions such as radiography, with some participants feeling that this was not always in the interest of the patient:

> *Diagnostic Radiographer – England (P#7)*
>
> *…there's always a bit of...knowledge is power…they're slightly reluctant to do that [regarding sharing workload with other professions]…And my colleagues have experiences with certain doctors who have been really obstinate and obstructive in [the]…learning [of others].*
>
> *Diagnostic Radiographer – England (P#18)*
>
> *…it's never a consensus…you know…even when…it's sort of played out as if it is a consensus, at the end of the day…basically, the Radiologist who is in the sort of controlling position…will have their way, whatever it might be.*
>
> *Diagnostic Radiographer – England (P#18)*
>
> *Unfortunately, it's a traditionally held attitude, that nobody in the world could possibly be as intelligent or as knowledgeable as a doctor is…*
>
> *…I do think that the patients go to the bottom of the list quite often…a lot of it's about power, position, money, and…increasing their own position and power by the way they manage other people*
>
> *Diagnostic Radiographer – England (P#4)*
>
> *…it's basically, I'll do what I like and that's it you can't…stop me*

One participant felt that medical ego could sometimes remove the focus from patient centred care, hinting that dominant characters tend to seek medical practice:

Diagnostic Radiographer – England (P#5)

…a lot of it is a power game…which is ridiculous when everyone should have the patients first. But they…[radiologists]…certainly appear to be more egos within the medical profession, but that gets them where they are maybe…?

Participants felt that radiologists often protected the inter-professional boundaries but acknowledged that radiologists might be apprehensive about relinquishing roles, giving rise to professional rivalry and snobbery, based on their own beliefs that quality standards might be diminished, even though radiographers felt the evidence was compelling in favour of role advancement. Where radiologists did relinquish a defined caseload – this was within a prescribed narrow field – with radiographers feeling the scope of their practice was constrained by another profession, and feeling that protectionism had a strong influence:

Diagnostic Radiographer - England (P#7)

…radiologists are stuck in…hierarchical ways…they don't want to share the workload, they don't feel it will be done to a good enough standard, so they're very reluctant.

Diagnostic Radiographer – Scotland (P#16)

…Radiologists…just are set in their opinion that no, we've got defined boundaries between a Radiologist and a Radiographer…for years and years I've been asking to do MR[I]…reporting and it's been a resounding 'No' from the Radiologist, that it's not going to happen.

Diagnostic Radiographer – Scotland (P#1)

[regarding radiographers reporting chest radiographs]…there's a few Radiologists…that are very much against it. Our Clinical Director is a specialist Chest Radiologist…he just blocks it and rules out any respiratory at all

Diagnostic Radiographer – England (P#18)

…I've a sneaky feeling…there has been a tendency to blur things…a…bit in order to stop Radiography…becoming…more creditable if…you like…as a career pathway.

Diagnostic Radiographer – England (P#13)

…I suppose with all doctors you have…you have professional snobbery…with some of them you definitely don't; …I'm keen not to generalise and say that all doctors are guilty of professional snobbery, because I'm sure they're not, but I'm sure we've all come across individuals who are…and think that they're better than non-doctors.

4.3.4.3 Dominance, Paternalism & Power

The data broadly reflected a sense of participants being frustrated by the perceived 'systemic power' of radiologists to consent or deny another profession's right to extend their practice boundaries and the concept of 'acting under a feudal banner of a ruler' – however this was tempered by some participants feeling that this was not necessarily malicious, but rather a paternalist tendency amongst radiologists to protect radiographers from extending their roles inappropriately:

Diagnostic Radiographer – England (P#5)

…there is a belief that we are… acting still under the banner of the radiologists, we are 'allowed' to report, we are 'allowed' to…[by consent of radiologists]

Diagnostic Radiographer – Scotland (P#1)

I think there's probably a bit of an issue with certain…medical staff allowing change to happen

One participant felt that because radiologists often don't fully understand the professional background of the radiographer, they tended to obstruct change:

Diagnostic Radiographer – England (P#13)

I think you get these pockets of…[NHS]Trusts where…the Radiologists don't see any evidence that Radiographers can go above and beyond just taking the images, therefore…they don't get to see the good practice that Radiographers do, and they tend to hold certain areas back.

Another participant felt that hospital politics meant that radiographers would be consulted informally regarding service change, however hospital management (macro) would see the radiologist as decision makers:

Diagnostic Radiographer – England (P#5)

[regarding management intitative to implement a new service]…unofficially they would come to the radiographers and then officially go to the radiologists…it's still very political and so the approach would have to be done delicately, which would mean getting the right people on board and there's no point…you've got to recognise who's got the power and the people with the power would be the radiologists – if they want to obstruct it.

A participant felt that radiographers often were more skilled in certain areas of clinical reporting (supported by audit evidence) rather than radiologists locally who relied more upon their status for credibility. She felt her clinical skills were often overshadowed by the radiologist when 'rank was pulled':

Diagnostic Radiographer – England (P#18)

…we receive our audited results about how good we are at our film reading, and we're…not too bad at all…we're probably better than the Radiologists; there's some really bad Radiologist film readers…But that is not taken into account when we do things like our consensus meeting, where we decide what patients need to come back for assessment, because, of course, then rank is pulled, and the Radiologist gets the last say as to, you know…it's supposed to be a consensus…it's never a consensus.

One participant linked the power of departmental culture and understanding the drivers for role extension as strong influencing factors on the ability of radiographers to implement evidence based extended roles, and linked this to paternalism:

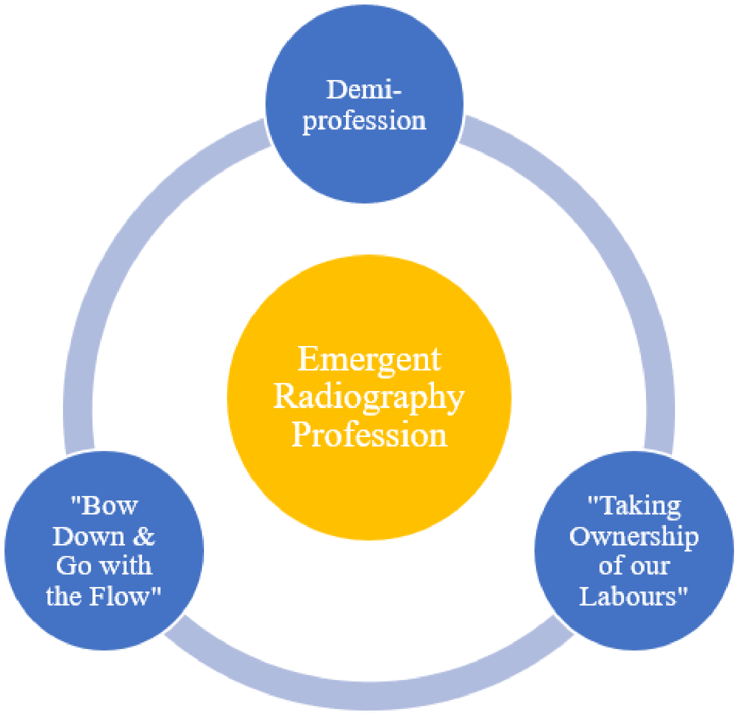
Diagnostic Radiographer – England (P#5)

[regarding removing professional barriers]…I think it depends on the…culture of the department…and what the drivers are…So if you've got a culture…which is, patriarchal, you've got this…radiologist…that don't believe that anybody who hasn't got the medical qualification can do something, then that's what's going to be resisting.

4.3.5 Theme 3 Emergent Radiography Profession

The third theme (Figure 23) represents the juxtaposition of professional apathy and reluctance, to that of radiographers pushing boundaries, breaking out of old ways of working and thinking, into a new environment of earned professional autonomy and recognition.

Figure 23 - Theme 3 - Emergent Radiography Profession



4.3.5.1 Bow Down and Go with the Flow

Some participants either exhibited a sense of apathy regarding their roles or of having a culture of being comfortable with diminished roles, and others exhibited disillusionment with their colleagues for having this attitude. Others exhibited a reluctance to develop extended roles, sometimes linked to poor morale.

Diagnostic Radiographer – England (P#13)

…there has been a push from some Radiologists…so, 'well you could do a nephrostogram'…[interventional procedure]…as well, 'we just need to check it's in the right place'…and I'm actually saying oh, no thank you…because I'm not covered.

Therapy Radiographer – (P#4)

[regarding other professionals implementing new technology in radiotherapy]…I felt uneasy as a radiographer…here we are basically relying on other professionals to help us do our job

Diagnostic Radiographer – England (P#5)

…there were some staff…[radiographers]…who didn't feel that we should be taking on extra responsibilities, and very much deferred to doctors

Diagnostic Radiographer – Scotland (P#1)

[about radiographer colleagues]…I think they just want to go home and forget about their work…

In this regard a participant felt that sometimes colleagues felt so disillusioned with their circumstances e.g., antisocial shift patterns, that what could otherwise be interpreted as apathy, in terms of lack of enthusiasm in their work, was more to do with morale and working conditions:

Diagnostic Radiographer – Scotland (P#1)

…I don't think it's apathy, I think it's…probably just had enough a lot of the time…some of the time they feel quite downtrodden…their shift pattern is brutal because…staff retention is really bad…they're always working at a much lower capacity than they should…

There was evidence that radiographers, culturally, exhibited low self-esteem, and one participant's account suggests that this could be linked to an enforced culture where other professions (such as radiologists), overshadow, and determine how radiographers should act in their day-to-day work. This was exemplified in the way radiographers talk about themselves, however some participants did try to discourage this behaviour amongst their colleagues, despairing that many 'bow down and go with the flow':

Diagnostic Radiographer – Scotland (P#16)

…the culture I see within Radiographers…every day I will hear a Radiographer say… 'I am just a Radiographer'…and I say to them don't say that…we're not just the Radiographer, we are the Radiographer.

And a comment by one participant gave a latent insight into a radiographer's own interpretation that 'just taking the images' might be an inferior role professionally:

Diagnostic Radiographer – England (P#13)

…the Radiologists don't see any evidence that Radiographers can go above and beyond just taking the images…

Diagnostic Radiographer – England (P#18)

[on being submissive]…I don't personally…I'd be quite happy to have the argument with them…but there are many of my colleagues who just bow down and…go with the flow…

Another manifestation of low self-esteem was shown by a participant who felt that because of her background, and perceived differences in training compared to medical staff, that certain situations would not 'occur to her' in advanced roles:

Diagnostic Radiographer – England (P#12)

…the more I've…studied…,I'm…consciously aware…of,…I have got a different background, there are things that won't occur to me because I haven't got that medical background…

A participant saw a clinical-technical divide between radiographers and radiologists – and did not reflect that radiographers are clinical practitioners in their own right:

Diagnostic Radiographer – England (P#6)

…there's…the age-old radiographer and radiologist…thing…There is that sort of…we have the technical knowledge, whereas they have the clinical knowledge, and it's trying to share what's best technically and what's best clinically…there's two different things isn't there…and…I suppose,…because we're always trying to bridge that gap between technical and clinical.

Another participant felt that generally in her experience, clinical radiographers on the 'shop floor' were generally lacking in confidence in seeking evidence in literature, and disseminating evidence in the workplace, and feeling that this is not a skill that radiographers feel at home with or to 'wear the hat naturally':

Diagnostic Radiographer – Scotland (P#11)

…people are…not very confident…in terms…of…very practical questions…as soon as she was put in that spot of having to talk about it she…lost…her ability to think sensibly…because she was…nervous…and thinking…'now I need to…put some hat on that's not my natural hat'…and therefore,…'I need to go and look at papers and do things I'm not very comfortable with'…

One participant felt that radiotherapy, as a branch of radiography, was eclipsed by the larger subdivision of diagnostic radiography, suggesting intra-professional tensions:

Therapy Radiographer – England (P#4)

…it's definitely inherent in the profession…because I'm a radiographer of over 30 years' experience…I still regard radiotherapy as in the diagnostic shadow

One participant, reflecting on the reliance of the radiography profession on another profession for their body of knowledge and interpretative skills, showed insight into the entanglement and transition of the radiography profession from being reliant on radiologists, as they extend their roles into what was traditionally the radiologists', and showing the need for further education so that radiographers can educate themselves in the future and not rely on doctors for this:

Diagnostic Radiographer – Scotland (P16)

…we need to have less reliance on Radiologists as mentors….If you go…to…university you still need to have that Radiologist mentor…is there a way around that[?]…we…need less Radiologist mentorship to still produce competency in reporting…skills?…Perhaps…as…more…move…towards…master's…or…consultant …[radiographer]…practitioners, then they can be the mentors…and then…that would facilitate that more.…We're not quite…there yet, because we're not self-sufficient, we're relying on Radiologists.

Another participant felt that although radiographers were at the patient-technology interface, and made decisions regarding radiation dose optimisation, that radiologists still had a responsibility to oversee their practice, and take some responsibility for radiographers' actions:

Diagnostic Radiographer – England (P#19)

…we're the ones…that are actually…exposing that radiation. But if we haven't got the support and the guidance in the Radiologists then…[we]…probably can't fully take the blame ourselves.

Professional obscurity was shown earlier, in theme one, relating to public nescience and other actors being unaware of the role of the radiographer more generally. An interesting example of the lack of knowledge of a radiographer's role at a personal level was given, whereby a radiographer's husband, being medically trained, was also ill-informed regarding the profession:

Diagnostic Radiographer – Scotland (P#16)

… a family member who is a…doctor, and he'll ask me something and then he'll quite often then say 'Oh, I wouldn't know you would know that' or…then he's asked me to come in and speak to…to his fellow registrars. So, you know, they just…they just don't understand what we do…

A participant indicated that she felt doctors were generally more naturally dominant personality types, and non-medics (radiographers) tended to be more passive perhaps by selection or lack of ambition or ability?

Diagnostic Radiographer – England (P#18)

INT:…do you feel that those who aren't medically qualified…do you think…we're submissive? Do you think we allow them to do it?

RES: Yes, I think we do….I don't personally.

Diagnostic Radiographer – England (P#18)

…And being surrounded by, you know, groups of very loyal sycophants who are willing to…to say yes sir, no sir, three bags full sir all the way down the line.

4.3.5.2 Demi-Profession

On a personal level, one respondent was frustrated with her colleagues' 'vow of silence', in that generally, in her eyes, radiographers feel that they should not show or tell the patient anything regarding their imaging procedure, or give out a professional opinion:

Diagnostic Radiographer – England (P#17)

…we run a mobile scanner, people[patients]…come out and quite often their images are still on the screen…[they ask]…can you tell me anything about my…you know, can you tell me anything? ...'Oh no, I can't tell you anything', and…it makes a bit cross.

When participants were asked about their experience of having 'clinical supervision', many were either unaware of the concept of clinical supervision (as a structured reflective process) or misunderstood this to be supervision in the workplace by senior staff. There seemed to be a general lack of appreciation of its benefit, in terms of developing reflective practice, and of having regular supporting sessions with an experienced practitioner, however there was a feeling that this would be a worthwhile supportive activity if it could be implemented:

Diagnostic Radiographer – England (P#6)

INT:…Have you heard of the term clinical supervision?

RES: Yes…It's not something we do…when you sort of…well, clinical supervision,…you think about…as I understand it, would be someone shadowing you and seeing sort of how you practice…

Diagnostic Radiographer – England (P#12)

…And when I was on maternity leave, the first thing I had to do when I came back from nine months off was…have supervised practice…to prove that I was still competent…

Therapy Radiographer – England (P#4)

INT: Can I ask your thoughts about 'clinical supervision' as a formal entity?

RES:…In other words - you are sort of, in a sense supervised by somebody higher up?

INT: …I was thinking more in terms of a system by where there's mentoring and support on a regular basis for individual radiographers and come under the term 'clinical supervision.'

RES: Ah…that would be brilliant. If that could be done.

An participant felt that 'clinical supervision' would be advantageous for reflective practice, however felt that barriers to implementation would be due to lack of resources, due to large teams and workloads, and that radiographers would need to view it positively as a peer-support process, rather than a top-down command and control review of performance:

Diagnostic Radiographer – England (p#5)

…I am very keen on…coaching, mentoring, within the department… if you spend time with people on a regular basis you can help them just deal with challenges that they might have on a day-to-day basis.

[resources]…I've got 20 members of staff and even if I wanted…it's a realisation that I can't do it all…

[team receptive to clinical supervision]…yes, because it's everybody, it's not just a hierarchy thing, it's just supporting people in that practice…I don't think they would be quite so keen if it was seen just as a very hierarchical thing because we are quite a flat team really…

Another participant found that a newly implemented performance review (PDR) system in her Trust had become a 'value for money' tool for employers to see if staff were pulling their weight, viewed negatively by staff:

Diagnostic Radiographer – England (P#9)

RES: [regarding performance indicators]…those are in our…in our…PDRs.

INT: So, they grade your potential?

RES: Yeah…they'll basically say whether they think you're working…working at your appropriate level or you should be doing more.

INT: And they use that as a tool, do they?

RES: Mmmm…!

There was a general impression amongst participants that radiographers without extended scope or advanced practice duties, needed to rely on, or follow protocols within their practice rather than develop or produce protocols as a fully autonomous practitioner might otherwise do implementing EBP. Also, the concept of 'making decisions' in advanced roles rather than following the 'decisions-of-others' in general radiographer roles gave a sense of demi-professionalism and reduced autonomy in radiographers without extended scope of training and practice:

Diagnostic Radiographer – England (P#5)

[regarding standard radiography practice]… they are working within a…more defined role…as long as they're acting within guidelines, they're covered, and the guidelines once perhaps you get to a consultant radiographer level then perhaps more autonomous than individually responsible…It's the nature of the work that they are doing I think it's the extended role and their reporting…they have to be making decisions rather than following set guidance maybe I don't know.

Another example of a participant's interpretation of knowledge use in radiography is illustrated by a radiographer's perspective, even though she had academic skills to research and implement evidence for practice, in the practice setting, it is the case that radiologists define the knowledge to be used (or implement) and radiographers apply that knowledge in practice:

Diagnostic Radiographer – Scotland (P#16)

RES:[Regarding evidence use]…that's a tricky question because, if I'm talking about it from academia then I would do it myself… I know how to do that through my master's education…but I don't think that applies to clinical…that that's not the way that we'd do it in clinical. In clinical practice we do it because a Radiologist tells us to.

INT:…So, Radiologists would…would seek the evidence and then…ask the Radiographers to implement it?

RES: Yeah.

A participant stated, that in their opinion, there was a stigma attached with research generation and seeking in clinical radiography that perpetuated from a negative experience at university. Others found that although they were involved in implementing clinical guidelines locally that radiologists needed to sign off the protocols, and that they were the ultimate arbiters, and could block clinical protocols if not in agreement with the radiographers, with the radiographers not ultimately being in control of evidence selection, and a general 'lack of vision' by the profession to undertake research in a clinical role:

Diagnostic Radiographer – England (P#13)

…Radiographers should be involved in research…but the stigma attached…to research when it comes to Radiographers, I feel most of this down to a poor experience at undergraduate level, it certainly was in my case…[it]… just leaves a sour taste of research in a lot of people's mouths which, unfortunately, persists into their career

Diagnostic Radiographer – England (P#19)

…[clinical protocols]…have been out of date for a number of years, and it's impacting…qualified Radiographers coming in, because they're sort of struggling…[s.l. with best practice guidelines]…and reassurance of what to do and stuff…And they have…written…new ones…but there's a big blockade…because of the fact that Radiologists need to sign them off and they're not in agreement with them.

Diagnostic Radiographer – England (P#10)

…We do have audit running within the department, but most of that seems to be led by our Radiologists.

Another participant found it difficult to get the research he was undertaking published due to, what he perceived to be, an unrealistic expectation of the standard required from clinically practicing staff, in terms of material of publishable quality, and he also felt that therapy radiographers were overshadowed by the larger (diagnostic) branch of radiography, and that radiography trailed behind other…professionals, in terms of research output:

Therapy Radiographer – England (P#4)

…I think…people see it as hard work and they don't know if they would get anywhere…virtually no encouragement to do it. I think there's no vision for that sort of thing…vision is a word I would use…I think it's definitely inherent in the profession, because I'm a radiographer of over 30 years' experience, I still regard radiotherapy…tend[ing]…to tragically trail behind doctors, physicists, and others in publishing stuff….

There was a sense in the data that radiographers, although with training in evaluating image appearances, felt uncomfortable giving ad hoc advice to medical staff outside radiology (for example in giving an opinion on a likely diagnosis to a surgeon).

Diagnostic Radiographer – Scotland (P#11)

[regarding remote island practice without a radiologist]…we probably step out of our role much more, and it can be difficult knowing whether you're doing the right thing or not…I spend a lot of time saying 'Well, it's that, but wait 'til the radiologist tells you that'….And, of course, sometimes I'm wrong….But there's a bit of a conflict between your actual expertise and you're sort of authority and your qualification…you have more expertise than is acknowledged…

Another participant felt that even though she had achieved good audit results in her extended role and practice, and undertook an almost identical role in the clinic - that there could never be equality with a medical consultant within the system:

Diagnostic Radiographer – England (P#18)

…your skills are good and your audits are good, then why on earth wouldn't that be taken into account when we're treating the patients?

One participant (who also had an academic post) felt that to be truly accepted within the system as regards to advanced roles, and to have 'equality of opinion' with medical staff, higher academic training was required for radiographers to have more credibility, even though this might have an effect on the quality of the clinical report, the recipient might have more confidence in those with higher qualifications:

Diagnostic Radiographer – Scotland (P#16)

…think it would improve acceptance because…certainly our PhD Reporting Radiographer has…[sl. higher standing]…than those who…who are just PgC…and I do completely agree that Reporting Radiographers…to be advanced practitioners should be working towards their Masters…and it's just about trust.

4.3.5.3 Taking Ownership of our Labours

There was overt and latent evidence in the data that the radiography profession was being 'liberated' and finding its way to greater autonomy and self-confidence, with advancing roles, developing a knowledge base, a sense of developing trust amongst associated professions and increasing evidence to support the efficacy of non-medical practitioners in delivering health interventions and diagnostics, facilitating new practices, evidence generation and use:

Diagnostic Radiographer – Scotland (P#16)

…it's…about trust…it's…about…[radiologists]…getting to know us, our team of Radiographers as reporters, and then…[other professions]… getting to trust…that, and then…they would happily work with us.

Diagnostic Radiographer – Scotland (P#16)

INT:…Do you think it's appropriate that one profession is the gatekeeper for a particular skill…[of another]?

RES: …No, it's not…It's absolutely not…we're not dependent…in that case, we're not dependent on Radiologists as a whole. I was dependent on our Radiology team, and one Radiologist in particular…so, it's just been really…one, or a very small group of people that have held back on…reporting…[locally]

Diagnostic Radiographer – England (P#12)

…[regarding potential concerns about the accuracy of radiographer reporting]…No…I have no concerns for that whatsoever. Because even with the 'red-dot' scheme that we operate in our hospital [abnormality flagging], we are working at a 95% sensitivity, specificity, and on accuracy.

Diagnostic Radiographer – England (P#18)

[regarding empowerment of extended roles]… I think as long as the back-up is there to show that the skills and the knowledge are equal…then there should be equal…empowerment to…be part of the decision-making team…

There was evidence of some radiographers taking control of their own destiny as a professional group, liberating professional practice in certain areas by claiming ownership of their professional rights, embracing their autonomous status, and nurturing this within a framework of governance, advanced knowledge base, analytical skills, and a contextual drive for maintaining service delivery, with ever increasing skills shortages in the workplace. The pivotal role of advanced practice radiographers in pushing boundaries and developing autonomy to a level worthy of consultant radiographer practice, indicated that these appointments had made a significant contribution to maintaining services at a time of skills shortages in radiology, whilst facilitating the adoption of new evidence and technique.

One participant, who was an advanced practitioner (consultant radiographer), felt that radiography as a profession, needed to improve its own confidence, and as a professional group move away from having to over-emphasise the need for continual role justification, not seen within more established roles such as the radiologist:

Diagnostic Radiographer – England (P#12)

…some of the barriers are possibly of our own making…I think, like any…extended role, we're continually having to justify ourselves and show that we are continually developing as a professional…and we have to justify our decisions so much more, whereas I think Radiologists, the culture is oh, they're a doctor, they must know best…

Another participant could see the benefit of role expansion in radiography and the concept of pushing forward boundaries, with extended roles becoming the new norm in clinical practice:

Diagnostic Radiographer – England (P#7)

…Practice boundaries; so, again its… changing slightly because you see articles…about radiographers doing things that traditionally used to be led by consultants…such as…reporting, interventions, the radiographers are putting in PIC lines and the kind of fistulograms. So, I think it's…blurring, again, those boundaries…but, again, I think…it's beneficial to both service and patients.

An example occurred in the data, of a radiographer who had advanced to the role of consultant radiographer in his hospital, to widen leadership and take 'ownership' of the whole conventional radiography reporting service, as a fully autonomous entity, independent of radiologist involvement, and appeared to be established within a strong framework of governance and national support:

Diagnostic Radiographer – England (P#13)

I'm the only Consultant Radiographer… I am in charge of the whole of the Trust's plain film workload…I report all areas of plain film, MSK, chest, abdomen….I am a member of the Reporting Radiographers Advisory Group, one of the founding members[of the group at the SCoR]. I'm…involved in research; I've had a few peer reviewed journal articles published over the last few years. I completed my Masters in 2016. I teach at a couple of local universities, I mentor, I have a mentee.

Diagnostic Radiographer – England (P#13)

…I want to be involved in education, and research, and teaching, and leadership, and all…service development. So, I probably put that pressure on myself.

One participant found that service pressures and demand for more imaging and diagnosis in radiology nationally, was now helping support role advancement and autonomy in radiography, and had wider acceptance with radiologists:

Diagnostic radiographer – England – (P#19)

INT: in terms of…you said 'push', where does the push come from do you feel?

RES: Just demand isn't it I guess…Servicing the needs and stuff….

INT: Would that be…from a lack of resources perspective, or lack of trained staff?

RES: Both.

One participant felt the lack of time and conventional working methods had an effect of hiding or silencing the role of the radiographer from the public, and felt that the profession and the patient would benefit from radiographers taking ownership of their work and viewed imaging as creating images with a suggestion of artistry:

Diagnostic Radiographer – England (P#17)

RES: [I]…show…an…[MRI image to a patient]…But, you know…it's…a time constraint as well because we clearly don't always have time to be doing this…and…that is the thing as well. Although it does make the patients feel very valued I think…and gives them a much happier experience.

INT: …do you think the overall effect on the profession is positive?

RES: I think so…Because…we're taking ownership of…our labours then, aren't we?…You know, I created this, you know, and I created this for you and you're seeing *it and, you know, this is what's going to happen next. The patient then gets a much better idea of…of their pathway….*

Evidence emerged in the data of a consultant radiographer acting as a change agent in the facilitation of organised knowledge gathering, and protocol development, to influence team evidence use in clinical practice, this would seem to be a key role of this participant:

Diagnostic Radiographer – England (P#13)

I've brought in a lot of research and evidence of updated protocols to reflect the latest guidance. And I'd like to think that…I'm…in the process of bringing the department into the 21st Century…

There was also evidence of the same individual nurturing and encouraging colleagues to adopt best practice, and evidence dissemination in the clinical setting:

Diagnostic Radiographer – England (P#13)

I've let the radiographers on the shop floor have a say in our protocols…encouraging our Reporting Radiographers, and the junior Radiographers, to be involved in evidence and research. I've encouraged a couple of them to submit posters to UKRC…[national radiology conference]…which they've never done before.

Another example of potential change agency in the data was the novel role of an advanced practitioner 'McMillan' radiographer who specialised in targeting patient 'recovery enhancement' in radiotherapy, being a champion for best practice:

Therapy Radiographer – England (P#4)

…we have now a full time Macmillan radiographer lead, called 'enhanced recovery', which has definitely improved the patient experience and the radiographer's experience…[too]

Another participant, working as a link-senior radiographer, with supervisory responsibilities, described his previous car sales experience as useful in 'selling' concepts and ideas to colleagues who were not receptive to change:

Diagnostic Radiographer – England (P#15)

…so when they introduced the Reporting Radiographers…it's all driven by…me…;a lot of it was seen as the Radiologists just telling us what to do, and I challenge that…and say…look,…the bit of salesman comes out in me, that I've got to sell that to the Band 5s…[linking reporting team to junior radiographers]

One reporting radiographer participant - described his sense of belonging to a young team, and being 'well led' by their consultant radiographer – instilling a 'drive and will' to use evidence in their clinical practice, with the consultant radiographer role helping to advance the profession in the region or sub-nation (Scotland):

Diagnostic Radiographer – Scotland (P#1)

[talking about their consultant radiographer]…He pushes them to doing as much…research or…audit as we can do…in the department in the wider sense, to look at…just to try and change the culture within Scotland. I think…again, we're a very young Reporting team…we've got a lot of knowledge amongst our-young selves, which will hopefully increase over the next few years. To get to this, because there's so few of us in Scotland, it requires…quite a strongminded person…

There were negative connotations in the data seeming to possibly perpetuate cultural barriers with the 'new' consultant radiographers possibly becoming a new dominant force in terms of the radiographic team. There was a sense that boundaries were being moved downstream, and rather than boundaries being between radiologists and radiographers, as shown earlier, a sense emerged of the boundary migrating to be between consultant radiographers and practicing radiographers, possibly the new 'demi-radiologist' culturally influencing new powers and dominance over supposedly autonomous practicing radiographers acquiring images, with controlling language using such phrases as '*I let them', 'quite a long leash' 'I give a lot of freedom'*, etc perhaps perpetuating the culture of servitude further down the ranks:

Diagnostic Radiographer – England (P#8)

… I let them…they've got quite…a long leash with…with me. I give them, I encourage them to have a lot of independence, a lot of say on what they should and shouldn't be doing. I don't expect them to bring everything…they've got a question on. I give them a lot of freedom to use their own initiative, their own knowledge, to make decisions based on whether to x-ray patients, whether things are and aren't justified.

4.4 Findings – Mixed Methods Merging

Table 51 shows the calculated CAI scores for each of the context constructs: *Culture, Leadership, and Evaluation* displayed with exemplars of weak and strong context data from the qualitative arm of this study, in order to gain further narrative insight when interpreting the data.

Merging of data was useful to highlight conceptual contrasts between the QUAN and QUAL findings prompting new insights and questions that were further developed in the discussion section, using CAS lenses (Ch.5). The main observations related to a strong observed overall context score using the CAI instrument, however, there was a strong undercurrent within the qualitative data of enduring contextual challenges (seemingly contradicting the quantitative data), necessitating further consideration, and a potential are for further study.

Table 51 Mixed Methods - Data Convergence

PARIHS Constructs for Context	QUAN (CAI) *(overall mean scores)*	QUAL – 'Weak' Exemplar Quotations	QUAL – 'Strong' Exemplar Quotations
Culture	73.53 %	*"I think they're very set in their ways" (P#17)* *"I think it's just protectionism of what they see as their own role and their own turf" (P#13)*	*"there's always people that are going to have different opinions about things, but we generally work around it" (P#8)* *"Practice-wise you wouldn't know that there was any difference between them, they all work really well together" (P#9)* *"So, you know, we all work together there's a really good culture, keen to share knowledge that you've gained personally and keen to learn new practice" (P#6)*
Leadership	67.35 %	*"there's a lack of communication and a lack of leadership, lack of clarifying roles….Lack of support a lot of the time" (P#15)* *"they're restricted in the roles that they can do from middle management…there's a conflict" (P#16)*	*"I think if someone comes forward with anything then it will be listened to. We often have frequent meetings to discuss things which was in a multidisciplinary team, and they have various skill mixes" (P#7)*
Evaluation	71.24 %	*"things have just festered and…yeah, I think they're very set in their ways" (P#17)* *"you just hear things through e-mails. And you can't… [go]…to staff meetings" (P#8)*	*"I am very keen on the whole idea of sort of coaching, mentoring, within the department" (P#5)*
Context Combined	**70.71 %**		
High Scoring Items in the CAI: *(based on **upper-quartile** mean scores - examples)*			
A proactive approach to care / imaging / treatment is taken			
A staff performance review process is in place which enables reflection on practice, goal setting and is regularly reviewed			
Personal and professional boundaries between HCPs are maintained			
HCPs share common goals and objectives about patient care			
There are good working relations between clinical and non-clinical staff			
Low Scoring Items in the CAI: *(based on **lower-quartile** mean scores - examples)*			
Staff use reflective processes (e.g., action learning, clinical supervision, or reflective diaries) to evaluate and develop practice			
Organisational management has high regard for staff autonomy			
The development of staff expertise is viewed as a priority by radiography leaders			
Patients have choice in assessing, planning, and evaluating their care and treatment			
In your MDT (multi-disciplinary team meetings e.g., breast / trauma) radiographer members have equal authority in decision making			

4.4.1 Chapter Summary

This chapter presented analysed data from both arms of the MMR study, together with merging and consideration of the overarching findings in relation to the mixed methods insights. The data and findings are compared and contrasted, and new knowledge and insight is generated within the next chapter.

5 Chapter 5 - Discussion

5.1 Chapter Overview

In this chapter the overall contribution of the thesis to new knowledge is discussed in relation to the study findings, as conceptualised in the project organising frameworks discussed in Ch1. and (Ch.3). This section will report the merged data and discuss these in relation to the existing evidence base. The CAI (survey) showed radiography implementation context to be relatively strong, however this contrasted with enduring implementation confounders found in the qualitative data, an insight reached by comparing data from both arms of the MMR study. Insights from the systematic review revealed the poor state of IR use in radiography, together with a new understanding of KT interventions used, and potential barriers and enablers to evidence utilised in practice. Although there were negative contextual influences in the data, a positive theme of emergence was found within radiography practice, and using CAS lenses, a potential for developing the role of middle-level clinico-managers in radiography is discussed in relation to facilitating implementation efforts in the future.

5.2 Context Assessment (QUANT)

5.2.1 Quantitative Assessment of Radiography Context

Ch.1 discussed the paucity of research and evidence supporting methods attempting to evaluate the nature of implementation context in practice settings, however the CAI shows promise in this field (Health Foundation, 2014). In order to determine, as far as was practicable, the readiness and willingness of the radiography context to use evidence in practice, the CAI (McCormack et al., 2009) was used as the quantitative instrument for this study, and formed the majority of the content of the online survey. The instrument itself was adapted and piloted for use within the radiography practice setting, minimal changes were necessary at the outset, and this helped preserve the integrity of the original instrument. Ch.3 discusses in detail how the instrument was adapted, piloted, and utilised to gather data as the Quantitative instrument of this MMR study. The questionnaire also gathered demographic information relating to area of expertise, years of service, identified gender, branch of radiography practiced, practice sector and UK home nation of practice. Data was rejected if the participants were not qualified, not UK practicing or not practicing in a clinical or clinical teaching role, although data was utilised if participants were UK practicing with overseas training.

The survey data was shown to be normally distributed and suitable for inferential statistical assumptions. There was no statistically significant difference shown in the mean CAI scores between gender, between therapy and diagnostic radiographers, and between home nations suggesting that there was no contextually significant difference in those context domains. However, there was a significant difference, between the CAI scores of those practicing in the public versus the private sector, number of years since qualifying and between pay bands, and these will be introduced in this section, and also considered later in comparison to the qualitative data where relevant.

Although it could be argued that 'pay bands' could be linked with career progression, and thus years of practice, very experienced practitioners can remain in the lower pay bands due to career choice, lack of career progression opportunity, or practitioners returning to the profession, therefore the mean CAI scores were calculated separately for both pay bands and years since qualifying (experience). There was a significant difference between the years of experience groups in the '0-5years' since qualifying group showing a significantly greater mean CAI score when compared to the '6-10' year group. This could suggest that newly qualified radiographers are keen to develop and exhibit positive contextual traits in the first 5 years, with a possible dip in their contextual characteristics during years 6-10 and Gerrish, Ashworth, Lacey, and Bailey (2008) found that junior nurses relied on their recent education during this period rather than accessing research. Gerrish et al. (2008) also found that junior nurses had less confidence, experienced greater barriers, and were less empowered to develop autonomy in implementing EBP, than senior nurses, and this phenomenon might be exhibited in the radiography context. Further research into how less experienced radiographers (or healthcare professionals generally) experience these barriers and challenges, might reveal further insight, into why their CAI scores were lower in the less experienced groups. This might be an interesting area for future study and targeted implementation efforts, in particular looking at 'length of experience' groups, where propensity for EBP might vary. Similarly, a significant difference was found between the mean scores in the 'pay band' groups, although subsequent comparisons between groups using a Hochberg comparison table did not show significance in any particular pay band. Low mean scores were noted in the ‘B5/6 split’ group, possibly linked to the low values or context expressed in the ‘6-10’ years of practice group mentioned earlier which may be linked to pay and reward disillusionment, lack of autonomy associated with the lower grades and possible lack of familiarity with EBP concepts some years after training. This is in contrast with the relatively high mean CAI scores in the ‘B8a’ group, possibly associated with pay satisfaction and more autonomous leadership roles, hence exhibiting a score more conducive to supporting EBP and a positive context. Saunders and Vehviläinen-Julkunen (2016) found that senior nurses in management and leadership roles had higher EBP knowledge and utilised research in their practice more than nurses in other positions.

The majority of responses by home nations were from England mainly, followed by Scotland, and the response rate from Wales and Northern Ireland was much lower in comparison. It is likely that the response frequency by home nation broadly reflects the home nation populations generally (Office for National Statistics (UK Gov), 2018). The gender split in the data and professional branch of radiography practiced, also appeared to broadly reflect the national population (Appendix 21) and was considered representative. Most responses by age were in the 26 to 45 year range, and in the mid-pay range, and it is possible that younger and older radiographers were less likely to respond to an online survey possibly due to a lack of confidence (due to lack of experience), or with older radiographers being less likely to access electronic surveys. Cho, Johnson, and Vangeest (2013) in their meta-analysis of poor response rates to surveys by healthcare professionals, found that the survey mode, and participant follow-up were effective in improving response rates, as well as incentives. Response rate might be improved in future similar studies by using other response modes such as telephone, postal or email, however no funding was available for this project, which limited its scope from this perspective. A financial incentive was used however to promote responses, in the form of an electronic tablet computer, which was advertised in a national professional magazine and online. Others have found a general decline in health professionals responding to research by surveys (Burke & Hodgins, 2015). Most responses were from staff working in the NHS.

There is paucity of research in relation to the adaptation and application of the CAI in various healthcare settings. Kajermo et al. (2013) adapted and tested the CAI for use with registered

Swedish nurses, in various healthcare settings, and similarly, Hølge-Hazelton et al. (2019) adapted and tested the instrument in a Danish context. One objective of this project was to determine the implementation context of radiography in the UK using the CAI. The approach used in this study in modifying, and applying the CAI in the radiography context, was novel and has not been undertaken previously, and represents new field data and knowledge. The data and analysis presented Ch.4(1), indicates that the sample reached is likely to be representative of the population as a whole, with respondent gender and branch of radiography practiced broadly matching the national ratios, although it is acknowledged a larger survey sample would have been more desirable statistically. Generally, although a margin of error of 5% is desirable in terms of sample size, the calculated margin of error with a sample of 152 cases was 7.93% and within a tolerable range according to literature (Serdar et al., 2021). Minimal changes were required to the original CAI statements to render the instrument contextually appropriate to radiography, other than some professional specific terminology such as nomenclature changes e.g. 'nurse' to 'radiographer', and adding radiographer specific actions to 'care' related statements e.g. 'imaging' and 'therapy', with an overall minimal effect on the original CAI statement meanings, protecting the validity of the instrument as originally tested by McCormack et al. (2009). Cognitive 'think aloud' interview techniques helped ensure that any conceptual ambiguity in the radiography context, and the related CAI statements, were clarified and understood by radiographers. There might be a possible link between some of the low scoring CAI statements in the final survey, and those identified previously at the cognitive testing stage as being less context specific to the radiography profession, and future research needs to be mindful of this, when designing future context assessment tools tailored for specific professions. Estabrooks et al. (2006) realised the importance of discipline specific terminology in applying implementation theory, and urge researchers and theorists, not to assume transferability. In this survey, examples such as CAI statements 18 and 22 might have less relevant 'context comprehensibility' terminology to radiography practice and could be substituted or removed completely in any future iterations of the tool for use outside nursing to improve statistical certainty and applicability to other professions. Only 8 cases out of 160 responses were discarded due to having greater than 20% missing values, suggesting that the majority of CAI statements used in this case, were on the whole, likely to be clear and comprehensible to the radiography context, and this was found to be the case in a similar study, although they had a much larger sample size than this study (Kajermo et al., 2013). The Skewness and Kurtosis of the CAI result was close to zero indicating that the distribution was close to normality, with ceiling effects unlikely (McHorney & Tarlov, 1995).

In their 'toolkit' for utilising the CAI in a clinical context, McCormack et al. (2008a) provide a method for interpreting the CAI results, and identifying key areas for improvement in the particular context being evaluated. Initially after approximately four weeks the survey responses were low (n=40), and a decision was made to place another advertisement in the SCoR's national journal (in a more prominent position), and to actively promote the survey using the SCoR's national Twitter™ account, and the response rate improved. The final response rate was lower than anticipated, however normality was shown in the data when analysed (see Ch4), and case numbers were adequate for SEM. There was virtually no difference between the imputed CAI results (for missing values) and the non-imputed data supporting the use of this method in maximising respondent data. The final context index (CI) of the radiography profession is shown in Ch4(1), with 'Overall Context' being in the upper quartile, and the PARIHS sub-element constructs of context: '*Culture', 'Leadership' and 'Evaluation'* all mostly in the upper quartile CI, indicating a quantified moderate to strong overall national radiography context in relation to implementation, as measured by the CAI. The leadership construct scored marginally lower than the other two, and interestingly, only 8% of the sample reported having any formal management or leadership training when asked in the background section of the questionnaire.

An underlying assumption of implementation frameworks such as PARIHS, is that context can be separated into individual components, in which each have an independent or combination 'cause & effect' on implementation outcomes (positive or negative) (Nilsen & Bernhardsson, 2019). The CAI used for the survey was essentially an objectivist instrument quantifying aspects of the radiography context, however this tool did allow the constituent parts of context to be distilled into 'strong' and 'weak' survey statements in this study, allowing the component parts of context having merit, and those needing improvement, to be identified. Even though there is not much published research on the adaptation and use of the CAI, there are early criticisms surrounding definitional clarity, and structural coherence, with the three PARIHS constructs being spread over five sections in the CAI (Kajermo et al., 2013).

The CAI statement items descending score means were grouped into upper-quartile and lower-quartile ranked scores. High scoring items indicating aspects of a strong implementation context, using the PARIHS three factor model for radiography, supports a strong culture and indicates that service evaluation is valued. Strong cultural CAI items included those such as: *having regard for client dignity; welcoming cultural diversity; proactive approach to care (imaging/treatment); professional boundaries being maintained; good working relations between clinical and non-clinical staff and use of evidence informed clinical protocols*. Conversely, low scoring items revealed issues surrounding culture, with a *lack of professional reflection and professional development* amongst radiographers and a lack of patient choice in planning treatment (however the latter item might be more relevant to therapy radiographers who were not as well represented in the data in terms of sample size). Other low scoring items *related to leadership* issues, with organisations having *low regard for staff autonomy, being hierarchical and having autocratic decision making*. Radiographers also scored very low in terms of having *equal decision-making authority in multi-disciplinary team meetings*. Having revealed the high and low scoring items, this should assist future researchers in being able to focus on areas shown to be strong and weak in the UK radiography context. The data would also be useful to policy makers in relation to understanding more fully how tailored implementation efforts, specifically in radiography, should be planned and executed.

5.2.2 Assessment of the Validity & Psychometric Properties of the Radiography CAI

In Ch.3, the approach to ensuring statistical rigour and confirmation of model fit was extensively discussed and justified. The reliability or consistency of responses to the survey was confirmed using a range of statistical methods for internal consistency and scalar item correlation (Ch.4). Cronbach's alpha is often reported in the validity assessment of multiple item scales, although researchers should be cautious in relying on Cronbach alone, as its values increase with increasing items in the scale (Shelby, 2011). This study found that responses in the survey generally met conventional standards for internal consistency of the 5-factor model of the CAI as used in the original instrument (McCormack et al., 2009). Four of the five factors showed good correlation with one item only being an outlier (factor 5 / 'Evaluation'), this was similarly the case with other attempts to use the CAI in different contexts with the published Swedish and Danish versions also showing poor correlations in factor 5 for the 5-factor model (Hølge-Hazelton et al., 2019; Kajermo et al., 2013). In an unpublished thesis, Hardy (2011) similarly found '*Evaluation*' to be an outlier, and as in this study, suggested that this could be due to the smaller number of items in this factor. In consideration of recommending future changes to the radiography CAI to render it more context sensitive, removing CAI statement 18 was considered, however when comparing the alpha for factor 5 with or without CAI 18, there was no material effect on the overall coefficient average, and therefore not evidence to support this recommendation. It might be useful in future research to examine the contextual appropriateness of the individual CAI items in factor-5 to radiography practice, with relevant modifications perhaps improving correlations as a result for this factor.

Although it was not a stated aim of this study to assess and evaluate the reliability, validity, and psychometric properties of the CAI per se, as mentioned earlier, others have recently modified and translated the instrument to their local contexts and have analysed its psychometric integrity to be true to the original, and also to ensure ongoing validity and applicability to their own research . In order to ensure that the modified CAI maintained its factor structure and structural validity, the reliability of the instrument was also assessed in this study using SEM. Analysis in Ch.4 shows that the factor loadings and fit statistics were acceptable, and statistically significant. SEM confirmed an 'excellent' fit with the 5-factor model, and the 3-factor model (being more closely aligned with the PARIHS theory) showed a slightly weaker fit structurally, however still graded 'very good' according to Hooper et al. (2008). One similar study found the 3-factor model to be a stronger fit, being more closely aligned with PARIHS (Hølge-Hazelton et al., 2019), and the only other published paper on the practical application of the CAI, did not produce a structural fit with the original 5-factor model (Kajermo et al., 2013). Regarding structural fit, Kajermo et al. (2013) cite potential issues such as lack of definitional clarity in the 'context' construct and the potential phenomenon of 'social desirability' where some individuals tend to misrepresent responses (introducing bias) by representing their own social values or prevailing professional norms. The use of the CAI in this study, in the radiography context, adds to the body of knowledge regarding the ongoing testing and use of the CAI in applied contexts. These additional findings might provide signposts for future researchers in the further refinement of the CAI in specific contexts.

5.2.3 Potential Response Bias

Whilst trying to achieve an optimal sample size for reaching practicing radiographers in the UK, limitations were encountered mainly due to the scope and availability of resources for undertaking this academic project, together with ethical assurances that were required in accessing participants from diverse backgrounds and locations throughout the UK. Volunteers who participated in the survey were reached by advertisement in a national professional journal, website, and Twitter™ social media, and this could potentially have produced bias in this study by only selecting from a sample of radiographers belonging to a professional body or accessing the professional body's media. Those without access to the former or without membership might not have had the opportunity to participate, and also with a subsequent limiting effect on recruitment and sample size.

5.3 Identified Qualitative Themes on Implementation in Radiography with Related Insights from the Merged Data (QUAN+QUAL)

The *three* main themes constructed from the qualitative data illuminate a background 'practice climate' and 'practice culture', positively and negatively interacting and permeating the implementation condition of an emergent radiography profession and its practice, analogous to a 'dynamic field'. Role boundary fluidity, boundary clashes, and turf wars highlighted radiography's enduring and complex relationship with radiologists, and these emerged as persistent issues of in the data. Leadership, individual and team behaviour and 'power influences' in the permeating field seem to exert forces influencing the ability or willingness of the radiography profession to practice EBR and implement evidence generally. The meaning and impact of the qualitative findings will be discussed in this section in relation to the merged study findings, the existing evidence base, and the original aims and objectives.

5.3.1 Radiography Practice Climate & Culture

The *first* theme, representing the contextual backdrop in which radiographic practice resides, was shaped by data coalescing around the concept of a 'context medium' or 'permeating field', with various external forces, opinions, practice boundary issues and misconceptions or misunderstanding, actively influencing radiography practice context, and as such requiring the backdrop to be dynamic and reactive. Kitson et al. (1998) describe context as "forces at work" (p. 152). As discussed in Ch.1, Pfadenhauer et al. (2015) explain that context has the potential to react, modify, facilitate or constrain interventions as a dynamic entity, however they argue against conceptualising context as a backdrop per se. A recent review of implementation frameworks supports the notion of context being an active construct, with the majority of implementation frameworks conceptualising context in this way (Nilsen & Bernhardsson, 2019) and data in this study supporting this theory. The emerging sense in the data of the active role of context shaping implementation efforts will be explored further in this section. Kurt Lewin's field theory found a resurgence in the 1990's being the basis of 'force field' analysis (Burnes & Cooke, 2013). Field theory was originally theorised by Lewin in order to understand the psychology of individual behaviour, however it was later used as a method for analysing and changing group behaviour, with the theory stating that it is possible to predict, understand

and provide the basis for individual and group behaviour change by conceptualising or constructing a "life space", and radiography context could be represented similarly, with some evidence in this study supporting this view (p. 409) (Burnes & Cooke, 2013). Lewin's theory holds that the 'field' allows us "to understand the forces that maintain current behaviour and identify those that would have to be modified in order to bring about change" (p. 409) (Burnes & Cooke, 2013). Lewin argued that the totality of coexisting in a field of interdependent forces impacts groups or individuals, making up the 'life space' being inhabited (Burnes & Cooke, 2013). Lewin's forces resonated with the 'external forces' theme in this respect.

Denison (1996) expounds and contrasts the origins, epistemology, and disciplines in which the constructs of organisational 'climate' and 'culture' reside, with *climate* residing within psychology, being etic (and subject to the researcher's viewpoint), comparative and nomothetic in epistemology; and *culture* being conceptualized as idiographic in its epistemology, with an emic point of view, and based in sociological and anthropological disciplines. It has been argued that the differences between the concepts of *climate* and *culture*, in organisational behaviour, stems from their respective theoretical foundations, with the former rooted in Lewinian field theory, and the latter emerging from social construction framework theories (Denison, 1996). This classification seemed to resonate with the data in this study, highlighting the actively permeating external forces influencing the ability of radiography actors to implement and effect change within the 'climate and culture field' or implementation context. Implementation climate has been linked with implementation effectiveness (Jacobs, Weiner, & Bunger, 2014). Nilsen and Bernhardsson (2019) in their recent scoping review, describe culture as "shared visions, norms, values, assumptions and expectations in an organization [influencing implementation]…[and climate as]…surface perceptions and attitudes concerning the observable, surface-level aspects of culture" (p.13), with this definition or description being useful to make sense of the qualitative data found in this study.

External forces, such as governmental and regulatory influences, and internal macro-level organisational and culturo-climate artefacts, permeating the contextual backdrop or 'context field' of radiography were found, including behaviours that some participants refer to as 'historical' or related to 'superstition'. This was seen to negatively pervade the professional function of radiographers without good cause or benefit to the service or patient. This included the external drive or pressure for service change, and the opposing external or contextual forces which seemed to interact positively or negatively with implementation or change efforts. Nilsen and Bernhardsson (2019) suggest that IS theorists have aimed their research mostly on the individual and organisational level, highlighting the need to also focus on the macro level, with a 'whole system approach', paying attention to other disciplines such as political science and complexity science, in an attempt to understand the 'whole'. Being mindful of the inherent quality of TA in placing the researcher in a firmly subjective philosophical role, where the data is actively sculpted and shaped (Braun & Clarke, 2006; Clarke & Braun, 2018), and reflecting on the view of Pfadenhauer et al. (2015) discussed in Ch.1 that context interacts, influences and shapes implementation efforts, the notion of an active 'field' when interpreting the data, resonated with this view. The data revealed powerful 'active' external influences at national (macro) level, limiting the ability of radiographers to adopt change, or be considered part of it by policy makers. This was seen at governmental (policy or regulatory level), where there were fragmented treatment regimens on a regional basis in radiotherapy due to political policy and practice variations between UK home nations, however some participants reported that sometimes good national policy, such as the NHS steering standardised treatment protocols, was seen to be a positive macro level influence on radiography practice. A therapy radiographer talked about a lack, at national level, of actively *"backing or pushing forward"* (P#4) new innovations in treatment (including funding), and a diagnostic radiographer discussed the difficulty of implementing new evidence on thrombolysis treatment in stroke care, without resourcing new CT scanners (p.156). Harvey and Kitson (2016) discuss how macro level policy can positively influence evidence adoption at local levels, together with monetary incentives, and evidence of this was found in this study, even though it was in a negative context.

An interesting aspect emerged in the qualitative data where sector contrasts influenced roles, potential for evidence adoption and radiographer opportunities. Some individuals felt that the private sector was occasionally more focussed on profit making than developing roles and felt that they were there "to just do a job" (P#7). In contrast, participants felt more supported to develop professionally in the NHS and stated they would be more likely to resist cost saving vs implementing best practice. However, in the Quantitative arm, the mean CAI scores were significantly higher in the private sector vs the public sector, indicating a 'stronger' context in relation to implementation. There might be merit in future studies in further exploring the public / private sector contextual contrasts for implementation in the UK. In their study in the USA, Aarons, Sommerfeld, and Walrath (2009), whilst examining the impact of organisation type on implementation context, found greater support for EBP in private agencies, with staff also reporting more positive attitudes towards EBP. This possibly resonating with the findings of this study, and the need to explore the possible impact of practice sector in radiography context, however it is acknowledged that the response rate was low from the private sector in the Quantitative study.

Some radiographers highlighted situations where outdated regulation stifled individual practice and autonomy, and this had a negative impact on patient care and workflow, even though the original intent of the law was to protect service users, this in effect hampered potential service improvement of implementation efforts. An example of which included the medicines regulations, where radiographers felt these were outdated and constricted professional progress in developing patient services, and perpetuated professional divides: *"we then have to get a radiologist to come and inject"* (P#6). Although government promotes role advancement for the non-medical professions in the UK, it has not been successful in fully addressing the need for legislation to keep up with role change, stifling the ability of radiographers and other professions to implement change (Borthwick, Short, Nancarrow, & Boyce, 2010). Borthwick et al. (2010) highlight the significant barrier of professional 'in-fighting' surrounding legal protections, limiting the practice of allied professionals, and protecting the status of the medical community, shown not to always be in the interest of the patient.

Another participant felt that the employing organisation had an important role to play in influencing individuals "stuck in their ways" (P#7) to adapt and adopt change, and that the employer as a contextual entity permeating the backdrop, needed to set goals, encourage change and actively deal with individuals who supressed or resisted change, but another radiographer acknowledged that persuading a group of individuals to change could sometimes be very challenging, and as difficult as "*holding back the tide*" (P#14), however the mean score for 'CAI-statement 3' (proactive approach to care) was high, indicating a strong perspective in the Quantitative study on this aspect. Another participant expressed views of a supportive 'positive external context' and influences on practice by working in a multi-organisation / multi-skillset team, extending beyond traditional boundaries and organisations, where charity institutions and the private sector provided a rich, encouraging and developmental environment infiltrating local practice positively. This was further supported by the higher mean CAI scores exhibited by those practicing in the private sector discussed earlier, and 'CAI-statement 36' (HCPs share common goals and objectives) being in the higher mean score range. Glegg, Jenkins, and Kothari (2019) found evidence that using a Social Network Analysis (SNA) lens, potentially broadens understanding of professional or organisational networks, personal attributes, and professional identities, to examine influences across contexts and KT strategies. This might be a novel area suitable for examining the radiography context further in future studies.

The RCR and the SCoR have been at odds, regarding the now fairly well-established role-extension of radiographers undertaking formal image interpretation and writing formal diagnostic reports (reporting). As discussed in Appendix 1, there has been much controversy historically regarding the 'turf war' whether non medically trained personnel can safely interpret medical images and extend their roles across boundaries into the realm of what was previously considered exclusive medical practice. The latest skirmish was the apparent result of a three year appointment of a 'traditionalist' president of the RCR, making her views known publicly (Society and College of Radiographers, 2017b), and shaking the already well established foundations of radiographer reporting in the UK, arguably supported by strong evidence of effectiveness and safety (Care Quality Commission (CQC), 2018). Many participants in this study were aware of this high level inter-professional friction, and it seemed to have a negative effect in terms of relations, however some participants felt that the negative attitude shown, made them more determined to push on and drive change regardless. Henderson, Mathers, and McConnell (2017) comment on the RCR pronouncements on radiographer practice, claiming that these would be unacceptable and unprecedented in other disciplines, and claiming that radiologists are pre-occupied with an insular radiology specialty, rather than a whole-system perspective, involving other professions.

External contextual influences on the ability of radiographers to access, implement and promote or generate new evidence for practice emerged as a recurrent theme in the data across many practice settings. Participants stated that their ability to access new evidence, was in stark contrast to when they were students, with issues surrounding time available to access evidence, personal or organisational costs as a barrier to accessing evidence (obtaining journal articles /attending conferences etc) and one radiographer suggested that the high academic bar set for publication, was an 'off-putting' barrier to practicing staff sharing their knowledge, experience and any research or audit they had performed. Lizarondo, Grimmer-Somers, and Kumar (2011) in their review of evidence use in AHP groups, discuss two influential aspects in applying evidence in practical settings, namely a 'practical component' and a 'knowledge component'. With the former heavily dependent on access to research and the AHPs ability to analyse and interpret the evidence in relation to their own practice, and the latter relating to research interpretation proficiency, both of which can be barriers to bridging the gap between knowledge and practice (Lizarondo et al., 2011). Participants also suggested that there could be a role for professional bodies and the NHS (employer) to provide straightforward free access to journal articles – with an ability to move beyond only having access to research abstracts (p.165). There has been much discussion within professional bodies and trade unions regarding a national approach to 'protected study time' for the AHPs, and this continues to be controversial in healthcare professions (Jones-Berry, 2016). An overall observation of evidence-based practice in the data (at a latent level) was that radiographers practice in large teams, and it might be therefore problematic to implement evidence at the 'individual' level, with wider team consensus required or necessary, involving other professions, either by law, convention, or necessity. Also Sim and Radloff (2009) suggest that radiography, by its nature in terms of regulatory compliance and standardised 'safe' practice, is highly reliant on protocol driven practice, with radiographers having to mostly be 'followers' and not 'thinkers'.

Researchers in the field have discussed the professional identity and public profile of radiographers (Decker, 2006; Sim & Radloff, 2009), with evidence of radiography suffering from a lack of recognition by other health professions and the public in general. This study found evidence that radiographers felt that the public, or other professionals, did not understand the role of the radiographer. A participant gave an example where this directly negatively impacted on patient care when she was relaying urgent imaging findings that she had found, to a ward doctor, who disregarded the clinical information in her opinion, because she was not medically trained, or that the doctor in question did not understand her role or ability (p.172). Another study found similar evidence of this and discusses how radiographer skills are often 'overlooked' (Lewis, Heard, Robinson, White, & Poulos, 2008) or that organisations are ignorant of them (Matilainen, Ahonen, Kankkunen, & Kangasniemi, 2017). Strudwick and Day (2014) in a study of radiographers and interprofessional working, found that in order to enhance the quality of care, professionals need to know and understand each other's roles, and cite similar examples of lack of interprofessional role knowledge between doctors and nurses on an intensive care ward. Another participant felt that the public had a diminished view of the status of radiographers due to the outdated convention that radiographers do not, or are not allowed, to give out results (p.171). This concurs with Abbott (1988) (in his essay on the division of expert labour) explaining that because the public believe nurses are subordinate to doctors, that the public believes that all nurses know less than doctors about medical issues, which is comparable to the radiography example illustrated. Decker (2006), whilst researching the 'identity of the radiographer', found that participants in her study situated their professional identity in three distinct discourses: 1) the healthcare system in which they operate; 2) Society's perception of the health profession and 3) The patriarchy that exists between the dominant medical profession and radiography, and these distinct categorisations resonated with the findings of this study also.

Radiographers traditionally practice within large teams in hospital departments. This study found evidence suggesting that leadership, team structures and size and team communication, as an 'external force', had potential to positively or negatively influence the ability of the 'individual' radiographer to implement or enact EBP. An interesting notion was formed from the data in respect of a 'hard' or 'soft' external pressure driving or indirectly promoting change. Participants felt that external regulation and governmental targets mandated or forced 'hard' change, however an insight emerged of a 'soft' external pressure, where visiting radiography students influenced local practice indirectly or 'softly' (p.158). There were examples of good and counterproductive teamwork as regards EBP in the data. Teamwork seemed to be most productive when there was good communication in flat hierarchical structures, in which staff seemed to respond to and flourish, and conversely, radiographer teamwork seemed to be less effective when: there was poor team feedback; working with other professionals such as radiologists and physicists; working remotely; working in small cliques; and when being managed by a non-radiographer. It was remarkable in the Quantitative data, in that the summed mean scores of most CAI items relating to leadership and teamworking (CAI-statements: 10,17, 22 & 35) were in the lower quartile, supporting negative contextual attributes in this respect. As an example, in a radiotherapy department, where radiographers work very closely with medical physicists, a participant bemoaned the fact that although they worked well as a team, the fact that the physicists were employed and funded through a separate department meant that their resourcing and availability were misaligned as a result, with negative team impact and possible sub-optimal teamwork in terms of implementing new initiatives. One participant explained that it would be practically impossible for radiographers practicing in the context of a large team to act as an 'individual' in terms of seeking and implementing evidence as an autonomous practitioner, and that leadership by an individual was required to undertake this task on behalf of the wider team of radiographers. Another salient point arising from the data was a sense of needing to be altruistic within at team facilitating optimal team dynamics and a sense of the 'collective-self' within a team, with non-compliant team members affecting the general team dynamic in radiography. 'CAI-statement 36' (HCPs share common goals and objectives) scored highly in the survey suggesting context specific evidence for the 'collective-self' in the Quantitative data for radiography. Effective leadership and teamwork are seen as positive contextual attributes for implementing evidence-based healthcare (Harvey & Kitson, 2016; Rycroft-Malone, Harvey, et al., 2004).

Largely, the discussion surrounding workforce redesign has focussed on individual professions, however the active boundaries of each discipline, results in an interrelationship between the constituents of the workforce, which cannot be disregarded (Nancarrow & Borthwick, 2005). Abbott (1988) describes the social nature of relationships in the workplace and the control exerted by professions, and this is a useful basis to examine the fluidity of professional workplace jurisdictions as was found in this study. As mentioned earlier in this section, Abbott (1988) views workplace jurisdiction as a flexible ownership of tasks open to continuous 'negotiated' or 'competitive' change, influenced by internal or external pressure (Wright et al., 2019). Abbott's work examines how entire professions vanish or thrive over time, but has been criticised for not being cognisant of the complexity of workplace jurisdictional negotiations (Wright et al., 2019). Boundary disputes can be inter or intra-profession, and between professions seen as owning similar traditional status, an example of which would be the merging of theatre nursing with theatre technicians into the Operating Department Practitioner in the UK (Wright et al., 2019).

There were numerous examples in the data where participants debated where radiographer ‘roles begin and end’, and the alignment of roles necessary to keep up with evolving technology and service needs. Role boundaries and role fluidity, conceptualised in the data as the ability of radiographers to cross boundaries and ‘dip’ into the roles of other professionals, was seen to be an important part of the development of radiography, however some felt that this was an external ‘force’, acting on the profession, with some embracing the force and some resisting or rejecting it. One participant commented that it was usual for role changes to be discussed between relevant parties, including managers, radiologists, and radiographers, as part of a multidisciplinary team, however others felt that macro level influences limited managers’ ability to implement role changes. Another participant felt that role boundaries (or fluidity) needed to be set locally, in tandem with localised service needs. There was a sense that radiographers accepted in certain circumstances, that their role would not transcend boundaries, due to a lack of service need (e.g., radiology registrars took on these roles). There was a need to feel protected by the legal system before radiographers took on new roles, however the role of the consultant radiographer, seemed to be viewed as more autonomous (by non-consultant grade radiographers) (p.180). Here the participant suggested that consultant level practitioners are less protocol driven or less constrained by them. Another participant felt that there should be more clarity surrounding the role of the radiographer generally, and that the boundaries should be signposted to other professions, managers and the public, to benefit more widely from exteded roles in the future (p.181). A notion of overstepping the boundary was discussed by one participant, with a feeling that the ‘system response’ to overstepping the traditional role boundary would be disciplinary or legal action, even if the professional felt competent, and that only the most confident radiographers would be brave enough to take on new roles for this reason (p.182). However, another participant talked of the external system pressure ‘role creep’, to informally take on new responsibilities, without being fully comfortable with this, highlighting the potential role boundary dilemma of role development within the traditional role boundaries of a profession or those encroaching the realm of another. The responses to ‘CAI-statement 1’ (personal and professional boundaries between HCPs are maintained) in the survey supported a high-level contextual attribute in this respect. Sevens and Reeves (2019) found intra-professional protectionism and boundary disputes within radiography, with extended scope sonographers resisting unconventional direct entry sonographer routes to address staffing shortages. Here issues such as deep-rooted entrenched views, were strong barriers to implementing new routes to practice, heavily influenced by traditional radiography culture, requiring strong leadership and education in order to empower internal change within the staff group, rather than external imposition (Sevens & Reeves, 2019).

Generational issues were unexpectedly quite apparent in the data, with insights such as: newer generations of radiographers being more open to change and new roles; radiographers who qualified more recently being more open to implementing new evidence and practices; and younger radiologists being more open to teamwork, and the influence of older radiologists on new generation radiologists' attitude towards change also remaining a powerful force. One participant discussed having moved recently from a predominantly 'young' department to a department with more established staff and found the latter to be content with carrying on with traditional methods, without questioning outdated practices. A pervading sense existed of radiography being quite established, with 'little new' to discover in the 'general radiography' (plain film) field, according to the older generation. Another participant in a similar situation, saw that the established staff became more receptive to innovation, when first implemented by someone else, and only then could they see the value of the change, with the participant feeling there was an aspect of 'fear of change' in their department. Another participant felt that the newer generation of radiographers (with degrees) were more used to searching and evaluating evidence as part of their training, conversely the older generation, having trained through the traditional professional diploma route, were less skilled in this respect or could not see the need for constant review of practice. The challenge by the newly qualified staff in potentially driving evidence-based practice in the older generation radiographers, seemed quite a powerful influence, and perhaps an area for further study in radiography. Interestingly, 'CAI-statement 23' (development of staff expertise is viewed as a priority by radiography leaders) reflected a negative contextual trait in this regard in the survey.

Saunders and Vehviläinen-Julkunen (2016) in their review of evidence-based nursing, found that nurse length of experience and increasing age, were both negatively associated with barriers to EBP in nursing. As discussed earlier, in the survey data, there was a significant difference in the CAI mean scores shown between the 0-5 and 6-10 years since qualifying groups, suggesting further evidence supporting this view. Similarly, Lizarondo et al. (2011) found that educational qualifications (level), and previous research involvement was a significant predictor of evidence uptake in allied health practitioners, and that without this, the ability to contextualise and operationalise evidence might be compromised. This potential barrier might be an area of useful future research in radiography specifically, as much of the evidence in this field lies in nursing. Inter-professional generational issues were also a finding in this study, where participants found fewer practice boundary issues and elitism when working with new generation radiologists (p.185). Henderson et al. (2017) also found a link to younger generation radiologists being more receptive to sharing roles between the professions. However, there also seemed to be a peer pressure effect which seemed to change this attitude in the younger radiologists when negatively influenced by the previous generation of radiologists in the same context (p.185).

The following two themes encompass *individual actor* traits residing in the Lewinian ‘life space’ discussed earlier:

5.3.2 Established Radiologist Eminence

The *second* theme represents the establishment of consultant radiologists firmly in UK practice, as the pre-eminent team member in a radiology department, with reserved privileges of medical status, decision-making power, and influence over the whole radiology service, and over the practice of individual and team radiographer practice with paternalism and power being evident. The section that follows explores further the ongoing influence of medical dominance over radiography practice, and the ability of radiographers to implement EBP in this context. Henderson et al. (2017) recently described the inappropriate influence of medical dominance and patriarchy within radiologist practice in the UK, historically rooted, with the RCR making pronouncements over radiographer practice, seen as unprecedented and unacceptable to other disciplines. This study also found similar negative influences over radiographer practice, presenting a potential barrier to EBP, with radiographers and their practice, both locally and nationally, being controlled by local radiologists or their national professional body.

The data revealed established rights and privileges embedded and enjoyed by radiologists in their practice, potentially to the detriment of radiographers, and their duties. This also concurs with the historical perspective discussed in Appendix 1. This might be partly due to a 'generic' privilege that comes with medical practitioner status, however the data also highlighted specific contextual influences in radiology practice specifically, seemingly negatively influencing the ability of the radiography profession to thrive in terms of EBP, role development and autonomy. Examples surrounded the fact that radiologists rarely get challenged as they exhibit superiority in terms of knowledge ownership, and decision making, and seemed to resent radiographers questioning their practice. *"The Radiologists do not expect to be challenged in any way"* (P#17), even though, in this case, the individual felt that challenging the radiologist was in the best interest of the patient, the radiologist was surprised to even be questioned by a radiographer. Others highlighted that because radiologists claim inherent 'ownership' of a case, they feel ultimately more responsible for the patient as a doctor, thus potentially removing the right of the radiographer to independently practice. There was evidence in the data that doctors claim responsibility using status or rank as a cultural artifact and participants suggested that this might reduce their own confidence in allowing non-medics to take on extended roles: *"well, I'm the one in the hot seat…my name goes on there [radiologist]"* (P#18). The quantitative data somewhat supported this weak contextual condition, with 'CAI statements 10 and 25' (Radiographers have equal authority in MDT and Management has high regard for autonomy) being in the lower quartile summed score category. The ability of radiologists to hold onto roles, as a privilege of position, seemed to be an issue that might stifle future implementation efforts in radiography, where much implementation efforts currently surround the increasing body of evidence supporting extended roles in radiography (Care Quality Commission (CQC), 2018; Henderson et al., 2017). Another interesting privilege, and possibly linked to the former emerging in the data, was that radiologists were able to pick and choose roles deliberately based on task desirability, or whether there was a personal financial incentive, and radiographers felt that they were more likely to be 'given' old roles disguised as role-extension, or be expected to take them on if the radiologists became increasingly disinclined to undertake them (p.188). Abbott (1988) discusses the jurisdictional claim by superordinate professions to control and perform work as they see fit, and the right to exclude others as it sees fit, and examples such as radiologists retaining financially lucrative roles were evident in the data, and not supporting radiographer role extension locally in this regard (p.188). 'CAI statement 35' (the organisation is non-hierarchical) was the lowest summed scoring element of all in the survey, highlighting the general view of radiographers in practice, of 'hierarchy' being a negative contextual trait. Another participant felt that the medical workforce, were themselves, feeling that their established roles were being challenged and were threatened existentially as a result, and there is evidence of this phenomenon in another study (Field & Snaith, 2013). This study did not elicit the opinion of radiologists and therefore this might be an interesting area for further study to reveal the views of this professional group in relation to radiographer role extension and the impact on radiologists and their practice.

The data showed that radiologists successfully propagate a sense of 'elitism' within the culture of radiology departments, perpetuating ingrained role differences, bolstering boundary defences, and 'owning rights' to knowledge and knowledge acquisition, not enjoyed (or shared) by or with the radiography profession. One participant discussed how she felt that radiologists had a monopoly on medical knowledge and were sometimes seen to be reluctant to share knowledge with radiographer colleagues, protecting their own roles (p.189). Another participant even felt that sometimes the inflated ego of some radiologists came before the welfare of the patient, *"it's about power, position, money, and increasing their own position and power by the way they manage other people"* (P#18). Another participant felt that medical ego might be perpetuated by the ability of the medical profession generally to recruit confident actors into the profession (p.190). Alexander, Humensky, Guerrero, Park, and Loewenstein (2010) concurs with this insight, observing that medicine does tend to select self-confident actors, sometimes exhibiting narcissistic behaviours, however they do make the point that the field “exposes them to situations characterized by great uncertainty and high stakes” (p. 944), thus necessitating this individual level trait. Physicians found to have a high level of self-esteem (measured by level of narcissism) tend to react to threats to their ego, by exhibiting greater self-perceived invulnerability to boundary threats (Alexander et al., 2010), and this might be an interesting area for further study in relation to implementation barriers at the individual level in radiology systems. This might be in itself a reason why some participants also felt that there was a tendency by some radiologists, to supress the role of the radiographer (linked to professional snobbery), where a participant felt that doctors saw themselves superior, although, they were keen to remark that they did not think this was universal. In many ways, it seems difficult to delineate between: medical dominance, paternalism, and patriarchy, all intertwined with narcissism as discussed above. Some participants did not believe that this was necessarily always malicious or self-centred, but rather a tendency for some radiologists to express a paternalistic stance towards protecting radiographers from potential pitfalls in inappropriate role extension. The data described scenarios where radiologists had the power and influence to obstruct change, and this was discussed earlier at the macro level (professional obscurity), however at the micro level this issue was also evident, where a radiographer commented that radiologists do not see that radiographers can go beyond producing images, and therefore do not understand their inherent capability to succeed in role extension. Participants expressed the need to gain professional approval from medical staff, as a prerequisite to developing their own roles within radiography, and this is inextricably linked with the turf wars and boundary issues discussed under ‘external forces’ earlier, where there are macro national tensions at professional and governmental level and local tensions at the micro, workplace level context.

Reflecting on the main themes developed from the interview data, there is apparent resonance with theory and the findings of this study, where Abbott (1988) describes professional jurisdictional claims residing in three main arenas, *the legal system*, *the arena of public opinion* and *the workplace*. Another participant gave an example where not only did radiologists control the implementation of new roles for radiographers, but that a notion of inherent superiority allowed radiologists locally to diminish the role of radiographers. A radiologist overruled one participant's professional opinion, based on medical professional power in her view, and she gave an example from an MDT consensus meeting for breast cancer, where her opinion was discarded, even though she felt her point was valid (p.193). Lewis et al. (2008); Matilainen et al. (2017) also found the views of radiographers to be ignored in clinical decision making, being stifled by paternalism, suggesting that the subordination of radiographers sometimes bordered on being 'unethical'. And denying their rights, with radiographers in their study reporting that they felt their professional opinions regarding patient outcomes, were sometimes supressed or diminished by radiologists, being unable to enter the ethical debate, with potential negative consequences for patients. This resonated with the comments of one participant in this study, who felt that without a medical qualification change would be difficult, with radiologists undervaluing the skills of radiographers with a paternalistic nuance, not being necessarily ill-intended (p.193). Henderson et al. (2017) found frequent tensions in the radiology workplace between radiographers and radiologists whilst implementing advanced practice, with evidence that the radiology profession can exert influence over the profession of radiography, especially in the evolution of the profession's scope of practice. Interestingly, Cowling (2018) found that in less developed countries, where there were fewer resources including radiologists, that radiographers tended to be more autonomous as a result or by necessity.

5.3.3 Emergent Radiography Profession

The *third* theme juxtaposes the seemingly imposed subservient culture found in the data in relation to radiography practice, with radiographers being content with their place in the pecking order, inhabiting a 'demi-professional' tradition, and being knowledge 'users' versus 'knowledge producers', to that of an emerging profession taking control of its own destiny. The data also revealed a sub-context of radiographers 'breaking out' of old traditions, becoming increasingly self-liberated with a new confidence, into fully autonomous professionals, claiming their rights to be recognised, and contributing to a new and expanding body of knowledge.

This study found evidence that radiographers tend to be most comfortable when reliant on other professionals for decision making. This might be due to lack of confidence, a training or background issue, or possibly that radiography attracts less confident actors, in contrast to medicine as discussed earlier. One individual in the study exclaimed disappointment with her colleagues: *"there were some staff who didn't feel that we should be taking on extra responsibilities, and very much deferred to doctors"*(P#5), and another participant was uncomfortable with being asked to extend her role, possibly hiding behind litigation risk: *"and I'm actually saying oh, no thank you because I'm not covered"*(P#13), and this is potentially also linked to some radiographers being reluctant to comment on the product of their work or give opinions. Another participant felt that their colleagues were disinterested in extending their roles, because they 'just want to come to work', and then 'go home and forget about it', possibly exhibiting apathy and demi-professional attributes. Yielder and Davis (2009) reviewed resistance and apathy in radiography practice, and suggested that professional advancement, supported by evidence, could be stifled by outdated misconceptions on the role of the radiographer and the profession's intrinsic tendency to be sub-servient. A multi-faceted approach to improving culture was recommended by Yielder and Davis (2009), including the reconceptualization of formal educational programmes with an increasing emphasis on critical reflection, targeted professional development and effective leadership. At the time, Yielder and Davis (2009) found that radiography was struggling to be recognised as a true profession, manifesting in low self-esteem, and apathy. Interestingly, as discussed earlier in relation to the first theme, respondents in the survey regarded the development of staff expertise and the availability of suitable educational programmes, to be negative contextual items, thus possibly adding further evidence to a need for improvement in this area. Lewis et al. (2008) describe how low autonomy led to radiographers capitulating to the “demands and decrees of radiologists” (p.93). Yielder and Davis (2009) contend that autonomy is linked to professional power, and as described earlier in this chapter, there was evidence in the data supporting this view, with radiologists retaining power in most radiography contexts, supported, or perpetuated by external forces. Restricting the role of the radiographer is de-motivating, “encourages mindless practice” (p.348) and discourages critically reflective and thus autonomous practitioners (Yielder & Davis, 2009).

There was evidence in the data of participants being unaware of what ‘clinical supervision’ meant as a concept, and radiographers generally viewed performance appraisals as a top-down organisational tool to ‘enforce’ value for money for the organisation, rather than embracing it as an act of reflective practice. However, ‘CAI statement 12’ in the survey (A staff performance review process is in place etc.), scored favourably in this regard when measuring radiography context. This potential anomaly might be explained by the CAI survey statement asking whether performance reviews take place per se, rather than confirming that these were helpful or productive in the view of respondents, and future development of the CAI might consider this aspect as a potential flaw. According to Sim and Radloff (2009), stifled practice can lead to defeatist attitudes, with radiographers possibly not being empowered or encouraged to contest the status quo, culminating in a self-defeating cycle. Here, there are parallels with the theories of ‘*Learned Helplessness*’ and ‘*Learned Hopelessness*’ (as applied to academic failure research) where “[the] inability to effect change and lack of personal agency give rise to motivational deficits” (p.348) (Yielder & Davis, 2009). Foucault (as cited in Yielder & Davis, 2009) argues that power is not inherent in individuals, but rather it is manifest in relationships, and that if passive roles are assumed, and others are allowed to wield power, then both parties are at fault, and as discussed earlier, aspects of negative hierarchy was the lowest scoring element of all, in the survey. Whilst discussing similar negative professional attributes found in nursing, Levett-Jones and Lathlean (2009) suggest that having “questioning, assertive practitioners are an asset to a profession that seeks to be innovative and forward thinking” (p.348), and the notion that medicine recruits confident actors, discussed earlier, might suggest that there is room for radiography as a profession, to examine the potential effect of promoting the recruitment of confident actors, as a means to developing attitudes and professionals willing to challenge the status quo, and might be worthy of future study in this respect.

Other studies have found evidence of radiographers being resigned to subordination, and an inherent reliance on medical practitioners for decision making (Lewis et al., 2008). Stone, Russell, and Patterson (2004) contend that leaders with narcissistic tendencies, manipulate and thrive on power, whereas dependent followers form strong connection to powerful individuals to satisfy their dependency needs. Yielder and Davis (2009) and Sim and Radloff (2009) suggest there is evidence that the radiography profession has a significant inferiority complex, and a tendency to under value the profession's role by its own practitioners, with a workplace culture perpetuating conformity and apathy, with a prevalent defeatist attitude. An example from the data reinforced this view: "*so, radiologists would seek the evidence and then ask the radiographers to implement it*" (P#16) highlighting the implied behaviour of knowledge user rather than knowledge producer. Strudwick (2011) cited an 'anti-research culture', found in her review of radiography practice, suggesting this might be endemic in the profession. Data in this study showed that radiographers saw radiologists as the final arbiters of knowledge selection and implementation in clinical practice, with evidence in one department where both professional groups were in dispute about sign off of clinical protocols (p.203). One participant linked professional credibility (within the organisation) to the level of training attainment, citing that a radiographer with a PhD was more likely to be taken seriously professionally compared to radiographers with entry or more advanced training.

The 'emerging professional liberation of radiographers', was an interesting phenomenon generally, and the development of issues and ideas surrounding the 'rights of the radiographer' to certain aspects of their practice as cultural artefacts, was liberating and powerful in the data. The data also highlighted the need for the professional right of radiographers to 'hold an opinion', based on their own professional knowledge, and the right to be able to disclose this to their patients, as part of normal practice, and this is linked to the first theme, where practice climate and cultural artifacts often prevented this. The notion of 'the rights of the radiographer' has been researched by others more recently and is explored in Appendix 1. Also, issues emerged encompassing the right of the radiographer to have time built into their role to discuss radiological image appearances with their patient, and an awareness emerged in the data of a sense of 'artistry' in the 'creation' of medical images, and the right to own, comment and interpret them. O'Regan (2018) discusses how scientific positivist research approaches have subordinated the reporting of artistry and creativity in radiographic science and research over the years, perpetuating the technical rational model of professional knowledge. O'Regan (2018) argues the paradox that the development of expert or advanced practice roles requires a transition from technical rationality to professional artistry encompassing professional craft knowledge. Higgs and Titchen (2001) discuss the work of Donald Schön (1983, 1987), in relation to exploring professional practice as an artistic endeavour, not inherently mysterious, but rather an alternative kind of knowing, which is potentially an important artifact of culture that could be explored further in terms of KT models in radiography. Professional practice is dynamic, and the absence of artistry in making informed judgements, can lead the practitioner to be an applied scientist, perhaps inflexible in the face of developing scenarios and new technology (Higgs & Titchen, 2001). There was however an emerging narrative in the qualitative data, that radiography was turning a corner, with the need for radiographers to break down barriers, or outdated opinions of role boundaries, both internally and externally, possibly supported by the high CAI score in the survey regarding ‘proactivity’, with a positive contextual connotation as discussed earlier in the first theme. With the emergence of advanced practice embedded in the national acceptance and the promotion of consultant level practice being positive in the data generally, interestingly, one participant saw this as a potential ‘newly emerging’ negative contextual trait, with consultant radiographers perpetuating the hierarchy, formerly occupied by radiologists in some instances, and simply repeating historical mistakes, by becoming the new dominant force in the team.

The notion of ‘change agency’ was seen in the qualitative data where a consultant radiographer felt that potentially barriers were created intrinsically within the profession, and in other ways radiographers are expected to continuously justify decisions with greater scrutiny, whereas the voice of the radiologist is heard and not challenged due to status. Whereas more than one participant noted how consultant level radiographer practice was now successful in establishing true autonomy in their workplaces, and previous barriers to advancement, were now being enabled by service need, and pressure to sustain services in the face of radiologist shortages, and increasing service demand. One aspect in the field promoting autonomy, seemed to relate to the notion of ‘trust’, and that radiographers needed to positively influence radiologists and other teams, to have confidence in the ability of radiographers in their expanded roles (p.205). Another participant stated that they did not feel it was appropriate for another profession to be a gatekeeper for radiographer roles. The Society and College of Radiographers (2017a) in their report on the scope of practice of consultant radiographers, declare the high level of autonomy expected in the role, and yet the quantitative data scored lowly in this regard in this study. Booth, Henwood, and Miller (2017) describe the importance of leadership in the role of the consultant radiographer, especially between teams in the healthcare setting, exerting positive influences on intra and inter-team dynamics and having and inspirational dimension. The exploration of the 'role of the individual' in the consultant radiographer (as a change agent) in influencing, promoting, and implementing EBP might be an area for further study in this respect. Henwood, Booth, and Miller (2016), in their review of the impact of consultant practitioners in radiography, noted that there was a limited body of evidence measuring their effect on patient outcomes, and the need to strategically plan future provision and role optimisation. In their review of the research practice domain of consultant radiographers, Harris and Paterson (2016) found a lack of preparedness and acceptance of research as a pivotal part of the role, with issues surrounding lack of confidence, ability or experience, compounded by the low number of participants in their study having masters or doctoral level training, and this was reflected in this study, with only 2% of respondents in the survey having doctoral level training, and only 15% having master's level training. These factors, linked with the views of participants regarding credibility, perhaps need further consideration when developing advanced roles. This study found examples of how 'consultant radiographers' positively influenced teams in evidence use and seemed to be strong proponents in their radiography contexts in encouraging local change, by raising interest amongst junior radiographers and 'reporting radiographers' in clinical research and local application (p.209). Another strong exemplar was that of a specialist 'McMillan Radiographer', targeting recovery management in radiotherapy, and championing best practice. And one participant with previous experience in sales, felt that he had to 'sell ideas' to his colleagues to effect change. Implementation researchers have more recently recognised the powerful role of individuals in mediating change, and influencing evidence and context (Harvey & Kitson, 2016), and this will be reflected upon later in this chapter, in relation to the findings of this study with a complexity theory perspective.

5.4 Impact of the Systematic Review on KT in Radiography

The systematic review offered new insights into an area of radiography of which there is little, if any, research extant in the UK. IS, and the application of its theories and frameworks to clinical practice, seems to be a mature subject in other health professions, with much of the literature surrounding implementation efforts in nursing. There was a distinct paucity in research, relating specifically to IR, found in the review. Other research efforts (found in the review) implementing evidence into practice, was not cognisant of the wider scientific approaches used by other professions, to understand the fundamental underlying principles linking modifying variables to causality in implementing change in radiography. It was not possible to undertake a meta-analysis of the included studies due to the diversity of the included research. The review focussed on identifying the state of implementation in UK practice alone, where it was argued in Appendix 1 that radiography (as a profession) has its own unique history, development, and advancement in its own unique context. As exemplified earlier, radiography has traits of an emerging profession (in terms of its established body of knowledge). Radiography suffers from professional dominance issues, apathy, and overreliance on the consumption of evidence produced by other professions, even though radiographers have practiced (using a unique body of knowledge and technical skill) for over one hundred years. Radiography has been shown to have its own unique epistemology and ontology, with technical, critical-emancipatory, and practical-hermeneutic interests, and proponents keen to stress the distinction between radiography as 'profession' - and radiography as a 'science' - necessitating a tailored philosophical approach in the systematic review (Metsälä & Fridell, 2018).

The systematic review adds to the body of current knowledge, by revealing what KT interventions have been used in radiography, in what circumstances, and the effect that they purported to have in practice (specific interventions tabulated in Table 4). However, it is acknowledged that the evidence found was of low-level quality mostly, with only one RCT found. This study did not attempt to grade the quality of the included evidence, as this has been shown to have potential flaws, and due to the heterogenicity of the included evidence, subjective quality checklists were used in order to minimise experimental bias reporting, and to highlight potential flaws in the included articles.

The method used for the review was guided by that of previous researchers in the area of interest in order to add to the wider body of knowledge surrounding what is known about implementation in the allied health professions. This study adds to this body of knowledge, by adding radiography practice in the UK context, to the list of included professions. However, this review was conducted as a research project, without the usual resources of a large systematic review involving many researchers, therefore some limitations have to be acknowledged, which might have had some bearing on checking the articles to be included or excluded, or the accuracy of data extraction, as these were partially appraised due to the limited time of the supporting researchers. There was no 'high-quality' research evidence found reporting how KT interventions worked or why they worked (or not) in radiography, and some of the studies were not recent. The small number of implementation studies found however, reported the effect implementing the evidence or innovation, rather than appraise the KT method per se. Examining how the interventions work in a particular radiography context will further implementation knowledge in the future. Illuminating the contextual issues, barriers and enablers should prove valuable to future research in the radiography domain and this study adds context specific information in this respect to the body of knowledge. The systematic review revealed issues such as: inter-professional barriers; professional dominance; access to research; low confidence to interpret research by radiographers and educational aspects seem to affect the context in radiography implementation. These were also strong negative contextual confounders found in the qualitative arm.

The professional bodies representing radiography, policy makers and government, should understand the benefits of developing and utilising evidence-based medical imaging and radiotherapy practice in the UK, together with research into KT strategies and interventions in radiography, specifically understanding what worked and how, and in what context, and this being supported by IS. The review implies therefore that there is a potential for sub-optimal evidence adoption by the radiography community, although no evidence was specifically found to support this view. Further research is recommended in developing a taxonomy of interventions that can be shown to be effective in radiography, showing what the modifying variables might be, and in what contexts they may work, in order to promote the science of implementation into the realm of radiography.

Reflecting critically on the review method, a more context sensitive approach could have been utilised adding more useful evidence of what works in what contexts, such as a realist review (Rycroft-Malone, 2015), however these are more challenging to conduct and it was considered to beyond the scope of this project, given that mixed methods were utilised to gain a wider understanding of the context. Questions remain unanswered, regarding the impact of KT strategies in radiography in the UK. A recently published research protocol shows promise in the use of Normalisation Process Theory as a guiding framework in the implementation of radiotherapy aftercare, however this study did not directly involve radiographers or the radiography service, and the results of the trial were, at the time of writing, unpublished (Taylor et al., 2016). An example of evidence-based national guidance on skin-care after radiotherapy, using strong evidence and promoting implementation with a 'packaged' approach supporting implementation, also showed promise (Society and College of Radiographers, 2015).

The systematic review has revealed the primitive state of IS theory application to radiography research, and that radiography appears to exist currently as an emerging profession in relation to its evidence base. There is a need to understand the fundamental issues surrounding implementation, and its potential positive effect on radiography as a profession and radiography as a science, in order to develop and sustain effective evidence-based practices in the future and to support the rights of radiographers to utilise evidence in their practice. Given that May et al. (2016) contend that IR can be used as a laboratory to investigate actors and how they interact in a complex adaptive social system, policy makers and the profession should consider the value of IR and supporting theories in future clinical or applied research.

5.5 Radiography Context – A Systems Perspective

Ch.1 discussed how CT has been adopted by researchers as a theoretical lens useful for evaluating implementation context in healthcare settings and discuss key complexity theory concepts (Chandler et al., 2016). Complexity thinking is gaining momentum in considering healthcare systems as complex adapting entities, requiring multifaceted solutions not found in the traditional reductionist paradigms, thus being a useful explanatory model in this respect, and a departure from conventional KT thinking (Khan et al., 2018; Kitson et al., 2018). Chandler et al. (2016) concluded in their study that CT is a useful guiding theory in seeking to explain or represent relations between 'parts and the whole' in system formation, and posit 'core concepts' for the application of the theory in the complex 'social system' applicable to implementation specifically. Moore et al. (2014) however criticise CT in relation to implementation, with little empirical evidence supporting its use in guiding KT efforts, however they acknowledge its potential utility in determining complex causal relationships in qualitative data, by examining feedback-loops. Dynamic systems-level behaviours and how they are influenced by the interconnections between agents can be represented using a conceptual framework in KT efforts (Braithwaite, Churruca, Long, Ellis, & Herkes, 2018). Braithwaite et al. (2018) suggest that triggering mechanisms are required using a systems-informed complexity approach to stimulate change, and give examples such as wide stakeholder agreement, legislative changes, evaluation and paying attention to feedback loops.

Nilsen and Bernhardsson (2019) remind us that most implementation frameworks consider organisational culture per se, however healthcare settings are multi-cultural by nature, given the diversity of departments, professions, and teams. Complexity thinking promotes a system based worldview, looking beyond particular contextual factors, and exploring the connectedness of those factors in its own system and larger systems beyond (Khan et al., 2018). Often, contextual characteristics are viewed as barriers in IS, however a systems viewpoint illuminates the uniqueness of local cultures and interconnections, highlighting confounders in one context being enablers in another, often facilitative (Braithwaite et al., 2018).

5.5.1 Complexity Theory – Systems Overview of Radiography Context

The following section briefly examines the study key findings using selected core complexity concepts as individual theoretical lenses.

5.5.1.1 System history

Path dependency, described by Gear et al. (2018), refers to the influence of system history on contemporary system behaviour and events. Chandler et al. (2016) discuss *System History* as the sensitivity a context has to its starting point, referring to such complexities as: boundaries, adherence to 'trace' behaviours, and historical social processes. Persisting power and influence issues found in this study can arguably be linked to the shared history and ongoing development of radiography and related medical professions such as radiologists, including their embedded local multi-contexts and external influences. Radiologists were found to habitually dominate radiographer development and individual practice, although there was evidence that 'new generation' radiologists were less likely to do so, perhaps suggesting that the historical link to dominance, paternalism and pre-eminence is waning or adapting. CAS theory suggests that although the system continually transforms over time, trace habits can remain, perpetuating boundary issues. Exploring multiple-radiology contexts in this study revealed a persisting theme of radiologists commanding superior status within organisations, with evidence that organisations paid greater heed to radiologists' opinions, with radiographers often content with their demi-professional status, seen to be subservient in their contexts. The emergence of consultant and advanced practice radiographers was seen however to make strides into the evolution of this systemic trait and individual actor behaviours. Boundary disputes and turf wars persisted across many contexts within this study. (May et al., 2016) explain that normative restructuring occurs in complex systems, where actors eventually adjust their accountabilities to each other, to enable group action in implementing change.

5.5.1.2 Self-organisation

This is a process where agents organize locally to give patterns of interaction, which can be stable or unstable, evolving with time, and can be a major source of healthcare variations across settings (Lanham et al., 2013). The local nature of *self-organisation* can be resistant to change efforts, due to powerful local roots in the way tasks are accomplished and can circumvent formal written procedures and structures designed to control local behaviour, often not understood by the higher order in the organisation (Lanham et al., 2013). Khan et al. (2018) describes self-organization as an adaptation characteristic inherent in a system, and that adaptability will be a system requirement when successfully restructuring healthcare. Understanding and attending to self-organisation at a local contextual level can be an effective method of diffusion of healthcare innovations, across various settings (Lanham et al., 2013). In this study, unstable traits were found where some medical professionals actively blocked role extension and knowledge sharing due to outdated paternalism and dominance, with advanced practice radiographers not being heard or blocked at a breast MDT, being one example as discussed earlier in this chapter. A stable example of self-organisation in this study saw radiographers develop their roles and challenging outdated boundaries despite strong resistance locally by other actors. Braithwaite et al. (2018) discuss the iterative and sometimes reverberant nature of this CAS characteristic, with system unpredictability and nonlinearity needing consideration in KT planning. Researchers and policymakers should be aware of the powerful nature of *self-organisation* in radiography contexts, although it was reassuring to find participants in this study, pushing back against engrained social norms in the system. Gear et al. (2018) observe that evolving patterns of interaction self-organise into new behaviours over time, and that this might allow health professionals to gain confidence and capability.

5.5.1.3 Interaction

Braithwaite et al. (2018) discuss the localized nature of agent interaction, and although they are similar in the wider system, there can still remain notable variation between organisations leading to sporadic implementation of a new intervention, with unsuccessful implementation of new practice being linked to generalizability being wrongly assumed, in various contexts. Contingency theory is founded on the assumption that processes are environmentally dependent (Engelseth & Kritchanchai, 2018). Given that much of the research and development in radiography practice currently surrounds the efficacy and expansion of role extension (Henderson et al., 2017; Milner & Snaith, 2017), it can be argued that a focus on radiologist and radiographer interaction and emerging structures of imaging and radiotherapy practice, might be enhanced by using CAS theory in future research in this field. The developing role of advanced practice radiographers in undertaking more complex diagnostic and radiotherapeutic interventions was seen in the data, and this is supported by Birken and Currie (2021), who recognise the key roles played by middle-level managers (MLM) as agents of evidence implementation in clinical settings. MLMs in hybrid clinico-managerial roles can be seen with the development of advanced and consultant practice in UK radiography, with Birken and Currie (2021) contending that system-wide role coordination, facilitated by deep relationships with frontline staff, can lead to effective localised implantation of EBP. Empowering MLMs using contingency theory, is more likely to succeed at local implementation rather than adopt implementation specific roles in facilitation, with MLMs working at a local level in context specific evidence promotion (Birken & Currie, 2021). Consultant radiographer roles were seen in this study, with evidence that more autonomous practice, greater responsibility and education level, led to greater interaction within the local radiography team, with a bespoke approach to collective EBP. Research into the role of MLMs, as embedded facilitators, might be a useful approach to understanding the effectiveness of clinico-managerial roles in future implementation efforts in radiography, which might be of interest to educators, organisations, and policy makers.

5.5.2 Chapter Summary

This section evaluated the findings of the study in relation to the existing evidence base. The Quantitative arm revealed a relatively high context index for UK radiography practice, together with identified high and low scoring CAI items, which were useful in comparing the merged data in the Qualitative arm. The potential limitations of the quantitative data were discussed and evaluated in relation to the contribution of the data to new knowledge in the field. Although not a stated aim of this study, it was necessary to evaluate the psychometric properties of the CAI, in order to evidence the maintained integrity of the modified instrument. This was shown to be consistent with the original tool, and with that of existing research, which has evaluated adapted versions of the CAI in other contexts. Three main themes were formed from the

Qualitative arm. A complex *practice climate and culture*, pervading the radiography practice context at all levels, had an enduring influence on the ability of radiographers to develop within their roles, with intrinsic and extrinsic contextual influences, either facilitating or confounding practice change and evidence adoption. The *Established Radiologist Eminence* theme exposed the strong paternalistic and mostly negative influence that radiologists had in relation to the autonomy of radiographers, sometimes feeding or perpetuating the established subservience of the radiography profession. This was contrasted by the *Emergent Radiography Profession* theme, despite some negativity expressed by some participants. In relation to ability, confidence and level of knowledge and training, there was evidence in the data of emergence and agency, with empowered radiographers in leadership roles and advanced roles, having a strong influence in developing the science and profession of radiography, into a more autonomous state. This section also considered the merged data within the MMR study, revealing some weaknesses in the CAI in relation to radiography, with the instrument possibly lacking definitional clarity and specificity to the context of radiography practice in some instances. The merged data also added to the existing body of knowledge and highlighted potential areas of further study in relation to radiography context per se, and in terms of the further development of the CAI for nursing, as well as other clinical professional contexts. The contribution of the systematic review to the overall study was also discussed in this section, highlighting the paucity of existing research specifically exploring how IS and theory can make a difference to radiography practice in the UK, as well as revealing potential KT interventions and confounders within existing research. Finally, the use of CAS theory lenses to further interpret the wider findings of the study, gave further 'systems' insights into the influential role that *system history*, *self-organisation*, and *interaction* might have on the ability of the system to change. Based on radiography and radiology's historical development and cultural artifacts, resistance to change due to self-organisation influences, and interaction highlighting false assumptions of generalizability between and within organisations, systems theory revealed powerful theoretical influences on implementation potential, and should be a useful theoretical companion to future implementation theory research in this field.

6 Chapter 6 – Conclusion & Recommendations

6.1 Contribution of the Study to New Knowledge

The aims of this study were to understand what is known about implementation within UK radiography practice, and to explore any influence that IR has had. MMR facilitated a novel approach to investigating radiography context using methods supported by the contrasting philosophical paradigms guided by the project organising framework. A pragmatic philosophical approach to data collection and analysis, enriched the final output, by adding further perspective and understanding of implementation in radiography, and the lived experience of practicing radiographers in their contexts.

The primitive state of IS theory application in UK radiography practice was revealed in this study. The systematic review expanded the work of Scott et al. (2012) and provided similar insight to the qualitative study, that radiography has traits of an emerging profession in relation to its evidence base compared to nursing and medicine, with interprofessional issues extant. The review adds to the body of knowledge as the only study to have explored IR in radiography, what KT strategies have been used, shown to work, and in what circumstances. The identified KT strategies were classified according to Powell et al. (2012), and this should be a useful framework to build upon in future research, relating to KT strategies shown to work and not work in radiography. The identified implementation barriers and enablers should also be useful to future research and policy.

The adaptation, testing and use of the CAI amongst UK radiographers is unique and should be of value in future research in this field, or as a diagnostic tool in the clinical setting to understand local contextual issues in practice. The instrument was adapted and tested in the field to be more context specific to the practice of radiographers, being mindful and tending to the integrity of the original instrument. Extensive statistical testing, including complex SEM, was undertaken to confirm the integrity of the modified instrument compared to the original. This study found that responses in the survey generally met conventional standards for the internal consistency of the 5-factor model of the CAI as used in the original instrument. As with other attempts to modify the CAI into other languages or contexts, the radiography CAI was shown to have strong factorability with the 5-factor model, and with that of the 3-factor model more closely aligned with the original PARIHS framework, supporting the reliability of the data acquired in the quantitative arm of this study. However, this and other studies have highlighted that there are still issues of 'lack of definitional clarity' within the CAI, perhaps needing a more context specific approach to future adaptation of the tool. Few have tested the psychometric properties of the CAI after its initial development, and there is no published research on the factorability of the CAI constructs in the radiography domain other than this study currently, adding to existing knowledge in this respect.

The use of MMR to understand implementation and its context as applied in radiography practice has not been undertaken before, with the qualitative arm revealing enduring systemic socio-cultural and regulatory confounders to improving practice, as well as an endemic professional tendency to subservience, possibly linked to system history, although there was encouraging evidence of professional advancement from within radiography, pushing boundaries and emerging as a more autonomous profession. The Qualitative data revealed a rich and deep understanding of the lived experiences of contemporary radiographers in the clinical setting. This highlighted the enduring contextual confounders of a dominating medical profession with a paternalistic tendency (not always malicious), and the sometimes predisposition of the radiography profession (either rooted in history, or by the natural selection of less confident actors into the profession) to be sub-servient and compliant. The Qualitative data also revealed evidence of emergence within radiography, with confident, educated actors leading advancement in the clinical and research domains, and building confidence into the system with growing acceptance of autonomy in advanced practice radiography roles. The use of the PARIHS framework as a constant guiding thread throughout this study is also unique in radiography research, and no other study could be found where its theorised elements were used as lenses to understand the unique context of UK practice, and its potential to positively or negatively influence future EBR. PARIHS has now evolved into a new proposition, and this study revealed evidence of the strong influence of individual actors on implementation, together with contextual confounders at multiple levels, with the qualitative data showing signs of being more aligned with the revisited version of PARIHS the i-PARIHS (Harvey & Kitson, 2016). The latest iteration of the framework hints as to why in this study the CAI revealed relatively high scores for context using the original PARIHS constructs, whereas the qualitative arm revealed a more mixed context, relating more with the latest version. The use of complexity theory lenses to summarise potential novel findings, highlighted that there might be merit in exploring the role of MLMs in promoting EBR and practice change in concordance with the i-PARIHS insight into the powerful role of actors.

6.2 Limitations & Reflection on Findings

6.2.1 Systematic Review

The mixed-method systematic review revealed the current elementary state of implementation in radiography and identified KT interventions that had been tried in practice or proposed to be potentially useful in future research or change efforts, and it was acknowledged in Ch.2 that there is controversy and sparse evidence supporting such methods aiming to synthesise qualitative and quantitative research. The inclusion of diverse evidence however did allow a greater understanding of the KT interventions described above. Although the review was extensive and was based on sound methods previously used in similar reviews in other health professions, the quality of research found was of mostly dated or of low research quality, and a meta-analysis was not possible due to the diverse nature of the articles found. The quality (strengths and weaknesses) of the included articles was accounted for in the review and clearly shown in the findings table Appendix 7. Nevertheless, the identified KT strategies, might be of use in future implementation efforts in radiography. As discussed in Ch.5, a more context sensitive approach might have been utilised such as a realist review, however this was considered beyond the scope of this study due to the resources and time required to conduct such a complex review. The review undertaken might have usefully informed the other arms of this study, however due to time and resource constraints it was considered to be relatively standalone, and was useful in giving a 'snapshot' of the current state of IS utilisation in radiography.

6.2.2 QUAN Arm (CAI Survey)

A significant finding of this study surrounds the misalignment of the high implementation context scores found in the survey, with the persistent negative contextual issues found in the qualitative arm, mostly surrounding the powerful role of individual actors in radiology departments, and external influences impeding the ability of radiographers to implement EBP. As highlighted earlier in this chapter, Factor Analysis of the modified CAI used in the questionnaire, showed an excellent fit with the 5-factor model proposed by (McCormack et al., 2009), and a good fit with the PARIHS 3-factor model. Although there has not been much published work exploring the factorability of the CAI, other research is in alignment with the findings of this study in this respect, however one group cited issues such as lack of definitional clarity in the *context* construct of PARIHS, adding potential bias in their data (Kajermo et al., 2013), and this aspect potentially might have influenced some of the data in this study. As mentioned above, a potential explanation for some disagreement between the MMR arms, might relate to lack of definitional clarity or ambiguity in the terminology used in the original CAI instrument and the PARIHS constructs. This was somewhat accounted for in the method design of this study, where some changes were made to the original instrument statements and piloted using cognitive interview techniques, revealing some definitional ambiguity relating to context applicability to radiography practice. The CAI was modified slightly to reduce ambiguity in terms (to radiographers), however this was not radical as to maintain the integrity of the original tested instrument. Some high and low scoring CAI items could be erroneous for this reason potentially skewing the overall context score. Further development of the CAI might include more generalisation to be less specific to nursing contexts (including statements with definitions) or develop a bespoke CAI for the radiography context. A larger study might include other means for gathering data, however no funding was available for this study, thus limiting the sample size in the survey. The sample characteristics were discussed in Ch.4 and Ch.5, and the overall recommended sample size was not attained, however the actual data utilised was shown to be within the recommended ME tolerance. The sample was reached through advertisements in the professional body's website and hand delivered journals. In this regard, there is potential to have only selected individuals predisposed to engage with research or continuous professional development. There was a variation in sample sizes between 'Home Nations', 'Therapy vs Radiography' practice and 'practice sector' (NHS vs Private Practice). This was somewhat expected at the outset, and broadly reflected the general population for each category, as shown in Ch.4. and discussed in Ch.5, and a larger and better resourced study might have gained more responses from these sample categories. For this reason, it was not possible to measure the CAI score variations between the home nations, although some inferences were possible between England and Scotland.

6.2.3 Critique of the Guiding Theory Used (PARIHS)

Whilst this study did not set out to evaluate the effectiveness of PARIHS as an implementation framework per se, it was used as a pragmatic guiding heuristic in the conceptual framework of this project. PARIHS, as proposed by its original architects and subsequent refinement team (Rycroft-Malone, 2004) was discussed in Ch.1 and provided a theoretical underpinning for the instrument used in the collection and subsequent statistical evaluation of the Quantitative data collected in the national survey. The interview schedule was also based on the original PARIHS framework (Kitson et al., 2008) and the ‘CAI tool-pack’ (McCormack et al., 2008b). This allowed a focus on the elements theorised to have an effect on the promotion of evidence-based practice, namely *context, evidence, and facilitation*, during the semi-structured interviews, gathering the qualitative data for this MMR study. PARIHS was also used to formulate the initial guiding coding framework for qualitative data analysis. Harvey and Kitson (2016) have more recently proposed an updated version of PARIHS (i-PARIHS) in order to address some key dimensions that were not adequately addressed in the original framework, such as the growing evidence on the role that individuals play in the implementation process, and the effect of the wider external context. The proposed new version of PARIHS (i-PARIHS) is described as being more integrative, with a reworked view of the *evidence* construct; more emphasis and understanding of the role of the individual; the effects a team has on implementation; as well as *context* being further delineated (Harvey & Kitson, 2016). The *innovation* concept further develops the original *evidence* construct, including inductive evidence found to be generated in practice, and within specific local contexts. This concurs with complexity and systems theory and its *Self-Organisation* concept as described in Ch.5, where local traits and systems can be powerful and resistant to change, with actors circumventing imposed protocols being one example. The *recipient* construct in i-PARIHS provides more emphasis on the role of individual actors and team behaviour in implementation. The enduring complex relationships between radiographers and radiologists in various teams across this study might have possibly been identified more specifically by the CAI, had an emphasis on individual actors been included in the original instrument, as described in i-PARIHS. Factors in the CAI touch on empowerment and mutual-respect, teamworking and respect for individuals, however a greater emphasis might be placed in future versions of the CAI to understand some specific individual traits found in the qualitative arm of this study, such as professional apathy, confidence issues, professional dominance and the external influence of professional bodies, regulators and legislation, on the ability of individuals to align their professional capability with the required practice development. i-PARIHS recognises specifically that facilitation needs to include an assessment of existential and potential boundaries (to implementation) amongst professionals, and in this study barriers and professional boundaries caused turf wars locally and nationally. Themes that emerged in the qualitative data also seemed to align with the i-PARIHS traits of individual behaviour (enablers and confounders), revealing that the new version of the framework might be more intuitive in guiding future similar qualitative research in this respect (Flottorp et al., 2013; Harvey & Kitson, 2016). One insight of this study is that MLMs might have a key role to play in tailored evidence implementation in various contexts, with advanced and consultant radiographers being empowered and skilled-up in this regard.

The revised PARIHS framework also has a wider view of context, at various levels to include the wider health system, and the expanded role of the facilitator at all levels see Appendix 25 (Harvey & Kitson, 2016). This study found a theme of wider system (macro) influences on radiography implementation context, with a climate and culture of complex factors ranging from outdated regulatory framework to public nescience and professional obscurity, interprofessional animosity at a national level and inadequate access to sources of good research. It was reassuring to find that the wider scope of the context construct in i-PARIHS in this respect being resonant with the findings of the qualitative data in this study – made real through the lived experiences of contemporary practicing radiographers. A final thought surrounding context assessment and the PARIHS framework surrounds the mechanistic approach to understanding and breaking context into constituent parts, and then facilitating a ‘repair’ in this respect. CAS theory might have merit in shining a light on individual micro contexts, where a complex network of actors inhabit large health systems with locally powerful influences on implementation. PARIHS, and its latest iteration, might show us where to look in the future.

6.2.4 QUAL Arm (Semi-Structured Interviews)

It is acknowledged that a sequential MMR approach might have been more powerful or effective in honing-in on specific areas of interest found in the survey and CAI result, and further evaluating these by informing the interview schedule and approach to questioning. This would have required much more time to conduct the study, and it was felt that having a fully inductive approach, would allow a deeper and wider understanding of the complex context in which radiographers practice, as facilitated by the TA method. Although the participant numbers were not high (n=20), it was considered that the themes generated were widely representative of the wider context, and that saturation had been attained.

6.3 Recommendations for Research

- A larger study exploring specifically the contextual differences between the public and private sectors might illuminate specific cultural contrasts.
- Gaining further insight into generational differences and years of experience in practice might allow targeted implementation efforts.
- Research is recommended in developing a taxonomy of interventions that can be shown to be effective in radiography, showing what the modifying variables might be, and in what contexts they may work, in order to further the science of implementation into the realm of radiography
- Researchers in radiography science and practice should consider using IS theory to inform their work.
- Further work adapting the CAI instrument into radiography context specific language (from nursing), improving definitional clarity, and consideration as to investigating various levels of context and the role of individuals by using the i-PARIHS framework as a model for an updated version of the CAI.
- To understand the impact that potentially outdated regulation has on the practice of allied health professions and their ability to develop EBP.
- Examining the access issues that practicing professionals have to full text articles to review evidence as related to their practice.
- Gaining further insight into the role of MLMs in promoting and sustaining practice change.
- Researching whether recruiting more confident actors to the profession might improve leadership and autonomy and resistance to professional dominance
- Consider the use of Social Network Analysis to broaden understanding of professional or organisation networks, personal attributes, and professional identities.
- Researching the views of radiologists in terms of IS, knowledge utilisation and radiographer role development and professional boundary issues.

6.4 Recommendations for Policy Makers and Practice

This study has highlighted that IS has not yet made an impact on those proposing practice change, recommending evidence use or those researching radiography practice and science. IS and its theorised models and frameworks should play a part in understanding context, and for planning practice or service improvement. National guidance by policymakers should consider the unique context that radiography has in health systems, and the unique interventions that might be required to promote and enable evidence use. The findings of this study should signpost future policy and research requirements in radiography being mindful of its unique context.

6.5 Chapter Summary

Policy makers and organisations should be aware that evidenced KT strategies and implementation efforts might not easily translate to the radiography context from nursing research or that undertaken in other contexts. Although this study is not exhaustive and has limitations (somewhat due to the sparse evidence found in the systematic review and relatively low response to the survey), there remains strong evidence that the CAI has merit in understanding national, regional, and localised context in its application, and showed robust factorability as adapted to radiography. Future adaptation of the CAI using i-PARIHS might further enhance its utility, especially in understanding context at multiple levels, and perhaps measuring more precisely the influence of individual actors, professional tensions, and historical artifacts that might unbalance local contexts. There is evidence that UK radiography practice is making strides towards fully autonomous practice, with consultant level practitioners in MLM hybrid clinico-manager roles, making a difference in this respect. Leadership was a low scoring CAI element in the survey, together with low numbers of respondents stating that they had any formal leadership training. As discussed earlier, only 8% of the quantitative respondents reported having any formal management or leadership training when asked in the background section of the questionnaire. The qualitative study revealed rigid historical team structures within radiography, and reliance on protocol-driven work, suggesting that a team-based approach with strong leadership is required for local implementation efforts. Further work to understand, develop and empower these roles might be key in promoting practice level changes in UK radiography, with evidence that implementation is more likely to succeed by empowering local actors in MLM roles than using implementation specific roles per se. Finally, radiographers need to be supported at all levels in the health system, to be empowered and legally enabled to undertake advancing roles, and professional bodies, health organisations and lawmakers need to understand this insight, to make future EBR achievable, effective, and sustainable, guided by strong evidence and implementation theory.

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8 Appendices

Appendix 1 - Contemporary Challenges in Evidence Based Radiography

Historical Emergence, Radiography Science and Professional Development

Medical or Clinical Radiography can be conceptualised as a science, an art or a discipline, with debate still enduring over whether radiography fully complies with the conventional tenets of a scientific paradigm (Metsälä & Fridell, 2018). The epistemological and ontological underpinnings of any profession can be argued to surround its science (knowledge foundations, theories, methodology and underlying concepts) (Ahonen & Liikanen, 2009; Metsälä & Fridell, 2018).

Radiography, conceptualised as a science, can be represented by the humanities, natural sciences and technology, with much in common with other academic disciplines (Ahonen & Liikanen, 2009). Yet proponents of the science and profession of radiography (as with other allied health professions) (AHPs) have long argued the underlying juxtaposition with the established autonomous traditional professions of medicine and law, and the ongoing struggle for recognition as an emerging profession in the public, political and professional domain (Sim & Radloff, 2009). Referring to medical radiography in particular, Lewis et al. (2008) state that "The development of radiography has been played out in a historical, political and professional context and has been largely controlled by the presence of medicine" (p. 91). Radiography continues to be practiced in a semi-autonomous mode in the UK and in other countries, with much of its function traditionally seen to be in support of medical practice (Lewis et al., 2008), with evidence of domination and interprofessional conflict being manifest internationally (Lewis et al., 2008; Strudwick & Day, 2014). This is also seen in other similar professions such as nursing, with evidence of physician oppression, damaging public and internal professional self-image (Ten Hoeve, Jansen, & Roodbol, 2014). More recently, in the past twenty years or so, there has been a macro level political drive, and service need, to develop and extend the roles of AHPs (Kelly, Piper, & Nightingale, 2008; Laurant et al., 2010). Reconfiguration of the UK National Health Service (NHS) in the 1990's necessitated a new strategy of skill deployment and the blurring of professional boundaries was required to meet new challenges (Kelly et al., 2008). New roles were created for nurses and AHPs in response to increasing service complexity and demand, and the politicisation of patient waiting times service standards, required an expanded and more skilled workforce in the face of increasing healthcare challenges (Harris & Paterson, 2016; Kelly et al., 2008). Henwood et al. (2016), in a more recent reflection on the development of consultant practice in the AHPs, suggest that the two main drivers supporting the need for consultant practice in the UK, has been "the achievement of better outcomes for patients" (p. 44) and "the maintenance of experience practitioners' position in clinical practice" (p. 44). The journey to advanced and consultant clinical roles for the AHPs has not been smooth, with legal, political and inter-professional issues of resistance and credibility, amongst others, still persisting in a context of increasing complexity and service demand (Henwood et al., 2016). The notion of EBP and EBR was introduced in earlier and its link with driving quality in role development and patient services in healthcare is clear, with the very nature of professional practice, and the advancement of AHP roles, being founded upon the skills required for knowledge generation and research utilisation (Harris & Paterson, 2016).

Historical Perspective, Professional Emergence and Nomenclature

Röentgen's discovery on the 8th of November 1895, of an invisible penetrating light, capable of producing shadows of bones and joints, not even conceived of previously in the realm of science fiction, rapidly became a global historical event (Decker, 2006; Smith, 2009). Towards the end of the 19th century, and the beginning of the 20th century, operators of the new x-ray apparatus, were multifarious, both medically and non-medically trained, but with a general interest in photography (Guy, 1995). The term 'radiographer' and 'radiologist' was used interchangeably until, in the 1920's, the former became associated with non-medically trained operators, and the latter with medical doctor's practice (Price, 2001). The general lack of awareness of the dangers of ionising radiation, meant that the early use of the technique, was by a diverse group of individuals inside and outside the hospital setting, including examples such as: nurses; porters; stokers; chemists; and clergymen as well as the more trusted surgeons (Guy, 1995). The invisible nature of X-rays, and the public awareness of early injuries and deaths from exposures lasting many hours, led to public suspicion regarding the malign nature of this early imaging technique (Guy, 1995). In the 1920's, as the use of X-rays for medical purposes became more prevalent in the UK, the growing number of lay-operators, resulted in the formation of the Society of Radiographers (Thomas, 2018), establishing the foundations for training, examination and the early formation of the profession in the UK. The 'medical oversight' of radiography, from its inception, and the "sociological recognition of medicine as a discipline, over radiography, as a technical skill" (p.264) promulgated the 'master-servant' relationship (Decker & Iphofen, 2005), with the following quotations illustrating this position, and medical opinion, in the early 20th century as the medical specialty began to develop, although acknowledging legitimate role for the 'lay operator':

> There is no reason for professional prejudices against the practice of radiology by lay-men, so long as they confine themselves to the mere mechanical act of producing a picture and abstain from assuming scientific knowledge of their bearing of their radiographs on diagnosis or prognosis
>
> (Price, 2001)

> Three things are necessary to give radiology that position of reliability in professional work which it is surely, namely, good apparatus, intelligent and skilled use of such apparatus, and sound general medical training and experience to interpret and control the results so obtained. The two former conditions are possible enough to operators outside the medical profession; the third is of its nature impossible to such persons, and the three cannot be efficiently separated. For a non-professional operator to offer a medical opinion on a radiogram is sheer impertinence.
>
> (Price, 2001)

Also, due to the heavy use of radiography in the 1st World War, many early radiographers were drawn from the armed forces, which led to gender issues with the nurses who had developed into radiography roles in hospitals (Decker & Iphofen, 2005). The strive for full professional recognition after the 2nd World War, eventually came to fruition in the UK, when radiography became a State Registered profession under the Council for Professions Supplementary to Medicine (CPSM), after its formation by Act of Parliament in 1960 (Decker, 2006; Nixon, 2001). Nowadays, radiography is a fully regulated profession in the UK and many other countries, and enjoys legal protection of title (Health and Care Professions Council, 2018b). The Health and Care Professions Council (HCPC) now regulates the profession, being responsible for education, practice standards and discipline for the purpose of public protection (Health and Care Professions Council, 2018b). The knowledge base of radiography (influenced initially by nursing, physics and medicine), developed from the need to have a code of conduct as a regulated profession, to ensure training standards and radiography practice development (Decker & Iphofen, 2005). By the 1990's the Society and College of Radiographers (SCoR) was publishing a Research Strategy for the profession in order to continue development (Decker & Iphofen, 2005). Professional nomenclature remains an issue internationally (in itself problematic when searching evidence), with: radiographer; radiologic technologist; X-ray technician and medical radiation practitioners having similar roles, but by far the most widely used term, for the practitioner level professional, is 'radiographer' (Cowling, 2008). Radiographers in the UK today practice in two main branches, diagnostic and therapeutic radiography. Diagnostic radiography is diverse with sub-specialties such as: projectional radiography including trauma; interventional radiography; Magnetic Resonance Imaging; Nuclear Medicine; Ultrasonography and Computer Tomography. Therapy radiography involves planning treatment delivery using radiation; delivering treatment using high energy radiation; aftercare and follow-up of the patient. Both branches have now extended their scope of practice to advanced and consultant level with diagnostic report writing and advanced planning and treatment being well established (Ford, 2010; Society and College of Radiographers, 2013).

The Evolved 'Philosophical-Science' Background of Radiography

Whether radiography exists as an independent science has been debated for over forty years, and even if conceptualised more recently as an academic discipline of its own, the science is still in its infancy (Metsälä & Fridell, 2018). Some propose 'clinical radiography' as a standardised nomenclature, although as shown earlier, there is wide variation in this regard as relating to the science and practice (Metsälä & Fridell, 2018). Schein and Glazer's epistemological interpretation of the nature of professional practice, emphasises the 'technical-rationality' of the application knowledge based on research application to the selection and logic of effective interventions (Schön, 2001). Glazer and Schein's essays on professions has dominated thinking and understanding of how professions are constructed and understood, and have shaped higher educational institution philosophy for many years (Schön, 2001). Their shared epistemology of professional practice is based on the positivist philosophy, that this has to be technical in nature to ensure reliability, based on testable and reproducible evidence (Schön, 2001). Schön (2001), reflecting on the unpredictable reality of everyday practice, where decisions are sometimes made in the absence of a full body of knowledge (or when acting in unique scenarios) introduces the concept of intuitive 'artistry' into the application of professional practice, and reflection-in action. O'Regan (2018) refers to the existence of duality in radiography ontology, both science and art, citing historical positivist approaches overshadowing the creativity and artistry residing in clinical practice.

Radiography science has been thus far closely related to the practice of radiography and the radiographer as a professional, this is possibly the attribute of a maturing profession and science, however it is likely that radiography science will expand to include the practice of other professional groups, and it needs to be conceptualised as a science to develop further (Ahonen & Liikanen, 2009). The epistemological underpinnings of radiography science are characterized by the humanities, technology and natural sciences – which are shared with other health sciences – although research focus and perspective differ, and relationships with similar disciplines are yet to be discovered and defined (Ahonen & Liikanen, 2009).

Identity Construction, Rights and Recognition

It has been generally accepted that for a role or occupation to be conferred professional status by society and legislature, within a nation state, its practitioners should be in possession of a unique specialist body of knowledge, developed through training in higher education (Lester, 2014; Sim & Radloff, 2009; Welie, 2004a). In addition, professions are characterised by: representation by a professional body or learned society; having a specific code of conduct and ethics; having autonomy within practice and altruism in the service of their clients (Sim & Radloff, 2009). Welie (2004a) also adds to his 'hallmarks of professional practice' (p. 529) the attributes of "unusually high levels of expertise and skilfulness, virtuousness and trustworthiness, as well as social status, class and market value". 'Internal discipline' either statutory or within profession, is another attribute adding to the status of a profession, with licensing or registration being revoked in cases of inappropriate or unsafe behaviour, protecting service users or society at large (Welie, 2004b). Another layer of professional protection and status, is by the use of ‘protected titles’ in law, with examples in the UK and the Nordic countries, making it a criminal act to misuse the title of a protected profession (Health and Care Professions Council, 2018a; VALVIRA: National Supervisory Authority for Wefare and Health, 2018). Radiography as a profession, at face value, would seem to satisfy all of the criteria above, in the UK.

Professional identity, as conceptualised by radiographers, centres around role-content preferences and perceptions of the ‘professional self’ and it shapes defined values and beliefs when interacting with the client (Niemi & Paasivaara, 2007). This is formed by: radiographic practice itself; educational setting; workplace context and embedded culture, resulting in a constructed identity of methods and professional language (Niemi & Paasivaara, 2007). Evidence in nursing practice, shows that a strong professional identity, establishes professional confidence and subject mastery by role ownership.

Rights in healthcare has mostly centred around patients, and their entitlement to receive ethical care and treatment by competent professionals (Kangasniemi, Viitalähde, & Porkka, 2010). However, in their theoretical examination of the rights of nurses, Kangasniemi et al. (2010) showed that very little research had been done in this area, and categorised nurses’ rights as being broadly: human and civil rights; rights embedded in healthcare legislation; professional rights and earned rights. Professional rights are closely related to professional ethics, with ethical guidelines legitimatising practice and giving individual circumstance to support the status of the profession (Kangasniemi et al., 2010; Schon, 1984). This concept was developed further by Matilainen et al. (2017), by applying this approach to the radiographic profession, and seeking the views of radiographers in their study. Matilainen et al. (2017) suggest that, as well as the other core rights shown above, the rights of radiographers specifically also surround the right to be an expert in radiography, with expertise identified in four key areas: “the right to plan, conduct and assess work as a radiographer”; “the right for patient advocacy in imaging [and treatment]”; “the right to practice radiation protection in an organisation” (referred to as special or unique expertise) and “the right to access updated professional knowledge” linked to ethical practice (p. 142). According to Matilainen et al. (2017) workplace culture is related to radiographers' ethics and ethical decision making, and that outdated professional knowledge manifested in communication and collaboration issues with poor acceptance at multi-professional decision making meetings, as an example, as well as outdated practice. Matilainen et al. (2017) concluded their recent study by reflecting that "In future, more theoretical and empirical research is needed in different cultures and contexts, in order to deepen our understanding of the professional ethics of radiographers, and their role in interprofessional ethics" (p. 144). Ethics requires professionals to act on knowledge based on evidence to decide "how and when to act" (p.450) founded on a philosophy of EBP, intertwined with the obligations expected in published codes of practice, for a particular profession (Gambrill, 2007). Conversely, EBP guides professionals to attend to the detail of ethical practice (Gambrill, 2007). Radiographers are often mistaken for other professional groups by the public and media. The professional body of radiographers in the UK often write to the media, to protest and raise awareness of the misrepresentation of the role of radiographers on popular medical dramas on television, and for misleading the public with inaccurate references to practice (Society and College of Radiographers, 2012). Radiographers often complain that they have poor visibility, and remain hidden away by the public misconception that the NHS in the UK is run only by doctors and nurses – however radiographers are notoriously bad at raising awareness of their own profession, possibly hiding away behind their science (Society and College of Radiographers, 2010). Also, the previously discussed 'dominance/patriarchy' phenomenon emerges when the media seeks the views of doctors on their television programmes (radiologist) and not the expert who necessarily understands the new equipment better (radiographer). Other researchers have highlighted similar issues in other countries, where 'radiography' is often not a subject prioritization field when researching articles and where radiographers are portrayed as anonymous (generic) technicians in local news reports when new scanning equipment is installed (Stalsberg & Thingnes, 2016).

International Contrasts in Professional Establishment and Practice

Radiography is practiced worldwide, however radiographer training, and scope of practice has developed according to national traditions (Couto, McFadden, Bezzina, McClure, & Hughes, 2018) although there seems to be some practice homogeneity internationally (Cowling, 2008). The International Society of Radiographers and Radiological Technologists (ISRRT) has issued more than one iteration of a worldwide standard for radiography entry level practice (International Society of Radiographers and Radiological Technologists, 2004), illustrating the core body of knowledge and skills required, and recommended degree level entry to the profession internationally (Cowling, 2008). In Europe (within the context of the European Union (EU)), professionalisation in radiography has varied according to the traditional higher educational models: Humboldtian; Napoleonic and Anglo-Saxonic, with variations related to the educational mode emphasis on professionalism, vocational training, research-emphasis and national regulation (Couto et al., 2018; Sam & Sijde, 2014). Political pressure is evident within the EU to work towards the standardisation of training and recognition, and to facilitate the free movement skills between member states, however there still remains no EU regulation standardisation for the profession of radiography (Couto et al., 2018). Cowling (2008), as a guide to the development and advancement of radiography practice internationally, described four levels of development and practice. At the first level, Cowling (2008) included the UK and the USA, where governmental and medical opinion has added to the drive by the professional associations, to undertake much research into role advancement, placing these countries at the forefront of development. The advancement of practice in the UK has arguably overtaken that of the USA, with autonomous consultant level roles for radiographers, reflected in research to be highly effective, safe and established in the culture of the NHS (Field & Snaith, 2013; Ford, 2010) with the UK being acknowledged as having a developed 'skill-mix model' to which other countries aspire (Field & Snaith, 2013). In contrast, the USA has developed a highly structured standardised advanced role for radiographers, the 'radiologist assistant', requiring additional training and certification, however this role, although transcending the traditional barriers of radiographic practice, is less autonomous, not able to act independently of the medically trained radiologist, unable to prescribe medications or write formal reports of the diagnostic images formed (May, Martino, & McElveny, 2008). This is confirmed by the most recent code of ethics document for American radiologist assistants: "interpretation and diagnosis are outside the scope of practice of the profession" (p. 1) with this still being firmly the domain of the medically trained radiologist (American Registry of Radiologic Technologists, 2018). Cowling's (2008) second level of development includes Canada, Australia, New Zealand, Japan and South Africa, with similar population and service demands being evident, but with full role advancement not being fully realised yet. Third level countries include those which do not as of yet have graduate entry into the profession, however progress is being made towards this goal, leading on to advanced roles in the future (examples of countries include: Jamaica; Barbados; Trinidad and Tobago; Uruguay; Brazil; Kenya;

Uganda; Malaysia and Hong Kong (Cowling, 2008). The fourth and final group in this classification are the countries without formal recognition for the profession or any standardised training or scope of practice (Nepal; Bangladesh; Central American Countries and some French and English speaking African nations) (Cowling, 2008). A recent survey of radiography education and accreditation in Europe showed, even with a general consensus between countries to move to the Anglo-Saxon / Bologna model of education and qualification framework, significant differences remain in training and level of practice in Europe (McNulty et al., 2016).

Appendix 2 - The PARIHS (Implementation) Framework

PARIHS has much in common with other theorised conceptual frameworks (Graham et al., 2006; Greenhalgh et al., 2004; Havelock, 1969), with one of the seminal frameworks constructed by Havelock (1969) and colleagues with its origins based on Roger's Diffusion of Innovation Theory (Kitson et al., 2008). However PARIHS has the benefit of offering a pragmatic approach to implementation, as a practical tool, that can be applied by individuals in the workplace (Kitson et al., 2008).

Nilsen (2015) describes PARIHS as a 'Determinant Framework', with each determinant variable representing barriers and enablers able to influence the uptake of research in practice. The overarching aim of a determinant framework is to "understand and/or explain influences on implementation outcomes, e.g. predicting outcomes or interpreting outcomes retrospectively" (p.3) (Nilsen, 2015). PARIHS has been utilised in a number of ways: as a conceptual or theoretical framework for evaluation or research; to guide instrument development and for modelling the use of research in practice (Rycroft-Malone, 2010).

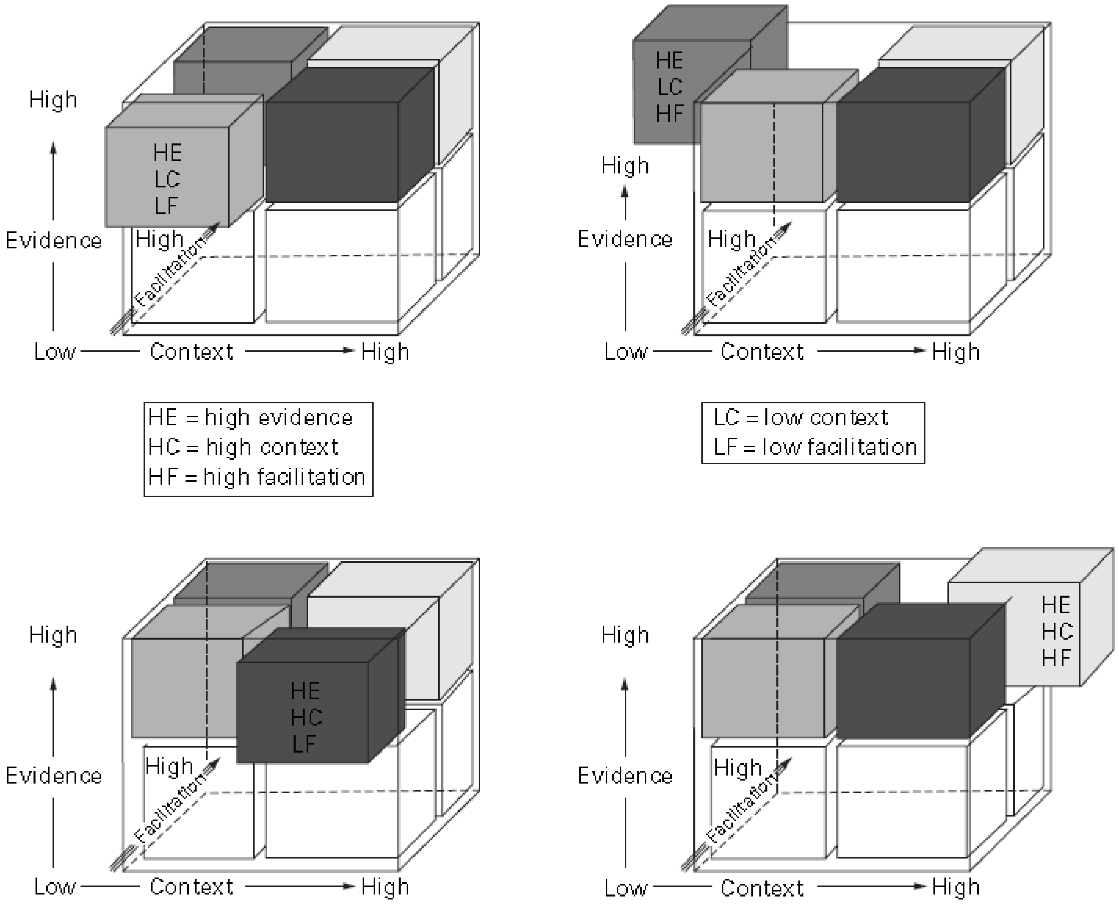
PARIHS has been cited frequently and used widely in empirical work on KT (Helfrich et al., 2010), and much ongoing interest is seen in its utility and "intuitive appeal and relevance to the real world setting" (p.2) (Harvey & Kitson, 2016) with much interest shown in its facility to "represent[ation of] the ingredients for successful implementation" (p.11) (Rycroft-Malone et al., 2013) .

In their critical synthesis of the use of PARIHS, Helfrich et al. (2010) found that the framework was mostly cited as an 'organising heuristic' examining KT initiatives post hoc, rather than the envisioned role for PARIHS by its developers, in assessing the context prior to guiding a successful evidence based implementation. The sparse evidence supporting PARIHS as a prospective heuristic is seen as a potential weakness in its application and utility (Harvey & Kitson, 2016; Helfrich et al., 2010).

In their research on the use of PARIHS, Ullrich et al. (2014) systematically reviewed documentation and used interview methods to gain the views of users of the utility of the framework. Frequently, users were using PARIHS due to the clarity of its underlying constructs, which were considered representative of factors influential in implementation, and due to its ease of use in the field (Ullrich et al., 2014). Ullrich et al. (2014) also found that PARIHS facilitated collaboration by adoption of common theory between users.

PARIHS represents a heuristic positing "successful research implementation as a function of the relationships among evidence, context and facilitation" (p. 298) and its developers argued that these elements (or determinants) interact dynamically (Rycroft-Malone, 2004). Each element in the framework is evaluated on a continuous scale from 'high' to 'low', with each element being sub-divided into sub-element factors theorised to have an effect on successful implementation (Harvey & Kitson, 2016). Kitson et al. (1998) hypothesised (in their original case studies) that in order to successfully implement evidence into practice, there needed to be an understanding of the context in which the change is to take place (its propensity to accept and enact the change); the nature of the evidence to be adopted needed to be clear; and that a method of facilitation was necessary to promote (support) the change process. The team proposed a matrix representing their hypothesis (Figure A) showing the various combinations of the PARIHS elements, representing the proposition that: *successful implementation (SI) is a function of evidence (E), context (C), and facilitation* (F), (SI = f (E,C,F)) (Kitson et al., 1998). The PARIHS team suggested that it would be possible to devise bespoke action plans, if those involved in implementing new evidence into practice, understood their local positions on the theoretical PARIHS model i.e. determining if each of the framework elements was 'high' (H) or 'low' (L) on the PARIHS continuum (Kitson et al., 1998) (Figure A), thus enabling an assessment of the element(s) needing attention.

Figure A: A three-dimensional matrix in which evidence, context, and facilitation can either be expected to influence the outcome in a positive or negative way



NB sourced from: (Kitson et al., 1998)

The original PARIHS team acknowledged that there was, at the outset, some limitations that needed further research, mainly in that the framework and its constructs were based on assumptions that context, evidence and facilitation, were discrete 'core' elements, having equal weight or importance, being linearly and causally connected (Kitson et al., 1998). Kitson et al. (1998) suggested further work to include inductive research to capture participants acting in their own unique context. There has been much interest and scrutiny in the field regarding the PARIHS proposition, and it appears to have face validity, and wide acceptance (Rycroft-Malone et al., 2002). It was further refined by 2002, and there was much more definitional clarity for the framework elements, with the group having pursued a concept analysis of each of the framework determinants, thus refining its theoretical and conceptual clarity (Rycroft-Malone et al., 2002).

With ongoing testing and evaluation of the PARIHS framework, it can be considered to have strong content and construct validity (Rycroft-Malone et al., 2013), and a "conceptually robust framework" (p. 5) and this is a good foundation upon which to proceed with testing a range of theories inductively and deductively (Kitson et al., 2008). More recent research utilising PARIHS as guiding framework in a prospective study of nineteen hospitals implementing clinical changes to peri-operative fasting times, the role of the 'individual' emerged as a powerful determinant, needing further research of its potential utility within the framework (Rycroft-Malone et al., 2013).

It was discussed earlier that the PARIHS framework is an example of an implementation model offering a mid-range theory, intended as a method of organizing aspects or influences within a system of social behaviour (Rycroft-Malone et al., 2013). A brief outline follows of the PARIHS elements and sub-elements relevant to this study.

PARIHS Elements (determinants)

Evidence

Evidence is composed of propositional and non-propositional knowledge, classified into four types of evidence: that of research (explicit); clinical experience; that of patients and their carers; and local context 'information' (Rycroft-Malone, 2010). Evidence is graded within a PARIHS evaluation in terms of a high/low continuum, having met the framework attributes (Rycroft-Malone, 2010). Propositional knowledge can be regarded as that which is derived from scholarly research, its nature being formal, unambiguous and can usually be generalised (Rycroft-Malone, Seers, et al., 2004). On the other hand non-propositional knowledge is usually derived from clinical experience, being implicit, derived from 'doing', including the tacit 'craft' of professionals, with their own experience and personal resources melding into their craft knowledge (Rycroft-Malone, Seers, et al., 2004). Good quality EBP centred on the individual patient, is contingent on the individual professional drawing on, and integrating various sources of evidence (propositional and non-propositional) (Rycroft-Malone, Seers, et al., 2004). Evidence as a PARIHS 'element' shows the interaction between the implicit and explicit forms of knowledge, its melding together by practitioners, and the need to interact during a participatory change process, "guided by skilled facilitation" (p.118) (Rycroft-Malone, 2010).

Facilitation

'Facilitation' in the PARIHS framework represents "the process of enabling or making easier the implementation of evidence into practice" (p.119), achieved by an actor undertaking the role of a 'facilitator' – having suitable attributes to be able to help individuals, teams and organisations, apply the intended evidence into their local practice (Rycroft-Malone, 2010). Facilitation can be thought of as "an intervention with a holistic purpose" (p.586) requiring multifarious skills and enabling roles (Harvey et al., 2002). Within the framework, sub-elements for facilitation are again assessed on a continual scale to determine strong or weak implementation attributes. The PARIHS proposition is that facilitation is a key role, with an ability to affect the 'context' of the implementation application, and forming and melding the practitioner role, influencing the understanding and application of evidence, therefore having a significant effect on the implantation effort a s a whole (Rycroft-Malone, 2010).

Context & Sub-Elements

Healthcare context was evaluated earlier in this section. 'Context' as a PARIHS determinant requires further conceptualisation, and refers to "the environment or setting in which the proposed change is to be implemented" (p.118) (Rycroft-Malone, 2010). Here, context is sub-divided into three extensive further elements: *culture; leadership and evaluation* – all interacting at various levels, dynamically (Rycroft-Malone, 2010). The context continuum in PARIHS includes an evaluation of how conducive the context is to change: role clarity; staff feel valued; devolved decision making; transformational leadership styles and the use of rich information sources on service performance (Rycroft-Malone, 2010). The table below (Table

A) links the PARIHS sub-elements with multiple perspectives of theory that might be applicable to test the framework constructs, and for context, Kitson et al. (2008) link theories for understanding organisations, contexts and cultures, with probing questions to encourage research into the preparedness of the 'context' to accept and sustain implementation.

Table A: PARIHS 'Context' determinant linked with theories and models

Context	Conceptual Framework	Theory	Model
Sub Elements: Culture Leadership Evaluation	Comprised 4 broad areas: (Context, culture, leadership & evaluation) -Some contexts are more conducive to the introduction of new ideas / innovations. -It is the interplay of the elements and sub-elements that make implementation easier or more difficult. -Big complex area operating at multiple levels. -Important to be able to see the whole picture when changing practice	The theoretical base of understanding organizations, contexts, cultures, and innovation is diverse, multifaceted and very complex. What criteria would you use to select the more appropriate theories that would elucidate how the elements of the PARIHS framework interact? How can theories be integrative in order to explain the realities of real-world implementation?	Testing different learning styles and experimenting with a variety of leadership roles and styles could be part of the range of interventions or models used. Selecting one leadership approach within leadership theory in general would be part of the multiple models and theories being tested within the framework.

NB Sourced from (excerpt): (Kitson et al., 2008)

Appendix 3 - Example Search Strategy for Systematic Review

Database: Embase <1974 to 2018 September 21>, Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily <1946 to September 21, 2018>, PsycINFO <1806 to September Week 3 2018>

Search Strategy:[1]

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1 exp *Audiovisual Aids/ (40163)
2 exp *Pamphlets/ (41010)
3 Education/ (417123)
4 exp *Teaching Materials/ (77610)
5 exp *Clinical Protocols/ (97321)
6 exp *Practice Guidelines as Topic/ (113902)
7 exp *Critical Pathways/ (6515)
8 exp *Inservice Training/ (22822)
9 exp *Consultants/ (18729)
10 exp *Staff Development/ (48149)
11 exp *Health Knowledge, Attitudes, Practice/ (104570)
12 exp *Reminder Systems/ (2933)
13 exp *Clinical Competence/ (63510)
14 exp *Education, Continuing/ (42233)
15 (professional adj development).tw. (36828)
16 exp *Professional Role/ (175764)
17 exp *Professional Competence/ (66752)
18 exp *Guideline Adherence/ (15820)
19 (adherence adj3 guidelines).tw. (11877)
20 exp "Attitude of Health Personnel"/ (314425)
21 exp *Evidence-Based Practice/ (117445)
22 exp *Evidence-Based Medicine/ (100542)
23 (workshop* or seminar* or training or in-service).tw. (1163105)
24 exp "Process Assessment (Health Care)"/ (2781172)
25 exp "Outcome and Process Assessment (Health Care)"/ (2412607)
26 exp "Delivery of Health Care"/ (3777914)
27 (journal adj club).ab,ti. (4178)
28 exp *Quality Assurance, Health Care/ (596351)
29 Organizational Case Studies/ (42431)
30 (champion* adj change*).tw. (39)

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[1] Adapted from Scott et al 2012

31 (change adj2 agent).tw. (2289)

32 ((facilitat* or coordinat*) adj2 change*).tw. (13158)

33 exp *Motivation/ (151739)

34 exp *Self Efficacy/ (78955)

35 exp *Organizational Innovation/ (210711)

36 exp *"Diffusion of Innovation"/ (179874)

37 ((research or evidence or guideline*) adj3 (implementation or utilization or utilisation or diffusion or translation)).tw. (45028)

38 (increase adj2 implementation).tw. (692)

39 ((predisposing or enabling or reinforcing) adj factor*).tw. (40550)

40 ((support or impede) adj change*).tw. (1186)

41 (knowledge adj2 (utilization or utilisation or uptake or transfer* or implementation or dissemination or diffusion* or translation)).tw. (18607)

42 (implementation adj2 (program or strategy or strategies)).tw. (18986)

43 Decision Making/ (349677)

44 (behavio?r adj2 change).tw. (47582)

45 *Radiology Department, Hospital/ (6892)

46 (diagnostic adj1 (department or unit)).tw. (694)

47 (radiodiagnostic adj1 (department or unit)).tw. (34)

48 exp *Diagnostic Imaging/ (830858)

49 exp *Radiography/ (528983)

50 exp *Radiology/ (51670)

51 radiographer.tw. (1648)

52 (medical adj imaging).ab,ti. (16899)

53 radiodiagnosis.ab,ti. (1617)

54 (x-ray adj department).ab,ti. (403)

55 Consultants/ (98538)

56 49 and 55 (415)

57 (advanced adj practice adj radiographer).ab,ti. (3)

58 (advanced adj radiographer).ab,ti. (5)

59 imaging professional.ab,ti. (24)

60 or/1-32 (8365453)

61 or/33-44 (1098196)

62 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 56 or 57 or 58 or 59 (1133703)

63 60 and 61 and 62 (3274)

64 Pamphlets.mp. (6300)

65 (teaching adj materials).ab,ti. (1951)

66 (clinical adj protocols).ab,ti. (5290)
67 (practice adj guidelines).ab,ti. (46197)
68 (critical adj pathways).ab,ti. (2051)
69 consultants.ab,ti. (31648)
70 (staff adj development).ab,ti. (5051)
71 exp Professional Development/ (25673)
72 exp Health Attitudes/ and exp Health Knowledge/ (99280)
73 (reminder adj systems).ab,ti. (837)
74 exp CONTINUING EDUCATION/ (93825)
75 (guidelines adj adherence).ab,ti. (440)
76 exp Health Personnel Attitudes/ (168481)
77 (process adj assessment).ab,ti. (551)
78 (outcome adj process adj assessment).ab,ti. (9)
79 exp Health Care Delivery/ (3814126)
80 ((health care or healthcare) adj quality adj assurance).ab,ti. (121)
81 (organisational adj case adj stud*).ab,ti. (69)
82 or/64-81 (4009928)
83 (diffusion adj of adj innovation).ab,ti. (1226)
84 (radiology adj department).ab,ti. (5334)
85 (diagnostic adj imaging).ab,ti. (27979)
86 84 or 85 (33187)
87 60 or 82 (8479426)
88 61 or 83 (1098866)
89 62 or 86 (1155963)
90 87 and 88 and 89 (3533)
91 90 not 63 (259)
92 limit 63 to english language (3020)
93 limit 92 to yr="1985 - 2017" (2868)
94 limit 91 to english language (244)
95 limit 94 to yr="1985 - 2017" (231)
96 93 or 95 (3099)
97 remove duplicates from 96 (2808)
98 exp Radiotherapy/ (625310)
99 therapeutic radiography.mp. (39)
100 therapeutic radiographer.mp. (13)
101 diagnostic radiography.mp. (494)
102 diagnostic radiographer.mp. (36)

103	98 or 99 or 100 or 101 or 102 (625818)
104	62 or 103 (1741773)
105	60 and 61 and 104 (6206)
106	89 or 104 (1763099)
107	87 and 88 and 106 (6469)
108	107 not 105 (263)
109	limit 105 to english language (5860)
110	limit 109 to yr="1985 -Current" (5768)
111	limit 108 to english language (247)
112	limit 111 to yr="1985 -Current" (243)
113	110 or 112 (6011)
114	("united kingdom" or "great britain" or "uk" or britain).in. (3670451)
115	exp United Kingdom/ (737073)
116	114 or 115 (4110276)
117	113 and 116 (536)
118	96 and 116 (255)
119	117 or 118 (536)

Appendix 4 - Data Extraction Form - Systematic Review

RAD_DEF v4

Data Extraction Form – Modified Systematic Review: **What Research is Evident Showing Implementation Science is Making a Difference to Evidence Based Radiography in the UK?**
General Researcher Initials: ______ Record #: *Title:* *Author(s):* *Year of Publication:* *Pub.Type:* *Confirm UK (or relating to):*
Quality Screen Result include for full review: Include broadly relevant: Reject:
Study Characteristics *Quan / Qual / Mixed M. (circle)* *Study Design:* *Aims / Obj.* *Incl.criteria:* *Excl.criteria:* *Recruitment:* *Unit allocation:* *Comment on Quality / Bias of method(s) used (CASP/AGREE etc):*

Participant Characteristics & Setting *(circle)*

Radiography: individual / team/ department or unit/ therapy / diagnostic / radiology but not radiographer-specific / students / diagnostic rad / therapy rad / service quality or safety / diagnostic or therapy outcome / other ____________

(notes):

Intervention & KT Theory**

Theory /Framework Described:

Single / Multiple intervention (circle)

Description of the Intervention & control /co-interventions/ Classification (Powell et. al): (circle and list beneath)

Plan Strategies: *Educate Strategies:* *Finance Strategies:* *Restructure Strategies:* *Quality Mgt. Strategies:* *Attend to Policy Context Strategies:*

WIDER:

Detailed description of Intervention?	Y	N
Clarification of assumed change process and design principles?	Y	N
Access to intervention manuals or protocols?	Y	N
Detailed description of active control conditions?	Y	N

Outcome Data /Results

As result of KT intervention what was the outcome?

Contextual related or influence(ing)?:

Other e.g. unexpected outcomes / barriers facilitators etc.

2nd Checker – Concordance: Discuss: Reject:
Notes (reflections / general observations / comments / further actions):

Appendix 5 - WIDER Standards Conformity Matrix

WIDER recommendations to improve reporting of the content of behaviour change interventions – UK Radiography Practice						
First Author / (Year)* *(Full References in Ch.2*)*	Record #	Detailed Description of Intervention? (Y/N)	Clarification of Assumed Changed Process and design principles? (Y/N)	Access to Intervention Manuals / Protocols? (Y/N)	Detailed Description of Active Control Conditions? (Y/N)	**WIDER standard met?**
Twomey (2003)	1	N	Y	Y	N	N
Society & College of Radiographers (2015)	2	*	*	*	*	*
Powell (2015)	3	Y	Y	N	Y	N
Plant (2001)	4	Y	N	N	Y	N
Elliott (2008)	5	*	*	*	*	*
Nightingale (2008)	6	*	*	*	*	*
Barlow (2018)	7	*	*	*	*	*
McNair (2015)	8	Y	N	Y	Y	N
Ellis (2006)	9	N	N	N	N	N
Jones (2008)	10	N	N	N	N	N
Goldsworthy (2015)	11	Y	N	Y	N	N
Bolderston (2018)	*	*	*	*	*	*
Henwood (2008)	*	*	*	*	*	*
Brealey (2001)	*	*	*	*	*	*
Snaith (2015)	*	*	*	*	*	*
Dean (2010)	*	*	*	*	*	*
Bridge (2017)	*	*	*	*	*	*
Hickman (2007)	*	*	*	*	*	*

* = N/A e.g. exploratory study - systematic review / expert opinion / review article/ context assessment etc.

Appendix 6 – Example Quality Checklist Excerpt – CASP

CASP
Critical Appraisal
Skills Programme

www.casp-uk.net
info@casp-uk.net
Summertown Pavilion, Middle Way Oxford OX2 7LG

CASP Checklist: 12 questions to help you make sense of a Cohort Study

How to use this appraisal tool: Three broad issues need to be considered when appraising a cohort study:

- Are the results of the study valid? (Section A)
- What are the results? (Section B)
- Will the results help locally? (Section C)

The 12 questions on the following pages are designed to help you think about these issues systematically. The first two questions are screening questions and can be answered quickly. If the answer to both is "yes", it is worth proceeding with the remaining questions. There is some degree of overlap between the questions, you are asked to record a "yes", "no" or "can't tell" to most of the questions. A number of italicised prompts are given after each question. These are designed to remind you why the question is important. Record your reasons for your answers in the spaces provided.

About: These checklists were designed to be used as educational pedagogic tools, as part of a workshop setting, therefore we do not suggest a scoring system. The core CASP checklists (randomised controlled trial & systematic review) were based on JAMA 'Users' guides to the medical literature 1994 (adapted from Guyatt GH, Sackett DL, and Cook DJ), and piloted with health care practitioners.

For each new checklist, a group of experts were assembled to develop and pilot the checklist and the workshop format with which it would be used. Over the years overall adjustments have been made to the format, but a recent survey of checklist users reiterated that the basic format continues to be useful and appropriate.

Referencing: we recommend using the Harvard style citation, i.e.: *Critical Appraisal Skills Programme (2018). CASP (insert name of checklist i.e. Cohort Study) Checklist. [online] Available at: URL. Accessed: Date Accessed.*

#8

Paper for appraisal and reference:..

Section A: Are the results of the study valid?

1. Did the study address a clearly focused issue?

Yes	✓
Can't Tell	
No	

HINT: A question can be 'focused' in terms of
- the population studied
- the risk factors studied
- is it clear whether the study tried to detect a beneficial or harmful effect
- the outcomes considered

Comments:
1 group B/A study.
A → Implement A → Re evaluate + report difference if imp.

2. Was the cohort recruited in an acceptable way?

Yes	✓
Can't Tell	
No	

HINT: Look for selection bias which might compromise the generalisability of the findings:
- was the cohort representative of a defined population
- was there something special about the cohort
- was everybody included who should have been

Comments:
Radiographers with previously no experience. However in both groups 2 of the readers/observers were clinicians but not clear if

Is it worth continuing?

their scores were added to the overall assessment ∴ potentially ↑ the radiographer score (bias)
Also 2 Rads dropped out (Round 2)

Comments:

Over 3 years.

Section B: What are the results?

7. What are the results of this study?

HINT: Consider
- what are the bottom line results
- have they reported the rate or the proportion between the exposed/unexposed, the ratio/rate difference
- how strong is the association between exposure and outcome (RR)
- what is the absolute risk reduction (ARR)

(R 53-93%)

Comments:

73% Concordance Prior to Training.
91% Concordance After training ($p<0.001$)
>3yrs 92% Concordance at audit. greater than standard @ 75%

(126/139) (R not quoted)

8. How precise are the results?

HINT:
- look for the range of the confidence intervals, if given

Comments:

– Range not quoted for after Intervention (92%) R?

12. What are the implications of this study for practice?

- Yes ✓
- Can't Tell
- No

HINT: Consider
- one observational study rarely provides sufficiently robust evidence to recommend changes to clinical practice or within health policy decision making
- for certain questions, observational studies provide the only evidence
- recommendations from observational studies are always stronger when supported by other evidence

Comments:

Yes – successful implementation c̄ training programme. But would have been good to compare 2 groups

A with observational one to one only

B c̄ as A but c̄ training intervention package.

compare concordance

would be good but not done.

Appendix 7 - Final Data Extracted from Review

#	Reference (1st Author)	Origin / Experimental Design[a] /Nature of evidence	Purpose	KT Theory & Effectiveness Evidence / Intervention Strategy Classification[b]	Discrete or Multifaceted-Interventions & Level(s) involved	Population / Context	(Main Outcome) Intervention Strategy(s) Change to practice / Made a difference?	Barriers to KT Noted / Negative Context	Enablers Noted / Positive Context	Possible area for further research?	Method: Strengths / Weaknesses
1	Twomey, P. (2003)	Peer Reviewed Journal Article / Interface Audit Programme - Before & After Study (empirical)	Implement Evidence based Referral Guidelines for Radiology Users	No Formal KT Theory Described/ **P/E/QM**	Multifaceted / Meso-Micro	NHS Primary care - setting /Local GPs and a Radiology Service / Patient Population	Significant reduction in referrals to imaging (35% reduction over previous year after implementing guidelines) / reduced population radiation dose due to inappropriate referring/ improving access times	None	Collaboration in a Primary Care Organisation / Developed a framework to implement local behaviour change and address the context prior to change / engagement with stakeholders / embedding change in commissioning model / local context was receptive / consultant gatekeeping	Assess sustainability / Use theory informed Implementation Framework	Not used robust research methodology to assess implementation method effectiveness or related to KT theory - Overall weak method / audit of before and after not very detailed or well reported / dated study/ no control group.
2	Society and College of Radiographers (2015)	Professional Body Guidance /Systematic Review (empirical)	Review Evidence on Skin Care & Treatments in Radiotherapy	No Formal KT Theory Described **P/E/QM**	Multifaceted / Macro	National Clinical Guidelines / Radiotherapy Professional and Patient Level	Evidence from Systematic Review to Produce Practice Guidelines and Implementation Framework	N/A	Implementation Advice / Tools Issued	Assess Uptake of Guidelines in Practice and assess Barriers & Enablers Evident	Did Not Utilise KT Theory in the Implementation Recommendations/Framework
3	Powell, R (2015)	Peer Reviewed Journal Article /Randomised Controlled Trial (Practice Improvement) (empirical)	Improve MRI Scan Image Quality / Patient Compliance	No Formal KT Theory Described/ **E**	Multifaceted / Micro	NHS Local Imaging Unit / Local Patient Population Sample (n=83)	Significant improvement in image quality and patient compliance compared to control group ($X^2(1,83) = 7.84, p<.001$)	None	Educational Media had a positive effect on patient outcomes locally/patient self efficacy improved	Further studies in different contexts to test generalizability	Not Generalizable without further research / in different contexts / and there was no KT theory or implementation plan used - However robust RCT design well reported with limitations acknowledged
4	Plant, R. (2001)	Peer Reviewed Journal Article /Non-Comparative Study - audit (empirical)	Implementation of EBP into local practice in 37 NHS Trusts within 6 professions (Inc Radiotherapy)	No KT Formal Theory Described/ **P/E/R/QM**	Multifaceted/ Meso-Micro	Region of 37 NHS trusts targeting 6 professional groups including radiographers in radiotherapy	Successful & sustained implementation of R&D network with the aim of promoting evidence use in each of the professions in the region / audit showed sustainability dependent on ongoing facilitation	Perceived or actual Inter-professional barriers between the 6 healthcare professions / not knowing how to access information	Methods used to make context more receptive to change / Use of facilitators to run project / and local R&D reps ongoing to facilitate sustainability	Undertake similar project with wider professional groups in other contexts	Method relating to setting up an R&D network - and not an effectiveness study / Audit undertaken but result not reported / Sustainability only measured over 1 year period - However challenges and options to sustain in the future listed

#	Reference (1st Author)	Origin / Experimental Design[a] /Nature of evidence	Purpose	KT Theory & Effectiveness Evidence / Intervention Strategy Classification[b]	Discrete or Multifaceted-Interventions & Level(s) involved	Population / Context	(Main Outcome) Intervention Strategy(s) Change to practice / Made a difference?	Barriers to KT Noted / Negative Context	Enablers Noted / Positive Context	Possible area for further research?	Method: Strengths / Weaknesses
5	Elliott, V. (2009)	National Radiographer Survey / Non-comparative Study (empirical)	Understand: 1) Levels of research activity; 2) attitudes towards research involvement; 3) perceived barriers to research utilisation	No Formal KT Theory Described/ **QM**	Multifaceted / Macro	Sample n=218 UK based sonographers (radiographers)	Detailed analysis of levels of research generation and utilisation in a sample of sonographers and exploration of contextual factors likely to influence involvement. 33.5% involved in research; 16.5% published their research; 42.2% Reported change to practice as result of their involvement; 72.9% reported implementing EBP based on research output of others;	**Resources** (Lack of time most frequently reported/ Heavy clinical workloads/ staff shortages/ A need for protected study time in the AHP group/ Perceived Difficult Ethical Approval Process). **Lack of Support** - by managers to facilitate research resources. **Training** - need to embed research skills at postgraduate level in clinical practice. **Autonomy** - 50% of sonographers felt they lacked authority to initiate research. **Evidence** - difficult to interpret	National Job Profiles (NHS) Specifying Research Involvement/ Undertake Research to Gain Qualification/ Staff in higher grades more involved/ Full Time staff more involved/ Higher Degrees More involved/ Older staff more likely to research/Consultant Radiographers More Likely Research/ Team Approach strong enabler. **Context**- research found to be embedded in culture / No strong belief that medical staff should lead research/ Supportive Organisational Structure to Embed Research into Clinical Context	Update study as the data is somewhat dated / expand on the method to explore further detail of each aspect on a larger scale.	Small study / doubtful generalizable/ recruitment bias discussed (taken from membership of professional body only) / Useful insight into possible further areas of research for Sonographer context and EBP
6	Nightingale, J. (2008)	Peer Reviewed Journal Article /Expert Opinion - Practice Recommendation (non-propositional)	Promotion of a framework to guide local clinical protocol design.	No Formal KT Theory Described/ **Educate**	Multifaceted / Intended for Micro Level Adoption	UK Radiographers / Practitioner Level	Published framework to guide local clinical practice	N/A	N/A	Test the framework to see the effect on local practice	Low level evidence (expert opinion in peer reviewed journal) / Framework not tested
7	Barlow, N. (2018)	Peer Reviewed Journal Article /Non-comparative Study / Participatory Action Research (Qualitative / empirical)	Examine the context for evidence adoption (service improvement) to identify barriers to change	No Formal KT Theory Described/ **Plan**	Multifaceted / Intended for Macro Level Adoption	Three NHS hospital sites / Practitioner & Service User Level	Research illuminated the context at a local level	Workload /Staffing Levels/ poor communication	Gather Information/ Staff recruitment /mandate change/ communication aids (posters)/consensus discussions restricting access hours	Expand work to include wider population	No KT theory used / small localised sample / focus groups not conducted at all of the sites, however Qualitative methods used to gain in-depth contextual information

#	Reference (1st Author)	Origin / Experimental Design[a] /Nature of evidence	Purpose	KT Theory & Effectiveness Evidence / Intervention Strategy Classification[b]	Discrete or Multifaceted-Interventions & Level(s) involved	Population / Context	(Main Outcome) Intervention Strategy(s) Change to practice / Made a difference?	Barriers to KT Noted / Negative Context	Enablers Noted / Positive Context	Possible area for further research?	Method: Strengths / Weaknesses
8	McNair, H. (2015)	Peer Reviewed Journal Article / Before-After Study (Quantitative /empirical)	Implement New Radiotherapy Technique - Radiographer Led 'Plan of the day'	No Formal KT Theory Described/ **P/E/R/QM**	Multifaceted /Micro Level Adoption	Radiographers n=8/ Medical Staff n =2 participated in the trial /NHS Radiotherapy Treatment Centre	Plan of the Day' successfully implemented and sustained over a 3 year period maintaining quality (73% success at planning prior to implementation / 91% ($p<0.001$) success at planning after implementation)	None	Resources matched to patient throughput (staff)/ Effective MDT working/ One-to-One tuition	0	Small clinical Study / Not RCT - but showed sustained period over 3 years and - how they successfully implemented the treatment
9	Ellis, T. (2006)	Peer Reviewed Journal Article / Non-Comparative Study - Using PDSA Cycle to Implement and Evaluate Change (empirical)	To assess the best implementation method for initiating radiographer led radiotherapy follow up clinics	No Formal KT Theory Described/ **P/E/R/QM**	Multifaceted / Intended for Micro Level Adoption	Therapy Radiographers/ NHS Radiotherapy Treatment Centre	PDSA Cycle examined context, and planned interventions leading to Successful implementation of a radiographer led radiotherapy review clinic pilot (extended role)	One patient was happy to receive follow up from non-medic - but with the proviso that they had the skills needed - ? Need to build /inform confidence at the patient level	PDSA used as a guiding framework to plan multifaceted strategies / Collaborative Approach required and Multidisciplinary review clinics to adequately replace the role of a solitary consultant.	Conduct RCT - however this may have been done now as this paper is from 2006	Not very well discussed or described /did not compare patients' views to that of patients getting the regular consultant led clinic/ some bias acknowledged and lack of generalisability acknowledged - however the PDCA guided the implementation and evaluation of a radiographer led clinic instead of consultant led radiotherapy follow up
10	Jones, H. (2008)	Peer Reviewed Journal Article / Case Report (reflective case study/action research) (empirical)	Use a reflective practice framework (Carr & Kemmis) to review the role of the consultant radiographer in a recent practice based problem	No Formal KT Theory Described/ **P/E/R/QM**	Multifaceted / Intended for Macro Level Adoption	Consultant Radiographer and team of Diagnostic Radiographers/ Ward Nurses/ NHS General Hospital	Implementation effort with an 'action plan' reduced inappropriate practice in Nasogastric Tube Placement and reduced referrals for NG Chest Radiography from 120 per month locally to 50.	Interprofessional barriers/ apathy to change at professional level and persistence required in maintaining change	National role specification embedding change management or facilitation as core role expectation / Higher training related to research use/ multifaceted implementation effort/ collaborative working/ improving communication/Infiltrating clinical team (cross profession)/ networking	Audit sustained change to ensure this has become embedded practice locally	Low quality evidence / reflective approach / not much detail regarding methods - however offers insight into what potential can work and the potential role of the consultant as facilitator and the barriers encountered between radiography and nursing

#	Reference (1st Author)	Origin / Experimental Design[a] /Nature of evidence	Purpose	KT Theory & Effectiveness Evidence / Intervention Strategy Classification[b]	Discrete or Multifaceted-Interventions & Level(s) involved	Population / Context	(Main Outcome) Intervention Strategy(s) Change to practice / Made a difference?	Barriers to KT Noted / Negative Context	Enablers Noted / Positive Context	Possible area for further research?	Method: Strengths / Weaknesses
11	Goldsworthy, S. (2016)	Peer Reviewed Journal Article/ Non-comparative Study - Service Evaluation (empirical)	Implement a 'lean process' project to design and test a 'Radiotherapy Research Activity Assessment Tool'	No Formal KT Theory Described/ **P/E/R/QM**	Multifaceted/ Micro Level	Radiotherapy MDT Team Members / NHS Cancer Treatment Centre	Developed, tested and Implemented a 'Radiotherapy Research Activity Assessment Tool'	Enthusiasm for local research projects stifled by local context: resource apportioning; costs of implementing; other competing developments	Flow-chart to create a 'lean process' multi-step development method to drive project; / Economic challenges requiring value for money driving innovation or change/Scoping Review to gather evidence/ collaborative decision making at MDT/ use of a tool to assess impact of implementing local research projects on service/ instruction information how to use tool / education through presentation at MDT. Use of facilitation to guide implementation (research radiographer appointed)	A larger study was recommended by the authors to reduce possible bias due to subjectivity of method, on a small scale.	Small study / possibility of bias / not suitable for generalisation - however useful insight into a method used recently for assessing research project applications and feasibility for operationalising locally and planning impact on local service.

#	Reference (1st Author)	Origin / Experimental Design[a] /Nature of evidence	Purpose	KT Theory & Effectiveness Evidence / Intervention Strategy Classification[b]	Discrete or Multifaceted-Interventions & Level(s) involved	Population / Context	(Main Outcome) Intervention Strategy(s) Change to practice / Made a difference?	Barriers to KT Noted / Negative Context	Enablers Noted / Positive Context	Possible area for further research?	Method: Strengths / Weaknesses
12	Bolderston, A. (2018)	Peer Reviewed Journal Article / Non-Comparative Study - Case Study (Thematic Analysis/ empirical)	Evaluate perceived benefits & limitations of 'radiographers' participating in an online journal club (Tweet chat) & Compare to Traditional Journal Clubs	No Formal KT Theory Described/ **P/ E**	N/A	2017 Twitter Chat (Journal Club) - international participants n = 37 medical imaging professionals including radiographers - International based chat - with UK researchers involved in Thematic Analysis	Provides a novel insight into participant experience during an online journal Tweet chat and compares user experience to that of traditional face-face journal clubs for EBP.	**Main barriers** Traditional (face to face): Limited time at work; personal effort required to organise and sustain; ability to coordinate availability; many are run by physicians - can be intimidating and non-relevant to the AHP; power differential between seniors and junior AHPs present - hindering free conversation; same group attending - lack of variance; if held in breaks or after work staff reluctant to use own time. Twitter: perceived disadvantage of character limit - restricting meaningful exchange; rapid tweets can be off-putting to some; One hour 'fast-format' can limit complex discussion; some not involved in use of social media - therefore not interested in format or unable to join if no account; unwilling to use in own time; perceived risks in using social media; organisational policies restricting social media use at work; fear of mixing professional and personal activities online; time zone differences can limit participation in live discussion.	**Main enablers** (benefits): Traditional - need enthusiastic local team keen on EBP; can introduce and encourage use of research in practice; can inspire participation in own research. Twitter - international participation; collaboration and networking; confidence enabling (attracts timid users by being able to 'lurk' anonymously); no physical barriers ease of access; electronic record exists for CPD use (Storify); 140 Character limit keeps discussion short and focused; electronic format eliminates nuances of body language useful for introverts; can access interactively from work whilst multi-tasking; use of open access papers on a regular basis allows easy access to recently published research; appears to be more sustainable.		International participation in study however included UK radiographer and relevant to UK practice. Some methodological problems may hav arisen with Twitter # tag being incorrectly used by participants; discussion was somewhat anecdotal and might not be generalizable; English only - therefore a small sample of self-selected participants. These point were acknowledged by the authors Provides useful insight into the rol of mass media/social media in promoting EBP. The study did not test whether Twitter clubs increase CPD or EBP - however offered insights into its use as a KT strateg

#	Reference (1st Author)	Origin / Experimental Design[a] /Nature of evidence	Purpose	KT Theory & Effectiveness Evidence / Intervention Strategy Classification[b]	Discrete or Multifaceted-Interventions & Level(s) involved	Population / Context	(Main Outcome) Intervention Strategy(s) Change to practice / Made a difference?	Barriers to KT Noted / Negative Context	Enablers Noted / Positive Context	Possible area for further research?	Method: Strengths / Weaknesses
13	Henwood, S. (2008)	Peer Reviewed Journal Article / Non-Comparative Study - Case Study (Interpretive Grounded Theory/ empirical)	Understanding individual CPD components in UK Radiography & investigating how they dynamically interact & the effect on Evidence Based Practice	No Formal KT Theory Described/ **P/E**	N/A	n =63 face to face interviews with radiographers (UK mainly)	Development of a CPD Process Model - CPD process is complex & dynamic and centres on the individual practitioner and their working environment. CPD process model generated: 'The Individual - drive and desire', 'Facilitation - Support', and 'External Influences - Push'.	Individuals generally unaware of a holistic concept of CPD as related to EBP. Dichotomy between individual responsibilities (professional) in CPD and the potential beneficiaries	**Individual**'s commitment to their profession; sense of professionalism; perception of value of CPD to EBP; personal drive or motivation to undertake CPD; desire to influence practice from CPD participation. **Facilitation** - surrounds and supports the individual to undertake CPD, found to be closely related to workplace culture; mandating CPD; Support found to be an important element of facilitation (emotional, respect, encouragement and recognition), facilitation supporting CPD likely to maintain motivation and enthusiasm. **External Influences** - Professional and Regulatory Bodies; Work Environment; Service Users; Other healthcare professionals.	N	Other studies have explored discrete components of CPD - however this study investigated the components as a holistic entity and how they interact with each other / Although Study Published in 2008 - interview data from 1990's. Data is old however the insights found and reported in study offer insight to current EBP.
14	Brealey, S. (2001)	Peer Reviewed Journal Article / Non-Comparative Study - Framework Development (non-propositional)	Development of a theory informed local framework for implementing and sustaining an evidence based and quality managed radiographer reporting service	No Formal KT Theory Described/ **P/E/R/QM**	Multifaceted / Intended for Macro/Meso/ Micro Level Adoption	Proposed Population: Professionals Producing Formal 'outcome reports' - especially radiographers (UK)	Formulated a theory informed radiographer reporting quality management framework / untested in practice.	N/A	Provides a framework recommending methods for: Defining the team; Adopting Guidelines and standards; Dissemination; and Implementation at a local practitioner /departmental level.	Test the framework to see the effect on local practice	Framework design theory informed / however not tested. Paper quite dated (2001) - however offers insight into implementation efforts that may be possible

#	Reference (1st Author)	Origin / Experimental Design[a] /Nature of evidence	Purpose	KT Theory & Effectiveness Evidence / Intervention Strategy Classification[b]	Discrete or Multifaceted-Interventions & Level(s) involved	Population / Context	(Main Outcome) Intervention Strategy(s) Change to practice / Made a difference?	Barriers to KT Noted / Negative Context	Enablers Noted / Positive Context	Possible area for further research?	Method: Strengths / Weaknesses
15	Snaith, B. (2015)	Peer Reviewed Journal Article/ Cross Sectional Study - Postal Survey (empirical)	Longitudinal Analysis of Radiographer Reporting in the UK (Implementation of Extended Role)	No Formal KT Theory Described/ **P/E/R/QM**	Multifaceted / Macro	All NHS Hospitals in the UK/ Adoption and State of Radiographer Extended Role (Reporting)	n=235/510 (63.7%) responses. Reporting undertaken at n=179 sites. Radiographer utilisation increased since 2007. Barriers to implementation and geographical variations found. Delayed reporting remains the standard service delivery in the UK.	Professional dominance; Nature and scope of training award; Availability of courses; interpretation still remains role substitution and not embedded/ delays to reporting radiographs in NHS endemic - reporting as core radiographer slow to embed as core function and not utilised even when accredited skills are present/ geographical variances also exist in the UK	radiographer reporting (interpretation) quality considered to be equivalent to a medical radiologist; 4 tier career progression structure.	Research into role substitution vs embedding in role	Database checked for errors and found to be consistent by more than one researcher/ No evidence of responder bias was found.
16	Dean, J. (2010)	Peer Reviewed Journal Article/ Non-comparative Study - (Technology Implementation /non-propositional)	Undertake Training Needs Analysis for implementation of Tomotherapy in the UK (Pilot)/ Plan implementation and Audit Quality	No Formal KT Theory Described/ **P/E/F/R/QM**	Multifaceted/ Macro-Micro	Team of radiotherapy radiographers in a centre of excellence / Technology Piloting and Implementation Planning Commissioned by NHS.	Training Needs Analysis	Resources in Radiotherapy vs Demand/ No bespoke educational courses available at the time	Role extension/ Facilitator appointed/ facilitator knowledge updated by training and attendance at conferences & visiting other centres with technology (abroad) / training needs analysis/ professional level - need rapid decision-making clinical skills; trainig package designed in-house with syllabus and essential skills; protocols; supplemental training by professional body and HEI and manufacturer; coaching; knowledge testing and practical assessment / ongoing audit of quality/fund and contract for the innovation(government)	No	Implementation not linked to theories or frameworks. Methods not well reported (detail).No information relating to audit results.

#	Reference (1st Author)	Origin / Experimental Design[a] /Nature of evidence	Purpose	KT Theory & Effectiveness Evidence / Intervention Strategy Classification[b]	Discrete or Multifaceted-Interventions & Level(s) involved	Population / Context	(Main Outcome) Intervention Strategy(s) Change to practice / Made a difference?	Barriers to KT Noted / Negative Context	Enablers Noted / Positive Context	Possible area for further research?	Method: Strengths / Weaknesses
17	Bridge, P. (2017)	Peer Reviewed Jouranl Article / Non-comparative Study - (Survey/ emprical)	Establish the Current Role of 'VERT' (Vertual Environment for Radiotherapy Training) / Future Potential / Explore Collaboration - Internationally	No Formal KT Theory Described/ **P/E/R**	Multifaceted / Macro	Online Survey of **n=47**/52 (90% response) International users of VERT Clinically	78.5% of Users Reported using the resource 1 day per week or less. Main use for training radiographers / support for developing collaboration internationally to increase scope of use and further research	Host location and availability for use; lack of technical support; perception by institutions (where VERT was hosted) that it was not useful (perhaps by lack of familiarity with under use)/ under use of valuable resource evident and undeveloped scope of use in training and patient education; inconsistent implementation of VERT	VERT has enabled introduction of new treatments to experienced staff; Train the trainers helps; Collaborative approach to resource development (VERT user group) Use online Forum; Research in VERT use to help close the gap between theory and practice; / Context Appearing to be Receptive to Change Adoption	Collaboration to promote evidence-based approach to use of VERT. Determine the Impact that VERT has on learning and assessment using both formative and summative methods. Potential for using VERT in clinical context to demonstrate/simulate patient experience at treatment	Bias controlled by exclusion of commercial partner from survey instrument design/ survey only
18	Hickman, C. (2007)	Peer Reviewed Journal Article / Cross-sectional Study - (Retrospective Audit /empirical)	Evaluate Impact of Implementing National Guidance	No Formal KT Theory Described/	Multifaceted / Macro	n = 100 patients attending A&E department / NHS Hospital	Applying NICE guidelines would have increased referrals for CT Head scans by 18% and 100% reduction in Skull X-rays	N/A	Application of national guidance / information gathering / inform local practice	Prospective Study and larger / multi-centre sample	Interpretive bias considered in applying the NICE guidance to medical records - researcher could have used intra-observer method

Appendix 8 – Synergy Advert for Survey

Your help is needed! Please participate in an online survey of Radiographers, studying Leadership, Culture and Service Evaluation, within the profession in the UK.

This survey is being undertaken as part of a research project for a professional doctorate in healthcare at Bangor University, and one lucky individual taking part, will receive a **prize of a brand-new *Samsung tablet PC***.

The questionnaire is online using Surveymonkey™. It is very easy to take part, just click on the link or type the link below into your browser – and it will be open for you to participate until **31st October 2017**:

https://www.surveymonkey.co.uk/

The survey should not take more than 10 to 15 minutes to complete and it just asks you for some general information about your background in radiography, and then there are some questions to go through exploring practice in your department. All you have to do is select the response category you choose for the question or statement.

Towards the end of the survey – there will be an opportunity for you to leave your contact details (optional) – and this will only be used to contact you if you win the prize or if you also agree to being contacted later on to clarify some of your responses or if you kindly agree to a 30-40 minute telephone discussion (in confidence, and at a time to suit you) – to explore the research topic in some more depth with you.

There is no specialist prior knowledge required – and we aim to be able to survey as many as possible of UK clinically practicing radiographers who are registered with the HCPC (NB you can still take part if you trained abroad as long as you are UK registered).

The output from the research process will be shared with Bangor University and the Society and College of Radiographers – but any data you input will be kept confidential and any future publication will only contain aggregated / anonymised data by region.

If you need any further information or if you have difficulty accessing the survey – please feel free to email me:
– Principal Investigator / 1st Contact: NB: please **do not** contact the Society of Radiographers (SCoR) directly – as this project is independent of the SCoR.

Thank you for taking the time to read this message and for hopefully taking part. Good luck also to the lucky winner in the prize draw!

Appendix 9 – Expert Panel Review of Cognitive Interview Findings (example data excerpt)

Narrative review of Cognitive Interviews Pilot for CAI questionnaire use in Radiography Context.

Questions 9,11,12,15,18,26,30,32 (n=8) did not have any comments, and interviewees felt that they were clear and could answer with no issue.

Q1. Comments:

Original Q1: "**Personal and professional boundaries between HCP's are maintained**"

Are you maintaining professional standards in your profession? / Is Question about professional relationship between service user and the professional? E.g. not having not-having personal relationship with co-workers / feels question is vague - Comment - when I asked her if this could mean barriers between professional practice e.g. doctors and HCP's - thought could be.	What does it mean by 'personal' / in work or out of work? / does it mean professional boundaries meaning between radiographers / in what ways can boundaries be breached? / C: examples might help in the Q/ Felt that Personal and Professional meant quite different things	What is meant by boundaries? / would interpret 'boundaries' after unpicking to mean not encroaching into someone else's role/	Could have answered question - however needed clarificaton on her interpretation of 'boundaries' - / interpreted boundaries to be 'way we speak and believe and discuss' e.g. outside work / boundaries between professionals / she did understand Q as being bounderies between professional roles and responsibilities.	Not sure what question means / very complicated and unclear question / Personal and Professional together is confusing. Agrees there are boundaries

Outcome Suggestion for change to: Q1R: ***"Relationships between radiographers and other colleagues are kept professional and non-personal"***

Confirmed by Expert Panel: Date: .

Appendix 10 – CAI Tool Showing Modified and Unmodified Questions

For each of the following statements, please put a cross in one box only. A – Strongly agree; A – Agree; D – Disagree; SD – Strongly disagree
HCP= Healthcare professionals

		SA	A	D	SD
01	Personal and professional boundaries between HCPs are maintained				
02	Decisions on care and management are clearly documented by all staff				
03	A proactive approach to care / imaging / treatment is taken				
04	All aspects of care /treatment / radiography are based on evidence of best practice				
05	The HCP leader acts as a role model of good practice				
06	HCPs provide opportunities for patients to participate in decisions about their own care / imaging procedure(s) / treatment				
07	Education of the team, is seen as important, and a priority in your department				
08	There are good working relations between clinical and non-clinical staff				
09	Staff receive feedback on the outcomes of complaints				
10	In your MDT (multi-disciplinary team meetings e.g. breast / trauma) radiographer members have equal authority in decision making				
11	Audit and/or research findings are used to develop practice				
12	A staff performance review process is in place which enables reflection on practice, goal setting and is regularly reviewed				
13	Staff have explicit understanding of their own attitudes and beliefs towards the provision of care / imaging / treatment				
14	Patients are encouraged to be active participants in their own care				
15	There is high regard for patients privacy and dignity				
16	HCPs and healthcare support workers understand each other's role				

For each of the following statements, please put a cross in one box only. A – Strongly agree; A – Agree; D – Disagree; SD – Strongly disagree
HCP= Healthcare professionals

		SA	A	D	SD
17	The management structure is democratic and inclusive				
18	Appropriate information (large written print, tapes, etc.) is accessible to patients				
19	HCPs and patients work as partners providing individual patient care / imaging / treatment				
20	Care / imaging/ therapy is based on comprehensive assessment				
21	Challenges to practice are supported and encouraged by radiography leaders and radiography managers				
22	Discussions are planned between HCPs and patients				
23	The development of staff expertise is viewed as a priority by radiography leaders				
24	Staff use reflective processes (e.g. action learning, clinical supervision or reflective diaries) to evaluate and develop practice				
25	Organisational management has high regard for staff autonomy				
26	Staff welcome and accept cultural diversity				
27	Evidenced-based knowledge on care /imaging / treatment is available to staff				
28	Patients have choice in assessing, planning and evaluating their care and treatment				
29	HCPs have the opportunity to consult with specialists				
30	HCPs feel empowered to develop practice				
31	Clinical radiography leaders create an environment conducive to the development and sharing of ideas				
32	Guidelines and protocols based on evidence of best practice (patient experience, clinical experience, research) are available				

For each of the following statements, please put a cross in one box only. A – Strongly agree; A – Agree; D – Disagree; SD – Strongly disagree
HCP= Healthcare professionals

		SA	A	D	SD
33	Patients are encouraged to participate in feedback on care, culture and systems				
34	Resources are available to provide evidence-based care				
35	The organisation is non-hierarchical				
36	HCPs share common goals and objectives about patient care				
37	Structured programmes of education are available to all HCPs				

Thank you for agreeing to participate in this questionnaire wording review.

KEY

Green = original

Yellow = additional words profession specific / or substitution e.g. nurse to radiographer

Blue = modified sentence to relate to radiography profession – decided at review panel after cognitive interviews

Purple = substitute nurse for HCP

ANALYSIS	
Unchanged Questions	N = 24
Minor nomenclature changes e.g. substitute nurse for radiographer or add imaging / therapy to care	N = 11
Reworked question to make more understandable to radiographers	N = 2

Appendix 11 - Participant Questionnaire and Final CAI Tool Used

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Radiographer Practice Context Survey

Thank you for your interest in completing this online survey. The intention of the survey is collect information, specifically from **UK Practicing** (registered) **Radiographers** (Diagnostic & Therapeutic), relating to the 'Context' in which practitioners work. 'Context' has been shown to be an important area to explore, when trying to implement research evidence into clinical practice. The School of Healthcare Sciences at the University of has a special interest in 'Implementation Science' – and exploring the 'Context' of the Radiography profession in relation to implementing evidence into the practice of radiography, specifically, will add to the body of knowledge in this field of healthcare research.

The survey is appropriate for any UK clinically practicing radiographer to participate who is registered with the 'Health and Care Professions Council' (HCPC) regardless of which country you originally trained in. Please **do not** complete the questionnaire if you are **not** personally directly involved in a clinical service on a day to day basis e.g. Teaching/ Managing etc. – as the questionnaire tests the context of radiographers practicing clinically 'hands on' with patients.

Data Protection Assurances:
The questionnaire asks for a little information about you – however this information will be kept securely and confidentially always, and any subsequent publication will anonymise data to maintain the privacy of those completing the questionnaire. There will be an assumption that if you complete the survey, then you also consent to the use of the data for research or publication purposes. The data collected will be used initially, to inform a project undertaken as part of a Doctorate in Healthcare, and might be used subsequently for publication. Where you agree to supply contact details also, this will be kept in the strictest of confidence, and will only be used to contact you specifically, where you agree, to discuss your views in more detail later in the research process or in relation to any prize won.

Data management will comply with the Data Protection Act (1998) and University data protection guidance. Telephone interviews will be digitally audio-recorded. Personal data will remain confidential throughout and will be anonymised. Individual participants will be allocated codes and/or pseudonyms, so that names are not identifiable, and any reference to workplace, location, names of individuals will be removed from the data and kept separately. All participants will be given a code so that no personal information is identifiable in the reporting and dissemination of results. Computerised data will be stored on Bangor University secure servers, accessed by password only. Paper copies of transcripts will be kept in secure filing cabinets. All anonymised data will be stored securely for a period of ten years after completion of the research University Code of Practice for the Assurance of Academic Integrity and Quality Assurance in Research). **Contact:**

As there is a 'prize draw' of a new 'tablet computer' – please be aware that the winner will be chosen randomly from all those who have supplied their contact details.

Please tick the box to state you understand and agree with the governance principles above ☐

Many thanks to UK practicing Radiographers who take the time to participate.!

Participant Information Sheet V4 July 2017

HCP = Healthcare Professionals.

Practice Setting? *(Please Tick all relevant)*	NHS Private Sector Acute Hospital Community Hospital Armed Forces Other (Please Specify)
Do you practice radiography clinically on a regular basis embedded in a clinical service i.e. 'hands on' with patients ?	Yes No
Branch of Radiography Qualified?	Diagnostic Therapeutic
Where did you obtain your initial qualification to practice as a radiographer?	UK EU Rest of World (specify country):
Is your original qualification in radiography?	Qualifying Professional Diploma Undergraduate course e.g. BSc Postgraduate Entry route (e.g. accelerated postgraduate diploma / MSc) Other (Please Specify):
How long have you been a qualified radiographer?	years
Who is your main employer? I mainly do managerial / teaching work	Please state: Yes No

Do you have a sub-specialty qualification?	Please specify… ______________________ *(e.g. PgC in Computed Tomography)*
Do you have a formal Masters or Doctoral Degree? *(please do not list master's level courses e.g. PgD)*	please specify… ______________________ *(e.g. MSc in Medical Ultrasound)*
Do you have a supervisory or management qualification?	Please specify… ______________________ *(e.g. ILM / MBA etc)*
What is your age range? *(please circle)*	18-25 26-35 36-45 46-55 56-65 66-75 76-80 Prefer not to say
Sex *(actual or by identity)*	Man ☐ Woman ☐ Prefer not to say ☐
AFC Band (if NHS)	Please specify… ______________________
Practicing Home Country:	Please specify… England ☐ Northern Ireland ☐ Scotland ☐ Wales ☐

If there is a **significant barrier** to you being able to develop as a professional or develop your service – please state it briefly here (e.g. inter-professional issues / financial & resources / poor evidence supporting practice development etc)	Briefly describe….

If you have any other comments please include below………………

Please note – *it is* <u>*not*</u> *a requirement for you to give your name and contact details below – however if you do – the information will only be used for the purposes of this piece of research. Also – if you tick the appropriate box – you agree that you consent to be contacted further for clarifying a piece of information you provided in the questionnaire or for a telephone discussion* if you agreed to this further by ticking the appropriate box, and similarly to consent to being entered into the free prize draw for a Tablet Computer. (Telephone discussions will last approximately 30-40min at a time to suit you*).*

Name*	
Contact Phone Number*:	
Contact e-mail address*:	
I agree to be entered into a free prize draw for completing this questionnaire - **Prize is a New Samsung Tablet Computer.**	Agree (please tick) ☐
I agree to be further contacted to <u>clarify information</u> on this survey	Agree (please tick) ☐
I agree to be further contacted to <u>participate in a 'one to one' **telephone discussion** to clarify your views more</u> –	Agree (Please tick) ☐

NB: *There is an assumption that you are willing to supply your address if you win the prize offered (for the sole purpose of prize delivery).

For each of the following statements, please put a cross in one box only. A – Strongly agree; A – Agree; D – Disagree; SD – Strongly disagree   ***HCP= Healthcare professionals***

V3, Final – July 2017

		SA	A	D	SD
01	Personal and professional boundaries between HCPs are maintained				
02	Decisions on care and management are clearly documented by all staff				
03	A proactive approach to care / imaging / treatment is taken				
04	All aspects of care /treatment / radiography are based on evidence of best practice				
05	The HCP leader acts as a role model of good practice				
06	HCPs provide opportunities for patients to participate in decisions about their own care / imaging procedure(s) / treatment				
07	Education of the team, is seen as important, and a priority in your department				
08	There are good working relations between clinical and non-clinical staff				
09	Staff receive feedback on the outcomes of complaints				
10	In your MDT (multi-disciplinary team meetings e.g. breast / trauma) radiographer members have equal authority in decision making				
11	Audit and/or research findings are used to develop practice				
12	A staff performance review process is in place which enables reflection on practice, goal setting and is regularly reviewed				
13	Staff have explicit understanding of their own attitudes and beliefs towards the provision of care / imaging / treatment				
14	Patients are encouraged to be active participants in their own care				
15	There is high regard for patients privacy and dignity				
16	HCPs and healthcare support workers understand each other's role				

For each of the following statements, please put a cross in one box only. A – Strongly agree; A – Agree; D – Disagree; SD – Strongly disagree
HCP= Healthcare professionals

V3, Final – July 2017

		SA	A	D	SD
17	The management structure is democratic and inclusive				
18	Appropriate information (large written print, tapes, etc.) is accessible to patients				
19	HCPs and patients work as partners providing individual patient care / imaging / treatment				
20	Care / imaging/ therapy is based on comprehensive assessment				
21	Challenges to practice are supported and encouraged by radiography leaders and radiography managers				
22	Discussions are planned between HCPs and patients				
23	The development of staff expertise is viewed as a priority by radiography leaders				
24	Staff use reflective processes (e.g. action learning, clinical supervision or reflective diaries) to evaluate and develop practice				
25	Organisational management has high regard for staff autonomy				
26	Staff welcome and accept cultural diversity				
27	Evidenced-based knowledge on care /imaging / treatment is available to staff				
28	Patients have choice in assessing, planning and evaluating their care and treatment				
29	HCPs have the opportunity to consult with specialists				
30	HCPs feel empowered to develop practice				
31	Clinical radiography leaders create an environment conducive to the development and sharing of ideas				
32	Guidelines and protocols based on evidence of best practice (patient experience, clinical experience, research) are available				

For each of the following statements, please put a cross in one box only. A – Strongly agree; A – Agree; D – Disagree; SD – Strongly disagree
HCP= Healthcare professionals

V3, Final – July 2017

		SA	A	D	SD
33	Patients are encouraged to participate in feedback on care, culture and systems				
34	Resources are available to provide evidence-based care				
35	The organisation is non-hierarchical				
36	HCPs share common goals and objectives about patient care				
37	Structured programmes of education are available to all HCPs				

Thank you for agreeing* to participate in this questionnaire wording review.

**Please see participant information sheet for further information about your contribution, DATA protection assurances, and your ability to withdraw your information from this survey, should you so choose at any stage.*

Appendix 12 - Online Survey Pilot Questionnaire

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" What is the Context of the UK Radiography Profession"? Professional Doctorate Thesis –

Pilot Study – Surveymonkey™ Questionnaire

NB: the purpose of the pilot is to test the integrity and ease of use of the online questionnaire rather than to test the content of the questionnaire itself. Thank you for taking part!

Please tick to confirm that you are a **registered student with Bangor University**: ☐

Please give your name if you are happy to be further contacted to clarify your responses:

Name: ____________________________

Please time your interaction with the questionnaire and note it at the end of this form.

Please undertake the Online Survey 1st – answering the questions as though you were qualified - then answer this questionnaire at the end – thank you!

(Please let me know if you have difficulty accessing a PC/Internet)

Survey access: https://www.surveymonkey.co.uk

Please Rate the **ease of accessing the survey online**: (*Circle One)*

Difficult..1…….2…….3…….4…….5 Easy

Comments:

Please Rate the clarity of the **background information** : (*Circle One)*

Bad..1…….2…….3…….4…….5 Good

Comments:

Please Rate the functionality of the web pages – did it work well without bugs?: (*Circle One)*

Bad..1…….2…….3…….4…….5 Good

Comments:

Please Rate the format *and content* of the introductory part (your background information): (*Circle One)*

Bad..1…….2…….3…….4…….5 Good

Comments:

Please Rate the format *ONLY* of the of the main question section: (*Circle One)*

(NB we are only looking at formatting and not the meaning of the questions themselves here)

Bad..1…….2…….3…….4…….5 Good

Comments:

Please Indicate the time you roughly took to undertake the survey:

General Comments:

MANY THANKS FOR TAKING THE TIME TO HELP WITH MY PROJECT!

Appendix 13 - Interview Schedule

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School of Healthcare Sciences

Participant #
Name:
Telephone No:

'Exploring the Factors that influence the evidence used by Radiographers in their practice in the UK'

Telephone Interview Schedule

Switch tape on

Many thanks for leaving your contact details on the online Surveymonkey™ which is the tool used as part of this. Just to recap, my Doctoral study is exploring the factors that might have an influence on how radiographers in the UK use evidence to change or improve their practice. The background information within the online survey explained, that if you left your contact details and ticked a box agreeing to a telephone interview, that this would imply that you would be happy to be contacted further to discuss this part of the project. Can I check that you are happy with this?

This part of the project explores further your views and opinions, regarding your own practice setting, and any information shared will be anonymised, and will not be attributable to any one person or organisation. Data will be kept securely on University servers and it will be encrypted and password protected. You are free to withdraw your consent to this telephone interview at any time during the conversation or afterwards (please notify me [ ] directly:), and you can request for your interview data to be destroyed at any time should you choose so.

The interview, will **take up to 40 minutes** to complete.

The results of the interview will be reported back as part of a Doctoral Thesis, and this will be shared with the Society and College of Radiographers, as it may help with future research and implementation strategy. No identifiable data will be reported or published.

Q: Do you have any further questions about the study before I seek your consent to participate?

....

Date ______________ **Code of interviewee #** ______________

Do you consent to your interview being audio-recorded on the basis that it will then be transcribed and anonymised, and the original recording destroyed in due course?

Yes / No

Can you confirm that you have read the telephone interview briefing sheet and had the opportunity to ask questions and have had these answered satisfactorily?

Yes / No

Do you understand that your participation is voluntary, and you are free to withdraw at any time, without giving any reason and without penalty?

Yes / No

Do you understand that the information given by you will be used to develop our future research and may be shared anonymously with other researchers at Bangor University, associated Universities, and the Society and College of Radiographers?

Yes / No

Do you understand that you can request your details be removed from our research database at any time?

Yes / No

Do you agree to participate in this interview and for your data to be used for the purposes of this study?

Yes / No

Fine, now we will start the interview. Just to give a little bit about Background:

Q1: Can you tell me about your current role in your department?

- **Diagnostic / therapeutic?**
- **Job title?**
- **Qualify UK or Abroad?**
- **Overview of any specialty / qualifications / duties?**
- **Why radiography as a career?**
- **Years of service? Current employer years?**
- **HCPC registered / AFC Band?**
- **Clinical or managerial?**
- **Thoughts on role clarity of radiographer / practice boundaries**

Self-Prompt –

Referring to themselves, Team, department or general profession?

get examples of scenarios etc.

Avoid leading Questions!!

Implementation Section:

Q2: 'Evidence Based Practice' is the process of making clinical decisions based upon evidence, using clinical experience, and patient expectations……………Can you explain to me your thoughts about 'evidence based practice'?

- What counts as evidence to them?
- Evidence quality/ credibility /sources / availability /barriers?
- Constraining practice? Guiding practice?
- Role of Expertise in EBP?
- Patient preferences / organisation / resources
- Initiatives they or colleagues have used for EBP?

Self-Prompt –

Referring to themselves, Team, department or general profession?

get examples of scenarios etc.

Avoid leading Questions!!

Q3: How do you generally seek out new evidence to improve your practice?

- How does the department help / encourage the individual?
- Barriers / facilitators e.g. time /money /resources/ personal drive / apathy etc.?
- CPD? 360 feedback / thoughts about 360 feedback/ Conferences? Courses? Journals? Contribute? Own Research?
- How does the department seek out? Is there structure and method?
- Can they give examples of local application / initiatives to implement
- Can they generalise how the Profession as a whole does it in UK?
- Where does responsibility lie for ensuring practice is always Evidence Based? Local / Organisational / National?
- Are they aware of implementation frameworks?

Self-Prompt –

Referring to themselves, Team, department or general profession?

get examples of scenarios etc.

Avoid leading Questions!!

Culture Section:

Q4: Could you tell me a bit about the culture of your workplace – in terms of professional practice and service development?

- Personal thoughts of local culture
- What would be their view of a good / bad culture?
- Inter-professional relationships? Any dominance issues by other professionals
- Local Team/ line management -professional team management / Organisational Culture / National Professional Culture in Radiography?
- Issues or concerns
- Culture affecting practice / adoption of EBP / quality / patient experience?

Self-Prompt –

Referring to themselves, Team, department or general profession?

get examples of scenarios etc.

Avoid leading Questions!!

Q5: A) Has your team identified key factors which have enabled a strong culture to develop? &

B) Can you tell me about any processes or initiatives used by your team to develop a strong culture?

*(*essential attributes of work based culture Manley et al 2011)*

• person-centeredness • lifelong learning • high support and high challenge • leadership development • involvement, collaboration and participation by stakeholders (including service users) • evidence-use and development • positive attitude to change • open communication • teamwork • safety (holistic) & explore barriers to change

Self-Prompt –

Referring to themselves, Team, department or general profession?

get examples of scenarios etc.

Avoid leading Questions!!

Q6: What is your understanding of 'practice development' or 'service development' and planning?

(from Society of Radiographers definitions of PDP):

- Explore approaches to service planning in the workplace
- Explore what they think about career progression and framework in radiography (local /national)
- Explore the notion of a 'personal development plan'
- Explore 'clinical supervision' understanding of? Participates? Team /embedded / engagement? Effective?
- Understanding of reflective practice
- Promotion of audit / research skills /evidence base for profession?

Self-Prompt –

Referring to themselves, Team, department or general profession?

get examples of scenarios etc.

Avoid leading Questions!!

Q7: Can you explain how your team or your service shares information about achievements with other areas?

- (e.g. between sister departments / other departments / other hospitals etc/ profession nationally.)
- How does your team document success stories & achievements and disseminate to others?

Self-Prompt –

Referring to themselves, Team, department or general profession?

get examples of scenarios etc.

Avoid leading Questions!!

Exploration of Leadership

Q8: Can you describe to me your thoughts about leaderships styles within your team:

- Transformational / transactional /authentic
- Clear understanding of goals / rewards / communication / leading by example
- Impact of leadership style on morale / culture / practice
- Supervisory style / presence / appropriate / overpowering
- Succession planning / training for the future
- How is good practice of the area shared with other clinical areas?

Self-Prompt –

Referring to themselves, Team, department or general profession?

get examples of scenarios etc.

Avoid leading Questions!!

Exploration of Evaluation

Q9: How do you gain the views and thoughts of patients about your practice or service?

- Surveys / questionnaires / novel approaches?
- Complaints / concerns / web-sites?
- Patient /user involvement at meetings / consultations / service planning / redevelopment?
- Use of online 'forums' or 'public engagement events' etc.
- Quality Impact Assessment?
- How is this integrated into local practice and that of the organisation?

Self-Prompt –

Referring to themselves, Team, department or general profession?

get examples of scenarios etc.

Avoid leading Questions!!

Q10: Do you know how data is used to inform practice / service improvement?

- Have findings from local service evaluation been compared with other areas / and with current evidence of best practice?

Self-Prompt –

Referring to themselves, Team, department or general profession?

get examples of scenarios etc.

Avoid leading Questions!!

Conclude………

Many thanks for your time, **Q: Have I missed anything important you wanted to add to this conversation?**

Please feel free to contact me if you have any further questions/comments.

Many thanks again for giving your valuable time to this research project.

Appendix 14 - Analytical Memo Example

Memo Report

Selected memos (1)

Participant 1 Analytic Memo

27/10/18 M D B7 Sc RPT 8y Verified. Feels that there is bad feeling / animocity between some radiologists and radiographers. Issue with 'medical staff allowing change to happen.' Feels that radiographer progression in Scotland is falling behind England. Not apathy - but feels that staff are burnt out with bad shift system and dont have the energy or motivation as a result to progress with development. Evidence of role blocking at odds with service needs (huge amount of plain film reporting outstdaning). Hints at professional protectionsism and feels that radiologists are feeling challenged in their roles (boundaries). NB: feels that radiologists are protecting 'overtime payments' to report backlog - with monetary gain negaively impacting on another profession? some radiologists locally supportive of developing radiographer roles though. Feels that in Scotland particularly there isnt enough support for radiographers to promote their role into extended areas like reporting. Financial barriers to getting advanced level courses fully funded. Radiographers having to partially fund post grad training in Scotland PN: potential barrier to implementation here? There is some funding from NES (national executive for scotland) but very long winded and hard to get throgh. Feels that more senior managers dont understand radiography service. Feels that having a radiographer as their senior manager (as oposed to an admin background or nursing) would understand radiogrphy roles better and undersatand what needs to change for improvement. Feels that management is too hierarchical. Says managers up to AFC B9 but no clinical manager in radiography until B7. Feels that more senior managers more hands on in other local professions e.g. physio/OT. B8 radiography managers hide away from clinical - little presence. Feels that consultant radiographer they have though understands radiography team development needs PN: is this seen as the role of consultant radiog? Is this something that could be harnessed more to improve context? Feels that his reporting role - its essential to be clinical hands on to ensure that they keep the skills of the general radiographers up by teaching old and new with constant improvement PB: Is this radiography taking ownership of the profession ULTIMATELY - buy developing itself, its own practice and not being developed by another professional like a radiologist - feeding back aspects of what was previously in the realm of another profession overshadowing it e.g. Radiology? Is reporting key to making radiography a FULLY Fledged profession or part of it? Feels that staff are overwhelmed most of the time due to work pressures so that they have not enough time to do CPD etc or undrstand recent advances therefore changes probably might not happen - but he feels that reporting / clinical interface of the reporting radiographer role might help with this. Feels that reporting radiographer has a bit more time in their job plan to be aware of cpd / improvement etc. Some CPD put on every three months

Appendix 15 - Theme Grouping with Sticky Notes

Appendix 16 - Identified Themes and Sub-Themes

Theme	Theme Sub-categories	Sub-Category Descriptors	Final Code(s)	Number of final merged codes used in sub-theme categories – representing data items used for analysis
I. Radiography Practice Climate & Culture	A. External Forces	External influences at the macro (national) or meso (regional) level which have an influence on how radiographers might have an ability or limited ability adopt or effect change. This includes historical or perpetuating negative culture, regulatory issues, and professional institutional level issues.	i. State or Government Influence ii. Regulatory Influence iii. Cultural Memory - Practice Not Evidential iv. Cultural Memory - Communal Memory v. Culture - Individual vs System Power to Change vi. Culture – Multidisciplinary as a Facilitator vii. External drive for change – students (soft pressure) viii. External service driven change e.g. cancer targets (hard pressure) ix. External scrutiny e.g. regulator or registration audits x. Professional Animosity - External / National (turf wars) xi. Professional Bodies – positive role in promoting evidence use xii. Professional Bodies – National drive for local learning representatives xiii. Professional Bodies – national recognition xiv. Sector Contrasts – profit vs evidence use or change	n=16

			xv. Sector Contrasts – lack of opportunity to develop roles or evidence use in private sector xvi. Sector Contrasts – more autonomy for change in private sector	
	B. Evidence Based Practice	How contextual factors influence the ability of the radiographer to access, implement, promote or generate new evidence in EBP.	i. Access to EBP – accessing evidence has financial cost ii. Access to EBP – no time to search or find research iii. Access to EBP – lack of drive to find or generate evidence/ bar set too high for publication iv. Poor resources in the context for implementing new evidence v. Teams too large in radiography to implement individually vi. Research – barren field	n=6
	C. Public Nescience & Professional Obscurity	The contextual historical / cultural background where the public and other professions miscomprehend the role of the radiographer – and how this affect the ability of the radiographer to implement evidence or research into practice.	i. Public – unaware of radiographer ability or skillset ii. Professional – Other professions unaware of radiographer potential and skillset – overlooked for new roles or opinion etc. iii. Button Pushers – patients don't hold radiographers in high regard as they don't give out results etc. iv. Not true professionals – public don't see radiographers as a source of health advice	n=4
	D. Team Working & Leadership	Perpetuating contextual professional structure and team structure issues which limit or prevent the role of the radiographer to influence change or adopt new evidence. Also the inherent professional culture	i. Pos. Context - flat team structures ii. Pos. Context - team working attains consensus iii. Pos. Context – good team communication iv. Pos. Context – altruism in the team	n-=12

		within radiography to be followers.	v. Pos. Context - collegiality – countering strong personalities vi. Pos. Context – social team vii. Neg. Context – team structure / dynamics issues viii. Neg. Context – professional boundary ix. Neg. Context – small town thinking x. Neg. Context – feedback poor xi. Neg. Context – isolation from radiologists xii. Neg. Context – radiographers want to be led by radiographers (-ve if not)	
	E. Role Clarity, Fluidity & Role Creep	Role boundaries as a cultural artefact or construct, how boundaries are set, transgressed and become fluid in terms of role development, role-creep and resistance to boundary movement.	i. Who sets the boundaries? ii. Leadership effect on boundaries iii. Management / leadership barriers iv. Role fluidity defined by service needs v. Role boundaries unclear vi. Governance supporting role fluidity vii. Protocols to clarify roles and boundaries viii. Understanding individual limitations ix. Role development & complexity definition x. Overstepping the boundary xi. Management support for crossing boundaries xii. Role creep xiii. Nationally Agreed Roles – higher status in law & respect? xiv. Crossing boundaries transcends professions	n=14
	F. Generational Issues	Professional stagnation or reluctance to change seems to be influenced by generation location of the profession. Resistance to change and	i. The young more open to change? ii. Older staff less open to implementation iii. Younger staff more receptive to new evidence	n=5

		accepting new roles seems to be generationally influenced.	iv. New generation radiologists more open to teamwork v. Demeanour of new generation radiologists dependent on system memory	
II. Established Radiologist Eminence	A. Established Rights and Privileges	Radiologists have an established privileged position within the pecking order or hierarchy, and sustain, nourish and perpetuate their rights to superiority of respect, hold onto roles for personal gain, and be more professionally accountable because they are medically qualified.	i. Radiologists don't get challenged ii. Radiologists right to own a case and be more professionally accountable than radiographers iii. Radiologist rights to hold onto old roles iv. Radiologist rights to riches v. Radiologists challenged by radiographer role extension	n=5
	B. Established Elitism	How elitism in radiology perpetuates differences between roles and rights to knowledge and protect professional boundaries.	i. Radiologist – autonomy & ego ii. Radiologist – right to knowledge ownership iii. Radiologists – recruit confident actors iv. Radiologists – protect own boundaries v. Radiologists – keep radiographers 'down' vi. Radiologists – professional snobbery	n=6
	C. Dominance, Paternalism & Power	How radiologists act to obstruct change, power relationships, and perpetuate a paternalistic dominance over radiography and radiographers.	i. Radiologists obstruct if they want to ii. Radiologists control change iii. Radiologists perpetuate hierarchy and rank iv. Radiologist – paternalism over radiographers	n=4
III. Emergent Radiography Profession	D. Bow Down & Go with the Flow	Radiographers have a tendency to be subservient, reliant on other professions, and be 'accepting' of their circumstance by nature. Radiographers feel inferior to other professions.	i. Radiographers – like the 'comfort zone' / apathy / have low professional esteem ii. Radiographers – confidence lacking iii. Radiographers – therapy in the diagnostic shadow	n=6

			iv. Radiographers – servility / reliance on others v. Radiographers – reside in obscurity vi. Radiography – recruits passive actors	
	E. Demi-profession	How radiographers are silenced (voluntarily or imposed), have limited scope in reflective practice and tend to 'use knowledge' rather than 'produce' knowledge. Other professions misunderstand radiographers and their skills.	i. Radiographers – 'vow of silence' ii. Radiographers – reflective practice lacking iii. Radiographers – 'knowledge users' iv. Radiographers – EBR difficult to achieve / 'not our job' v. Radiographers – credibility lacking / misunderstood K&S (undersold / underselling)	n=5
	F. Taking Ownership of our Labours (Liberation & Breakout)	How radiographers are becoming 'liberated' or 'breaking out' of comfort zones, taking a lead, becoming more autonomous, and claiming professional rights to be recognised and acknowledged to undertake new roles, and implement their own knowledge into practice with a newly found freedom.	i. Emerging Professional Confidence – trust ii. Emerging Professional Confidence – confidence iii. Emerging Professional Confidence – parity with medics iv. Emerging Professional Confidence – empowerment v. Liberation – breaking barriers vi. Liberation – pushing boundaries vii. Liberation – consultant radiographers viii. Liberation – education & research ix. Liberation – acceptance by others x. Liberation – claimed rights xi. Change agent – implementing knowledge xii. Emerging Knowledge Producer xiii. Radiographer Consultants – perpetuating a new hierarchy / regime	n=13
			Merged codes contributing to the final analysis	**Total** = **96**

Appendix 17 – Academic Ethics Committee (AEC)

Ethical approval granted for 2016-15862 A Mixed Methods Study of the Implementation 'Context' within the UK Radiography Profession

H

Reply all

Mon 24/07/2017, 16:11

Dear XXXXX,

2016-15862 A Mixed Methods Study of the Implementation 'Context' within the UK Radiography Profession

Your research proposal number 2016-15862
has been reviewed by the Healthcare Sciences (Post-reg) Ethics and Research Committee and the committee are now able to confirm ethical and governance approval for the above research on the basis described in the application form, protocol and supporting documentation. This approval lasts for a maximum of three years from this date.

Ethical approval is granted for the study as it was explicitly described in the application

If you wish to make any non-trivial modifications to the research project, please submit an amendment form to the committee, and copies of any of the original documents reviewed which have been altered as a result of the amendment. Please also inform the committee immediately if participants experience any unanticipated harm as a result of taking part in your research, or if any adverse reactions are reported in subsequent literature using the same technique elsewhere.

Appendix 18 - Additional Ethics Amendment Approval

Fri 19/01, 17:50

Dear

xxx asked me to formally write to you in your capacity of Chair of the ethics committee.

At supervision - I discussed a problem with him that has arisen with my implementation project. I have not got any volunteers in the survey for interview from Wales or Northern Ireland.

Please could you kindly consider 'chair action' on the following variation to my method:

- Increasing sample size for interview from 12 to 20 individuals
  - Reason for request - increasing sample size will hopefully yield greater confidence in the data to compensate for not having a fully representative sample from the whole UK.
  - There will be no design or method changes as a result.

We both agreed at this late stage it was not feasible or absolutely necessary (given the above modification to the method) to ask for Health Board ethics approval for purposely selecting a staff volunteer from Wales and Northern Ireland.

I welcome your comments on the above - and if you are in agreement - a formal endorsement of this minor modification.

Best Wishes

XXX

Response

Tue 23/01, 14:54

Thanks XXX -just wanted to be sure.

Please take this email as confirmation that the increase sample size is appropriate.

best wishes

XXX

Chair – Ethics Committee – School of Healthcare Science

Ysgol Gwyddorau Gofal Iechyd/School of Healthcare Sciences

Prifysgol XXX University

Appendix 19 - NHIR Good Clinical Practice Course

NHS
National Institute for
Health Research

CERTIFICATE of ACHIEVEMENT

This is to certify that

has completed the course

Good Clinical Practice (GCP) -Oct to Dec 2017

A practical guide to ethical and scientific quality standards in clinical research

10 October 2017

Including EU Directives, Medicines for Human Use (Clinical Trials) Regulations & the Department of Health Research Governance Framework for Health & Social Care, as applied to the conduct of Clinical Trials & other studies conducted in the NHS

Modules completed:

Introduction to Research and the GCP standards
Preparing to deliver your study
Identifying and recruiting participants: eligibility and informed consent
Ongoing study delivery and data collection
Safety Reporting
Study closure

This course is worth 6 CPD credits

CPD

Delivering research to make patients, and the NHS, better

Appendix 20 - Narrative Review of Learning & Dissemination Event

Introduction

One aim of this project was to *engage with key stakeholders to explore how the research findings can make a difference to the implementation strategy of the radiography profession*. At an early stage, contact was made with the professional body in the UK for radiography, The Society and College of Radiographers (SCoR), to explore opportunities for research funding, logistical support and eventual research adoption. Research funding for the project was not granted, however the SCoR offered support for logistics: including survey advert publication in their monthly magazine; main website landing page adverts; use of conference facilities at their headquarters in London; and the possibility for knowledge adoption from the research output of the project, if judged to be in alignment with the research strategy of the SCoR. The aim being to influence evidence adoption strategy and policy by the professional body.

The Need to Disseminate and Influence Policy

"Effective dissemination is essential to ensure that the message is read, understood and acted upon by others, including practitioners, researchers or policy makers" (p. 85) (Nightingale, 2017). The dissemination of research findings into practice can be defined as "the targeted distribution of information and intervention materials to a specific public health or clinical practice audience" (p. 49) (Neta et al., 2015). Nutley, Walter, Davies, and Davies (2007) introduce the concept of research typology, describing the distinction between "instrumental" (p. 36) and "conceptual" (p. 36) uses of research, with the former intended to directly impact on policy making and the latter, describing the indirect way in that conceptual research can shape the future development of research or research adoption per se.

It is a natural academic expectation that any piece of research should have an output and that this, if possible and justified, should be acted upon. There has not been much attention given to how researchers may optimally provide sound evidence to influence policy makers in their policy making (Otten, Dodson, Fleischhacker, Siddiqi, & Quinn, 2015). There is however substantial body of knowledge on the best techniques of communicating evidence-based information, e.g. the production /publication of short summaries applicable to policy makers (Otten et al., 2015). The output of doctoral training is usually propagated by making the final thesis available to others through electronic libraries, by publication or showcasing at conferences or by other novel means (Smith, 2009). Increasingly, evidence suggests that engaging with alternative modes of disseminating research findings, can aid reflexivity and engagement with policymakers and 'knowledge users' with researcher interaction adding value to adoption (Smith, 2009).

In their study examining the barriers and facilitators to engaging with policymakers to disseminate new research findings, Otten et al. (2015) found that "personal desire to make a difference" (p. 3), amongst other reasons, made a positive difference as to how research reached policy makers, including a strong culture and support mechanism for engaging with policymakers, within academic institutions. Neta et al. (2015) explain the many reasons for the often drawn-out or incomplete adoption of new research by policy makers and knowledge users, finding that some do not find research relevant, either to their cause, or situation, or even do not have the required skills in the institution to understand the relevance or meaning of research to their institutional mission (Cairney & Oliver, 2017). Engagement with policymakers or institutions at an early stage of the research project, can add value in terms of adoption, by "designing for dissemination" (p. 50) (Neta et al., 2015).

In their research looking at how research gets onto the policy table, Otten et al. (2015) amongst a list of possible interventions, describe the opportunity of dissemination by engaging with key players at professional meetings or conferences, presenting and targeting dissemination where it can have most impact in relation to the study output (Otten et al., 2015). This supported the initial thinking surrounding the methods which might be suitable for having the greatest impact in promoting the dissemination of findings into national policy. The following potential methods were then proposed:

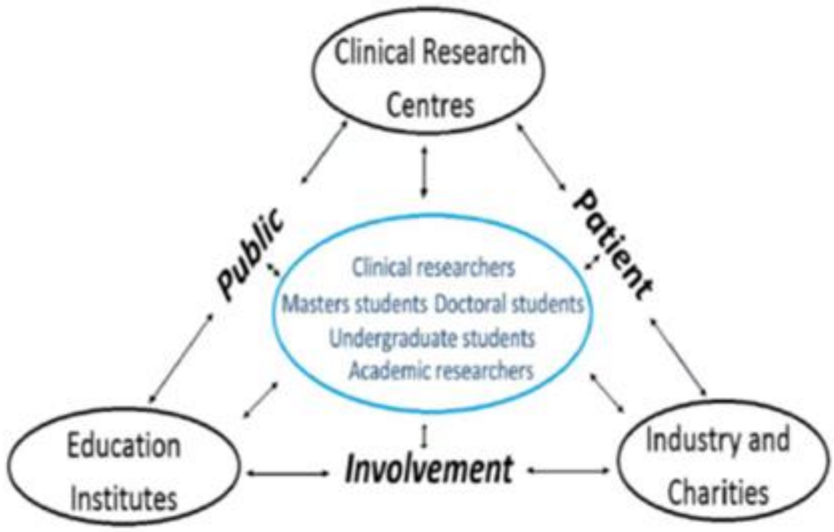
- Engagement at an early stage with a key institution, with national and international presence, and an ability to directly influence the direction of professional policy within radiography (specifically in relation to research evidence adoption)
- Dissemination by publication in peer reviewed journals and posters at professional meetings (professional and implementation science related)
- Availability of the thesis in electronic form through University library
- Dissemination event with a key institution, and research / policy champions within that organisation.

At an early stage of development, therefore, this project necessarily sought to include early contact with the key institution, to improve familiarity with the subject of implementation science, and its possible relevance to the radiography profession in the UK, and to showcase early findings together with an exploration of potential implementation methods of the final research outcome.

Society and College of Radiographers (UK) Research Policy and Strategy

"Establishing the radiography evidence base has been vital in enabling the radiography profession to develop and evolve in its own right" (p. 85) (Nightingale, 2017). In their latest research strategy the SCoR highlight the need for links with academic institutions and postgraduate research students at the core of their strategy (Figure 1) (Society and College of Radiographers (UK), 2016). However, a review of their strategy for the period 2016 to 2021 does not reveal any intention to explore KT, in terms of how research can be effectively implemented into practice at all levels, maximising impact, even though implementation responsibility is attributed at various levels of their strategy document. The SCoR highlight in the document that research is a key part of the organisation's mission, emphasising research into "Supporting professional development….and…..building professional credibility through research" (p. 2).

Figure 1 SCoR Collaborative Links for Research



NB Sourced from: (Society and College of Radiographers (UK), 2016)

Dissemination Event

Method

Ethical approval to engage with an external professional stakeholder was sought and granted by the university research ethics committee. A meeting took place at the SCoR headquarters in London on the 8th October 2018. It was intended, as part of the method of this project, to involve senior actors from the professional body for radiographers in the UK. The event was organised in advance to ensure optimal attendance, however, a few individuals could not be present on the day (representatives of the Health Board). The director of professional policy, and the head of research strategy for the SCoR attended, together with an academic supervisor (who was also an implementation research expert) from University. The programme for the event included a presentation introducing key theory and concepts surrounding 'Implementation', a presentation highlighting the background to the project (including initial key findings likely to be relevant to the SCoR), and then a facilitated group discussion on the following three predetermined questions, intended to focus the discussion (Figure 2):

Figure 2 Questions for Group Discussion

Questions for Round Table Discussion:

(ideas / themes / concepts recorded on flip chart)

To what extent do colleagues feel that the initial findings fit in with **what the profession already knows, or suspects**, about UK radiography context?

Three **surprising findings** emerging from the data for discussion in the room:

-
-
-

What possible **impact** can this piece of work have on:

SCoR policy / strategy for practice development?

Ongoing research into evidence-based radiography?

Outcomes

Discussion surrounding the 1st question revealed that the discussion group members felt that the data presented from the initial findings, was in alignment with the suspected contextual norms already perceived by the SCoR to exist within the professional environment and comments were made and discussed, for example:

- the pre-formed view was that radiographers tend to "hide behind technology / complexity" (e.g. from giving early opinions on image findings to patients or medical colleagues – does the culture supress this perhaps radiologist / radiographer dynamic – or do radiographers hide from risk or lack of knowledge?)
- "negative assumptions by radiographers on own skillset".

- “we already know about some of the issues raised from the research”
- “diagnostic radiographers view their role as a production line – whereas therapeutic radiographers not so”
- “I feel that radiographers need to be more personally involved in patient pathways, and the skillset for this need focussing or developing”.
- “is there squabbling for territory going on?”
- “good patient care involves more than a radiographer just being a technical expert – this needs education and diffusion into the workforce”

In relation to question 2, there were some surprising findings for example:

“practice apathy – disappointing to hear - is it old style (Diploma qualified radiographers) vs more recently qualified radiographers (with a BSc) with differing perspectives on the use of research?”

“disappointing from a patient perspective, why are radiographers allowing the profession to be like this when other AHP’s have moved on?” (in relation to the advanced knowledge and skills that radiographers seem to shy away from even though they feel able to occupy advanced / consultant roles)

The possible impact of the study on UK professional practice and the research strategy and policy of the SCoR was then discussed, including the possibility of promoting KT within radiography. The following key areas were explored by discussion and viewed as a positive area for further work and development:

Embedding radiography culture as a core concept in undergraduate training.

How can the SCoR generate evidence / co-produce evidence with other health professions (HP’s) and will this possibly be a product of naturally closer working / collaboration / training with other HP’s in the future?

Showcase and publicise real life exemplars of radiographers meeting the core tenets of advanced and consultant practice. And raise awareness within practitioners of the 4 core pillars of advanced practice.

Raise awareness amongst practitioners that radiography involves more than technical expertise – that patient care and patient care pathways need to be more embedded.

Promote "Making Every Encounter Count" for example as promoted by major department stores.

Explore building 'implementation systems' into research proposals (up front) – especially for application for CORIPS funding by the SCoR.

Actively promote 'professional confidence' within radiography – able to seamlessly absorb and understand relevant evidence emerging from research.

The SCoR team were then able to comment on the possible impact of this study on their ongoing research strategy and policy generation, and the following outcomes and recommendations were noted:

- Make strong and clear study recommendations for the professional body to consider (output of this project)
- Consider making recommendations to professional regulators e.g. Health and Care Professions Council (HCPC) on embedding the 'four pillars' as a developmental domain within their standards of proficiency document
- The SCoR would consider embedding 'implementation strategy' as a section in their application forms for CORIPS research funding
- Publish a magazine article raising awareness of the dissemination event and also raising awareness of implementation and context in radiography.
- The SCoR will look to support publishing academic papers from the output of the study and possibly embed the findings into their three-year strategy plan.
- The SCoR stated that they felt that implementation was a very important topic for healthcare and radiography, and they did not know of any other implementation research work currently being undertaken in radiography

Reflection and Conclusion

The dissemination event proved useful for gaining further insight into early findings from the data, co-producing knowledge, and shaping further insights into the full data emerging from the analysis. Nutley et al. (2007) discuss "research payback" (p. 277) in terms of dissemination and potential impact from research and its value to professional practice, where input into policymaking or official guidelines can be far reaching and influential. Also, the face-to-face contact and discussion at a high professional level, facilitated the raised awareness of KT and the possibilities for understanding the radiography context (and policy drivers) and the advantages of tailoring knowledge or shaping the context to improve the successful implementation of research evidence into practice. The value of involving the various perspectives of stakeholders, that influences understanding, is supported by the ontology of co-production (Rycroft-Malone et al., 2016).

The final learning from the dissemination event for further consideration was to further consider the following at the QUAL data analysis stage and discussion:

- The 'Technical Nature' of the role of the radiographer – how does this influence the context?
- The 'Existential Question' - The uncertainty surrounding future roles within radiography as the service develops.
- 'Hiding behind technology'
- 'Low professional esteem (internal and external)'
- 'Should radiographers have opinions'?
- How is the profession implementing knowledge?
- Is there evidence to support 'Joint Architecture' in pathways of learning shared between HP's?

- 'Professional Visibility and Credibility'
- 'Knowledge Ownership' by professions
- 'What do radiographers perceived their roles to be"?
- 'What are the advanced and consultant role educational and skillset standards for other Allied Health Professions in the UK?
- 'Embedding clinical leadership in professional education e.g. pre-registration courses'
- 'Radiographers migrating from the technical domain to the care pathway domain for practice'

References – Learning Event

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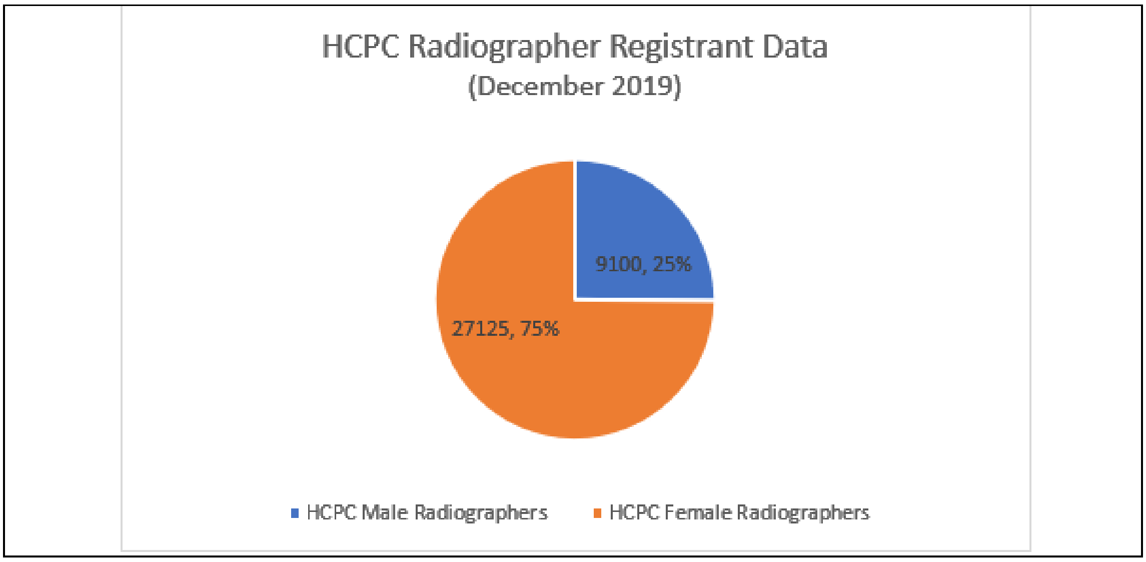
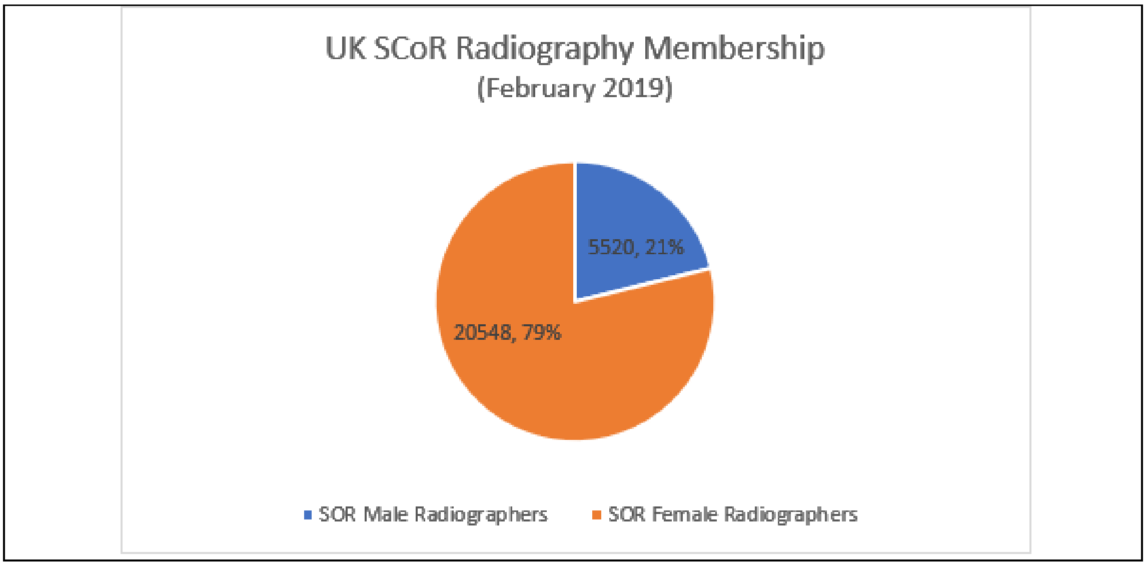
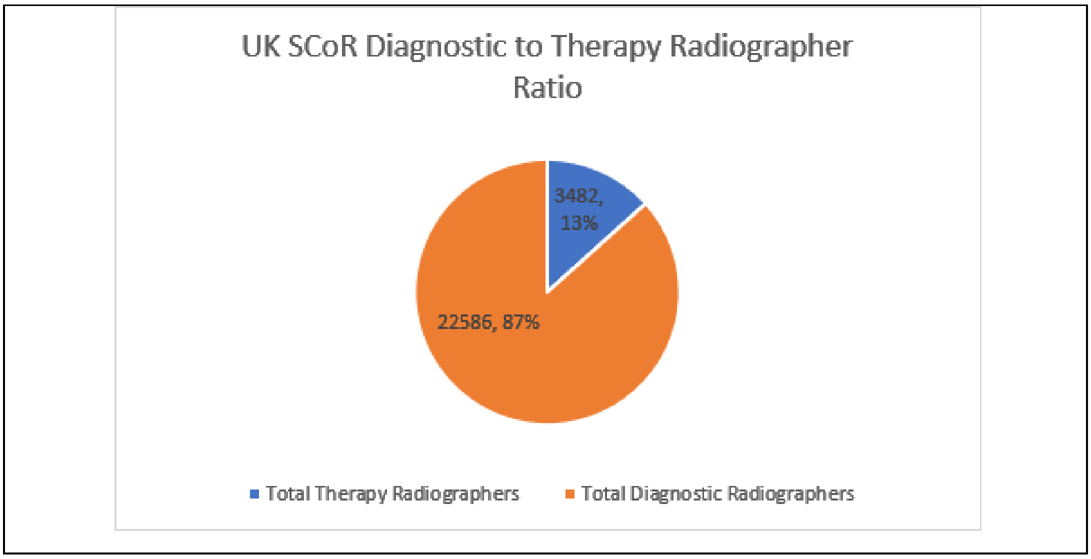
Appendix 21 - Comparison of SCoR Membership and Health and Care Professions Registrants (2019 Data)





SCoR Radiography Membership (2019) Personal Communication.



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SCoR Radiography Membership (2019) Personal Communication.

Appendix 22 - Factor Loadings - Radiography CAI 37 Item Instrument

Factor Loadings for the 3 and 5 Factor Model:

Q. No.	Radiography Specific CAI Questions (Modified)	Three Factor Loading	Five Factor Loading
1	Personal and professional boundaries between HCPs are maintained (PB; C)	0.271	0.200
2	Decisions on care and management are clearly documented by all staff (RP, L)	0.310	0.414
3	A proactive approach to care / imaging / treatment is taken (CP, C)	0.626	0.574
4	All aspects of care /treatment / radiography are based on evidence of best practice (EIP, E3)	0.617	0.454
5	The HCP leader acts as a role model of good practice (RP; E)	0.508	0.529
6	HCPs provide opportunities for patients to participate in decisions about their own care / imaging procedure(s) / treatment (CP, L)	0.625	0.758
7	Education of the team, is seen as important, and a priority in your department (C)	0.576	0.772
8	There are good working relations between clinical and non-clinical staff (RP; E3)	0.466	0.418
9	Staff receive feedback on the outcomes of complaints (E; C)	0.538	0.625
10	In your MDT (multi-disciplinary team meetings e.g. breast / trauma) radiographer members have equal authority in decision making (CP: L)	0.523	0.425
11	Audit and/or research findings are used to develop practice (EIP; E3)	0.593	0.608
12	A staff performance review process is in place which enables reflection on practice, goal setting and is regularly reviewed (E; C)	0.654	0.451
13	Staff have explicit understanding of their own attitudes and beliefs towards the provision of care / imaging / treatment (PB; E3)	0.567	0.724
14	Patients are encouraged to be active participants in their own care (CP; E3)	0.611	0.745
15	There is high regard for patient's privacy and dignity (RP; C)	0.575	0.582
16	HCPs and healthcare support workers understand each other's role (PB; C)	0.561	0.574
17	The management structure is democratic and inclusive (EIP; L)	0.619	0.492
18	Appropriate information (large written print, tapes, etc.) is accessible to patients (E; C)	0.210	0.269
19	HCPs and patients work as partners providing individual patient care / imaging / treatment (CP; E3)	0.554	0.686
20	Care / imaging/ therapy is based on comprehensive assessment (RP; E3)	0.624	0.530
21	Challenges to practice are supported and encouraged by radiography leaders and radiography managers (PB; C)	0.690	0.504
22	Discussions are planned between HCPs and patients (CP; L)	0.470	0.492
23	The development of staff expertise is viewed as a priority by radiography leaders (EIP; C)	0.694	0.600
24	Staff use reflective processes (e.g. action learning, clinical supervision or reflective diaries) to evaluate and develop practice (E; C)	0.528	0.480
25	Organisational management has high regard for staff autonomy (PB; E3)	0.573	0.817
26	Staff welcome and accept cultural diversity (RP; E3)	0.357	0.415
27	Evidenced-based knowledge on care /imaging / treatment is available to staff (EIP; L)	0.598	0.522
28	Patients have choice in assessing, planning and evaluating their care and treatment (CP; C)	0.450	0.668
29	HCPs have the opportunity to consult with specialists (EIP; L)	0.518	0.750
30	HCPs feel empowered to develop practice (PB; E3)	0.697	0.616

31	Clinical radiography leaders create an environment conducive to the development and sharing of ideas (CP; C)	0.777	0.550
32	Guidelines and protocols based on evidence of best practice (patient experience, clinical experience, research) are available (EIP; E3)	0.649	0.485
33	Patients are encouraged to participate in feedback on care, culture and systems (CP; C)	0.364	0.461
34	Resources are available to provide evidence-based care (EIP; C)	0.631	0.700
35	The organisation is non-hierarchical (EIP; E3)	0.439	0.458
36	HCPs share common goals and objectives about patient care (RP; C)	0.633	0.512
37	Structured programmes of education are available to all HCPs (EIP; E3)	0.552	0.672

Letters in brackets represent the question position in the respective models. Five-factor constructs: collaborative practice (CP); evidence-informed practice (EIP); respect for persons (RP); practice boundaries (PB) and evaluation (E5). Three-factor model constructs: culture (C); leadership (L); and evaluation (E3).

Appendix 23 - Table Showing the Nature of the CAI Data (Skewness and Kurtosis)

CAI Instrument Item:		CAI 1	CAI 2	CAI 3	CAI 4	CAI 5	CAI 6	CAI 7	CAI 8	CAI 9	CAI 10	CAI 11	CAI 12	
N	Valid	152	152	152	152	152	152	152	152	152	152	152	152	
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	
Mean		3.14	2.84	3.20	2.99	3.06	2.84	2.68	3.11	2.86	2.13	2.89	3.14	
Skewness		-0.438	-0.303	-0.320	-0.435	-0.609	-0.024	-0.218	-0.485	-0.281	0.212	-0.212	-0.557	
Std. Error of Skewness		0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197	
Kurtosis		1.295	0.066	0.341	-0.588	0.523	-0.398	-0.746	-0.060	-0.422	-0.438	-0.308	0.344	
Std. Error of Kurtosis		0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	
CAI Instrument Item:		CAI 13	CAI 14	CAI 15	CAI 16	CAI 17	CAI 18	CAI 19	CAI 20	CAI 21	CAI 22	CAI 23	CAI 24	
N	Valid	152	152	152	152	152	152	152	152	152	152	152	152	
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	
Mean		2.95	2.76	3.48	3.14	2.48	2.73	2.84	2.96	2.78	2.44	2.59	2.64	
Skewness		-0.279	-0.054	-0.678	-0.433	-0.009	-0.058	-0.023	-0.563	-0.363	0.155	-0.088	-0.133	
Std. Error of Skewness		0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197	
Kurtosis		0.451	-0.321	-0.486	0.036	-0.502	-0.314	-0.185	0.814	-0.186	-0.168	-0.525	-0.277	
Std. Error of Kurtosis		0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	
CAI Instrument Item:		CAI 25	CAI 26	CAI 27	CAI 28	CAI 29	CAI 30	CAI 31	CAI 32	CAI 33	CAI 34	CAI 35	CAI 36	CAI 37
N	Valid	152	152	152	152	152	152	152	152	152	152	152	152	152
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean		2.61	3.45	2.96	2.56	3.10	2.65	2.78	3.10	3.03	2.86	1.89	3.12	2.47
Skewness		-0.040	-0.359	-0.336	0.106	-0.455	-0.085	-0.475	-0.695	-0.532	-0.230	0.476	-0.233	-0.046
Std. Error of Skewness		0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197	0.197
Kurtosis		-0.396	-0.859	0.260	-0.217	-0.197	-0.366	0.008	0.848	0.189	0.104	-0.034	0.564	-0.461
Std. Error of Kurtosis		0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391	0.391

Appendix 24 - Interview Participant Demographics

Interview Participant - Demographics

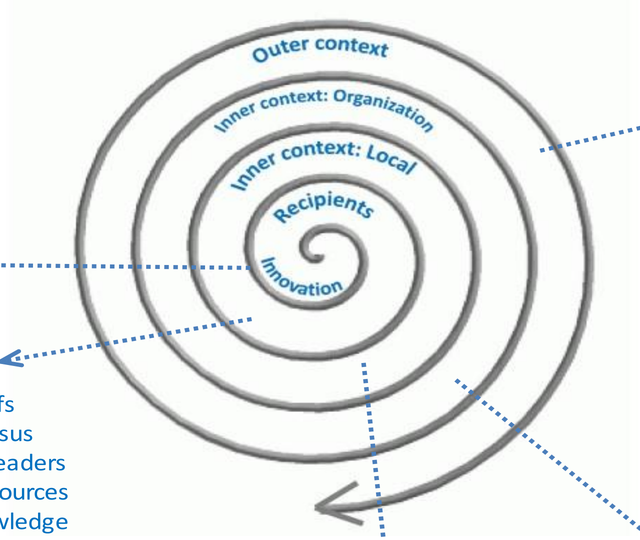
Interviewee Code	Gender	Experience (yrs.) /NHS Band	Home Nation	NHS /Other	Background
1	MALE	8 / 7	Scotland	NHS	Reporting Radiographer / Diagnostic
2	MALE	4 / 7	England	NHS	Clinical Lead - General Radiography / Diagnostic
3	FEMALE	29 / 7	England	NHS	Advanced Practitioner (brachytherapy) /Therapy
4	MALE	31 / 6	England	NHS	Senior Radiographer (CPD interest) / Therapy
5	FEMALE	30 / 8a	England	NHS	Clinical Lead Sonographer / Diagnostic
6	MALE	4 / 6	England	NHS* (PFI)	Senior Radiographer MRI / Diagnostic
7	MALE	11 / 6	England	NHS	Radiographer Generalist / Diagnostic
8	FEMALE	10 / N/A	England	Independent Clinic (charity)	Clinical Radiographer MRI / Diagnostic
9	FEMALE	9 / 7	England	NHS	Advanced Practitioner (mammography) / Diagnostic
10	MALE	11 / 7	England	NHS	Radiographer generalist (educational lead) / Diagnostic
11	FEMALE	8 / 7	Scotland	NHS	Radiographer Generalist (remote island) / Diagnostic
12	FEMALE	25 / 7	England	NHS	Reporting Radiographer / Diagnostic
13	MALE	11 / 8b	England	NHS	Consultant Radiographer (reporting) / Diagnostic
14	FEMALE	24 / 6	Scotland	NHS	Radiographer (generalist & CT) / Diagnostic
15	MALE	6 / 6	England	NHS	Clinical Lead Radiographer (practice quality) / Diagnostic
16	FEMALE	18 / 6	Scotland	NHS/HEI	Clinical Radiographer MRI & Lecturer / Diagnostic
17	FEMALE	2 /N/A	England	Private Sector	Senior Radiographer (MRI) / Diagnostic
18	FEMALE	30 / 7	England	NHS	Advanced Practitioner (mammography) / Diagnostic
19	FEMALE	7	England	NHS/HEI	Senior Radiographer & Lecturer / Diagnostic
20	FEMALE	13 / N/A	England	HEI	Clinical Research MRI (NHS patients)/ Diagnostic

National Health Service - NHS
* Private Finance Initiative
Higher Education Institution - HEI

Appendix 25 - Facilitator Focus and Activity - i-PARIHS (Harvey & Kitson 2015)

Facilitator focus and activity

What the facilitator looks at
What the facilitator does



Outer context
Policy drivers & priorities
Incentives & mandates
Regulatory frameworks
Environmental (in)stability
Inter-organisational networks & relationships

Political awareness & influence
Communication
Marketing
Networking
Boundary spanning
Sustainability & spread

Characteristics of the innovation
Underlying knowledge sources
Clarity
Degree of fit (compatibility or contestability)
Degree of novelty
Likely boundaries
Trialability
Relative advantage

Problem identification
Acquiring/appraising evidence
Baseline context & boundary assessment
Stakeholder mapping

Recipients
Motivation
Values & beliefs
Clinical consensus
Local opinion leaders
Existing data sources
Skills and knowledge
Time and resources
Learning environment
Collaboration and teamwork
Power & authority
Professional boundaries & networks

Goal setting
Consensus building
Audit & feedback
Improvement methods
Project management
Change management
Team building
Conflict management & resolution
Barriers/boundary assessment
Boundary spanning

Inner context: local level
Formal & informal leadership support
Culture
Past experience of change
Mechanisms for embedding change
Evaluation & feedback processes

Local context assessment
Communication & feedback
Networking
Boundary assessment & spanning
Negotiating & influencing
Policies & procedures
Structuring learning

Inner context: organisational level
Organisational priorities
Structure
Leadership & senior management support
Systems & processes
Culture
History of innovation & change
Absorptive capacity

Stakeholder engagement
Communication & feedback
Marketing & presentation
Networking
Boundary spanning
Negotiating & influencing
Policies & procedures

Source: Harvey G & Kitson A (2015) Implementing Evidence -Based Practice in Healthcare: A facilitation guide. Abingdon, Oxon: Routledge

Appendix 26 - Personal Reflection on the Thesis

This project is the culmination of much work into gaining insights into radiography practice, of which I have been part as a practicing radiographer for over thirty years. The professional knowledge I have gained during this time is largely based on learning from predecessors, peers and new generation radiologists and radiographers. The insight that academic study has provided along my career, has had a large impact on my personal beliefs and professional development, however my individual ability to effect change has been challenging in clinical practice. Having previously undertaken a master's degree in a clinical radiography specialism, embarking on a professional doctorate journey (completely beyond my comfort zone) and being largely based on the large body of knowledge developed by academic nurses, I have been overwhelmed by the expertise and advanced status of nurse and healthcare science. Radiography from my perspective is a science and profession that is very siloed and would learn much by venturing out into the wider healthcare research sphere. IS for me, has been an eye opener, something not yet widely understood in radiography, and needs much work to raise awareness and understanding amongst policy makers, practitioners, and educators.

I have tried throughout this work to set aside my own personal experience and preconceptions of being embedded int the radiography culture at a local and national level. I have learned much from the qualitative paradigm, something that is mostly alien to the clinico-scientific background of most practicing radiographers and radiologists perhaps? It was refreshing to hear the personal insights of practicing radiographers, being offered to an outside observer, removed from their local contexts. I was indeed truly amazed as to the persistence of some themes, and although careful not to bias participant views, was sympathetic to their lived experiences.

Finally, undertaking an MMR project, sounded exciting and developmental for me personally at the outset, little did I know the amount of work that was required in completing both arms, as well as the systematic review. I have gained much personal and academic experience in undertaking this project as part of the taught doctorate programme. The personal development portfolio (submitted separately) was highly reflective, gaining much personal insight which is highly valued in professional practice. Much reflection in the portfolio surrounded perfectionism and impostor syndrome (now I realise this is a common symptom amongst doctoral students) – however I hope the output from this project will help to illuminate the status of implementation in radiography and help move things forward.

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